DEPARTMENT OF WATER AFFAIRS

MADIKWE REGIONAL WATER SUPPLY SCHEME

UPGRADING OF MADIKWE WATER PURIFICATION WORKS

DESIGN REPORT

JANUARY 1994

EVN Ref : 8830

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MADIKWE WATER SUPPLY SCHEME

UPGRADING OF AND EXTENSIONS TO MADIKWE WATER PURIFICATION WORKS

DESIGN REPORT

EXECUTIVE SUMMARY

The Madikwe Regional Water Supply Scheme presently supplies water to the Madikwe Township, as well as the villages of Vrede, Sesibitswe (Vrede 2) and Tlokweng (Silwerkrans). The scheme is located in the southern central portion of the Madikwe District of Bophuthatswana, and presently serves some 31 000 people. The scheme is supplied with raw water from the Madikwe Dam, which is in turn purified and treated at the Madikwe Water Purification Works.

Recent reports have indicated that the purification plant has been operating 24 hours/day, and that restrictions have had to be imposed on consumers from time to time as a result of the plant not being able to keep pace with demand. An appraisal of the theoretical demand which can be expected to be generated by the township and villages served by the scheme indicates that the capacity of the purification plant is presently approximately 27% less than required.

These observations, together with the fact that the Bophuthatswana Housing Corporation (BHC) is planning the construction of a further 440 houses in Madikwe township over the next 5 years, prompted the undertaking of an investigation and preliminary design for the upgrading of the existing purification works, completed by EVN Consulting Engineers in November 1993.

It was recommended that the capacity of the plant be extended as follows :-

* Upgrading of the abstraction works by installation of an additional pump.

* Upgrading of the existing plant by the addition of another module with the same capacity as that of the existing plant. The capacity will thus be increased from 50 m^3/hr to 100 m^3/hr.

A detailed proposal for the mechanical and electrical works for both of the above recommendations, as well as all of their associated pipework, was received from Messrs. Aquatek, the suppliers of the existing plant.

A number of other requirements were identified by BWSA staff to improve the operation of the plant. It is recommended that a single civil contract be put out for tender, which will require Contractors to price for :-

* Construction of a new plant building, located immediately adjacent to the existing plant building. The building will be comprised of structural steel trusses mounted on steel columns, with cladding to d=suit the existing structure.

* Construction of an additional chemical store, similar in size and finishes to the existing office block.

* Construction of a lockable double vehicle garage for vehicle security, also similar in finishes and appointment to the existing structures.

* Relocation of the existing roadworks on the site and the paving of the new roads with 80 mm interlocking precast concrete blocks.

* Cleaning, resealing and painting of the existing 1.5 Ml steel reservoir.

* Installation of security lights

Provisional sums will be allowed for in the Contract Document for the appointment of Messrs. Aquatek as a nominated sub-contractor, who will undertake the following :-

* Supply and installation of the additional abstraction pump, as well as the components of the second module of the purification works

* All associated pipework, fittings and electrical reticulation and controls for the additional abstraction pump and plant module

* Minor repairs to the existing plant

The total cost estimate for this phase of upgrading is expected to amount to approximately R 1.28 million, and can be completed by August 1994.

MADIKWE WATER SUPPLY SCHEME

UPGRADING OF AND EXTENSIONS TO MADIKWE WATER PURIFICATION WORKS

DESIGN REPORT

CONTENTS

1. INTRODUCTION AND BACKGROUND

The Madikwe water purification works is located near the western edge of the Madikwe dam wall, approximately 6.5 km south east of the township of Madikwe, in the Madikwe Region of Bophuthatswana. The works was originally constructed to supply the Madikwe Township. The Madikwe Regional water supply scheme was augmented in 1990 with the construction of a pumping main and pumpstation from the water purification works to supply the villages of Sesibitswe (Vrede 1), Vrede and Tlokweng (Silwerkrans). The scheme was further expanded with the construction of additional reservoirs in Sesibitswe and Tlokweng, and the construction of reticulation systems in all three villages, which was completed in 1992.

The locality of the Madikwe region in a national context is shown in figure 1.1, while the Madikwe purification works, township and surrounding villages are shown in the regional context in figure 1.2.

It has been reported by the BWSA that the existing water purification works, which is partially a package plant, has become inadequate to supply the demands of these villages as well as that of Madikwe township, and restrictions have had to be applied on consumers in the area at various times. This situation, together with the proposed construction of a further approximately 400 stands in Madikwe township, led to a feasibility and preliminary design report being completed by EVN Consulting Engineers in November 1993.

In the preliminary design it was proposed that both the abstraction works at the Madikwe Dam and the purification plant be extended to treat double the present capacity of 1200 kl/24hr. Any further extension of the plant would exceed the acceptable minimum yield of the dam and is therefor not considered feasible until a viable additional source of water is identified, which is expected to become necessary by 1996.

A number of additional requirements, including additional storage space and a lockable garage were also requested by the BWSA.

2. DEVELOPMENT PERSPECTIVE FOR MADIKWE TOWNSHIP AND SURROUNDING VILLAGES

2.1 Madikwe Township Proposed Development

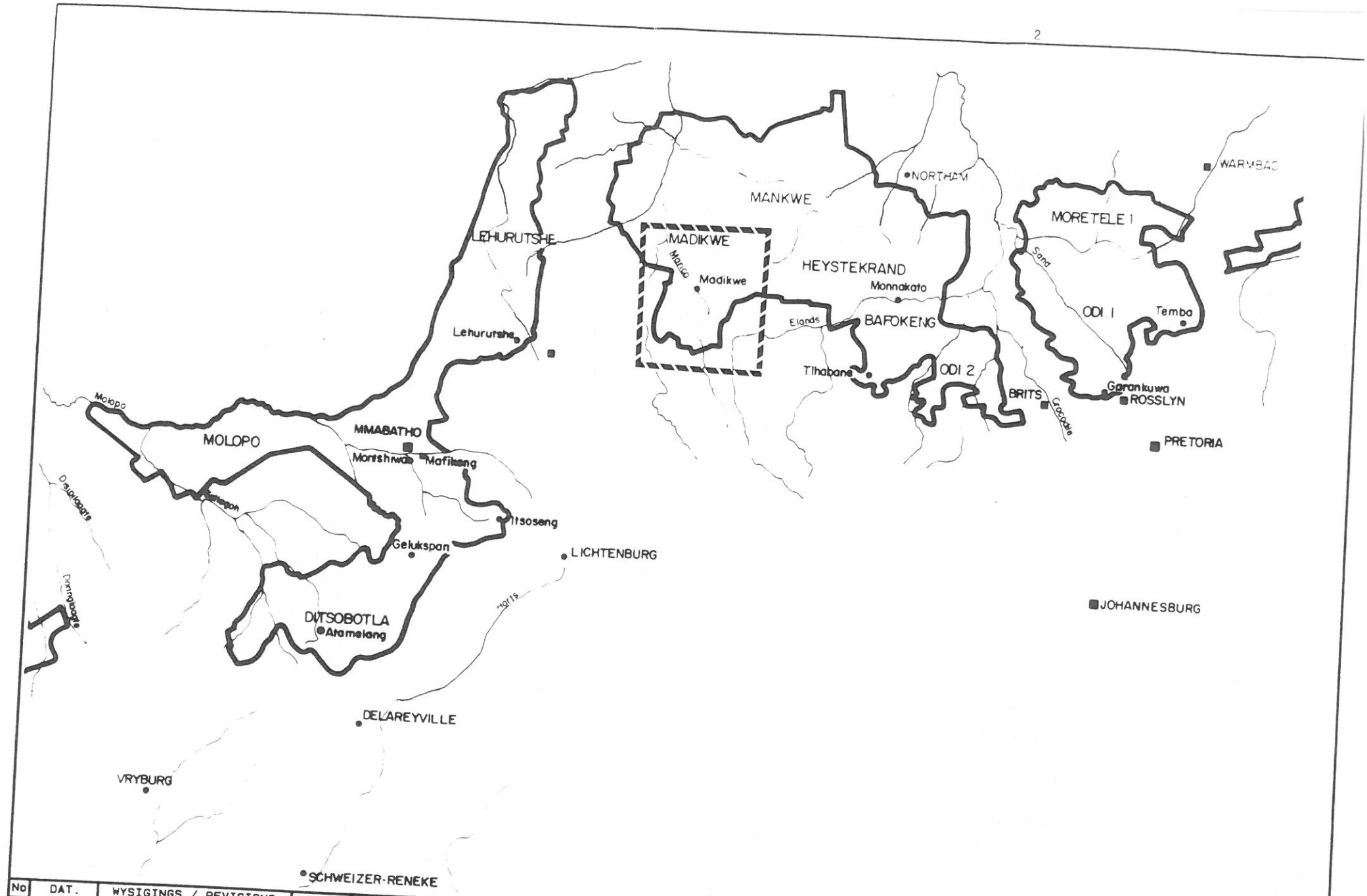
The existing Madikwe township includes a total of 838 residential stands, as well as 1 high school and 3 primary schools. Limited commercial and light industrial facilities also exist in the township. The construction of a further 444 residential stands is presently being planned for short term implementation by the Bophuthatswana Housing Corporation.

The provision of a water borne sewage reticulation was commenced in 1990, and it is envisaged that all of the new stands to be developed will also be served by water borne sewer reticulation.

2.2 Community Participation

It is the policy of the Department of Water Affairs that water supply projects such as that supplying the villages of Sesibitswe, Vrede and Tlokweng are implemented with the full sanction of the community. Village Water Committees were formed in these villages, as well as a steering committee, convened by the Madikwe Governor's office, to oversee community participation in the scheme.

The steering committee approved the proposals put forward regarding the Madikwe Regional Water Supply Scheme, as well as the priorities proposed by the Department of Water Affairs.



No	DAT.	WYSIGINGS / REVISIONS	GETEKEN DRAWN	GOEDGEKEUR APPROVED

LOCALITY PLAN
NATIONAL CONTEXT

EVN RAADGEWENDE INGENIEURS (EDP) (EDMS) BPK
CONSULTING ENGINEERS (EDP) (PTY) LTD
POSBUS P.O.BOX 373 8570
TEL. 0140-810500
MAFIKENG
9 TILLARD STR. 9 MAFIKENG 8570

FIGURE 1.1

No	DAT.	WYSIGINGS / REVISIONS	GETEKEN DRAWN	GOEDGEKEUR APPROVED	LOCALITY PLAN REGIONAL CONTEXT

EVN
RAADGEWENDE INGENIEURS (BOP) (EDMS) BPK
CONSULTING ENGINEERS (BOP) (PTY) LTD
POSBUS P.O. BOX 373 8670
TEL. 0140-810500
9 TILLARD STR. 9 MAFIKENG 8670
MAFIKENG

FIGURE 1.2

Village Preference Surveys (VPS) were completed in 1990 for the three villages to be supplied by the scheme, in order to establish the approximate number of yard connections which would have to be supplied, and what percentage of the population would be satisfied with public standpipe supply. The results of these surveys were used in the design of the initial phases of the Madikwe Regional Water Supply Scheme.

3. DEVELOPMENT AIMS AND OBJECTIVES

The broad objectives with which this study is concerned are those laid down by the Bophuthatswana Development Council. The specific objectives to be addressed are seen to be as follows :-

* The provision of a well planned infrastructure as a prerequisite for the efficient economic Development of the country.

* The preferential allocation of water for domestic consumption and other uses which yield the highest return, in terms of raising the standard of living, for the smallest amount of investment in water supply.

In particular, the major objective is to provide sufficient water to meet the needs of the population and thereby improve on both the quality of life and standards of health in general.

Other secondary objectives may be defined as follows :-

- To stimulate community involvement in the formulation and implementation of Development projects.

- To utilise appropriate technology.

- To create local employment during construction.

- To provide training for the operation and maintenance of the new scheme.

- To optimise utilisation of all the water resources available in the area to meet the requirements of the Madikwe Township and surrounding villages.

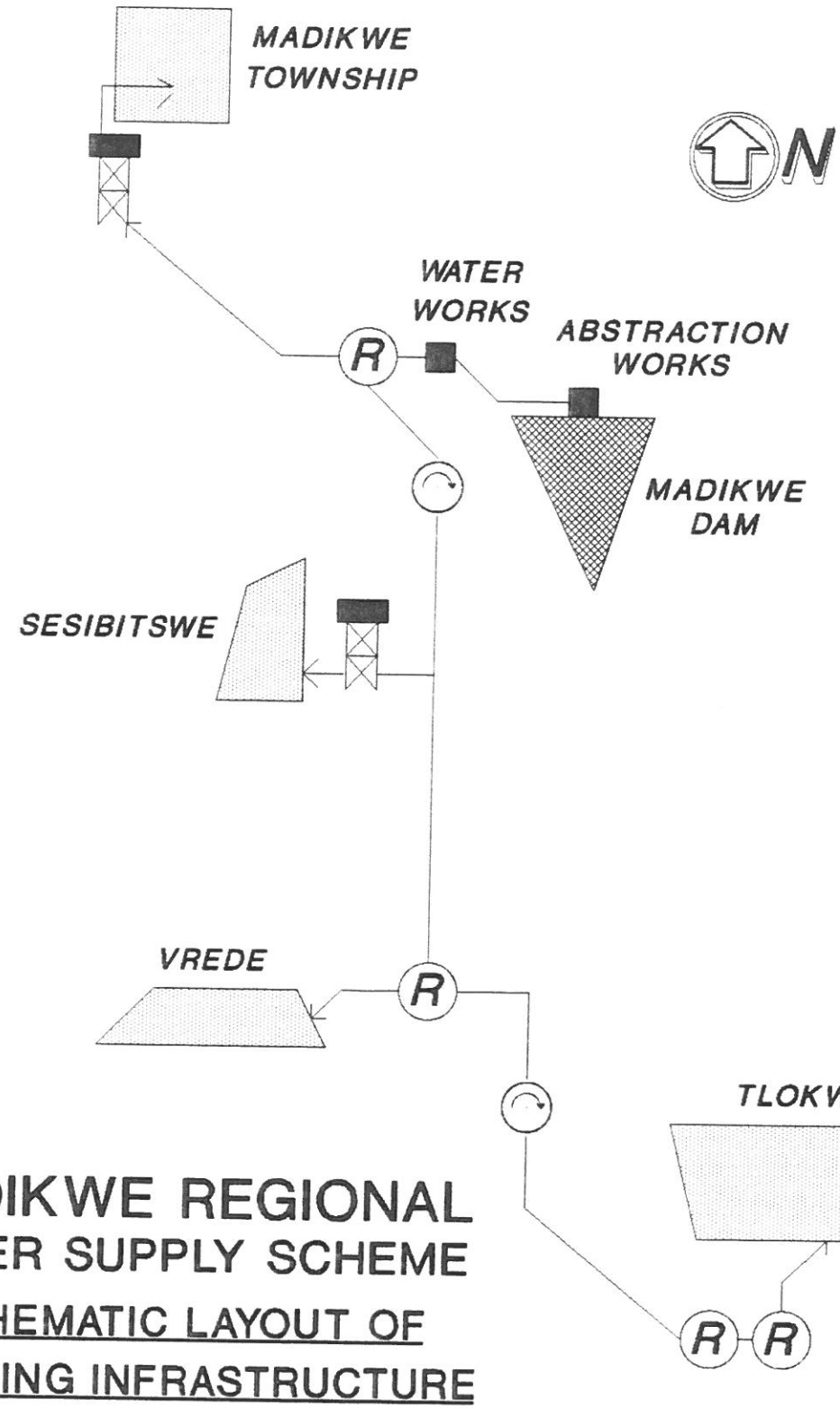
4. PROJECT DESCRIPTION

4.1 Existing Water Supply Infrastructure

The existing infrastructure included in the Madikwe Regional Water Supply Scheme is shown schematically in figure 4.1. The capacities of the various components to meet future supply were fully assessed in our report entitled "Madikwe Regional Water Supply Scheme; Upgrading of Madikwe Water Purification Works; Preliminary Design Report; November 1993".

4.2 Proposed Upgrading of Madikwe Purification Works

The upgrading of the purification works will be undertaken with a view to meeting all requirements to adequately serve consumers in the area up to an acceptable design horizon, in accordance with the Bophuthatswana Department of Water Affairs' "Guideline for the Selection of Design Criteria".



MADIKWE REGIONAL WATER SUPPLY SCHEME

SCHEMATIC LAYOUT OF EXISTING INFRASTRUCTURE

Figure 4.1

Since the object of the preliminary design and feasibility study was not only to investigate the capacity of the treatment works alone, but also that of all other allied components of infrastructure, a study was also done on the maximum potential yield of the Madikwe Dam. It was found that this yield was not likely to be capable of supplying the 5 year design horizon demand for its service area, and the plant will therefor only be upgraded to treat the maximum yield which can be supplied by the dam, until such time as a viable additional source of water for the area can be identified.

5. PROJECT JUSTIFICATION

Upgrading of the capacity of the Madikwe water purification works was originally mooted in 1988, and was again identified as being required over the short term in the report prepared by EVN Consulting Engineers, entitled "Report on the adequacy of the Water Bulk Supply and Reticulation System to Madikwe Township, September 1990", which was accepted in principle by the Department of Water Affairs.

An appraisal of recent supply versus demand shows that supply from the works has recently abandoned a previous growth rate of almost 44 % p.a., and has since early 1993 appeared to be operating at a constant output of within 10% of its rated maximum capacity of 1200 kl/d. This, together with reports from the BWSA that the works is currently operating 24 hours per day, and that certain supply zones have to be cut off over certain times of the day to stop the bulk storage reservoir at the works running dry, indicate that demand has increased to the point where the present capacity of the works is now acting as a limiting factor and restricting the amount of water which can be supplied.

The capacity of the Madikwe water purification works will therefor, unless adequately upgraded, provide a serious restriction to further development in the area, for which an urgent need has been identified.

6. DETAILED DESIGN AND TECHNICAL CONSIDERATIONS

6.1 Demand Estimates

Population Projections

The original population growth estimates for the villages of Sesibitswe, Tlokweng and Vrede were used for this study, as they have appeared reasonably accurate to date and have been confirmed by the most recent census.

The population growth estimate for Madikwe has however been updated as a result of the proposed development of a further 444 residential stands in the township, bringing the total number of residential stands in the township to 1282. It was assumed that the proposed new stands would be developed and fully occupied within the next five years, thus requiring them to be catered for in full within the design horizon for the proposed upgrading of the water purification and allied works.

The revised population projections for the region are as shown in table 6.1.

Village/ Township	Population / Year				
	1993	1998	2003	2008	2013
Madikwe	5336	8664	9566	10561	11660
Sesibitswe	938	1036	1144	1263	1394
Vrede	1209	1334	1473	1626	1796
Tlokweng	23741	26212	28940	31953	35279
TOTAL	31224	37246	41123	45403	50129

Table 6.1

Level of Service of Supply

The original estimated preferred level of service for Tlokweng was exceptionally high, at 60 % yard connections, and was used as a result of the results of the VPS in which 100 % of residents stated that they would apply for yard connections. The estimates for Sesibitswe and Vrede were very low, with only 2 % of respondents stating that they would apply for yard connections.

Subsequent figures provided by the BWSA have however revealed that up until September 1993, only 7 applications had been made for yard connections in Sesibitswe, 10 in Vrede and 116 in Tlokweng, giving corresponding yard connection percentages of only 0.7%, 0.8% and 0.5% respectively. It is therefor clear that the initial response in Tlokweng to the VPS was misinterpreted and is clearly not applicable.

It was therefor decided to use LOS estimates which have previously been accurate for other villages of a similar nature and size. The levels of service estimated for Tlokweng were therefor 10 % yard connections initially, rising to 20 % over 20 years, while for Sesibitswe and Vrede they were taken as 5 % initially, rising to 10 % over 20 years. The level of service for Madikwe township was taken as 100 % House Connections, since all of the stands in the township have individually metered connections, and installation of sewers will shortly be completed.

The total demand generated by the above estimates of population and levels of service, was estimated in accordance with the Bophuthatswana Department of Water Affairs' "Guidelines for the Selection of Design Criteria", the relevant extracts of which are included in Annexure A1. The demands estimated are shown in figure 6.1. Detailed demand figures, and peak factors are shown in Annexure A2.

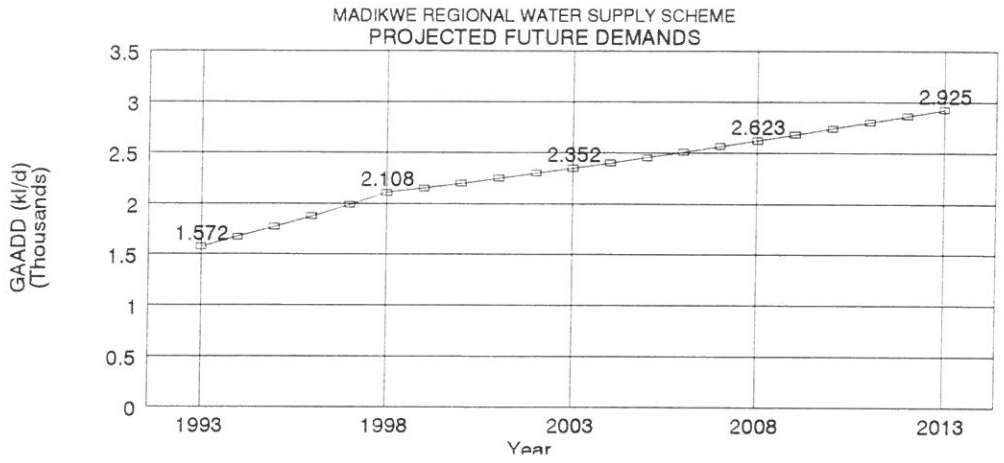


FIGURE 6.1

6.2 Bulk Supply Source

The existing Madikwe water works is presently supplied by an abstraction works at the Madikwe dam. The dam itself was built before Bophuthatswana attained independence.

No accurate record of the hydrology of the dam or yield estimates thereof could be found by EVN Consulting Engineers. An initial estimate was done on an empirical determinate basis to establish a realistic yield, based on the Water Research Commission's Hydrological Research Unit (HRU) findings and recommendations. The 98% level of assurance yield indicated by this exercise was equal to 0.657 million m^3/annum, or 1.8 Ml/d.

It was noted that this yield is some 15% less than the GAADD required for 1998, and a more detailed simulation was carried out, again based on the HRU recommendations. A realistic level of assurance, based on a number of different indicators yielded by the analysis, again indicated a 98 % level of assurance yield very close to 1.8 Ml/d. The details of the hydrological analysis are shown in Annexure C.

It is therefor clear that, if the projected demands follow the trends described above, an alternative source will have to be found to augment the bulk water supply for the Madikwe Regional supply scheme, and we recommend that a detailed investigation be undertaken shortly in this regard.

6.3 Capacity of Existing Bulk Storage and Distribution Infrastructure

The capacities of the existing bulk storage and distribution infrastructure were thoroughly assessed in our feasibility and preliminary design report for the project, completed in November 1993. It was found that all of these are adequate for an acceptable design horizon, with the exception of the Madikwe Dam itself, as discussed above, the abstraction works at the dam, and the water purification works.

6.4 Implementation of the Project

Demand estimates originally indicated that the water purification works at Madikwe Dam should be upgraded from 50 m^3/hr to 150 m^3/hr to meet the projected 5 year demands. However, upgrading to a capacity in excess of what can be supplied by the bulk supply source, ie. Madikwe Dam, is not considered feasible until an alternative source of bulk supply can be found to augment the Madikwe Dam. We therefor recommend that an additional 50 m^3/hr module be constructed at this stage.

Furthermore, we have liaised with Mr V Oppel of the Mogwase office of the BWSA and he has made a list of additional items which is required to be repaired or constructed to improve the operation of the plant.

The following drawings for the works are also to be read in conjunction with this report.

8830/30/100	Locality Plan
8830/30/200	Site Layout Plan
8830/30/201	Road and Siteworks Details
8830/30/400	Nameboard Details
8830/30/401	Security Fencing Details
8830/30/402	Stock and Vermin Proof Fencing Details
8830/30/600	Plant Room Building Details
8830/30/601	Reinforced Concrete Details
8830/30/602	Structural Steel Layout and Details
8830/30/603	New Chemical Store Layout and building Details
8830/30/604	New Lock-up Garage Layout and Building Details

The proposed upgrading will include the components listed below, pertinent design considerations of which have been included where necessary.

1. Additional pump at the abstraction tower

An additional of the same type and size as the existing pumps is required to be installed in abstraction tower. This will provide a configuration of 2 duty pumps and 1 standby, as opposed to the existing 1 duty / 1 standby configuration.

The additional pump will be a 'MONOPUMP' model, with a rated capacity of 16 l/s against a head of 40 meters. The pumproom floorslab on the abstraction tower already makes provision for the installation of two additional pumps. However, approximately 10 m of 150 mm diameter additional steel pipework will be required in order to link the new pump into the existing outlet manifold.

The electrical distribution board will have to be altered and upgraded to accommodate the additional pump. It is proposed that the additional abstraction pump, as well as its associated pipework and electrical supply and controls be supplied and installed by Messrs. Aquatek, who have included for these in their detailed proposal and cost estimate, as shown in Annexure D.

2. Construction of Additional Plant Building

A new plant building covering some 109 m^2 will be required to house the new plant. The building will comprise a steel structure, fully cladded in brickwork around the filter plant, and partially cladded in sheeting around the settling tank area, which accounts for approximately 70% of the building area.

The existing building was built in such a way as to allow for extensions to be built on to accommodate the new plant. While a similar structural configuration was used to the existing plant building, civil and structural components of the new building were sized to be as economical as possible. The integrity of the combined existing and proposed new structure was also checked. Detailed structural design considerations are included in Annexure C.

3. Additional Plant

The existing plant makes provision for being extended by another module of the same size. Connections for a new dosed raw water feed, settled water sump interconnection and clean water outlet are all provided on the existing pipework.

Upgrading of the plant will include the provision of the following components :-

* The existing dosing pumps will be replaced by larger, more efficient primary coagulant (Ferric Chloride or Polyaluminium Chloride or Polyamine), lime and polyelectrolyte dosing pumps. Note that the existing dosing room will not have to be extended or replicated.

* A new floc column for the existing plant, as well as one for the new module. These will enhance the existing floc mixing pipework and provide extended contact and floc formation time.

* An additional 8 settling tanks. The new tanks will have a diameter 300 mm larger than the existing tanks (1800 mm diameter).

* A single additional filter pump, which will provide a 2 duty pump / 1 standby configuration, as opposed to the existing 1 duty / 1 standby arrangement.

* An additional bank of 10 high pressure filters.

* All additional pipework to connect the new plant components to the existing plant

* All electrical works to provide sufficient power supply and control facilities for the operation of the upgraded plant.

It is proposed that all of the above components be supplied and installed by the supplier of the original plant viz. Messrs. Aquatek (Pty)Ltd. A detailed proposal and cost estimate as submitted by Messrs. Aquatek for the above works is included in Annexure D.

4. Additional Chemical Store

Mr Oppel of the BWSA has requested that additional storage facilities be constructed at the plant. It is therefor proposed that a chemical store the same size and shape as the existing office / store building be constructed. The store is to have the same finishes as the existing building.

5. Garages

An additional 2 garages were also requested for safety and security of BWSA vehicles at the plant. A double garage structure using a similar structural configuration as the existing office building is to be provided, which will also have the same finishes as the existing building.

6. Site Works

The most suitable arrangement for construction of the new buildings required will necessitate the re-arrangement of certain of the roadworks on the site, as well as the re-location of gates and fence posts etc. It has also been requested that the roadworks within the boundaries of the plant be paved, and 80 mm block paving has been included.

The site works are expected to be of a relatively minor nature, and it is not envisaged that a separate roads and earthworks Contract will be required to complete these.

7. Repairs to Existing Steel Reservoir

Mr Oppel of the BWSA has reported that the existing 1500 kl reservoir adjacent to the works has some leaks and is in need of cleaning and rehabilitation. It is proposed that the rehabilitation, including cleaning and lining with a suitable industrial coating, be completed as part of the upgrading contract.

8. Minor Repairs to the Existing Plant

Messrs. Aquatek were requested to report on certain repairs which were identified as being necessary at the plant, and have done so. It is proposed that these repairs also be undertaken concurrently with the upgrading of the plant.

9. Security Lights

Mr Oppel has reported that the need has been identified to install security lights at the plant, to ensure safe and secure operation of the plant. It has been recommended that the installation of the security lights be included as part of the Contract.

6.5 Programme for Implementation

Our proposed proposed programme for further implementation is shown in figure 6.5.1.

7. FINANCIAL IMPLICATIONS

The detailed cost estimates for the various components of the work, as well as the projected cash flow, are shown in Annexure E.

It is recommended that the Works be undertaken as a single Civil Contract. A tender will be put out for the building and civil works for the extension of the plant building, the new store building, the new garage building, site works and rehabilitation of the existing steel reservoir.

The upgrading and repairs to the existing plant, proposed new plant extensions, additional abstraction pump, as well as all associated pipework, electrical distribution and controls should be done by Messrs. Aquatek, who supplied and installed the existing plant. It is recommended that a Provisional Sum be allowed in the civil tender for all of the electrical and mechanical works, and that Aquatek be appointed as a nominated sub-contractor to undertake these.

The total project cost is expected to amount to R 1 284 109-00, including professional fees and V.A.T.

EVN CONSULTING ENGINEERS (BOP) (PTY) LTD
PROGRAMME

MADIKWE REGIONAL WATER SUPPLY SCHEME – UPGRADING OF MADIKWE WATER PURIFICATION WORKS

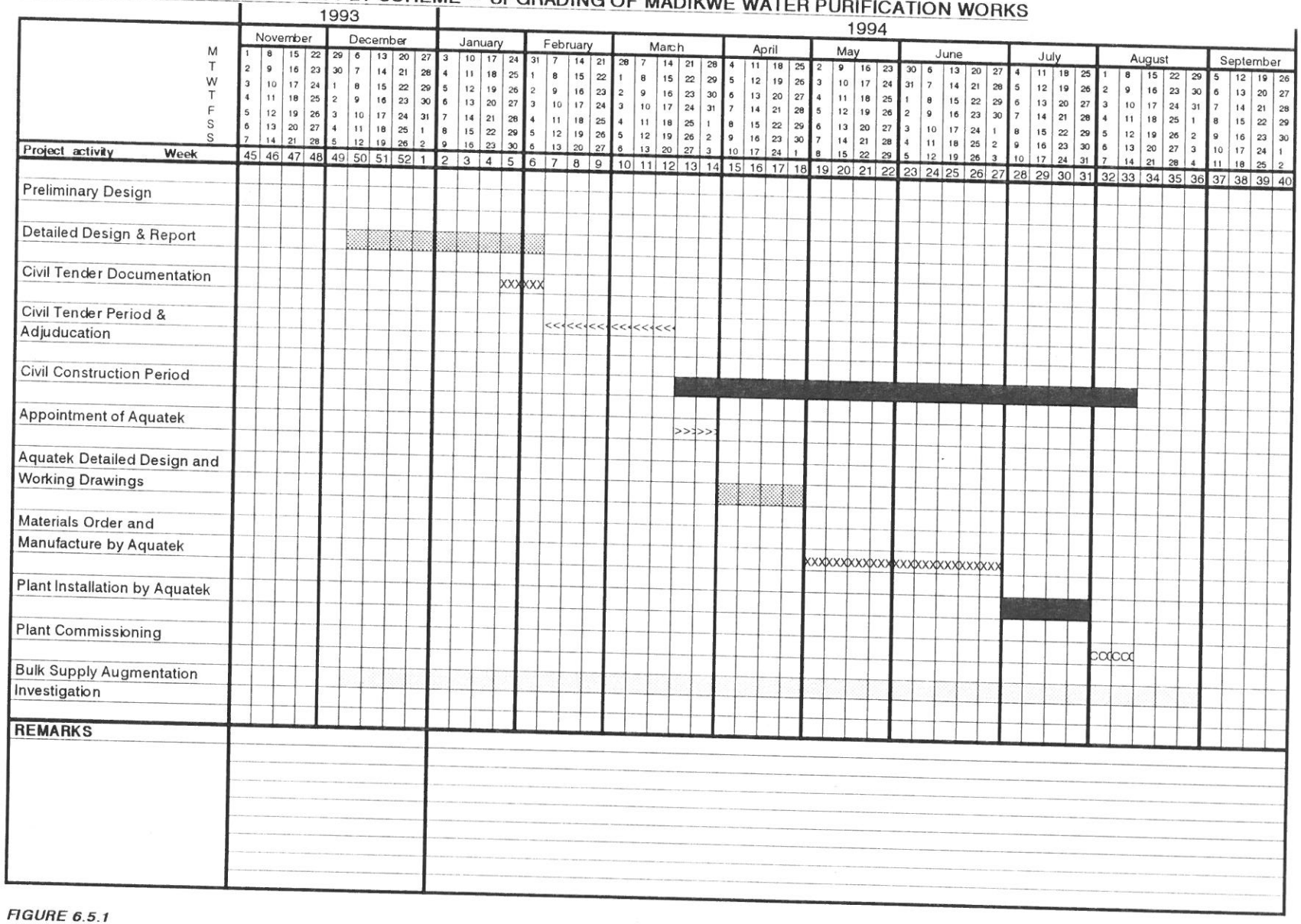


FIGURE 6.5.1

ANNEXURE A

HYDRAULIC DESIGN PARAMETERS

ANNEXURE A - HYDRAULIC DESIGN PARAMETERS

A1 GENERAL

A1.1 General Basis of Planning

The average daily demand has been estimated for the projected population and development within the demand area up to the year 2013 (20 years hence).

The base data for water consumption was based on the guidelines agreed by a committee on which the DBSA is also represented. The committee had as its task the establishment of design guidelines for all water projects in Bophuthatswana and the following people were involved:

K.U. Pelpola P. Fernandez S.N. Makgetha R. Piyasena	Department of Water Affairs
B. Jackson M. Muller G.J. Malan	Development Bank of Southern Africa
S.G. Pienaar J.W. Lijnes	EVN
C.J. Marx	Van Wyk & Louw
S.J.P. Ellis	Geustyn, Forsyth & Joubert
P.J. Kleynhans	Sviridov & De Waal
R. Cronwright	Setplan

A1.2 Design Standards and Criteria

1.2.1 General Philosophy

The planning and design of infrastructure for Hoekfontein are related to the norms and standards laid down in the Bophuthatswana Department of Water Affairs publication "*Guidelines for the Selection of Design Criteria*", these having been designated by the above-mentioned committee.

The most relevant extracts from this document are listed below :-

a) Definitions

Throughout this section the following definitions and abbreviations apply :-

* **Standpipe supply**

  Supply where water is distributed to manually operated taps located in public open spaces and street reserves.

* **Yard Connection**

  Supply where each yard (erf) is provided with a (metered) single tap and which is not expected to be upgraded during the design horizon.

* **House Connection**

  Supply where the building on each erf (plot) is fitted with a (metered) multiple tap installation and sanitary fittings.

* **Building Connection**

  Metered multi-tap and sanitary fittings installation for buildings intended for other uses than domestic.

* **AADD - Average Annual Daily Demand (Ml/d)**

  The AADD is the total volume of water required by a demand centre divided by the number of days in the year.

* **GAADD - Gross Average Annual Daily Demand (Ml/d)**

  The GAADD is the AADD plus system losses allowed.

* **SDD - Summer Daily Demand (Ml/d)**

  The SDD is the maximum demand (including losses) required over a single day during the year and can be expressed as the AADD multiplied by a Summer Peak Factor (SPF)

* **SPF - Summer Peak Factor (factor)**

  The Summer Peak Factor is a factor (not less than 1,0) by which the AADD should be multiplied to obtain the SDD. This SPF is a function of use of the water (e.g. gardening, lawns, washing of cars, household, industrial) as well as the climatic conditions of the Demand Centre.

* **DPFR - Design Peak Flow Rate (l/s)**

The DPFR is the flow capacity required in a pipeline to cater for the instantaneous peak consumption of a demand centre. This DPFR is determined by multiplying the SDD by a Design Peak Factor (DPF).

* **DPF - Design Peak Factor (factor)**

The daily peak factor is a value by which the SDD should be multiplied to obtain the DPFR. This DPF is derived in accordance with the following concepts for:

i) Stand-Pipe supply

The DPF for stand-pipe supply is derived from that portion of the day during which consumers generally obtain their requirements. In most cases of stand-pipe supply, no street lights are available and hence the draw-off period is normally limited to daylight hours. If the assumption is made that all stand-pipes supplied are open permanently during daylight hours and that consumers are constantly obtaining water from such stand-pipes, the minimum value of the DPF for summer (10 hours of daylight) is therefore 2,4 and for winter 3,0 (8 hours daylight).

This situation is however considered unlikely in practice due to the occupation of people fetching the water and a minimum DPF for standpipe supply is therefor recommended as 3.0

ii) Yard, House and Building connections

The DPF describes the requirement that at certain peak periods of the day a large portion of the consumers require water at the same time (e.g. morning, evening). This factor can vary in accordance with the number of consumers being serviced and can be equated to the "Peak Factor" defined in "Guidelines for the provision of Engineering Services in Residential Townships - RSA Department of Community Development" (A.K.A. The Blue Book) as given in figure F3 of that publication, divided by the SPF.

* **Gross Floor Area**

Total enclosed floor area of a building.

* **Design Horizon**

That length of time for which the physical components of the system are to be sized.

* **Planning Horizon**

That length of time for which the system is planned to cater for projected demands.

b.) Demand Criteria

The following design criteria are to be adopted for the end of the design horizon :-

*	**Water Demand (AADD)**	**Range**
	Standpipe supply	20 - 50 l/c/d
	Yard Connections	50 - 100 l/c/d
	House Connections	100 - 150 l/c/d

Note :
The values at the lower end of the ranges are to be used in general and higher values used only when motivation exists for the use thereof.

*	**Peak Factors**	**SPF**	**DPF**
	Standpipe supply	1.2	3.0
	Yard Connections	1.5	3.0
	House Connections	1.5	3.0

Note :
Means of reducing these values, e.g. by the use of on-site storage tanks may be considered providing these measures are economically justified.

* **Target maximum walking distance to standpipe :**

500 m

* **Maximum number of people per tap**

(Multiple taps per standpipe are acceptable)

50 to 75 with 75 as the norm and
motivation required for a lower number.

* **Storage**

(Fire requirements are additional to these values)
The extent of storage to be provided shall be based on rational design including a site specific risk analysis, e.g. consequences of supply interruption. The following values serve to indicate the maximum which could be provided.

Surface -	Pump supply	: 48 hours of GAADD
	Gravity supply	: 24 hours of GAADD
Elevated (Pump supply)		: 4 hours at DPFR
Capacity of distribution from reservoirs		: DPFR plus fire flow
Capacity of bulk supply mains to reservoirs		: Optimise with reservoir capacity

* **Residual Pressures**

Minimum :-

Standpipes	: 5 m
Yard Connections	: 5 m
House Connections	: 12 m at highest point on erf

Maximum (under static conditions) -

All cases	: 90 m

* Where applicable, pressure required for fire supply purposes should be provided.

* **Losses**

The design of the reticulation is to be based on the nett requirements using the appropriate peak factors. The gross system demand is to include for losses of 10 % of the AADD as a norm. Provision for losses in excess of 10 % must be motivated.

* **Design Life of Components**

(For economic analysis)

Bulk supply lines	: 20 years
Treatment Works	: 20 years
Reservoirs	: 20 years
Reticulation mains	: 20 years
Electrical equipment	: 15 years
Mechanical Equipment	: 10 years
Buildings	: 20 years

* **Development Horizons**

	Planning	**Design**
Bulk supply lines	: 20 years	10 years
Treatment Works	: 10 years	5 years
Reservoirs	: 10 years	5 years
Reticulation mains	: 10 years	5 years

Notes :
Final selection of planning and design horizons should be based on a socio-economic evaluation of the conditions pertaining to the project.

In situations of high uncertainty shorter horizons than those given above should be considered.

Treatment works capacities and reservoir sizes should take practical sizes of modules into account.

A2 DEMANDS AND RELATED FACTORS

The detailed demands and related factors calculated for the Dry Harts, as based on socio-economic data available and the above design criteria, are all as per table A2.1 below.

MADIKWE REGIONAL WATER SUPPLY SCHEME
DEMANDS AND FACTORS

1993

Village	Population	%H.C. @ 100 l/c/d	%Y.C. @ 50 l/c/d	%S.P. @ 25 l/c/d	GAADD (kl/d)	SDD (kl/d)	DPFR (l/s)
Madikwe	5336	100.0%	0.0%	0.0%	675.0	981.8	29.89
Vrede 1	938	0.0%	5.0%	95.0%	31.2	38.6	1.15
Vrede 2	1209	0.0%	5.0%	95.0%	40.1	49.8	1.48
Silwerkrans	23741	0.0%	10.0%	90.0%	825.9	1041.1	31.01
TOTAL	31224				1572.2	2111.2	63.53

1998

Village	Population	%H.C. @ 100 l/c/d	%Y.C. @ 50 l/c/d	%S.P. @ 25 l/c/d	GAADD (kl/d)	SDD (kl/d)	DPFR (l/s)
Madikwe	8664	100.0%	0.0%	0.0%	1096.0	1594.1	48.53
Vrede 1	1036	0.0%	6.3%	93.8%	34.8	43.4	1.29
Vrede 2	1334	0.0%	6.3%	93.8%	44.8	55.8	1.66
Silwerkrans	26212	0.0%	12.5%	87.5%	932.6	1184.5	35.32
TOTAL	37246				2108.2	2877.8	86.81

2003

Village	Population	%H.C. @ 100 l/c/d	%Y.C. @ 50 l/c/d	%S.P. @ 25 l/c/d	GAADD (kl/d)	SDD (kl/d)	DPFR (l/s)
Madikwe	9566	100.0%	0.0%	0.0%	1210.0	1760.1	53.58
Vrede 1	1144	0.0%	7.5%	92.5%	38.9	48.6	1.45
Vrede 2	1473	0.0%	7.5%	92.5%	50.1	62.6	1.86
Silwerkrans	28940	0.0%	15.0%	85.0%	1052.5	1346.5	40.20
TOTAL	41123				2351.5	3217.8	97.10

2008

Village	Population	%H.C. @ 100 l/c/d	%Y.C. @ 50 l/c/d	%S.P. @ 25 l/c/d	GAADD (kl/d)	SDD (kl/d)	DPFR (l/s)
Madikwe	10561	100.0%	0.0%	0.0%	1336.0	1943.3	59.16
Vrede 1	1263	0.0%	8.8%	91.3%	43.4	54.5	1.62
Vrede 2	1626	0.0%	8.8%	91.3%	55.9	70.2	2.09
Silwerkrans	31953	0.0%	17.5%	82.5%	1187.4	1529.3	45.72
TOTAL	45403				2622.7	3597.4	108.59

2013

Village	Population	%H.C. @ 100 l/c/d	%Y.C. @ 50 l/c/d	%S.P. @ 25 l/c/d	GAADD (kl/d)	SDD (kl/d)	DPFR (l/s)
Madikwe	11660	100.0%	0.0%	0.0%	1475.0	2145.5	65.32
Vrede 1	1394	0.0%	10.0%	90.0%	48.5	61.1	1.82
Vrede 2	1796	0.0%	10.0%	90.0%	62.5	78.7	2.35
Silwerkrans	35279	0.0%	20.0%	80.0%	1338.8	1735.7	51.94
TOTAL	50129				2924.8	4021.1	121.42

TABLE A2.1

ANNEXURE B

HYDROLOGICAL ANALYSIS OF THE YIELD CAPACITY OF THE MADIKWE DAM

B HYDROLOGICAL ANALYSIS OF THE YIELD CAPACITY OF THE MADIKWE DAM

B1 General

The analysis was carried out using the methodology and data as set out in the Reports developed by the Hydrological Research Unit (HRU) of the University of the Witwatersrand, the main report of which is entitled "Design Flood Determination in South Africa".

Pertinent hydrological data for the catchment area is shown in table B1.1.

MADIKWE DAM
PERTINENT GENERAL HYDROLOGICAL DATA

MAP	641 mm/a
MAE	1860 mm/a
Dam Catchment Area	28000 ha
Dam Area at FSL	434.3 ha
Dam Storage Capacity at FSL	14.747 million m^3
Maximum Dam Depth at FSL	9.3 m
Quartenary Catchment	A331
Quartenary Catchment Area	41500 ha
Quartenary Catchment MAR	8 million m^3/a

TABLE B1.1

B2 Determinate Analysis

The initial analysis which was completed was of a determinate nature, ie. using trends previously encountered for models of the area, and taking into account such factors as catchment size, dam size and volume, in order to determine empirically the 98 % level of assurance yield of the dam.

The procedure for this analysis was as shown in Table B2.1.

MADIKWE DAM
HYDROLOGICAL YIELD ANALYSIS – DETERMINATE METHOD

Catchment Area of Madikwe Dam =		67.5% of Quartenary Catchment Area
Madikwe Dam Virgin MAR =		5.40 million m^3/a
Madikwe Dam FSL Storage Capacity =		273.2% x Madikwe Dam MAR
From HRU Report Volume I, Part 2, Appendices C, Table F4 for Hydrological Zone Z14 :–		
Gross Darft :–	=	46.1% Madikwe MAR (99% L.O.A.) 52.1% Madikwe MAR (98% L.O.A.)
	=	2.49 million m^3/a (99% L.O.A.) 2.81 million m^3/a (98% L.O.A.)
Less Evaporation (ave 50 % FSL Area) :–		–3.23 million m^3/a
Plus Direct Rainfall :–		1.11 million m^3/a
Less Seepage :–		–0.10 million m^3/a
Nett Yield	=	0.28 million m^3/a (99% L.O.A.) = 754.7 kl/d 0.60 million m^3/a (98% L.O.A.) = 1641.3 kl/d

TABLE B2.1

B3 Detailed Modelled Analysis

The determinate analysis carried out above indicated that there is some doubt as to whether the 98% level of assurance yield which the dam can be expected to supply will be able to meet long term demands of the Madikwe regional supply scheme. It was thus decided to model the behaviour of the dam, given the various hydrological parameters pertinent to it, and under certain demand cycles, under the actual measured rainfall, run-off and evaporation conditions which occurred over the period 1920 - 1975.

The model works on an incremental month by month basis. It assumes the dam to be half full at the start of the simulation period. The net inflow/outflow for the month as a result of the factors listed below, is determined.

* Catchment run-off :- This is determined as a pro-rata portion of the run-off for the entire quaternary catchment in which the Madikwe Dam falls. The quaternary run-off was simulated by the hydrological model used by the HRU, and takes into account such factors as the actual measured rainfall pattern for the area, topography, veld and terrain types and slopes etc.

* Nett direct contribution to the dam volume as a result of actual measured rainfall and seasonal evaporation, both as a function of the dam area for the month, which is in turn a function of the volume at that point.

* Outflow due to the demand imposed on the dam. The demand is selected by the user and, while subject to a seasonal variation, does not have any nett annual growth over the simulation period.

* Seepage losses which are a function of a recorded maximum seepage loss for the dam of some 3 l/s, and also a function of the water level in the dam at that particular time interval.

Since the demand imposed on the dam for a particular simulation run does not grow on an annual basis, the method must represent and indeterminate approach, and the actual probable yield of the dam estimated on a trial and error basis.

The actual level of the dam over the simulation period of 1920 - 1975, based on an annual demand from the dam of 1.8 Ml/d, is shown in Figure B3.1. Pertinent indicators from the other simulation runs are included for the sake of comparison in table B3.3.

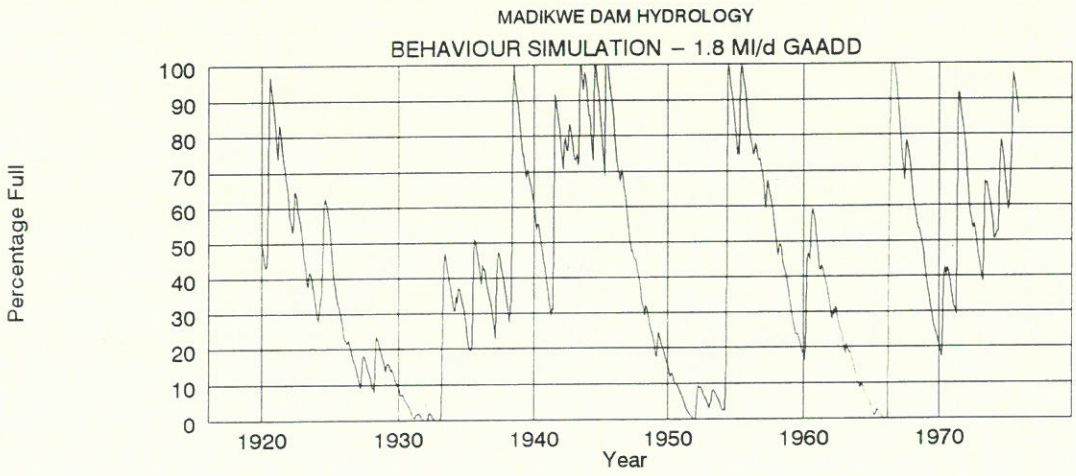


FIGURE B3.1

MADIKWE DAM HYDROLOGY

PERTINENT INDICATORS RESULTING FROM MODELLING EXERCISE

INDICATOR	1993	1995	1998	2003	2008	2013
GAADD (Ml/d) Applied to Model	1.572	1.800	2.108	2.352	2.623	2.925
Percentage Non–failure Months	98.5%	97.5%	95.8%	95.1%	94.0%	92.6%
Percentage Non–failure Years	92.9%	87.5%	87.5%	87.5%	85.7%	82.1%
Number of Failure Events	4	4	6	6	6	8
Average Failure Event Length (months)	2.50	4.25	4.67	5.50	6.67	6.25
Percentage of Required Yield Supplied	98.7%	98.0%	96.8%	96.0%	94.9%	93.8%

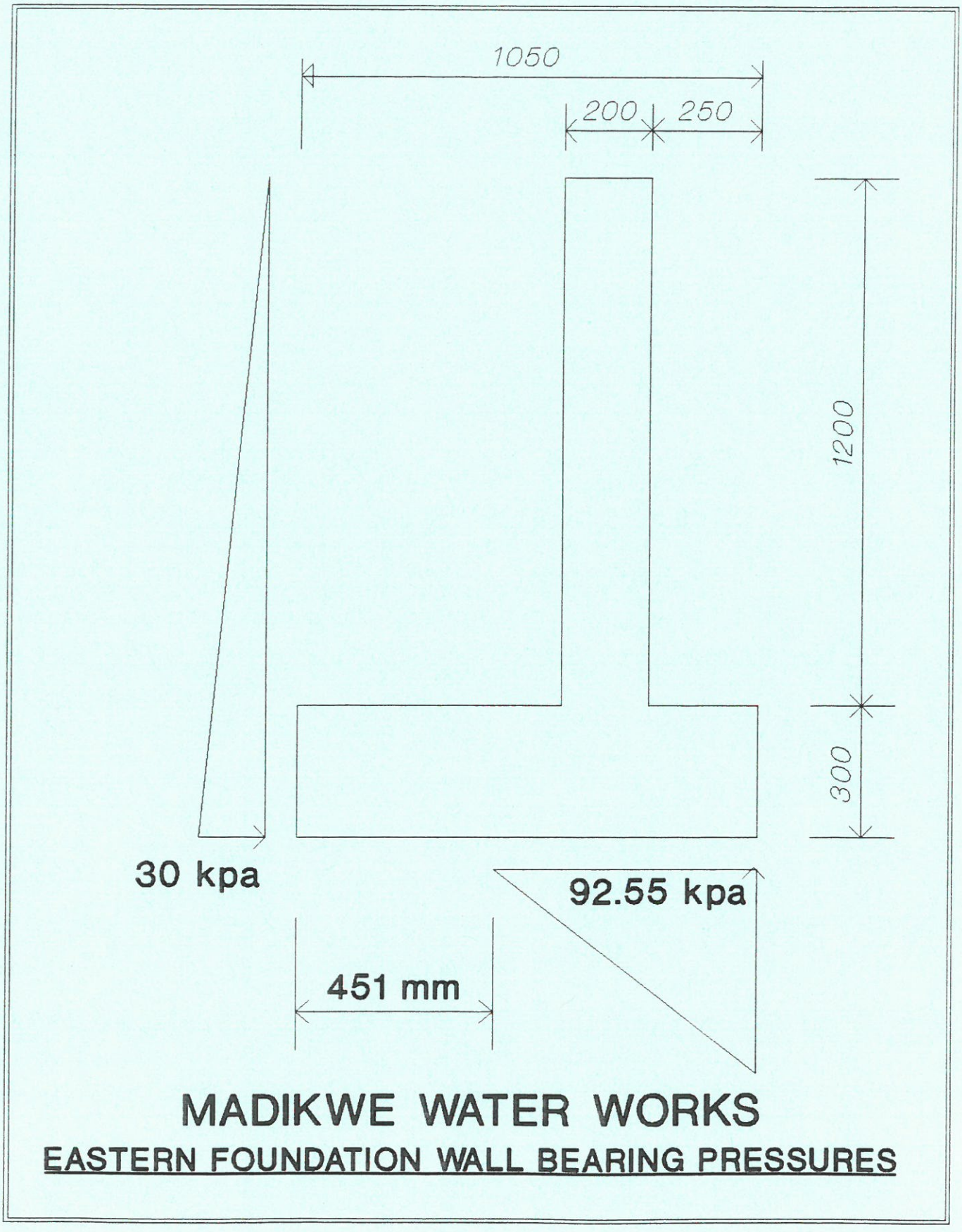
TABLE B3.1

ANNEXURE C

STRUCTURAL DESIGN DETAILS

ANNEXURE C - STRUCTURAL DESIGN DETAILS

C1 FOUNDATION RETAINING WALL - STABILITY AND BEARING PRESSURE



C2 FOUNDATION RETAINING WALL - REINFORCEMENT

JOB:– MADIKWE WATER WORKS
SECTION:–RETAINING WALL 1.2 m HIGH

Concrete strength= 25 mpa

High yield steel strength = 450 mpa

Enter Section properties :–

Cover =	40 mm
Breadth =	1000 mm
Height =	200 mm

Enter Design Bending Moment :– 8.138 KNm
Enter Design sheer Force :– 15.630 KN

Permissible sheer stress :– 0.35 mpa

Enter tension reinforcing steel to be used :–

No. bars=	5	Ay=	392.7 mm2
Nom.dia.=	10 mm	%age=	0.25

Enter compression reinforcing steel to be used :–

No. bars=	5	Ay=	392.7 mm2
Nom.dia.=	10 mm	%age=	0.25

b=	1000 mm	Nominal % area of reinf. req'd=	233 mm2
d=	155 mm		
z=	147 mm		
d'=	45 mm		

Ultimate moments of resistance :–

Steel –	22.6 KNm
Concrete–	104.1 Knm

Sheer stress v= 0.10 mpa
Sheer safety F= 3.491

Sheer Reinforcement :– Not Necessary

Deflection Check ;–

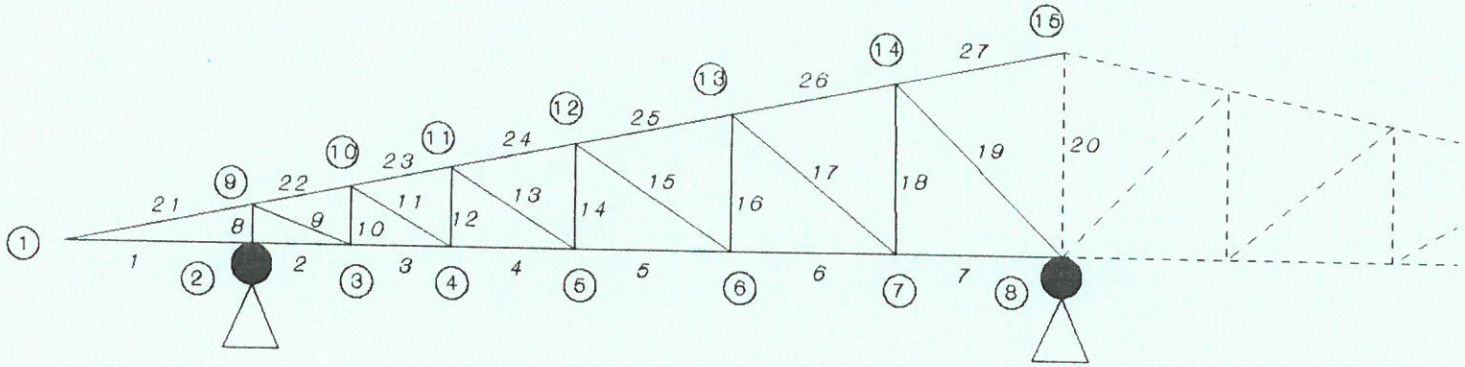
Type of beam :–	Simple	Cont.	Cantilever
(Mark with 1)	0	0	1

Then fs = 261 N/mm2

Factors are :–	Basic As	As'
	7	1.444	1.071

Maximum Span = 1.677 m

Adequacy of Design:–		
Bending		Adequate
	Nominal Reinft.	Adequate
	Sheer	Adequate



ROOF TRUSS CONFIGURATION

MADIKWE WATER PURIFICATION WORKS

STEEL ROOF TRUSS ANALYSIS

-o- PIN - JOINTED TRUSS ANALYSIS -o-

Section Properties

Member No.	E (x10^9 N/mm2)	A (x10^-3m2)	Length (m)	Angle to +ve horiz	Start Joint No.	Joint No.
1	260	.8127	1.50	0.00	1	2
2	260	.8127	0.80	0.00	2	3
3	260	.8127	0.80	0.00	3	4
4	260	.8127	1.00	0.00	4	5
5	260	.8127	1.25	0.00	5	6
6	260	.8127	1.33	0.00	6	7
7	260	.8127	1.33	0.00	7	8
8	260	.4803	0.31	90.00	2	9
9	260	.4803	0.86	159.15	3	9
10	260	.4803	0.47	90.00	3	10
11	260	.4803	0.93	149.72	4	10
12	260	.4803	0.63	90.00	4	11
13	260	.4803	1.18	147.80	5	11
14	260	.4803	0.83	90.00	5	12
15	260	.4803	1.50	146.33	6	12
16	260	.4803	1.09	90.00	6	13
17	260	.4803	1.71	140.64	7	13
18	260	.4803	1.36	90.00	7	14
19	260	.4803	1.90	134.34	8	14
20	260	.8127	1.63	90.00	8	15
21	260	.8127	1.53	11.48	1	9
22	260	.8127	0.82	11.48	9	10
23	260	.8127	0.82	11.48	10	11
24	260	.8127	1.02	11.48	11	12
25	260	.8127	1.28	11.48	12	13
26	260	.8127	1.35	11.48	13	14
27	260	.8127	1.35	11.48	14	15

JOINT FIXITIES

Joint No.	Fixity in X-dir'n	Fixity in Y-dir'n
1	1	1
2	1	0
3	1	1
4	1	1
5	1	1
6	1	1
7	1	1
8	0	0
9	1	1
10	1	1
11	1	1
12	1	1
13	1	1
14	1	1
15	1	1

Section Properties

Member No.	E (x10^9 N/mm2)	A (x10^-3m2)	Length (m)	Angle to +ve horiz	Start Joint No.	Joint No.
1	260	.8127	1.50	0.00	1	2
2	260	.8127	0.80	0.00	2	3
3	260	.8127	0.80	0.00	3	4
4	260	.8127	1.00	0.00	4	5
5	260	.8127	1.25	0.00	5	6
6	260	.8127	1.33	0.00	6	7
7	260	.8127	1.33	0.00	7	8
8	260	.4803	0.31	90.00	2	9
9	260	.4803	0.86	159.15	3	9
10	260	.4803	0.47	90.00	3	10
11	260	.4803	0.93	149.72	4	10
12	260	.4803	0.63	90.00	4	11
13	260	.4803	1.18	147.80	5	11
14	260	.4803	0.83	90.00	5	12
15	260	.4803	1.50	146.33	6	12
16	260	.4803	1.09	90.00	6	13
17	260	.4803	1.71	140.64	7	13
18	260	.4803	1.36	90.00	7	14
19	260	.4803	1.90	134.34	8	14
20	260	.8127	1.63	90.00	8	15
21	260	.8127	1.53	11.48	1	9
22	260	.8127	0.82	11.48	9	10
23	260	.8127	0.82	11.48	10	11
24	260	.8127	1.02	11.48	11	12
25	260	.8127	1.28	11.48	12	13
26	260	.8127	1.35	11.48	13	14
27	260	.8127	1.35	11.48	14	15

JOINT FIXITIES

Joint No.	Fixity in X-dir'n	Fixity in Y-dir'n
1	1	1
2	1	0
3	1	1
4	1	1
5	1	1
6	1	1
7	1	1
8	0	0
9	1	1
10	1	1
11	1	1
12	1	1
13	1	1
14	1	1
15	1	1

JOINT LOADS

Joint No.	Load in X-dir'n (kN)	Load in Y-dir'n (kN)
1	0.00	-1.35
2	0.00	0.00
3	0.00	0.00
4	0.00	0.00
5	0.00	0.00
6	0.00	0.00
7	0.00	0.00
8	0.00	0.00
9	0.00	-2.07
10	0.00	-1.44
11	0.00	-1.62
12	0.00	-2.03
13	0.00	-2.32
14	0.00	-2.39
15	0.00	-1.19

JOINT DEFLECTIONS

Joint No.	Deflection in X-dir'n (m)	Deflection in Y-dir'n (m)
1	-0.00012	-0.00038
2	-0.00017	0.00000
3	-0.00019	-0.00039
4	-0.00017	-0.00063
5	-0.00013	-0.00075
6	-0.00007	-0.00068
7	-0.00003	-0.00040
8	0.00000	0.00000
9	-0.00014	-0.00002
10	-0.00008	-0.00041
11	-0.00007	-0.00064
12	-0.00010	-0.00075
13	-0.00016	-0.00067
14	-0.00025	-0.00037
15	-0.00032	-0.00001

MEMBER LOADS AND STRESSES

Member No.	Force Magnitude (kN)	Force Type	Stress (mpa)
1	6.646	Compression	8.18
2	6.646	Compression	8.18
3	4.984	Tension	6.13
4	8.782	Tension	10.81
5	9.500	Tension	11.69
6	7.691	Tension	9.46
7	4.247	Tension	5.23
8	8.862	Compression	18.45
9	12.445	Tension	25.91
10	4.429	Compression	9.22
11	4.398	Tension	9.16
12	2.218	Compression	4.62
13	0.848	Tension	1.77
14	0.452	Compression	0.94
15	2.174	Compression	4.53
16	1.205	Tension	2.51
17	4.453	Compression	9.27
18	2.824	Tension	5.88
19	6.077	Compression	12.65
20	1.193	Compression	1.47
21	6.782	Tension	8.34
22	5.086	Compression	6.26
23	8.961	Compression	11.03
24	9.694	Compression	11.93
25	7.848	Compression	9.66
26	4.334	Compression	5.33
27	0.000	Compression	0.00

TRUSS MEMBER NUMBER 19

++ MEMBER LOAD CAPACITY ANALYSIS ++

l/rx= 125.83 l/ry= 175.93 h/tf= 10

pc= 31.221 mpa pmc= 150.628 mpa f'cr= 77.05

comp. strs= 26.338mpa bending strs= 0.437mpa.

Stability Test

$$\frac{cs}{pcs} + \frac{mcs}{(1 - \frac{cs}{fcr})pmcs} = 0.848$$

Section is O K !!

This Section's Maximum Moment capacity under these conditions is 0.035 kNm.

TRUSS MEMBER NUMBER 25

++ MEMBER LOAD CAPACITY ANALYSIS ++

l/rx= 59.88 l/ry= 93.1 h/tf= 11.67

pc= 95.660 mpa pmc= 182.879 mpa f'cr= 340.25

comp. strs= 11.886mpa bending strs= 0.179mpa.

Stability Test

$$\frac{cs}{pcs} + \frac{mcs}{(1 - \frac{cs}{fcr})pmcs} = 0.125$$

Section is O K !!

This Section's Maximum Moment capacity under these conditions is 0.864 kNm.

C4 STRUCTURAL STEEL COLUMN DESIGN

PLANT ROOM COLUMN 100 x 100 x 5 x 3440 HIGH

++ MEMBER LOAD CAPACITY ANALYSIS ++

l/rx= 89.82 l/ry= 89.82 h/tf= 20

pc= 100.306 mpa pmc= 169.180 mpa f'cr= 151.22

comp. strs= 10.170mpa bending strs= 18.819mpa.

Stability Test

$$\frac{cs}{pcs} + \frac{mcs}{(1 - \frac{cs}{fcr})pmcs} = 0.221$$

Section is O K !!

This Section's Maximum Moment capacity under these conditions is 7.535 kNm.

ANNEXURE D

DEVELOPMENT PROPOSAL AND COST ESTIMATE BY AQUATEK

AQUATEK

Aquatek (Pty) Ltd
REG NO 67/05992/07

Aquatek House
11 Hazelwood Road
Hazelwood Pretoria
P.O. Box 35422
Menlo Park 0102

Tel: (012) 46-6261
Fax: (012) 46-4298
Intern: 27-12-46-6261
South Africa

10 January 1994
Our Ref: T4072

EVN Consulting Engineers
(Bophutatswana) (Pty) Ltd
PO Box 373
MAFIKENG 8670

ATTENTION MR BILL BOSMAN
FAX 0140 816 051

Dear Sirs

MADIKWE WATER PURIFICATION WORKS - PHASE II

Thank you for your fax sent through to us at the beginning of the year in connection with the above extension.

We have pulled out all our files and drawings on this project and are now in a position to recommend how the extension should be handled and to give you a cost associated with this extension.

In the first instance we agree with you that the plant should be extended by adding a structural model on to the side of the existing plant where provision is already made for clamping the roof and picking up existing points there and provision is made in the pipework in the filter room to extend through to the next room. This extension would be on the side remote from the chemical dosing section on the left-hand side as you look at the filter room, i.e. the extension on the right-hand side.

In the first instance we recommend that the plant be run, not as originally envisaged, stepping up it's capacity as demand increases, but at a fixed rate of 100m3/hour. This means that whenever the plant starts. two raw water pumps start and two filter pumps will start as the water arrives in the settled water tank.

At present there are 2 raw water pumps installed and 2 filter pumps installed and therefore, we will install a new filter pump and raw water pump to act as a third or stand-by to any one of the other 2.

We have been through this in detail with our switchboard supplier who built the original switchboard and we have agreed to attack the process as follows:-

1. 1 x level probe set in the clean water tank will determine whether or not to start the plant and to stop the plant on high level. The signal cable for these probes exists and will be taken to a single new level relay in the plant.

2. The instruction to start the raw water pumps will then be sent as an electrical signal to a relay in the board at the abstraction tower.

This will start the first pump at the abstraction tower as selected and the second pump will come in via a cascade timer once the first pump has been in operation for a few seconds.

3. At the main plant a flow switch will detect the presence of flow in this pipeline and shut down the raw water pumps if there is no flow or, alternatively start the dosing pumps, if there is flow.

4. The existing dosing pumps will be replaced with 3 large pumps capable of handling the entire 100m3/h flow and all 3 will be 46 l/h pumps feeding primary coagulant (Ferric Chloride or Polyaluminium Chloride/Polyamine), Pump 2 will feed Lime and will be fitted with a stainless steel head for the purpose and Pump 3 will be capable of delivering Polyelectrolyte if required. Apart from the stainless steel head on Pump 2, all 3 pumps will be identical.

5. Three static mixers will be replaced so that the entire flow can go through the existing 3 static mixers and we recommend that the retention piping be replaced with our new floc columns which have better retention time and at the same time just the correct amount of energy. Each floc column can handle approximately 50m3/h and, therefore, we would put a floc column up stream of each set of settlers, both the existing set and the new set.

6. The settled water sump would remain the same extended, of course, between the 2 buildings and the new filter pump would have the suction connected into the sump which is then broken out from the original sump to form 1 sump. Treated water would discharge into the existing treatment line.

We will arrange these pumps to start at slightly different times to avoid water hammer but we also recommend that we install a new non-return valve in the common delivery line after the filters to prevent water hammer which has been occurring in the past. This will be a fast closing spring-loaded valve at the outlet of both filter sets.

7. The switchgear will be modified to suit the arrangement as specified above and there is plenty of space in the switchboard to accommodate all the thoughts we have had here.

The Price Schedule we have set out below is broken down into a few sections, however, please bear in mind that in all cases, we have allowed for everything we consider necessary to install the additional items as well as those items that we know ought to be replaced such as flow switch, level units and so on. With our experience over the last 12 years, we have located more reliable items in most of these applications and we will incorporate these items in our price.

We trust that we have given you sufficient information here to evaluate our suggestions but please do not hesitate to discuss them with us if necessary.

Yours faithfully,
for AQUATEK (PTY) LTD

RICHARD A STARKE
MANAGING DIRECTOR

ANNEXURE E
FINANCIAL MODULE

ANNEXURE E - FINANCIAL MODULE

E1 CAPITAL COST ESTIMATES

The detailed breakdown of estimated total capital cost for the proposed upgrading of the works is shown in Table E1.1.

UPGRADING OF MADIKWE WATER PURIFICATION WORKS

ITEM	DESCRIPTION	AMOUNT
1.	ABSTRACTION WORKS	
	Supply & Install new MB100 Pump	R35 000
	Pipework	R15 000
	Electrical	R30 000
	Sub–total	R80 000
2.	NEW PURIFICATION PLANT	
	Supply & Install ex Aquatek (Incl. Elec. & Mech.) the following :–	
	New mixers, floc columns etc.	R39 307
	New dosing system	R22 980
	New clarifiers	R72 350
	New filter pump and filters	R53 998
	Switchgear and controls	R19 981
	Sundry Pipework etc.	R4 395
	Labour to above	R25 874
	Sub–total	R238 885
3.	BUILDINGS	
	Plant House	R205 000
	Chemical Store	R70 000
	Lock–up Garages	R40 000
	Sub–total	R315 000
4.	SITE WORKS	
	Construct New Internal Road (incl. paving)	R40 000
	Relocate Gates & Fencing	R10 000
	Drainage Structures	R15 000
	Plant Grass	R5 000
	Sub–total	R70 000
5.	REPAIRS TO EXISTING PLANT	
	Ex Aquatek	R20 000
6.	REPAIRS TO EXISTING 1.5 Ml RESERVOIR	
	Cleaning, Repair & Painting	R50 000
7.	SECURITY LIGHTS	
	Supply & Installation x 8 Units	R9 600
	PRELIMINARY & GENERAL	R117 523
	CONTINGENCIES	R90 101
	PRE–CONTRACT ESCALATION	R42 000
	CONTRACT ESCALATION	R56 000
	PROFESSIONAL FEES	R195 000
	TOTAL PROJECT COST	R1 284 109

TABLE E1.1

E2 CASH FLOW

The projected cashflow for the project, based on the programme shown in paragraph 6 of this report, is shown in Figure E2.1.