SANTALPUR REGIONAL WATER SUPPLY SCHEME, GUJARAT, INDIA

OPERATION & MAINTENANCE

Volume I

EVALUATION EXISTING
OPERATION & MAINTENANCE

OCTOBER 1990

HASKONING
Royal Dutch Consulting
Engineers and Architects

Barbarossastraat 35
P. O. Box 151
6500 AD Nijmegen
The Netherlands
Telephone +31 (0)80 284284
Telex 48015 hask nl.
Telefax +31 (0)80 239346/242101

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1. INTRODUCTION

This evaluation of the existing operation and maintenance of the Santalpur Regional Water Supply Scheme (SRWSS) has been conducted in order to prepare an Operation & Maintenance Manual. The evaluation forms the basis for the manual and focuses on the existing O & M practice, organizational aspects and also gives some recommendations which are essential for future proper operation and maintenance.

In the next chapter a short description of the existing water supply system is given, limited to the main components. Chapter 3 discusses the existing organizational structure of the Gujarat Water Supply and Sewerage Board and in particular the division directly responsible for the O & M of the SRWSS. The existing operation and maintenance is described in Chapter 4, which concentrates on the status and shortcomings of present operation and maintenance. Finally, chapter 5 presents the conclusions and also gives some recommendations which are a prior condition for improvement of O & M.

2. SANTALPUR REGIONAL WATER SUPPLY SCHEME

Demand

The original aim of the first phase of the Santalpur Regional Water Supply Scheme was to provide drinking water to 72 villages in the Santalpur, Radhanpur and Kankrej talukas in the Banaskantha district. The first phase was designed for a population of 90,000 in the year 1993 and 1,20,000 in 2008. Presently, the second phase is being executed which aims at providing water to 48 additional villages with an expected population of about 1,24,000 in the year 2008.

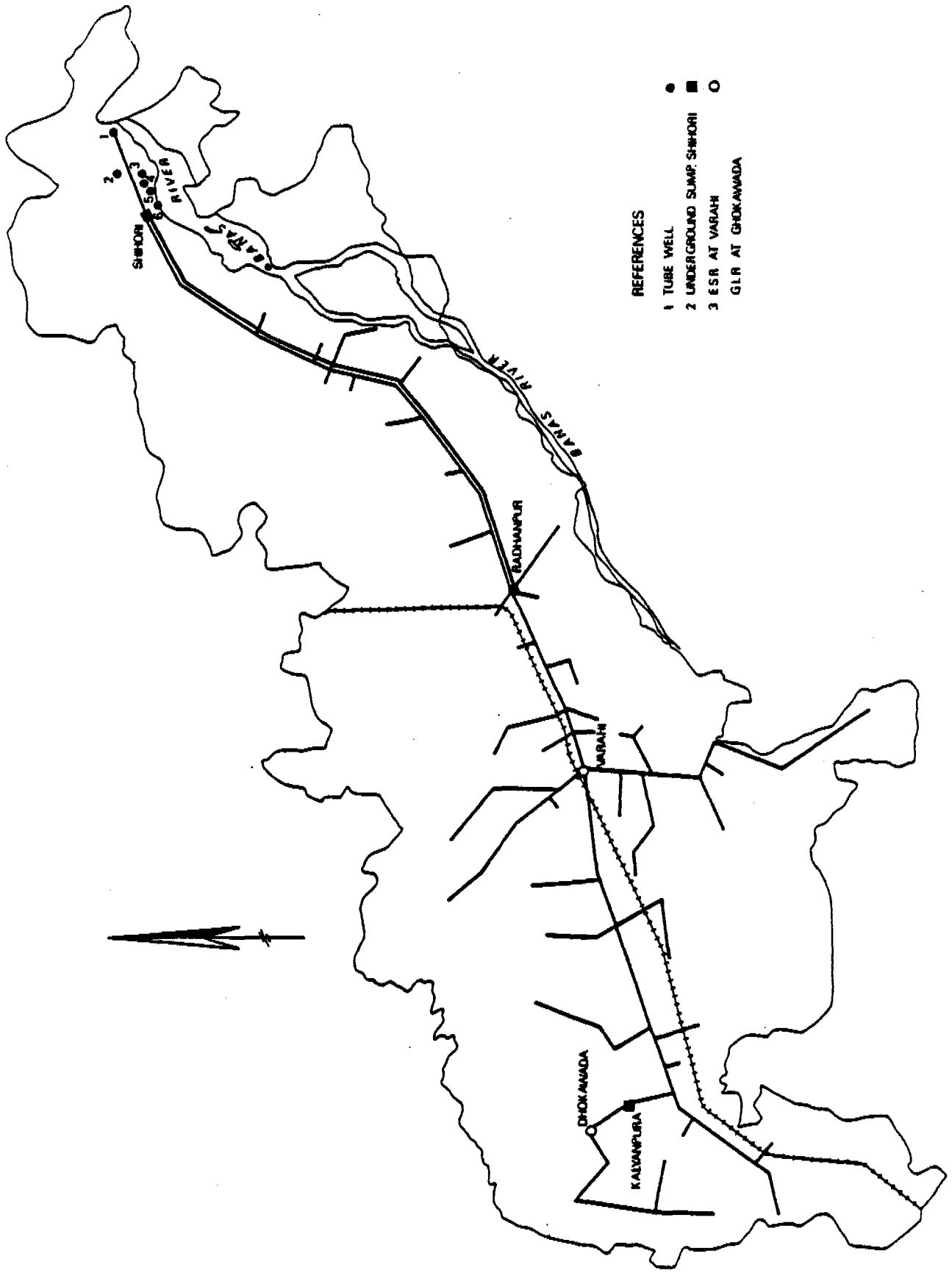
The design demand was fixed at 55 litre per capita per day (lpcd) for the maximum day, which comprises of: 30 lpcd for human consumption, 15 lpcd for cattle and a provision of 10 lpcd (22%) for leakage and wastage. Futhermore an hourly peak factor of 1.2 has been taken into account for the distribution system.

Due to connection of so called problem villages during the last drought years, the number of people connected to the system has reached approximately 1,00,000. This figure combined with the demand figure brings the present demand to about 5.5 Million Litre per Day (MLD).

Source

The source consists of six tube wells with a design capacity of 75,000 litre per hour, located at Shihori (Figure 2.1). The average daily production is estimated to be 9.0 MLD, based on 20 hours of pumping per day. However, it was reported that the daily production varies between 8.0 and 12.0 MLD. Each tube well is equipped with an electrical drive submersible pump, a pressure and water meter, non-return and sluice valve, and a standby diesel engine with a generator set.

FIGURE 2.1 SCHEMATIC LAY-OUT OF SANTALPUR R.W.S.S



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Treatment
Treatment is limited to chlorination, which takes place just before the storage reservoirs at the end of the rising main which connects all the tube wells by means of a gaseous chlorinator.

Storage
The storage incorporated in the design can be divided into the following main components:

- Ground level reservoirs at the Shihori headworks, consisting of two reservoirs of 7,50,000 litre, which are directly fed by the tube wells. Another reservoir has been recently constructed for the second phase with a capacity of 15,00,000 litre;
- Elevated storage reservoir (ESR) of 6,50,000 litre at Varahi with a height of 18 meters above ground level. At present, the reservoir is being by-passed;
- Ground level reservoir with a capacity of 1,05,000 litre at Dhokawada, which is fed by a booster station at Kalyanpura and has to supply four tail end villages. The booster station includes an underground sump and is equipped with a standby diesel generating set;
- One or more cisterns at each village, with varying capacity (10,000 to 50,000 litre), dependent on the size of the village and the number of stand posts.

The total storage capacity of the first phase programme comes to 22,55,000 litre which is about one third of the design demand in the year 2008 of 6.6 MLD.

Distribution
The distribution system mainly consists of a branched pipe line system. From the headworks at Shihori the water flows under gravity through a duplicate pipe line with diameters of 450, 400, 350 mm) up to Radhanpur. The two pipes are interconnected every five km. Thereafter, there is a single pipe line decreasing in size from 400 mm to 80 mm, up to Rozu.

Distribution from the main pipe line to the villages is through branches of AC and PVC, with a smallest diameter of 80 mm, to the village cisterns.

Village Level Facilities
Village level facilities comprise of cisterns, stand posts and cattle troughs. The cisterns are connected to the branch lines with an orifice consisting of a sluice valve, 20 mm GI pipe, and at some places a water meter. The orifice was designed to establish a constant flow to the cistern according to the demand, the flow can be tuned by closing or opening the valve.

From the cisterns public stand posts and cattle troughs are being fed. The stand posts have four or more taps dependent on the number of people to be served.

Metering
As mentioned before, all tube wells have been equipped with bulk water meters. Futhermore, some bulk meters have been provided on the main transmission pipe line.

The connections of villages between Shihori and Varahi, have been provided with a 20 mm domestic water meters just before the village cisterns. Villages connected to the system downstream of Varahi are not being metered at the moment but it has been proposed to install water meters at all villages under the second phase programme.

Pressure Monitoring
Manometers have been provided on the main pipe line approximately every 14 km, in order to monitor the prevailing pressures (in total 5 manometers have been provided). However, between Shihori and Radhanpur manometers have only been installed on one of the two pipes of the duplicate pipe line.

3. ORGANIZATIONAL STRUCTURE

The organization chart of the Gujarat Water Supply and Sewerage Board is presented in Figure 3.1. The organization chart concentrates on Zone II, responsible for the management of the Santalpur Regional Water Supply Scheme . Zone I and II, the World Bank Cell, and the Mechanical Cell have a similar set-up, with circle, division, sub division and section offices. Respectively headed by a Superintending Engineer, a Executive Engineer, a Deputy Executive Engineer, and an (Add.) Assistant Engineer.

The organization chart has been elaborated for the offices responsible for the operation and maintenance of the SRWSS. The division office in Radhanpur has the overall responsibility for the Santalpur scheme. The division is also responsible for a number of villages water supply schemes but the SRWSS constitutes the main part of the work responsibility. The sub division offices are responsible for the daily operation and maintenance of specific parts of the system. The sub division Radhanpur II has been divided into two section because of the large area under its jurisdiction.

All sub division offices are headed by a Deputy Executive Engineer and have the following responsibilities:

- Shihori sub division; monitoring, operating and maintaining tube wells, storage reservoirs and approximately 14 km of main transmission pipe line;
- Thara and Radhanpur I sub division; operating and maintaining certain section of the distribution system including village level facilities;
- Radhanpur II sub division; operating and maintaining the lower part of the distribution system including an ESR at Varahi, a booster station at Kalyanpura and a ground level reservoir at Dhokawada. The sub division has section offices at Varahi and Santalpur.

4. EXISTING OPERATION AND MAINTENANCE

4.1 Operation

At present the operation of the scheme differs considerably from the operation planned during the design of the system. The existing operation of the main components of the Santalpur Regional Water Supply Scheme and some remarks are listed below:

Source
During the design it was decided to construct six tube wells of which one should be considered as standby capacity, and to operate the wells for 20 hours a day. Presently, all tube wells are being operated for 24 hours, if possible. According to estimates of the Shihori sub division, the water production varies from 8.0 to 12.0 MLD. However, these figures are unreliable because the bulk water meters which should monitor the output of each wells, are out of order.

From the field visit it became clear that these meters have not been installed in accordance with the specifications of the manufacturer, which might be the cause of the malfunctioning of these meters. The specification indicate that a bulk meter requires an undisturbed flow to prevent inaccuracy of the meters. Probably, it also causes damage to the meters. The undisturbed flow can be maintained by installation of meters in between two straight piece of pipe with a length of approximately 10 times the diameter of the pipe.

Ground Level Reservoirs (Shihori)
The operation of the reservoirs is limited to the opening or closing of the supply valve to the distribution system. The valve is opened only partly, 5 threats out of 45. According to the Shihori sub division the valve has to be throttled to prevent complete emptying of the reservoir, and bursting of the down stream pipe lines.

Distribution System
The prevailing pressures in the distribution system are considerably lower then the design pressure. The first 9 to 10 km of the pipe line between Shihori and Radhanpur, are without any pressure because the duplicate line is only partially filled. Because of too low pressures water rationing has become necessary to supply water to all villages. During day time water is supplied to the villages between Shihori and Varahi, including the village along the Aniyana and Korda branch. During the night water is supplied to the villages downstream of Varahi. So, actual practice is to supply these zones intermittent while the original design was based on 24 hours of pressure in the distribution system.

In general, the village cisterns are being filled only once a day after which the delivery valve is closed. During the filling of the cistern water is also supplied through the stand post. Therefore, it is not possible to determine the exact amount of

water supplied to a village unless a functioning water meter is available. However, it is likely that less water is being supplied then the design demand because of the limited capacity of the cisterns. This conclusion is supported by an at random check at villages with functioning water meters.

4.2 Maintenance

In this section some remarks about the present state of maintenance of the main components of the system are made.

Tube Wells
The tube well pumps and tube well buildings are being maintained rather well. This can be concluded from the guesstimated daily production and the limited occurrence of breakdowns. However, the bulk meters provided at each tube well are not in working condition. This is probably due to improper installation.

Diesel Generating Set
The diesel generating sets are being maintained reasonable, all sets which were tested during the field visits were operating satisfactory. On the other hand the regular maintenance of the diesel engine can be improved, considerably

Distribution System
The prevailing maintenance of the distribution system doesn't meet the standards necessary to ensure adequate water supply to the villages, and to maintain the design pressure. During the field visit several major leaks were detected which existed already for a long period. Futhermore, sluice valves and air valves are often leaking.

In view of the large amount of water produced (9.0 MLD) at the Shihori well field and the estimated total demand of 5.5 MLD, it can be concluded that a lot of water is unaccounted for. Another indication for the large losses is the low pressures which are prevailing in the system. This is either caused by a higher demand (higher per capita consumption or number of people connected to the system) or by excessive leakage. As mentioned before, the water supplied per capita is probably less then the design demand. This leads to the conclusion that a considerable amount of water is lost due to leakage.

no of people served?

Village Level Facilities
In general the village level facilities are being maintained, properly. A point for improvement is the drainage of spillage water from the stand posts.

However, at one location near Santalpur it was observed that a hose was connected to a stand post which discharged water directly into a pond of sewage. This can be very dangerous because the hose might function as a siphon during non-pressure hours and contaminated water might enter into the pipe.

Water Meters/Manometers
The bulk water meters and the domestic water meters installed before the cisterns are often out of order, and are not being replaced. This is due to the lack of spare meters and repair facilities. The same is applicable for manometers, although most of them are still working, there are no spare manometer available.

4.3 Monitoring

Whenever water meters and manometers are in working condition they are being read and recorded systematically. However, these data are not being collected by the sub division offices, and are not used to evaluate the performance of the scheme. It was noticed that these records are kept in the field until the recording book is full (after approximately six month) after which it is brought to the offices and filed. Therefore, it is not possible to under take systematic action to improve the performance of the water supply system.

Analysis of the collected data in the field is of important relevance to detect problems in an early stage. Besides, indication of amount of leakage it will also indicate the development of demand figures.

5. CONCLUSIONS AND RECOMMENDATIONS

It can be concluded that the supply of water to most villages is reasonable. Although, it is assumed that less water is supplied to the villages then the design demand, people are quite satisfied. Villages at the tail end however, do not get water regularly and often in insufficient quantity. It is not possible to determine the exact reasons for the unsatisfactory performance of the system. However, there are strong indications that a substantial amount of water is wasted through leaks. Especially, along the pipe line between Varahi and Santalpur major leaks have been noticed.

The reason for the present poor state of maintenance are not of a technical nature but the absence of clear job descriptions and responsibilities. Futhermore, the recording and reporting system for maintenance activities is not well established, irregular and unformatted.

Monitoring and tuning of the system is not possible due to the limited data available and the present condition of the distribution system. Listed below are some recommendations to improve the performance of the Santalpur Regional Water Supply Scheme:

- Repair of major leaks which can be easily detected by means of visual inspection;
- Regular visual inspection of the pipe lines, sluice valves and air valves followed by proper action;
- Installation of additional water meters (in accordance with specifications) and manometers for proper monitoring of the

system;
- Improvement of the installation of existing water meters in order to ensure the accuracy and to prevent damaging the meter;
- Establishment of a recording and reporting system of water meter and manometer readings, and maintenance requirements to ensure that data reach the proper level;
- Improve the availability of spare parts and spare equipment especially with regard to water meters, manometers and rubber gaskets;
- Establish a contract with a private firm for the repair of water meters;
- Prepare as-built drawing indicating exact location of pipes, pipe material and diameter, valves, water meters and manometers. Also, all appurtenances should be given identification numbers which will simplify the recording of required maintenance and the execution of maintenance by the Mobile Repair Crew;
- Install every 10 to 15 km manometers on the main transmission pipe line;
- Check the pressure loss due to the orifice which have been installed before the village cisterns, the pressure loss might be too high with the prevailing pressures in the distribution system.