Government of India
Government of Andhra Pradesh
Ministry of Panchayati Raj and Rural Development

Government of the Netherlands
Ministry of Foreign Affairs
Directorate General of
International Cooperation

RURAL WATER SUPPLY ANDHRA PRADESH

WATER RESOURCES STUDY AP-III

VOLUME II - MAIN REPORT

IWACO
Consultants for Water & Environment

Head Office:
P.O. Box 8520
3009 AM Rotterdam
The Netherlands

Rotterdam

July 1992

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In the last and **fourth** phase in the Netherlands the data collected and prepared into a data base were analyzed and processed by means of a geographical information system. Village wise groundwater alternatives were defined and combined to regional supply alternatives. An economical model to calculate investments of groundwater supply options was prepared. The results of the first three phases of the study were incorporated in a multi criteria analyses. Final reporting followed hereafter.

By the end of each visit in India the most important findings were reported to the Engineer in Chief of the Panchayati Raj Engineering Department and representatives of the Royal Netherlands Embassy.

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This is the second volume of a two volume report. The first volume contains the findings of the study in short and the main conclusions and recommendations.
The present volume presents the background information, the data base and details on the models that have been uses.

The second chapter contains a description of the study area and presents the existing water supply systems and water resource developments with emphasizes on the water supply systems of the PRED.

Chapters 3 and 4 concern the groundwater resources in terms of quantity and quality. Chapter 5 describes the surface water resources in and near the study area.

Chapter 6 describes the methods and results of the generation of groundwater alternatives. A village based approach has been adopted. The final sections of chapters 3 and 4 form the main input for the identification of local village water supply systems. Chapter 6 includes the explanation and application of the economical model that has been developed to estimate the cost of the groundwater alternative.

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- "Preliminary Geophysical Surveys for groundwater in Nalgonda District by CGWB; A.N. Bhowmic a.o.

The most important parts of these reports are integrated in the present report and appendices.

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ABBREVIATIONS AND EXCHANGE RATES

AP	Andhra Pradesh
AP-I (to III)	Andhra Pradesh I (to III) rural water supply scheme
APSRAC	Andhra Pradesh State Remote Sensing Applications Centre
CPWS	Comprehensive Protected (or Piped) Water Supply
DGIS	Directorate General for International Cooperation, Ministry of Foreign Affairs, the Netherlands
ETC	Consultants for Development Programmes, Leusden, the Netherlands
Gram	Village
GLSR	Groundlevel storage reservoir
GOAP	Government of Andhra Pradesh
GOI	Government of India
GON	Government of the Netherlands
HMWSSB	Hyderabad Metro Water Supply and Sewerage Board
IPM	Institute of Preventive Medicine
IWACO	International Consultants for Water and Environment
m.a.m.sl	meters above mean sea level
Mandal	Government level between District and village
MPWS	Mini Protected Water Supply
NAP	Netherlands Assisted Project(s)
NGO	Non-Governmental Organization
O&M	Operation and Maintenance
OHSR	Overhead storage reservoir
Panchayati	Local self government
PR & RD	Panchayati Raj and Rural Development
PRED	Panchayati Raj Engineering Division
PWSS	Protected Water Supply Scheme
Raj	Rule
RNE	Royal Netherlands Embassy
RWS	Rural Water Supply
SERIFED	Federation of Sericulturists and Silk Weavers Cooperative Societies Limited
TOR	Terms of Reference

1 Dfl.	= Rs	13.1
1 US$	= Rs	25.5
1 US$	= Dfl.	1.95

1. INTRODUCTION

1.1 BACKGROUND

The Government of India (GOI) has requested financial support from the Government of the Netherlands (GON) for the implementation of an integrated rural water supply and sanitation project in the Nalgonda District, Andhra Pradesh. This AP-III project is to cover a total of 226 scarcity and fluoride affected villages. The project proposed the construction of two piped water supply systems with the Nagarjuna Sagar Left Bank Canal as raw water source.

An appraisal of the proposed project was carried out on behalf of DGIS in October 1991. The main recommendation of the appraisal team was to carry out a more detailed study of the water resources in and near the project area as locally available water might reduce the cost and increase the reliability of the proposed system, and that possibly a large scale piped system can be avoided completely.

The water resources study has been carried out in four phases by Mr. J.J. van der Sommen, hydrogeologist of IWACO, with the support of Mr. Krupanidhi, retired Director of the Central Groundwater Board. The study was done in close cooperation with the Panchayati Raj Engineering Department and in consultation with the Netherlands Assisted Projects (NAP) Office in Hyderabad. The study took place in the period of January to June 1992, in the framework of the Review and Support Missions for the Andhra Pradesh projects.

Specific tasks were carried out by the Andhra Pradesh State Remote Sensing Agency (APSRAC) (Satellite image interpretation and fieldwork) and the Central Groundwater Board (CGWB) (geophysical measurements). Among other organizations that participated in the study are State Groundwater Department (SGWD), Irrigation Development Cooperation (IDC) and the Institute for Preventive Medicine (IPM).

1.2 THE PROJECT

The proposed AP-III project covers a total design population in 2022 of 880,000. The project is subdivided in two phases. Phase I aims at providing 82 villages with reliable water by means of a single comprehensive surface water scheme. In order to reach the potential benefits, additional activities are proposed in the fields of community based support activities and institution development. Phase 2 covers the remaining 144 villages with a similar comprehensive piped scheme. The main characteristics of the water supply component of both phases are presented in table 1.1.

Table 1.1: Main characteristics of the water supply component of the AP-III proposal

	No. of villages	Population 1992	Design capacity 2022 l/s	Costs water supply in Rs/mln	Total project costs in Rs/mln
Phase I	82	226.000	259	386,3	536,4
Phase II	144	257.000	298	374	714
Total	226	483.000	557	760,3	1250,4

1.3 OBJECTIVES OF THE WATER RESOURCES STUDY

The main objective of the study is to estimate the quantities of reliable ground and surface water that are available in or near the project area for drinking water supply on a sustainable basis.

Secondary objectives are:

- to distinguish groundwater sources as to their fluoride content and to find out whether fluoride content in groundwater has a tendency to increase.
- to analyze water samples of potential sources on the presence of micro pollutants.
- to asses the possibilities of making maps of the villages in the project area.
- to collect data concerning the suitability of water, soils and land in the area for the proposed dairy and sericulture activities.

Following the preliminary results of the study that indicate the possibility of groundwater based water supply systems the need was felt to define and to evaluate different surface water, groundwater or combined supply alternatives. This task was incorporated into the study to be carried out in the Netherlands. Use was made of multi-criteria analysis to come to a workable number of alternatives that show in clear terms the supply options of the project area. The objective is to assist the decision makers involved to make a sound and well founded choice for the future water supply of the area.

The Terms of Reference for the groundwater study (hereafter "the study") are shown in Appendix 1.

1.4 EXECUTION OF THE STUDY

The study was realized in four phases:

During the **first** visit to India (21-1-1992 to 12-2-1992) institutions are visited and available data collected and evaluated. Mr Krupanidhi joined the mission in Hyderabad. A list of persons met is shown in Appendix 2. Appendix 3 lists the main reports and data sources used during the study. In this first period the project area, including the Nagarjuna Sagar Dam was visited and the first field measurements carried out by means of portable fieldkits for fluoride determination. A database structure was set up at the PRED and data handling started by PRED staff. Two parties (APSRAC and CGWB) were selected to carry out further investigations and job descriptions were made (see Appendix 4). A water sampling programme was initiated by the APSIDC sampling over 188 irrigation wells.

In the **second** period work was going on in India carried out by the Panchayati Raj Engineering Department (PRED) and the Andhra Pradesh State Remote Sensing Centre (APSRAC), including:

- an inventory of existing water supply systems, additional water sampling for fluoride and micro pollutants;
- preparation of thematic maps and correlation to the fluoride content in groundwater and surface water.

The Central Groundwater Board was preparing for the geophysical measurements to detect kankar deposits and fractures in recharge areas.

In the **third** phase Mr van der Sommen visited India again (26-3-1992 to 15-4-1992) and detailed field work was carried out, including chemical measurements, geophysical measurements and field checks for satellite interpretation. The necessary data for the analysis to generate and select water supply alternatives were collected. It concerned mainly economical data that are prepared by the PRED. The methodology to be followed in the final fourth phase was discussed with the parties involved.

In the last and **fourth** phase in the Netherlands the data collected and prepared into a data base were analyzed and processed by means of a geographical information system. Village wise groundwater alternatives were defined and combined to regional supply alternatives. An economical model to calculate investments of groundwater supply options was prepared. The results of the first three phases of the study were incorporated in a multi criteria analyses. Final reporting followed hereafter.

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2. STUDY AREA

2.1 DESCRIPTION OF THE AREA

The study area is located in the Nalgonda District and it covers an area of 2,750 km^2 of the district. It includes 16 mandals, 226 villages and 336 hamlets (see figure 2.1).

The Nalgonda District is one of the 23 districts of Andhra Pradesh. With a total population of 2.94 million spread over 1,115 villages and 10 towns and about 83% of the population being rural and 40% of the area being sown, the district is, by and large, agrarian. Due to the low annual rainfall and large rainfall variability the district is chronically drought affected. Many parts of the district are afflicted by fluorosis due to a high fluoride content in the drinking water.

Soils in the district have a poor fertility. 8% of the area is under irrigation: 50% is under canal irrigation, 19% is irrigated by groundwater and 8% by surface water from tanks. Mainly rice is grown (90%) and 5% groundnut. Industry is only poorly developed and largely limited to the agricultural sector. Of the about 859 registered industrial units, 502 are rice mills, and 118 are related to other food products.

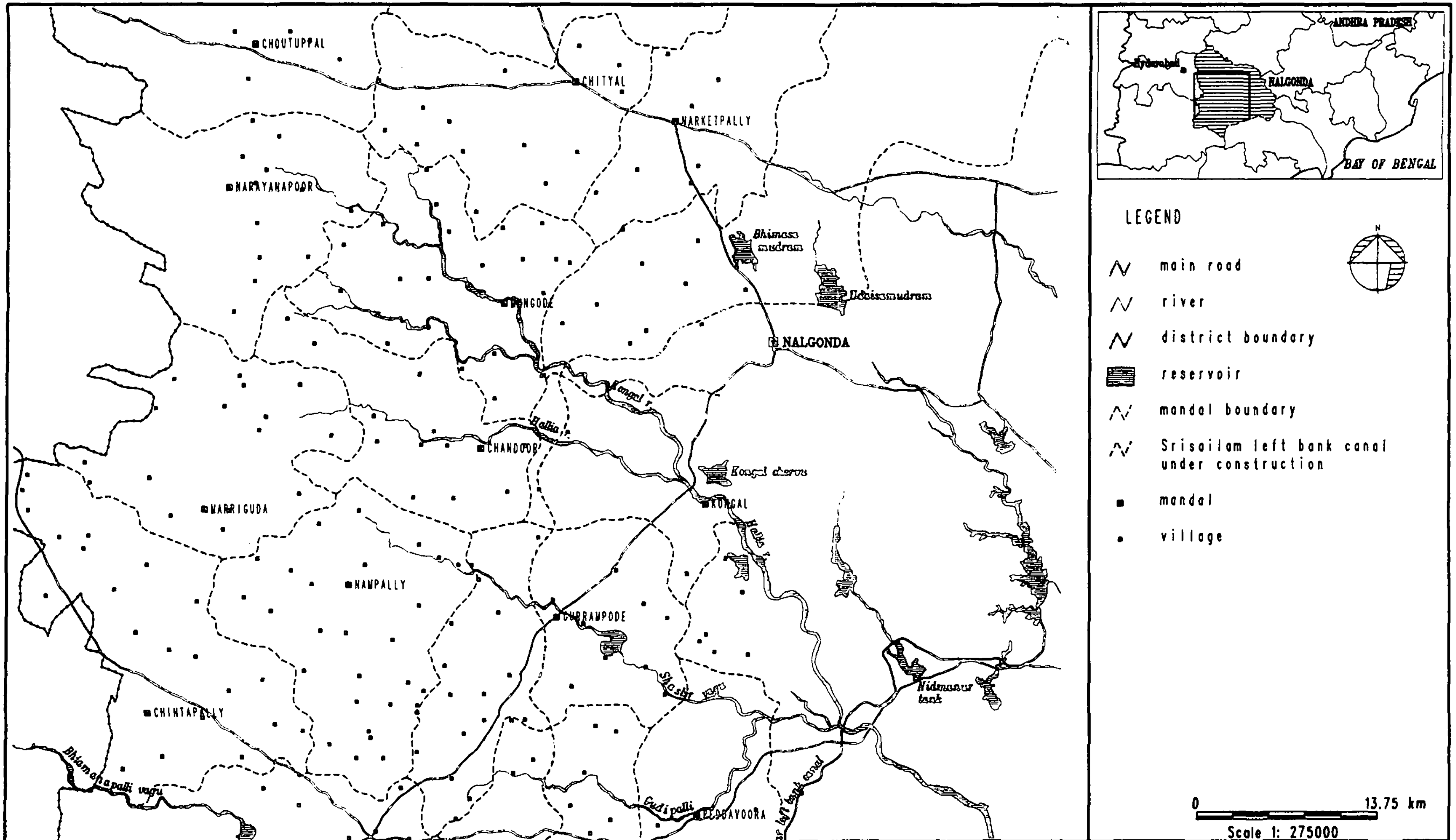
The area is underlain by fractured rocks, covered with a thin weathered layer. Groundwater is exploited by a large number of dug wells and boreholes used for irrigation and drinking water supply. Except for tanks and reservoirs there are no surface water resources during most of the year.

2.2 POPULATION AND WATER DEMAND

The study area has a population of 458,000 (1991 census). Most of the people are living in villages. Figure 2.2 shows the size of the villages in the area. 63 villages of more than 2,500 inhabitants are present. In the same figure the water demand is presented and the projections for 2007 and 2022 based on a growth rate of 2% and a water consumption of 55 liter per capita per day (lpcd). Total water demand is expected to increase from 25,175 m^3/day in 1991 to 34,200 in 2007 and to 45,600 m^3/day in 2022. Figure 2.3 presents the frequency diagram of village population and water demand for the 226 villages in the area.

2.3 RURAL WATER SUPPLY

The project area comprises several villages and 3 small towns and their water supply comes under the responsibility of Rural Water Supply Wing of Panchayati Raj Department of the State Government. The nearest Municipality to the project area is the Nalgonda Town, the water supply of which comes under the responsibility of Public Health Engineering Department and Municipality.



Client
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Project
INTEGRATED RURAL WATER SUPPLY PROJECT (NAP AP-III) -WATER RESOURCES STUDY-

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Approved: JvdS
Figure number: 2.1
Date: 15-07-92

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Description
Administrative map of project area

Drawing number
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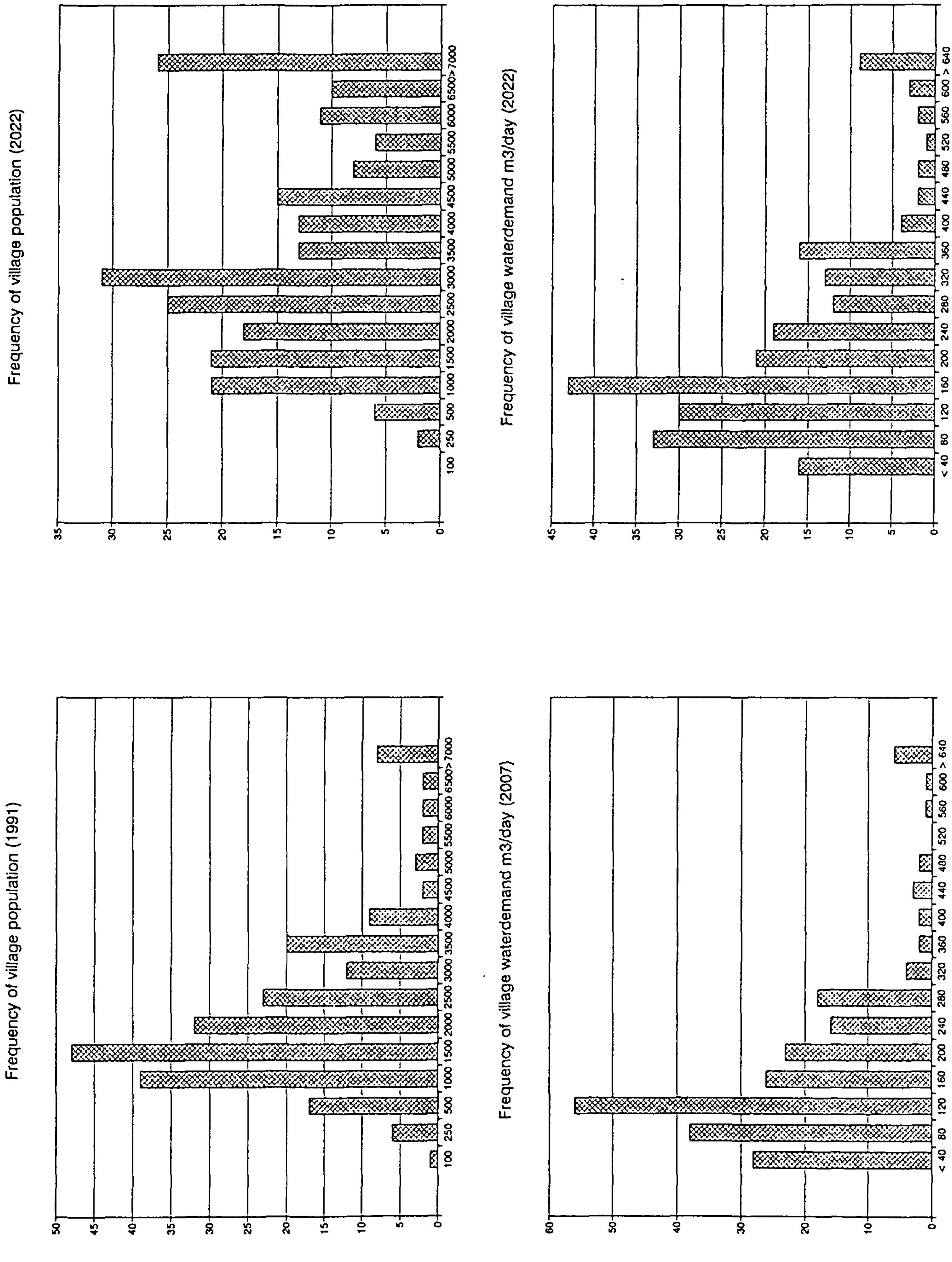


Figure 2.3: Frequency diagram of village population and water demand

The water supply to all the villages and towns in the project area presently originates from groundwater resources. The following schemes are in use:

- Bore wells fitted with hand pumps.
- Mini protected water supply Schemes (MPWS).
- Protected Water Supply Schemes (PWSS). Schemes with groundwater or surface water as a source and a distribution system supplying one to three villages.
- Comprehensive Protected Water Supply Schemes (CPWS). These are covering a larger area from 6 to 100 or more villages.

Appendix 5.3 presents the existing drinking water systems in the project villages. There are 73 MPWS and 29 PWSS schemes. In 12 villages defluoridation plants are in operation or under construction.

Data on the water supply systems have been gathered by the PRED and during the first mission a database has been set-up to handle this information. It must be noted that these data could not be verified in the field and existing data were collected from different sources (field officers, laboratory etc.). There are no general standards nor routines for data gathering. A complete print out of the database can be found in Appendix 5. Village and hamlet names and code numbers are presented on the enclosed maps 1 and 2.

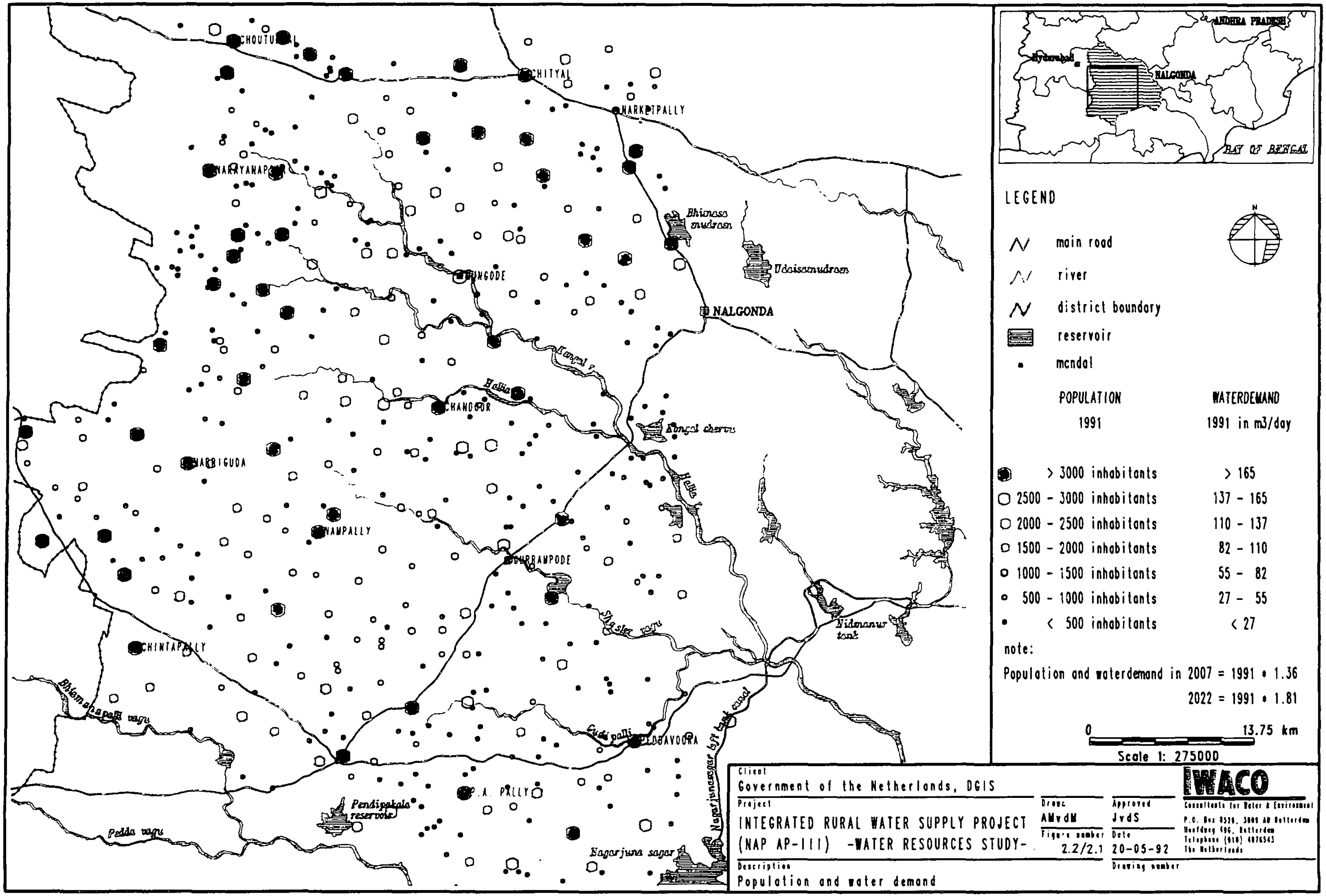
2.3.1 Bore wells fitted with handpumps.

The well discharge required is about 10 m^3/day to sustain 10 to 12 hours pumping. Most hand pumps have been installed in emergency projects following the drought of 1983 when many shallow wells fell dry and surface water sources disappeared. Still most of the wells presently being drilled by the PRED are in the frame work of drought relief projects. In a very short time a large number of wells has been drilled. All hand pump wells are constructed as open hole but a casing of 6 to 12 m is installed to prevent the upper part of the well from caving. Figure 2.4 shows histograms of main characteristics of the wells. Depths vary from 20 to 65 m, 35 m median. Discharge varies from 1 to 14 m^3/hr with median values of 4 m^3/hr.

Many of the wells reportedly fall dry in the summer months. A considerable number of wells are out of order for various reasons and need repair. Regular repairs are carried out by maintenance teams of the PRED that reportedly at least once a year visit the villages for well repair. Unfortunately data on well depth, pump depth and water levels that can give indications on reasons for well failure are not properly registered and collected.

The reasons of the frequent disfunctioning of the wells is a combination of technical and hydrogeological factors. A proper constructed borehole of adequate depth with proper handpump normally should not fail. Based on available data and field visits the main reasons for failure encountered in the field are:

- Hand pump failure (mechanical breakdown).
- Falling dry of pump intake due to falling water levels. It remains to be verified if this is caused by wrong installation of the pump or caused by a shallow depth of the well, or a failure of the well itself.
- Silting up or caving of wells is (must be) an important factor. From the scarce data obtained from mandal hydrogeologists it appears that in some cases 30% of depth loss was registered and caving over a length of 4-8 m is not uncommon. The water entrance into the well will be hindered and the yield decreases which in turn leads to excessive drawdowns when pumped.


CHOUTUPPAL
CHITYAL
NARKETPALLY
NARAYANAPUR
Bhimasamudram
Udaisamudram
MUNGODE
NALGONDA
Kangal
Halia
CHANDUR
Kangal cheruvu
MARRIGUDA
Halia
NAMPALLY
GURRAMPODE
Shaler vagu
Nidmanur tank
CHINTAPALLY
Bhimanapalli vagu
Gudipalli
PEDDAVOORA
Nagarjunasagar left bank canal
P.A. PALLY
Pendipakala reservoir
Pedda vagu
Nagarjuna sagar
ANDHRA PRADESH
Hyderabad
NALGONDA
BAY OF BENGAL
LEGEND
N
main road
river
district boundary
reservoir
mandal
POPULATION 1991
WATERDEMAND 1991 in m3/day
> 3000 inhabitants > 165
2500 - 3000 inhabitants 137 - 165
2000 - 2500 inhabitants 110 - 137
1500 - 2000 inhabitants 82 - 110
1000 - 1500 inhabitants 55 - 82
500 - 1000 inhabitants 27 - 55
< 500 inhabitants < 27
note:
Population and waterdemand in 2007 = 1991 * 1.36
2022 = 1991 * 1.81
0 13.75 km
Scale 1: 275000
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Project
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(NAP AP-III) -WATER RESOURCES STUDY-
Drawn
AMvdM
Approved
JvdS
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Date
20-05-92
Drawing number
IWACO
Consultants for Water & Environment
Description
Population and water demand

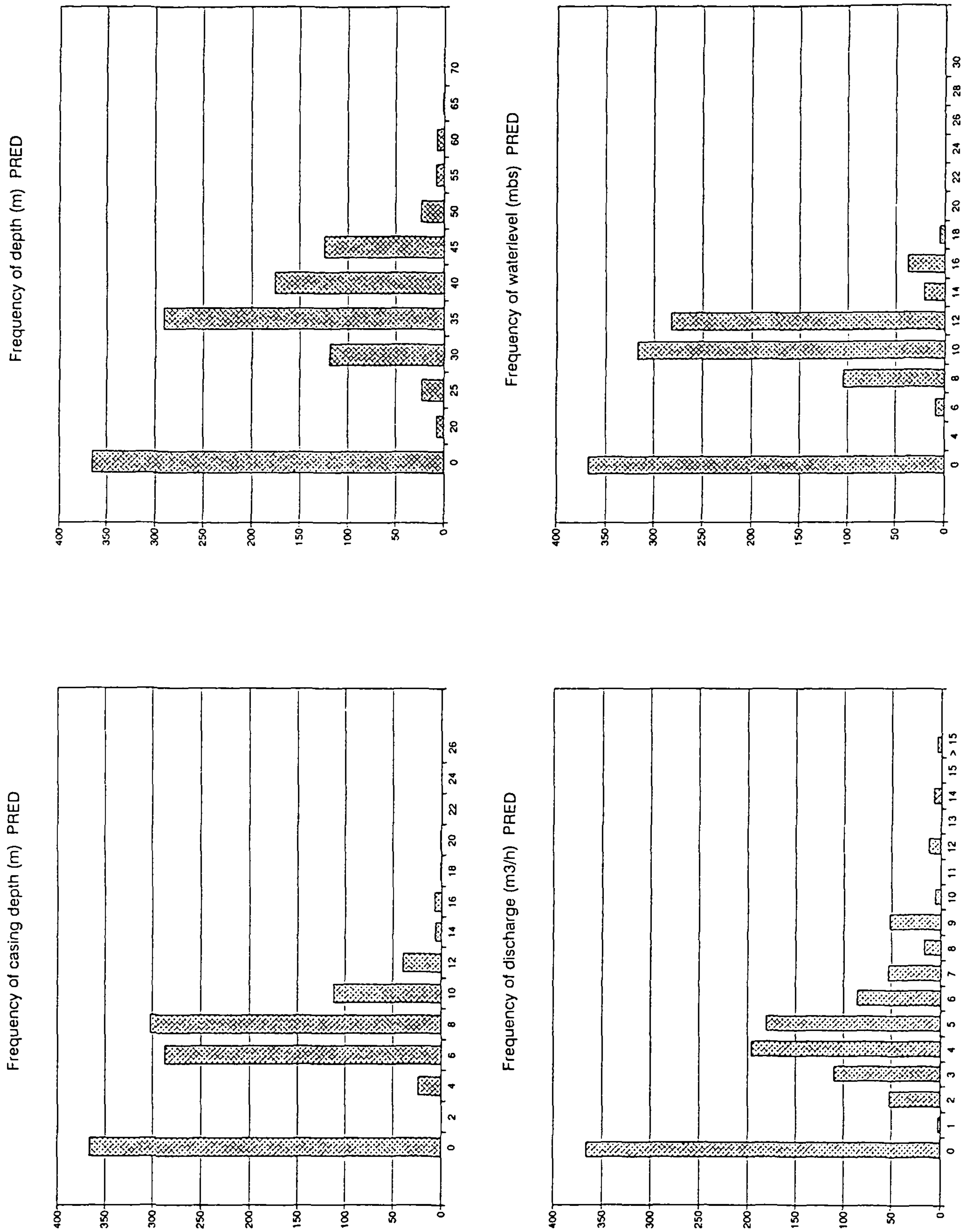


Figure 2.4: Depth and discharge of PRED wells

- Regional drop in water levels following drought. From data of observation boreholes by SGWD this lowering is in the order of 1 to 6 m over an extreme dry period. In wet years water levels will rise accordingly. Depth of wells and pump installation depth should allow for these fluctuations. In general this will not lead to dewatering of the water bearing fractures that are encountered at depth. Shallow wells that depend on the storage in the weathered layer will fall dry, boreholes seldom.
- Influence of neighbouring wells. In several cases it was observed that an irrigation well was drilled along a handpump well. In the immediate vicinity (less than 50 m) the original well may fall dry (if less deep).

It is obvious that a borehole with a minimal depth and poor construction is vulnerable to the above mentioned impacts.

The only criteria to locate a new handpump has been its proximity to its users. This may not be a feasible approach everywhere and more consideration needs to be given to hydrogeological criteria. The same holds for the water quality aspect of bore wells located inside or downstream of a village. There are no provisions (protective wall or fence) being made to protect wells from local pollution (soak pits). As is widely investigated in India 75% of these wells are contaminated bacteriologically or chemical by (nitrates etc.). This was clearly confirmed in the field by the high electrical conductivity of these waters.

2.3.2 Protected water supply schemes.

Many of the boreholes that supply the protected groundwater supply schemes display the same problems as the handpumps wells: decreased yields or complete failure in dry seasons. Again analysis of the problem is hampered by a systematic collection of data. A systematic inventory of the state of the water supply systems to be carried out in the second phase of the mission has yet to be completed. It has been observed that several systems are still under construction or are only partly completed. Bore wells are hardly protection against surface pollution. Safety chlorination is generally not applied.

There are no site reports or hydrogeological investigation reports available. Implantation procedures are not clearly specified and in general the same procedure is adopted as for hand pumps. Minimal yield for a MPWS borehole is officially 4.5 m^3/hr, for a PWS borehole this is 9.0 m^3/hr. No pumptests on wells are carried out and the approximate yield during drilling is the only indication of its productivity.

The task of the hydrogeologist is limited to the estimation of the required pump yield (population over 30 years at 50 lpd assuming 16 hours pumping a day) and the indication of the type and location of the well. After handing over the site plan to the Executive Engineer his task is over. Drilling and testing if any is done by the PRED drilling authority or a private company. A borehole of 50 m costs some 15,000 Rs for drilling and about 2,000 Rs for the installation of a casing (250 Rs/m). The casing is supplied by the department.

Apart from deep wells a number of systems are supplied by large diameter wells and inwell bores. If the hard rock is at a depth less than 15 m a large diameter well is made.They are maximal 10 m in diameter and have a depth of 15 m at most. Excavation of a typical large diameter well of 15 m with 5 m in hard rock using explosives cost some 50,000 Rs. Depending on the local situation an inwell bore of 15 to 20 m and diameter of 4 1/2 or 6 " is drilled (at 5,000 Rs to 10,000 Rs per well). In some rare cases horizontal wells are drilled up to 15 m distance using jack hammers (70 Rs/m horizontal well). This procedure is preferably done in the presence of dikes that are highly fractured and were it is difficult to drill vertically.

2.3.3 Defluoridation plants

Defluoridation plants have been established at several places in Andhra Pradesh under the National Drinking Water Mission Programme. These include 28 defluoridation plants in Kurnool District under the Mini-Mission programme which are well-received by the local population. All these plants use the Nalgonda Technique which comprises addition in sequence of (i) bleaching powder; (ii) lime; and (iii) aluminium sulphate or aluminium chloride or a combination of these two. Addition of these chemicals is followed by flocculation, sedimentation and filtration. This programme is being continued under the Rajiv Gandhi National Drinking Water Mission and 31 defluoridation plants are under various stages of construction in Nalgonda, Prakasam, Krishna, Ananthapur districts in Andhra Pradesh. Of these, 11 plants have been completed by the end of December, 1991.

The cost of defluoridation plants as estimated for a number of localities in Nalgonda District as per original sanction of the Government of India, dated 31-1-1991 are summarized as follows:

• For a population of 1,250 to 1,500 20 lpcd - D.F.Plant capacity 40 to 60 m^3/day	Rs. 0.5 to 0.7 million
• For a population of 2,000 to 3,000 D.F.Plant capacity 60 to 80 m^3/day	Rs. 0.7 to 1.0 million
• For a population of 4,000 to 6,000 D.F.Plant capacity 100 to 180 m^3/day	Rs. 1.1 to 1.8 million

The operational cost of a 80 m^3/day defluoridation plant at Yellareddyguda in Nalgonda is stated to be of the order Rs. 140,000 per annum. The National Industrial Development Corporation (NIDC) has selected the firms who can built them. These plants are constructed under the technical guidance of NIDC. Water quality of the plants is monitored regularly by the PRED. Field measurements indicated that indeed the produced water is well within the permissable fluoride limits. It was also observed that at some distance from plants boreholes are present with low fluoride concentration. There has not been found a proper solution for the disposal of the fluoride rich sludge. At present it is stored at the plant site.

The Prasanthi Technique of defluoridation using activated alumina for community rural water supplies is also used in Rangareddy and Ananthapur districts in Andhra Pradesh and 12 plants have been constructed and are presently in operation. It is understood that total defluoridation costs for a 1,000 ltr/day plant has been determined at Rs. 0.04/ltr. This compared favourably with the cost of Rs. 0.07/ltr for plants adopting the Nalgonda Technique.

Domestic defluoridation schemes are in use at pilot scale in selected villages under the supervision of the Institute of Preventive Medicine (IPM). They consist of filters of bone and charcoal that are very effective in removing fluoride. In several villages these filters have been encountered during field surveys and they all decrease fluoride levels to less than 1.5 mg/l. The filter medium is to be replaced every 2 to 3 months depending on the initial fluoride content.

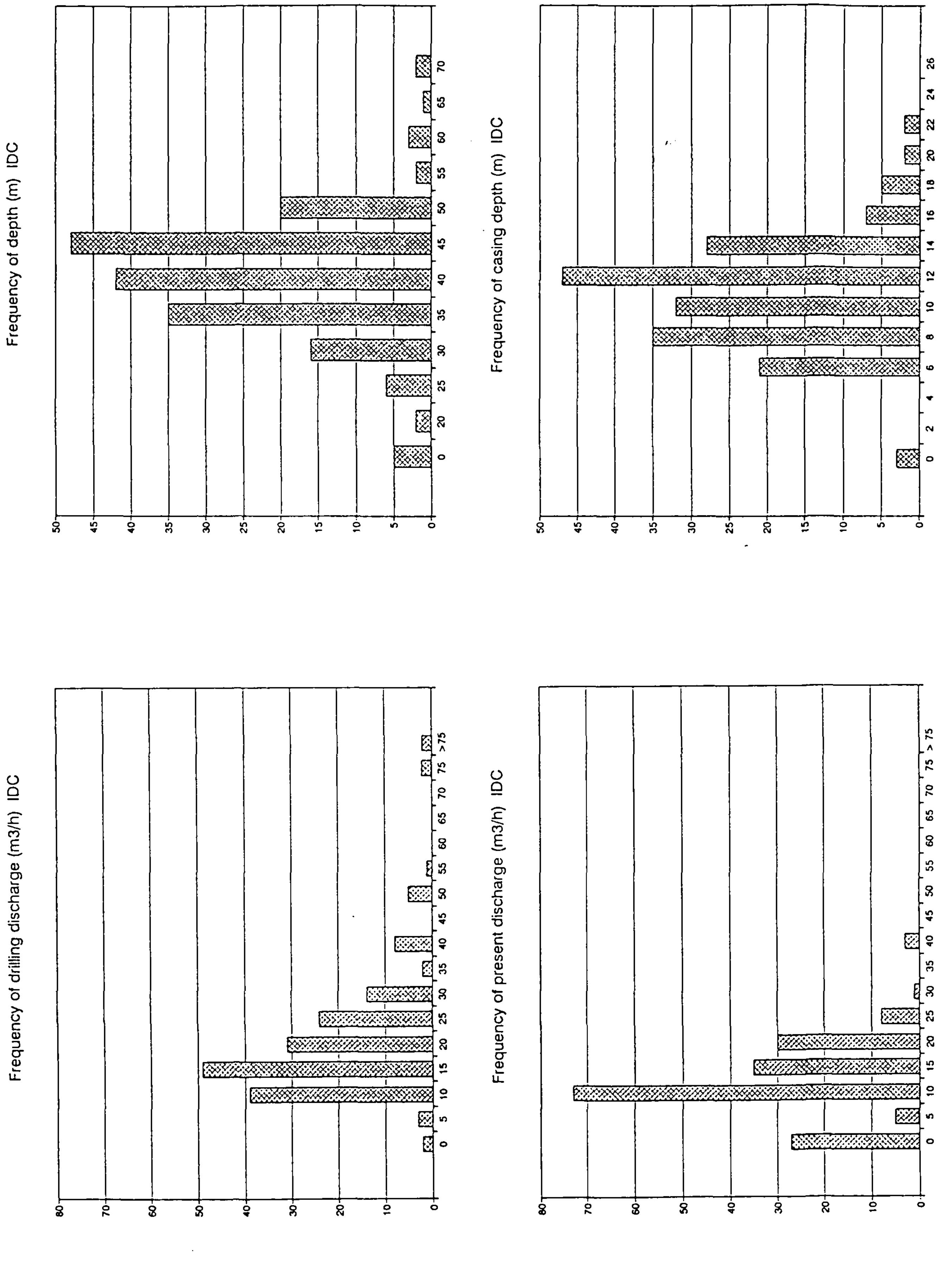


Figure 2.5: Depth and discharge of IDC wells

2.4 IRRIGATION

The Andhra Pradesh State Irrigation Development Corporation is investigating,executing and maintaining bore wells and infiltration wells for supplying water for irrigation purposes. In the study area there are 260 APIDC wells. The characteristics of these wells obtained from the Corporation are stored in the data base (Appendix 5). These data are far more reliable as systematic collection, verification and interpretation is taken place. Figure 2.5 shows depth and discharge histograms of the wells in the area. Depth of wells are general deeper than PRED wells. They are located in fracture zones that are more productive.

A well is considered successful if the discharge during drilling is 11.4 m³/hr (2500 gal/hr). Bore wells if properly sited and constructed can ensure a high rate of success as revealed by the data of presented by the APSIDC Ltd during the field visit for the irrigation bore wells constructed in Nalgonda District during the years 1983 to 1991 as given in table below:

Table 2.1: Discharge of IDC wells in the Nalgonda District

Year	Successful bore wells (discharge > 2500 gph)	Failed bore wells (discharge < 2500 gph)
1983 - 1984	177	122
1984 - 1985	130	80
1985 - 1986	85	48
1986 - 1987	98	55
1987 - 1988	5	3
1988 - 1989	19	12
1989 - 1990	54	35
1990 - 1991	106	75
Total	674	430

During the year 1990-1991, the APSIDC Ltd considered that all bore wells yielding more than 1500 gph are successful wells as a number of bore wells were constructed for scheduled castes whose lands are generally not located in hydrogeologically favourable areas. It was reported that failures after commissioning are generally rare among these irrigation bore wells although the yield may reduce (figure 2.5). However, these data could not be verified in the field.

The Andhra Pradesh State Cooperative Rural Irrigation Cooperation Ltd. undertakes and execute in-well drilling and revitalisation of existing dug wells for small and marginal farmers. In-well drilling results in increasing yield of wells at much lesser cost per unit of water.

In-well bores up to 30 m length are made. This results in yield increases of 20 to 30 m³/day. Due to in-well drilling the wells may irrigate up to about 1.5 ha of the average holding of the well throughout the year (or 75 m³/day).

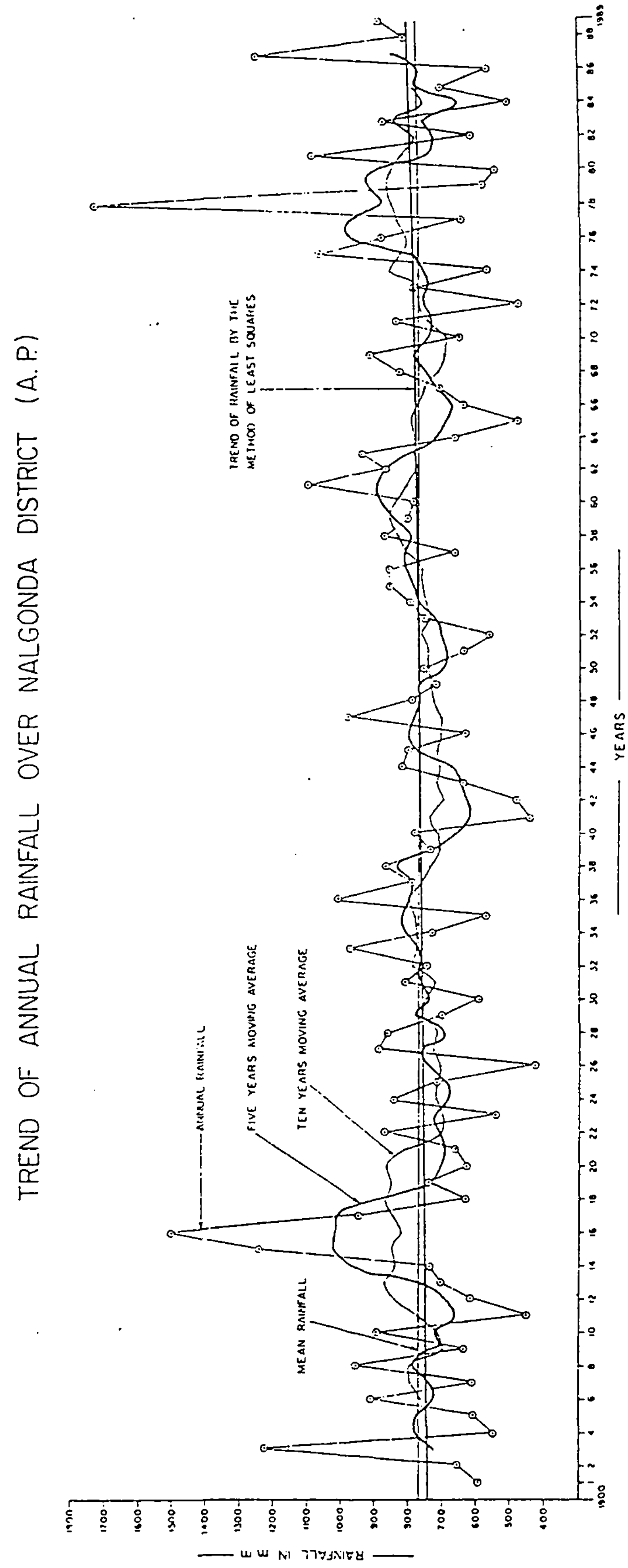


Figure 3.1: Trend of annual rainfall over Nalgonda District (CGWB, 1991)

3 GROUNDWATER RESOURCES

In this chapter the groundwater resources are discussed from a quantity point of view. After a description of the physical background the hydrogeology (section 3.2) and groundwater availability is discussed (section 3.3). The possibilities of exploitation of groundwater in the area for domestic water supply is presented in the last section (section 3.4). Depending on the local hydrogeology, four well types can be used for groundwater exploitation for public water supply.

In order to find relations between water quality and quantity and data on natural resources such as geology, structure, soils, drainage and surface water, land cover and groundwater irrigated area thematic maps are prepared by APSRAC using remote sensing techniques. The maps are checked in the field by both the mission and APSRAC field teams. Legend of the maps are presented in Appendix 6, the colour maps itself are distributed on limited scale only. The results are integrated in the text of this chapter and are discussed in more detail in chapter 4. They give a detailed picture at 1:100.000 scale of the natural resources of the area and form a base for interpretation and evaluation of the water resources.

3.1 PHYSICAL BACKGROUND

3.1.1 Hydrometeorology

The average annual rainfall in the area is 720 mm. The rainfall is unevenly distributed over the year. About 70% falls during the southwest monsoon in the period from june to september. A post monsoon rain period occurs in the months october and november (table 3.1). There is a large variation of rainfall from year to year as can be seen from figure 3.1. The 5-year and 10-year moving averages do not show any downward trend. There is no indication of prolonged drought (CGWB, 1991). The standard deviation of annual rainfall is 217 mm. The possibility of occurrence of normal rainfall is 0.6 and those of above normal and below normal are 0.15 and 0.25 respectively.

Table 3.1: Normal monthly rainfall and temperatures in the Nalgonda District (CGWB, 1991)

	Jan.	Feb.	Mrch	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Total
Rainfall in mm	6	9	6	21	29	102	138	110	167	105	37	8	738
Temp. in °C	24.0	26.0	28.9	32	33.8	31.4	27.4	27.7	27.5	26.9	24.0	22.3	–

Mean daily temperature range from 40°C to 28°C in the hottest month may and from 30°C to 16°C in december. Potential evapotranspiration is 1380 mm/y.

3.1.2 Geomorphology

The project area (western part of the Nalgonda district) is located in the Krishna river basin. The most important river draining the area is the Kangal, with its tributary the Hallia river and three minor sub basins Wailapalli, Kodatkal and Peddavagu. All the streams in the area are intermittent. The direction of the river courses is structurally controlled. Three main geomorphological units can be distinguished:

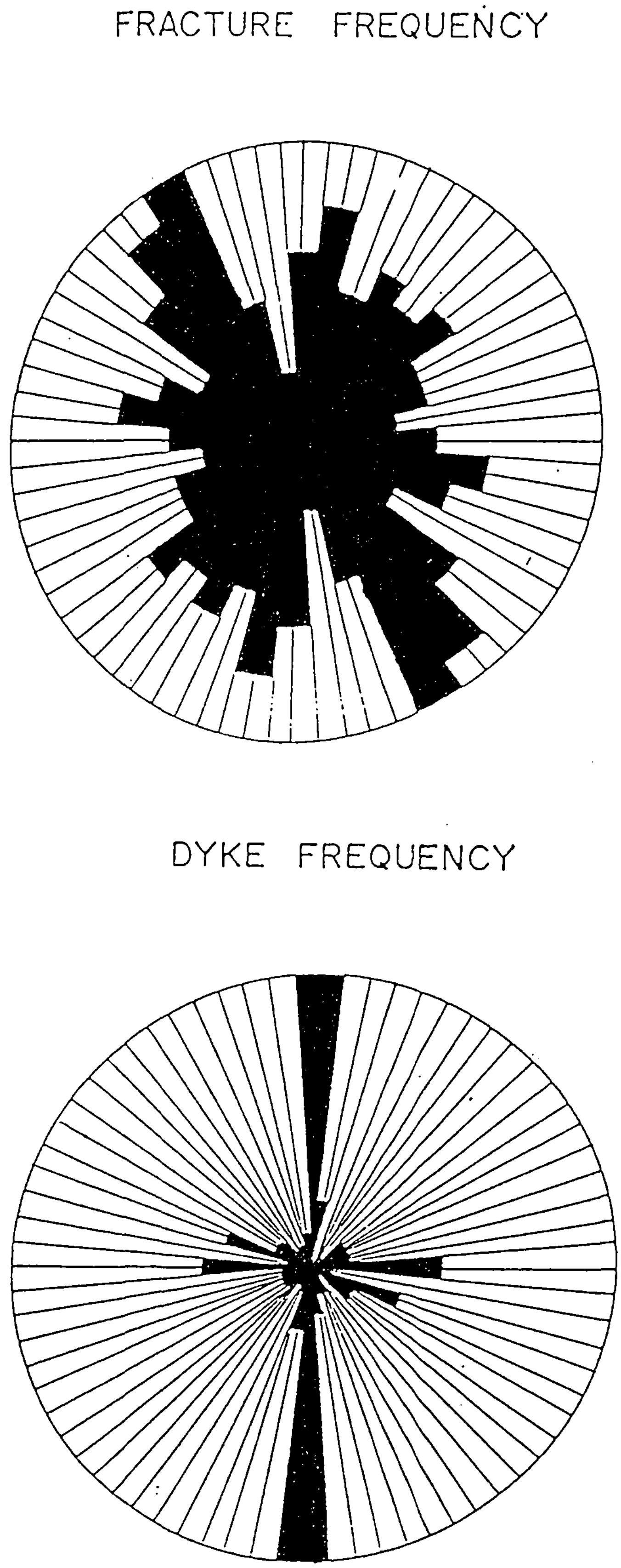
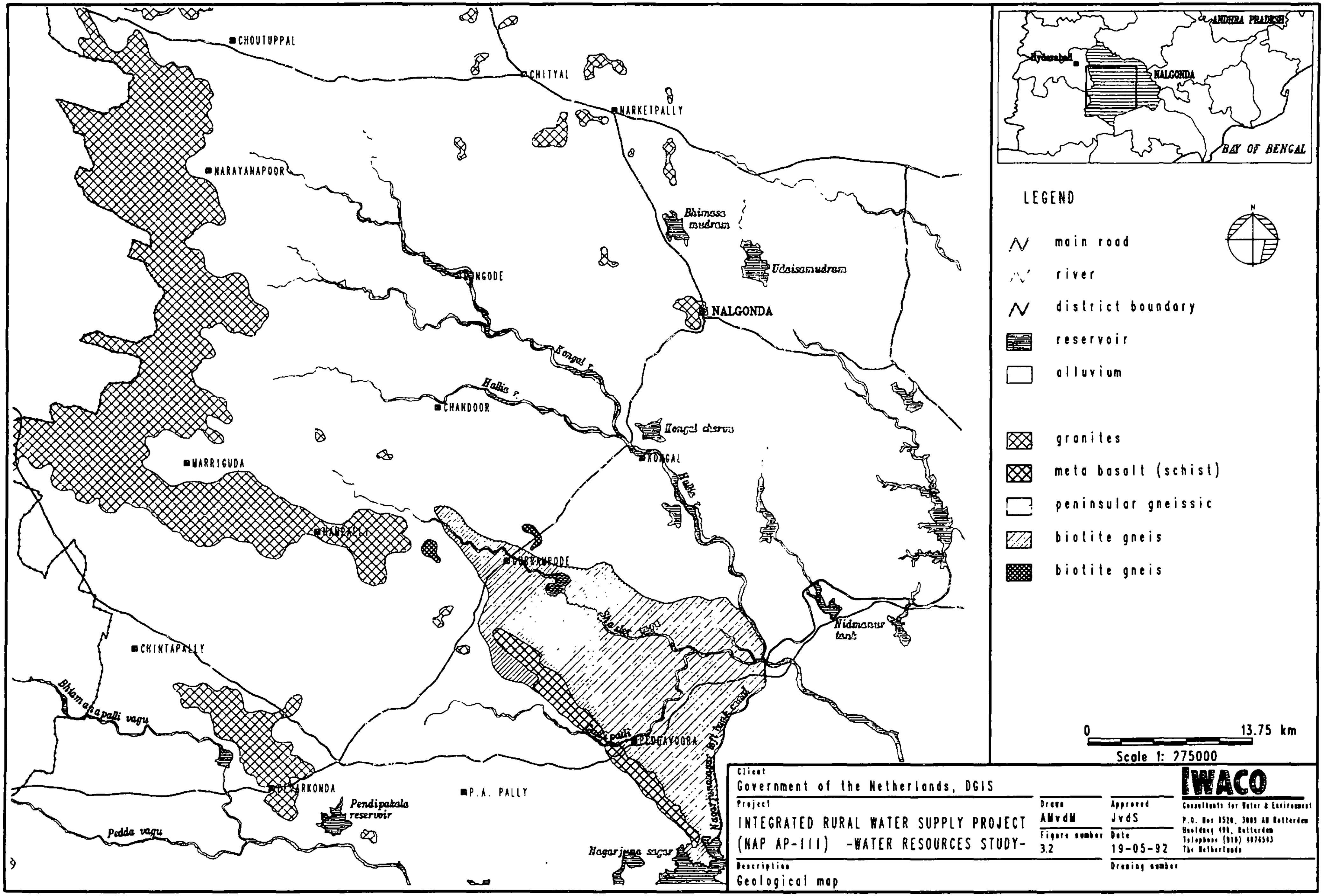


Figure 3.3: Fracture frequency diagrams



CHOUTUPPAL
CHITYAL
NARKETPALLY
NARAYANAPOOR
NALGONDA
Bhimasamudram
Udaisamudram
Kongal r.
Halia r.
CHANDOOR
Kongal cheruv
KONGAL
Halia r.
MARRIGUDA
CHINTAPALLY
Bhimanapalli vagu
P.A. PALLY
Pendipakala reservoir
Pedda vagu
Nagarjuna sagar
PEDDAVOORA
Nidmanur tank
ANDHRA PRADESH
Hyderabad
NALGONDA
BAY OF BENGAL
LEGEND
main road
river
district boundary
reservoir
alluvium
granites
meta basalt (schist)
peninsular gneissic
biotite gneis
biotite gneis
N
0
13.75 km
Scale 1: 275000
Client
Government of the Netherlands, DGIS
Project
INTEGRATED RURAL WATER SUPPLY PROJECT
(NAP AP-III) -WATER RESOURCES STUDY-
Drawn
AMvdM
Approved
JvdS
Figure number
3.2
Date
19-05-92
Drawing number
Description
Geological map
IWACO
Consultants for Water & Environment

- Denudated hills
  This unit occupies the high hill range in the west and isolated hills (inselbergs).They range in elevation from 240 to 700 m above msl. with the individual hills ranging from 50 m to 200 m in height above the plain. They also include the intrusive rocks that are observed along the major lineaments in the form of steep linear ridges and dikes.

- Dissected pediment
  They border the residual hill ridge in the west and the area north-west of Nalgonda. They consist of fresh erosion material from the hills.

- Pediplain
  Characterized by low-lying flat terrain and covered by a weathered layer of 5-10 m.

- Valley fills
  They are only of limited importance along the Kangal and Hallia rivers and in the tectonic valleys bordering the western hills.

3.1.3 Geology and structure

The largest part of the area is underlain by the rocks of the peninsular gneissic complex (see figure 3.2). These include granites, gneisses and intrusive dolerites, quartz and pegmatites. In the south east the Sri Sailam quartzites are exposed, they cover only a limited surface.

The massive **granitic rocks** are intruded in the older gneisses and occupy the hills in the west and the isolated hills. These pink porphyritic granites seem to be associated with the areas of high fluoride content. Apart from the high hill range in the west they occur as inselbergs around Chityal, Narketpally and Nalgonda. The **gneisses** are generally found below the plains or occur as low lying outcrops and hills of less than 20 m height.

The complex of granites and gneisses is intruded by younger dolerite dikes,quartz and pegmatite veins. The **dolerite dikes** occur as elongated low ridges that can be traced over kilometers. The area has undergone three major deformations as can be seen from the dyke and fracture frequency diagrams (based on satellite image interpretation APSRAC) shown in figure 3.3.

There are three prominent sets of dikes in the area trending N-S, E-W and WNW-ESE. The E-W dikes are considered the oldest. The dikes have an important influence on groundwater flow. The main fractures are directed NW-SE, NNE-SSW and WWN-ESE. Among these, the NW-SE direction forms 26% of the total fractures. It can be inferred from the fractures and dike frequencies that the N-S, EW and WNW-ESE are tensile fracture directions. E-W tensile fractures are older than the N-S tensile fractures. Both EW and NS fractures are normally filled with dykes. The WNW-ESE tensile fractures may be the youngest and are good conduits for groundwater flow.

Apart from vertical and sub vertical fractures, also horizontal fractures occur. They occur near the surface and are the result of decompression of the cristalline rocks. Exploratory drilling down to a depth of 75 m showed these horizontal fractures also at greater depth. The deeper fractures are tapped by irrigation bore wells.

Recent **alluvium** comprising sands, gravels and sandy clay occurs along the Hallia and Kangal rivers. The depth is restricted to 2-5 m. Valley fills that can be found in the western hills contain thick layers of sandy colluvial material and alluvial deposits up to 20 m thickness which are exploited by irrigation wells near Loyapalli and Woipally.

3.1.4 Soils

A detailed description of the soil types is given in Appendix 6.2 Red, sandy soil mixed with loam is the chief soil type.It is derived from the weathering material of granites and gneisses and can be found on the plain and in the valley bottoms. The soils are not very fertile. They are classifies as having a "moderately high runoff potential" and an infiltration capacity in between 2.5 and 12.5 mm/hr (APSGWD, 1977).

Black-cotton soils are found on higher elevations and are surrounded by the red soils. They are probably related to remnant weathering products of Deccan lavas.

In valley bottoms alluvial soils, a mixture of the above mentioned soil types can be found. In many places calcium precipitates are found locally known as kankar, they form hard layers within 1 m below the surface and have generally a high fluoride content. Often the soils are strongly alkaline. Locally effervescent salts are present in the valley bottoms. These saline soils are often found at the upstream part of the tanks where water stagnates and can easily evaporate.

3.2 HYDROGEOLOGY

3.2.1 Description of aquifers

Groundwater occurs in the study area both under phreatic and semi-confined conditions in the weathered and fractured part of the precambrian younger granites and in the alluvium along narrow patches along the stream and river courses. Three types of water bearing formations are present:

- The weathered rock which is exploited by a large number of open dug wells and shallow tubewells. The thickness of the weathered zone varies widely but occurs within a depth of 35 m and is usually 10 to 25 m. The saturated thickness of the weathered rock in the area varies from less then a meter to 20 m in low lying areas in fracture zones along streams. The average saturated thickness is 10 m.

- The hard rock beneath the weathered zone. If is fractured and fissured it can be exploited by deep boreholes. Significant fractures occur upto depths of about 30 m below the weathered zone. In regional fracture zones open fractures are encountered at depths of 75 m.

- The alluvial deposits along the major streams.The thickness of these layers is less than 10 m. They are only of local importance.

The occurrence of groundwater in hard rock areas depend on the intensity of fractures and fissures and on the thickness of the weathering layer on top of the rocks. The fractures in the hardrocks can be seen as collectors of water that is stored in the overlaying weathered layer.In order to locate highly fractured and weathered areas use is made of aerial photographs for an approximate location of these zones, followed by a geophysical field survey to pinpoint the exact location of the fracture that sometimes is only a couple of meters wide.

3.2.2 Characteristics of the aquifers

Yield test that are conducted on shallow wells up to a depth of 27 m in weathered granite and gneiss revealed a specific yield in the range of 2.5 to 16 m^3/hr/m. Open wells that also tap part of the fractured rock have values in between 10 to 19 m^3/hr/m (CGWB, 1991). Table 3.2 shows the yield per meter of saturated aquifer for different depth categories.

Table 3.2: Yields of wells per meter of saturated aquifer in the Nalgonda district

Max. depth	Number of wells	Yield in m^3/hr/m saturated aquifer		
		minimum	maximum	mean
10.7	96	0.05	7.9	2.35
18.3	85	0.40	3.1	1.38
27.4	20	0.06	3.7	0.87

Table 3.3 shows yields and depth to water level of shallow dug wells (5-16 m) in the phase I project area reported by APSGWD.

Table 3.3: Yields of dug wells in NAP area Phase I

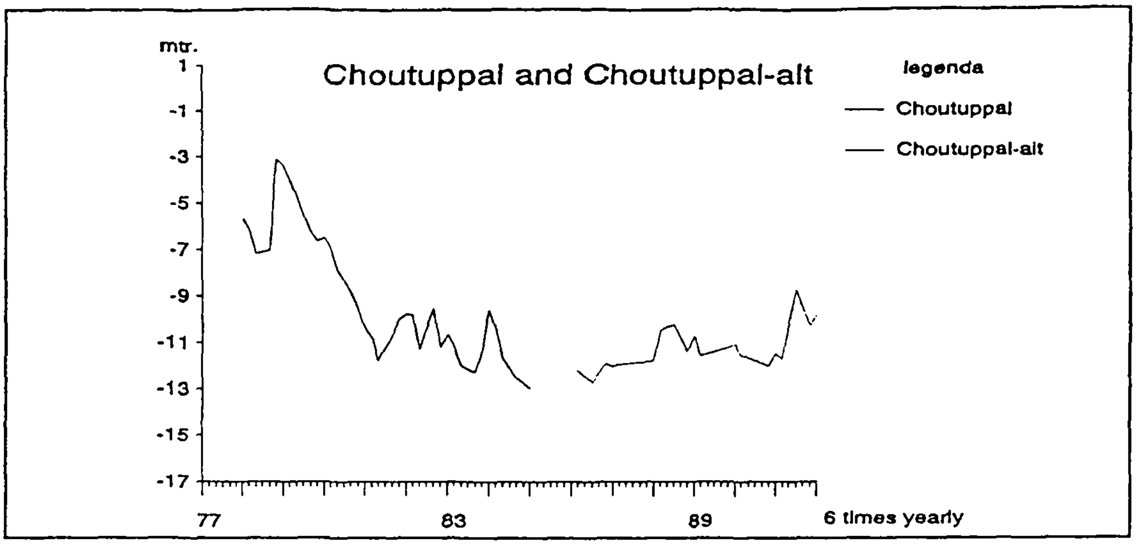
S No.	Name of the village	Depth (m)	Yield (m^3/day)	Water level depth
1.	Nalgonda	9.2	60 - 80	9.0 - 11.5
2.	Vamipakala	10.50 - 13.5	30	9.0 - 11.5
3.	Chityal	10.50 - 12.0	60 - 80	8.0 - 10.5
4.	Ratipalli	10.00 - 12.60	80 - 90	8.6 - 12.0
5.	Idikuda	5.15 - 7.0	100 - 150	3.6 - 6.5
6.	Kondapur	8.6 - 12.0	60 - 80	8.0 - 10.5
7.	Malkapur	6.0 - 9.6	60 - 80	5.0 - 6.60
8.	Nalgonda	8.3 - 11.6	40 - 60	8.8 - 11.0
9.	Nereda	10.0 - 14.0	60 - 80	8.5 - 13.2
10.	Urumandla	13.0 - 15.5	60 - 80	12.0 - 15.2
11.	Wattimarthy	8.00 - 12.00	50 - 70	4.9 - 11.0
12.	B. Velumula	11.0 - 13.0	80 - 100	10.5 - 12.0
13.	Pittampalli	7.0 - 11.0	60 - 100	6.0 - 10.0
14.	Dompalapally	10.2 - 13.5	60 - 80	9.5 - 11.5
15.	Kangal	10.2 - 11.2	70 - 80	9.7 - 10.5
16.	Kanchanpally	5.8 - 12.8	100 - 150	7.5 - 10.2

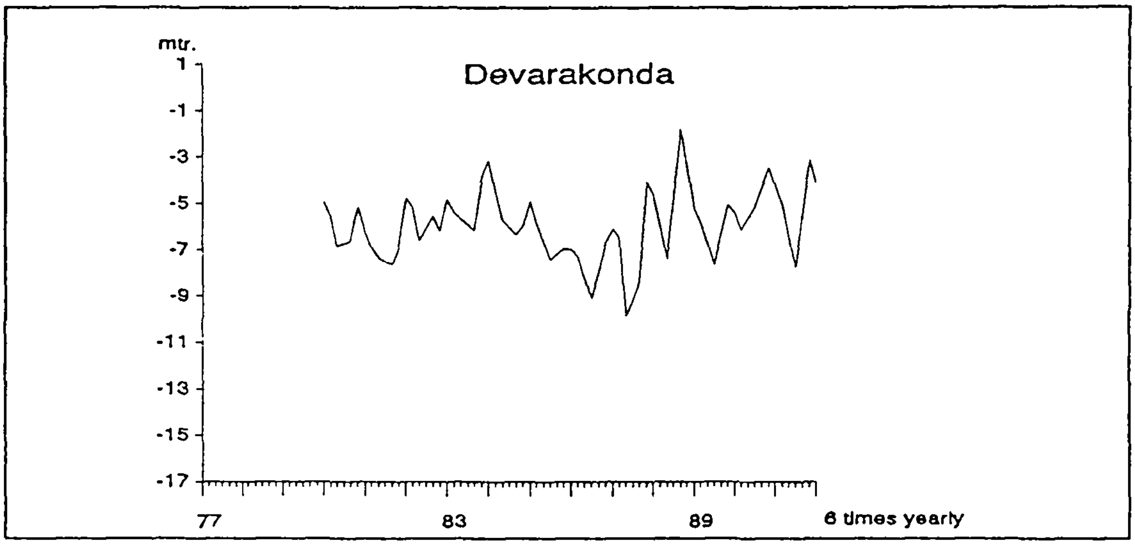
Transmissivity of the shallow weathered aquifers is 5 to 20 m^2/day. Horizontal hydraulic conductivity for the weathered rock aquifers will be around 0.5-1.0 m/day. Storage coefficients range from 0.01 to 0.02.

Aquifer tests have been carried out by the CGWB on 15 exploratory boreholes in the southern part of the study area (Peddavagu and Gudapalli basins). The results are presented in Table 3.4 Transmissivity ranges from 1 to 377 m^2/day and specific yields 0.04 to 9.16 m^3/hr/m on the average 2.4 m^3/hr/m.

Table 3.4: Results from pumping test on exploratory wells in the Nalgonda district (CGWB, 1991).

Village	Total depth drilled (m)	Fracture zones encountered (m)	Geology	SWL (m bgl)	Discharge (lps) m³/hr	Qspec m³/hr/m	Drawdown (m)	T (m²/d)	S
Peddavoora	79.0	8 - 15.0 16.50 40.0 - 41.0 48.0 - 51.0	Granite gneiss	2.0	1.6	0.05	29.8	2.37	–
Dugiyal	69.5	8.0 - 10.0 10.0 - 11.0 18.8 - 20.0	"	4.46	24.4	2.63	5.48	60.23	–
Kondabheemanpalle	90.0	8.0 - 15.0 27.0 - 28.0 31.0 - 33.0 40.0 - 43.0 45.35 - 46.0 47.0 - 51.0	"	0.93	5.8	0.33	17.47	1.31	–
Mynampalle	73.0	9 - 9.6 11 - 12 19.0 - 20.0 26.6 - 27.0 66.0 - 67.0	"	3.88	21.6	7.7	2.80	282.0	–
Ghanapur	90.0	10.0 - 14.0 15.0 - 16.0 17.0 - 20.0 32.0 - 34.0 67.0 - 68.0	"	6.40	2.9	0.2	12.08	11.3	–
Parmatpalle	90.0	13.6 - 20.0 33.0 - 35.0 39.0 - 40.0	Granite & dolerite dyke	4.26	2.5	0.04	63.89	1.77	–
Azampur	90.0	8.0 - 10.0 10.0 - 110 53.0	Granite gneiss	3.02	18.0	3.91	4.61	79.0	–
Cherukupalle	80.0	26.0 - 27.0 44.0 - 47.20 64.0 - 65.0	"	3.27	2.02	0.13	15.26	5.90	–
Pothnur	90.0	26.0 44.0 - 56.0? 76.0	"	4.25	9.0	0.30	30.0	18.3	–
Pulicheria	55.0	19.0 - 20.0 36.0 - 37.0 43.0 - 44.0 52.0 - 53.0	"	4.95	18.0	9.	1.965	376.7	1.12 x 10^{-3}
Mushtipalle	57.6	15.0 - 16.0 39.0 - 40.0 41.0 - 43.0	Granite gneiss	2.4	20.5	3.1	6.5	8.0	–
P.A. Palle	90.0	10.00 - 11.00 14.00 - 15.00 36.00 - 36.25 38.00 - 42.00	"	8.96	7.2	0.4	16.16	5.45	1.5 x 10^{-5}
Kothabhavi	90.0	8.0 - 9.0	"	4.0	18.0	0.	42.0	5.0	–
Vinjamura	65.0	8.0 - 9.0 13.0 - 14.2 17.0 - 18.0 38.0 - 39.0 56.0 - 57.0	"	2.5	21.6	7.	2.9	90.0	–





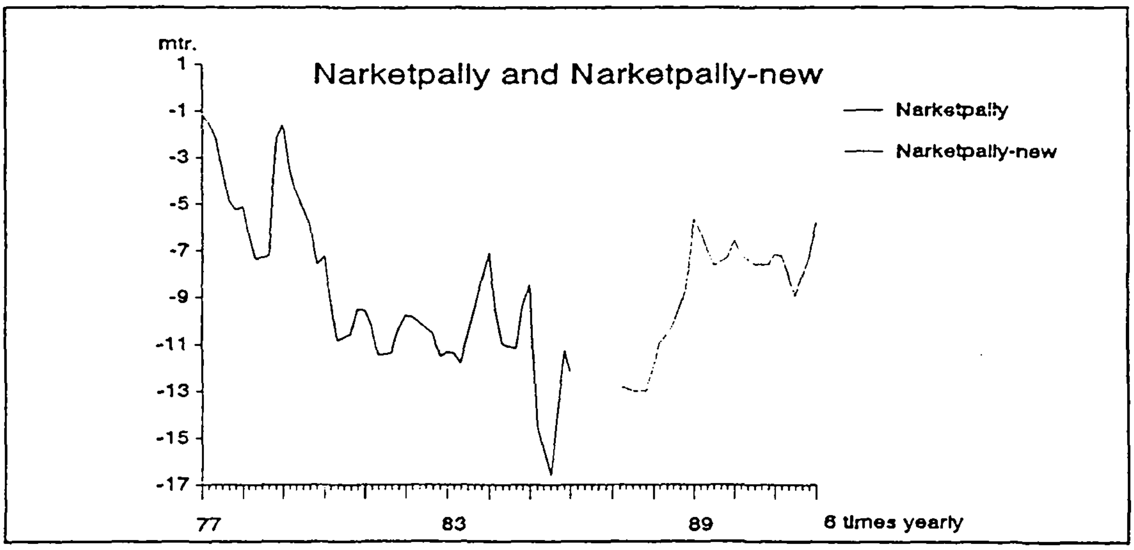


Figure 3.4: Water table fluctuations in Narketpally, Devarakonda and Choutuppal

Aquifer parameters determined in the Dullapally basin (located near Hyderabad) and used in a regional groundwater surface water model are in the same range. Transmissivity varies from 19 to 125 m^2/day and storage coefficients of 0.0084 to 0.016. Transmissivity of granites on the average is 80 m^2/d 109 wells, 40 m deep). Permeability is around 1 m/d.

3.2.3 Groundwater levels and fluctuations

During the field survey in February-March water tables are varying from 12 m to 20 m. In figure 2.5 that shows a histogram of depth to water levels in PRED wells it can be seen that most water levels are within 10 to 14 m below surface. In general the water level follows the topography and flows in south eastern direction. In valley bottoms water levels are close to the surface (less than 3 m) and along the Hallia and Kangal rivers water logged areas are observed. Water table maps prepared by the CGWB display a hydraulic gradient of 0.015 in the western hills to 0.002 in the south east.

Natural water level fluctuations range from 1 to 6 m. Levels are measured through extensive observation networks of the APSGWD and CGWB. A example of water table fluctuation is presented in figure 3.4. The hydrographs confirm that the groundwater system is sensitive to rainfall fluctuation.

There is no trend of declining water levels at a regional scale. In fact water levels depend largely on rainfall as can be seen from the hydrographs of the networks of SGWD and CGWB. Up to 1986 a decreasing trend could be observed after the year 1978 with abnormal high rainfall (1,670 mm) and following the dry years of 1982-1986. Since then nearly all hydrographs have shown a gradual increase. However all hydrographs should be very carefully interpreted especially if no details of location and position relative to other wells are known! Furthermore the trend analyses that are commonly used might give misleading results, if the period of observation is too short. Without careful hydrogeological evaluation single hydrographs can not be used to give regional trends in water levels.

3.3 GROUNDWATER RESOURCES EVALUATION

Groundwater availability and safe yield (or permissible yield) of an aquifer requires a reliable estimate of the recharge, the efficient use of a well or borehole to draw water from the aquifer and methods of identifying the groundwater potential. Recharge in semi-arid hard rock areas is highly variable over a catchment area and does vary from year to year with the rainfall. There are several methods to estimate recharge none of which gives entirely satisfying results.

It is recommended by the Groundwater Estimation Committee (1989) appointed by the Government of India that the groundwater recharge should be estimated based on the groundwater level fluctuation method.The methodology adopted is still a matter of much debate but it is widely used in groundwater resources evaluation. The method will be applied here on the study area, but first a summary will be given of recharge studies carried out in and near the Nalgonda district.

3.3.1 Recharge estimates

From the recharge studies that are summarized it appears that it is unlikely that the recharge over an entire catchment area will be more than 15% of the annual rainfall and probably it is less, somewhere around 10%. Recharge will vary of a catchment being higher in the recharge areas (15-20%) than in the lower situated discharge areas (1-5%). From water balance studies in the Kanchapally basin (located in the study area) it was concluded that in recharge areas locally 15 to as much as 50% of rainfall can infiltrate.

Groundwater recharge can increase substantially in the vicinity of tanks as a result of seepage. Results of tank infiltration studies showed that average seepage from tanks is about 9 mm/day or 0.4 m^3/day per m length of tank embarkment. Lack of exploitation of the seepage resulting from tanks is responsible for development of alkaline and saline soils on the downstream parts of the tanks.

SUMMARY OF RECHARGE STUDIES

Canadian assisted project
Groundwater potential in the western part of Andhra Pradesh (Medak, Hyderabad and Mahbubnagar districts) that is comparable with the study area was evaluated in a yet undeveloped catchment. The recharge or annually replenishable reserves were estimated to range from 150 mm (15 to 20% of annual precipitation) in uplands areas to 10 mm (1-5% of annual precipitation) in major valley bottoms. The average for the studied area of 11000 km^2 under maximum groundwater development approximated 70 mm or 8.3% from total rainfall.

Tritium profiles
Recharge measurements by tritium injection techniques were carried out in the Aurepalle catchment near Hyderabad in 1984-1987 (Athavale, 1991). This area is comparable to the Nalgonda district and results can be applied.Recharge measurements at 15 sites injected in june 1984 gave a mean value of 32 mm or 6.2% of the annual rainfall of 563 mm. Within the catchment the recharge ranged from 0 to 103 mm. In the dry year of 1985 repeated experiments gave a mean value of recharge at 12 sites of 17 mm or only 3.4% of the total rainfall. The variation in recharge was 5 mm to 39 mm. Table 3.5 gives a summary of recharge measurements in the watershed since 1984.

Table 3.5: Results of recharge measurements in Aurepalle watershed (Athavale a.o., 1992)

Year	Number of measurements	Rainfall (mm)	Mean recharge (mm)	Recharge as a percentage of rainfall
1984	14	540	32	5.9
1985	12	505	17	3.4
1987	13	750	109	14.5

Studies of the Kanchenapally basin
Detailed water balance studies were carried out in this basin of 10 km^2 in the Nalgonda district during 1974-1975 by the Andhra Pradesh Groundwater Department as part of a large study of groundwater recharge in Andhra Pradesh (APSGD, 1977). 15 catchment areas were studied.

Recharge coefficient (rainfall infiltration factor) estimated by different methods indicated that it is less than 5% in hilly terrains, 5-10% in cultureable areas where slopes are more than 2% and from 15 to as much as 50% in areas with slopes of less than 2% (depending on soil group). The threshold value of rainfall required for recharge to the groundwater is estimated at 40 mm. Recharge areas are determined based on slope classification and land use. It was estimated that 60% of the land can be classified as rechargeable area.
Groundwater recharge can increase substantially in the vicinity of tanks as a result of seepage.

Results of tank infiltration studies vary from 2.6 to 114 mm or (eliminating two extreme values) from 2.6 to 12.1 mm. Average seepage from tanks is about 9 mm/day or 0.4 m^3/day per m length of tank embarkment (this is equivalent for a well for every 100 m). Lack of exploitation of the seepage resulting from tanks is responsible for development of alkaline and saline soils on the downstream parts of the tanks.

Individual water level hydrograph analysis in Nalgonda district gave infiltration factors of 5 to 45% of annual rainfall. Over an entire catchment the rainfall infiltration factor was estimated in between 12 to 13% of rainfall. Infiltration from paddy fields in the basin range 8.2 to 18 mm/day, about 60-65% of applied water. Lateral flow to valleys is important as can be seen from areas with a high well density exceeding 40 wells/km. Tracer experiments indicated flows in granites of 400 m^3/day/km width across a 2% slope (equivalent to 13 pump fitted wells).

Groundwater model Dulapally basin
An integrated groundwater surface water model has been prepared by the APSGWD for the Dulapally basin. Located near Hyderabad hydrogeological conditions are similar to the Nalgonda District. The model was calibrated using hydrographs of 13 observation wells over a period of 1977 to 1990. Mean annual groundwater recharge has been estimated at 124 mm. The average percentage of groundwater recharge and surface runoff is 14.4 and 20.9% respectively.

3.3.2 Groundwater resource evaluation

It is recommended by the Groundwater Estimation Committee (1984) appointed by the Government of India that the groundwater recharge should be estimated based on groundwater level fluctuation method. The total groundwater resources from water table aquifers in an administrative unit namely a taluk or block should be taken as sum of arrival recharge and potential recharge in shallow water table and water logged areas. 15 per cent of total groundwater resources are ear-marked for drinking, industrial purposes for committed baseflow and to account for the unrecoverable losses. The remaining 85 percent is considered as resource utilisable for irrigation purposes.

Based on these concept and norms stipulated, the annual dynamic recharge potential of Nalgonda district has been estimated as on November 1989 by the State Groundwater Department of the Government of Andhra Pradesh. In table 3.5 the results of the estimates have been given for the project area by adjusting for the percentage of taluk area that is covered by the project.

The total **dynamic groundwater resources** are estimated by using the long-term water level fluctuation data from existing hydrograph networks and by taking into account the net area suitable for recharge. Specific yield values in the range of 1% to 3% have been adopted. The total yearly dynamic groundwater resources (i.e. total annual recharge) in the project area are of the order of $188*10^6$ m^3 while the resources ear-marked for domestic and industrial uses are $28*10^6$ m^3, leaving $159*10^6$ m^3 for irrigation development.

The **net groundwater draft** is calculated using an estimate of the numbers of wells groundwater draft norms. Groundwater used to be abstracted only by dug wells that are limited to the weathered layers. Since 1975 deep boreholes for drinking water supply and irrigation purposes are drilled in the hard rock. To supply more water dug wells are depend by boreholes (dug cum bores). The following wells are common in the area:

Table 3.6: Dynamic groundwater resources in the study area (as on November, 1989)

Taluk	Total dynamic groundwater resources 10^6 m³/y	Groundwater resources earmarked for domestic uses 10^6 m³/y	Utilisable groundwater resources for irrigation 10^6 m³/y	Net groundwater draft 10^6 m³/y	Balance groundwater potential 10^6 m³/y	Present stage of development %	Stage of development at year 5 %	Groundwater development category
Chandar (Mungode)	22.70	3.70	19.00	16.87	2.14	88.7	97.6	dark
Deverakonda	50.76	7.62	43.14	8.44	34.70	19.5	21.5	white
Nalgonda	42.05	6.29	35.76	28.07	7.98	78.5	89.8	dark
Nampalli (Chintapalli)	42.60	6.40	36.20	13.80	22.40	38.0	41.9	white
Nidamanur (Peddavoora)	20.72	3.12	17.62	2.43	15.19	13.6	15.1	white
Ramannapet	8.97	1.35	7.62	5.24	2.38	68.0	75.6	grey
Project Total	187.80	28.48	159.34	74.85	84.49	47.0		

- A typical dug well for domestic purposes range in diameter from 0.8 to 4.0 m. and are 4 to 16 m deep. Water levels in these wells are situated in between 5 and 14 m. Discharge range from 50-150 m³/day.
- Bore wells used for domestic purposes are drilled up to 20 to 65 m depth and are equipped with handpumps (India MarkII). They are being drilled, installed and maintained by the PRED. They are being exploited at maximum 10 m³/day. No individual well records are available.
- Irrigation dug wells are either circular and 4 to 20 m in diameter or rectangular (4.6 to 12.2 m). Wells are often deepened into the hardrock Open wells tapping the hard rock sustain pumping of 3 to 6 hours daily and yielding around 50 to 180 m³/day for drawdowns from 2 to 4 m and take 12 to 48 hours for full recovery (CGWB, 1991).
- Bore wells (or tube wells or boreholes) are 4" to 6" in diameter and 40 to 60 m deep. Most of these wells are being drilled by the IDC. Only wells of more than 11 m³/hr (2500 gph) are being completed. Daily discharge of the irrigation wells vary according to their yield from 200 to 500 m³.

The water abstracted for domestic purposes (in the study area) is in the order of $11*10^6$ m³/y. There are no figures on industrial water abstraction but it is not likely to exceed $2*10^6$ m³/y. The irrigation water use is far the largest. There are at least 200 APIDC irrigation , over 7500 dug wells with electric motors and diesel pumpsets and some 900 wells with traditional devices. The groundwater draft from a dug well is 3,100 m³/y, 9,300 m³/y for an energised well and 24,700 m³/y for an irrigation borehole. 70% of the net draft is considered as net groundwater draft. In this way it is calculated that about $75*10^6$ m³/y is presently being used by irrigation, leaving a balance of $85*10^6$ m³ for further groundwater development as on November 1989.

As can be seen from the table the groundwater development over the area is not uniform. Net extraction vis-a-vis utilisable groundwater resources is expressed as a percentage to indicate the stage of groundwater development over 5 year assuming an 2% growth rate. White areas have an index < 65%, grey areas in between 65% and 85% and the areas having an index > 85% are classified as dark. The present stage of groundwater development is only 47% over the study area. In Mungode and Nalgonda groundwater development exceeds 85% and these areas are classified as dark areas. Here well density is around 4 to 6 well per km2. Choutuppal that is located in the Ramannapet taluk is considered a grey area where the stage of development is within 65 and 85%. The remaining areas are all white areas with a well density of 2 to 3 wells per km² only and a development less than 65%. Farmers in dark areas receive no longer credit for well sinking by financial institutions and grey areas face restrictions. Even if the government declares a certain area 'dark' and instructs the bank not to finance any new wells in it, farmers are free to construct new wells with their own private funds. According to estimates of the APSGWD these private wells are less than 5% of the total number of wells drilled.

Plans have been made by the CGWB and the APSGWD to better organise groundwater development that is yet unorganised (CGWB 1991). As part of these plans maps have been prepared showing areas that are promising for groundwater exploitation. The maps have been prepared using information aerial photographs and geophysical surveys. Figure 3.5 displays part of the hydrogeological map that cover the study area. It shows areas where bore wells of yields ranging from 1 to 10 l/s can be expected with 50 to 70% success rate. It was estimated that in the Nalgonda District a total of about 900 wells of 6 l/s and 3000 wells of 3 l/s are feasible down to depths of 45 to 60 m.

The above described methods of groundwater assessment are the only method presently available to make an estimate on regional scale. It should however be interpreted with caution. In 'dark' areas white gaps will occur and in 'white' areas locally over exploitation occurs. Groundwater recovery in aquifers with a low transmissivity has predominant local impacts rather than regional. This means that at the scale of a sub basin covering an area of 20 to 50 km² the terms of the water balance should be in broad agreement if not overexploitation will occur. It will be clear that with an annual recharge of 75 mm (or 0.2 mm/day) only a fraction of the area can be brought under irrigation as water requirements are in the order of 5 mm/day.

3.4 GROUNDWATER DEVELOPMENT FOR PUBLIC WATER SUPPLY

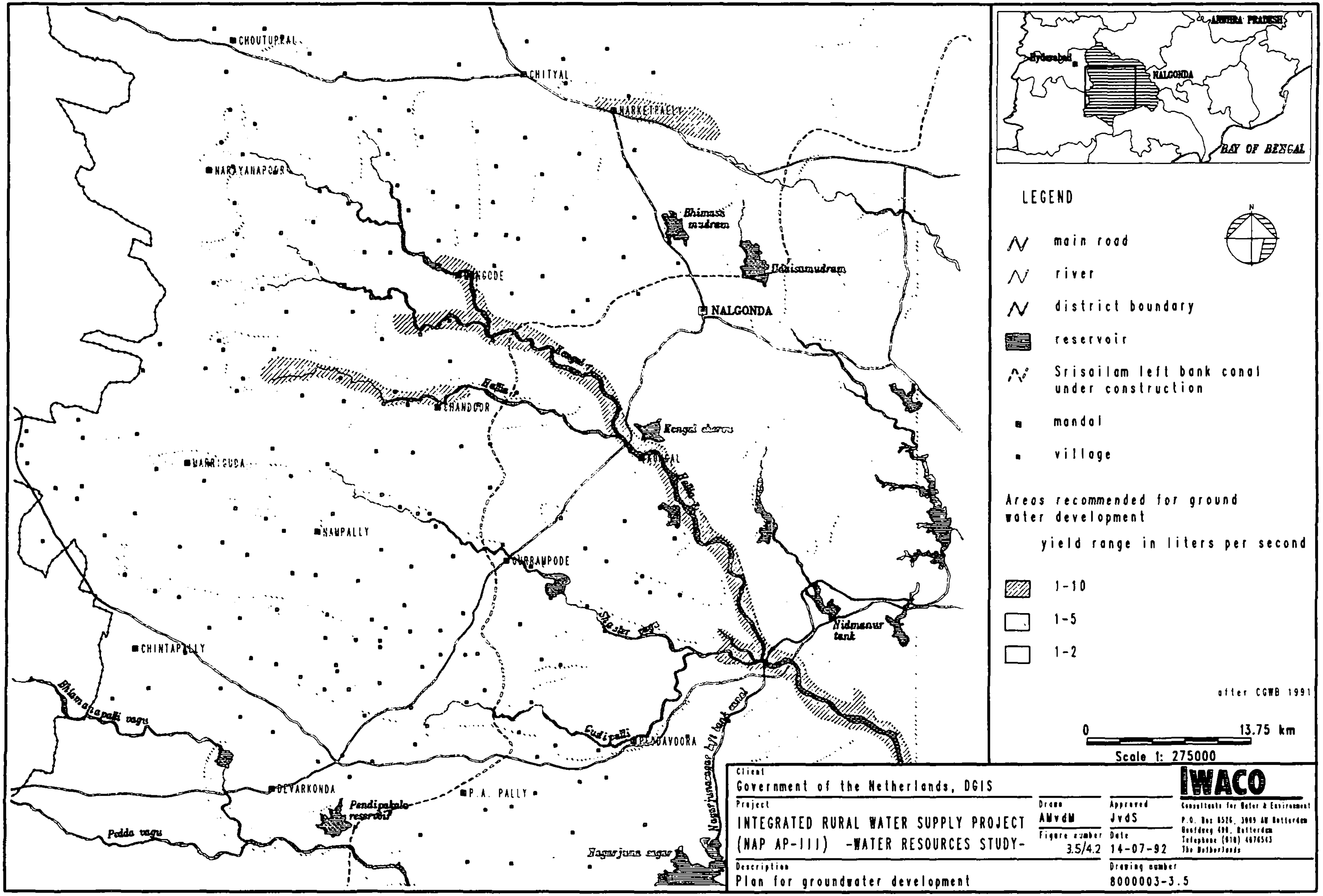
On a regional scale there is a large groundwater potential. Problems of over exploitation can however occur locally resulting in reduction of well yield or complete failure of wells. Still there are possibilities for safe drinking water supply systems based on groundwater. Drinking water has been given top priority in the recently declared national water policy for India and it has been stressed that any new development should not interfere with the yields from drinking water wells. Although the failure of individual wells due to an uncontrolled private abstraction can never be excluded several steps can be taken to reduce this risk to a minimum.

Hydrogeological measures

The most appropriate way of abstracting water from the aquifer should be used to develop the groundwater resources thereby combining optimal yields with a minimum of negative impact. Well design and well spacing are important to this respect. An optimal well design should taken into account the following parameters:

- water requirements;
- aquifer characteristics such as transmissivity;
- radius of influence of the well;
- saturated thickness of the aquifer (compared to the maximum requirements in dry season);
- heterogeneity of the aquifer: permeable and less permeable layers etc.

The **water requirements** of villages is in general less than 200 m³/day. The minimum discharge for a water supply well should be at least 40 m³/day to be practical. This minimum discharge suits best the prevailing hydrogeological situation especially as far as water quality is concerned (see chapter 4).



Client
Government of the Netherlands, DGIS

Project
INTEGRATED RURAL WATER SUPPLY PROJECT
(NAP AP-III) -WATER RESOURCES STUDY-

Drawn: AMvdM
Approved: JvdS
Figure number: 3.5/4.2
Date: 14-07-92

IWACO
Consultants for Water & Environment
P.O. Box 8520, 3009 AM Rotterdam
The Netherlands

Description
Plan for groundwater development

Drawing number
8000003-3.5

It was seen that except for the large fracture zones, **aquifer characteristics are** rather poor. The transmissivity is low, less than 100 m^2/day and typically 20-30 m^2/day. Withdrawing water from such aquifers can be difficult. The yields of boreholes are small but the large diameter wells provide an efficient means of withdrawing water. Because of the large diameter of the well a reservoir is created from which a high yield can be pumped by centrifugal pump in only a couple of hours. Water is taken from well storage and the aquifer slowly replenishes the well even if the pump is switched off. 50% of the pumped discharge is abstracted from the aquifer after the pump has stopped in a typical situation.

If wells are spaced too closely, lowering of the whole water level will occur, but if the well spacings are too large the **radius of influence** will not interfere and therefore the aquifer is not efficiently being exploited.

An example of the situation that will occur as wells are too closely spaced is given in figure 3.6. A groundwater model of Rathod and Rushton has been applied which has been developed especially to model aquifers of low transmissivity. The influence of a borehole exploited at 80 m^3/day on a dug well (40 m^3/day) is shown in the example using the aquifer parameters presented in the figure. The dug well draws most water from less than 100 m. The discharge of 40 m^3/day represents a recharge (at 75 mm/yr) on an area of 62,000 m^3 or a radius of 250 m around the well. If more water is been abstracted the whole water level will lower accordingly as can be seen from the figures.

Areas with a thick **saturated weathering layer** are favourable as they contain a large storage water and makes the wells less vulnerable to years of rainfall deficit. At least 4 m of saturated weathered layer should be present. The thickness of the saturated weathered layer is highly variable over an area. On a regional scale the hydrogeomorphical map can be used that was made using satellite images (see map 4 and legend in Appendix and report APSRAC.).On this map the thickness of the weathered layer and areas favourable of groundwater exploitation are shown. At a local scale the use of geophysical methods are required. The field work done by CGWB has shown that in the study area, the seismic refraction method gives good results (Appendix 7).

The above considerations and the results from the field work have resulted in the identification of four hydrogeological situations that are typical for the study area and that are important for public water supply. Water quality aspects play an important role in the selection of these four types (as will be shown in chapter 4).

1 Fractured rock well
Borehole of 6" with a depth of 50-80 m depending on fracture depth. Discharge range will be 80 m^3/day to 160 m^3/day, occasionally it might more.

2 Wells in dike rock or in weathered layers of unconsolidated material (same characteristics as type 1).

3 Surface water infiltration well
A dug well or a dug cum bore well with a diameter of less than 5 m is a depth range of 10 to 20 m. The bore inside the well (if needed) may reach up to 60 m depth. The discharge range is assumed to be 40 to 160 m^3/day.

4 Recharge area well
This dug well is of the same design as type 3 but located in recharge areas. There the weathered layer is thinner and the fracture density will be less. Consequently discharge will be 40 to 80 m^3/day.

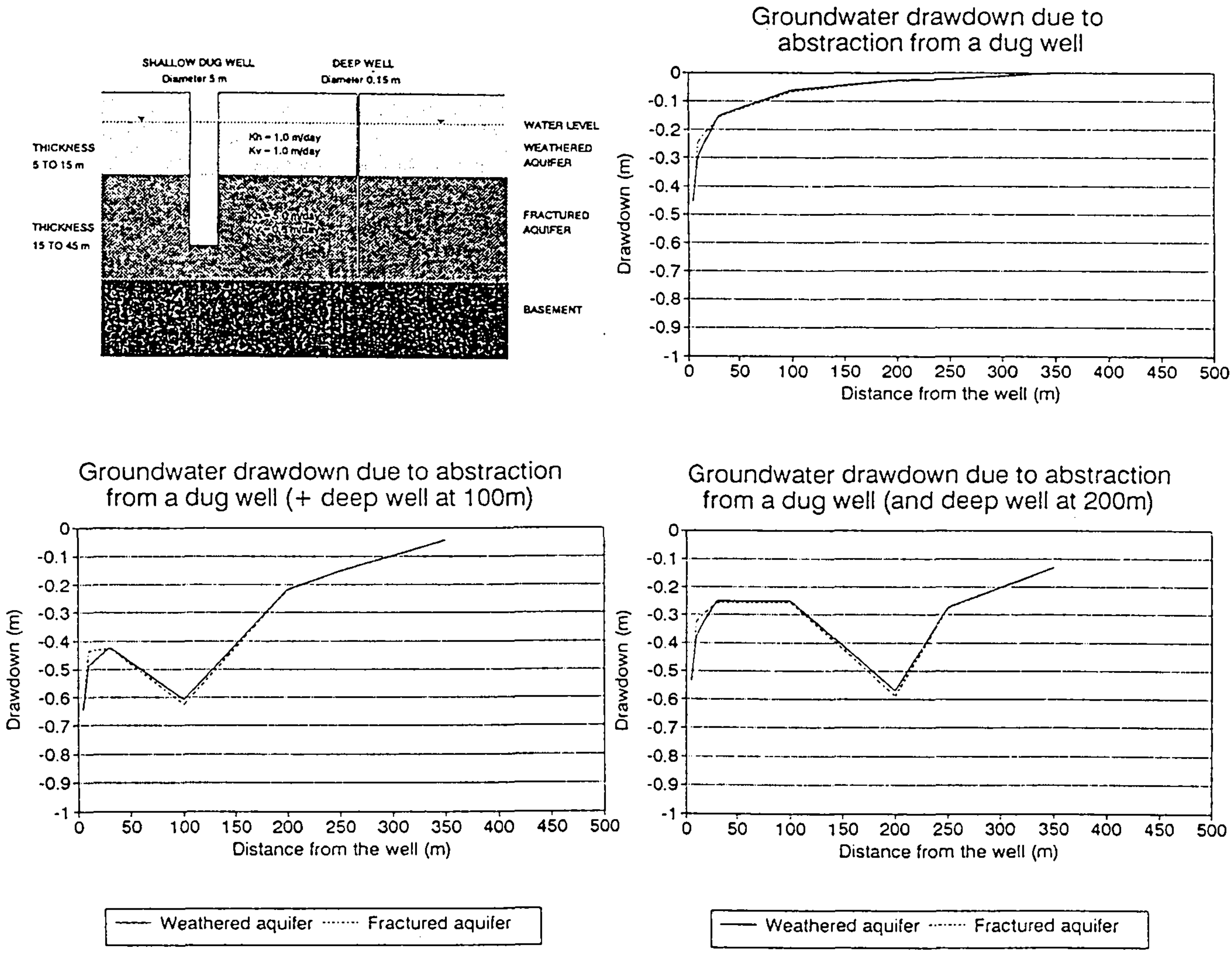


Figure 3.6: Example of groundwater model showing influence of neighbouring wells

In practice detailed design should be made based on local aquifer conditions and results from pump test. Groundwater models as the ones that were mentioned earlier should be used for this purpose.

Where it is not likely that extensive irrigation will occur wells should preferably be located. As will be concluded in the next chapter from water quality considerations it is better not to locate wells in fracture zones as the fluoride concentration is likely to be too high. Recharge areas are more suitable and as soils are poor and well discharge is often too low for efficient irrigation, private abstractions of any importance are not likely.

Technical aspects
Drinking water wells should be properly constructed and of adequate depth. There is a general feeling that better results can be obtained at least compared to irrigation wells. Large diameter wells can be optimised by increasing the diameter and by drilling horizontal wells etc. Well discharge periods can be optimised in such a way that the aquifer is best exploited. In case of a dug well the aquifer can be exploited more efficient by pumping only a couple of hours a day and deplete the well storage than pumping more hours at a lesser discharge.

Institutional aspects
The hydrogeological and technical aspects of the implementation of drinking water systems deserve more attention (this requires a strongly developed hydrogeological wing within the PRED and adequate use of the knowledge and expertise in this field with other organizations). Well siting should be carried out carefully making use of remote sensing data, aerial photographs and geophysical measurements. Existing abstractions need to be examined in detail. Site reports and well reports must be made and data stored in a systematic way. All technics that are well known but rarely fully applied.

Preventive measures
Wells can be protected by creating a water sanctuary around the well. Typical size depending on the situation will be an area with a radius of 50 to 200 m. Approximately it depends on the ratio of transmissivity and the specific yield of the weathered rock aquifer apart from inhomogeneities in the aquifers. Applying the groundwater model in which these inhomogeneities can be introduced the radius of influence can be estimated. The size of a protection area not necessarily needs to cover the influence area. A protective zone with a radius of 50 to 100 m to prevent the direct influence of a private abstraction might be sufficient in most cases. Nor does the area needs to be always circular in shape and depending on the sub surface structure the optimal lay out should be determined.

There are several ways in which a water sanctuary can be established:

- <u>Acquisition of land around the well</u>. Land prices as inquired during field visits range from Rs. 2,000 an acre for poorly fertile dry land to Rs 18000 per acre for fertile irrigated land. Land inside villages is more expensive and not suitable for bore wells for groundwater quality reasons.
- <u>Optimal use of government owned land</u>. It was equally observed that the higher grounds that still have an interesting groundwater potential and are excellent from groundwater quality point of view are often government owned. It will be much easier to put restrictions on land use and private groundwater abstractions.

- Community property. In several villages the community donate land for community purposes such as for example the construction of a defluoridation plant. The community should be involved in protecting their own water supply wells.
- Natural protection. Wells located near surface water, near tank bunds etc. are at least partially protected. It deserves even further consideration to locate wells in tank areas. An adapted well design should be made in such a case.

Legislation
The Government can declare an area over exploitated (dark and grey areas) and instruct banks not to finance any new wells. But this will not prevent a farmer to dig a well from his own private funds. The National water policy states that any legislation on groundwater should not appear to be restrictive for farmers but should promote augmentation of the resources and its equitable distribution. Drinking water however has been given top priority and it has been stressed that any new developments should not interfere with the yields from drinking water wells. According to this policy it is possible at District level to interfere in disputes over drinking water wells. At present further legislation for control of groundwater development is under consideration of the State Government.

Financial control
95% of the wells that are sunk benefit from funding from through Government Organizations or Development Banks. Loans are subject to approval and there are norms regarding well design, well spacing and yields. Banks and other institutions get cooperation from the APSGWD in these matters. The implementation of drinking water schemes requires coordination at an early stage with these institutions.

Cropping pattern
In the vicinity of public water supply wells less water consuming crops can be promoted. Sericulture that requires only one fifth of water compared to paddy would be such an alternative that if properly planned can provide an attractive way to protect drinking water wells.

In Nalgonda concerted efforts to promote sericulture have been made since the last three years. It is one of the income generating activities within the AP-III project. Farmers receive good returns from sericulture. No special land or water resources are required for the growth of the mulberry threes that feed the silk worms.

Community involvement
The community can be involved actively in protecting there own drinking water wells. There are many ways they can participate, from donating land to agree on crops to be grown near wells. If in any case pumpage control in an area is required as an emergency and temporary measure this is best done at the level of the Gram Panchayati (village council). In such an emergency the Village Council may restrict pumpage, especially in the summer season, from different wells. If necessary it may decide on the protection of a new well during a certain period.

Non Governmental Organizations and Voluntary agencies play a role in solving problems associated to water supply and ensuring community participation. Village maps showing land and water resources, location of wells etc might be an important tool in the managing of water resources at local level.

4. GROUNDWATER QUALITY

4.1 INTRODUCTION

Groundwater with high fluoride is common in India. It is found in Gujarat, Karnataka, Tamil Nadu, Andhra Pradesh, Punjab and Rajasthan. The formation of high fluoride groundwaters is principally governed by climate, composition of bedrocks and hydrogeology. Areas with semi arid climate, cristalline, igneous rocks and alkaline soils are mainly affected. The occurrence of fluoride groundwater is closely related to groundwater flow systems as will be shown in the following chapters. Identifying local recharge areas appeared to be a key in detecting waters with acceptable fluoride content.

In the following the sources of fluoride in the area and the processus governing the formation of fluoride rich waters are discussed. Use has been made of several studies carried out in Andhra Pradesh and other states in India (Handa 1975, Jacks 1977, 1979, R.M. Rao 1982, Alveteg a.o. 1991). Studies on fluoride in groundwater in the Nalgonda district are summarized in section 4.3. Work carried out during the present study and results of the field sampling and water analyses are presented in section 4.4. Correlation of fluoride content in groundwater with various aspects of land and water resources are discussed in section 4.5. A summary of the results is presented in section 4.6.

Interpretation of the results can be found in sections 4.6 (variation of fluoride content) and 4.7 which describe a methodology to identify groundwater sources with acceptable fluoride content.

4.2 OCCURRENCE OF FLUORIDE RICH GROUNDWATER

4.2.1 Sources of fluoride

Fluoride is present in small amounts in the cristalline rocks in the area. Fluorite (CaF_2) is the principal bearer of fluoride and is found in granite, granitic gneiss and pegmatite. Fluoride is released to the soil and the groundwater through weathering of the primary minerals in the rocks. Leaching of fluoride-containing minerals may yield fluoride in solution. Fluoride can form a number of complexes in water or exist in free form, eventually precipitating as fluorite. It was found elsewhere that secondary calcium concretions, locally known as kankar can release considerable amounts of fluoride (Jacks 1977).

Fluoride released through weathering can be transported by the groundwater (or surface water) and subsequently be partly redeposited in a more soluble form in carbonate deposits. These carbonate precipitates are common in areas with low precipitation and can accumulate in thick layers in valley bottoms where groundwater levels are shallow. Eventually the kankar deposits can be redissolved and released to the groundwater.

Kankar is not present in all valleys and not all kankar deposits are rich in fluoride. This depends mainly on groundwater flow paths and rock material in the recharge area. The pink grey granite which forms the western hill range and which occurs as isolated hills north west of Nalgonda are the primary sources of fluorite in the areas. The gneisses which underlie the plain contain much less fluoride.

4.2.2 Chemical characteristics

The geochemistry and genesis of high fluoride groundwaters has been studied by Handa (1975). Out of groundwater analyses from all of India he derived some general characteristics, common to high fluoride groundwaters:

- groundwater with high levels of fluoride generally contain low amounts of calcium;
- fluoride content of water is positively correlated to bicarbonate;
- high fluoride groundwaters are close to saturation with respect to fluorite and saturated or oversaturated with respect to calciumcarbonate.

Negative correlation between F^- and Ca^{2+}
The Ca^{2+} activity in natural environments is regulated by activities of some anions. With these, mainly with carbonate, calcium forms insoluble compounds. The fluoride content of many natural waters seems to be controlled by the solubility of fluorite (CaF_2) according to literature. Fluorite has a comparatively low solubility product and the activities of F^- and Ca^{2+} are negatively correlated. Thus, if the amount of dissolved calcium is low, fluoride can accumulate in groundwater.

Positive correlation between F^- and HCO^-_3
When computing thermodynamic equilibrium reactions for groundwaters in contact with both calcite and fluorite solid phases, Handa used a combined mass law equation:

$$CaCo_{3(S)} + H^+ + 2F^- <> CaF_{2(S)} + HCO_3$$

$$K_{calcite-fluoride} = \frac{aHCO_3}{aH^+ \text{ x } (aF^-)^2}$$

The conclusion derived from this was that any change in bicarbonate concentration will be accompanied by a corresponding change in the concentration of fluoride ions, since $K_{calcite-fluorite}$ is constant, indicating a positive correlation between these two variables. This was also observed by the study of Rama Mohana Rao (1962) in the Nalgonda District.

4.2.3 Genesis of fluoride groundwaters

In the situation occurring in the Nalgonda District the fluoride groundwaters are formed mainly as a result of evapotranspiration along the groundwater flowpath from recharge areas to (local) discharge areas. In the recharge areas fluoride is available from the weathering of primary minerals, along the flow path concentrations increase to a level that carbonates including fluorite can precipitate (see figure 4.1).

Due to the precipitation of calcium, soils become alkaline with high contents of sodium. Water percolating through such soils gets a high pH and since $CaCO_3$ is sparingly soluble at high pH, concentration of calcium in soil solutions and the groundwater will be low. These conditions allow fluoride to accumulate in water and in discharge areas fluoride rich groundwater can be found. The presence of kankar with a high fluoride content further enforces this process.

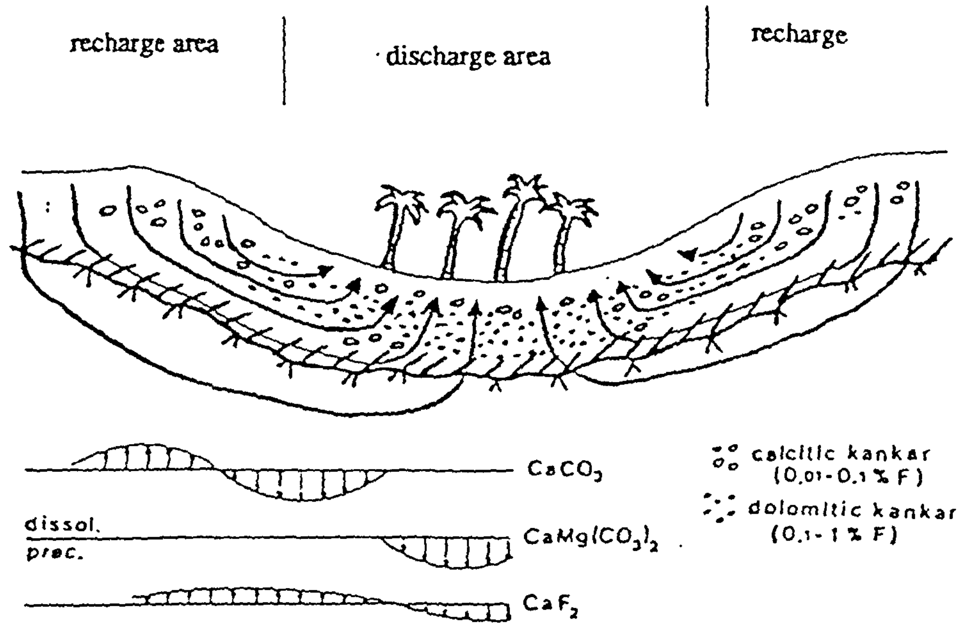
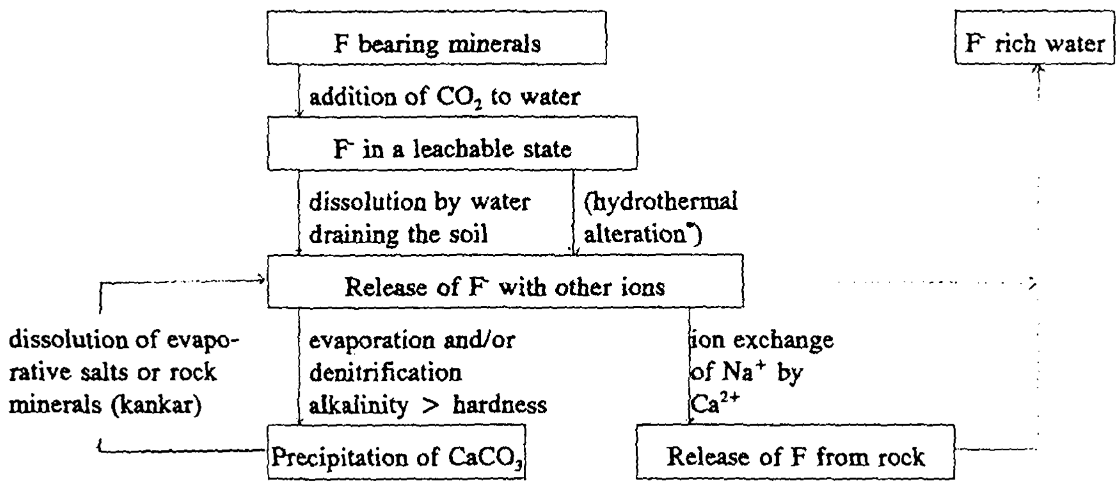


Figure 4.1: Hypothetic cross-section of a valley in an area with high fluoride groundwater showing distribution of calcite and dolomite. The lines below the profile illustrates dissolution and precipitation of solid phases. From Jacks (1979).

The process of formation of fluoride waters is schematised in figure 4.2 (modified after Griffioen, 1987).



* not occurring in the region

Figure 4.2: Process of formation of fluoride rich water (source: Griffioen, 1986)

From the above it will be clear that high fluoride groundwaters are found to be associated with alkaline soils, low in exchangeable calcium and with a high exchangeable sodium potential (ESP). Jacks (1979) examined the possibility of applying gypsum to soil in such a way that the soluble calcium from gypsum would decrease the alkalinity of the soil and restrain the transport of fluoride to the groundwater.

4.3 PREVIOUS STUDIES

Several studies have been carried out in Nalgonda and a large number of samples have been taken over the years. Unfortunately location and characteristics of sample points are seldom reported. Furthermore studies put more emphasis on areas and water points where fluoride is present in excessive concentrations than those areas, in the same regions, where it is not.

- **D.V. Rama Murthy** collected 29 ground and surface water samples in the vicinity of Nalgonda. The fluoride content in the water from river Kangal varied from 2.0 to 3.0 and in groundwater 1.0 to 3.0. The F-content in the Kangal varied from 1.4 in 1962, 2.5 1965 to 3.2 in 1968.Later the level dropped to 2.4 mg/l.
- A study of high fluoride bearing waters of Nalgonda area was carried out by the **Central Groundwater Board** (field season 1970-1971) 27 water samples and 112 soil samples were taken.It was observed that the Hallia river has a lower [F] (1.25 mg/l) compared to the Kongal river (2.0). Measurements were done on 22-6-1971.
  Water of dug wells displayed low [F] in the range of 1.0 to 2.5 mg/l with 23 samples less or equal of 1.5 mg/l.(see area on figure 4.2).The geochemical samples did not present any regular patterns. High fluoride zones occur as pockets sometimes near the surface sometimes in depth. Only locally a correlation between high [F] in wells and soil samples could be found.
- Geochemical factors influencing the distribution of fluoride in rocks, soils and water sources in the Nalgonda district. By **N.V.Rama Mohana Rao 1982** is the most detailed study in the region.(Mr N.V Rama Mohana Rao is presently director of the Institute of Preventive Medicine IPM). Some of his conclusions are mentioned in the box, other results are integrated in the chapter at different places.
- Recently a study was carried out by Alveteg and Jonson (1991) students of G.Jacks and K. Rajagopalan in the area around Yellareddi located near Nalgonda town and part of the project area. They evaluated a field experiment which started in 1977 in which gypsum was applied to soils in order to decrease soil alkalinity and to cause water-soluble fluoride to precipitate in the soil. There appear to be no marked decrease in F content in groundwater although soil conditions showed clearly effect of the treatment.

4.4 AVAILABLE DATA AND ANALYSIS

Data that are collected comprise:

- PRED well data (existing and newly collected)
- APSIDC data collected through a well survey
- Data collected by APSRAC during field surveys in connection with the correlation of fluoride content and the preparation of thematic maps
- Field observations of the mission team
- The Institute of Preventive Medicine presented in 1987 the results of 1640 fluoride analysis of the Nalgonda district. A number of the analyses is located in the study area but again no exact location is known.

Fluoride in rocks and soils
(43 samples from Sivannagudem, in the west part of the study area, 12 from Hyderabad).
Wide variations are observed in [F] of rocks and nearby soils. Easily weathering fluoride bearing minerals such as fluorite are found. The presence of extensive dolerite dikes act as groundwater flow barriers thereby increasing residence time of water. Evapotranspiration makes [F] to increase and as the [Ca] is kept low by the early precipitation of calcite, the [F] increase is not counterbalanced by precipitation of CaF^2. In dry periods F-rich salts may temperately precipitate in the top layers of the soil, or locally as salt deposits. These are redissolved again by precipitation and constitute a permanent reservoir of F.

Fluorite occurs as concentration in the porphyritic granite gneisses. It also was found in the form of veins. The high [F] in soils and rock is the reason for the [F] rich groundwaters.Stream sediments contain more F than soils.

The two main factors governing F in groundwaters are the presence of high and easily weathered F bearing minerals such as fluorite in the rocks and the low calcium content of the rocks. Low Ca results in low Ca in soils and groundwater

Fluoride in water
Based on 1680 samples from 1460 wells and 220 surface water sources in 180 villages in Nalgonda District it was concluded that the distribution of F was found highly variable even among waters of different wells in one village. No correlation was found between F and well depth nor between F in the rocks and well water.

F in dugwells and bore wells
A comparison of F content of dug wells and bore wells in a village indicated that the maximum F content of borewells is usually less than the maximum in dug wells.

Seasonal variation in F
20 wells were sampled in summer, rainy season and winter. The variation recorded between rainy season and summer range from 0 to 0.4 mg/l. The variations between winter and summer are low.

Variation of F with time
25 samples were collected in the summer of 1977 and 1981.4 showed no variation and in others it ranged from 0.2 to 0.8 mg/l. While in some cases there has been an increase others showed a reverse trend.

F in surface waters
220 samples, including 80 from Nagarjuna Sagar and its left bank canal, 10 from tanks and 130 from Musi, Kangal and Hallia rivers and tributaries. The water in Nagarjuna Sagar had 0.5 to 0.6 mg/l F content.Samples from the Hallia river contained significant less than waters from the Kangal rivers (1.2-1.8 mg/l versus 2.0-3.4 mg/l) The streams draining the western hills and join the Kangal river showed F in the range of 3.0 to 7.0 mg/l. Excessive F of stream water correlated well with high F in stream sediments.

Health effects
The Ministry of Health has predescribed fluoride concentration of 1.0 as desirable and 1.5 mg/l as maximum permissible. F in raw foods and plant leaves has been tested in endemic areas. Vegetation has low F, some millet varieties have F content up to 74 mg/kg (dry weight).

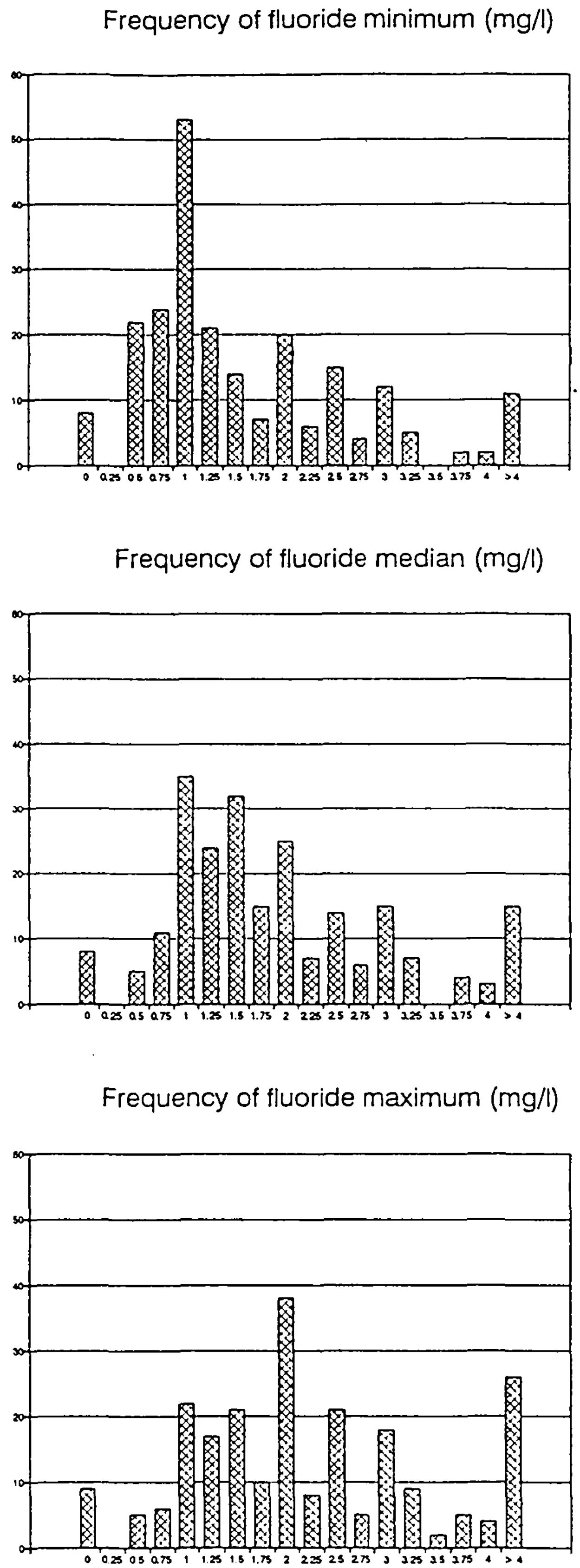
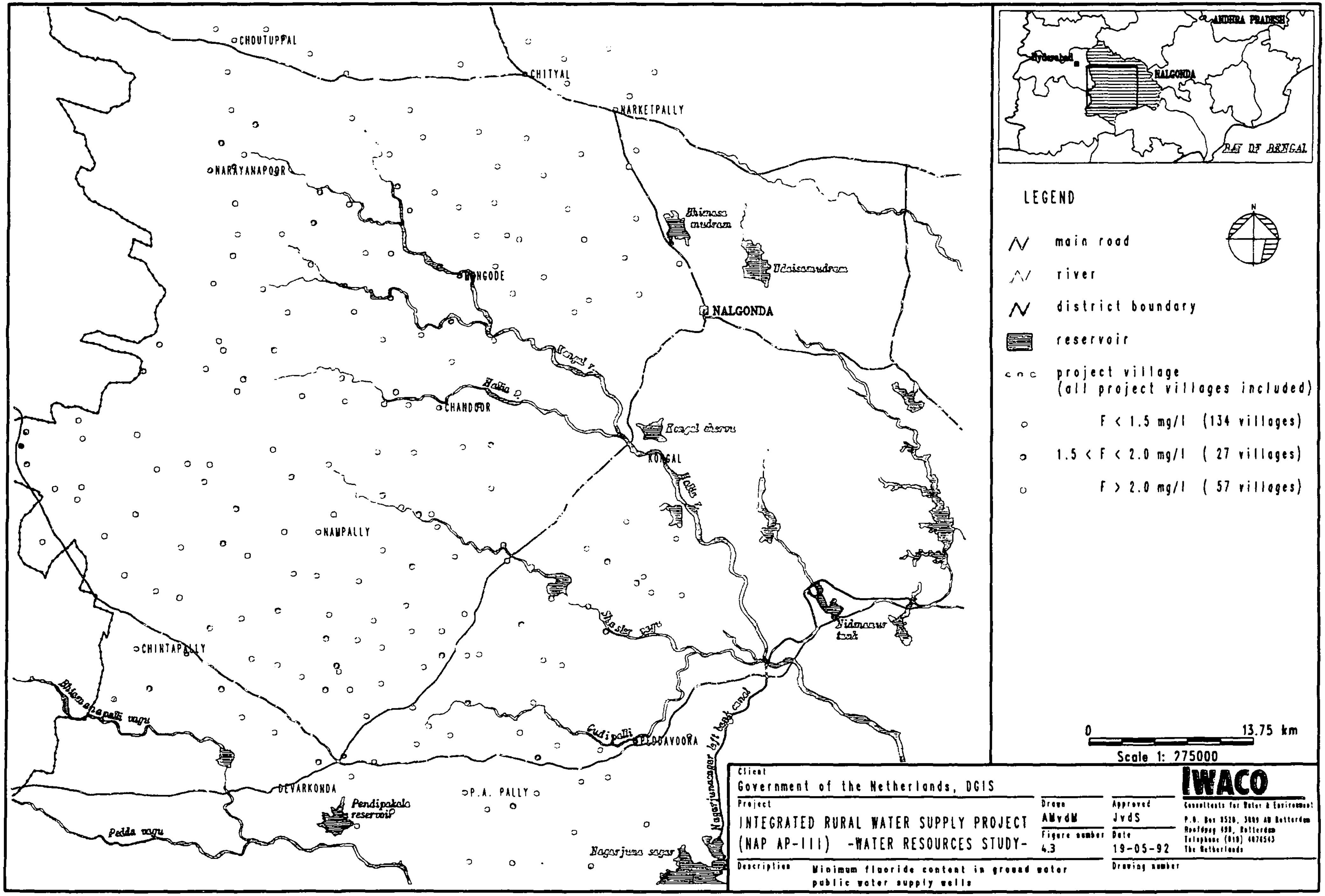


Figure 4.6: Histogram of minimum, median and maximum fluoride content in PRED wells


ANDHRA PRADESH
Hyderabad
NALGONDA
BAY OF BENGAL
LEGEND
main road
river
district boundary
reservoir
project village
(all project villages included)
F < 1.5 mg/l (134 villages)
1.5 < F < 2.0 mg/l (27 villages)
F > 2.0 mg/l (57 villages)
N
CHOUTUPPAL
CHITYAL
NARKETPALLY
NARAYANAPOOR
MONGODE
NALGONDA
CHANDOOR
KONGAL
NAMPALLY
CHINTAPALLY
DEVARKONDA
P.A. PALLY
PEDDAVOORA
Bhimasamudram
Udaisamudram
Kongal cheruvu
Pendipakala reservoir
Nagarjuna sagar
Nagarjunasagar left bank canal
Pedda vagu
Gudipalli
0 13.75 km
Scale 1: 275000
Client
Government of the Netherlands, DGIS
Project
INTEGRATED RURAL WATER SUPPLY PROJECT
(NAP AP-III) -WATER RESOURCES STUDY-
Drawn
AMvdM
Figure number
4.3
Approved
JvdS
Date
19-05-92
IWACO
Consultants for Water & Environment
P.O. Box 8520, 3009 AM Rotterdam
The Netherlands
Description
Minimum fluoride content in ground water
public water supply wells
Drawing number

4.4.1 Laboratory facilities

There are several organizations which can analyse fluoride. In Hyderabad PRED, IPM, CGWB and NEERI can perform analyses using the colour method. IPM and NEERI have also an selective ion electrode and SPANS-apparatus. CGWB has equipment but this was not operational. The Nalgonda PRED laboratory which has started since February 1992 can perform fluoride tests as well.

19 water samples are taken during field surveys and analyzed at PRED and IPM laboratories. Results showed large variations in EC measurements, including some well out of the range values measured in the field. The electrical conductivity apparatus at PRED laboratory does not function well, at IPM deviations at higher EC values appeared to be related to wrong calibration.

Fluoride analysis results showed reasonable agreement at low concentration (< 1.5 mg/l) but not so at higher levels. This can partly be attributed to the decrease of precision inherent to the method used (in both cases the colour method was used, the dilution of samples and test chemicals can easily led to errors). The selective ion electrode is to be preferred. The field method (DR-100 Colorimeter-HACH) to determine F has performed satisfactorily and is easy to use. Three sets with sufficient stock of chemicals are available for use by the PRED.

4.4.2 PRED data

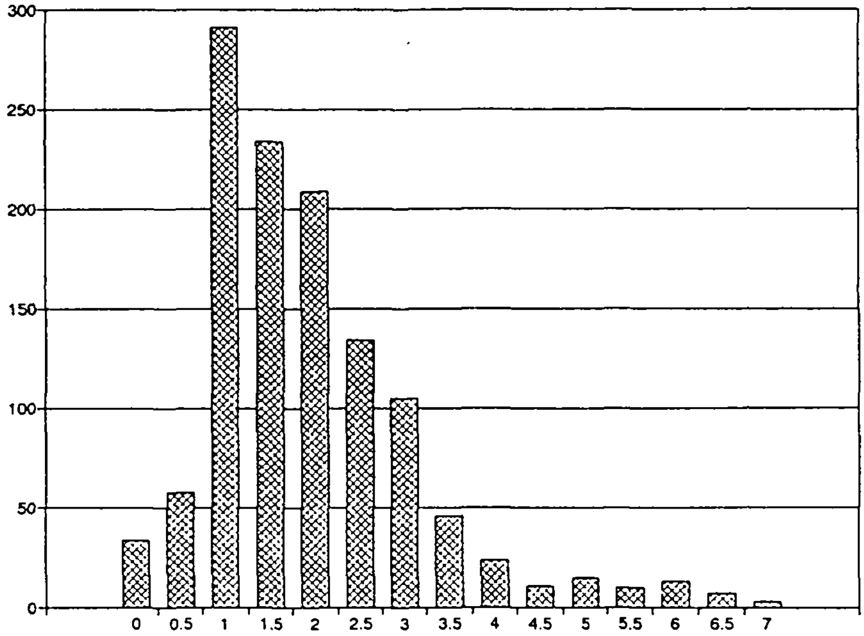
- Collection and presentation

  Water quality data are available from the PRED laboratory which has sampled a large number of bore wells in the project area since 1986. Wells are in some cases sampled more than once. Only results of electrical conductivity, chloride and fluoride are used as no complete analyses are available. Unfortunately, no exact location of the sampled wells is available, data are grouped per village or hamlet. Furthermore, only maximum values of fluoride are considered. Maps had to be prepared on suitable scales for interpretation.(1:50,000 and 1:100,000 scale). All of the villages and hamlets in the first phase of the project are covered. For the second phase villages only part of the villages were sampled and additional sampling has been carried out.

  Data are stored in the database that is installed at the PRED office and all data processing is done by PRED officers. Original laboratory registers are used as source of input. Digitized maps are compiled in the Netherlands using a Geographical Information System (ARC-INFO). Base maps have been prepared by APSRAC using 1:50,000 scale toposheets and reduced to 1:100,000 scale showing the distribution of fluoride in the project area. Reduced versions showing only the project villages, are presented in the report. The base maps showing villages and hamlets in and outside the project area, database code numbers and fluoride content values are included in the maps annexed to the report. (Well numbers in the database always have 10 digits: for example 16.09.02.001: 16 Choutuppal mandal, 09 Nagaram village, 02 Yallembai hamlet, 001 Kummari colony well).

  Map 3 shows the distribution of fluoride in groundwater indicated by the minimum, median and maximum fluoride content that has been found in a number of PRED samples in a particular village. Figures 4.3 to 4.5 are derived from this map and display areas where the median or maximum content is above the thresholds of 1.5 mg/l and 2.0 mg/l.

Frequency of fluoride (mg/l) PRED



Frequency of fluoride (mg/l) IDC

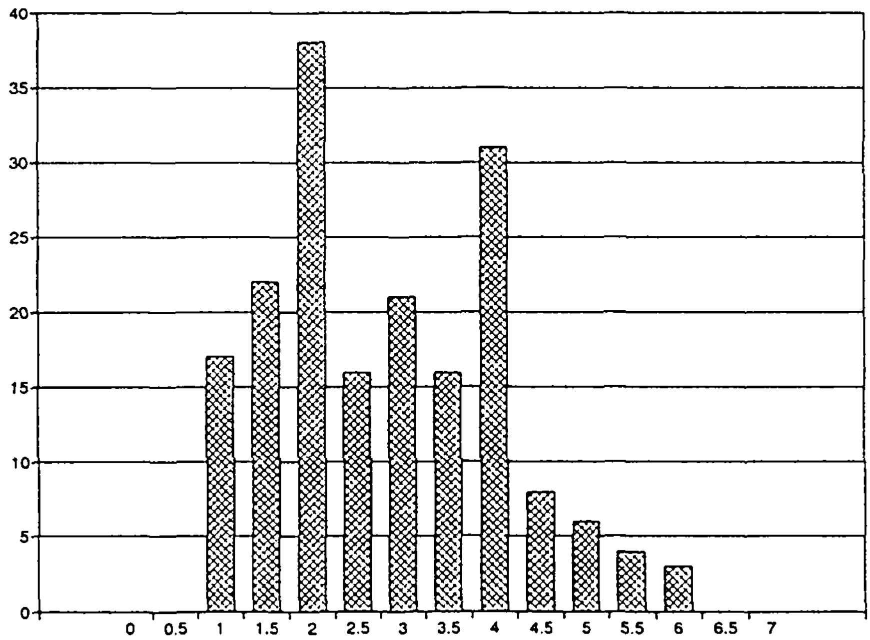
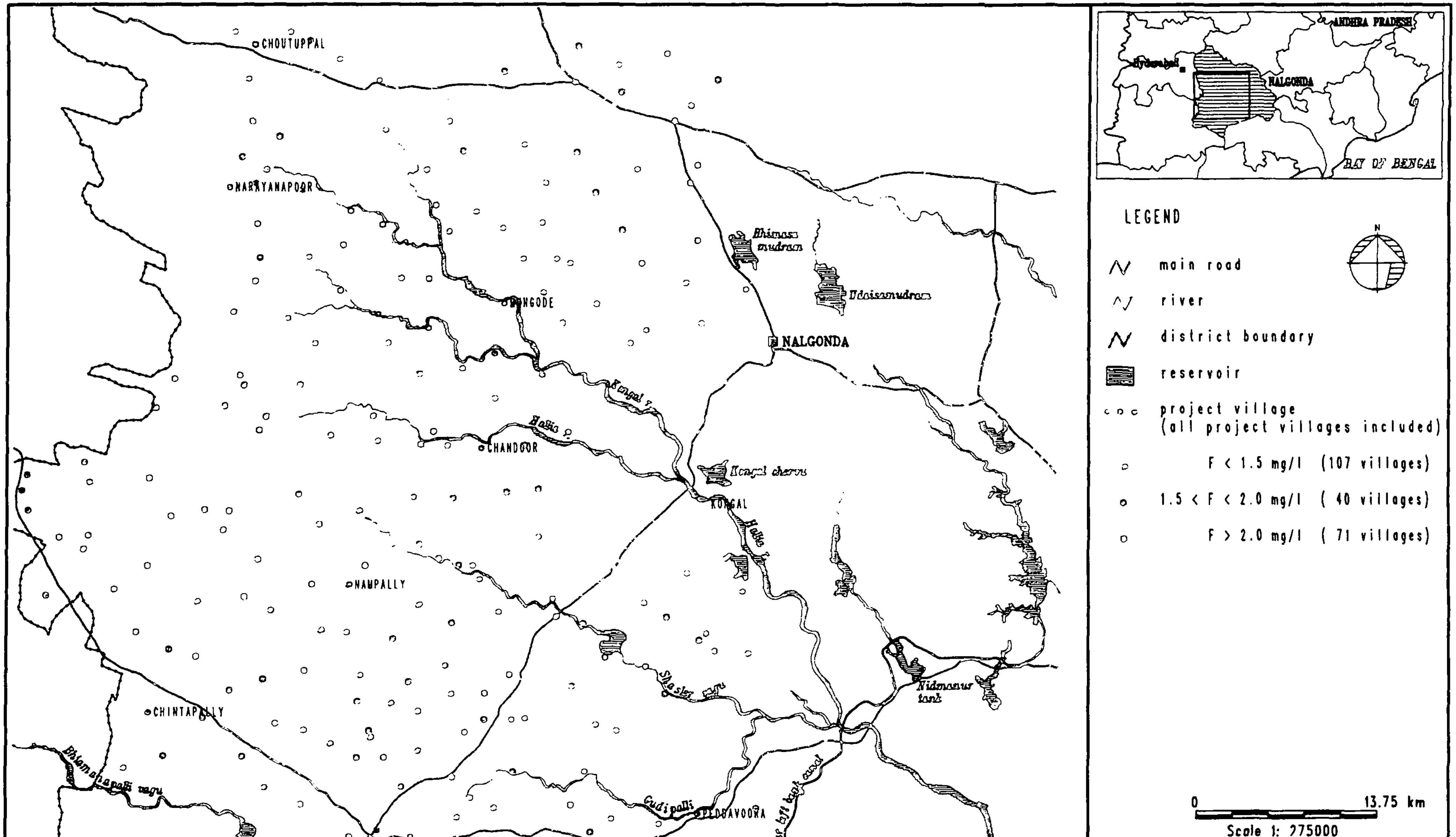


Figure 4.7: Histogram of fluoride content in IDC and PRED wells



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IWACO
Consultants for Water & Environment
P.O. Box 8520, 3009 AM Rotterdam
Hoofdweg 490, Rotterdam
Telephone (010) 4076543
The Netherlands

Description: Median fluoride content in ground water public water supply wells

Characteristics of the wells can be found in the data base (Appendix 5) and in the histograms of figures 4.6 and 4.7. It must be noted that the PRED wells are mostly wells with a low yield that are located in villages at sites selected for their proximity to the users. They are rarely located in the large fracture zones that mostly coincide with valley floors.

In the area of phase II the distribution of fluoride shown on the maps is less reliable as for many villages and hamlets only one sample is available. In 8 villages, still no fluoride samples have been taken.

- Discussion

The frequency distribution of village minimum, median and maximum fluoride content is presented in figure 4.6. In 134 villages at least 1 well containing ≤ 1.5 mg/l F is present (see table 4.1).

Table 4.1: Distribution of fluoride in villages in the study area

Fluoride content (mg/l)	Number of villages		
	Minimum F content	Medium F content	Maximum F content
≤1.5	134	107	62
1.5 < F ≤ 2.0	27	40	32
> 2.0	57	71	98

The aerial distribution is presented in figures 4.3 to 4.5. The following three zones can be distinguished:

- zone 1, when all water samples have F > 1.5 mg/l
  In total 84 villages. 34 restricted to the western hills and 2 to the area north west of Nalgonda. These are the worst affected regions. The other high F villages are scattered over the area, often only 1 sample is available.
- zone 2, where water samples have a variable F content between 1,5 and 2 mg/l
  Total 94 villages, in lower parts of the catchment area mainly in the south
- zone 3 all groundwater have F < 1.5 mg/l
  Total 62 villages, scattered over the area, but most in the area north of the Kangal river and in the south.

The electrical conductivity and chloride of the well water shows a clear linear relation indicating the importance of evapotranspiration (figure 4.8). No relation is present between either chloride and EC with the fluoride content.

4.4.3 Irrigation well data

- Collection and presentation

A large number of irrigation wells was sampled during the first and second phase of the study by the APIDC. Well characteristics and (approximate) locations were available and entered in the data base. APIDC wells were all sited by means of geo-electrical siting techniques and aerial photographs. Most wells are located outside the village in large fracture zones. In general only wells of more than 11.4 m^3/hr are considered successful.

• Discussion

Well yields are considerable higher than the PRED wells as can be seen from the data in Appendix 5 and the histograms in figures 2.5 and 2.6. Figure 4.7 shows clearly that fluoride concentrations are higher too. Out of 181 samples 142 have concentrations over 1.5 mg/l. The results confirm that the large fracture zones are associated with high fluoride groundwaters. The wells that have low fluoride contents are associated with specific hydrogeological conditions which are not related to fractured zones. This is observed in the IDC wells near Chityal and Gundrampally where bore wells are located near dolerite dikes. Near Waitipalli valley fill deposits can be found that are exploited by a number of wells (see figure 4.10). In Hydalapur, high yielding wells with acceptable fluoride content are found in a local recharge area.

No linear correlation between discharge and fluoride content is present, nor between well depth and fluoride.

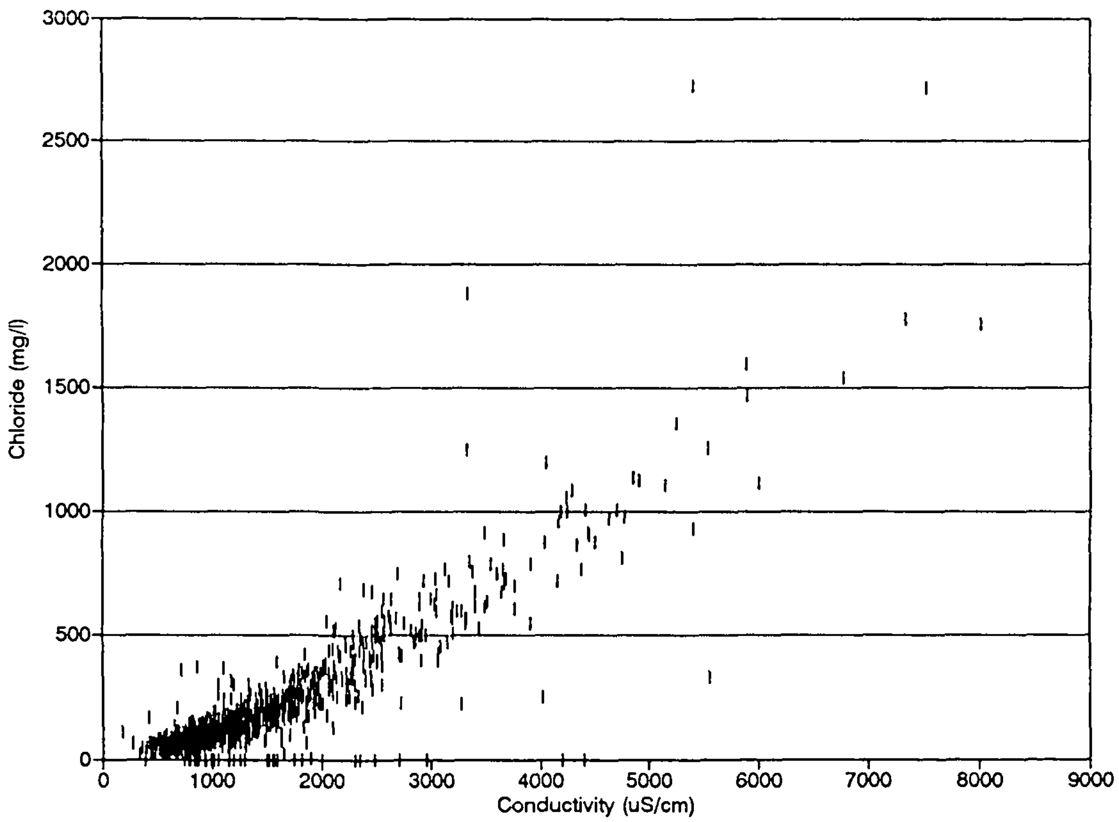
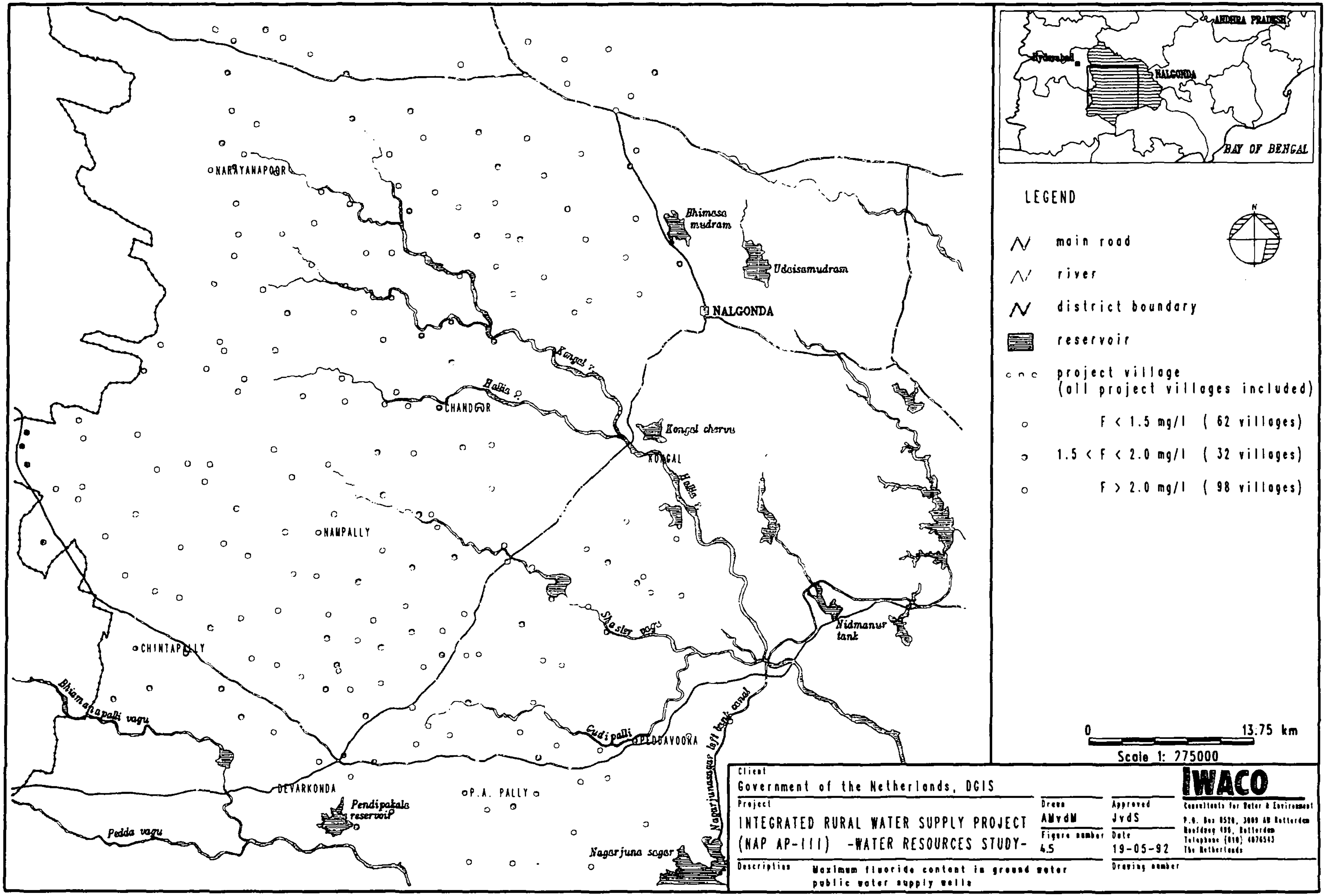


Figure 4.8: Electrical conductivity and chloride in PRED well waters



ANDHRA PRADESH
Hyderabad
NALGONDA
BAY OF BENGAL
LEGEND
main road
river
district boundary
reservoir
project village
(all project villages included)
F < 1.5 mg/l (62 villages)
1.5 < F < 2.0 mg/l (32 villages)
F > 2.0 mg/l (98 villages)
NARAYANAPOOR
Bhimasa mudram
Udaisamudram
NALGONDA
Kongal r.
Hallia r.
CHANDOOR
Kongal cheruvu
KONGAL
Hallia r.
NAMPALLY
Shasler vagu
Nidmanur tank
CHINTAPALLY
Bhimanapalli vagu
Gudipalli
PEDDAVOORA
Nagarjunasagar left bank canal
DEVARKONDA
Pendipakala reservoir
P.A. PALLY
Pedda vagu
Nagarjuna sagar
0
13.75 km
Scale 1: 275000
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Maximum fluoride content in ground water
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4.5 CORRELATION OF FLUORIDE CONTENT IN GROUNDWATER WITH VARIOUS ASPECTS OF LAND- AND WATER RESOURCES

4.5.1 Natural resource mapping

The aim is to find relations between water quality and data on natural resources such as geology, structure, soils, drainage and surface water, land cover and groundwater irrigated area. Thematic maps are prepared by APSRAC using remote sensing techniques. The maps were checked in the field by both the mission and APSRAC field teams and at selected locations fluoride samples were taken from ground and surface water. The following maps were prepared of the study area:

- Geology and structure
- Hydrogeomorphology
- Soils
- Slopes
- Drainage and Surface Water Resources
- Land Use / Land Cover
- Hydrogeology
- Groundwater irrigated areas

Legends of the maps are presented in Appendix 6 together with a reduction of the maps. The coloured maps on 1:100,000 scale have only be reproduced in limited number.

Initially, Indian Remote Sensing (IRS) False Colour Composite (FCC) (L2A2 25-56 & L2B2 25-56, dt. 17-3-91 & L2B2 25-56 and L2B2 25-56, dt. 23-2-91) and Landsat TM (143-48, dt.13- 10-89 & 17th January, 1990) data has been subjected to visual interpretation using a Light table, Procom-II and a Large format optical enlarger. Thematic maps were prepared based on image characteristics such as tone, texture, shape, pattern, association, location, etc. Preliminary interpretation was carried out on 1:100,000 scale covering the study area using IRS and TM data of two seasons. Extensive field work was carried out and doubtful areas were verified during the field investigation. The slope map was prepared based on the Survey of India toposheets of 1:50,000 scale.

An unbiased approach has been adopted with an aim to identify the factors that control the occurrence of high fluoride content in both surface water and groundwater. The multi thematic information derived from remotely sensed data and field investigations were individually and collectively correlated with fluoride information collected during the study. The fluoride values obtained from the field sampling by APSRAC, IWACO and APSIDC were utilised with their spatial locations. The PRED information, as the exact location was not known, has been attributed to the location of the main village. The median values were used for correlation.

Surface water bodies and fluoride content
All twenty surface water bodies were sampled for fluoride content. The minimum and the maximum contents were found to be 0.2 and 4.0 mg/lt. Very high fluoride content of 4 mg/lt and above was observed along the western margin of the study area from the east west flowing streams. Moderate values of about 2 mg/lt were observed in the Southern part of the study area. Very low fluoride values (less than 1.0 mg/lt) were observed in the North Eastern part of the study area mainly from North South flowing streams. The fluoride values of tanks are presented in table 4.2. Tanks located in valleys of large fracture zones are more likely to have a high F content.

Table 4.2: Fluoride variations in surface water bodies

1	Shivannagudem tank	4.0	
2	Yerragandlapalli	4.0	
3	Kottaguda	3.8	Average fluoride value is
4	Paluvai	2.4	2.3 mg/lt for surface water
5	Pendlipakala	2.2	bodies having fluoride values
6	G. Gauraram	2.2	> 1.5 mg/lt
7	Daniyal	2.0	
8	Chepur	2.0	
9	Tangedupalli	1.95	
10	Lambadi tanda	1.6	Average fluoride value is
11	Darveshpuram	1.6	0.8 mg/lt for surface water
12	Chinnakaparti	1.4	bodies having fluoride values
13	Kompalli	1.2	< 1.5 mg/lt
14	Munugod	1.0	
15	Mantronigudem	0.7	
16	Gulapur	0.6	
17	Cherlapalli	0.6	
18	Peddacheruvu	0.35	Total average fluoride values
19	Aurwani	0.3	is 1.6 mg/lt for 20 tank water
20	Kongal cheruvu	0.2	samples

Geology and fluoride value

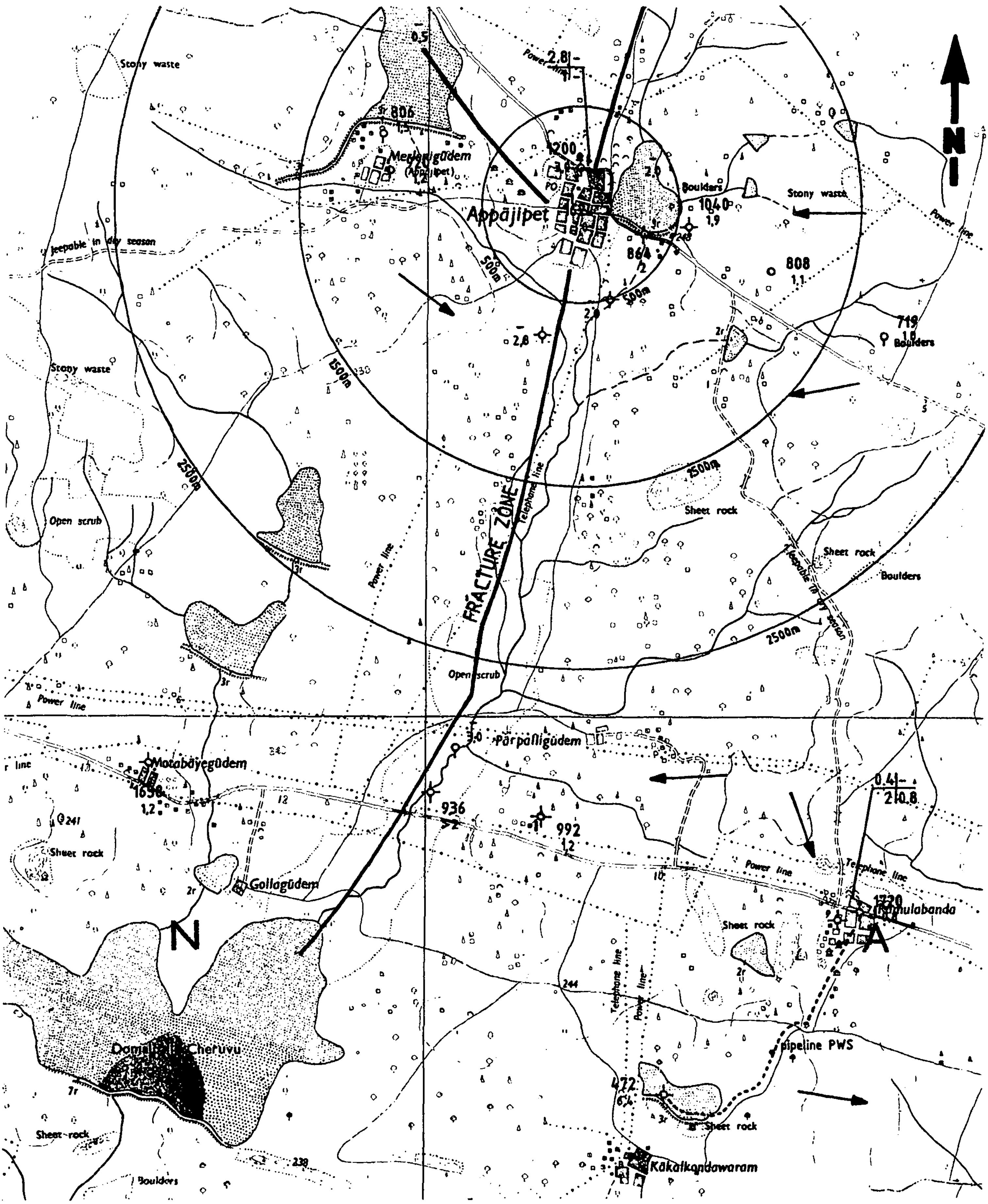
The fluoride values obtained from the groundwater samples have been correlated with the various lithological units obtained from the geological mapping. The fluoride content of samples are grouped in four classes as shown in table 4.3. In Younger granites 88% of the samples were having > 1.5 mg/lt, while about 57% of the samples have > 3 mg/lt. 80% of the samples in the Kankar formation over gneisses to contain more than 1.5 mg/lt. In Kankar about 33% of the samples contain more than 3 mg/lt.

Table 4.3: Fluoride in groundwater of several geological formations

Geologic Unit	Total samples	No. of samples			
		< 1.5	1.5 - 2.0	2.0 - 3.0	> 3.0
Biotite Gneiss	44	12 (27%)	11	16	5
Peninsular Gneissic complex	514	238 (46%)	92	121	63
Younger Granite	72	9 (12%)	6	16	41
Kankar	42	8 (20%)	8	12	14
Alluvium	8	3 (37%)	2	1	2

Geologic structure and fluoride value

The fluoride content of groundwater from different directional fractures have been analyzed. Initially the locations of the samples are superimposed on a geological structure map and only those sites which are falling on the fracture zones are considered for evaluation. Analysis shows that the fractures falling in approximate EW direction are having very high concentration of fluorides with an average value of about 3 mg/lt. The minimum value of average 1.5 mg/lt is observed in almost all the directions of the fractures. Among the fractures those which are having connections with the source rocks are observed to contain very high fluoride value. They are WNW, NW-SE, NE-SW in order of decreasing fluoride values.



IDC well	1658	electric conductivity US/cm	fracture zone
PRED well	1.2	fluoride mg/l	500m radius from village centre
dug well	0.4 | 0.7	number of samples PRED wells (8)	direction of ground water flow
dug cum bore	8 | 1.4	minimum, median maximum fluoride	

Figure 4.9 fluoride distribution in ground water near Appadjipet
scale 1 : 25000

The slope and soil maps or land use maps did not show any clear relationship between fluoride content and map units. Neither did the map that was composed from single value thematic maps.

4.5.2 Field observations

The above described results indicate that it is difficult to find regional characteristics in the fluoride content of the groundwater. It seems that a scale of 1:100,000 is not sufficient to locate and analyze the differences. The factors controlling the fluoride concentrations are far too complex to be expressed in simple correlations between discharge, depth etc.

The objective of the field work was in particular to study the fluoride content of water in its hydrogeological context and not merely as a chemical parameter of water quality. Use was made of detailed topographical maps at 1:25,000 and 1:50,000 scale. These maps proved essential in taking groundwater flow, recharge and discharge areas into account.

In total, 168 fluoride measurements of ground and surface water were done using the DR-100 Colorimeter. A large part of the project area was covered. Figures 4.9 and 4.10 give a typical example of how the field work was conducted and about the most important findings. The following findings can be presented:

- Fluoride content can vary significantly over short distances of even 200 m. This is related to groundwater flow between recharge and discharge areas. Fluoride content is lower in recharge areas and increases in the direction of flow towards discharge areas, in most cases related to kankar and alkaline soils.

- Fluoride content is considerably lower (mostly within acceptable limits of 1.5 mg/l) in local recharge areas that are not connected with the large fracture systems. This can be seen in figure 4.9, where wells in the large fractures have high fluoride content. Outside this zone F concentration decreases.

- Wells located below surface water ponds, tanks or reservoirs usually have lower [F] due to dilution by surface water infiltration. During field work it was observed on several occasions that bore wells close (< 100 m) to a tank showed lower content than bore wells at greater distance. This opens perspectives for infiltration wells in favourable locations downstream of tank bunds or even wells within the limits of tanks. Wells close to the Nagarjuna Sagar canal displayed clearly the diluting effects of infiltrating surface water.

- Dike rocks in several cases contain groundwater with low fluoride concentration as is the case near Chytial and south of Peddavur.

- Valley fill deposits which consist of fine-sand deposits are encountered in some areas. In the case that these deposits are recharged locally, like near Waipally, the [F] is low < 1.5 mg/l (see figure 4.10). Saturated thickness of the deposits is about 30 m and although of local extent they contain an important aquifer.

- Existing boreholes or dug wells with acceptable fluoride levels can be found within a distance of 2,500 m, in nearly all villages.

4.6 VARIATION OF FLUORIDE CONTENT - SUMMARY

- Occurrence of fluoride
  Fluoride released through weathering can be transported by the groundwater and subsequently be partly redeposited as carbonate deposits (or kankar) in discharge areas. In large fracture zones that serve as conduits for groundwater flow, fluoride concentrations are high. In local recharge areas not in connection with the regional fracture system, low fluoride concentrations are found.

- Fluoride variation over the study area
  An appraisal of the groundwater quality is made in the area using the results of the study. The possibilities of locating groundwater resources with acceptable fluoride levels ($\leq$ 1.5 mg/l) are examined for each village within a radius of 2.5 km. Use has been made of the topographic maps on which recharge and discharge areas have been delineated and groundwater flow direction has been examined. Fluoride content of existing wells has been taken into account as well as other important hydrogeological observations.

  The result of this analysis is presented in figure 4.11. For 89 villages it is certain that water with acceptable fluoride concentrations can be found. In 101 villages this is likely to be so. In 22 villages the chances of locating good groundwater is still possible but not very likely and in 13 villages there is no groundwater with acceptable fluoride content at all.

- Fluoride variation in time
  The distribution of F is highly variable even among waters of different wells in one village. The variation recorded between rainy season and summer ranges from 0 to 0.4 mg/l. The variations between winter and summer are low.

  No trend of increasing fluoride content was observed in earlier studies nor could it be seen from available data (Nalgonda water supply, PRED samples etc.). In some cases there has been an increase, while others showed a reverse trend. The fluoride of the Nalgonda infiltration wells in the Kangal river shows large fluctuations. Water from the wells consist of a mix of fluoride rich baseflow water and surface water that varies over the year with rainfall.

- Fluoride in surface water
  Theoretically it is possible that due to infiltration of surface water (near canals) with a low pH the fluoride concentration will increase due to the dissolution of CaF_2 in kankar if present. No indication for this has been found till sofar. The diluting effect of surface water with a low concentration most probably offsets the dissolution of CaF_2 effect.

  Wells have in general low F content in the immediate vicinity (less than 100 m) of surface water bodies. Not all surface waters are low in F. High [F] surface waters are found mainly in the west while in the north-east tanks from north-south flowing streams have low F content.

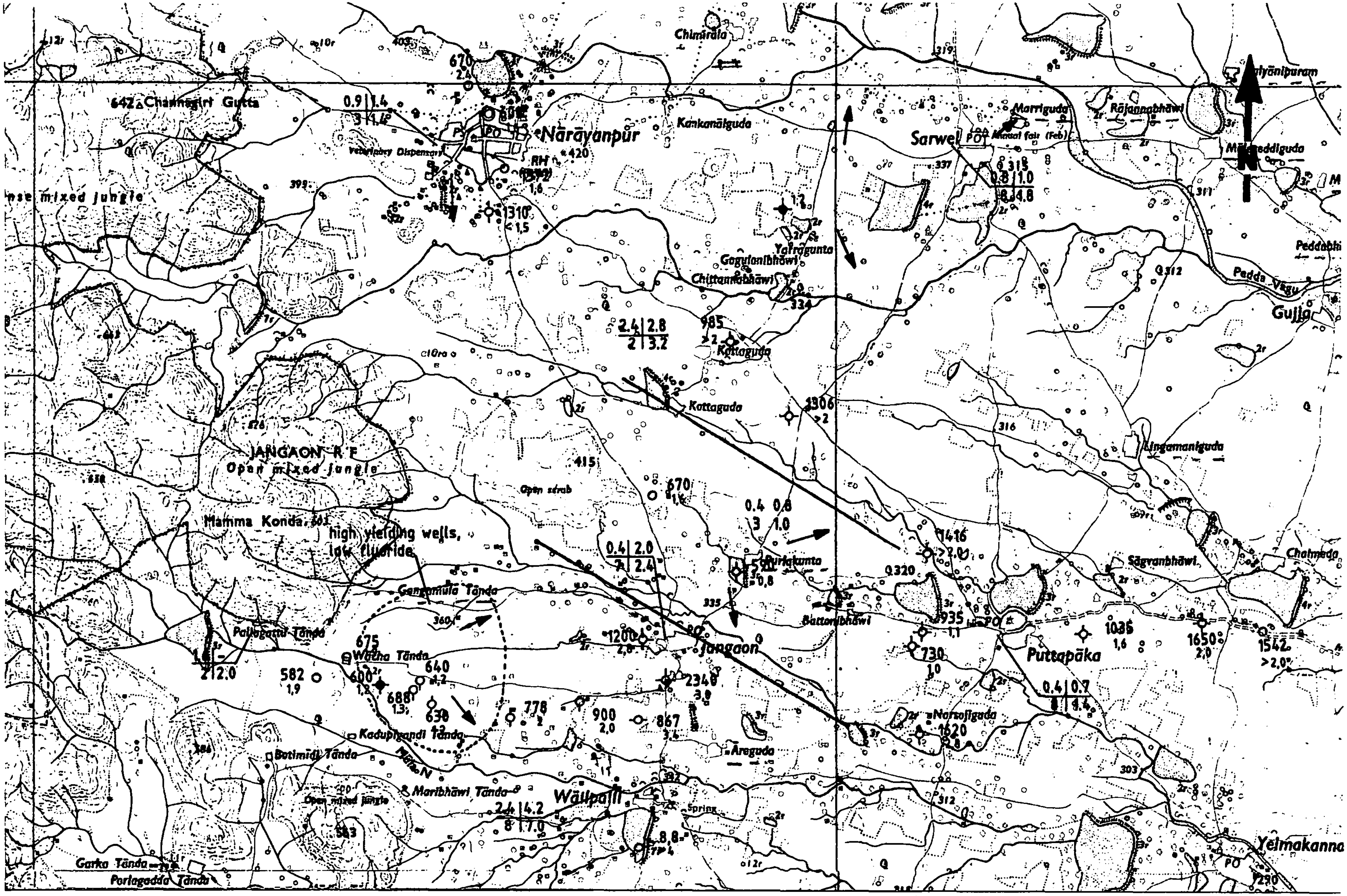
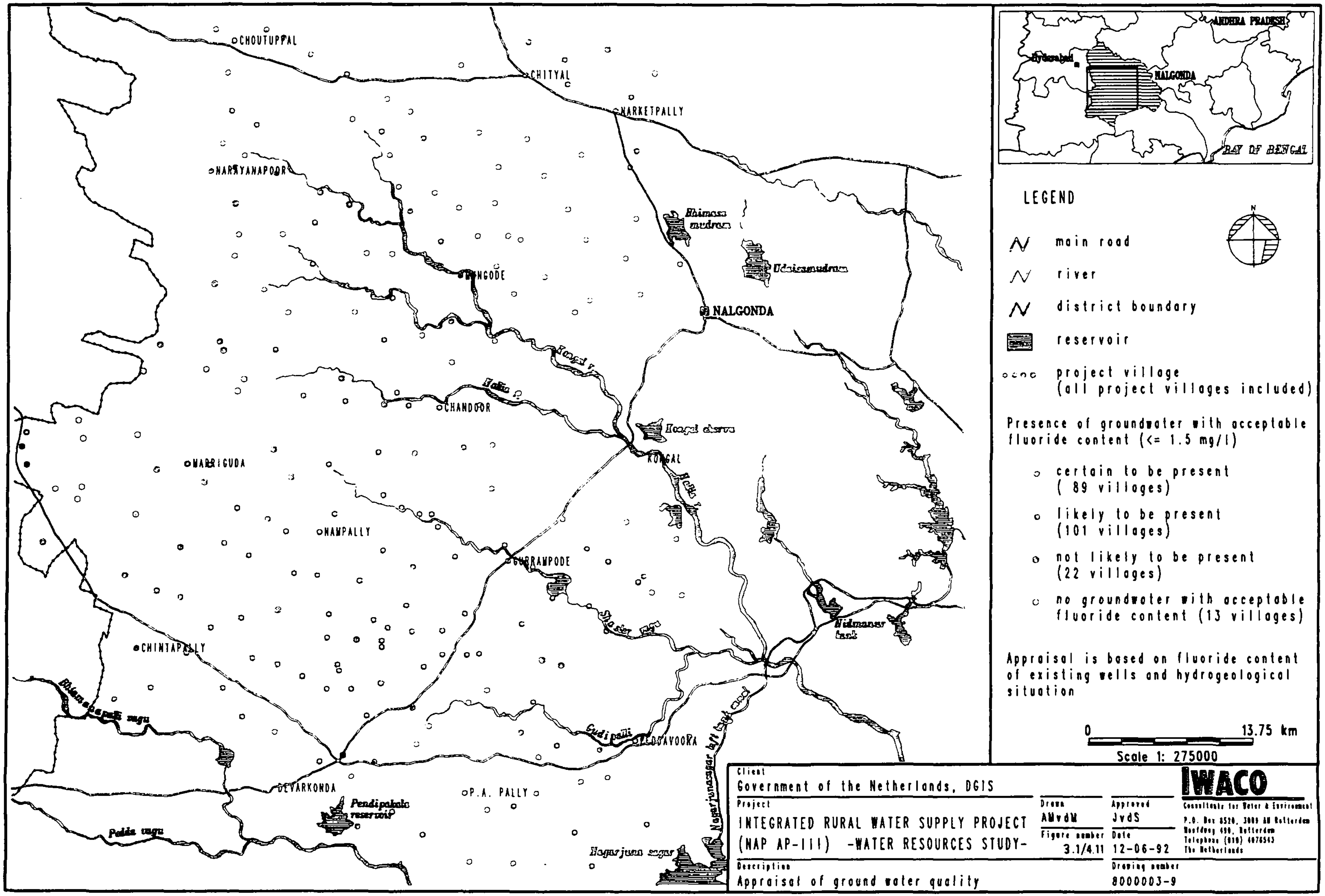


Figure 4.10 Fluoride distribution in ground water near Jangaon
(legend see figure 4.11) scale 1 : 50000



CHOUTUPPAL
CHITYAL
MARKETPALLY
NARAYANAPOOR
MUNGODE
NALGONDA
CHANDOOR
KONGAL
MARRIGUDA
NAMPALLY
GURRAMPODE
CHINTAPALLY
DEVARKONDA
P.A. PALLY
PEDDAVOORA
Pendipakala reservoir
Nagarjuna sagar
Nidmanoor tank
Kongal cheruvu
ANDHRA PRADESH
Hyderabad
NALGONDA
BAY OF BENGAL
LEGEND
main road
river
district boundary
reservoir
project village
(all project villages included)
Presence of groundwater with acceptable fluoride content (<= 1.5 mg/l)
certain to be present
(89 villages)
likely to be present
(101 villages)
not likely to be present
(22 villages)
no groundwater with acceptable fluoride content (13 villages)
Appraisal is based on fluoride content of existing wells and hydrogeological situation
0
13.75 km
Scale 1: 275000
Client
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JvdS
Date
12-06-92
IWACO
Consultants for Water & Environment
Description
Appraisal of ground water quality
Drawing number
8000003-9

5. SURFACE WATER RESOURCES

In order to examine sources of surface water in- and outside the project area, particulary to the north and to the east, surface water sources were investigated in a wide area using satellite images. This investigation did not reveal any potential water source for the project other than the Krishna river water, the only perennial river. Some projects are under consideration by the Government of Andhra Pradesh to transfer Krishna water through or near the study area. These will be discussed in the following after a brief description of the main surface water features in the area.

5.1 MAIN RIVERS AND CATCHMENT AREAS

The proposed project area falls in the Krishna River Basin and the main surface water resources are the Krishna river and its tributaries including the Musi river flowing to the North of the area and Dindi river flowing to the South of the area. The largest streams flowing in the area are the Kangal vagu, Hallia river and Peddavagu. These are intermittent streams and can not be considered for rural water supply.

- Krishna River
  The Krishna river is a large perennial stream with a vast catchment area. The Nagarjuna Sagar Project, one of the biggest multipurpose projects in India, is situated in Nalgonda district. It is about 140 km from Hyderabad.

- Musi River
  A medium irrigation project has been constructed on the Musi river with a dam across the river at Solipet (17°14':79°32') village (Suryapet Mandat) in Nalgonda district, about 65 km upstream of the confluence of Musi and Krishna rivers. It has a catchment area of 9,090 km^2 above the aforesaid dam.

- Dindi River
  A reservoir was constructed across Dindi river near Gundlapally village at the extreme border of Kalwakurthy taluk of Mehaboobnagar district adjoining Nalgonda district with a catchment area of 3,920 km2.

5.2 WATER BALANCE

5.2.1 Nagarjuna Sagar Left Bank Canal

The main surface water body close to the study area is the Nagarjuna Sagar Reservoir. The project is constructed with a gross storage capacity of 408.16 TMC and live storage capacity of 240 TMC for utilization of the allocated quantity of 264 TMC with equal distribution of 132 TMC from each of Right and Left Bank Canals. The Nagarjuna Sagar Left Bank Canal (Lat Bahadur Canal) passes close to the project area. The flow in the canal exceeds 132 TMC per year at present. It is understood that the canal water releases are required must be restricted to 132 TMC by the year 2000 as per the award of the Committee which has examined the interstate allocations of Krishna waters.

The total requirement of water for rural water supply to all 226 villages in the project area is estimated to be of the order of 1.1 TMC and the necessary permission to draw this amount of water from Nagarjuna Sagar Left Bank Canal has already been obtained. Accordingly the availability of the required quantity of water from Nagarjuna Sagar Left Bank Canal is not a limiting factor if it is ultimately decided to have a surface water alternative for water supply to the project.

The canal is closed for maintenance on the average 75 days per year as can be seen from table 5.1. Once in 10 to 15 days water will be released during this period. Two summer storage tanks in Nidamanur and Awal will be used to bridge the period of the canal closure. The tank at Awal needs to be renovated and improved.

Problems will arise if the tanks are not filled before the closure period as is the case this year (1992). The Nidamanur tank has not been filled and according to officials the town of Nalgonda will experience serious shortages this year. The problem is further aggravated by a conflict of water use with local farmers who refuse to stop irrigation water intake from the tank. During a field survey it was observed that the irrigation water intake sluice was demolished so it could not be closed.

Table 5.1 Nagarjuna Sagar Left bank Canal closure periods since 1981.

Nagarjuna Sagar Left Bank Canal		
Year	Canal opening	Canal close-up
1981 - 1982	23-06-1981	15-12-1981
1982 - 1983	01-07-1982	01-05-1983
1983 - 1984	15-07-1983	30-04-1984
1984 - 1985	26-06-1984	15-04-1985
1985 - 1986	15-06-1985	15-02-1986
1986 - 1987	04-06-1986	15-03-1987
1987 - 1988	16-06-1987	17-03-1988
1988 - 1989	16-06-1988	10-04-1989
1989 - 1990	01-07-1989	20-04-1990
1990 - 1991	01-07-1990	29-04-1991
1991 - 1992	15-07-1991	20-03-1992

5.2.2 Musi Project

The Musi river is an intermittent stream and the Musi Project mentioned earlier is the one of the surface water bodies that can be considered for water supply to the project particularly in view of the fact that the proposed Sri Sailam Left Bank Canal is expected to feed the Musi Project at its tail end. Under present conditions there is a water shortage and irrigation command areas have been decreased. The flows in the catchment of the river are intercepted by several tanks and the river flows are also directly utilized for irrigation. The Musi Project is also supplying drinking water to the Suryapet town.

The Musi Project was originally designed with a live storage of 130,31 10^6 m^3 to extend irrigation facilities to 16,916 ha of khariff (first crop, monsoon crop) from both canals covering 42 villages. Due to late receipt and uncertainty of inflows into the reservoir during the months of July and August, the tail end command area has been deleted and the ultimate command area has been decreased considerably.

Table 5.2: Cropping pattern in command area of the Musi project.

Canal	Khariff (ha)	Rabi (ha)		Total (ha)
		Wet	I.D.	
L.B. Canal	----	350	6,867	7,217
R.B. Canal	----	333	5,810	6,143
Total		683	12,677	13,360

5.2.3 Dindi Project

Dindi river is another intermittent stream in the vicinity of the study area, it is situated about 50 km from the study area. The Dindi project is originally contemplated for a command area of 10,000 ha irrigated dry crop benefitting 34 villages. After the inception of the project, the cropping pattern has been modified to only wet cultivation benefitting 19 villages. The canals and distributaries which had been originally excavated spread over a vast area have been abandoned. An extent of 3125 ha during Khariff (first crop period) and 625 ha during Rabi (second crop period) have been developed since 1953-1954. Surveys conducted in 1976 showed that the actual area developed has been 4,625 ha, out of which 108 ha are under tank command area. It appears that there is a proposal under consideration of the Government to raise the full reservoir level of the Dindi reservoir.

From an evaluation of the irrigated area and surplus yield from Dindi Reservoir it became clear that there is hardly any possibility for tapping water for the project under consideration, apart from the fact that the project is situated too far from the NAP AP III project area.

5.3 SURFACE WATER PROJECTS UNDER CONTEMPLATION

5.3.1 Sri Sailam Left Bank Canal

The Sri Sailam Left Bank Canal being constructed under this project runs for about 100 km within the project area. Although most of canal has already been dug, there is likely to be considerable delay according to the local authorities, as the work related to two tunnels for an aggregate length of 46,25 km is yet to commence and the required funding from the World Bank has yet to be arranged. The salient features of the project are furnished below.

The main components of the Sri Sailam Left Bank Canal Gravity Scheme are:

- The Head Regulator: situated in the foreshore of Sri Sailam reservoir at about 12 km upstream of Sri Sailam Dam.
- Tunnel-I: 9 m.diameter and 39 km in length starting downstream from the Head Regulator to cross the Amrabad plateau with a maximum cover of 523 m and debouching into the Dindi Balancing Reservoir.
- Dindi Balancing Reservoir (length of dam 2,33 km) across the Dindi Valley.
- Tunnel-II: 9 m.diameter and 7,25 km in length for crossing the hill range between the Dindi and Peddavagu valleys with a maximum depth of cover of 340 m.
- There are two link canals, one of 0,40 km in length from the exit of Tunnel-I towards the Dindi Balancing Reservoir and the other of 1,79 km in length from the foreshore of Dindi Balancing Reservoir to the entry of Tunnel-II.
- Open canal from the exit portal of Tunnel-II to Musi Reservoir for a length of 134,22 km.

The Pendlipakala tank is proposed as a balancing reservoir for the proposed Sri Sailam Left Bank Canal Project. At present the Pendlipakala tank is a large irrigation project within the proposed project area. The Pendlipakala tank will only be of interest for the AP-III project in connection to the Sri Sailam Left Bank Canal.

5.3.2 Water Supply Project to the Twin Cities of Hyderabad and Secunderabad

This project which is still under consideration will increase the water supply to the twin cities of Hyderabad and Secunderabad from Nagarjuna Sagar.

Raw water will be drawn from the offshore of Nagarjuna Sagar near the existing approach channel of the Left Bank Canal. The raw water will be pumped over 23 km to the treatment works near Akkampally at 114 km from Hyderabad. The water will be pumped in three stages to the city after purification. The pipe line will be located within the boundaries of the Hyderabad- Nagarjuna Sagar highway to avoid land acquisition. Clear water reservoirs and pumping stations are located at Chintapalli (352 mamsl), Mal (488 mamsl) and Gungal (626 mamsl) From a Master Balancing Reservoir at Gungal the water will be gravitated to the city over 42 km. Clear water production capacity of the scheme is 410,000 m^3/day. At present 22,500 m^3/day is reserved for enroute villages situated at 3-5 km from the pipeline traject.

The cost of the scheme is estimated at Rs 5150 million. For strengthening and improvements to the water distribution and sewage systems Rs 5160 million are required. The cost of production water and transmission to Hyderabad is expected to be 7 Rs per m^3. 65% of the cost is needed for power supply.

The identification phase of the project nears completion, some complementary studies are being done at the request of the World Bank, through which financement is being sought. The project proposal is send to the Government of India for approval agreement from the World Bank and clearance from the Central Government the project is likely to be obtained in 2 to 3 years time according to the Managing Director of the Hyderabad Metropolitan Water Works. Start of the project is anticipated in 1994-1995 and completion around the year 2000, although not everybody agrees with this optimistic time schedule. However, the water shortage in Hyderabad is severe and dry periods may accelerate the procedures. In 1996 the water shortage in the city will be about 395,000 m^3/day. Postponement of the scheme is not thought to be very likely under the given conditions.

Supply of 30,000 m^3/day treated water to the fluoride affected villages in the Nalgonda district by means of tapping from the clear water transmission line at Chintapalli, Mal or Gungal is well possible as far as water quantity is concerned. Large parts of the project area can be supplied by gravity.

5.4 WATER QUALITY ASPECTS

Only the Nagarjuna Sagar Left Bank Canal waters would be available at the present time in adequate quantity for use in the NAP AP-III Project if ultimately surface water is required to be tapped for all 226 villages or some of the villages. The canal waters are low in chemical constituents and suspended solids.

The water from the Nidamanur tank and several other irrigation tanks in the area have been sampled for micro-pollutants. Test results are presented in Appendix 7.The levels of pesticides in all samples were below detectable limits, as was the concentration of heavy metals.

5.5 SUMMARY AND CONCLUSIONS

Water from the Krishna river, stored behind the Nagarjuna Sagar dam is the only source of water that is available in adequate quantity and quality. There are no alternative surface water sources even far outside the project area.

The water from the Krishna river can be tapped in three ways:

- from de Nagarjuna Sagar Left Bank Canal. Intake sites are best at Awal and Nidamanur as summer storage tanks are present. These will be required to store water during the canal closure period of 75 days;

- from the future Sri Sailam Left Bank Canal that runs through the project area. The advantage is that a number of villages can be supplied under gravity and the pumping head and distance to the remaining villages can be reduced. The disadvantage is that it is still not certain if and when the project will be completed. Completion is not likely before the year 2005;

- from the future pipeline to Hyderabad. Water can be supplied under gravity to the project area from Mal. Agreement probably can be reached for 30,000 m^3/day. However, the project has not yet started and is not likely to be completed before the year 2000.

Table 6.1: Water supply system classification

Demand categories m³/day	
1	< 40
2	40 - 80
3	80 - 160
4	160 - 240
5	240 - 320
6	> 320

Water quality category in mg F/l	
1	≤ 1.5
2	> 1.5 and ≤ 2.0
3	> 2.0

Well options		Discharge category in m³/day			
		1	2	3	4
Category	Well type	40	40 - 80	80 - 160	> 160
1	Fractured rock	+	+	+	+
2	Valley fill/dike	-	+	+	+
3	Surface water infiltration	+	+	+	-
4	Recharge area well	+	+	-	-

Distance category in m from village centre	
1	< 500 m
2	> 500 and < 1,500 m
3	> 1,500 m and < 2,500 m

Stage of groundwater development	
1	Low development
2	Moderate development
3	High development

Hydrogeological units	
1	Moderate to good groundwater prospects
2	Moderate to poor prospects
3	Poor to no prospects

General appraisal of groundwater quality	
1	Certain to find groundwater with acceptable F content
2	Likely
3	Not likely
4	Not possible

6. GROUNDWATER SUPPLY SYSTEMS

6.1 INTRODUCTION

The groundwater resources are discussed in terms of quantity and quality in the foregoing chapters. It appeared that groundwater with acceptable fluoride levels can be located in most of the villages. At a regional scale there are sufficient groundwater resources for public water supply, but on a local scale problems of water quantity may occur. In this chapter a groundwater supply strategy will be defined in detail. A village wise approach is adopted to evaluate the regional feasibility of the groundwater strategy and the risks involved. For each village supply options are examined and evaluated.

In order to have a first estimate of the cost of groundwater supply systems an economical model has been developed. With design criteria and unit rates according to the PRED, the model computes design parameters and specific costs calculations for a given set of input data. It can be used for a groundwater system for an individual village or for a group of villages.

The adopted procedure consists of three steps:

- Village classification is made based on general characteristics (6.2)
- Village water supply systems are 'designed' and specified (6.3)
- The cost of each system is estimated (6.4)

Use is made of spreadsheet models to process the village and system data. A complete print is given in Appendix 8, presenting the basic data that can be printed via the Geographical Information System.

6.2 VILLAGE CLASSIFICATION

In the spreadsheet of Appendix 8 the different parameters to characterise each village are given in the first 12 columns. They will be briefly explained below.

- General identification: data base code number, name and location.

- Population and water demand.
  Population data of the 1991 census are used and a growth rate of 2% is assumed. The villages are classified according to 6 demand classes in m^3/day. The class intervals are shown in table 6.1.

- Water quality
  Based on the minimum fluoride content of PRED wells three categories are made (table 6.1). The water quality parameter should be interpreted together with the water quality data reliability parameter. This indicate the number of water samples that are available in one village. Category 1 is reliable (more than two samples), category 2 has only 1 sample, in category 3 no water samples are available. Figures 4.3 to 4.5 show the areal distribution of these categories.

- Elevation in meters above mean sea level obtained from a PRED topographical survey or from topographical maps.

- Existing systems
The capacity of the existing system will be taken into account in the financial estimates (section 6.4). The number and capacity of storage reservoirs of the given. The capacity of the storage reservoir is assumed to be the system capacity. In fact this is an under estimation of installed capacity as in the PRED design it is assumed that the reservoirs are filled 3 times a day. In most villages this is not the case as not only the sources are not sufficient but in general the storage capacity is overdimensioned.

  The number of handpumps in a village and the number of handpumps working are counted by the PRED. For each village the number of hand pumps with a fluoride content ≤ 1.5 mg/l is given. In phase I area at least 360 such bore wells are present in 134 villages.

- Stage of groundwater development
The stage of groundwater development is assessed using the groundwater irrigation maps made from Landsat images (1991) and the classification in grey, dark and white blocks as used by the SGWD. Areas with low groundwater development fall in category 1, areas with an intensive groundwater use fall in category 3.

- Hydrogeological unit
Three units are distinguished based on the hydrogeomorphological map 4 and the predominance of one of the following units near the village (in an approximate radius of 2.5 km)

  1 moderately weathered pediplains on schist and gneiss having moderate to good groundwater prospects.
  2 shallow weathered pediplain with moderate to poor groundwater prospects
  3 remaining units such as structural hills, inselbergs, pediments and areas of denudation hills,sheet rock etc.,having poor to no groundwater prospects.

- General appraisal of water quality.
This parameters indicates the likelihood of finding groundwater with acceptable fluoride content at less than 2500 m from the village (see figure 4.11). The four categories range from certain (1) likely (2), not likely (3) to not possible to find good groundwater in the area (4). Use has been made of the topographic maps (1:25,000 and 1:50,000 scale) on which recharge and discharge areas have been delineated and groundwater flow direction has been examined. Fluoride content of existing wells has been taken into account as well as other important hydrogeological observations. Use was made of the thematic maps and satellite images. For 89 villages it is certain that water with acceptable fluoride concentrations can be found. In 101 villages this is likely to be so. In 22 villages the chances of locating good groundwater is still possible but not very likely and in 13 villages there is no groundwater with acceptable fluoride content at all.

6.3 WATER SUPPLY OPTIONS CLASSIFICATION

6.3.1 Classification procedure

For each village an assessment is given of the local supply options. The following steps have been carried out:

- Evaluation of the hydrogeological situation.
  Thematic maps prepared earlier and results of field investigation give a first indication of the water resources around a village. The hydrogeological map and figure 4.11 showing the appraisal of water quality and the topo maps are especially used for this purpose.

- Examine the possibilities of exploitation of category 1 groundwater (< =1.5 mg/l F) around a village and select the type of well that is most appropriate. Four well types and hydrogeological standard situations have been defined in section 3.4:

  1 Fractured rock bore well
  2 Bore wells in valley fill or dike rock
  3 Surface water infiltration dug well
  4 Recharge area dug well (or dug cum bore)

  An option is considered appropriate if the fluoride content is within the acceptable limits (water quality category 1) and the location is within 500 m of the village center (distance category 1) (see table 6.1). If no such well location can be found the distance is increased to 1500 m or 2,500 m (distance categories 2 and 3). If still no favourable location for a well can be indicated water of quality category 2 (> 1.5 m/l and < 2,0 mg/l) is looked for, at 500 m distance or if necessary 1,500 m etc.

- Each type of well is assigned to the most likely discharge category depending on the hydrogeological situation. Given the village water demand the number of wells is calculated. A conservative approach is adopted as the individual discharges of wells are set very low (40 m^3/day for recharge area wells for example).

  Often for one village more options are possible; the two ' best' options are retained in order of priority. For example a bore well with a discharge of 80 m^3/day at a distance of 1,500 m, might be preferred over a dug well in a recharge area at 500 m from the village provided that the water quality is acceptable. In general, first option infiltration wells are avoided in favour of low yielding recharge wells and bore wells at some distance.

- Each village water supply system is expressed by a code. The system code (for example 2411) is a reflection of water demand category 2 (40 to 80 m^3/day), well type 4 (recharge area well) with a well discharge 1 (40 m^3/day) within distance category 1 (less than 500 m from the village centre) (see table 6.1).

6.3.2 Results

Table 6.2 gives a summary of the selected systems categories.

Using the results of the study an appraisal of the groundwater quality is made in the area. For each village the possibilities of locating groundwater resources with acceptable fluoride levels (< =1.5 mg/l) are examined within a radius of 2.5 km.

In 190 villages water with acceptable fluoride levels can be found within 2500 m from the village centre (figure 4.11). It can be assumed that is still within most village limits. In 35 villages this is not possible within the limit of 2,500 m, but it is likely that for 10 villages good quality groundwater can be located within a radius of 5,000 m from the village. For option 1 the distance source to village is less than 500 m in 142 cases and for 74 villages inbetween 500 m and 1,500 m.

Table 6.2: Number of system types in groundwater options.

Well type	Option 1 systems	Option 2 systems
1. Fractured rock borehole	103	47
2. Valley fill or dikerock borehole	8	5
3. Surface water infiltration well	9	24
4. Recharge area well	106	150

The number of wells per village required is shown in figure 6.1. In 146 villages a system can be installed based on 1 or 2 wells. In 12 villages more than 6 wells are required up to 8 wells in Choutuppal, Appadjipet, Chillapur, Cherrugata, Chinakaparty, Nampally, Peddavura, Kurmaid, Marriguda, and Chepur. The number of wells required is in between 550-620. This should be regarded as a maximum number as the well discharges adopted are conservative estimates. There will be villages where more problems will occur in finding a suitable source than expected, in others the revers might be true, on a regional scale the picture will not be modified substantially.

6.4 GROUNDWATER ECONOMICAL MODEL

6.4.1 General

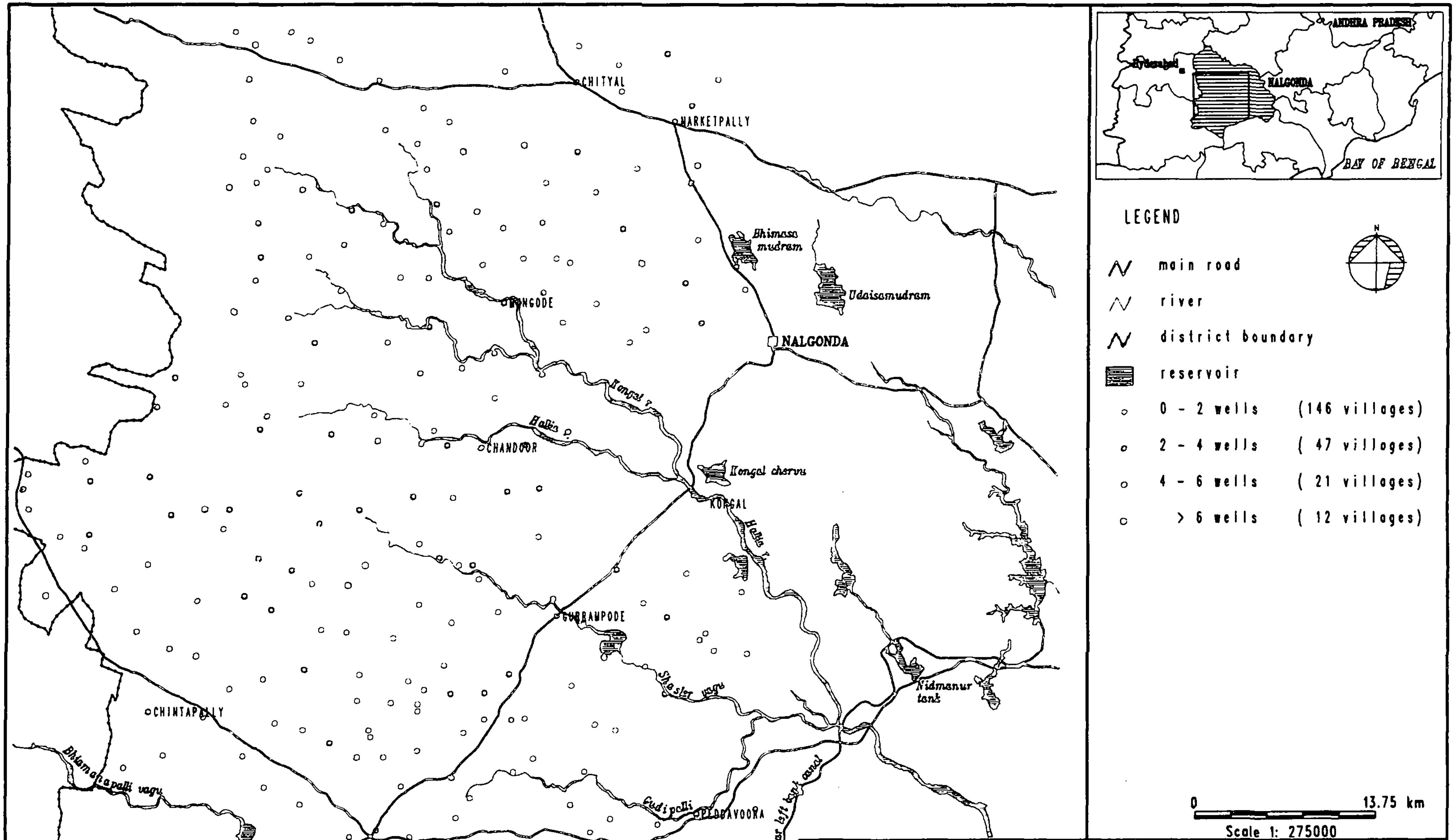
In order to have a first estimate of the cost of alternatives that are (partly) based on groundwater an economical model has been developed. With design criteria and unit rates according to the PRED and with similar assumptions as used in the estimates of the surface water system, the model computes design parameters and specific cost calculations for a given set of input data. It can be used for a groundwater system for an individual village or for a group of villages.

Every piped water supply system consists of three main units:

- Water production unit (source, treatment.)
- Water transmission unit (storage reservoirs and pipelines)
- Water distribution unit

The model determines the main design parameters of a groundwater system for a given (hydrogeological) situation and water demand, in terms of pipe diameters, pumping heads, power supply and chemical requirements It can be used to calculate the present costs of investments and operation and maintenance of water production, transmission and treatment units. The costs of a groundwater system is influenced by the following factors:

- the type of source (bore well, dug well)
- the required capacity
- the number of sources required
- the distance source - supply area
- the elevation difference source - supply area



Client
Government of the Netherlands, DGIS

Project
INTEGRATED RURAL WATER SUPPLY PROJECT (NAP AP-III) -WATER RESOURCES STUDY-

Drawn: AMvdM | Approved: JvdS
Figure number: 6.1 | Date: 12-06-92

IWACO
Consultants for Water & Environment
P.O. Box 8520, 3009 AB Rotterdam
Hoofdweg 490, Rotterdam
Telephone (010) 4978543
The Netherlands

Description
Number of wells per village in groundwater option 1

Drawing number
8000003-11

- water treatment requirements (chlorination and or defluoridation)
- distribution system and storage reservoirs
- presence of an existing system
- others such as land acquisition, power connection etc.

Both investment and operation and maintenance costs depend strongly on a combination of these factors. Present values are calculated for an economic horizon of 30 years based on the following cost parameters:

- Investments: Initial and re-investments
- Operation and maintenance
- Discount rate.

In the following section the main assumption underlying the model and its limitations are discussed briefly. Its application in the project is illustrated. For more details reference is made to Appendix 9. The unit prices and design criteria are discussed with the PRED and are based on model calculations and standard system layout made by the department.

6.4.2 Description of the model

The ***initial investments*** *are subdivided in the following categories:*

- pipe materials (only asbestos cement pipes are in use);
- power cables;
- wells (deep well - shallow well);
- water treatment (chlorination and defluorination);
- buildings (utility building, power house);
- power supply (electricity connection);
- land acquisition;
- storage reservoirs (OHSR; GLSR):
- distribution system.

The unit rates are shown in the tables of Appendix 9. The total investment is subject to 10% contingencies, 12.5% establishment charges and 15% tender premium conform the estimates of the AP-III surface water scheme.

The **operation and maintenance costs** in the present model are defined as those costs which are directly related to the production unit, transport mains and to the distribution system. These costs consist of:

- energy costs;
- maintenance costs;
- manpower costs;
- chemicals costs.

Although the Kwh price changes over the day, for the subject calculations an average of Rs 1.61/Kwh is assumed (price level April 1991). If necessary, the price can be adapted to a new situation. Maintenance costs are estimated as a percentage of the investment costs and have been assumed for pipelines 0.5%, structures 1% and E/M works 3.0%. The manpower requirements are: 2 operators in case of any system without defluoridation and 4 if a defluoridation plant is present. The chemical requirements depend on the type of source and thus on the type of treatment. According to the PRED for a 100 m^3/day capacity system 9.6 kg bleaching powder is used. In the model 7.5 adopted although this remains still at the high side. In case of defluoridation aluminium sulphate at 375 mg/l and lime 20 mg/l are applied.

In the following **the design assumptions** for the different components in the model are described. Design assumptions are based on standard designs of the PRED groundwater systems and based on a model-design as prepared by PRED staff. The average day system requirements represent the average daily demand.

- Distribution system
  The costs of a distribution system are estimated at Rs 175,000 per l/s of production capacity. Not included are the costs of house connections. If a distribution system is present, the user can decide not to incorporate the costs in the model.

- Wells
  Two types of wells can be chosen that fit the four hydrogeological standard situations that prevail in the area. Type and well discharge depend on the hydrogeological situation as does the distance between well and the village. This is expressed in the system code discussed in section 6.4. A standard deep well design has been assumed with a depth of 60 m. The number of deep wells to be drilled and the average distance between the wells is determined by the yield per well. In general the 500 m is taken between two sources. A standard shallow well has a depth of 20 m. The hydrogeological conditions, type of well discharge, distance from village water wells and elevation has to be given by the user of the model. These parameters are determined for each village.

- Water treatment
  Water treatment include chlorination and if necessary defluoridation. Standard designs for defluoridation plants, as installed in the area by the National Drinking water mission are adopted.

- Storage reservoirs
  The volume of reservoirs, overhead or ground level is designed at 40% of the daily water production. In most cases it is assumed that the location of the reservoir is near the wells. From the wells the water is pumped into the reservoir. The water flows under gravity to the supply area. If not certain whether a ground level storage reservoir is feasible, an overhead storage reservoir has been assumed. In case a OHSR or GLSR is present no additional reservoirs were assumed to be required.

- Buildings
  They include staff quarters, utility buildings for storages, operation room, workshop and have a surface of 65 m^2. A power house of 12 m^2 is needed for accommodation of electrical equipment near the wells.

- Land acquisition
  For each well at least 100 m^2 land need to be purchased. Additional land to be acquired for protection of well intake areas can be introduced in the model. Standard 500 m^2 is introduced at 30 Rs/m^2. In most cases 1000 m^2 per well is added or 30,000 Rs.

- Power connection
  It is assumed that for each well on the average 500 m cable needs to be installed for power connected. Also this value can be adopted to the local situation. Power supply is assumed to be at least 12 hours a day, however for dug wells with a well storage capacity that equals the daily discharge, say the 40 m^3/day can be pumped in 4 hours with a suitable pump or

over 12 hours continuously. For boreholes there is no such large storage capacity, but yields are generally higher.

- Water transmission system
  A large part of the investment- and energy costs (in pumped systems) depends on the selected pipe diameter of the water transmission system. Methods of calculation are presented in Appendix 9.

6.4.3 Use of the model

The model asks for certain input variables to be given by the user (see input sheet in figure 6.2). Thereafter the computer automatically computes the design parameters and cost calculations up to the present values. Input and output of some typical situations is presented in the Appendix. The output consists of the following:

- summary of system characteristics;
- initial investments;
- reinvestment;
- operation and maintenance costs;
- present values.

Figure 6.3 shows the present values of a system based on boreholes of 80 m^3/day each, with and without defluoridation plant. Figure 6.4. shows the same for a system based on dug wells of 40 m^3/day. Figure 6.5 shows the influence of severable variables on the total costs of the system. Finally the costs of a system with a defluoridation plant and a source (consisting of borehole of 80 m^3/day) located at less than 500 m from the village is compared with a system without plant and a source (2 dug wells of 40 ^{3}/day each) at increasing distance from the village (figure 6.6). It shows that the break even point is around 10 km; if within 10 km from a fluoride affected village a good groundwater source can be found, a defluoridation plant can better be avoided. At increased production capacity this distance only increases.

The model is run for all the system combinations (codes 2412,4132, ..etc.) up to a demand category 5. For the villages with a water demand of more 320 m^3/day, the costs are estimated for each individual village and real demand.

The cost per liter per second obtained by the model has been used to estimate the production cost for the real demand in the year 2007, thus adjusting for the demand category. The same liter per second costs are used to arrive at the 2022 figures.

In case an existing system is present with storage reservoirs and distribution system, both are assumed to be integrated into the new system and the model input has been entered accordingly. If the choice between ground level storage reservoir and overhead storage reservoir was not evident the overhead storage level reservoir has been assumed.

6.4.4 Results

The spread sheet in Appendix 8 shows the investment costs (total costs), the present value of reinvestment cost,the present values of operation and maintenance costs and the total present values for the two options of each village. Table 6.3 summarises the overall estimates.

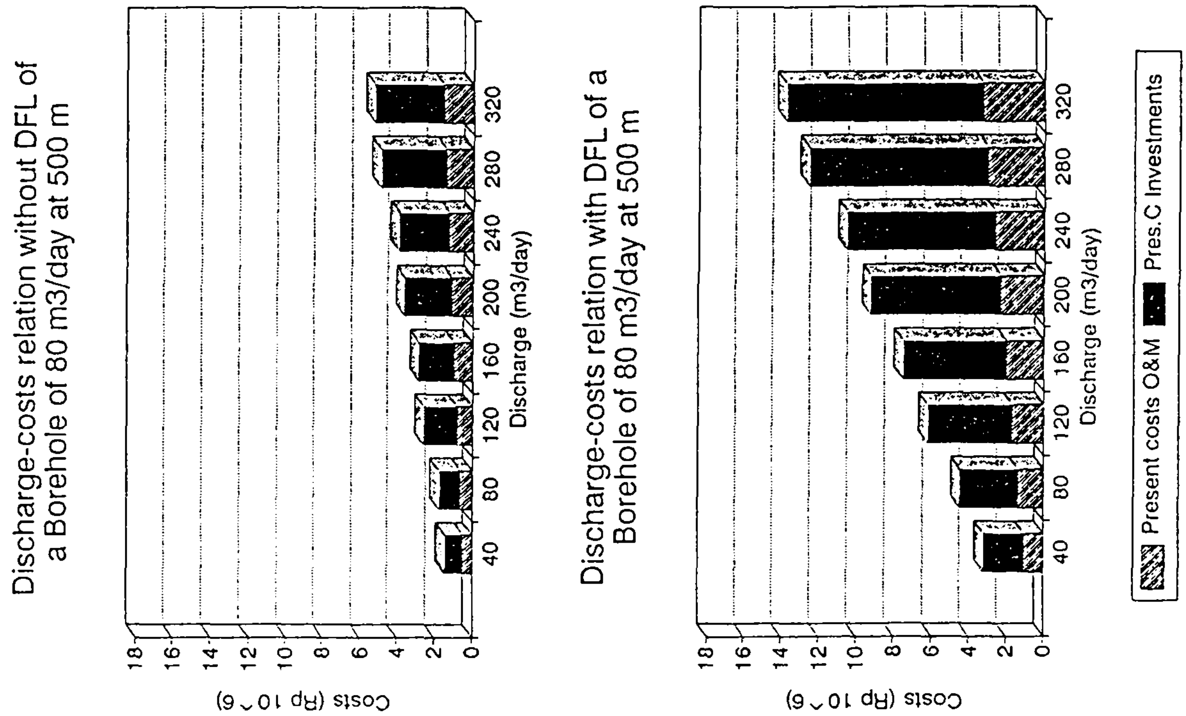
Table 6.3: Summary of cost of groundwater options in 2007 and 2022 (in Rs mln)

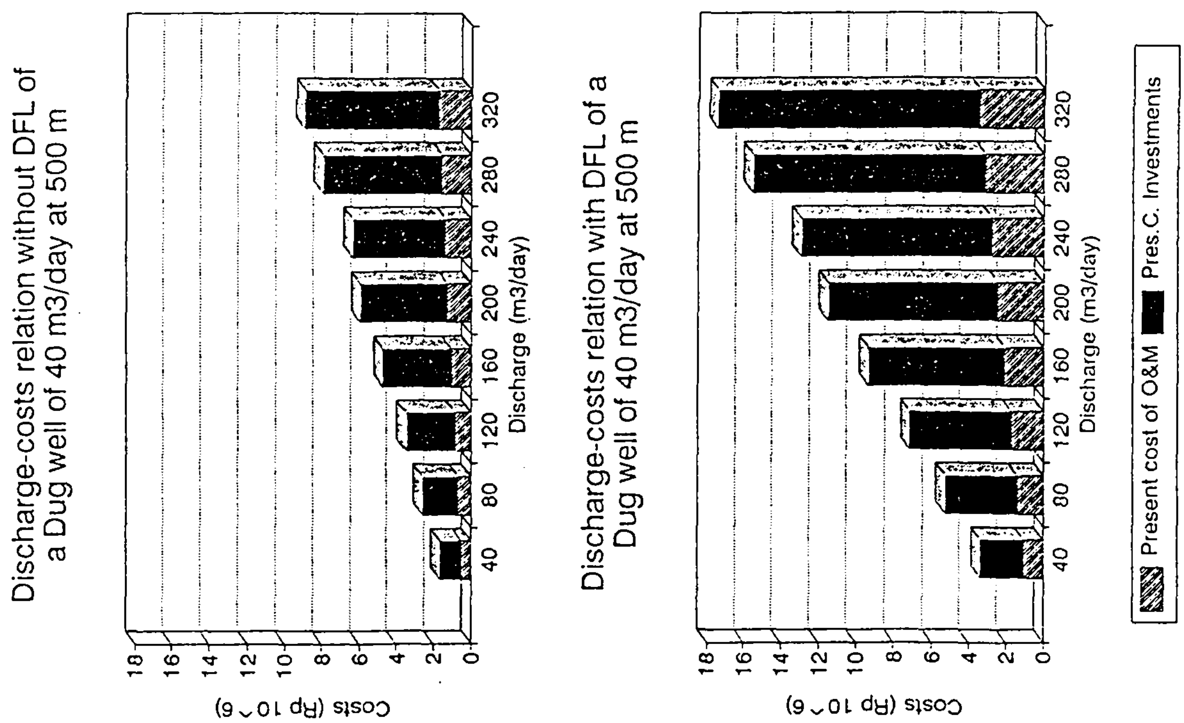
Year	Option	Capacity l/s	Initial Investments Rs/mln	Annual Operation and maintenance Rs/mln	Total present value	Total present value Rs l/s
2007	1	396	684	30.1	875	2.74
	2	396	661	29.3	828	2.64
2022	1	528	-	-	1161	2.74
	2	528	-	-	1101	2.64

WATER RESOURCES STUDY AP III

- VILLAGE : NALGONDA
- CODE : 1605000
- DATE : 16-6-1992
- AVERAGE DAY SYSTEM REQUIREMENTS : 1.87 l/s
- TYPE OF SYSTEM : 1 RURAL (1)
- CLEAR WATER DISTRIBUTION : Y (Yes/No)
- TYPE OF SOURCE : 5 DEEP WELL (5)
SHALLOW WELL (6)
- NUMBER OF SOURCES : 2
- AVERAGE DISTANCE BETWEEN SOURCES : 500 m
- RAW WATER TRANSMISSION (SOURCE -> TREATMENT) : 8 PUMPED (8)
GRAVITY (9)
- TREATMENT : 10 CHLORINATION (10)
CHL./DEFLUORIDATION(11)
- CLEAR WATER STORAGE : 12 ELEVATED - OHRS - (12)
GROUND LEVEL - GLRS - (13)
- WATERLEVEL SOURCE : 0 m +REF
- INFLOWLEVEL TREATMENT : 35 m +REF
- DISTANCE SOURCE -> TREATMENT : 100 m
- CLEAR WATER TRANSMISSION (TREATMENT -> SUPPLY AREA) : 15 PUMPED (14)
GRAVITY (15)
- OUTFLOWLEVEL TREATMENT : 30 m +REF
- ELEVATION SUPPLY AREA : 20 m +REF
- DISTANCE TREATMENT-> SUPPLY AREA : 1000 m
- LENGTH REQUIRED POWER LINE : 1000 m
- ADDITIONAL LAND AQUISITION : 2000 m^2 (30 Rs/m^2)

Figure 6.2: Input sheet groundwater economic model





Figures 6.3 and 6.4:

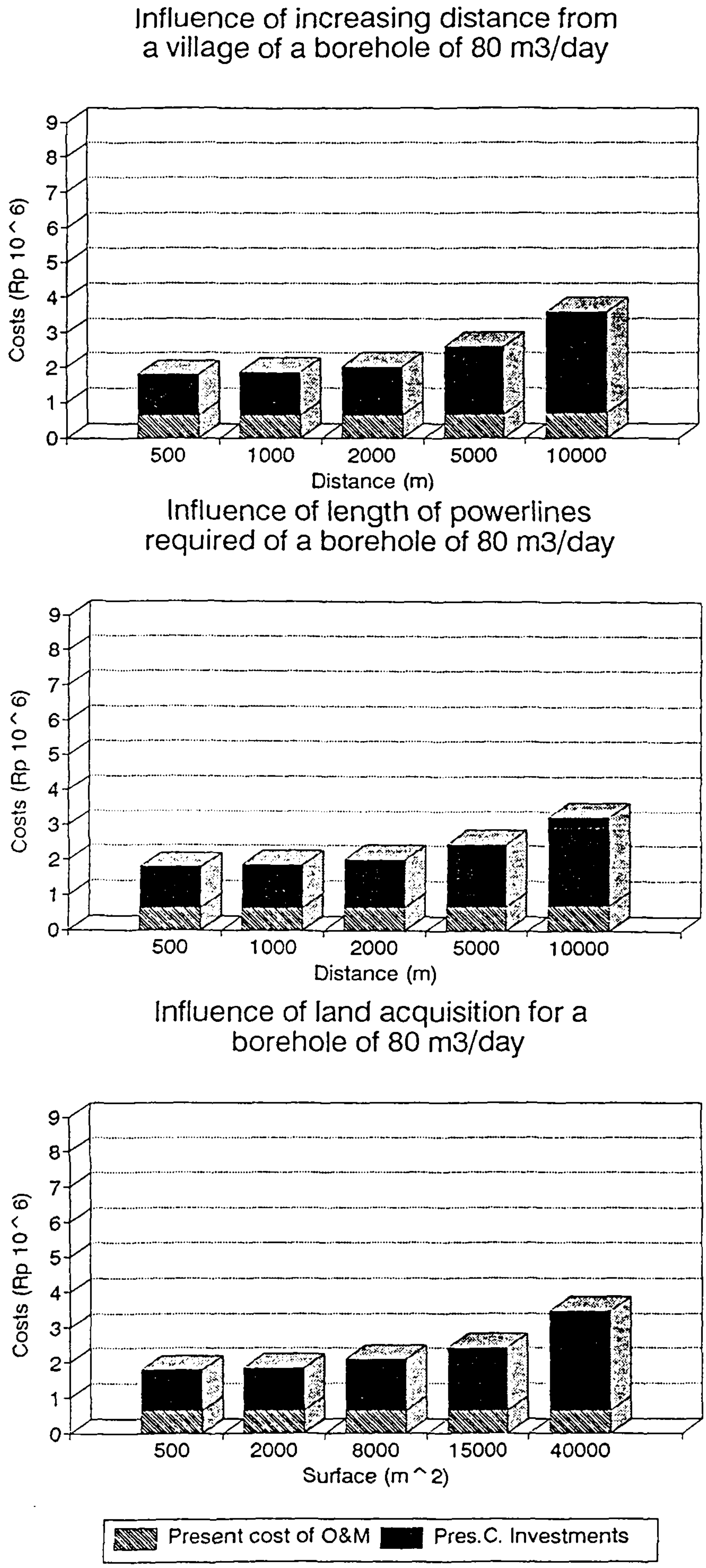

Influence of increasing distance from a village of a borehole of 80 m3/day
Costs (Rp 10^6)
0
1
2
3
4
5
6
7
8
9
500
1000
2000
5000
10000
Distance (m)
Influence of length of powerlines required of a borehole of 80 m3/day
Costs (Rp 10^6)
0
1
2
3
4
5
6
7
8
9
500
1000
2000
5000
10000
Distance (m)
Influence of land acquisition for a borehole of 80 m3/day
Costs (Rp 10^6)
0
1
2
3
4
5
6
7
8
9
500
2000
8000
15000
40000
Surface (m^2)
Present cost of O&M
Pres.C. Investments

Figure 6.5:

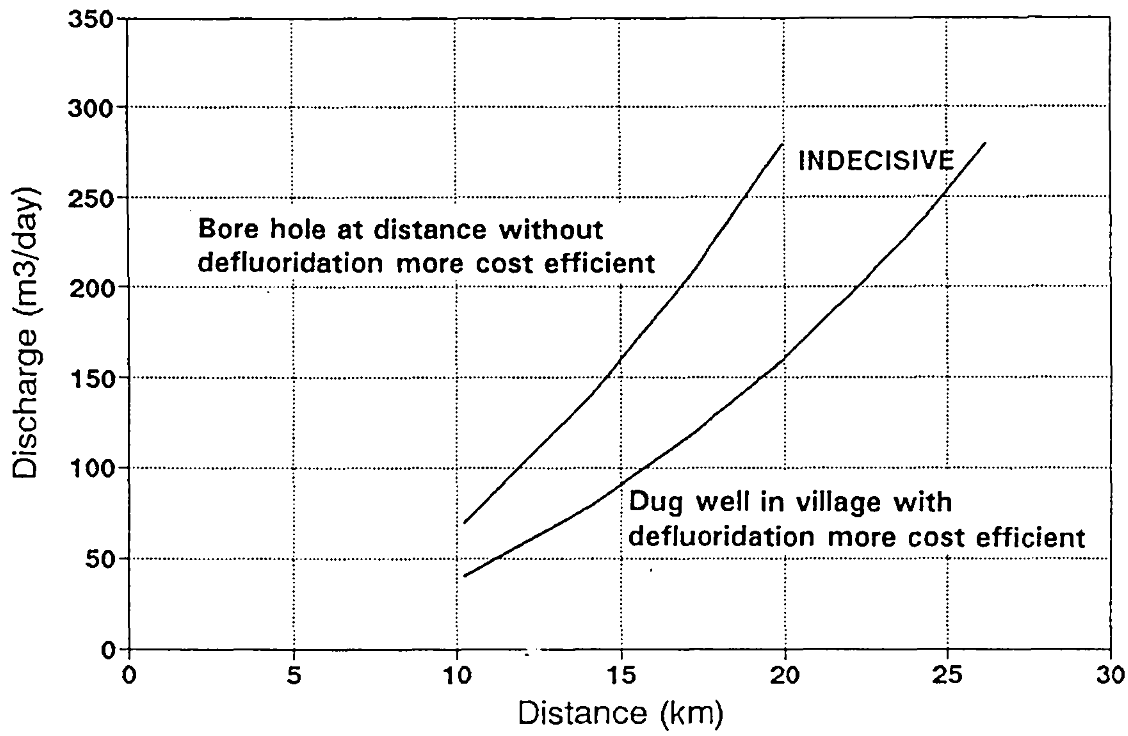


Figure 6.6: Break points between borehole of 80 m^3/h without defluoridation at variable distances from the village

The cost of the 35 villages where a defluoridation plant is assumed is Rs. 342 million. The annual operation and maintenance cost are in the order of Rs. 8 million.

The overall costs of the groundwater systems is high compared to the systems constructed by the PRED uptill now. The reason for this should be sought in the following items:

- well discharge is estimated conservatively and safe distance between well location and village are assumed;
- construction costs of dug wells are relatively high, it include lining of the wells from top to bottom which might not be necessary in all cases;
- chlorination is provided for each system. This is not strictly necessary for groundwater of the quality encountered in the study area. Nowhere PRED systems in the area are equipped with chlorination equipment. The provision of chlorination is heavily felt in the operation and maintenance costs. According to the PRED 9.6 kg bleaching powder is required for a 100 m^3 water production. The chemical costs amounts to 20% of the annual O&M costs (see also Appendix 9);

- manpower costs makes up some 40% of the O&M costs of a 100 m^3/day groundwater system (without defluoridation). It is questionable however if 2 technicians are required for the operation of a simple system, and if they need to be paid by the PRED;
- extra costs that have been included are land acquisition, 1,500 Rs for each system and 30,000 m^2 for each well, powerlines (500 m for each well, and pipelines for transmission);
- for most of the villages it was assumed that an overhead storage reservoir is required while in some cases a ground level storage reservoir might be sufficient.

7. WATER SUPPLY ALTERNATIVES

7.1 INTRODUCTION

In this chapter the water supply alternatives will be presented. They are a compilation of the local village supply options as far as groundwater is concerned. The surface water alternatives are defined using the AP-III project proposal of phase I and phase II.

First the goals of the water supply system and regional strategies will be discussed. This includes a priority ranking of the water need of the villages in the project. Alternative supply options are generated and presented. The cost of each alternative is estimated and a financial analysis is carried out to compare the cost for each of them.

7.2 GOALS AND STRATEGIES

7.2.1 Goals

The goals of the water supply system can be defined in terms of the water demand, quality and design horizon. For the analysis the following possible goals can be considered:

Demand
The population figures of the 1991 census are applied with a growth rate of 2% per year to estimate the water demand at the design horizon. Per capita supply is 55 ltr/day including provision for 25% house connections, cattle troughs and sanitation facilities.

Quality
The following water quality goals can be defined:

- Preferably, the fluoride level of all 55 lpcd should be below the 1.5 mg/l limit.
- The fluoride level must be below 1.5 mg/l for at least 10 lpcd for drinking water purposes.
- Locally higher values may be accepted but only in combination with other measures such as domestic defluoridation.

Design period
A design period of 30 years was adopted in the surface water option. This is for most of the components longer than is optimal under normal circumstances (Appraisal Report). Given the changes in the water situation that are likely to occur in the project area somewhere around 2005-2010 (Sri Sailam canal, Hyderabad water works) it is recommended to include an analysis based on a shorter design period of 15 years eg. 2007. Both design periods will be considered in the analysis.

7.2.2 Regional water supply strategies

Four regional strategies are discerned:

- Surface water system covering all the villages (I)
- Groundwater systems with defluoridation plants in some areas (II)
- Combined surface water groundwater systems (III)
- One system using a mixture of both groundwater and surface water as a source (IV).

Within each strategy various alternatives can be defined. These will be elaborated upon in the next section. If not mentioned otherwise the system capacity is that of 2022.

7.2.3 Prioritization of water need

In generating regional alternatives it will be necessary to have an indication of priority or urgency of village water needs. The general norms for identifying problem villages specify three problem categories; scarcity villages where there is no drinking water available within 1.6 km, villages in areas endemic to water born diseases and villages with chemically contaminated sources.

In the socio-economic survey carried out during the preparation of the project scarcity problem villages have been defined. These have been used together with the following indicators for the prioritization of water need:

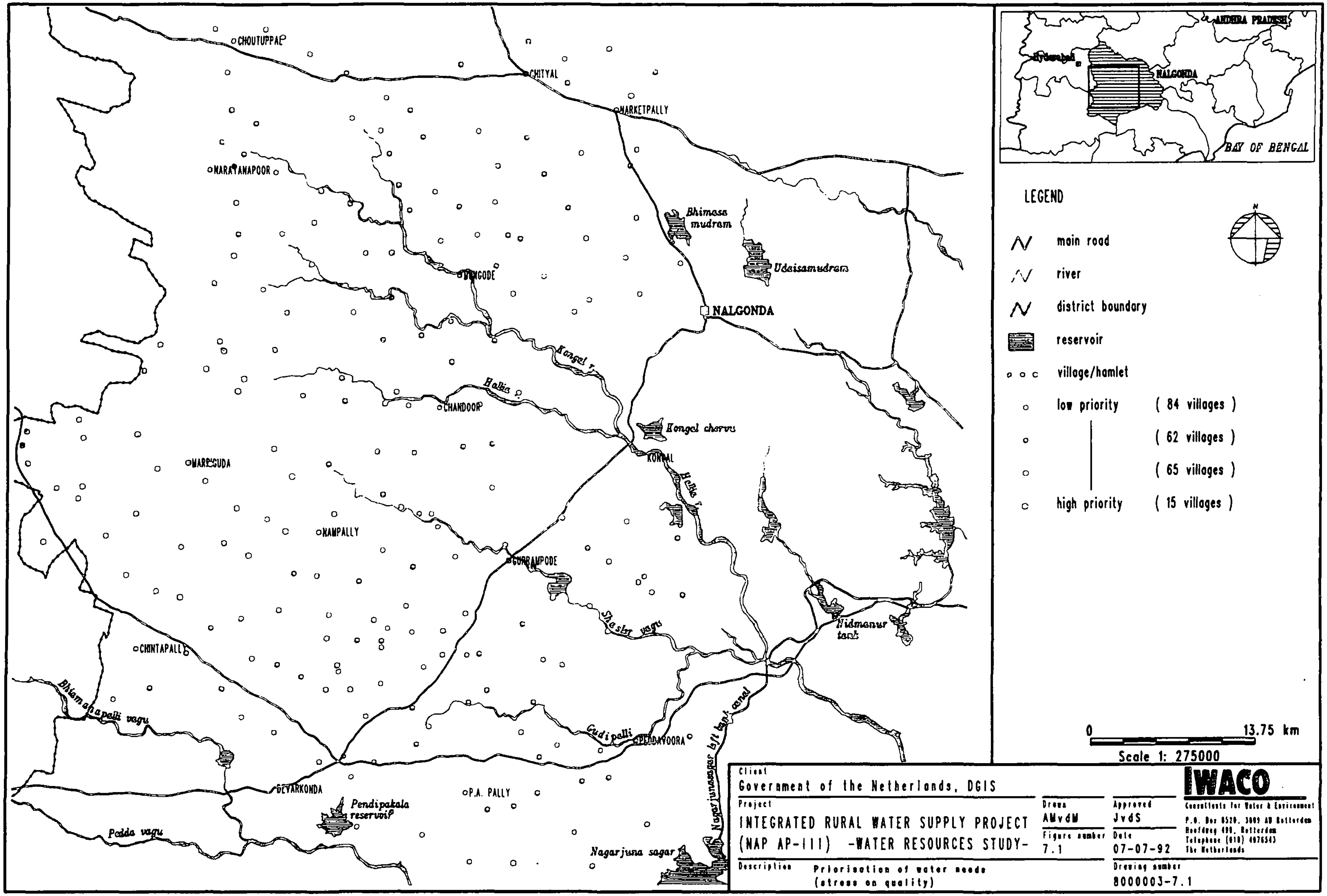
- Water quality
  The number of sources with acceptable fluoride is used as a measure of availability of good quality drinking water.
- Water quantity (scarcity)
  Three categories are considered: water sources at more than 1.6 km (great scarcity), water sources inbetween 1 to 1.5 km (scarcity) other, no scarcity.
- Evaluation of existing systems (PWSS, MWSS) in terms of quality and quantity.
- Water demand
  The 6 water demand categories as specified in section 6.2 are used as a weighing factor to stress the importance of the village size.

The different criteria have been normalised and weighing factors were determined by pairwise comparison. The result is shown in figure 7.1 and listed per village in Appendix 8. In figure 7.1 the results of the priority ranking are shown in which the water quality aspect received more weight. From low to high priority 4 classes are distinguished of 84, 62, 65 and 15 villages respectively (the last class having the highest priority).

7.3 SURFACE WATER ALTERNATIVES (I)

7.3.1 The original AP-III proposal (I-1)

The original AP III surface water system is worked out in some detail in the project proposal. The project will be executed in two phases, phase I covering the northern part of the area (zone D in figure 7.2), phase two the southern part (zone A+B+C). The main characteristics of the project are:



Client
Government of the Netherlands, DGIS

Project
INTEGRATED RURAL WATER SUPPLY PROJECT
(NAP AP-III) -WATER RESOURCES STUDY-

Drawn: AMvdM
Approved: JvdS
Figure number: 7.1
Date: 07-07-92

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Description: Priorisation of water needs (stress on quality)

Drawing number: 8000003-7.1

- Source
  As source, the Nagarjuna Sagar Left Bank canal selected with intakes at Nidanamur (phase I) and Awal (phase II) summer storage tanks at 33 km and 20 km from the project area respectively. The canal supplies abundant water of good quality, fluoride content is 0.6 mg/l, no pesticides or micro pollutants have been detected in the canal nor in the storage tanks. Treatment includes rapid sand filtration and desinfection through chlorination.

- System lay out
  The first phase with a design capacity of 259 l/s (22,400 m^3/day) covers 82 villages and 99 hamlets. The second phase has a capacity of 299 l/s (25,800 m^3/day) and covers 144 villages and 238 hamlets. Pumping in four stages is required for parts of the supply area. The maximum level difference to overcome is 230 m and the maximum distance from the source to the most distant village is 90 km.

- Financial aspects
  The investment costs are 293 million Rs for phase I and 374 million Rs for phase II. Total annual costs for operation and maintenance for both phases are estimated at Rs 56 million (Appraisal Report).

- Environmental aspects
  The environmental impact is minimal: quantities of water abstracted are small compared to the canal flow. This holds also for the sludge that will be brought back into the canal. There will be a slight positive effect on the groundwater balance in the area.

- Health and social aspects
  Although small, there is a risk that the source might get polluted or that the treatment is not properly working, resulting in an infection of the whole area. High priority villages (see section 7.3) will unfortunately only be served in phase II of the project. There are about 50 enroute villages that have to be incorporated in the scheme, though low in priority.

- Problems and risk
  At least four pumps need to work in series more or less at the same time. Losses in the scheme might be considerable. The system might be hard to adjust to difference in growth and water demand over the area that can be expected over a 30 period. The reliability of the source can decrease in summer time when water has to be taken from the storage tanks which are also used for irrigation. Conflict of interest between the farmers and the Nalgonda town water supply system has already led to illegal tapping of the tankwater.

7.3.2 Modified AP-III proposal (I-2)

Following the recommendations of the Appraisal Mission the original layout of the scheme was modified in such a way that 32 high priority villages, worst affected by fluorosis in the south western part of the area are included in phase I (this area is depicted as zone A and B in figure 7.2. This will increase the production capacity of phase I to 347 l/s. Phase II decreases to 180 l/s (zone C). All other aspects of the system remain similar to the original design.

A preliminary cost estimate has been made of the modified option using the PRED design of the original project and applying the unit prices for different system components. If necessary system components have been adjusted to allow for the new dimensions like pipe diameters, reservoirs, pumps and distribution systems. Furthermore it was assumed that the total cost of the system remains the same. This preliminary cost estimate of phase I amounts to Rs

409 million and Rs 231 million for phase II. Operation and maintenance cost are divided proportionally.

7.3.3 Phase I and II from Nidanamur tank (I-3)

Another variant on the original design of the PRED is the use of the Nidanamur tank as unique source for the whole of the project area. According to the department the capacity of the tank will be sufficient after some improvements. It is assumed that this alternative does not differ significantly from the first option in total investment cost and other aspects.

7.4 GROUNDWATER ALTERNATIVES (II)

7.4.1 Protected water supply schemes for single villages (II-1)

This all groundwater supply alternative consists of the total of the first village options as were determined in chapter 6. In areas without groundwater of acceptable quality within 2500 m radius of the village, defluoridation plants are proposed. The systems are specified for each village in Appendix 8. The main characteristics:

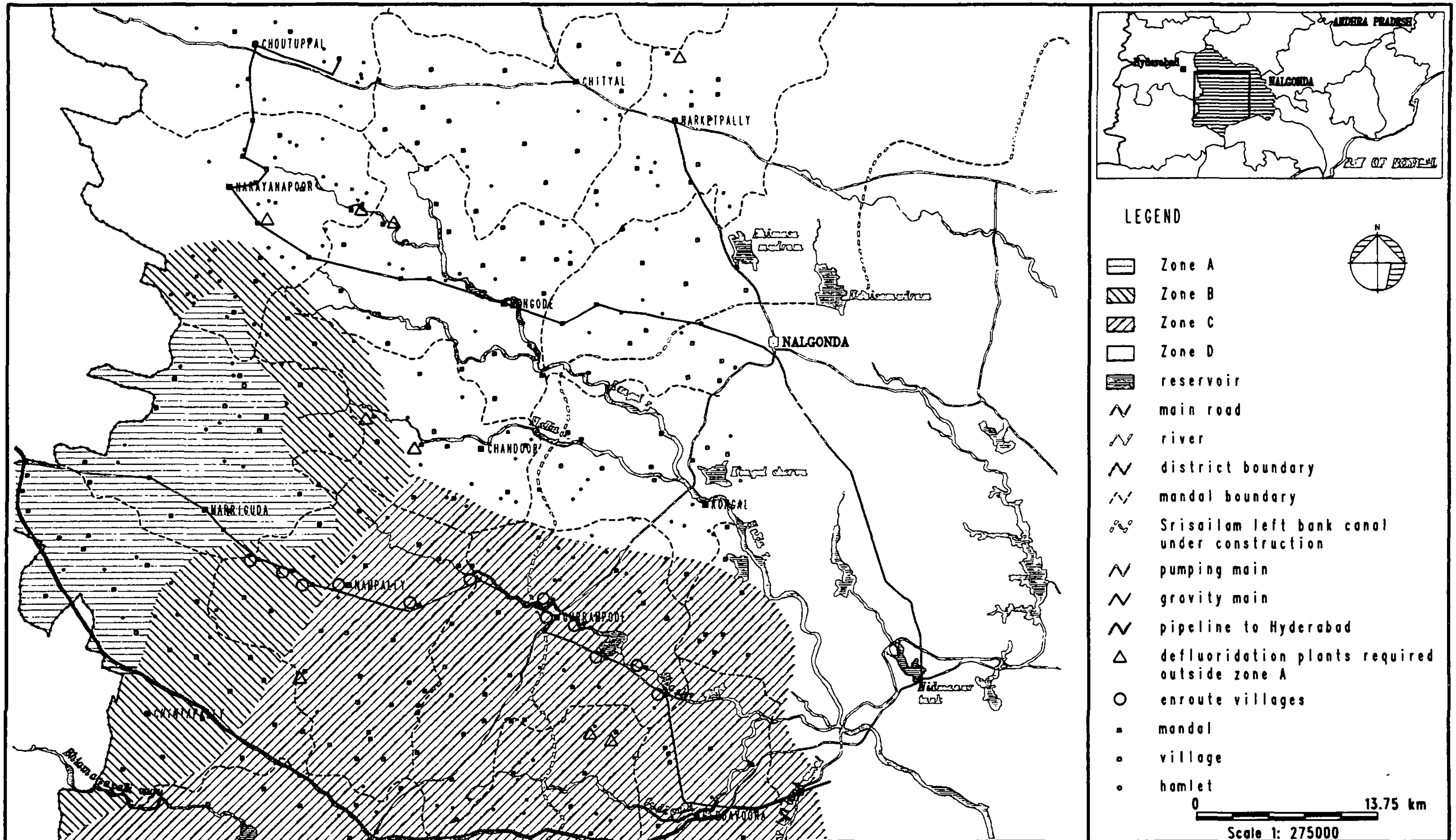
- Source
  Groundwater by a total of 550 to 620 wells. In all villages the source can be located within a 2500 m radius and in 147 villages at less than 1500 m. The maximum Fluoride content of all the schemes ranges from 0.7 to 1.4 mg/l. If sources are well placed and not located inside villages, water quality will remain safe. Although it is no current practise, safety chlorination is provided.

  In some cases wells need to be protected by creating a water sanctuary. The dimensions of this zone around the well depend on the local situation and vary from 50 to 200 m. In most cases, protective measures can probably be avoided by means of proper well construction and site selection.

- System layout
  No group schemes are considered and in at least 147 villages 1 or 2 boreholes are sufficient. In case of 12 villages more than 6 wells are needed. Water is pumped from the source directly in the storage reservoir and will be transported by gravity to the supply area over an average distance per village of some 1,100 m.

  Power will be supplied by the Rural Electrification Corporation of India Ltd (REC). If the minimum period of 13 hours of 3 phase supply per day is not adequate single phase submersible pumps may be deployed. For most dug wells schemes the well storage is sufficient to attain the daily yield within 6 hours.

- Defluoridation plants
  35 defluoridation plants will be needed varying in capacity from 40 m^3/day to 320 m^3/day to supply the full 55 lpcd. The total defluoridation capacity in 2007 is 4,000 m^3/day, in 2022 5,400 m^3/day. The Nalgonda technique using the fill and draw type will be applied as in the standard plants installed by the Technology Mission.



Client: Government of the Netherlands, DGIS

Project: INTEGRATED RURAL WATER SUPPLY PROJECT (NAP AP-III) -WATER RESOURCES STUDY-

Drawn: AMvdM | Approved: JvdS | Figure number: 4.1/7.2 | Date: 08-07-92

IWACO Consultants for Water & Environment

Description: Water supply alternatives

Drawing number: 8000003-7.3

- Financial aspects
  Present values of total costs (investment and O&M) amount to Rs 1161 million (2022). Annual operation and maintenance costs vary from Rs 0.07 million to Rs 0.13 million for individual schemes to approximate Rs 31 million for the entire scheme at 2022 capacity (see section 7.5).

- Environmental aspects
  The groundwater abstractions have a negative effect on the groundwater balance in the area but abstraction amount to only a small percentage of present total abstractions (mainly for irrigation). In some areas water sanctuaries around wells need to be created that can be used for afforestation or less water consuming crops. In areas where water logging occur (upstream or downstream of tanks) lowering of the groundwater table will decrease evapotranspiration and hence salinization of soils. In these areas groundwater exploitation has a positive environmental effect.

  Serious consideration needs to be given to the disposal of sludge. Some 500 ton of sludge clear water production will be annually produced at full production capacity. It should however not be too difficult to locate proper disposal sites or use the waste as construction material as the sludge is rather stable from a chemical point of view.

- Health and social aspects
  It is assumed that sources can be found within a radius of 2500 m from the village and that in general this will be within the village administrative boundaries. This might not always be the case and problems might arise over water rights. The small scale of the systems makes this alternative more adopted to the village level and is in line with the trend to increase the involvement of the village population in the management of their own water resources

  Consumers should be made aware of the difference of the new bore well systems and many old systems (including handpumps) with a lesser water quality. It is recommended to mark well with a high fluoride content so that they can easily be recognized.

- Risks and problems
  The water resources assessment needs to be confirmed in the field.
  The water supply systems should be carefully designed with due attention given to the location of the source. The hydrogeological wing of the PRED needs to be extended and reinforced as it is presently not well equipped to this task.
  There will be always a risk that certain wells will be influenced by private wells that cannot be controlled by any of the proposed measures. In the worst case a new well needs to be drilled.

  Although small there is a risk of deteriorating groundwater quality. Due consideration should be given to the implementation of wells in order to minimize this risk. In an individual case a certain source might have to be abandoned, or a defluoridation plant might be required.

  In this alternative it is assumed that the operation and maintenance will be carried out by the PRED, additional institutional and organizational arrangements and reinforcement need to be made.

  There will be villages where more problems will occur in finding a suitable source than expected, in others the revers might be true, on a regional scale the result will not be influenced.

7.4.2 Protected water supply schemes for groups of villages (II-2)

Whenever feasible protected water supply schemes are installed with a single distribution system for a group of villages.

- Group schemes of several villages in certain areas. The first choice will be the villages with high water production costs. Other group schemes can be made in areas where high yielding wells are found. Although not many of these areas exist, several have been localised in the field near the dikes in Choutupal, the valley fills of Waipally and Jangoan. Some surface water infiltration wells belong also to the potential source for group schemes. The total number of schemes can decrease from 226 to 180-200.

- If possible defluoridation plants are avoided in favour of wells at some distance of the supply areas provided that better water quality can be found. In this way the number of plants can be reduced to 23.

- Centralised defluoridation plants to cut operation and maintenance cost and increase reliability. Assuming a plant capacity of 200 m³/day as optimum, 12 plants can probably be reduced to 6 in the western hilly area.

- Reduction of operation and maintenance by assuming that part of the cost (work) can be done by the Gram Panchayatis. Part of the maintenance and surveillance of the equipment etc. can be handed over. In the estimates manpower cost alone is 40% of the total OM costs. Involvement of PRED can thus be reduced to a minimum.

- Risks and problems
  The sharing of water sources that will be necessary for the group schemes might cause problems. Involvement of the population in an early stage of the water system design including the selection of a suitable (and for all parties acceptable) well site might minimize problems of this kind.

  (Other risks and problems will be similar to alternative II-1).

7.5 CONJUNCTIVE SURFACE GROUNDWATER ALTERNATIVES (III)

7.5.1 Combination of original AP-III and groundwater (III-1)

The first option is a combination of groundwater alternative II-1, covering the area of the original phase 1 of the first surface water option (zone D on figure 7.2) and surface water in the phase 2 area (zone A+B+C).

The villages of highest priority are situated in the surface water area. Out of 33 villages with more than 4 wells, 17 are covered by the surface water.

The surface water source is the Awal tank. The surface water system production capacity is 282 l/s (2022). The groundwater contribution amounts to 246 l/s. The same figures are used as for the existing surface water phase 2 estimates. The cost of groundwater is the total of the individual systems in the phase 1 area.

7.5.2 Conjunctive option III-2

This option is identical to conjunctive option I, but with protected water supply schemes for groups of villages as in groundwater system according to groundwater alternative II-2.

7.5.3 Conjunctive option III-3

This option III of the conjunctive source alternative is based on option 1 of the groundwater alternative and a reduced version of the surface water alternative supplied by the Awal tank, covering the fluoride villages in zone A.

The villages in zone A have the highest Total Present Values (per liter per second of water production) of the groundwater option and a high priority, 27 out of 35 villages where no suitable groundwater resources are present or not likely to be present are covered in this area.

- Source and system lay out
  Water is pumped from the Awal tank following the design of the original phase 2. The production capacity in 2022 is 83 l/s including provisions for en route villages (15-20 l/s). 8 defluoridation plants are still required. In the remaining area groundwater supply is 445 l/s (2022 figures).

- Financial aspects
  Using the phase 2 design and unit prices from the AP-III proposal, an estimate is made of the cost involved. Design of system elements has been adjusted to new capacity where necessary. The surface water scheme at 2022 capacity is estimated at Rs 105 million, the groundwater part Rs 884 million.

7.5.4 Conjunctive option III-4

The same as conjunctive option III but with protected water supply schemes for groups of village where possible, according to groundwater alternative II-2.

7.5.5 Conjunctive option III-5

The areas covered by surface water from the Awal tank in the previous option will be supplied from the Hyderabad water supply pipeline. This pipe line will not be completed before the year 2000.

- Source and system lay out
  The transmission main of the Hyderabad supply system will follow the road from Nagarjuna Sagar via Chintapally and Mal (utmost western part of the study area and highest elevated village) to the town. From Mal the water can be supplied under gravity over the area.

- Financial aspects
  The production cost of Hyderabad water is estimated at maximum 7 Rs/m^3, it might be lower however. For the largest part this amount has to be paid to the Hyderabad Metropolitan Water Works. This is a heavy burden on the operation costs. The investment costs of the distribution system (applying again PRED standard figures and design assumptions) are estimated at Rs 63 million (2022 capacity).

7.6 MIXING OF SOURCES

To obtain water of acceptable fluoride level it is possible to mix water up to the permissible fluoride levels and thus reducing the required quantity of scarce low fluoride waters. In this way surface water of the Nagarjuna Sagar canal having 0.6 mg/l fluoride content can be mixed with groundwater of 2.4 mg/l in equal quantities. In the same way groundwater sources can be mixed.

As far as surface water is concerned this does not seem an attractive alternative from a financial or operational point of view. Double systems are required to be installed and maintained. This alternative is not considered in the analysis.

In case of groundwater it might be a good alternative in the villages were more than 4 wells are needed and where reliability of supply is low. It is also wise to have a backup source in case of temporarily shortage of supply. This possibility should be considered in the design and implementation of groundwater systems but will not be considered here as a single supply alternative.

7.7 FINANCIAL ANALYSIS

The costs of the different alternatives have been determined in this analysis in order to select the least-cost alternative. Because of lack of data, market prices have been used. Moreover, no external costs have been included in the analysis. Therefore this analysis can not be considered as an economic analysis. Yet the indicators which are used in an economic analysis have been employed in order to determine the least-cost alternative.

This analysis calculates the net present cost per m^3 sold (or long-run marginal cost of water). These long-run marginal costs are calculated by dividing the present values of investment and operation and maintenance costs by the volume sold, based on a life expectancy of the project of 30 years. The assumptions underlying the analysis are discussed in the following section. The alternatives that have been analyzed and the results are presented in table 7.1.

The production capacity of the first surface water alternative is slightly less than in the original AP-III proposal (528 l/s instead of 558 l/s). A correction had to be made to adjust for the lower population projections that where based on the 1991 census results. All other assumptions have been according to the original AP-III proposal.

7.7.1 Assumptions

Investment
Investments are differentiated into two types of investments:

1. Initial investments
   These investments are made at the start of the project. It is assumed that for all options, the first phase of investment will start in 1992 and be finished in 1995. The second phase of the project will cover the period 1995 to 1998. One exception is the conjunctive surface and groundwater alternative III-3 and III-5 which --due to the scale of the system-- is assumed to start and finish construction in 1995.

2. Replacement investments
   During the time horizon of the project which is set at 30 years, replacement investments will be needed. The lifetime for electro-mechanical equipment and pumps is set at 10 year. During the time horizon of the project this equipment will have to be replaced twice.

Operation and maintenance cost
The operation and maintenance costs consist of raw water costs, energy, chemicals, manpower and maintenance. The operation and maintenance costs for the surface water option are set at Rs. 28 million per year in the PRED-report. However, according to the appraisal report of the Integrated Rural Water Supply Project Nalgonda District (AP-III), the operation and maintenance costs are seriously underestimated. According to the appraisal team, it is more realistic to assume that the surface water option will require annual O&M costs of Rs. 52 million. These costs have been taken as a starting point for the calculations. For the groundwater option, the operation and maintenance costs are set at Rs. 31.4 million per year. The alternatives which combine the two options of surface and groundwater are based upon the assumption that the operation and maintenance costs vary proportionally with the volume sold.

Discount rate
For the analysis a discount rate of 10% has been used.

System capacity
The production is based upon an average daily demand of 55 liter per capita per day. For the groundwater alternative population figures of 1991 are used, while in the surface water AP-III proposal population figures based on the 1981 census are applied.

7.7.2 Analysis

The alternatives that will be investigated through a financial analysis are reported in table 7.1. The costs of these alternatives have been calculated (see Appendix 10). Due to lack of data, assumptions had to be made in order to determine the replacement investment of the alternatives in which surface and groundwater are combined[1)].

In table 7.1, the net present cost per m^3 (or long-run marginal cost of water) of each alternative is shown. This criterion has chosen as the options differ in the water volume to be sold (this is caused by the different water demand projection based on 1981 population census for surface water and based on the 1991 census in case of groundwater alternatives). Moreover, the different alternatives display various consumption patterns for the period under review. The alternative with the lowest net present cost per m^3 can be selected as the least-cost alternative.

1) It has been assumed that 25% of the initial investment costs consists of investments which have to be replaced after 10 years.

Table 7.1: Summary of alternatives

			2007				2022			
				Costs per m³				Costs per m³		
Alternative	Discussion	Phase	Capacity l/s)	Investment	Operation and maintenance	Total	Capacity l/s	Investment	Operation and maintenance	Total
I-1	Original AP-III proposal	phase 1	185	7.73	2.96	10.68	246	9.82	2.96	12.78
		phase 2	212				282			
I-2	Modified AP-III proposal	phase 1	261	8.19	2.98	11.15	347	9.43	2.98	12.41
		phase 2	136				181			
II-1	Protected water supply schemes for single village	226 systems	397	8.88	1.89	10.77	528	9.89	1.89	11.78
II-2	Protected water supply schemes for group of villages	198 systems	397	8.43	1.70	10.13	528	9.39	1.70	11.09
III-1	Combination I-1 and II-1	surface water	212	8.44	2.38	10.82	282	10.60	2.36	12.96
		ground-water	185				246			
III-3	Combination II-1 and reduced surface water from Awal-tank	surface water	62	11.32	2.55	13.88	83	10.47	1.91	12.38
		ground-water 187 systems	335				445			
III-5	Combination of II-1 and reduced surface water from Hyderabad	surface water	47	11.06	3.12	14.18	63	10.36	2.03	12.39
		ground-water 199 systems	350				465			

The variation in total net present costs per m³ is rather small. Although the variation in costs for the medium-term horizon (2007) is bigger than that for the long-term horizon (2022). The table also shows the first water surface supply alternative I-1 (original AP-III proposal) is the second least-cost alternative for a horizon of 2007. This alternative is based upon higher 1981 census population figures, wherefore it can profit disproportionally (compared with the other alternatives) from economies of scale. The Hyderabad pipeline alternative III-5 has the highest O&M cost in 2007 due to the high cost price of Hyderabad water. In 2022 this effect is reduced due to the increased proportion of groundwater in the alternative.

The two least cost alternatives for a horizon of 2022 are alternatives II-1 and II-2. The groundwater supply systems can profit from the fact that the construction of the facilities can be subdivided in smaller portions. Thus this options can reduce overcapacity through the construction scheme. II-1 and II-2 have also the lowest O&M costs.

8. MULTI CRITERIA DECISION-MAKING

8.1 INTRODUCTION

For the water supply development of the region, several alternatives have been formulated. A complete set of factors influencing the water supply development are called indicators. Each of the alternatives have different emphasizes for the various indicators. The selection among alternatives would be relatively easy if one could find a single option which performs best with respect to all indicators. However, in water supply development generally no such overall optimum solution can be found, and the selection among options is possible only by considering tradeoffs among those options. This type of selection is called multicriterion decision making (MCDM) and ranges from simple engineering judgement to sophisticated multi-objective programming methods.

In the previous chapters alternative supply options have been defined and worked out in some detail. For the groundwater options criteria could be established to evaluate reliability of supply using different indicators like number of wells, stage of groundwater development, etc. Financial indicators have been calculated for most of the supply alternatives.

In the following the multicriteria decision analysis will be applied to select an optimal alternative. The mathematical scheme selected for the aggregation and evaluation of the indicators and of system performance is called composite programming. The method is simple to use, utilizing an interactive computer programme on a micro-computer, and displays the results numerically and graphically. The alternatives that will be analyzed are summarised in 8.2. Evaluation criteria will be established and discussed in section 8.3. The weighing of evaluation criteria and the final computation procedures and result are presented in section 8.4.

The procedure should ideally be carried out by the decision makers themselves, this can be considered in a next stage of the project. In the present report ranking and weighing has been carried out by a group of experts of IWACO with a long year experience in rural water supply projects.

8.2 SELECTED ALTERNATIVES

The composite programming analysis has been applied to the following water supply alternatives:

I 1 Surface water alternative 1 original AP-III proposal
  2 Surface water alternative 2 modified AP-III proposal

II 1 Groundwater alternative 1 PWSS in single villages
   2 Groundwater alternative 2 PWSS in group villages

III 1 Conjunctive use alternative 1 (groundwater in phase 1 and surface water in phase 2 area)
    3 Conjunctive use alternative 3 (reduced surface water scheme from Awal tank in phase 2 area, remaining groundwater)
    5 Conjunctive use alternative 5 (same as III-3 but surface water from Hyderabad pipeline)

8.3 EVALUATION CRITERIA AND INDICATORS

The use of the composite programming methodology begins with the selection of basic indicators to represent the system being analyzed. These basic indicators can be combined to a limited set of evaluation criteria (or second level indicators). As evaluation criteria were taken:

- Total investments
- Operation and maintenance costs
- Reliability of supply
- Coverage of priority needs
- Investigation requirements
- Environmental impact
- Community involvement

Weighing factors for the different indicators are determined by pairwise comparison of the indicators and normalization of the scores (Seaty method). A matrix is set up with all indicators in the upper row and in the left column (see Appendix 11). Calculation of the weighing factors is done by a judgement for each cell of the importance of the left indicator compared to the upper indicator. Basic indicators and weighing procedures of each of the evaluation criteria will be discussed below except for the financial criteria that have been explained in the previous chapter.

8.3.1 Reliability of supply

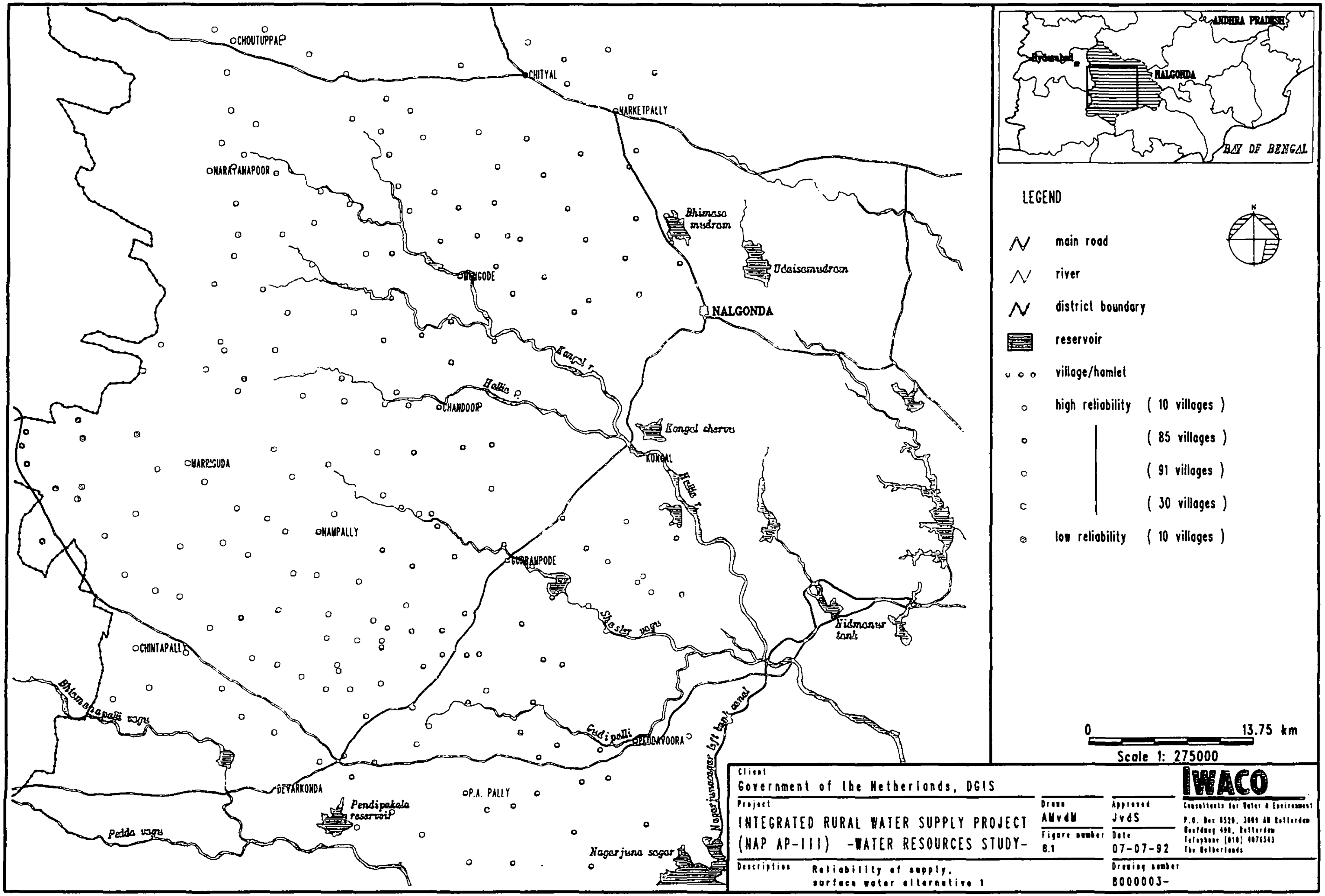
The reliability of supply is defined as the ability of a system to supply water of sufficient quantity. It depends on technical and hydrological aspects. In case of groundwater systems the reliability is more determined by hydrogeological factors than by mere technical ones. The technical (un)certainties are more or less equal for all the villages, except for the schemes with defluoridation plants. For individual groundwater systems the reliability of supply is expressed as a combination of the following indicators:

- type of wells
- number of wells
- hydrogeological zone
- stage of groundwater development.

The four indicators were combined to one in a way similar to the composite programming analysis itself. The result of the reliability of groundwater systems per village is presented in figure 8.1.

For the surface water system the reliability of supply in a particular village is more determined by technical aspects (the hydrological factors being the same for the area as a whole). The reliability is expressed as a function of the following basic indicators:

- pipe line distance from supply area to the source (intake)
- elevation difference between intake and supply area
- number of pumping stages to the supply area



CHOUTUPPAL
CHITYAL
NARKETPALLY
NARAYANAPOOR
MUNGODE
NALGONDA
Bhimasamudram
Udaisamudram
Kangal r.
Hallia r.
CHANDOOR
Kongal cheruvu
KONGAL
MARRIGUDA
NAMPALLY
GURRAMPODE
Shasler vagu
Nidmanur tank
CHINTAPALLI
Bhimanapalli vagu
Gudipalli
PEDDAVOORA
Nagarjunasagar left bank canal
DEVARKONDA
P.A. PALLY
Pendipakala reservoir
Pedda vagu
Nagarjuna sagar
ANDHRA PRADESH
Hyderabad
NALGONDA
BAY OF BENGAL
LEGEND
main road
river
district boundary
reservoir
village/hamlet
high reliability (10 villages)
(85 villages)
(91 villages)
(30 villages)
low reliability (10 villages)
0
13.75 km
Scale 1: 275000
Client
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Project
INTEGRATED RURAL WATER SUPPLY PROJECT
(NAP AP-III) -WATER RESOURCES STUDY-
Drawn
AMvdM
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Approved
JvdS
Date
07-07-92
IWACO
Consultants for Water & Environment
Description
Reliability of supply,
surface water alternative 1
Drawing number
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A village at 90 km from the intake and located in the western hills to be reached after three pumpstages has a lower reliability of supply than the villages in the lower elevated areas near the intake as can be seen from figure 8.2. All three indicators are assumed to have equal weight.

The reliability scores of individual villages are weighed according to village population and summed to obtain the reliability of the system score. This is done for all the alternatives.

In order to compare the reliability of a surface water system to a groundwater system essentially the same weighing procedure has been adopted. This time the alternatives are arranged along the matrix axis and a score is given for the pairwise comparison of reliability of two alternatives. Appendix 11 shows the outcome of the scorings of 5 experts in the field of rural water supply. The same exercise can be done by other parties involved.

8.3.2 Coverage of priority needs

The alternatives are being evaluated for the extend and the moment in which the villages with the highest priority ranking are being covered. The score for the coverage of priority needs will be lower in the original AP-III proposal, that cover most of the priority villages in the second implementation phase, than for the groundwater option where the most urgent villages can be covered at the beginning of the implementation.

8.3.3 Investigation requirements

The groundwater assessment carried out indicated that at a regional scale sufficient water is available, at a local scale problems might arise concerning water quality and water quantity. There will be villages where locating acceptable sources will be more problematic than in other villages. The criteria will give a measure of success in locating borewells of the expected type, discharge and distance. The present village water availability assessment can only be verified while drilling wells. For surface water no such incertainty exists as the source is visibly present. The need for further investigations increases as the component of groundwater increases.

8.3.4 Environmental impact

Although the overall environmental impact is low for all the alternatives, the production of fluoride rich sludge can not be neglected.
The environmental impact has been considered but is not taken as a criteria as overall impact is small and differences among the alternatives are assumed to be marginal. In fact, negative impact increases with the number of defluoridation plants required in an alternative.

8.3.5 Community involvement

This criteria reflects the extent of community involvement required and/or possible. A high level of community participation can be seen as an advantage or as a disadvantage. It will be clear that in the groundwater alternatives a higher participation of the community is required than in the surface water alternatives. The village community should be involved in selecting suitable well sites and eventually donate land etc.. They eventually can play an active role in the management and operation of the system. This in turn might it make possible for the PRED to transfer some of their operational tasks to the village. Although it has not received an important weight in the analysis, it is a criteria worth considering as the project as a whole is a rural development project in which the self reliance of the population is one of the objectives.

8.4 RESULTS OF THE ANALYSIS AND DISCUSSION

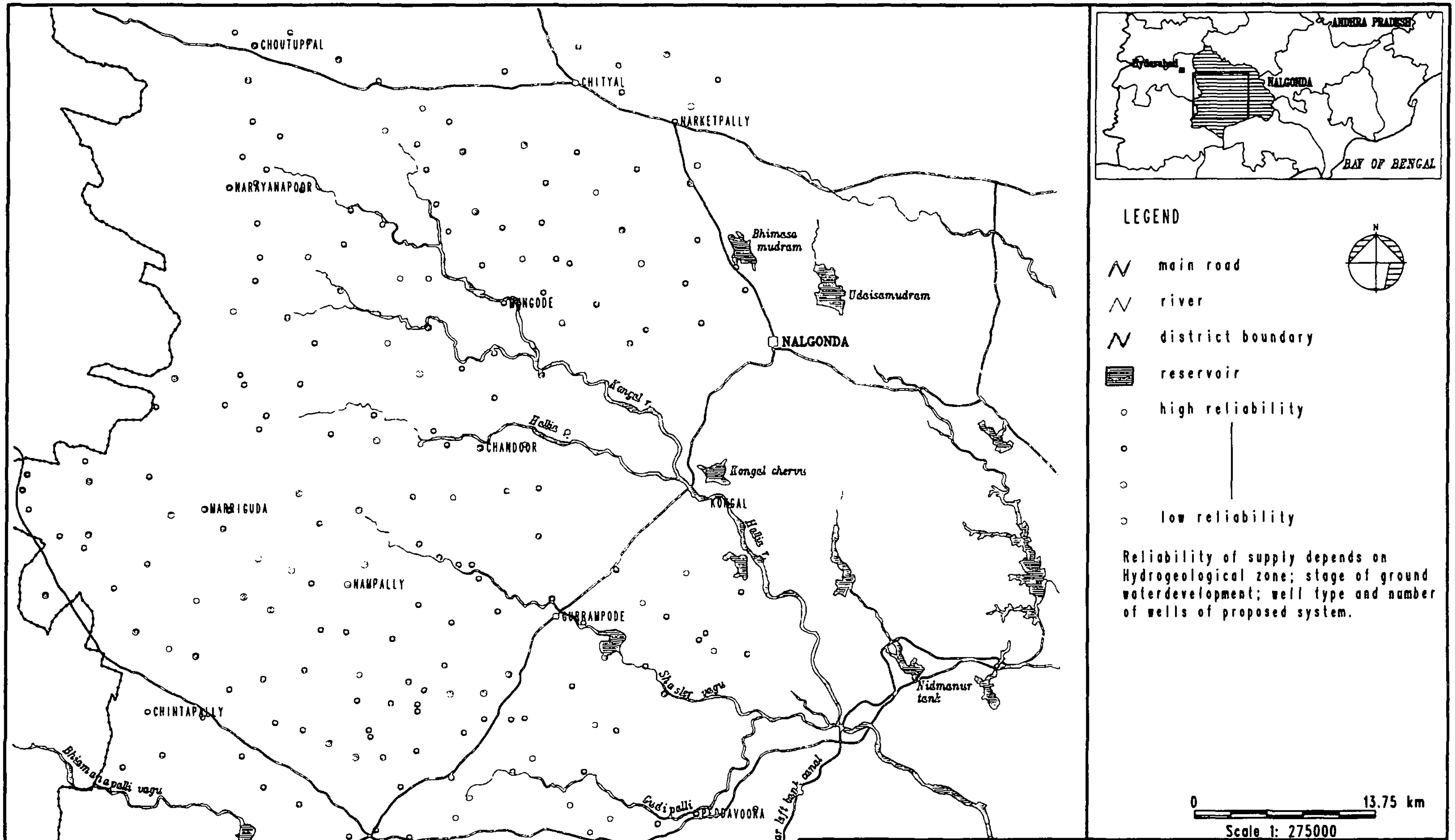
In table 8.1 the values of each of the indicators for the situation 2022 are presented. Table 8.2 shows the results of the analysis for different weights of the indicators.

Table 8.1: Indicator values

Alternatives	INDICATORS						
	Investments 2022	Operation and Maintenance 2022	Priority coverage	Reliability of supply	Investigation requirements	Environmental impact	Community involvement
I-1	9.82	2.96	0.05	0.074	0.05	0.18	0.04
I-2	9.43	2.98	0.08	0.075	0.05	0.18	0.03
II-1	9.89	11.89	0.27	0.129	0.23	0.11	0.24
II-2	9.39	1.70	0.27	0.132	0.23	0.11	0.28
III-1	10.60	2.36	0.11	0.096	0.10	0.15	0.08
III-3	10.47	1.91	0.13	0.122	0.16	0.14	0.12
III-5	10.36	2.03	0.09	0.141	0.18	0.13	0.21
best value	9.39	1.70	0.27	0.141	0.05	0.18	0.28
worst value	10.60	2.98	0.05	0.074	0.23	0.11	0.03

Table 8.2: Weightage of criteria and score of alternatives

Criteria	WEIGHTAGE SCHEMES				
	1	2	3	4	5
Investment	0.05	0.14	0.10	0.11	0.24
Operation and Maintenance	0.26	0.14	0.31	0.26	0.24
Reliability of supply	0.32	0.14	0.01	0.43	0.01
Coverage of priority	0.10	0.14	0.16	0.01	0.01
Investigation requirements	0.17	0.14	0.21	0.18	0.24
Environmental impact	0.04	0.14	0.09	0.01	0.24
Community involvement	0.07	0.14	0.12	0.01	0.01
ALTERNATIVES					
I-1	0.34 (7)	0.39 (6)	0.37 (7)	0.26 (7)	0.65 (2)
I-2	0.36 (6)	0.44 (5)	0.42 (6)	0.29 (6)	0.72 (1)
II-1	0.59 (3)	0.59 (2)	0.59 (2)	0.67 (3)	0.38 (7)
II-2	0.65 (1)	0.69 (1)	0.70 (1)	0.75 (1)	0.51 (3)
III-1	0.48 (5)	0.38 (7)	0.43 (5)	0.45 (5)	0.44 (5)
III-3	0.56 (4)	0.46 (4)	0.50 (3)	0.61 (4)	0.45 (4)
III-5	0.60 (2)	0.49 (3)	0.46 (4)	0.70 (2)	0.38 (6)



Client: Government of the Netherlands, DGIS			IWACO Consultants for Water & Environment
Project: INTEGRATED RURAL WATER SUPPLY PROJECT (NAP AP-III) -WATER RESOURCES STUDY-	Drawn: AMvdM	Approved: JvdS	
	Figure number: 6.8	Date: 12-05-92	
Description: Reliability of supply -ground water option 1-		Drawing number: 8000003-12	

An essential part to interpret the results is the weight that have been attributed to each of the evaluation criteria. The weights are determined by pair wise comparison and are given in table 8.2 in column 1. A sensItivity analysis was carried out in order to get a clearer understanding of which indicators and the weights assigned to them, most influence the final results. Some of the results of the analysis for different weights are shown in the same table. The results for the horizon 2007 are not shown as they do not differ substantially from the 2022 horizon.

It can be seen from the table that the groundwater alternative II-2 ranks highest in the first weight scheme. The weights assigned to each of the indicators is obtained from a carefull evaluation of the indicators by pairswise comparison by several water supply experts. The investments are considered of limited importance in the case of the project compared to the other indicators as operation and maintenance cost or reliability of supply. As can be seen from table 8.1 the investment costs of the alternatives do not vary much. The alternatives II-2 (groundwater group schemes) is clearly to be prefered over II-1 (single village PWSS systems). Changing the weight factors cause only some minor changes in the score but does not change the ranking. In weight scheme 2 all factors are set equal. In scheme 3 the reliability of supply (that is in favor of the groundwater options) is considered equal for all alternatives and is set at 0.01. The end result is not modified.

In scheme 4 the weights of the 'soft' indicators such as coverage of priority needs, community involvement and environmental impact are not considered important and set at 0.01 in order to have a more technical and economical evaluation. The gap between surface water and groundwater alternatives remains the same. Only if the reliability criteria, the coverage of priority and the community involvement indicators are not considerd (weightage scheme 5) the surface water alternative ranks first.

The alternative III-5 (Hyderabad pipeline supply) ranks second in weighting schemes 1 and 4 and ranks third or four in others. This despite the high operation and maintenance cost and a low priority coverage (see table 8.1). If the operation and maintenance cost appear to be lower than assumed it might rank first. This depends for an important part on the price per m³ that has to be paid to the Hyderabad Metropolitan Water works.

8.4.1 Discussion

In the following the indicators will be discussed. The indicator value adopted and as is presented in table 8.1 can modify if more details about the study area and sytem design aspects become availible. Some aditional research might be required if a larger reliability is needed before a final decision can be made.

Although many assumptions had to adopted in order to make a financial comparisson of the alternatives possible it is not likely that any change will modify the results. The operation and maintenance cost of the groundwater alternative is more likely to be lower than those of the surface water alternative. With some community participation and other measures these cost probably can be reduced with 25 to 45 %. Even the investments are at the high side compared to existing rural water supply systems. It is not known however, till what extend the cost of the surface water system can be reduced by optimising the current design.

The reliability of supply indicator can be a subject of discussion. What will be more reliable: a regional surface water system or the summ up of individual groundwater systems. The scorings that results from the evaluation of 5 experts in the field might be considered not representative for the local situation. It might be considered to have an evaluation done of existing rural water supply schemes in Andrha Pradesh and to see wether they are reliable or not.

The importance of the criteria 'coverage of priority needs' can be relativated against the fact that the people in the area live for decades with the situation of high fluoride in food and drinking water. A couple of years delay in improvement of the situation seems not relevant. This argument however is in favor of the alternatives based on futur developments, like the construction of the Sri Sailim Canal or the pipe line to Hydrabad that can be tapped.

The requirements for investigation is used as an indicatior to express the disadvantage of the groundwater alternatives over surface water as far as the location and suitability of the source is concerned. Whereas the surface water source is present and well located, the groundwater sources need to be localised for each village in detail. The overall appraisal of groundwater in terms of water quality and quantity is done at a regional scale and a preliminary estimate is given at village scale. Additional investigations are required for exact source location. The success rate in finding suitable sources in a village will increase during the project preparation and during its realisation. Coordination with other water development projects in the area and the start of systematic data collection is highly recommended to this respect.

The environmental impact of all alternatives is small. The negative impact of the groundwater alternative as a result of high fluoride containing sludge production might possibly be reduced. Alternative defluoridation technics do exist and it should be investigated if they can be applied.

8.5 CONCLUSIONS AND RECOMMANDATIONS

Prospects for developing groundwater resources for drinking water supply are good. It is a realistic alternative that deserves to be considered in more detail.

The groundwater alternative with Protected Water Supply Schemes that supply more than one village and with boreholes at distance to evitate defluoridation plants where possible has additional benifits over the alternative that consists of single village supply schemes only.

The evaluation criteria 'reliability of supply' might be disputed. According to experts the reliability of the sum of individual groundwater systems is higher than one regional surface water. Even if the rialibility indicator is not considered in the multi criteria analysis groundwater alternatives rank substantial higher. In case this criteria needs to be defined with more precission it is recommended to evaluate the reliability of existing surface water schemes in Andrha Pradesh.

The investment cost of the studied alternatives do not differ significantly. Highest and lowest values are within 12 % difference. Operation and maintenance cost differ as much as 75%. An important weight is assigned to it in the analysis. There is still some uncertainty about these operation and maintenance costs. For the surface water alternative an estimate has been used that should be specified in more detail. The same holds for the groundwater alternative where there is a general feeling that costs are estimated too high.

From the analysis the alternative III-5, in which part of the area is supplied by water from the Hyderabad pipeline, seems an atractive option as it means a reliable supply for that part of the study area that is worst affected by fluorosis. It is recommended to study this alternative closer. The real cost per m^3 that has to be paid to the Hyderabad Metro Water Supply and Sewerage Board, the completion date of the project and the maximum capacity that eventually can be supplied should be known before a final evaluation of this alternative.

APPENDIX 1

Terms of Reference

2nd DRAFT

(including comments by NAP Office)

Terms of Reference
AP-III Water Resources Study

1. Introduction

The Government of India (GOI) has requested financial support from the Government of the Netherlands (GON) for the implementation of an integrated rural water supply and sanitation project in Nalgonda District, Andhra Pradesh. This AP-III project (the Project) is to cover a total of 226 scarcity and fluoride affected villages. The total design population (2022) is 880,000. The Project proposes the construction of two piped water supply systems with the Nagarjuna Sagar Left Bank Canal as raw water source. This involves long distance transport and multi-stage pumping. Additional activities in the fields of dairy and sericulture for income generation are part of the proposed Project.

An appraisal of the proposed Project was carried out on behalf of DGIS in October last. A main recommendation of the appraisal team was to carry out a more detailed study of water resources in and near the Project area. Use of locally available water may reduce the cost and increase the reliability of the proposed system; possibly a large scale piped system can be avoided completely.

2. Objectives

The main objective of the study is to estimate the quantities of reliable ground and surface water that are available in or near the Project area for drinking water supply on a sustainable basis.

Secondary objectives are:

- to find out whether fluoride contents of ground water sources have a general tendency to increase and if so, why;
- to analyze water samples of different potential sources on the presence of micro pollutants of agricultural or industrial origin;
- to collect data concerning the suitability of water, soils and land in the area for the proposed dairy and sericulture activities;
- to assess the possibility of making maps of the villages in the Project area.

3. Requirements

The study shall be carried out in close cooperation with the Panchayati Raj Engineering Department (PRED) and be mostly based on available data. These data can be found with the various institutions in Hyderabad and Nalgonda of which a tentative list is given in Appendix 1. A limited amount of field work will be required for calibrations, water sampling, etc. The study shall take into account the following:

- The total amount of water required for full coverage of the 226 villages by the end of the design period is about 2,000 m^3 per hour; on average 9 m^3 per hour (2,000 gph) per village. Of course, a substantial part of this quantity is already being abstracted at present as ground water in the Project area.
- High fluoride contents of the ground water are found in many places in the Project area. The study shall attempt to distinguish sources as to their fluoride content. The possible variations per source should also be studied. It may be possible to use sources with different fluoride contents and mix these in order to arrive at an acceptable level for drinking water (maximum 1.5 ppm). Only in exceptional cases will defluoridation be acceptable for village water supplies.
- Direct use of surface water from minor irrigation schemes is not envisaged. Preference is given to so called percolation schemes where feasible to improve shallow aquifers.
- Sources outside the Project area should be considered, particularly to the north and west where the elevation of the land increases, allowing for gravity transport towards the Project area.
- No legislation is in force to protect ground water abstractions for water supply against over-exploitation by private abstractions nearby. Estimates should therefore be made of likely future private abstractions. Alternatively, the possibility to acquire sufficient surrounding land ("water sanctuaries") shall be assessed. Past experience in acquisition of land shall be borne in mind.

- The study shall clearly indicate how water sources that are expected to be available can be identified in the field and how they should be developed once the actual implementation starts.
- Specific requirements for the proposed dairy and sericulture shall be established in consultation with the relevant organisations, NARMUL and SERIFED.
- Maps of the villages will be required for the preparation of village master plans as proposed in the Project. The study shall therefore assess the possibility of preparing maps based on aerial photographs and propose the production of these as part of the Project. The maps shall be on scale 1:2,000 or 1:5,000 and show

as a minimum roads and the main buildings. The possible inclusion of the data in a geographical information system (GIS) shall be taken into account.

4. Activities and time schedule

The work shall be guided and monitored by a Dutch expert with ample experience with similar problems. However, the main body of the work shall be carried out by the PRED and parties to be contracted locally. As a consequence the activities will be carried out in 3 phases.

In the **first phase** the Dutch expert will inform himself on the Project by means of documentation and then visit Andhra Pradesh. During this visit the expert will:

a. familiarize himself with the site and the available institutions and data;
b. define in close cooperation with the PRED the tasks to be done in the next phase and select suitable parties to carry out these tasks. Parties that are to be considered, besides PRED and Iwaco, are those listed in Appendix 1;
c. prepare job descriptions or contracts for these parties and arrange, in close cooperation with Netherlands Assisted Projects (NAP) Office, for contracts to be finalized by the Royal Netherlands Embassy (RNE);
d. assess whether other expatriate inputs may be required;
e. assess the possibility of producing village maps based on aerial photographs and propose this activity to be taken up as part of the Project if appropriate.

The expert shall take with him 3 numbers of simple comparator type test kit for analyzing fluoride in the range from 0.5 to 10 ppm for use in the field.
A special point of attention is the possibility to find correlations between ground water with high fluoride and certain features of satellite images.
Duration 2 to 3 weeks.

In the **second phase** the tasks defined in the first phase will be carried out. These may include:

a. satellite image and aerial photo interpretation;
b. geophysical measurements in the field (for calibration purposes);
c. sampling and analysis on fluoride of a large number of ground water wells;
d. sampling and analyzing on micro pollutants of a limited number of possible sources.

Data shall be processed by computer with a suitable data base. This data base shall be of a commonly used type and if at all possible be operated by the PRED. Retrieval of the data should be at least possible per village and per mandal. The

possibilities of using a practical computerized (GIS) for the same purpose shall be considered.
NAP Office will monitor progress of activities in India and report any constraints encountered through RNE.
Duration 2 to 3 months.

In the **third phase** the Dutch expert will visit India again and prepare the final report in close cooperation with the PRED and the parties involved. The final report shall contain maps of appropriate scale that clearly show the findings such as availability of ground and surface water and water quality. The resolution shall be such that at least individual villages can be distinguished.
Duration 2 to 3 weeks.

5. Execution

Iwaco shall make available Mr. J. van der Sommen, hydrogeological expert, to carry out the two visits mentioned earlier. The work shall be done in the framework of the Review and Support Mission for the AP projects. The first visit shall take place in the second half of January 1992 under the AP-25 mission. The second visit is expected to be a special Review and Support Mission (AP-26). By the end of each visit the expert will inform the Water Coordinator of RNE of his findings.

The activities to be carried out by local parties in the second phase may be funded by RNE through the Local Consultancy Fund. Such activities need the prior approval of the Water Coordinator of RNE.

The final report in the English language shall be submitted to DGIS not later than 3 weeks after the second visit. The report shall be submitted in 20 copies.

17/12/92

INSTITUTIONS

1. A.P. State Remote Sensing Applications Centre (APSRAC)
   38, Nagarjuna Hills, Punjagutta, Hyderabad.
   Mr. R.S. Rao, Director.

2. National Remote Sensing Agency
   Balanagar, Hyderabad.
   Dr. A. Bhattacharya, Head Geosciences Division

3. NEERI, Hyderabad Zonal Lab.
   IICT Campus, Hyderabad.
   Dr. M. Vittal Rao, Scientist and Head.

4. (State) Ground Water Department
   B.R.K.R. Govt. Office Complex, Tankbund Road, Hyderabad.
   Mr. T. Narasimha Reddy, Director.

5. (State) Irrigation Department.
   Hyderabad
   Mr. A.V. Appa Rao, Chief Engineer Minor Irrigation

6. (District) Ground Water Department
   Nalgonda town
   Mr. Chandra Sekhar, Deputy Director.

7. Irrigation Division Nalgonda District.
   Nalgonda Town
   Mr. C. Murlydkar, Executive Engineer Minor Irrigation

8. Narmul: through NAP Office.

9. Serifed: through NAP Office.

DOCUMENTATION

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3. Hydrological maps 1:50,000 available with the irrigation department

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7. Draft final report of the appraisal mission for AP-III, December 1991.

8. Report of the appraisal mission to the Ground Water Minor Irrigation Schemes of the Government of Andhra Pradesh, TNO, December 1990.

APPENDIX 2

List of persons met

APPENDIX 3

Documentation

DOCUMENTATION

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APPENDIX 4

Job descriptions APSRAC

APPENDIX 5

Data Base

5.1 Project
5.2 Population and water demand
5.3 Existing drinking water supply systems in the project villages
5.4 Water demand coverage in 1991
5.5 Data drinking water wells PRED
5.6 Data irrigation wells IDC

Appendix 5.1

Project villages and hamlets

PROJECT VILLAGES AND HAMLETS

WELL NO	MANDAL	VILLAGE	HAMLET
10100001	NALGONDA	ANNAPARTHY	
10300001	NALGONDA	BUDDHARAM	
10400001	NALGONDA	CHERLAPALLI	
10600001	NALGONDA	KANCHANPALLY	
10601001	NALGONDA	KANCHANPALLY	DEEPAKUNTA
10700001	NALGONDA	K.KONDARAM	
10701001	NALGONDA	K.KONDARAM	RAMULABANDA
10900001	NALGONDA	MARRIGUDA	
11200001	NALGONDA	DONAKAL	
11300001	NALGONDA	APPAJIPET	
11301001	NALGONDA	APPAJIPET	BATTUGUDA
11302001	NALGONDA	APPAJIPET	NARLONIGUDA
11500001	NALGONDA	P.DOMALAPALLY	
11501001	NALGONDA	P.DOMALAPALLY	M.DOMALAPALLY
11502001	NALGONDA	P.DOMALAPALLY	MALLUBAVIGUDA
11503001	NALGONDA	P.DOMALAPALLY	GOLLAGUDA
11504001	NALGONDA	P.DOMALAPALLY	PONEPALLYGUDA
21000001	KANGAL	PONGODU	
21001001	KANGAL	PONUGODE	RAMCHANDRAPUR
21100001	KANGAL	REGATTA	
21500001	KANGAL	TURKAPALLY	
21501001	KANGAL	THURKAPALLI	AGLAPUR
30100001	MUNGODE	MUNGODE	
30101001	MUNUGODE	MUNUGODE	KAMMAGUDA
30102001	MUNUGODE	MUNUGODE	LAXMIDEVIGUDA
30107001	MUNUGODE	MUNUGODE	TURPUGUDA
30108001	MUNUGODE	MUNUGODE	SOMBATLA
30109001	MUNUGODE	MUNUGODE	MANGELLAGUDA
30110001	MUNUGODE	MUNUGODE	NATHONIGUDA
30111001	MUNUGODE	MUNUGODE	BATTAKALWA
30200001	MUNGODE	KISTAPUR	
30300001	MUNGODE	IPPARTHY	
30400001	MUNGODE	SINGARAM	
30500001	MUNGODE	KATCHAPUR	
30600001	MUNGODE	PALIWALA	
30700001	MUNGODE	CHALIMEDA	
30800001	MUNGODE	KOMPALLY	
30801001	MUNUGODE	KOMPALLY	TURPUGUDA
30802001	MUNUGODE	KOMPALLY	PADAMATIGUDA
30900001	MUNGODE	CHIKATIMAMIDI	
30901001	MUNUGODE	CHIKATIMAMIDI	KOMMAGUDA
30902001	MUNUGODE	CHIKATIMAMIDI	YERUKALAGUDA
31000001	MUNGODE	KORATIKAL	
31001001	MUNUGODE	KORATIKAL	DUBBAKALWA
31100001	MUNGODE	CHOLLEDU	
31101001	MUNUGODE	CHOLLEDU	GOLLAGUDA
31200001	MUNGODE	KALVAKUNTA	
31201001	MUNUGODE	KALWAKUNTA	BALLAVANIGUDA
31300001	MUNGODE	VELMAKANNE	
31301001	MUNUGODE	VELMAKANNE	KASHOLLAGUDA
31400001	MUNGODE	PULIPALUPULA	
31402001	MUNUGODE	PULIPALUPULA	VEERAVALIGUDEM
31403001	MUNUGODE	PULIPALUPULA	GANGOLIGUDA
31500001	MUNGODE	KALVALAPALLY	
31600001	MUNGODE	JAMISTHANPALLY	

PROJECT VILLAGES AND HAMLETS ANNEX 1

WELL NO	MANDAL	VILLAGE	HAMLET
31700001	MUNGODE	GUDAPUR	
31800001	MUNGODE	SOLIPUR	
31900001	MUNGODE	KOTHLARAM	
31901001	MUNUGODE	KOTHULARAM	MADAPUGUDEM
32000001	MUNGODE	RATHIPALLY	
32100001	MUNGODE	OOKONDI	
40100001	CHANDOOR	CHANDOOR	
40101001	CHENDUR	CHENDUR	LAKKINENIGUDA
40200001	CHANDOOR	THEROTPALLI	
40201001	CHENDUR	TEREDPALLY	SERIGUDA
40202001	CHENDUR	TEREDPALLY	KAMMAGUDA
40300001	CHANDOOR	PULEMLA	
40301001	CHENDUR	PULLEMLLA	SINGARONI BAVI
40302001	CHENDUR	PULLEMLLA	MARRI BABI
40400001	CHANDOOR	IDIKUDI	
40401001	CHENDUR	IDIKUDA	THURAKONI GUDA
40500001	CHANDOOR	ANGADIPET	
40600001	CHANDOOR	DONIPAMULA	
40601001	CHENDUR	DONIPAMULA	JOGIGUDA
40700001	CHANDOOR	GUNDRAPALLY	
40701001	CHENDUR	GUNDREPALLY	ANJULABAI GUDA
40702001	CHENDUR	GUNDREPALLY	KOMATIBAVIGUDA
40800001	CHANDOOR	GHATUPPAL	
40801001	CHENDUR	GATTUPPAL	DHARMA TANDA
40900001	CHANDOOR	KONDAPUR	
41000001	CHANDOOR	BODANGAPARTHY	
41100001	CHANDOOR	BANGARIGADDA	
41101001	CHENDUR	BANGARUGADDA	PAPIREDDIGUDA
41102001	CHENDUR	BANGARUGADDA	GOLLAGUDA
41200001	CHANDOOR	NERMETTA	
41300001	CHANDOOR	THUMMALAPALLY	
41301001	CHENDUR	THUMMALAPALLI	THUMAREDDI GUDA
41400001	CHANDOOR	KASTALA	
41500001	CHANDOOR	SERIDEPALLY	
41501001	CHENDUR	SIRDEPALLY	GOLLAGUDA
41600001	CHANDOOR	UDTHAPALLY	
41602001	CHENDUR	UDATHALAPALLI	DUBBA GUDA
41603001	CHENDUR	UDATHALAPALLI	PERUMALLA TANDA
41604001	CHENDUR	UDATHALAPALLI	YOTAVALLI GUDA
50100001	NARAYANAPOOR	NARAYANAPOOR	
50101001	NARAYANPUR	NARAYANPUR	G.NAGAR THANDA
50102001	NARAYANPUR	NARAYANPUR	KUMAKASHARAM
50200001	NARAYANAPOOR	GUJJA	
50201001	NARAYANPUR	GUJJA	BUDAMARLAGUDA
50202001	NARAYANPUR	GUJJA	KAMMAGUDEM
50203001	NARAYANPUR	GUJJA	PEDDABAVIGUDA
50204001	NARAYANPUR	GUJJA	MUKIDEDIUMMABAVIGUDA
50205001	NARAYANPUR	GUJJA	TANGELLAGUDA
50300001	NARAYANAPOOR	MOHAMMADABAD	
50301001	NARAYANPUR	MOHAMMABAD	V.B.L.THANDA
50302001	NARAYANPUR	MOHAMMABAD	DHIBBA THANDA
50400001	NARAYANAPOOR	CHINNA MIRIYALA	
50401001	NARAYANPUR	CHIMIRYALA	BANTONIBAVI
50402001	NARAYANPUR	CHIMIRYALA	SUDDABAVIGUDA
50403001	NARAYANPUR	CHIMIRYALA	MARRIBAVI

PROJECT VILLAGES AND HAMLETS ANNEX 1

WELL NO	MANDAL	VILLAGE	HAMLET
50500001	NARAYANAPOOR	GUDDIMALKAPUR	
50600001	NARAYANAPOOR	KOTHALAPUR	
50601001	NARAYANPUR	KOTHULAPUR	MUDUPUGUDEM
50700001	NARAYANAPOOR	PUTTAPAKA	
50701001	NARAYANPUR	PUTTAPAKA	BALTONIBAVI
50702001	NARAYANPUR	PUTTAPAKA	SAIGONIBAVI
50703001	NARAYANPUR	PUTTAPAKA	MATHRONIGUDA
50800001	NARAYANAPOOR	KANKHANALAGUDA	
50801001	NARAYANPUR	K.K.GUDA	SERIGUDA
50802001	NARAYANPUR	K.K.GUDA	NARRAMMABAVI
50803001	NARAYANPUR	K.K.GUDA	LOVADI THANDA
50900001	NARAYANAPOOR	KOTHAGUDA	
50901001	NARAYANPUR	KOTHAGUDA	KURMAGUDA
50902001	NARAYANPUR	KOTHAGUDA	GAGULONIBAVI
51000001	NARAYANAPOOR	JANGAON	
51001001	NARAYANPUR	JANGAON	PORLU KUNTA
51002001	NARAYANPUR	JANGAON	VACHYA TANDA
51003001	NARAYANPUR	JANGAON	PALLEGATTU TANDA
51004001	NARAYANPUR	JANGAON	AREGUDEM
51005001	NARAYANPUR	JANGAON	BOTIMEDITANDA-1
51006001	NARAYANPUR	JANGAON	GADAPAGANDI TANDA
51007001	NARAYANPUR	JANGAON	GANDHAMALLA TANDA
51008001	NARAYANPUR	JANGAON	BOTIMEDITANDA-II
51009001	NARAYANPUR	JANGAON	AMBOTHU TANDA
51010001	NARAYANPUR	JANGAON	TURUPUTANDA
51100001	NARAYANAPOOR	VOIPALLY	
51101001	NARAYANPUR	VOILAPALLI	GOLLAGUDA
51102001	NARAYANPUR	VOILAPALLI	PALLEGATTU THANDA
51103001	NARAYANPUR	VOILAPALLI	RADHANAGAR THANDA
51105001	NARAYANPUR	VOILAPALLI	KORRA THANDA
51106001	NARAYANPUR	VOILAPALLI	MARRIBAVI THANDA
51107001	NARAYANPUR	VOILAPALLI	SATYA THANDA
51108001	NARAYANPUR	VOILAPALLI	ANUBOTHU THANDA
51109001	NARAYANPUR	VOILAPALLI	POTHULURI THANDA
51110001	NARAYANPUR	VOILAPALLI	SAPARATA TANDA
51111001	NARAYANPUR	VOILAPALLI	LOHADI THANDA
51112001	NARAYANPUR	VOILAPALLI	JAGAN THANDA
51200001	NARAYANAPOOR	CHILLAPUR	
51201001	NARAYANPUR	CHILLAPUR	LACHEMMA GUDA
51202001	NARAYANPUR	CHILLAPUR	KORRA TANDA
51203001	NARAYANPUR	CHILLAPUR	DAKU TANDA
51204001	NARAYANPUR	CHILLAPUR	KOPPULA THANDA
51205001	NARAYANPUR	CHILLAPUR	DUBBA THANDA
51206001	NARAYANPUR	CHILLAPUR	KADDILA TANDA
51207001	NARAYANPUR	CHILLAPUR	GOLLAMDEVI THANDA
51208001	NARAYANPUR	CHILLAPUR	RAKU THANDA
51209001	NARAYANPUR	CHILLAPUR	KOTHAGUDA
51300001	NARAYANAPOOR	SERVOIL	
51301001	NARAYANPUR	SURVAIL	MALREDDYGUDA
51302001	NARAYANPUR	SURVAIL	YELLAMDEVICHERUVU
51303001	NARAYANPUR	SURVAIL	TURKONIGUDA
51304001	NARAYANPUR	SURVAIL	GOLLAGUDA
51305001	NARAYANPUR	SURVAIL	ERRAKUNTA
51306001	NARAYANPUR	SURVAIL	CHITTAMBAVI
51307001	NARAYANPUR	SURVAIL	RAJAMMABAVI

PROJECT VILLAGES AND HAMLETS ANNEX 1

WELL NO	MANDAL	VILLAGE	HAMLET
51308001	NARAYANPUR	SURVAIL	MORONIGUDA
51309001	NARAYANPUR	SURVAIL	LINGAVARIGUDA
51310001	NARAYANPUR	SURVAIL	DEVIREDDIGUDA
60100001	NARKETPALLY	NARKETPALLY	
60101001	NARKATPALLY	NARKATPALLY	GOPALPALLY
60102001	NARKATPALLY	NARKATPALLY	CHINTHABAVIGUDA
60200001	NARKETPALLY	B.YELEMLA	
60201001	NARKATPALLY	B.VELLEMLA	KOTHAGUDA
60300001	NARKETPALLY	AURAVANI	
60400001	NARKETPALLY	CHOUDAMPALLY	
60600001	NARKETPALLY	CHERUGATTA	
60601001	NARKATPALLY	CHERVUGATTU	THUMMALABAVI
60602001	NARKATPALLY	CHERVUGATTU	ENUGULADHORI
60700001	NARKETPALLY	YELLAREDDYGUDA	
60701001	NARKATPALLY	YELLAREDDYGUDA	KONDAPAKAGUDEM
60702001	NARKATPALLY	YELLAREDDYGUDA	DASARIGUDA
60703001	NARKATPALLY	YELLAREDDYGUDA	SERIBAVIGUDA
60704001	NARKATPALLY	YELLAREDDYGUDA	CHINANARAYANPUR
60800001	NARKETPALLY	M.YEDAVELLY	
60801001	NARKATPALLY	M.YEDAVALLY	NAIBAVI
60802001	NARKATPALLY	M.YEDAVALLY	PUSALPAD
61100001	NARKETPALLY	NEMMANI	
61300001	NARKETPALLY	MANDRA	
70100001	CHITYAL	CHITYAL	
70101001	CHITYAL	CHITYALA	VENKATAPURAM
70102001	CHITYAL	CHITYALA	POCHAMBAVIGUDA
70200001	CHITYAL	URUMADLA	
70300001	CHITYAL	NEREDA	
70301001	CHITYALA	NERADA	GUDDIREDDIPALLY
70400001	CHITYAL	THALVELEMALA	
70401001	CHITYAL	T.VELLEMLA	VEMBAI
70500001	CHITYAL	YELLIKATA	
70600001	CHITYAL	GUNDRAMPALLI	
70700001	CHITYAL	EAPOOR	
70701001	CHITYAL	AIPUR	SATHIGUDEM
70800001	CHITYAL	CHINAKAPARTY	
70801001	CHITYAL	CHINNAKAPARTHY	BOYAGUBBA
70802001	CHITYAL	CHINNAKAPARTHY	MOSUGUDEM
70803001	CHITYAL	CHINNAKAPARTHY	ENUGLADORI
70900001	CHITYAL	PEDDAKAPAPRTHY	
71000001	CHITYAL	PITTAMPALLY	
71200001	CHITYAL	VANIPAKALA	
71300001	CHITYAL	VATTIMARTHI	
71400001	CHITYAL	SHIVANENIGUDEM	
71600001	CHITYALA	PEREPALLY	
71700001	CHITYALA	BONGONICHERUVU	
80100001	NAMPALLY	NAMPALLY	
80101001	NAMPALLY	NAMPALLY	UPPARAGUDA
80102001	NAMPALLY	NAMPALLY	UNTLEGADDAGUDA
80200001	NAMPALLY	PEDDAPUR	
80201001	NAMPALLY	PEDDAPUR	NARSIMHAGUDA
80202001	NAMPALLY	PEDDAPUR	NAVELLAGUDEM
80203001	NAMPALLY	PEDDAPUR	BANDLAGUDA
80204001	NAMPALLY	PEDDAPUR	PEDDA TANDA
80205001	NAMPALLY	PEDDAPUR	RAJAKUNTA TANDA

PROJECT VILLAGES AND HAMLETS

ANNEX 1

WELL NO	MANDAL	VILLAGE	HAMLET
80206001	NAMPALLY	PEDDAPUR	TURPU TANDA
80207001	NAMPALLY	PEDDAPUR	NIMMATONIBAVI
80208001	NAMPALLY	PEDDAPUR	BOGYA TANDA
80209001	NAMPALLY	PEDDAPUR	JIN TANDA
80300001	NAMPALLY	NEREDLAPALLY	
80400001	NAMPALLY	DAMERA	
80500001	NAMPALLY	DEVATHPALLY	
80501001	NAMPALLY	DEVATPALLY	KUSUMA TANDA
80502001	NAMPALLY	DEVATPALLY	REKYA TANDA
80503001	NAMPALLY	DEVATPALLY	DEVATAPALLY TANDA
80600001	NAMPALLY	S.W.LINGOTAM	
80601001	NAMPALLY	S.LINGOTAM	LAXMAPURAM
80700001	NAMPALLY	WADDEPALLY	
80800001	NAMPALLY	CHITTAMPADU	
80900001	NAMPALLY	THIRMALGIRI	
81000001	NAMPALLY	MALLAPURAJPALLY	
81100001	NAMPALLY	PASNUR	
81101001	NAMPALLY	PASNOOR	CHOLLONA KUNTA
81102001	NAMPALLY	PASNOOR	NAMINAIK TANDA
81103001	NAMPALLY	PASNOOR	RAJA TANDA
81104001	NAMPALLY	PASNOOR	JAMMI TANDA
81105001	NAMPALLY	PASNOOR	POGILLAGUDA
81200001	NAMPALLY	K.THIRMALGIRI	
81300001	NAMPALLY	CHAMALAPALLY	
81400001	NAMPALLY	GANUGUPALLY	
81500001	NAMPALLY	MOHAMMADAPUR	
81501001	NAMPALLY	MOHAMMADAPUR	CHINNA MOHAMMADAPUR
81600001	NAMPALLY	G.MALLEPALLY	
81601001	NAMPALLY	G.MALLEPALLY	BANTUGUDA
81700001	NAMPALLY	KETHEPALLY	
81800001	NAMPALLY	MEDLAVAI	
81900001	NAMPALLY	THUMMALAPALLY	
82000001	NAMPALLY	B.THIMMAPUR	
82100001	NAMPALLY	REVALLY	
82200001	NAMPALLY	SUNKISALA	
82201001	NAMPALLY	SUNKISALA	POTHIMEEDI TANDA
82300001	NAMPALLY	FAKEERPUR	
82400001	NAMPALLY	PAGIDIPLALLY	
82500001	NAMPALLY	MUSTIPALLY	
82501001	NAMPALLY	MUSTIPALLY	RAJNAIK TANDA
82502001	NAMPALLY	MUSTIPALLY	BOTAI TANDA
82503001	NAMPALLY	MUSTIPALLY	MUNTI TANDA
82504001	NAMPALLY	MUSTIPALLY	PERSAI TANDA
82505001	NAMPALLY	MUSTIPALLY	RATHGOI TANDA
82600001	NAMPALLY	HYDALAPUR	
82700001	NAMPALLY	T.P.GOWRARAM	
82701001	NAMPALLY	T.P.GOURARAM	THISAPADU
82702001	NAMPALLY	T.P.GOURARAM	NARSIMHULAGUDEM
82800001	NAMPALLY	SHARBAPUR	
90100001	CHINTAPALLY	CHINTAPALLY	
90200001	CHINTAPALLY	NASARLAPALLY	
90201001	CHINTAPPLI	NARASARALA PALLI	N.PALLI TANDA
90300001	CHINTAPALLY	MALLAREDDIPALLI	
90400001	CHINTAPALLY	HUMANTHLAPALLY	
90500001	CHINTAPALLY	THIRUMALAPUR	

PROJECT VILLAGES AND HAMLETS ANNEX 1

WELL NO	MANDAL	VILLAGE	HAMLET
90600001	CHINTAPALLY	NALVALPALLY	
90800001	CHINTAPALLY	GADIA GOWRARAM	
90801001	CHINTAPPLI	G.GOWRARAM	HANDANPUR
90803001	CHINTAPPLI	G.GOWRARAM	MADUSU GOWRARAM
90900001	CHINTAPALLY	VARKALA	
91000001	CHINTAPALLY	VINJAMOOR	
91001001	CHINTAPPLI	VINJAMUR	NARASHIMHAPUR
91002001	CHINTAPPLI	VINJAMUR	RAYANIGUDA
91003001	CHINTAPPLI	VINJAMUR	BATTUGUDA
91004001	CHINTAPPLI	VINJAMUR	BEDDAMVARIGUDA
91005001	CHINTAPPLI	VINJAMUR	CHITTARAYANIPALLI
91006001	CHINTAPPLI	VINJAMUR	EDULPALLI
91007001	CHINTAPPLI	VINJAMUR	VINJAMUR TANDA
91008001	CHINTAPPLI	VINJAMUR	DEVULA TANDA
91100001	CHINTAPALLY	P.K.MALLAPALLI	
91200001	CHINTAPALLY	KURMAPALLY	
91201001	CHINTAPPLI	KURMAPALLI	M.MALLIPALLI
91202001	CHINTAPPLI	KURMAPALLI	SAIREDDIGUDEM
91300001	CHINTAPALLY	KURMAID	
91301001	CHINTAPPLI	KURMED	GOLLAPALLLI
91302001	CHINTAPPLI	KURMED	BOJYA TANDA
91303001	CHINTAPPLI	KURMED	RATYA TANDA
91304001	CHINTAPPLI	KURMED	GOPYA TANDA
91400001	CHINTAPALLY	UMMAPUR	
91500001	CHINTAPALLY	SUKILISERIPALLY	
91600001	CHINTAPALLY	TAKKELLAPALLY	
91601001	CHINTAPPLI	THAKKADAPALLI	BOTIGADDA TANDA
91700001	CHINTAPALLY	GODAKONDLA	
91701001	CHINTAPPLI	GODUKONDLA	MAL
91900001	CHINTAPALLY	POLEPALLY	
91901001	CHINTAPPLI	POLEPALLI TAM NAGAR	BOTIMIDITANDA
91902001	CHINTAPPLI	POLEPALLI TAM NAGAR	THOORPUTANDA
91903001	CHINTAPPLI	POLEPALLI TAM NAGAR	PADAMATI TANDA
92000001	CHINTAPALLY	MADNAPUR	
92100001	CHINTAPALLY	VENKATAMPET	
92102001	CHINTAPPLI	VENKATAMPET	K.TANDA
92103001	CHINTAPPLI	VENKATAMPET	GASIRAMTHANDA
92103001	CHINTAPPLI	VENKATAMPET	LAXMI TANDA
92104001	CHINTAPPLI	VENKATAMPET	AMORAGANI TANDA
92105001	CHINTAPPLI	VENKATAMPET	DONIYATANDA
92300001	CHINTAPALLY	K.GOURARAM	
100100001	MARRIGUDA	K.B.PALLY	
100102001	MARRIGUDA	K.B.PALLY	SAIBABA TANDA
100103001	MARRIGUDA	K.B.PALLY	BANDAKINDA TANDA
100104001	MARRIGUDA	K.B.PALLY	RENI TANDA
100105001	MARRIGUDA	K.B.PALLY	PADMATI TANDA
100200001	MARRIGUDA	ANTHAMPET	
100201001	MARRIGUDA	ANTHAMPET	ANTHAMPET TANDA
100300001	MARRIGUDA	SOMARAJGUDA	
100301001	MARRIGUDA	SOMARAJA GUDA	ARJUN TANDA
100303001	MARRIGUDA	SOMARAJA GUDA	DHARMA TANDA
100304001	MARRIGUDA	SOMARAJA GUDA	RAJYA TANDA
100305001	MARRIGUDA	SOMARAJA GUDA	BATLA TANDA
100306001	MARRIGUDA	SOMARAJA GUDA	ORODHAN TANDA
100400001	MARRIGUDA	NAMAPURAM	

WELL NO	MANDAL	VILLAGE	HAMLET
100500001	MARRIGUDA	LENKALAPALLY	
100501001	MARRIGUDA	LANKALAPALLY	POLIVIGUDEM
100502001	MARRIGUDA	LANKALAPALLY	IMULA GUDEM
100600001	MARRIGUDA	METICHANDAPUR	
100601001	MARRIGUDA	MEDCHANDAPUR	KOTHALA
100602001	MARRIGUDA	MEDCHANDAPUR	GAJALAPUR
100700001	MARRIGUDA	VENKAPALLY	
100800001	MARRIGUDA	INDURTHY	
100801001	MARRIGUDA	INDURTHY	SIVANNA GUDEM
100802001	MARRIGUDA	INDURTHY	TANEDARPALLY
100803001	MARRIGUDA	INDURTHY	RAMREDDIPALLI
100804001	MARRIGUDA	INDURTHY	NAMIREDDIGUDA
100805001	MARRIGUDA	INDURTHY	CHERLAGUDA
100900001	MARRIGUDA	D.B.PALLI	
100901001	MARRIGUDA	D.BHIMANAPALLY	KAMMAGUDA
100902001	MARRIGUDA	D.BHIMANAPALLY	CHIMAL TANDA
100903001	MARRIGUDA	D.BHIMANAPALLY	BOYATANDA
101000001	MARRIGUDA	SARAMPET	
101001001	MARRIGUDA	SARAMPET	GADDONIGUDEM
101002001	MARRIGUDA	SARAMPET	SARAMPET TANDA
101003001	MARRIGUDA	SARAMPET	MUMMORIGUDA
101100001	MARRIGUDA	VATTIPALLI	
101101001	MARRIGUDA	VATTIPALLY	RAJAPET
101200001	MARRIGUDA	YERGANDLAPALLY	
101201001	MARRIGUDA	YERRAGANDLAPALLY	NARASIMHAPUR
101202001	MARRIGUDA	YERRAGANDLAPALLY	AULAPUR
101203001	MARRIGUDA	YERRAGANDLAPALLY	AZULAPUR TANDA
101300001	MARRIGUDA	THIRGANDLAPALLY	
101400001	MARRIGUDA	THAMMADAPALLY	
101500001	MARRIGUDA	KONDUR	
101501001	MARRIGUDA	KONDUR	KOTHAGUDA
101502001	MARRIGUDA	KONDUR	PADAMATI TANDA
101503001	MARRIGUDA	KONDUR	BOTIMEDI TANDA
101600001	MARRIGUDA	MARRIGUDA	
101601001	MARRIGUDA	MARRIGUDA	THANDA
101700001	MARRIGUDA	BATLAPALLI	
110100001	GURRAMPODE	GURRAMPODE	
110101001	GURRAMPODE	GURRAMPODE	VADDIREDDIGUDA
110102001	GURRAMPODE	GURRAMPODE	UPPARIGUDEM
110200001	GURRAMPODE	CHAMALAID	
110201001	GURRAMPODE	CHAMLED	KOTTONIGUDA
110202001	GURRAMPODE	CHAMLED	BANTIGUDA
110203001	GURRAMPODE	CHAMLED	PEDDABAVIGUDA
110204001	GURRAMPODE	CHAMLED	PITTALAGUDA
110400001	GURRAMPODE	VATTIKODU	
110401001	GURRAMPODE	VATTIKODE	MUNGONIBAVI
110402001	GURRAMPODE	VATTIKODE	CHEMMULORIBAVI
110600001	GURRAMPODE	KOPPOLE	
110601001	GURRAMPODE	KOPPOLE	BUDDAREDDIGUDA
110602001	GURRAMPODE	KOPPOLE	YELMALPAHAD
110603001	GURRAMPODE	KOPPOLE	AGRAGUDEM
110604001	GURRAMPODE	KOPPOLE	VENKATAPURAM
110605001	GURRAMPODE	KOPPOLE	KOYAGRONIBAVI
110606001	GURRAMPODE	KOPPOLE	BODAPAHAD
110607001	GURRAMPODE	KOPPOLE	LAXMIDEVIGUDA

PROJECT VILLAGES AND HAMLETS | ANNEX 1

WELL NO	MANDAL	VILLAGE	HAMLET
110900001	GURRAMPODE	AMLUR	
111000001	GURRAMPODE	BOLLARAM	
111100001	GURRAMPODE	NADIKUDA	
111200001	GURRAMPODE	KOTHALAPUR	
111300001	GURRAMPODE	MOSANGI	
111301001	GURRAMPODE	MOSANGI	REDLAGUDA
111400001	GURRAMPODE	CHEPUR	
111401001	GURRAMPODE	CHEPUR	KONNIGUDA
111402001	GURRAMPODE	CHEPUR	BAPANGUDA
111403001	GURRAMPODE	CHEPUR	TERETIGUDA
111404001	GURRAMPODE	CHEPUR	BATTUGUDA
111500001	GURRAMPODE	PALLEPAHAD	
111600001	GURRAMPODE	KACHARAM	
111700001	GURRAMPODE	TANDARPALLI(JUVIGUDA	
111701001	GURRAMPODE	JUVVIGUDA	THANDARIPALLY
111702001	GURRAMPODE	JUVVIGUDA	JUVVIGUDA TANDA
111703001	GURRAMPODE	JUVVIGUDA	JINNAICHINTA
111800001	GURRAMPODE	MYLAPUR	
111900001	GURRAMPODE	PARLAPALLI	
112000001	GURRAMPODE	JUNUTHALA	
112001001	GURRAMPODE	JUNUTHALA	THANDARIPALLY
112002001	GURRAMPODE	JUNUTHALA	MEDIBAIGUDA
112003001	GURRAMPODE	JUNUTHALA	RAJYAGARI TANDA
112100001	GURRAMPODE	TENEPALLI	
112101001	GURRAMPODE	TENEPALLI	SATYAGAPU TANDA
112102001	GURRAMPODE	TENEPALLI	CHINTAGUDA
112103001	GURRAMPODE	TENEPALLI	KOTTOWIGUDA
112200001	GURRAMPODE	UTLAPALLY	
112300001	GURRAMPODE	SHAKAJIPUR	
112400001	GURRAMPODE	CHINTAGUDA	
112500001	GURRAMPODE	POCHAMPALLY	
112501001	GURRAMPODE	POCHAMPALLY	PAPPONIGUDA
112502001	GURRAMPODE	POCHAMPALLY	BANTIGUDA
112600001	GURRAMPODE	MULKAPALLI	
112700001	GURRAMPODE	SULTHANPUR	
112701001	GURRAMPODE	SULTANPUR	PADAMATIVARIGUDA
112800001	GURRAMPODE	MAKKAPALLI	
112900001	GURRAMPODE	KALVAPALLI	
112901001	GURRAMPODE	KALWALPALLY	VADDARIGUDA
113000001	GURRAMPODE	PALVAI	
113001001	GURRAMPODE	PALWAI	MODIKANI TANDA
113100001	GURRAMPODE	GOURARAM	
113200001	GURRAMPODE	KONDAPUR	
120300001	DEVARAKONDA	K.MALLEPALLY	
120303001	DEVARAKONDA	K.MALLEPALLY	MALLEPALLY X ROADS
120304001	DEVARAKONDA	K.MALLEPALLY	CHIMMORIGUDEM
120305001	DEVARAKONDA	K.MALLEPALLY	POCHETTIBAVI
120306001	DEVARAKONDA	K.MALLEPALLY	GOWRIKUNTA TANDA
120307001	DEVARAKONDA	K.MALLEPALLY	BUDDORI TANDA
120308001	DEVARAKONDA	K.MALLEPALLY	NATYALA TANDA
120309001	DEVARAKONDA	K.MALLEPALLY	GEEJA TANDA
120310001	DEVARAKONDA	K.MALLEPALLY	PATHALAVATTU TANDA
120600001	DEVARAKONDA	PENDLIPAKALA	
120602001	DEVARAKONDA	PENDLIPAKALA	PENDLIPAKALA TANDA
120603001	DEVARAKONDA	PENDLIPAKALA	ISLABAD TANDA

PROJECT VILLAGES AND HAMLETS

WELL NO	MANDAL	VILLAGE	HAMLET
120604001	DEVARAKONDA	PENDLIPAKALA	HONICA
120605001	DEVARAKONDA	PENDLIPAKALA	BAROGANI
120700001	DEVARAKONDA	CHENNARAM	
120701001	DEVARAKONDA	CHENNARAM	GEMNAIK TANDA
120702001	DEVARAKONDA	CHENNARAM	KOMYANAIK TANDA
120703001	DEVARAKONDA	CHENNARAM	ANUBOTHU TANDA
120704001	DEVARAKONDA	CHENNARAM	KURULU TANDA
120800001	DEVARAKONDA	DONIYAL	
120801001	DEVARAKONDA	DONIYAL	KEDDIYAGARI TANDA
120900001	DEVARAKONDA	KOLMUNTHALAPAD	
120901001	DEVARAKONDA	KOLMUNTHALAPAD	KOTHABAVI
120902001	DEVARAKONDA	KOLMUNTHALAPAD	RAMUNIGUDLA TANDA
120903001	DEVARAKONDA	KOLMUNTHALAPAD	KENCHI TANDA
120904001	DEVARAKONDA	KOLMUNTHALAPAD	KESHAVA TANDA
120905001	DEVARAKONDA	KOLMUNTHALAPAD	JAGGAYA TANDA
121000001	DEVARAKONDA	SERIPALLY	
121001001	DEVARAKONDA	SERIPALLY	PEDDA TANDA
121002001	DEVARAKONDA	SERIPALLY	JALJYA TANDA
121003001	DEVARAKONDA	SERIPALLY	RATYA TANDA
121100001	DEVARAKONDA	GUMMADAVELLY	
121200001	DEVARAKONDA	CHINTHAKUNTLA	
121201001	DEVARAKONDA	CHINTHAKUNTA	KORRONI TANDA
121202001	DEVARAKONDA	CHINTHAKUNTA	CHIMMANIBAVI TANDA
121203001	DEVARAKONDA	CHINTHAKUNTA	DESHMUK TANDA
121204001	DEVARAKONDA	CHINTHAKUNTA	PALAPATLA TANDA
121205001	DEVARAKONDA	CHINTHAKUNTA	MODUGUNDLA TANDA
121300001	DEVARAKONDA	FAKEERPUR	
130100001	PEDDAVOORA	PEDDAVOORA	
130101001	PEDDAVOORA	PEDDAVOORA	BHATTIGUDA
130102001	PEDDAVOORA	PEDDAVOORA	KOTHAGUDA
130103001	PEDDAVOORA	PEDDAVOORA	ELLULLAGUDA
130300001	PEDDAVOORA	POTHNUR	
130400001	PEDDAVOORA	PARVEDLA	
130401001	PEDDAVOORA	PARVEDULA	PATTI TANDA
130402001	PEDDAVOORA	PARVEDULA	SUDDABAI TANDA
130403001	PEDDAVOORA	PARVEDULA	BETTU TANDA
130500001	PEDDAVOORA	SINGARAM	
130600001	PEDDAVOORA	PULICHERLA	
130601001	PEDDAVOORA	PULICHERLA	KOMATIKUNTA TANDA
130602001	PEDDAVOORA	PULICHERLA	ERRAKUNTA TANDA
130700001	PEDDAVOORA	VUTLAPALLY	
130701001	PEDDAVOORA	UTLAPALLY	GANGANAIK TANDA
130702001	PEDDAVOORA	UTLAPALLY	KASAIAH TANDA
130703001	PEDDAVOORA	UTLAPALLY	JAGYARAM TANDA
130800001	PEDDAVOORA	PINNAVOORA	
131600001	PEDDAVOORA	CHINTAPALLY	
131601001	PEDDAVOORA	CHINTHAPALLY	CHINTAPALLYTANDAEAST
131602001	PEDDAVOORA	CHINTHAPALLY	CHINTAPALLYTANDAWEST
140200001	P.A.PALLY	WADDIPATLA	
140202001	P.A.PALLY	WADDIPATLA	CHINTALA TANDA
140203001	*P.A.PALLY*	*WADDIPATLA*	*PUTTAGANDI THANDA*
140205001	P.A.PALLY	WADDIPATLA	PADAMATI TANDA
140206001	P.A.PALLY	WADDIPATLA	PALGU TANDA
140207001	P.A.PALLY	WADDIPATLA	HANUMAGONI TANDA
140208001	P.A.PALLY	WADDIPATLA	PAVURALLA TANDA

PROJECT VILLAGES AND HAMLETS ANNEX 1

WELL NO	MANDAL	VILLAGE	HAMLET
140300001	P.A.PALLY	MALLAPUR	
140301001	P.A.PALLY	MALLAPUR	YERRAKUNTLA TANDA
140400001	P.A.PALLY	P.A. PALLY	
140401001	P.A.PALLY	P.A.PALLY	NENAVATH TANDA
140402001	P.A.PALLY	P.A.PALLY	MANGALI TANDA
140403001	P.A.PALLY	P.A.PALLY	AKKINEPALLY
140403001	P.A.PALLY	P.A.PALLY	POTHIREDDIPALLY
140406001	P.A.PALLY	P.A.PALLY	RAMAPUR
140407001	P.A.PALLY	P.A.PALLY	POGAKAIGUDA
140408001	P.A.PALLY	P.A.PALLY	POLEPALLY TANDA
140409001	P.A.PALLY	P.A.PALLY	RAMAVATH TANDA
140410001	P.A.PALLY	P.A.PALLY	ANGADIPETA
140411001	P.A.PALLY	P.A.PALLY	SURYAGANI TANDA - I
140500001	P.A.PALLY	DUGYAL	
140501001	P.A.PALLY	DUGYAL	PILLIGUNTLA TANDA
140700001	P.A.PALLY	CHILAKAMARRI	
140701001	P.A.PALLY	SUREPALLY	
140702001	P.A.PALLY	CHILKAMARRI	PEDDABAIGUDA
140800001	P.A.PALLY	TIRUMALAGIRI	
140801001	P.A.PALLY	TIRUMALAGIRI	VEDDERIGUDEM
140900001	P.A.PALLY	MEDARAM	
140901001	P.A.PALLY	MEDARAM	MADHARIGUDEM
140902001	P.A.PALLY	MEDARAM	RANGAREDDIGUDA
141000001	P.A.PALLY	KESHAMANENIPALLY	
141100001	P.A.PALLY	GHANPUR	
141101001	P.A.PALLY	GHANPUR	KONDANDAPUR
141102001	P.A.PALLY	GHANPUR	MUNAVATH THANDA
141103001	P.A.PALLY	GHANPUR	GHANPUR GATE
141200001	P.A.PALLY	GUDIPALLY	
141201001	P.A.PALLY	GUDIPALLY	NADIMBAVIGUDEM
141202001	P.A.PALLY	GUDIPALLY	SINGARAJUPALLY
141203001	P.A.PALLY	ROLEKAI	
141204001	P.A.PALLY	GUDIPALLY	BHARTHAPUR
141205001	P.A.PALLY	GUDIPALLY	CHUGULLAGUDA
141300001	P.A.PALLY	G.BHEEMANAPALLY	
141301001	P.A.PALLY	GHANPALLY	
141303001	P.A.PALLY	G.BHEEMANPALLY	GINUKULAVANIGUDA
141304001	P.A.PALLY	G.BHEEMANPALLY	NAYANIPALEM
141500001	P.A.PALLY	POLKAMPALLY	
141501001	P.A.PALLY	G.NEMLIPUR	
141600001	P.A.PALLY	C.A.PALLY	
141601001	P.A.PALLY	C.A.PALLY	CADDIYA TANDA
141700001	P.A.PALLY	MADHAPUR	
150100001	ANUMALA	YACHARAM	
150101001	ANUMULA	YACHARAM	KOCHOLLAGUDA
150200001	ANUMALA	VENKATADRIPALEM	
150400001	ANUMALA	MUKKAMALA	
150500001	ANUMALA	MAREPALLI	
150600001	ANUMALA	KESALAMARRI	
150700001	ANUMALA	ALWAL	
160200001	CHOUTUPPAL	CHOUTUPPAL	
160203001	CHOUTUPPAL	CHOUTUPPAL	LINGAREDDIGUDA
160300001	CHOUTUPPAL	LAKKARAM	
160301001	CHOUTUPPAL	LAKKARAM	DARMOJIGUDA
160400001	CHOUTUPPAL	TANGADAPALLY	

PROJECT VILLAGES AND HAMLETS ANNEX 1

WELL NO	MANDAL	VILLAGE	HAMLET
160401001	CHOUTUPPAL	TANGADAPALLY	CHINTALAGUDA
160402001	CHOUTUPPAL	TANGADAPALLY	DAMERA
160500001	CHOUTUPPAL	LINGOJIGUDEM	
160501001	CHOUTUPPAL	LINGOJIGUDA	JILLEDU CHELKA
160502001	CHOUTUPPAL	LINGOJIGUDA	ANKIREDDIGUDA
160503001	CHOUTUPPAL	LINGOJIGUDA	KATUR
160600001	CHOUTUPPAL	PANTHANGI	
160601001	CHOUTUPPAL	PANTHANGI	SAIDABAD
160602001	CHOUTUPPAL	PANTHANGI	AREGUDEM
160603001	CHOUTUPPAL	PANTHANGI	REDDIBAVI
160604001	CHOUTUPPAL	PANTHANGI	GUNDLABAVI
160605001	CHOUTUPPAL	PANTHANGI	THUMBAVI
160800001	CHOUTUPPAL	TALASINGARAM	

Appendix 5.2

Population and water demand

POPULATION AND WATERDEMAND PROJECTIONS

ANNEX 2

WELL NO.	MANDAL	VILLAGE	ELEV. MASL	PROJ. PHASE	POP. 1991	POP. 2007	POP. 2022	WATERDEMAND (M3/DAY) 1991			WATERDEMAND (M3/DAY) 2007			WATERDEMAND (M3/DAY) 2022		
								DRINK.	OTHER	TOTAL	DRINK.	OTHER	TOTAL	DRINK.	OTHER	TOTAL
10100001	NALGONDA	ANNAPARTHY	251.52	1	1784	2426	3229	17.8	80.3	98.1	24.3	109.2	133.4	32.3	145.3	177.6
10300001	NALGONDA	BUDDHARAM	249.99	1	3304	4493	5980	33.0	148.7	181.7	44.9	202.2	247.1	59.8	269.1	328.9
10400001	NALGONDA	CHERLAPALLI	245.32	1	4768	6484	8630	47.7	214.6	262.2	64.8	291.8	356.6	86.3	388.4	474.7
10600001	NALGONDA	KANCHANPALLY	0.00	1	2217	3015	4013	22.2	99.8	121.9	30.2	135.7	165.8	40.1	180.6	220.7
10700001	NALGONDA	K.KONDARAM	236.53	1	1747	2376	3162	17.5	78.6	96.1	23.8	106.9	130.7	31.6	142.3	173.9
10900001	NALGONDA	MARRIGUDA		1	2743	3730	4965	27.4	123.4	150.9	37.3	167.9	205.2	49.6	223.4	273.1
11200001	NALGONDA	DONAKAL	228.16	1	754	1025	1365	7.5	33.9	41.5	10.3	46.1	56.4	13.6	61.4	75.1
11300001	NALGONDA	APPAJIPET	249.60	1	3325	4522	6018	33.3	149.6	182.9	45.2	203.5	248.7	60.2	270.8	331.0
11500001	NALGONDA	P.DOMALAPALLY	238.73	1	1272	1730	2302	12.7	57.2	70.0	17.3	77.8	95.1	23.0	103.6	126.6
21000001	KANGAL	PONGODU	226.24	1	2774	3773	5021	27.7	124.8	152.6	37.7	169.8	207.5	50.2	225.9	276.2
21100001	KANGAL	REGATTA	223.53	1	3607	4906	6529	36.1	162.3	198.4	49.1	220.7	269.8	65.3	293.8	359.1
21500001	KANGAL	TURKAPALLY	187.00	2	683	929	1236	6.8	30.7	37.6	9.3	41.8	51.1	12.4	55.6	68.0
30100001	MUNGODE	MUNGODE	247.23	1	8005	10887	14489	80.1	360.2	440.3	108.9	489.9	598.8	144.9	652.0	796.9
30200001	MUNGODE	KISTAPUR	288.66	1	1425	1938	2579	14.3	64.1	78.4	19.4	87.2	106.6	25.8	116.1	141.9
30300001	MUNGODE	IPPARTHY	274.94	1	1238	1684	2241	12.4	55.7	68.1	16.8	75.8	92.6	22.4	100.8	123.2
30400001	MUNGODE	SINGARAM	251.40	1	1142	1553	2067	11.4	51.4	62.8	15.5	69.9	85.4	20.7	93.0	113.7
30500001	MUNGODE	KATCHAPUR	258.28	1	463	630	838	4.6	20.8	25.5	6.3	28.3	34.6	8.4	37.7	46.1
30600001	MUNGODE	PALIWALA	280.66	1	2379	3235	4306	23.8	107.1	130.8	32.4	145.6	177.9	43.1	193.8	236.8
30700001	MUNGODE	CHALIMEDA	292.09	1	893	1214	1616	8.9	40.2	49.1	12.1	54.7	66.8	16.2	72.7	88.9
30800001	MUNGODE	KOMPALLY	273.65	1	2310	3142	4181	23.1	104.0	127.1	31.4	141.4	172.8	41.8	188.1	230.0
30900001	MUNGODE	CHIKATIMAMIDI	267.72	1	2389	3249	4324	23.9	107.5	131.4	32.5	146.2	178.7	43.2	194.6	237.8
31000001	MUNGODE	KORATIKAL	232.10	1	3193	4342	5779	31.9	143.7	175.6	43.4	195.4	238.8	57.8	260.1	317.9
31100001	MUNGODE	CHOLLEDU	267.27	1	1358	1847	2458	13.6	61.1	74.7	18.5	83.1	101.6	24.6	110.6	135.2
31200001	MUNGODE	KALVAKUNTA	277.45	1	916	1246	1658	9.2	41.2	50.4	12.5	56.1	68.5	16.6	74.6	91.2
31300001	MUNGODE	VELMAKANNE	290.43	1	2232	3036	4040	22.3	100.4	122.8	30.4	136.6	167.0	40.4	181.8	222.2
31400001	MUNGODE	PULIPALUPULA	254.75	1	2495	3393	4516	25.0	112.3	137.2	33.9	152.7	186.6	45.2	203.2	248.4
31500001	MUNGODE	KALVALAPALLY		1	1962	2668	3551	19.6	88.3	107.9	26.7	120.1	146.8	35.5	159.8	195.3
31600001	MUNGODE	JAMISTHANPALLY	248.88	1	345	469	624	3.5	15.5	19.0	4.7	21.1	25.8	6.2	28.1	34.3
31700001	MUNGODE	GUDAPUR		1	1342	1825	2429	13.4	60.4	73.8	18.3	82.1	100.4	24.3	109.3	133.6
31800001	MUNGODE	SOLIPUR		1	384	522	695	3.8	17.3	21.1	5.2	23.5	28.7	7.0	31.3	38.2
31900001	MUNGODE	KOTHLARAM	297.06	1	851	1157	1540	8.5	38.3	46.8	11.6	52.1	63.7	15.4	69.3	84.7
32000001	MUNGODE	RATHIPALLY	264.01	1	735	1000	1330	7.4	33.1	40.4	10.0	45.0	55.0	13.3	59.9	73.2
32100001	MUNGODE	OOKONDI	261.42	1	1942	2641	3515	19.4	87.4	106.8	26.4	118.9	145.3	35.2	158.2	193.3
40100001	CHANDOOR	CHANDOOR	250.03	1	8862	12052	16040	88.6	398.8	487.4	120.5	542.4	662.9	160.4	721.8	882.2
40200001	CHANDOOR	THEROTPALLI		1	3421	4653	6192	34.2	153.9	188.2	46.5	209.4	255.9	61.9	278.6	340.6
40300001	CHANDOOR	PULEMLA	268.13	1	2270	3087	4109	22.7	102.2	124.9	30.9	138.9	169.8	41.1	184.9	226.0
40400001	CHANDOOR	IDIKUDI	263.25	1	1785	2428	3231	17.9	80.3	98.2	24.3	109.2	133.5	32.3	145.4	177.7
40500001	CHANDOOR	ANGADIPET	258.26	1	1485	2020	2688	14.9	66.8	81.7	20.2	90.9	111.1	26.9	121.0	147.8
40600001	CHANDOOR	DONIPAMULA		1	2162	2940	3913	21.6	97.3	118.9	29.4	132.3	161.7	39.1	176.1	215.2
40700001	CHANDOOR	GUNDRAPALLY	250.00	2	1752	2383	3171	17.5	78.8	96.4	23.8	107.2	131.0	31.7	142.7	174.4

POPULATION AND WATERDEMAND PROJECTIONS

ANNEX 2

WELL NO.	MANDAL	VILLAGE	ELEV. MASL	PROJ. PHASE	POP. 1991	POP. 2007	POP. 2022	WATERDEMAND (M3/DAY) 1991			WATERDEMAND (M3/DAY) 2007			WATERDEMAND (M3/DAY) 2022		
								DRINK.	OTHER	TOTAL	DRINK.	OTHER	TOTAL	DRINK.	OTHER	TOTAL
40800001	CHANDOOR	GHATUPPAL		1	6022	8190	10900	60.2	271.0	331.2	81.9	368.5	450.4	109.0	490.5	599.5
40900001	CHANDOOR	KONDAPUR	276.15	1	1583	2153	2865	15.8	71.2	87.1	21.5	96.9	118.4	28.7	128.9	157.6
41000001	CHANDOOR	BODANGAPARTHY	252.97	1	1135	1544	2054	11.4	51.1	62.4	15.4	69.5	84.9	20.5	92.4	113.0
41100001	CHANDOOR	BANGARIGADDA	260.13	1	2515	3420	4552	25.2	113.2	138.3	34.2	153.9	188.1	45.5	204.8	250.4
41200001	CHANDOOR	NERMETTA		1	1577	2145	2854	15.8	71.0	86.7	21.4	96.5	118.0	28.5	128.4	157.0
41300001	CHANDOOR	THUMMALAPALLY	280.00	2	1440	1958	2606	14.4	64.8	79.2	19.6	88.1	107.7	26.1	117.3	143.4
41400001	CHANDOOR	KASTALA	238.09	1	2616	3558	4735	26.2	117.7	143.9	35.6	160.1	195.7	47.3	213.1	260.4
41500001	CHANDOOR	SERIDEPALLY	246.16	1	1125	1530	2036	11.3	50.6	61.9	15.3	68.9	84.2	20.4	91.6	112.0
41600001	CHANDOOR	UDTHAPALLY		1	956	1300	1730	9.6	43.0	52.6	13.0	58.5	71.5	17.3	77.9	95.2
50100001	NARAYANAPOOR	NARAYANAPOOR	355.53	1	8224	11185	14885	82.2	370.1	452.3	111.8	503.3	615.2	148.9	669.8	818.7
50200001	NARAYANAPOOR	GUJJA	303.70	1	2887	3926	5225	28.9	129.9	158.8	39.3	176.7	215.9	52.3	235.1	287.4
50300001	NARAYANAPOOR	MOHAMMADABAD	350.85	1	958	1303	1734	9.6	43.1	52.7	13.0	58.6	71.7	17.3	78.0	95.4
50400001	NARAYANAPOOR	CHINNA MIRIYALA	334.95	1	1195	1625	2163	12.0	53.8	65.7	16.3	73.1	89.4	21.6	97.3	119.0
50500001	NARAYANAPOOR	GUDDIMALKAPUR	346.91	1	858	1167	1553	8.6	38.6	47.2	11.7	52.5	64.2	15.5	69.9	85.4
50600001	NARAYANAPOOR	KOTHALAPUR		1	632	860	1144	6.3	28.4	34.8	8.6	38.7	47.3	11.4	51.5	62.9
50700001	NARAYANAPOOR	PUTTAPAKA	312.07	1	3111	4231	5631	31.1	140.0	171.1	42.3	190.4	232.7	56.3	253.4	309.7
50800001	NARAYANAPOOR	KANKHANALAGUDA		1	1405	1911	2543	14.1	63.2	77.3	19.1	86.0	105.1	25.4	114.4	139.9
50900001	NARAYANAPOOR	KOTHAGUDA	338.11	1	1454	1977	2632	14.5	65.4	80.0	19.8	89.0	108.8	26.3	118.4	144.7
51000001	NARAYANAPOOR	JANGAON		1	4834	6574	8750	48.3	217.5	265.9	65.7	295.8	361.6	87.5	393.7	481.2
51100001	NARAYANAPOOR	VOIPALLY		1	3982	5416	7207	39.8	179.2	219.0	54.2	243.7	297.9	72.1	324.3	396.4
51200001	NARAYANAPOOR	CHILLAPUR		1	3251	4421	5884	32.5	146.3	178.8	44.2	199.0	243.2	58.8	264.8	323.6
51300001	NARAYANAPOOR	SERVOIL	320.69	1	8159	11096	14768	81.6	367.2	448.7	111.0	499.3	610.3	147.7	664.6	812.2
60100001	NARKETPALLY	NARKETPALLY	278.96	1	1221	1661	2210	12.2	54.9	67.2	16.6	74.7	91.3	22.1	99.5	121.6
60200001	NARKETPALLY	B.YELEMLA	277.57	1	3094	4208	5600	30.9	139.2	170.2	42.1	189.4	231.4	56.0	252.0	308.0
60300001	NARKETPALLY	AURAVANI	262.21	1	1449	1971	2623	14.5	65.2	79.7	19.7	88.7	108.4	26.2	118.0	144.2
60400001	NARKETPALLY	CHOUDAMPALLY	280.00	1	433	589	784	4.3	19.5	23.8	5.9	26.5	32.4	7.8	35.3	43.1
60600001	NARKETPALLY	CHERUGATTA	265.22	1	3373	4587	6105	33.7	151.8	185.5	45.9	206.4	252.3	61.1	274.7	335.8
60700001	NARKETPALLY	YELLAREDDYGUDA	256.57	1	3107	4226	5624	31.1	139.8	170.9	42.3	190.1	232.4	56.2	253.1	309.3
60800001	NARKETPALLY	M.YEDAVELLY	274.93	1	1336	1817	2418	13.4	60.1	73.5	18.2	81.8	99.9	24.2	108.8	133.0
61100001	NARKETPALLY	NEMMANI		1	2221	3021	4020	22.2	99.9	122.2	30.2	135.9	166.1	40.2	180.9	221.1
61300001	NARKETPALLY	MANDRA	298.74	1	1484	2018	2686	14.8	66.8	81.6	20.2	90.8	111.0	26.9	120.9	147.7
70100001	CHITYAL	CHITYAL	314.42	1	9824	13361	17781	98.2	442.1	540.3	133.6	601.2	734.8	177.8	800.2	978.0
70200001	CHITYAL	URUMADLA	295.80	1	7226	9827	13079	72.3	325.2	397.4	98.3	442.2	540.5	130.8	588.6	719.3
70300001	CHITYAL	NEREDA	292.39	1	3732	5076	6755	37.3	167.9	205.3	50.8	228.4	279.2	67.5	304.0	371.5
70400001	CHITYAL	THALVELEMALA	274.13	1	2358	3207	4268	23.6	106.1	129.7	32.1	144.3	176.4	42.7	192.1	234.7
70500001	CHITYAL	YELLIKATA	276.78	1	1888	2568	3417	18.9	85.0	103.8	25.7	115.5	141.2	34.2	153.8	188.0
70600001	CHITYAL	GUNDRAMPALLI	319.36	1	3128	4254	5662	31.3	140.8	172.0	42.5	191.4	234.0	56.6	254.8	311.4
70700001	CHITYAL	EAPOOR		1	2188	2976	3960	21.9	98.5	120.3	29.8	133.9	163.7	39.6	178.2	217.8
70800001	CHITYAL	CHINAKAPARTY	297.41	1	3613	4914	6540	36.1	162.6	198.7	49.1	221.1	270.3	65.4	294.3	359.7
70900001	CHITYAL	PEDDAKAPAPRTHY		1	4131	5618	7477	41.3	185.9	227.2	56.2	252.8	309.0	74.8	336.5	411.2

POPULATION AND WATERDEMAND PROJECTIONS

ANNEX 2

WELL NO.	MANDAL	VILLAGE	ELEV. MASL	PROJ. PHASE	POP. 1991	POP. 2007	POP. 2022	WATERDEMAND (M3/DAY) 1991			WATERDEMAND (M3/DAY) 2007			WATERDEMAND (M3/DAY) 2022		
								DRINK.	OTHER	TOTAL	DRINK.	OTHER	TOTAL	DRINK.	OTHER	TOTAL
71000001	CHITYAL	PITTAMPALLY		1	1280	1741	2317	12.8	57.6	70.4	17.4	78.3	95.7	23.2	104.3	127.4
71200001	CHITYAL	VANIPAKALA	245.62	1	2242	3049	4058	22.4	100.9	123.3	30.5	137.2	167.7	40.6	182.6	223.2
71300001	CHITYAL	VATTIMARTHI	296.19	1	1839	2501	3329	18.4	82.8	101.1	25.0	112.5	137.6	33.3	149.8	183.1
71400001	CHITYAL	SHIVANENIGUDEM	317.27	1	1092	1485	1977	10.9	49.1	60.1	14.9	66.8	81.7	19.8	88.9	108.7
71600001	CHITYALA	PEREPALLY	299.06	1	1450	1972	2625	14.5	65.3	79.8	19.7	88.7	108.5	26.2	118.1	144.3
71700001	CHITYALA	BONGONICHERUVU	314.13	1	516	702	934	5.2	23.2	28.4	7.0	31.6	38.6	9.3	42.0	51.4
80100001	NAMPALLY	NAMPALLY	290.00	2	3501	4761	6337	35.0	157.5	192.6	47.6	214.3	261.9	63.4	285.2	348.5
80200001	NAMPALLY	PEDDAPUR	290.00	2	3592	4885	6502	35.9	161.6	197.6	48.9	219.8	268.7	65.0	292.6	357.6
80300001	NAMPALLY	NEREDLAPALLY		1	1452	1975	2628	14.5	65.3	79.9	19.7	88.9	108.6	26.3	118.3	144.5
80400001	NAMPALLY	DAMERA		1	1730	2353	3131	17.3	77.9	95.2	23.5	105.9	129.4	31.3	140.9	172.2
80500001	NAMPALLY	DEVATHPALLY	290.00	2	1486	2021	2690	14.9	66.9	81.7	20.2	90.9	111.2	26.9	121.0	147.9
80600001	NAMPALLY	S.W.LINGOTAM		1	1946	2647	3522	19.5	87.6	107.0	26.5	119.1	145.6	35.2	158.5	193.7
80700001	NAMPALLY	WADDEPALLY	ERR	1	1242	1689	2248	12.4	55.9	68.3	16.9	76.0	92.9	22.5	101.2	123.6
80800001	NAMPALLY	CHITTAMPADU	320.00	2	948	1289	1716	9.5	42.7	52.1	12.9	58.0	70.9	17.2	77.2	94.4
80900001	NAMPALLY	THIRMALGIRI	291.00	2	1004	1365	1817	10.0	45.2	55.2	13.7	61.4	75.1	18.2	81.8	99.9
81000001	NAMPALLY	MALLAPURAJPALLY	360.00	2	1188	1616	2150	11.9	53.5	65.3	16.2	72.7	88.9	21.5	96.8	118.3
81100001	NAMPALLY	PASNUR	302.00	2	3531	4802	6391	35.3	158.9	194.2	48.0	216.1	264.1	63.9	287.6	351.5
81200001	NAMPALLY	K.THIRMALGIRI	305.00	2	127	173	230	1.3	5.7	7.0	1.7	7.8	9.5	2.3	10.3	12.6
81300001	NAMPALLY	CHAMALAPALLY	245.00	2	1401	1905	2536	14.0	63.0	77.1	19.1	85.7	104.8	25.4	114.1	139.5
81400001	NAMPALLY	GANUGUPALLY	275.00	2	647	880	1171	6.5	29.1	35.6	8.8	39.6	48.4	11.7	52.7	64.4
81500001	NAMPALLY	MOHAMMADAPUR	245.00	2	1403	1908	2539	14.0	63.1	77.2	19.1	85.9	104.9	25.4	114.3	139.7
81600001	NAMPALLY	G.MALLEPALLY	293.00	2	1275	1734	2308	12.8	57.4	70.1	17.3	78.0	95.4	23.1	103.8	126.9
81700001	NAMPALLY	KETHEPALLY	300.00	2	626	851	1133	6.3	28.2	34.4	8.5	38.3	46.8	11.3	51.0	62.3
81800001	NAMPALLY	MEDLAVAI		2	1351	1837	2445	13.5	60.8	74.3	18.4	82.7	101.1	24.5	110.0	134.5
81900001	NAMPALLY	THUMMALAPALLY	290.00	2	790	1074	1430	7.9	35.6	43.5	10.7	48.3	59.1	14.3	64.3	78.6
82000001	NAMPALLY	B.THIMMAPUR	290.00	2	583	793	1055	5.8	26.2	32.1	7.9	35.7	43.6	10.6	47.5	58.0
82100001	NAMPALLY	REVALLY	290.00	2	835	1136	1511	8.4	37.6	45.9	11.4	51.1	62.5	15.1	68.0	83.1
82200001	NAMPALLY	SUNKISALA	295.00	2	526	715	952	5.3	23.7	28.9	7.2	32.2	39.3	9.5	42.8	52.4
82300001	NAMPALLY	FAKEERPUR	299.00	2	324	441	586	3.2	14.6	17.8	4.4	19.8	24.2	5.9	26.4	32.3
82400001	NAMPALLY	PAGIDIPLALLY	290.00	2	380	517	688	3.8	17.1	20.9	5.2	23.3	28.4	6.9	31.0	37.8
82500001	NAMPALLY	MUSTIPALLY	290.00	2	2244	3052	4062	22.4	101.0	123.4	30.5	137.3	167.9	40.6	182.8	223.4
82600001	NAMPALLY	HYDALAPUR	ERR	1	168	228	304	1.7	7.6	9.2	2.3	10.3	12.6	3.0	13.7	16.7
82700001	NAMPALLY	T.P.GOWRARAM		1	1527	2077	2764	15.3	68.7	84.0	20.8	93.5	114.2	27.6	124.4	152.0
82800001	NAMPALLY	SHARBAPUR	290.00	2	258	351	467	2.6	11.6	14.2	3.5	15.8	19.3	4.7	21.0	25.7
90100001	CHINTAPALLY	CHINTAPALLY	367.00	2	3815	5188	6905	38.2	171.7	209.8	51.9	233.5	285.4	69.1	310.7	379.8
90200001	CHINTAPALLY	NASARLAPALLY	360.00	2	1962	2668	3551	19.6	88.3	107.9	26.7	120.1	146.8	35.5	159.8	195.3
90300001	CHINTAPALLY	MALLAREDDIPALLI	354.00	2	1530	2081	2769	15.3	68.9	84.2	20.8	93.6	114.4	27.7	124.6	152.3
90400001	CHINTAPALLY	HUMANTHLAPALLY	360.00	2	1514	2059	2740	15.1	68.1	83.3	20.6	92.7	113.2	27.4	123.3	150.7
90500001	CHINTAPALLY	THIRUMALAPUR	350.00	2	286	389	518	2.9	12.9	15.7	3.9	17.5	21.4	5.2	23.3	28.5
90600001	CHINTAPALLY	NALVALPALLY	260.00	2	1411	1919	2554	14.1	63.5	77.6	19.2	86.4	105.5	25.5	114.9	140.5

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WELL NO.	MANDAL	VILLAGE	ELEV. MASL	PROJ. PHASE	POP. 1991	POP. 2007	POP. 2022	WATERDEMAND (M3/DAY) 1991			WATERDEMAND (M3/DAY) 2007			WATERDEMAND (M3/DAY) 2022		
								DRINK.	OTHER	TOTAL	DRINK.	OTHER	TOTAL	DRINK.	OTHER	TOTAL
90800001	CHINTAPALLY	GADIA GOWRARAM	350.00	2	2464	3351	4460	24.6	110.9	135.5	33.5	150.8	184.3	44.6	200.7	245.3
90900001	CHINTAPALLY	VARKALA	360.00	2	1047	1424	1895	10.5	47.1	57.6	14.2	64.1	78.3	19.0	85.3	104.2
91000001	CHINTAPALLY	VINJAMOOR		1	5694	7744	10306	56.9	256.2	313.2	77.4	348.5	425.9	103.1	463.8	566.8
91100001	CHINTAPALLY	P.K.MALLAPALLI		1	918	1248	1662	9.2	41.3	50.5	12.5	56.2	68.7	16.6	74.8	91.4
91200001	CHINTAPALLY	KURMAPALLY		1	4769	6486	8632	47.7	214.6	262.3	64.9	291.9	356.7	86.3	388.4	474.8
91300001	CHINTAPALLY	KURMAID		1	3348	4553	6060	33.5	150.7	184.1	45.5	204.9	250.4	60.6	272.7	333.3
91400001	CHINTAPALLY	UMMAPUR		1	517	703	936	5.2	23.3	28.4	7.0	31.6	38.7	9.4	42.1	51.5
91500001	CHINTAPALLY	SUKILISERIPALLY	ERR	1	792	1077	1434	7.9	35.6	43.6	10.8	48.5	59.2	14.3	64.5	78.8
91600001	CHINTAPALLY	TAKKELLAPALLY		1	1512	2056	2737	15.1	68.0	83.2	20.6	92.5	113.1	27.4	123.2	150.5
91700001	CHINTAPALLY	GODAKONDLA		1	3105	4223	5620	31.1	139.7	170.8	42.2	190.0	232.3	56.2	252.9	309.1
91900001	CHINTAPALLY	POLEPALLY		1	2332	3172	4221	23.3	104.9	128.3	31.7	142.7	174.4	42.2	189.9	232.2
92000001	CHINTAPALLY	MADNAPUR		1	885	1204	1602	8.9	39.8	48.7	12.0	54.2	66.2	16.0	72.1	88.1
92100001	CHINTAPALLY	VENKATAMPET	304.00	2	1939	2637	3510	19.4	87.3	106.6	26.4	118.7	145.0	35.1	157.9	193.0
92300001	CHINTAPALLY	K.GOURARAM	355.00	2	792	1077	1434	7.9	35.6	43.6	10.8	48.5	59.2	14.3	64.5	78.8
100100001	MARRIGUDA	K.B.PALLY		1	3006	4088	5441	30.1	135.3	165.3	40.9	184.0	224.8	54.4	244.8	299.2
100200001	MARRIGUDA	ANTHAMPET		1	1118	1520	2024	11.2	50.3	61.5	15.2	68.4	83.6	20.2	91.1	111.3
100300001	MARRIGUDA	SOMARAJGUDA		1	1275	1734	2308	12.8	57.4	70.1	17.3	78.0	95.4	23.1	103.8	126.9
100400001	MARRIGUDA	NAMAPURAM		1	1355	1843	2453	13.6	61.0	74.5	18.4	82.9	101.4	24.5	110.4	134.9
100500001	MARRIGUDA	LENKALAPALLY		1	1776	2415	3215	17.8	79.9	97.7	24.2	108.7	132.8	32.1	144.7	176.8
100600001	MARRIGUDA	METICHANDAPUR		1	1260	1714	2281	12.6	56.7	69.3	17.1	77.1	94.2	22.8	102.6	125.4
100700001	MARRIGUDA	VENKAPALLY		1	846	1151	1531	8.5	38.1	46.5	11.5	51.8	63.3	15.3	68.9	84.2
100800001	MARRIGUDA	INDURTHY		1	6036	8209	10925	60.4	271.6	332.0	82.1	369.4	451.5	109.3	491.6	600.9
100900001	MARRIGUDA	D.B.PALLI		1	3673	4995	6648	36.7	165.3	202.0	50.0	224.8	274.7	66.5	299.2	365.6
101000001	MARRIGUDA	SARAMPET		1	1246	1695	2255	12.5	56.1	68.5	16.9	76.3	93.2	22.6	101.5	124.0
101100001	MARRIGUDA	VATTIPALLI		1	1822	2478	3298	18.2	82.0	100.2	24.8	111.5	136.3	33.0	148.4	181.4
101200001	MARRIGUDA	YERGANDLAPALLY		1	3381	4598	6120	33.8	152.1	186.0	46.0	206.9	252.9	61.2	275.4	336.6
101300001	MARRIGUDA	THIRGANDLAPALLY		1	1455	1979	2634	14.6	65.5	80.0	19.8	89.0	108.8	26.3	118.5	144.8
101400001	MARRIGUDA	THAMMADAPALLY		1	792	1077	1434	7.9	35.6	43.6	10.8	48.5	59.2	14.3	64.5	78.8
101500001	MARRIGUDA	KONDUR		1	1141	1552	2065	11.4	51.3	62.8	15.5	69.8	85.3	20.7	92.9	113.6
101600001	MARRIGUDA	MARRIGUDA		1	3334	4534	6035	33.3	150.0	183.4	45.3	204.0	249.4	60.3	271.6	331.9
101700001	MARRIGUDA	BATLAPALLI		1	344	468	623	3.4	15.5	18.9	4.7	21.1	25.7	6.2	28.0	34.2
110100001	GURRAMPODE	GURRAMPODE	223.00	2	1831	2490	3314	18.3	82.4	100.7	24.9	112.1	137.0	33.1	149.1	182.3
110200001	GURRAMPODE	CHAMALAID	220.00	2	2696	3667	4880	27.0	121.3	148.3	36.7	165.0	201.7	48.8	219.6	268.4
110400001	GURRAMPODE	VATTIKODU	255.00	2	2455	3339	4444	24.6	110.5	135.0	33.4	150.2	183.6	44.4	200.0	244.4
110600001	GURRAMPODE	KOPPOLE	208.00	2	5489	7465	9935	54.9	247.0	301.9	74.7	335.9	410.6	99.4	447.1	546.4
110900001	GURRAMPODE	AMLUR	210.00	2	677	921	1225	6.8	30.5	37.2	9.2	41.4	50.6	12.3	55.1	67.4
111000001	GURRAMPODE	BOLLARAM	200.00	2	787	1070	1424	7.9	35.4	43.3	10.7	48.2	58.9	14.2	64.1	78.3
111100001	GURRAMPODE	NADIKUDA	180.00	2	1529	2079	2767	15.3	68.8	84.1	20.8	93.6	114.4	27.7	124.5	152.2
111200001	GURRAMPODE	KOTHALAPUR	188.00	2	473	643	856	4.7	21.3	26.0	6.4	28.9	35.4	8.6	38.5	47.1
111300001	GURRAMPODE	MOSANGI	180.00	2	1525	2074	2760	15.3	68.6	83.9	20.7	93.3	114.1	27.6	124.2	151.8

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WELL NO.	MANDAL	VILLAGE	ELEV. MASL	PROJ. PHASE	POP. 1991	POP. 2007	POP. 2022	WATERDEMAND (M3/DAY) 1991			WATERDEMAND (M3/DAY) 2007			WATERDEMAND (M3/DAY) 2022		
								DRINK.	OTHER	TOTAL	DRINK.	OTHER	TOTAL	DRINK.	OTHER	TOTAL
111400001	GURRAMPODE	CHEPUR	210.00	2	4040	5494	7312	40.4	181.8	222.2	54.9	247.2	302.2	73.1	329.1	402.2
111500001	GURRAMPODE	PALLEPAHAD	222.00	2	440	598	796	4.4	19.8	24.2	6.0	26.9	32.9	8.0	35.8	43.8
111600001	GURRAMPODE	KACHARAM	240.00	2	417	567	755	4.2	18.8	22.9	5.7	25.5	31.2	7.5	34.0	41.5
111700001	GURRAMPODE	TANDARPALLI(JUVIGU	240.00	2	2072	2818	3750	20.7	93.2	114.0	28.2	126.8	155.0	37.5	168.8	206.3
111800001	GURRAMPODE	MYLAPUR	238.00	2	622	846	1126	6.2	28.0	34.2	8.5	38.1	46.5	11.3	50.7	61.9
111900001	GURRAMPODE	PARLAPALLI	258.00	2	143	194	259	1.4	6.4	7.9	1.9	8.8	10.7	2.6	11.6	14.2
112000001	GURRAMPODE	JUNUTHALA		2	1401	1905	2536	14.0	63.0	77.1	19.1	85.7	104.8	25.4	114.1	139.5
112100001	GURRAMPODE	TENEPALLI	230.00	2	1458	1983	2639	14.6	65.6	80.2	19.8	89.2	109.1	26.4	118.8	145.1
112200001	GURRAMPODE	UTLAPALLY	260.00	2	615	836	1113	6.2	27.7	33.8	8.4	37.6	46.0	11.1	50.1	61.2
112300001	GURRAMPODE	SHAKAJIPUR	260.00	2	540	734	977	5.4	24.3	29.7	7.3	33.0	40.4	9.8	44.0	53.8
112400001	GURRAMPODE	CHINTAGUDA	272.00	2	724	985	1310	7.2	32.6	39.8	9.8	44.3	54.2	13.1	59.0	72.1
112500001	GURRAMPODE	POCHAMPALLY	247.00	2	1610	2190	2914	16.1	72.5	88.6	21.9	98.5	120.4	29.1	131.1	160.3
112600001	GURRAMPODE	MULKAPALLI	245.00	2	404	549	731	4.0	18.2	22.2	5.5	24.7	30.2	7.3	32.9	40.2
112700001	GURRAMPODE	SULTHANPUR	270.00	2	777	1057	1406	7.8	35.0	42.7	10.6	47.6	58.1	14.1	63.3	77.4
112800001	GURRAMPODE	MAKKAPALLI	260.00	2	1198	1629	2168	12.0	53.9	65.9	16.3	73.3	89.6	21.7	97.6	119.3
112900001	GURRAMPODE	KALVAPALLI	260.00	2	819	1114	1482	8.2	36.9	45.0	11.1	50.1	61.3	14.8	66.7	81.5
113000001	GURRAMPODE	PALVAI	280.00	2	3074	4181	5564	30.7	138.3	169.1	41.8	188.1	229.9	55.6	250.4	306.0
113100001	GURRAMPODE	GOURARAM	180.00	2	739	1005	1338	7.4	33.3	40.6	10.1	45.2	55.3	13.4	60.2	73.6
113200001	GURRAMPODE	KONDAPUR	260.00	2	62	84	112	0.6	2.8	3.4	0.8	3.8	4.6	1.1	5.0	6.2
120300001	DEVARAKONDA	K.MALLEPALLY	275.00	2	3309	4500	5989	33.1	148.9	182.0	45.0	202.5	247.5	59.9	269.5	329.4
120600001	DEVARAKONDA	PENDLIPAKALA	248.00	2	2051	2789	3712	20.5	92.3	112.8	27.9	125.5	153.4	37.1	167.1	204.2
120700001	DEVARAKONDA	CHENNARAM	290.00	2	1761	2395	3187	17.6	79.2	96.9	23.9	107.8	131.7	31.9	143.4	175.3
120800001	DEVARAKONDA	DONIYAL	244.00	2	756	1028	1368	7.6	34.0	41.6	10.3	46.3	56.5	13.7	61.6	75.3
120900001	DEVARAKONDA	KOLMUNTHALAPAD	276.00	2	2130	2897	3855	21.3	95.9	117.2	29.0	130.4	159.3	38.6	173.5	212.0
121000001	DEVARAKONDA	SERIPALLY	290.00	2	2357	3206	4266	23.6	106.1	129.6	32.1	144.2	176.3	42.7	192.0	234.6
121100001	DEVARAKONDA	GUMMADAVELLY	271.00	2	1567	2131	2836	15.7	70.5	86.2	21.3	95.9	117.2	28.4	127.6	156.0
121200001	DEVARAKONDA	CHINTHAKUNTLA	250.00	2	2969	4038	5374	29.7	133.6	163.3	40.4	181.7	222.1	53.7	241.8	295.6
121300001	DEVARAKONDA	FAKEERPUR	250.00	2	244	332	442	2.4	11.0	13.4	3.3	14.9	18.3	4.4	19.9	24.3
130100001	PEDDAVOORA	PEDDAVOORA	183.00	2	3331	4530	6029	33.3	149.9	183.2	45.3	203.9	249.2	60.3	271.3	331.6
130300001	PEDDAVOORA	POTHNUR	213.00	2	1397	1900	2529	14.0	62.9	76.8	19.0	85.5	104.5	25.3	113.8	139.1
130400001	PEDDAVOORA	PARVEDLA	220.00	2	2518	3424	4558	25.2	113.3	138.5	34.2	154.1	188.3	45.6	205.1	250.7
130500001	PEDDAVOORA	SINGARAM	205.00	2	1153	1568	2087	11.5	51.9	63.4	15.7	70.6	86.2	20.9	93.9	114.8
130600001	PEDDAVOORA	PULICHERLA	230.00	2	3490	4746	6317	34.9	157.1	192.0	47.5	213.6	261.1	63.2	284.3	347.4
130700001	PEDDAVOORA	VUTLAPALLY	218.00	2	2041	2776	3694	20.4	91.8	112.3	27.8	124.9	152.7	36.9	166.2	203.2
130800001	PEDDAVOORA	PINNAVOORA	209.00	2	502	683	909	5.0	22.6	27.6	6.8	30.7	37.5	9.1	40.9	50.0
131600001	PEDDAVOORA	CHINTAPALLY	165.00	2	1075	1462	1946	10.8	48.4	59.1	14.6	65.8	80.4	19.5	87.6	107.0
140200001	P.A.PALLY	WADDIPATLA	228.00	2	2982	4056	5397	29.8	134.2	164.0	40.6	182.5	223.1	54.0	242.9	296.9
140300001	P.A.PALLY	MALLAPUR	250.00	2	1530	2081	2769	15.3	68.9	84.2	20.8	93.6	114.4	27.7	124.6	152.3
140400001	P.A.PALLY	P.A. PALLY	245.00	2	8452	11495	15298	84.5	380.3	464.9	114.9	517.3	632.2	153.0	688.4	841.4
140500001	P.A.PALLY	DUGYAL	233.00	2	1757	2390	3180	17.6	79.1	96.6	23.9	107.5	131.4	31.8	143.1	174.9

POPULATION AND WATERDEMAND PROJECTIONS

ANNEX 2

WELL NO.	MANDAL	VILLAGE	ELEV. MASL	PROJ. PHASE	POP. 1991	POP. 2007	POP. 2022	WATERDEMAND (M3/DAY) 1991			WATERDEMAND (M3/DAY) 2007			WATERDEMAND (M3/DAY) 2022		
								DRINK.	OTHER	TOTAL	DRINK.	OTHER	TOTAL	DRINK.	OTHER	TOTAL
140700001	P.A.PALLY	CHILAKAMARRI	260.00	2	856	1164	1549	8.6	38.5	47.1	11.6	52.4	64.0	15.5	69.7	85.2
140800001	P.A.PALLY	TIRUMALAGIRI	237.00	2	1176	1599	2129	11.8	52.9	64.7	16.0	72.0	88.0	21.3	95.8	117.1
140900001	P.A.PALLY	MEDARAM	239.00	2	2477	3369	4483	24.8	111.5	136.2	33.7	151.6	185.3	44.8	201.8	246.6
141000001	P.A.PALLY	KESHAMANENIPALLY	239.00	2	1023	1391	1852	10.2	46.0	56.3	13.9	62.6	76.5	18.5	83.3	101.8
141100001	P.A.PALLY	GHANPUR	226.00	2	1942	2641	3515	19.4	87.4	106.8	26.4	118.9	145.3	35.2	158.2	193.3
141200001	P.A.PALLY	GUDIPALLY	235.00	2	2965	4032	5367	29.7	133.4	163.1	40.3	181.5	221.8	53.7	241.5	295.2
141300001	P.A.PALLY	G.BHEEMANAPALLY	240.00	2	2107	2866	3814	21.1	94.8	115.9	28.7	128.9	157.6	38.1	171.6	209.8
141500001	P.A.PALLY	POLKAMPALLY	235.00	2	960	1306	1738	9.6	43.2	52.8	13.1	58.8	71.8	17.4	78.2	95.6
141501001	P.A.PALLY	G.NEMLIPUR	215.00	2	333	453	603	3.3	15.0	18.3	4.5	20.4	24.9	6.0	27.1	33.2
141600001	P.A.PALLY	C.A.PALLY	271.00	2	1107	1506	2004	11.1	49.8	60.9	15.1	67.7	82.8	20.0	90.2	110.2
150100001	ANUMALA	YACHARAM	190.00	2	1633	2221	2956	16.3	73.5	89.8	22.2	99.9	122.1	29.6	133.0	162.6
150200001	ANUMALA	VENKATADRIPALEM	185.00	2	193	262	349	1.9	8.7	10.6	2.6	11.8	14.4	3.5	15.7	19.2
150400001	ANUMALA	MUKKAMALA	178.00	2	577	785	1044	5.8	26.0	31.7	7.8	35.3	43.2	10.4	47.0	57.4
150500001	ANUMALA	MAREPALLI	195.00	2	1781	2422	3224	17.8	80.1	98.0	24.2	109.0	133.2	32.2	145.1	177.3
150600001	ANUMALA	KESALAMARRI	186.00	2	139	189	252	1.4	6.3	7.6	1.9	8.5	10.4	2.5	11.3	13.8
150700001	ANUMALA	ALWAL		2	2532	3444	4583	25.3	113.9	139.3	34.4	155.0	189.4	45.8	206.2	252.1
160200001	CHOUTUPPAL	CHOUTUPPAL	358.91	1	8529	11599	15437	85.3	383.8	469.1	116.0	522.0	638.0	154.4	694.7	849.1
160300001	CHOUTUPPAL	LAKKARAM	374.03	1	2540	3454	4597	25.4	114.3	139.7	34.5	155.4	190.0	46.0	206.9	252.9
160400001	CHOUTUPPAL	TANGADAPALLY	366.61	1	5700	7752	10317	57.0	256.5	313.5	77.5	348.8	426.4	103.2	464.3	567.4
160500001	CHOUTUPPAL	LINGOJIGUDEM	340.49	1	3074	4181	5564	30.7	138.3	169.1	41.8	188.1	229.9	55.6	250.4	306.0
160600001	CHOUTUPPAL	PANTHANGI	332.28	1	5264	7159	9528	52.6	236.9	289.5	71.6	322.2	393.7	95.3	428.8	524.0
160800001	CHOUTUPPAL	TALASINGARAM	353.52	1	1401	1905	2536	14.0	63.0	77.1	19.1	85.7	104.8	25.4	114.1	139.5

Assumptions :

Total waterdemand 55 lcd
Drinkwaterdemand 10 lcd
2007 population = 1.36 x 1991 census population
2007 population = 1.81 x 1991 census population

Appendix 5.3

Existing drinking water supply systems in the project villages

EXISTING DRINKING WATER SUPPLY SYSTEMS IN PROJECT VILLAGES — ANNEX 3

NO.	MANDAL	VILLAGE	ELEV. MASL	PROJ. PHASE	HANDPUMPS (HP) TOTAL	WORK.	CAP. M3/DAY	NO. of SAMPLES	F mg/l MIN.	F mg/l MED.	F mg/l MAX.	NO. HP. F <= 1.5	MPWS / PWS SCHEMES * NO. of GLSRS	CAP. GLSR M3/DAY	CAP. MPWS M3/DAY	No. of OHSRS	CAP. OHSR M3/DAY	CAP. PWS M3/DAY	STAND-POSTS	PRIVATE CONNECT	FLUORIDE mg/l
10100001	NALGONDA	ANNAPARTHY	251.52	1	8	4	40	13	1.4	2.1	3.2	3				3	40	360	6		2.1
10300001	NALGONDA	BUDDHARAM	249.99	1	5	5	50	2	1.0	1.0	1.0	2									1.0
10400001	NALGONDA	CHERLAPALLI	245.32	1	17	11	110	9	0.6	0.8	1.4	9				3	50	450	6		1.4
10600001	NALGONDA	KANCHANPALLY		1	9	9	90	8	0.8	1.0	1.4	9				3	60	540	10	50	1.1
10700001	NALGONDA	K.KONDARAM	236.53	1	6	4	40	1	0.6	0.6	0.8	2	1	20	60						
10900001	NALGONDA	MARRIGUDA		1	8	8	80	6	0.6	1.3	2.0	5				3	40	360			1.5
11200001	NALGONDA	DONAKAL	228.16	1	3	2	20	1	1.0	1.0	1.0	1	1	5	15						1.0
11300001	NALGONDA	APPAJIPET	249.60	1	17	13	130	1	2.8	2.8	2.8										
11500001	NALGONDA	P.DOMALAPALLY	236.73	1	16	16	160	3	1.0	1.4	1.4	3				3	100	900	20		
21000001	KANGAL	PONGODU	226.24	1	11	11	110	3	1.8	1.8	2.8	1									
21100001	KANGAL	REGATTA	223.53	1	4	2	20	1	0.6	0.8	0.8	1	3	10	90						0.8
21500001	KANGAL	TURKAPALLY	187.00	2	4	4	40	3	1.0	1.2	1.4	3									
30100001	MUNGODE	MUNGODE	247.23	1	20	18	180	11	0.6	1.4	3.6	9				3	60	540	28	26	2.0
30200001	MUNGODE	KISTAPUR	288.66	1	9	7	70	5	1.2	1.4	2.4	4									
30300001	MUNGODE	IPPARTHY	274.94	1	12	10	100	4	2.4	2.4	2.4		1	10	30						
30400001	MUNGODE	SINGARAM	251.40	1	7	2	20	4	0.4	1.2	1.6	2									
30500001	MUNGODE	KATCHAPUR	258.28	1	4	3	30						1	10	30						
30600001	MUNGODE	PALIWALA	280.66	1	10	7	70	4	0.8	0.9	1.6	3	1	10	30						
30700001	MUNGODE	CHALIMEDA	292.09	1	5	5	50	4	2.0	2.3	2.4										
30800001	MUNGODE	KOMPALLY	273.65	1	8	8	80	11	0.4	0.6	1.2	11									
30900001	MUNGODE	CHIKATIMAMIDI	267.72	1	10	10	100	2	2.4	2.6	2.8	6									1.2
31000001	MUNGODE	KORATIKAL	232.10	1	7	7	70	3	0.8	1.5	1.8	2	1	10	30						
31100001	MUNGODE	CHOLLEDU	267.27	1	12	12	120	2	2.4	2.8	2.9		3	10	90						
31200001	MUNGODE	KALVAKUNTA	277.45	1	3	3	30	2	1.8	2.1	2.4										
31300001	MUNGODE	VELMAKANNE	290.43	1	12	12	120	9	2.4	2.8	4.8										
31400001	MUNGODE	PULIPALUPULA	254.75	1	9	6	60	1	0.6	0.6	0.8	4	3	10	90						0.6
31500001	MUNGODE	KALVALAPALLY		1	5	5	50	7	1.2	1.5	2.0	4									
31600001	MUNGODE	JAMISTHANPALLY	248.88	1	3	2	20	3	1.4	1.5	1.5	3									
31700001	MUNGODE	GUDAPUR		1	5	5	50	4	1.2	1.3	1.4	4									1.4
31800001	MUNGODE	SOLIPUR		1	3	3	30	2	0.4	0.8	1.2	2									
31900001	MUNGODE	KOTHLARAM	297.06	1	4	4	40	5	2.1	5.6	6.8										
32000001	MUNGODE	RATHIPALLY	264.01	1	3	2	20	3	0.4	0.8	0.8	3	2	10	60						
32100001	MUNGODE	OOKONDI	261.42	1	10	8	80	4	1.0	1.1	1.4	4									
40100001	CHANDOOR	CHANDOOR	250.03	1	28	21	210	14	0.6	0.8	1.8	18				3	60	540			
40200001	CHANDOOR	THEROTPALLI		1	5	5	50	10	0.6	1.0	1.8	10									
40300001	CHANDOOR	PULEMLA	268.13	1	8	8	80	10	1.0	2.0	3.0	2	4	10	120						3.0
40400001	CHANDOOR	IDIKUDI	263.25	1	11	11	110	5	2.8	3.2	5.2	4				3	40	360			3.2
40500001	CHANDOOR	ANGADIPET	258.26	1	7	7	70	6	0.8	1.3	2.4	4									
40600001	CHANDOOR	DONIPAMULA		1	9	9	90	3	0.6	1.2	3.2	2									3.2
40700001	CHANDOOR	GUNDRAPALLY	250.00	2	6	6	60	4	0.6	1.6	2.2	3									
40800001	CHANDOOR	GHATUPPAL		1	16	16	160	14	0.8	1.3	4.4	8				1	60	180			
40900001	CHANDOOR	KONDAPUR	276.15	1	5	4	40	8	0.4	0.6	0.8	8	5	2	30						0.8
41000001	CHANDOOR	BODANGAPARTHY	252.97	1	7	7	70	5	0.4	0.8	2.0	4									
41100001	CHANDOOR	BANGARIGADDA	260.13	1	10	8	80	4	2.4	2.8	3.0		4	10	120						2.8
41200001	CHANDOOR	NERMETTA		1	9	9	90	6	1.2	2.8	3.2	2	3	10	90						
41300001	CHANDOOR	THUMMALAPALLY	260.00	2	4	4	40	4	1.2	1.4	1.8	3									1.2
41400001	CHANDOOR	KASTALA	238.09	1	8	8	80	4	0.4	2.0	2.2	4	1	10	30						
41500001	CHANDOOR	SERIDEPALLY	246.16	1	6	5	50	6	0.6	1.2	2.0	3									
41600001	CHANDOOR	UDTHAPALLY		1	12	11	110	10	1.0	2.0	4.8	6									
50100001	NARAYANAPOOR	NARAYANAPOOR	355.53	1	14	14	140	3	0.9	1.4	1.4	3				3	60	540			1.4
50200001	NARAYANAPOOR	GUJJA	303.70	1	10	9	90	7	2.0	2.2	2.6		3	10	90						
50300001	NARAYANAPOOR	MOHAMMADABAD	350.85	1	9	5	50	1	1.8	1.8	1.8		1	10	30						1.8
50400001	NARAYANAPOOR	CHINNA MIRIYALA	334.95	1	10	8	80	2	1.4	1.5	1.5	2	5	10	150						

EXISTING DRINKING WATER SUPPLY SYSTEMS IN PROJECT VILLAGES — **ANNEX 3**

NO.	MANDAL	VILLAGE	ELEV. MASL	PROJ. PHASE	HANDPUMPS (HP) TOTAL	WORK.	CAP. M3/DAY	NO. of SAMPLES	F mg/l MIN.	F mg/l MED.	F mg/l MAX.	NO. HP. F <= 1.5	MPWS / PWS SCHEMES * NO. of GLSRS	CAP. GLSR M3/DAY	CAP. MPWS M3/DAY	No. of OHSRS	CAP. OHSR M3/DAY	CAP. PWS M3/DAY	STAND-POSTS	PRIVATE CONNECT	FLUORIDE mg/l
50500001	NARAYANAPOOR	GUDDIMALKAPUR	348.91	1	7	7	70	7	0.4	2.4	3.6	2	4	5	60						3.6
50600001	NARAYANAPOOR	KOTHALAPUR		1	5	5	50	4	1.8	2.0	2.2										
50700001	NARAYANAPOOR	PUTTAPAKA	312.07	1	10	10	100	8	0.4	0.7	1.4	8									
50800001	NARAYANAPOOR	KANKHANALAGUDA		1	8	4	40	1	0.8	0.8	0.8	1									
50900001	NARAYANAPOOR	KOTHAGUDA	338.11	1	4	4	40	2	2.4	2.8	3.2										
51000001	NARAYANAPOOR	JANGAON		1	17	17	170	7	0.4	2.0	2.4	5	3	10	90						
51100001	NARAYANAPOOR	VOIPALLY		1	6	6	60	8	2.4	4.2	7.0					1	60	180			
51200001	NARAYANAPOOR	CHILLAPUR		1	6	6	60	4	2.8	3.0	3.2										
51300001	NARAYANAPOOR	SERVOIL	320.69	1	56	33	330	6	0.8	1.0	1.8	11				3	40	360			1.4
60100001	NARKETPALLY	NARKETPALLY	278.96	1	13	13	130	14	0.8	2.4	3.4	5				3	60	540			3.2
60200001	NARKETPALLY	B.YELEMLA	277.57	1	21	21	210	15	0.6	1.6	2.4	8				3	60	540	10		1.4
60300001	NARKETPALLY	AURAVANI	262.21	1	7	7	70	4	1.5	1.7	2.2	1	2	10	60						2.6
60400001	NARKETPALLY	CHOUDAMPALLY	280.00	1	8	7	70	1	1.4	1.4	1.4	1									
60600001	NARKETPALLY	CHERUGATTA	265.22	1	16	13	130	11	0.4	3.2	6.4	2	1	10	30						3.2
60700001	NARKETPALLY	YELLAREDDYGUDA	256.57	1	14	14	140	11	2.2	3.2	6.8	1				3	60	540	40	60	2.4
60800001	NARKETPALLY	M.YEDAVELLY	274.93	1	4	1	10	7	2.6	4.8	5.2		2	10	60						2.6
61100001	NARKETPALLY	NEMMANI		1	8	3	30	8	1.0	1.6	2.0	4	1	3	7.5						
61300001	NARKETPALLY	MANDRA	298.74	1	6	4	40	10	1.2	2.7	4.0	1	1	10	30						2.8
70100001	CHITYAL	CHITYAL	314.42	1	24	19	190	15	1.0	2.4	5.1	8				3	90	610	50	10	2.8
70200001	CHITYAL	URUMADLA	295.80	1	10	5	50	10	0.4	1.0	2.0	6				3	25	225	20		1.0
70300001	CHITYAL	NEREDA	292.39	1	16	6	60	13	0.6	1.6	3.6	5				3	40	360	10	60	0.6
70400001	CHITYAL	THALVELEMALA	274.13	1	5	5	50	6	0.8	1.0	2.2	4	1	10	30						
70500001	CHITYAL	YELLIKATA	276.78	1	8	4	40	8	1.0	1.2	1.6	5	2	10	60	3	20	180	8	32	
70600001	CHITYAL	GUNDRAMPALLI	319.36	1	10	5	50	12	1.0	1.5	2.0	7	3	10	90						2.0
70700001	CHITYAL	EAPOOR		1	14	12	120	10	0.6	1.2	2.0	7	3	10	90						0.6
70800001	CHITYAL	CHINAKAPARTY	297.41	1	21	12	120	12	0.8	1.8	2.4	9	4	10	120						
70900001	CHITYAL	PEDDAKAPAPRTHY		1	10	7	70	17	0.8	2.0	3.4	6	3	10	90						2.2
71000001	CHITYAL	PITTAMPALLY		1	3	2	20	7	0.8	1.5	1.9	4									
71200001	CHITYAL	VANIPAKALA	245.62	1	6	5	50	6	1.0	1.4	2.4	3	3	10	90						2.4
71300001	CHITYAL	VATTIMARTHI	296.19	1	12	8	80	13	1.0	1.8	4.8	3				3	30	270			1.8
71400001	CHITYAL	SHIVANENIGUDEM	317.27	1	8	7	70	8	0.4	1.6	2.4	3	2	10	60						
71600001	CHITYALA	PEREPALLY	299.06	1	7	4	40						3	10	90						
71700001	CHITYALA	BONGONICHERUVU	314.13	1	2	2	20														
80100001	NAMPALLY	NAMPALLY	290.00	2	14	14	140	2	1.2	1.2	1.2	2				1	60	180			
80200001	NAMPALLY	PEDDAPUR	290.00	2	7	7	70	1	2.6	2.6	2.6	2									
80300001	NAMPALLY	NEREDLAPALLY		1	3	3	30	1	1.5	1.5	1.5	1									
80400001	NAMPALLY	DAMERA		1	3	3	30	2	3.2	4.2	5.2		2	10	60						5.2
80500001	NAMPALLY	DEVATHPALLY	290.00	2	3	3	30	1	1.5	1.5	1.5	1									
80600001	NAMPALLY	S.W.LINGOTAM		1	4	4	40	1	3.2	3.2	3.2		2	10	60						
80700001	NAMPALLY	WADDEPALLY	ERR	1	4	4	40														
80800001	NAMPALLY	CHITTAMPADU	320.00	2	3	3	30	1	2.8	2.8	2.8										2.8
80900001	NAMPALLY	THIRMALGIRI	291.00	2	4	4	40	3	0.6	1.0	1.5	3									1.0
81000001	NAMPALLY	MALLAPURAJPALLY	360.00	2	1	1	10	1	2.4	2.4	2.4		1	10	30						
81100001	NAMPALLY	PASNUR	302.00	2	5	5	50	2	2.0	2.2	2.4		2	10	60						
81200001	NAMPALLY	K.THIRMALGIRI	305.00	2	1	1	10	1	1.6	1.6	1.6										
81300001	NAMPALLY	CHAMALAPALLY	245.00	2	4	4	40	2	1.0	2.8		1									
81400001	NAMPALLY	GANUGUPALLY	275.00	2	6	6	60	2	1.6	1.6	2.0		1	10	30						1.6
81500001	NAMPALLY	MOHAMMADAPUR	245.00	2	6	6	60	2	1.0	1.1	1.2	2									1.0
81600001	NAMPALLY	G.MALLEPALLY	293.00	2	6	6	60	2	1.4	1.7	2.0	1	1	10	30						
81700001	NAMPALLY	KETHEPALLY	300.00	2	3	3	30	1	1.2	1.2	1.2	1									
81800001	NAMPALLY	MEDLAVAI		2	5	5	50	1	0.8	0.8	0.8	1	3	10	90						
81900001	NAMPALLY	THUMMALAPALLY	290.00	2	3	3	30	2	1.2	2.0	2.8	1									
82000001	NAMPALLY	B.THIMMAPUR	290.00	2	3	3	30	1	1.2	1.2	1.2	1									

EXISTING DRINKING WATER SUPPLY SYSTEMS IN PROJECT VILLAGES

ANNEX 3

					HANDPUMPS (HP)								MPWS / PWS SCHEMES *								
NO.	MANDAL	VILLAGE	ELEV. MASL	PROJ. PHASE	TOTAL	WORK.	CAP. M3/DAY	NO. of SAMPLES	F mg/l MIN.	F mg/l MED.	F mg/l MAX.	NO. HP. F <= 1.5	NO. of GLSRS	CAP. GLSR M3/DAY	CAP. MPWS M3/DAY	No. of OHSRS	CAP. OHSR M3/DAY	CAP. PWS M3/DAY	STAND-POSTS	PRIVATE CONNECT	FLUORIDE mg/l
82100001	NAMPALLY	REVALLY	290.00	2	3	3	30	3	1.0	1.2	1.2	3									
82200001	NAMPALLY	SUNKISALA	295.00	2	3	3	30	1	2.0	2.0	2.0										
82300001	NAMPALLY	FAKEERPUR	299.00	2	2	2	20	1	1.8	1.8	1.8										
82400001	NAMPALLY	PAGIDIPLALLY	290.00	2	2	2	20	1	2.6	2.6	2.6										
82500001	NAMPALLY	MUSTIPALLY	290.00	2	4	4	40	1	2.0	2.0	2.0		2	10	60						
82600001	NAMPALLY	HYDALAPUR	ERR	1	1	1	10	1	0.8	0.8	0.8	1									
82700001	NAMPALLY	T.P.GOWRARAM		1	3	3	30	2	1.6	2.3	3.0										
82800001	NAMPALLY	SHARBAPUR	290.00	2	2	2	20	1	1.0	1.0	1.0	1									
90100001	CHINTAPALLY	CHINTAPALLY	367.00	2	12	12	120	1	1.4	1.4	1.4	1	2	10	60						
90200001	CHINTAPALLY	NASARLAPALLY	360.00	2	7	7	70	2	1.2	1.6	2.0	1									1.2
90300001	CHINTAPALLY	MALLAREDDIPALLI	354.00	2	4	4	40	2	2.0	2.0	2.0										
90400001	CHINTAPALLY	HUMANTHLAPALLY	360.00	2	4	4	40	2	1.2	1.4	1.6	1				1	60	180			
90500001	CHINTAPALLY	THIRUMALAPUR	350.00	2	3	3	30	1	1.8	1.8	1.8										
90600001	CHINTAPALLY	NALVALPALLY	260.00	2	6	6	60	1	1.2	1.2	1.2	1	2	10	60						
90800001	CHINTAPALLY	GADIA GOWRARAM	350.00	2	10	10	100	1	2.4	2.4	2.4		2	10	60						
90900001	CHINTAPALLY	VARKALA	360.00	2	6	6	60	1	1.2	1.2	1.2	1									
91000001	CHINTAPALLY	VINJAMOOR		1	10	10	100	2	2.2	2.5	2.8		2	10	60						
91100001	CHINTAPALLY	P.K.MALLAPALLI		1	3	3	30	1	2.4	2.4	2.4										
91200001	CHINTAPALLY	KURMAPALLY		1	8	8	80	2	2.4	2.5	2.6										2.4
91300001	CHINTAPALLY	KURMAID		1	7	7	70	1	2.8	2.8	2.8		2	10	60						
91400001	CHINTAPALLY	UMMAPUR		1	2	2	20	1	5.6	5.6	5.6										
91500001	CHINTAPALLY	SUKILISERIPALLY	ERR	1	4	4	40	1	2.4	2.4	2.4										
91600001	CHINTAPALLY	TAKKELLAPALLY		1	5	5	50	1	3.2	3.2	3.2										
91700001	CHINTAPALLY	GODAKONDLA		1	5	5	50	4	2.8	3.0	4.0		2	10	60						
91900001	CHINTAPALLY	POLEPALLY		1	6	6	60	2	3.0	3.9	4.8		2	10	60						
92000001	CHINTAPALLY	MADNAPUR		1	5	5	50	1	5.6	5.6	5.6										
92100001	CHINTAPALLY	VENKATAMPET	304.00	2	6	6	60	2	4.0	4.0	4.0										4.0
92300001	CHINTAPALLY	K.GOURARAM	355.00	2	2	2	20	1	2.0	2.0	2.0	1									
100100001	MARRIGUDA	K.B.PALLY		1	9	9	90	2	2.8	3.7	4.5					1	80	240			
100200001	MARRIGUDA	ANTHAMPET		1	7	7	70	1	5.6	5.6	5.6		2	10	60						
100300001	MARRIGUDA	SOMARAJGUDA		1	4	4	40	1	4.8	4.8	4.8										
100400001	MARRIGUDA	NAMAPURAM		1	6	6	60	1	3.6	3.6	3.6										
100500001	MARRIGUDA	LENKALAPALLY		1	5	5	50	1	2.4	2.4	2.4		2	10	60						
100600001	MARRIGUDA	METICHANDAPUR		1	4	4	40	1	4.4	4.4	4.4										
100700001	MARRIGUDA	VENKAPALLY		1	3	3	30	1	6.0	6.0	6.0										
100800001	MARRIGUDA	INDURTHY		1	14	14	140	2	4.8	5.0	5.1										
100900001	MARRIGUDA	D.B.PALLI		1	8	8	80	2	2.2	3.7	5.2					1	60	180			2.2
101000001	MARRIGUDA	SARAMPET		1	4	4	40	1	6.0	6.0	6.0										
101100001	MARRIGUDA	VATTIPALLI		1	6	6	60	1	4.4	4.4	4.4		1	10	30						
101200001	MARRIGUDA	YERGANDLAPALLY		1	6	6	60	1	4.4	4.4	4.4		2	10	60						
101300001	MARRIGUDA	THIRGANDLAPALLY		1	5	5	50	1	2.8	2.8	2.8		2	10	60						
101400001	MARRIGUDA	THAMMADAPALLY		1	4	4	40	1	2.8	2.8	2.8										
101500001	MARRIGUDA	KONDUR		1	6	6	60	1	4.4	4.4	4.4										4.4
101600001	MARRIGUDA	MARRIGUDA		1	11	11	110	1	3.2	3.2	3.2					3	40	360			
101700001	MARRIGUDA	BATLAPALLI		1	4	4	40	1	2.8	2.8	2.8										
110100001	GURRAMPODE	GURRAMPODE	223.00	2	7	5	50	1	4.0	4.0	4.0										
110200001	GURRAMPODE	CHAMALAID	220.00	2	11	11	110	1	3.6	3.6	3.6										
110400001	GURRAMPODE	VATTIKODU	255.00	2	6	6	60	4	0.8	0.9	1.0	4									
110600001	GURRAMPODE	KOPPOLE	208.00	2	11	11	110						1	10	30						
110900001	GURRAMPODE	AMLUR	210.00	2	4	4	40	2	2.4	2.6	2.8	1									
111000001	GURRAMPODE	BOLLARAM	200.00	2	3	3	30	2	0.8	1.0	1.2	2									
111100001	GURRAMPODE	NADIKUDA	180.00	2	3	3	30	1	2.0	2.0	2.0		1	10	30						
111200001	GURRAMPODE	KOTHALAPUR	168.00	2	3	3	30	1	2.4	2.4	2.4										

EXISTING DRINKING WATER SUPPLY SYSTEMS IN PROJECT VILLAGES

ANNEX 3

NO.	MANDAL	VILLAGE	ELEV. MASL	PROJ. PHASE	HANDPUMPS (HP) TOTAL	WORK.	CAP. M3/DAY	NO. of SAMPLES	F mg/l MIN.	MED.	MAX.	NO. HP. F <= 1.5	MPWS / PWS SCHEMES * NO. of GLSRS	CAP. GLSR M3/DAY	CAP. MPWS M3/DAY	No. of OHSRS	CAP. OHSR M3/DAY	CAP. PWS M3/DAY	STAND-POSTS	PRIVATE CONNECT	FLUORIDE mg/l
111300001	GURRAMPODE	MOSANGI	180.00	2	3	3	30	1	2.0	2.0	2.0		3	10	90						2.0
111400001	GURRAMPODE	CHEPUR	210.00	2	2	2	20	2	2.0	2.0	2.0	1	2	10	60						2.0
111500001	GURRAMPODE	PALLEPAHAD	222.00	2	3	3	30	1	1.6	1.6	1.6										
111600001	GURRAMPODE	KACHARAM	240.00	2	2	2	20	1	1.5	1.5	1.5	1	1	10	30						
111700001	GURRAMPODE	TANDARPALLI(JUVIGU	240.00	2	5	5	50	1	2.8	2.8	2.8		2	10	60						
111800001	GURRAMPODE	MYLAPUR	238.00	2	2	2	20	1	2.0	2.0	2.0										
111900001	GURRAMPODE	PARLAPALLI	258.00	2	1	1	10	1	1.0	1.0	1.0	1									
112000001	GURRAMPODE	JUNUTHALA		2	3	3	30	1	2.2	2.2	2.2		2	10	60						
112100001	GURRAMPODE	TENEPALLI	230.00	2	5	5	50	2	1.0	1.3	1.6	1	2	10	60						
112200001	GURRAMPODE	UTLAPALLY	260.00	2	3	3	30	1	1.8	1.8	1.8										
112300001	GURRAMPODE	SHAKAJIPUR	260.00	2	2	2	20	2	1.0	1.4	1.8	1									1.0
112400001	GURRAMPODE	CHINTAGUDA	272.00	2	2	2	20														
112500001	GURRAMPODE	POCHAMPALLY	247.00	2	1	1	10	1	1.2	1.2	1.2	1									
112600001	GURRAMPODE	MULKAPALLI	245.00	2	2	2	20	1	1.0	1.0	1.0	1									
112700001	GURRAMPODE	SULTHANPUR	270.00	2	2	2	20	1	1.0	1.0	1.0	1									
112800001	GURRAMPODE	MAKKAPALLI	260.00	2	2	2	20	2	0.6	1.3	2.0	1									2.0
112900001	GURRAMPODE	KALVAPALLI	260.00	2	6	6	60	1	0.8	0.8	0.8	1	2	10	60						
113000001	GURRAMPODE	PALVAI	280.00	2	5	5	50	3	0.6	1.5	2.4	3	3	10	90						
113100001	GURRAMPODE	GOURARAM	180.00	2	3	3	30	1	0.6	0.6	0.6	1									
113200001	GURRAMPODE	KONDAPUR	260.00	2																	
120300001	DEVARAKONDA	K.MALLEPALLY	275.00	2	5	5	50	1	0.4	0.4	0.4	1	3	10	90						
120600001	DEVARAKONDA	PENDUPAKALA	248.00	2	3	3	30	4	0.8	1.2	2.0	2	1	10	30						
120700001	DEVARAKONDA	CHENNARAM	290.00	2	4	4	40	2	0.6	0.6	0.6	2									
120800001	DEVARAKONDA	DONIYAL	244.00	2	4	4	40	3	0.8	1.0	1.0	3									
120900001	DEVARAKONDA	KOLMUNTHALAPAD	276.00	2	8	8	80	2	1.6	2.2	2.8										
121000001	DEVARAKONDA	SERIPALLY	290.00	2	4	4	40	2	1.0	1.3	1.6	1									
121100001	DEVARAKONDA	GUMMADAVELLY	271.00	2	6	6	60	3	0.6	1.0	1.8	2									
121200001	DEVARAKONDA	CHINTHAKUNTLA	250.00	2	4	4	40	2	0.9	1.1	1.2	2	2	10	60						
121300001	DEVARAKONDA	FAKEERPUR	250.00	2	3	3	30														
130100001	PEDDAVOORA	PEDDAVOORA	183.00	2	6	6	60	5	0.6	1.4	2.0	4				1	60	180			
130300001	PEDDAVOORA	POTHNUR	213.00	2	4	4	40	2	0.9	1.7	2.4	1									
130400001	PEDDAVOORA	PARVEDLA	220.00	2	5	5	50	1	1.5	1.5	1.5	1									
130500001	PEDDAVOORA	SINGARAM	205.00	2	3	3	30	1	1.5	1.5	1.5	1									
130600001	PEDDAVOORA	PULICHERLA	230.00	2	5	5	50	1	1.4	1.4	1.4	1									
130700001	PEDDAVOORA	VUTLAPALLY	218.00	2				1	2.2	2.2	2.2										
130800001	PEDDAVOORA	PINNAVOORA	209.00	2	1	1	10	1	1.2	1.2	1.2	1									
131600001	PEDDAVOORA	CHINTAPALLY	165.00	2	3	3	30	2	0.8	1.6	2.4	1									
140200001	P.A.PALLY	WADDIPATLA	228.00	2	4	4	40	1	3.2	3.2	3.2	2									
140300001	P.A.PALLY	MALLAPUR	250.00	2	7	6	60	1	0.4	0.4	0.4	2									
140400001	P.A.PALLY	P.A. PALLY	245.00	2				1	0.6	0.6	0.6	9				1	60	240			
140500001	P.A.PALLY	DUGYAL	233.00	2	3	3	30	1	0.3	0.3	0.3	2									
140700001	P.A.PALLY	CHILAKAMARRI	260.00	2	2	2	20	1	1.2	1.2	1.2	3									
140701001	P.A.PALLY	SUREPALLY	255.00	2				1	0.7	0.7	0.7	1									
140800001	P.A.PALLY	TIRUMALAGIRI	237.00	2	7	7	70	1	2.0	2.0	2.0										
140900001	P.A.PALLY	MEDARAM	239.00	2	3	3	30	1	0.8	0.6	0.6	2									
141000001	P.A.PALLY	KESHAMANENIPALLY	239.00	2	3	3	30	1	1.2	1.2	1.2	1									
141100001	P.A.PALLY	GHANPUR	228.00	2	4	4	40	1	2.6	2.6	2.6	1									
141200001	P.A.PALLY	GUDIPALLY	235.00	2	3	3	30	1	1.6	1.6	1.6	3	2	10	60						1.6
141203001	P.A.PALLY	ROLEKAI	255.00	2				1	1.2	1.2	1.2	1									
141300001	P.A.PALLY	G.BHEEMANAPALLY	240.00	2	2	2	20	1	0.8	0.8	0.8	3									
141301001	P.A.PALLY	GHANPALLY	240.00	2				1	1.2	1.2	1.2	1									
141500001	P.A.PALLY	POLKAMPALLY	235.00	2	4	4	40	1	0.6	0.6	0.6	2									
141501001	P.A.PALLY	G.NEMLIPUR	215.00	2	2	2	20	1	1.4	1.4	1.4	1									

EXISTING DRINKING WATER SUPPLY SYSTEMS IN PROJECT VILLAGES

ANNEX 3

					HANDPUMPS (HP)								MPWS / PWS SCHEMES *								
NO.	MANDAL	VILLAGE	ELEV. MASL	PROJ. PHASE	TOTAL	WORK.	CAP. M3/DAY	NO. of SAMPLES	F mg/l MIN.	F mg/l MED.	F mg/l MAX.	NO. HP. F <= 1.5	NO. of GLSRS	CAP. GLSR M3/DAY	CAP. MPWS M3/DAY	No. of OHSRS	CAP. OHSR M3/DAY	CAP. PWS M3/DAY	STAND-POSTS	PRIVATE CONNECT	FLUORIDE mg/l
141600001	P.A.PALLY	C.A.PALLY	271.00	2	4	4	40	3	0.4	0.8	1.0	3									
141700001	P.A.PALLY	MADHAPUR	235.00	2				1	1.6	1.6	1.6	1									
150100001	ANUMALA	YACHARAM	190.00	2	7	7	70	1	0.4	0.4	0.4	1									
150200001	ANUMALA	VENKATADRIPALEM	185.00	2	3	3	30	1	0.8	0.8	0.8	1									
150400001	ANUMALA	MUKKAMALA	178.00	2	2	2	20	1	2.0	2.0	2.0										
150500001	ANUMALA	MAREPALLI	195.00	2	5	5	50	2	0.6	0.7	0.8	2									
150600001	ANUMALA	KESALAMARRI	188.00	2	3	3	30	1	0.4	0.4	0.4	1									
150700001	ANUMALA	ALWAL		2	3	3	30	2	0.6	0.7	0.8	2									
160200001	CHOUTUPPAL	CHOUTUPPAL	358.91	1	24	17	170	24	0.4	1.6	2.8	22	2	10	60	3	60	540	4		2.8
160300001	CHOUTUPPAL	LAKKARAM	374.03	1	7	6	60	6	0.6	1.0	2.2	6	1	10	30						0.8
160400001	CHOUTUPPAL	TANGADAPALLY	366.61	1	9	8	80	6	0.8	1.2	1.8	6	4	10	120						1.2
160500001	CHOUTUPPAL	LINGOJIGUDEM	340.49	1	6	6	60	10	0.5	1.0	2.4	9									1.5
160600001	CHOUTUPPAL	PANTHANGI	332.28	1	15	13	130	10	0.4	1.0	1.5	15	1	10	30	3	40	360	8		0.9
160800001	CHOUTUPPAL	TALASINGARAM	353.52	1	5	2	20	2	1.1	1.2	2.0	2	1	10	30						

LEGEND :

OHSRS	Overhead storage reservoir
GLSRS	Groundlevel storage reservoir
CAP.	Capacity of reservoir
MPWS	Mini protected watersupply scheme
PWS	Protected watersupply scheme

Appendix 5.4

Water demand coverage in 1991

WATERDEMAND COVERAGE IN 1991 ANNEX 4

WELL NO.	MANDAL	VILLAGE	ELEV.	PHASE	POP. 1991	WATERDEMAND (M3/DAY) 1991		HP WORK.	CAP. MPWS	CAP. PWS	NO. HP. F <= 1.5	REQUIRED	
						DRINK.	TOTAL					DRINK.	TOTAL
10100001	NALGONDA	ANNAPARTHY	251.52	1	1784	17.8	98.1	40		120	30	-12.2	-61.9
10300001	NALGONDA	BUDDHARAM	249.99	1	3304	33.0	181.7	50			20	13.0	131.7
10400001	NALGONDA	CHERLAPALLI	245.32	1	4768	47.7	262.2	110		150	90	-42.3	2.2
10600001	NALGONDA	KANCHANPALLY		1	2217	22.2	121.9	90		180	90	-67.8	-148.1
10700001	NALGONDA	K.KONDARAM	236.53	1	1747	17.5	96.1	40	60		20	-2.5	-3.9
10900001	NALGONDA	MARRIGUDA		1	2743	27.4	150.9	80		120	50	-22.6	-49.1
11200001	NALGONDA	DONAKAL	228.16	1	754	7.5	41.5	20	15		10	-2.5	6.5
11300001	NALGONDA	APPAJIPET	249.60	1	3325	33.3	182.9	130				33.3	52.9
11500001	NALGONDA	P.DOMALAPALLY	238.73	1	1272	12.7	70.0	160		300	30	-17.3	-390.0
21000001	KANGAL	PONGODU	226.24	1	2774	27.7	152.6	110			10	17.7	42.6
21100001	KANGAL	REGATTA	223.53	1	3607	36.1	198.4	20	90		10	26.1	88.4
21500001	KANGAL	TURKAPALLY	187.00	2	683	6.8	37.6	40			30	-23.2	-2.4
30100001	MUNGODE	MUNGODE	247.23	1	8005	80.1	440.3	180		180	90	-10.0	80.3
30200001	MUNGODE	KISTAPUR	288.66	1	1425	14.3	78.4	70			40	-25.8	8.4
30300001	MUNGODE	IPPARTHY	274.94	1	1238	12.4	68.1	100	30			12.4	-61.9
30400001	MUNGODE	SINGARAM	251.40	1	1142	11.4	62.8	20			20	-8.6	42.8
30500001	MUNGODE	KATCHAPUR	258.28	1	463	4.6	25.5	30	30			4.6	-34.5
30600001	MUNGODE	PALIWALA	280.66	1	2379	23.8	130.8	70	30		30	-6.2	30.8
30700001	MUNGODE	CHALIMEDA	292.09	1	893	8.9	49.1	50				8.9	-0.9
30800001	MUNGODE	KOMPALLY	273.65	1	2310	23.1	127.1	80			110	-86.9	47.1
30900001	MUNGODE	CHIKATIMAMIDI	267.72	1	2389	23.9	131.4	100			60	-36.1	31.4
31000001	MUNGODE	KORATIKAL	232.10	1	3193	31.9	175.6	70	30		20	11.9	75.6
31100001	MUNGODE	CHOLLEDU	267.27	1	1358	13.6	74.7	120	90			13.6	-135.3
31200001	MUNGODE	KALVAKUNTA	277.45	1	916	9.2	50.4	30				9.2	20.4
31300001	MUNGODE	VELMAKANNE	290.43	1	2232	22.3	122.8	120				22.3	2.8
31400001	MUNGODE	PULIPALUPULA	254.75	1	2495	25.0	137.2	80	90		40	-15.1	-32.8
31500001	MUNGODE	KALVALAPALLY		1	1962	19.6	107.9	50			40	-20.4	57.9
31600001	MUNGODE	JAMISTHANPALLY	248.88	1	345	3.5	19.0	20			30	-26.6	-1.0
31700001	MUNGODE	GUDAPUR		1	1342	13.4	73.8	50			40	-26.6	23.8
31800001	MUNGODE	SOLIPUR		1	384	3.8	21.1	30			20	-16.2	-8.9
31900001	MUNGODE	KOTHLARAM	297.06	1	851	8.5	46.8	40				8.5	6.8
32000001	MUNGODE	RATHIPALLY	264.01	1	735	7.4	40.4	20	60		30	-22.7	-39.6
32100001	MUNGODE	OOKONDI	261.42	1	1942	19.4	106.8	80			40	-20.6	26.8
40100001	CHANDOOR	CHANDOOR	250.03	1	8862	88.6	487.4	210		180	180	-91.4	97.4
40200001	CHANDOOR	THEROTPALLI		1	3421	34.2	188.2	50			100	-65.8	138.2
40300001	CHANDOOR	PULEMLA	268.13	1	2270	22.7	124.9	80	120		20	2.7	-75.2
40400001	CHANDOOR	IDIKUDI	263.25	1	1785	17.9	98.2	110		120	40	-22.2	-131.8
40500001	CHANDOOR	ANGADIPET	258.26	1	1485	14.9	81.7	70			40	-25.2	11.7
40600001	CHANDOOR	DONIPAMULA		1	2162	21.6	118.9	90			20	1.6	28.9
40700001	CHANDOOR	GUNDRAPALLY	250.00	2	1752	17.5	96.4	60			30	-12.5	36.4
40800001	CHANDOOR	GHATUPPAL		1	6022	60.2	331.2	160		60	80	-19.8	111.2
40900001	CHANDOOR	KONDAPUR	276.15	1	1583	15.8	87.1	40	30		80	-64.2	17.1

WATERDEMAND COVERAGE IN 1991 ANNEX 4

WELL NO.	MANDAL	VILLAGE	ELEV.	PHASE	POP. 1991	WATERDEMAND (M3/DAY) 1991		HP WORK.	CAP. MPWS	CAP. PWS	NO. HP. F <= 1.5	REQUIRED	
						DRINK.	TOTAL					DRINK.	TOTAL
41000001	CHANDOOR	BODANGAPARTHY	252.97	1	1135	11.4	62.4	70			40	-28.7	-7.6
41100001	CHANDOOR	BANGARIGADDA	260.13	1	2515	25.2	138.3	80	120			25.2	-61.7
41200001	CHANDOOR	NERMETTA		1	1577	15.8	86.7	90	90		20	-4.2	-93.3
41300001	CHANDOOR	THUMMALAPALLY	280.00	2	1440	14.4	79.2	40			30	-15.6	39.2
41400001	CHANDOOR	KASTALA	238.09	1	2616	26.2	143.9	80	30		40	-13.8	33.9
41500001	CHANDOOR	SERIDEPALLY	246.16	1	1125	11.3	61.9	50			30	-18.8	11.9
41600001	CHANDOOR	UDTHAPALLY		1	956	9.6	52.6	110			60	-50.4	-57.4
50100001	NARAYANAPOOR	NARAYANAPOOR	355.53	1	8224	82.2	452.3	140		180	30	52.2	132.3
50200001	NARAYANAPOOR	GUJJA	303.70	1	2887	28.9	158.8	90	90			28.9	-21.2
50300001	NARAYANAPOOR	MOHAMMADABAD	350.85	1	958	9.6	52.7	50	30			9.6	-27.3
50400001	NARAYANAPOOR	CHINNA MIRIYALA	334.95	1	1195	12.0	65.7	80	150		20	-8.1	-164.3
50500001	NARAYANAPOOR	GUDDIMALKAPUR	346.91	1	858	8.6	47.2	70	60		20	-11.4	-82.8
50600001	NARAYANAPOOR	KOTHALAPUR		1	632	6.3	34.8	50				6.3	-15.2
50700001	NARAYANAPOOR	PUTTAPAKA	312.07	1	3111	31.1	171.1	100			80	-48.9	71.1
50800001	NARAYANAPOOR	KANKHANALAGUDA		1	1405	14.1	77.3	40			10	4.1	37.3
50900001	NARAYANAPOOR	KOTHAGUDA	338.11	1	1454	14.5	80.0	40				14.5	40.0
51000001	NARAYANAPOOR	JANGAON		1	4834	48.3	265.9	170	90		50	-1.7	5.9
51100001	NARAYANAPOOR	VOIPALLY		1	3982	39.8	219.0	60		60		39.8	99.0
51200001	NARAYANAPOOR	CHILLAPUR		1	3251	32.5	178.8	60				32.5	118.8
51300001	NARAYANAPOOR	SERVOIL	320.69	1	8159	81.6	448.7	330		120	110	-28.4	-1.3
60100001	NARKETPALLY	NARKETPALLY	278.96	1	1221	12.2	67.2	130		180	50	-37.8	-242.8
60200001	NARKETPALLY	B.YELEMLA	277.57	1	3094	30.9	170.2	210		180	80	-49.1	-219.8
60300001	NARKETPALLY	AURAVANI	262.21	1	1449	14.5	79.7	70	60		10	4.5	-50.3
60400001	NARKETPALLY	CHOUDAMPALLY	280.00	1	433	4.3	23.8	70			10	-5.7	-46.2
60600001	NARKETPALLY	CHERUGATTA	265.22	1	3373	33.7	185.5	130	30		20	13.7	25.5
60700001	NARKETPALLY	YELLAREDDYGUDA	256.57	1	3107	31.1	170.9	140		180	10	21.1	-149.1
60800001	NARKETPALLY	M.YEDAVELLY	274.93	1	1336	13.4	73.5	10	60			13.4	3.5
61100001	NARKETPALLY	NEMMANI		1	2221	22.2	122.2	30	7.5		40	-17.8	84.7
61300001	NARKETPALLY	MANDRA	298.74	1	1484	14.8	81.6	40	30		10	4.8	11.6
70100001	CHITYAL	CHITYAL	314.42	1	9824	98.2	540.3	190		270	80	18.2	80.3
70200001	CHITYAL	URUMADLA	295.80	1	7226	72.3	397.4	50		75	80	-7.7	272.4
70300001	CHITYAL	NEREDA	292.39	1	3732	37.3	205.3	80		120	50	-12.7	5.3
70400001	CHITYAL	THALVELEMALA	274.13	1	2358	23.6	129.7	50	30		40	-16.4	49.7
70500001	CHITYAL	YELLIKATA	276.78	1	1888	18.9	103.8	40	60	60	50	-31.1	-56.2
70600001	CHITYAL	GUNDRAMPALLI	319.36	1	3128	31.3	172.0	50	90		70	-38.7	32.0
70700001	CHITYAL	EAPOOR		1	2188	21.9	120.3	120	90		70	-48.1	-89.7
70800001	CHITYAL	CHINAKAPARTY	297.41	1	3613	36.1	198.7	120	120		90	-53.9	-41.3
70900001	CHITYAL	PEDDAKAPAPRTHY		1	4131	41.3	227.2	70	90		60	-18.7	67.2
71000001	CHITYAL	PITTAMPALLY		1	1280	12.8	70.4	20			40	-27.2	50.4
71200001	CHITYAL	VANIPAKALA	245.62	1	2242	22.4	123.3	50	90		30	-7.6	-16.7
71300001	CHITYAL	VATTIMARTHI	296.19	1	1839	18.4	101.1	80		90	30	-11.6	-68.9
71400001	CHITYAL	SHIVANENIGUDEM	317.27	1	1092	10.9	60.1	70	60		30	-19.1	-69.9

WATERDEMAND COVERAGE IN 1991 — ANNEX 4

WELL NO.	MANDAL	VILLAGE	ELEV.	PHASE	POP. 1991	WATERDEMAND (M3/DAY) 1991 DRINK.	WATERDEMAND (M3/DAY) 1991 TOTAL	HP WORK.	CAP. MPWS	CAP. PWS	NO. HP. F <= 1.5	REQUIRED DRINK.	REQUIRED TOTAL
71600001	CHITYALA	PEREPALLY	299.06	1	1450	14.5	79.8	40	90			14.5	-50.3
71700001	CHITYALA	BONGONICHERUVU	314.13	1	516	5.2	28.4	20				5.2	8.4
80100001	NAMPALLY	NAMPALLY	290.00	2	3501	35.0	192.6	140		60	20	15.0	-7.4
80200001	NAMPALLY	PEDDAPUR	290.00	2	3592	35.9	197.6	70			20	15.9	127.6
80300001	NAMPALLY	NEREDLAPALLY		1	1452	14.5	79.9	30			10	4.5	49.9
80400001	NAMPALLY	DAMERA		1	1730	17.3	95.2	30	60			17.3	5.2
80500001	NAMPALLY	DEVATHPALLY	290.00	2	1486	14.9	81.7	30			10	4.9	51.7
80600001	NAMPALLY	S.W.LINGOTAM		1	1946	19.5	107.0	40	60			19.5	7.0
80700001	NAMPALLY	WADDEPALLY	ERR	1	1242	12.4	68.3	40				12.4	28.3
80800001	NAMPALLY	CHITTAMPADU	320.00	2	948	9.5	52.1	30				9.5	22.1
80900001	NAMPALLY	THIRMALGIRI	291.00	2	1004	10.0	55.2	40			30	-20.0	15.2
81000001	NAMPALLY	MALLAPURAJPALLY	360.00	2	1188	11.9	65.3	10	30			11.9	25.3
81100001	NAMPALLY	PASNUR	302.00	2	3531	35.3	194.2	50	60			35.3	84.2
81200001	NAMPALLY	K.THIRMALGIRI	305.00	2	127	1.3	7.0	10				1.3	-3.0
81300001	NAMPALLY	CHAMALAPALLY	245.00	2	1401	14.0	77.1	40			10	4.0	37.1
81400001	NAMPALLY	GANUGUPALLY	275.00	2	647	6.5	35.6	60	30			6.5	-54.4
81500001	NAMPALLY	MOHAMMADAPUR	245.00	2	1403	14.0	77.2	60			20	-6.0	17.2
81600001	NAMPALLY	G.MALLEPALLY	293.00	2	1275	12.8	70.1	60	30		10	2.8	-19.9
81700001	NAMPALLY	KETHEPALLY	300.00	2	626	6.3	34.4	30			10	-3.7	4.4
81800001	NAMPALLY	MEDLAVAI		2	1351	13.5	74.3	50	90		10	3.5	-65.7
81900001	NAMPALLY	THUMMALAPALLY	290.00	2	790	7.9	43.5	30			10	-2.1	13.5
82000001	NAMPALLY	B.THIMMAPUR	290.00	2	583	5.8	32.1	30			10	-4.2	2.1
82100001	NAMPALLY	REVALLY	290.00	2	835	8.4	45.9	30			30	-21.7	15.9
82200001	NAMPALLY	SUNKISALA	295.00	2	526	5.3	28.9	30				5.3	-1.1
82300001	NAMPALLY	FAKEERPUR	299.00	2	324	3.2	17.8	20				3.2	-2.2
82400001	NAMPALLY	PAGIDIPLALLY	290.00	2	380	3.8	20.9	20				3.8	0.9
82500001	NAMPALLY	MUSTIPALLY	290.00	2	2244	22.4	123.4	40	60			22.4	23.4
82600001	NAMPALLY	HYDALAPUR	ERR	1	168	1.7	9.2	10			10	-8.3	-0.8
82700001	NAMPALLY	T.P.GOWRARAM		1	1527	15.3	84.0	30				15.3	54.0
82800001	NAMPALLY	SHARBAPUR	290.00	2	258	2.6	14.2	20			10	-7.4	-5.8
90100001	CHINTAPALLY	CHINTAPALLY	367.00	2	3815	38.2	209.8	120	60		10	28.2	29.8
90200001	CHINTAPALLY	NASARLAPALLY	360.00	2	1962	19.6	107.9	70			10	9.6	37.9
90300001	CHINTAPALLY	MALLAREDDIPALLI	354.00	2	1530	15.3	84.2	40				15.3	44.2
90400001	CHINTAPALLY	HUMANTHLAPALLY	360.00	2	1514	15.1	83.3	40		60	10	5.1	-16.7
90500001	CHINTAPALLY	THIRUMALAPUR	350.00	2	286	2.9	15.7	30				2.9	-14.3
90600001	CHINTAPALLY	NALVALPALLY	260.00	2	1411	14.1	77.6	60	60		10	4.1	-42.4
90800001	CHINTAPALLY	GADIA GOWRARAM	350.00	2	2464	24.6	135.5	100	60			24.6	-24.5
90900001	CHINTAPALLY	VARKALA	360.00	2	1047	10.5	57.6	60			10	0.5	-2.4
91000001	CHINTAPALLY	VINJAMOOR		1	5694	56.9	313.2	100	60			56.9	153.2
91100001	CHINTAPALLY	P.K.MALLAPALLI		1	918	9.2	50.5	30				9.2	20.5
91200001	CHINTAPALLY	KURMAPALLY		1	4769	47.7	262.3	80				47.7	182.3
91300001	CHINTAPALLY	KURMAID		1	3348	33.5	184.1	70	60			33.5	54.1

WATERDEMAND COVERAGE IN 1991 ANNEX 4

WELL NO.	MANDAL	VILLAGE	ELEV.	PHASE	POP. 1991	WATERDEMAND (M3/DAY) 1991		HP WORK.	CAP. MPWS	CAP. PWS	NO. HP. F <= 1.5	REQUIRED	
						DRINK.	TOTAL					DRINK.	TOTAL
91400001	CHINTAPALLY	UMMAPUR		1	517	5.2	28.4	20				5.2	8.4
91500001	CHINTAPALLY	SUKILISERIPALLY	ERR	1	792	7.9	43.6	40				7.9	3.6
91600001	CHINTAPALLY	TAKKELLAPALLY		1	1512	15.1	83.2	50				15.1	33.2
91700001	CHINTAPALLY	GODAKONDLA		1	3105	31.1	170.8	50	60			31.1	60.8
91900001	CHINTAPALLY	POLEPALLY		1	2332	23.3	128.3	60	60			23.3	8.3
92000001	CHINTAPALLY	MADNAPUR		1	885	8.9	48.7	50				8.9	-1.3
92100001	CHINTAPALLY	VENKATAMPET	304.00	2	1939	19.4	106.6	60				19.4	46.6
92300001	CHINTAPALLY	K.GOURARAM	355.00	2	792	7.9	43.6	20			10	-2.1	23.6
100100001	MARRIGUDA	K.B.PALLY		1	3006	30.1	165.3	90		80		30.1	-4.7
100200001	MARRIGUDA	ANTHAMPET		1	1118	11.2	61.5	70	60			11.2	-68.5
100300001	MARRIGUDA	SOMARAJGUDA		1	1275	12.8	70.1	40				12.8	30.1
100400001	MARRIGUDA	NAMAPURAM		1	1355	13.6	74.5	60				13.6	14.5
100500001	MARRIGUDA	LENKALAPALLY		1	1776	17.8	97.7	50	60			17.8	-12.3
100600001	MARRIGUDA	METICHANDAPUR		1	1260	12.6	69.3	40				12.6	29.3
100700001	MARRIGUDA	VENKAPALLY		1	846	8.5	46.5	30				8.5	16.5
100800001	MARRIGUDA	INDURTHY		1	6036	60.4	332.0	140				60.4	192.0
100900001	MARRIGUDA	D.B.PALLI		1	3673	36.7	202.0	80		60		36.7	62.0
101000001	MARRIGUDA	SARAMPET		1	1246	12.5	68.5	40				12.5	28.5
101100001	MARRIGUDA	VATTIPALLI		1	1822	18.2	100.2	60	30			18.2	10.2
101200001	MARRIGUDA	YERGANDLAPALLY		1	3381	33.8	186.0	60	60			33.8	66.0
101300001	MARRIGUDA	THIRGANDLAPALLY		1	1455	14.6	80.0	50	60			14.6	-30.0
101400001	MARRIGUDA	THAMMADAPALLY		1	792	7.9	43.6	40				7.9	3.6
101500001	MARRIGUDA	KONDUR		1	1141	11.4	62.8	60				11.4	2.8
101600001	MARRIGUDA	MARRIGUDA		1	3334	33.3	183.4	110		120		33.3	-46.6
101700001	MARRIGUDA	BATLAPALLI		1	344	3.4	18.9	40				3.4	-21.1
110100001	GURRAMPODE	GURRAMPODE	223.00	2	1831	18.3	100.7	50				18.3	50.7
110200001	GURRAMPODE	CHAMALAID	220.00	2	2696	27.0	148.3	110				27.0	38.3
110400001	GURRAMPODE	VATTIKODU	255.00	2	2455	24.6	135.0	60			40	-15.5	75.0
110600001	GURRAMPODE	KOPPOLE	208.00	2	5489	54.9	301.9	110	30			54.9	161.9
110900001	GURRAMPODE	AMLUR	210.00	2	677	6.8	37.2	40			10	-3.2	-2.8
111000001	GURRAMPODE	BOLLARAM	200.00	2	787	7.9	43.3	30			20	-12.1	13.3
111100001	GURRAMPODE	NADIKUDA	180.00	2	1529	15.3	84.1	30	30			15.3	24.1
111200001	GURRAMPODE	KOTHALAPUR	188.00	2	473	4.7	26.0	30				4.7	-4.0
111300001	GURRAMPODE	MOSANGI	180.00	2	1525	15.3	83.9	30	90			15.3	-36.1
111400001	GURRAMPODE	CHEPUR	210.00	2	4040	40.4	222.2	20	60		10	30.4	142.2
111500001	GURRAMPODE	PALLEPAHAD	222.00	2	440	4.4	24.2	30				4.4	-5.8
111600001	GURRAMPODE	KACHARAM	240.00	2	417	4.2	22.9	20	30		10	-5.8	-27.1
111700001	GURRAMPODE	TANDARPALLI(JUVIGU	240.00	2	2072	20.7	114.0	50	60			20.7	4.0
111800001	GURRAMPODE	MYLAPUR	238.00	2	622	6.2	34.2	20				6.2	14.2
111900001	GURRAMPODE	PARLAPALLI	258.00	2	143	1.4	7.9	10			10	-8.6	-2.1
112000001	GURRAMPODE	JUNUTHALA	.	2	1401	14.0	77.1	30	60			14.0	-12.9
112100001	GURRAMPODE	TENEPALLI	230.00	2	1458	14.6	80.2	50	60		10	4.6	-29.8

WATERDEMAND COVERAGE IN 1991 | ANNEX 4

WELL NO.	MANDAL	VILLAGE	ELEV.	PHASE	POP. 1991	WATERDEMAND (M3/DAY) 1991 DRINK.	TOTAL	HP WORK.	CAP. MPWS	CAP. PWS	NO. HP. F <= 1.5	REQUIRED DRINK.	TOTAL
112200001	GURRAMPODE	UTLAPALLY	260.00	2	615	6.2	33.8	30				6.2	3.8
112300001	GURRAMPODE	SHAKAJIPUR	260.00	2	540	5.4	29.7	20			10	-4.6	9.7
112400001	GURRAMPODE	CHINTAGUDA	272.00	2	724	7.2	39.8	20				7.2	19.8
112500001	GURRAMPODE	POCHAMPALLY	247.00	2	1610	16.1	88.6	10			10	6.1	78.6
112600001	GURRAMPODE	MULKAPALLI	245.00	2	404	4.0	22.2	20			10	-6.0	2.2
112700001	GURRAMPODE	SULTHANPUR	270.00	2	777	7.8	42.7	20			10	-2.2	22.7
112800001	GURRAMPODE	MAKKAPALLI	260.00	2	1198	12.0	65.9	20			10	2.0	45.9
112900001	GURRAMPODE	KALVAPALLI	260.00	2	819	8.2	45.0	60	60		10	-1.8	-75.0
113000001	GURRAMPODE	PALVAI	280.00	2	3074	30.7	169.1	50	90		30	0.7	29.1
113100001	GURRAMPODE	GOURARAM	180.00	2	739	7.4	40.6	30			10	-2.6	10.6
113200001	GURRAMPODE	KONDAPUR	260.00	2	62	0.6	3.4					0.6	3.4
120300001	DEVARAKONDA	K.MALLEPALLY	275.00	2	3309	33.1	182.0	50	90		10	23.1	42.0
120600001	DEVARAKONDA	PENDLIPAKALA	248.00	2	2051	20.5	112.8	30	30		20	0.5	52.8
120700001	DEVARAKONDA	CHENNARAM	290.00	2	1761	17.6	96.9	40			20	-2.4	56.9
120800001	DEVARAKONDA	DONIYAL	244.00	2	756	7.6	41.6	40			30	-22.4	1.6
120900001	DEVARAKONDA	KOLMUNTHALAPAD	276.00	2	2130	21.3	117.2	80				21.3	37.2
121000001	DEVARAKONDA	SERIPALLY	290.00	2	2357	23.6	129.6	40			10	13.6	89.6
121100001	DEVARAKONDA	GUMMADAVELLY	271.00	2	1567	15.7	86.2	60			20	-4.3	26.2
121200001	DEVARAKONDA	CHINTHAKUNTLA	250.00	2	2969	29.7	163.3	40	60		20	9.7	63.3
121300001	DEVARAKONDA	FAKEERPUR	250.00	2	244	2.4	13.4	30				2.4	-16.6
130100001	PEDDAVOORA	PEDDAVOORA	183.00	2	3331	33.3	183.2	60		60	40	-6.7	63.2
130300001	PEDDAVOORA	POTHNUR	213.00	2	1397	14.0	76.8	40			10	4.0	36.8
130400001	PEDDAVOORA	PARVEDLA	220.00	2	2518	25.2	138.5	50			10	15.2	88.5
130500001	PEDDAVOORA	SINGARAM	205.00	2	1153	11.5	63.4	30			10	1.5	33.4
130600001	PEDDAVOORA	PULICHERLA	230.00	2	3490	34.9	192.0	50			10	24.9	142.0
130700001	PEDDAVOORA	VUTLAPALLY	218.00	2	2041	20.4	112.3					20.4	112.3
130800001	PEDDAVOORA	PINNAVOORA	209.00	2	502	5.0	27.6	10			10	-5.0	17.6
131600001	PEDDAVOORA	CHINTAPALLY	165.00	2	1075	10.8	59.1	30			10	0.8	29.1
140200001	P.A.PALLY	WADDIPATLA	228.00	2	2982	29.8	164.0	40			20	9.8	124.0
140300001	P.A.PALLY	MALLAPUR	250.00	2	1530	15.3	84.2	60			20	-4.7	24.2
140400001	P.A.PALLY	P.A. PALLY	245.00	2	8452	84.5	464.9			80	90	-5.5	384.9
140500001	P.A.PALLY	DUGYAL	233.00	2	1757	17.6	96.6	30			20	-2.4	66.6
140700001	P.A.PALLY	CHILAKAMARRI	260.00	2	856	8.6	47.1	20			30	-21.4	27.1
140800001	P.A.PALLY	TIRUMALAGIRI	237.00	2	1176	11.8	64.7	70				11.8	-5.3
140900001	P.A.PALLY	MEDARAM	239.00	2	2477	24.8	136.2	30			20	4.8	106.2
141000001	P.A.PALLY	KESHAMANENIPALLY	239.00	2	1023	10.2	56.3	30			10	0.2	26.3
141100001	P.A.PALLY	GHANPUR	226.00	2	1942	19.4	106.8	40			10	9.4	66.8
141200001	P.A.PALLY	GUDIPALLY	235.00	2	2965	29.7	163.1	30	60		30	-0.3	73.1
141300001	P.A.PALLY	G.BHEEMANAPALLY	240.00	2	2107	21.1	115.9	20			30	-8.9	95.9
141500001	P.A.PALLY	POLKAMPALLY	235.00	2	960	9.6	52.8	40			20	-10.4	12.8
141501001	P.A.PALLY	G.NEMLIPUR	215.00	2	333	3.3	18.3	20			10	-6.7	-1.7
141600001	P.A.PALLY	C.A.PALLY	271.00	2	1107	11.1	60.9	40			30	-18.9	20.9

WATERDEMAND COVERAGE IN 1991 ANNEX 4

WELL NO.	MANDAL	VILLAGE	ELEV.	PHASE	POP. 1991	WATERDEMAND (M3/DAY) 1991 DRINK.	TOTAL	HP WORK.	CAP. MPWS	CAP. PWS	NO. HP. F <= 1.5	REQUIRED DRINK.	TOTAL
150100001	ANUMALA	YACHARAM	190.00	2	1633	16.3	89.8	70			10	6.3	19.8
150200001	ANUMALA	VENKATADRIPALEM	185.00	2	193	1.9	10.6	30			10	-8.1	-19.4
150400001	ANUMALA	MUKKAMALA	178.00	2	577	5.8	31.7	20				5.8	11.7
150500001	ANUMALA	MAREPALLI	195.00	2	1781	17.8	98.0	50			20	-2.2	48.0
150600001	ANUMALA	KESALAMARRI	186.00	2	139	1.4	7.6	30			10	-8.6	-22.4
150700001	ANUMALA	ALWAL		2	2532	25.3	139.3	30			20	5.3	109.3
160200001	CHOUTUPPAL	CHOUTUPPAL	358.91	1	8529	85.3	469.1	170	60	180	220	-134.7	59.1
160300001	CHOUTUPPAL	LAKKARAM	374.03	1	2540	25.4	139.7	60	30		60	-34.6	49.7
160400001	CHOUTUPPAL	TANGADAPALLY	366.61	1	5700	57.0	313.5	80	120		60	-3.0	113.5
160500001	CHOUTUPPAL	LINGOJIGUDEM	340.49	1	3074	30.7	169.1	60			90	-59.3	109.1
160600001	CHOUTUPPAL	PANTHANGI	332.28	1	5264	52.6	289.5	130	30	120	150	-97.4	9.5
160800001	CHOUTUPPAL	TALASINGARAM	353.52	1	1401	14.0	77.1	20	30		20	-6.0	27.1

Appendix 5.5

Data drinking water wells PRED

DATA ON DRINKING WATER WELLS (PREP) ANNEX 5

WELL NO	MANDAL	VILLAGE	HAMLET	WELL NAME	CONSTR. DATE	WELL TYPE	DEPTH	CASING	WATER LEVEL	DISCHARGE l/h	LAB. NO	ELECT. COND. uS/cm	CHLORIDE mg/l	FLUORIDE mg/l
10100001	NALGONDA	ANNAPARTHY		PWSS	1980	BW	31.00	4.57	7.00	1500	0	805	36	2.1
10100002	NALGONDA	ANNAPARTHY		GOLLIKASAIAH	1972	BW	30.50	6.00	8.00	1100	1698	2270	330	3.2
10100003	NALGONDA	ANNAPARTHY		SCHOOL	1980	BW	34.00	10.00	15.00	2000	1699	1227	116	2.2
10100004	NALGONDA	ANNAPARTHY		CHANDRAMMA HOUSE	1978	BW	20.00	8.00	9.00	1800	1700	1889	256	3.0
10100005	NALGONDA	ANNAPARTHY		ANANTHAREDDY HOUSE	1978	BW	31.00	10.00	12.00	1000	1701	1824	252	2.4
10100006	NALGONDA	ANNAPARTHY		J.REDDY HOUSE	1981	BW	34.00	10.00	12.00	600	1702	1524	152	2.0
10100007	NALGONDA	ANNAPARTHY		B.C.COLONY	1984	BW	36.00	11.00	13.00	600	1703	907	68	2.8
10100008	NALGONDA	ANNAPARTHY		NAP	/	BW	0.00	0.00	0.00	0	2401	750	52	1.4
10100009	NALGONDA	ANNAPARTHY		NAP	/	BW	0.00	0.00	0.00	0	2770	709	48	1.6
10100010	NALGONDA	ANNAPARTHY		NAP	/	BW	0.00	0.00	0.00	0	3068	724	68	1.8
10100011	NALGONDA	ANNAPARTHY		NAP	/	BW	0.00	0.00	0.00	0	33	795	44	1.5
10100012	NALGONDA	ANNAPARTHY		PWSS	1980	BW	31.00	4.57	7.00	1500	514	820	36	2.4
10100013	NALGONDA	ANNAPARTHY		PWSS(D.F.PLANT)	/	BW	0.00	0.00	0.00	0	893	865	40	1.6
10101001	NALGONDA	ANAPARTHY	KAMMAGUDEM	KAMMAGUDEM	1975	BW	30.50	6.00	12.00	1000	1016	2480	0	3.6
10200001	NALGONDA	ANANTHARAM		GOLLAVADA	1979	BW	25.00	6.00	10.00	1000	2209	4460	910	0.4
10300001	NALGONDA	BUDDHARAM		BUDHAARAM	1983	BW	36.00	10.00	14.00	400	2231	953	120	1.0
10300002	NALGONDA	BUDDHARAM		PWSS ROAD SIDE	1989	BW	50.00	12.00	15.00	2000	646	845	68	1.0
10400001	NALGONDA	CHERLAPALLI		PWSS	1983	BW	41.00	16.00	12.00	2000	164	1545	240	1.4
10400002	NALGONDA	CHERLAPALLI		B.C.COLONY	1985	BW	36.00	10.00	14.00	600	1693	594	48	0.6
10400003	NALGONDA	CHERLAPALLI		GOUNDLAWADA	1981	BW	42.00	10.00	11.00	1500	1694	1177	168	0.8
10400004	NALGONDA	CHERLAPALLI		HARIJANWADA	1977	BW	27.45	8.00	10.00	2000	1695	712	72	0.6
10400005	NALGONDA	CHERLAPALLI		PADMASALIWADA TEMPLE	1979	BW	30.50	10.00	16.00	2000	1696	744	60	1.0
10400006	NALGONDA	CHERLAPALLI		OPP:PRIMARY SCHOOL	1976	BW	27.45	6.00	12.00	1500	1697	4730	980	0.8
10400007	NALGONDA	CHERLAPALLI		CHERLAPALLY PWSS	1976	BW	27.45	8.00	10.00	1500	1299	2350	540	0.8
10400008	NALGONDA	CHERLAPALLI		NAP	1980	BW	40.00	6.00	12.00	1000	2406	2390	690	1.4
10400009	NALGONDA	CHERLAPALLI		ARWS	1982	BW	40.00	10.00	10.00	2000	2769	1883	364	0.8
10500001	NALGONDA	GUNDLAPALLY			1975		27.50	6.00	10.00	500	0	0	0	0.0
10600001	NALGONDA	KANCHANPALLY		PWS SCHEME	1989	BW	45.00	10.00	15.00	1200	163	936	40	1.1
10600002	NALGONDA	KANCHANPALLY		KANCHANPALLY	1978	BW	27.45	12.00	18.00	300	562	1443	148	1.0
10600003	NALGONDA	KANCHANPALLY		PWS SCHEME	1989	BW	45.00	10.00	15.00	1200	1295	685	80	1.2
10600004	NALGONDA	KANCHANPALLY		PWS SCHEME	1989	BW	45.00	10.00	15.00	1200	2469	775	28	1.0
10600005	NALGONDA	KANCHANPALLY		NAP	/	BW	0.00	0.00	0.00	0	2766	849	72	0.8
10600006	NALGONDA	KANCHANPALLY		NAP	/	BW	0.00	0.00	0.00	0	3066	748	64	1.0
10600007	NALGONDA	KANCHANPALLY		PWS SCHEME	/	BW	0.00	0.00	0.00	0	515	819	64	1.4
10600008	NALGONDA	KANCHANPALLY		PWSS NEAR OLD NAP	/	BW	0.00	0.00	0.00	0	647	831	88	1.0
10601001	NALGONDA	KANCHANPALLY	DEEPAKUNTA	DEEPAKUNTA	1980	BW	22.00	6.00	15.00	500	563	705	40	1.2
10700001	NALGONDA	K.KONDARAM		K.KONDARAM	1980	BW	30.50	6.00	15.00	800	565	922	64	0.8
10701001	NALGONDA	K.KONDARAM	RAMULABANDA	RAMULABANDA	1977	BW	30.50	6.00	18.00	1000	564	2520	490	0.4
10701002	NALGONDA	K.KONDARAM	RAMULABANDA	NORTH SIDE OF VLG	1978	BW	30.50	6.00	12.00	800	520	387	32	1.8
10800001	NALGONDA	KOTHAPALLY		ROAD SIDE	1981	BW	39.00	8.00	10.00	1500	2210	1177	240	1.2
10800002	NALGONDA	KOTHAPALLY		PRIMARY SCHOOL	1982	BW	35.00	8.00	12.00	600	2211	794	144	1.2
10800003	NALGONDA	KOTHAPALLY		REDDYWADA	1984	BW	38.00	10.00	12.00	500	2212	807	152	1.0
10800004	NALGONDA	KOTHAPALLY		HARIJANWADA	1986	BW	42.00	10.00	13.00	700	2213	1035	192	0.8
10900001	NALGONDA	MARRIGUDA		PWS SCHEME	1980	BW	38.00	11.00	14.00	1500	160	796	60	1.5
10900002	NALGONDA	MARRIGUDA		MARRIGUDEM	1980	BW	25.00	10.00	15.00	800	2239	1780	216	2.0
10900003	NALGONDA	MARRIGUDA		PWS AT MARRIGUDA	/	BW	0.00	0.00	0.00	0	1298	881	128	1.2
10900004	NALGONDA	MARRIGUDA		NAP	/	BW	0.00	0.00	0.00	0	2405	870	104	0.6
10900005	NALGONDA	MARRIGUDA		NAP	/	BW	0.00	0.00	0.00	0	2768	919	116	1.0
10900006	NALGONDA	MARRIGUDA		NAP	/	BW	0.00	0.00	0.00	0	3067	888	126	1.4
11000001	NALGONDA	NARSINGBATLA		NARSINGBATLA	1972	BW	25.00	6.00	12.00	1200	558	1731	216	1.5
11001001	NALGONDA	NARSINGBATLA	PATHUR	PATHUR	1973	BW	28.00	9.00	15.00	700	559	1299	136	1.4
11100001	NALGONDA	MAMILLAGUDEM		NEAR GPO	1978	BW	25.00	10.00	15.00	1000	2207	0	0	0.0
11101001	NALGONDA	MAILLAGUDEM	KOTHALAGUDEM	PWD ROAD SIDE	1980	BW	30.50	8.00	12.00	1000	2218	1056	260	0.6
11200001	NALGONDA	DONAKAL		PWSS	1988	BW	55.00	10.00	15.00	2000	2767	1150	100	1.0

WELL NO	MANDAL	VILLAGE	HAMLET	WELL NAME	CONSTR. DATE	WELL TYPE	DEPTH	CASING	WATER LEVEL	DISCHARGE l/h	LAB. NO	ELECT. COND. uS/cm	CHLORIDE mg/l	FLUORIDE mg/l
11300001	NALGONDA	APPAJIPET		APPAJIPET	1979	BW	30.50	8.00	10.00	1000	2226	762	84	2.8
11301001	NALGONDA	APPAJIPET	BANTUGUDEM		1981	BW	34.00	8.00	12.00	500	2228	910	128	3.0
11500001	NALGONDA	DOMALAPALLY		BORE WELL 1	/	BW					963	790	0	1.0
11500002	NALGONDA	DOMALAPALLY		BORE WELL 2	/	BW					964	850	0	1.4
11500003	NALGONDA	DOMALAPALLY		BORE WELL 3	/	BW					965	830	0	1.4
20100001	KANGAL	BUDAMARLAPALLI		NEAR SCHOOL	1981	BW	35.00	8.00	10.00	700	1631	934	140	1.2
20100002	KANGAL	BUDAMARLAPALLI		@PAPAIAH HOUSE	1974	BW	30.00	6.00	12.00	500	1632	1316	208	1.8
20100003	KANGAL	BUDAMARLAPALLI		ROAD SIDE	1975	BW	29.00	6.00	10.00	400	1633	561	92	0.8
20100004	KANGAL	BUDAMARLAPALLI		HARIJAN COLONY	1981	BW	38.00	6.00	12.00	2000	1634	745	72	1.2
20200001	KANGAL	BOMMEPALLI		BOMMEPALLI	1973	BW	30.50	6.00	10.00	600	585	1706	220	2.4
20300001	KANGAL	BOINPALLI		BOINPALLI	1980	BW	31.00	8.00	10.00	400	2252	1452	216	1.8
20400001	KANGAL	CH.GOURARAM		PWSS MISAMMA TEMPLE	1990	BW	60.00	12.00	10.00	2000	650	2310	410	1.5
20401001	KANGAL	CH.GOURARAM	KUMMARIGUDA	KUMMARIGUDA	1982	BW	42.00	7.00	10.00	1000	2251	1262	244	1.5
20402001	KANGAL	CH.GOURARAM	NIMMALAGUDEM	NIMMALAGUDEM	1982	BW	36.60	6.00	10.00	363	597	1208	68	2.0
20500001	KANGAL	DARVESHPUR		DARVESHPUR	1979	BW	25.00	8.00	11.00	750	2249	1235	180	1.6
20600001	KANGAL	DOREPALLY		@MANGAMMA HOUSE	1975	BW	30.50	10.00	12.00	800	581	1140	104	2.0
20600002	KANGAL	DOREPALLY		GOUNDLAWADA	1976	BW	31.00	10.00	12.00	600	1643	1808	260	2.4
20600003	KANGAL	DOREPALLY		PRIMARY SCHOOL	1975	BW	28.00	8.00	10.00	800	1644	3200	620	1.4
20600004	KANGAL	DOREPALLY		HARIJAN WADA	1978	BW	28.00	8.00	12.00	1000	1645	1153	124	1.5
20600005	KANGAL	DOREPALLY		MUSLIM BAZAR	1973	BW	28.00	8.00	12.00	1000	1646	718	84	1.4
20700001	KANGAL	G.YADAVELLI		G.YADAVELLI	1971	BW	30.50	8.00	10.00	400	2253	3330	1250	1.4
20701001	KANGAL	G.YADAVELLI	LINGULAGUDEM	LINGULAGUDEM	1978	BW	28.00	6.00	8.00	400	611	599	64	0.6
20702001	KANGAL	G.YADAVELLI	PAPATLAGUDEM	PAPATLAGUDEM	1976	BW	26.50	10.00	8.00	350	610	1525	180	1.2
20800001	KANGAL	KANGAL		PWSS	1983	BW	45.00	12.00	10.00	2000	260	1650	20	1.8
20800002	KANGAL	KANGAL		BEHIND R.RAO LAND	1980	BW	25.00	8.00	10.00	800	261	940	64	2.4
20800003	KANGAL	KANGAL		RAMALINGAIAH HOUSE	1979	BW	30.50	10.00	12.00	500	1647	1340	164	2.8
20800004	KANGAL	KANGAL		GOLLA BAZAR	1984	BW	41.00	10.00	12.00	500	1648	1339	172	2.8
20800005	KANGAL	KANGAL		V.R.LINGAM HOUSE	1980	BW	40.00	10.00	12.00	700	1649	1357	180	2.8
20800006	KANGAL	KANGAL		OPP:VET.HOSPITAL	1980	BW	25.00	6.00	8.00	800	1650	996	120	2.0
20800007	KANGAL	KANGAL		GOPAL SWAMY TEMPLE	1983	BW	38.00	11.60	12.00	600	1651	970	116	2.0
20800008	KANGAL	KANGAL		NEAR SHIVALAYAM	1983	BW	35.00	12.00	10.00	400	1652	1080	136	2.4
20800009	KANGAL	KANGAL		HARIJANWADA	1979	BW	33.00	12.00	10.00	500	1653	1211	160	2.0
20800010	KANGAL	KANGAL		PRIMARY HEALTH CENTR	1979	BW	30.50	10.00	8.00	500	1654	848	120	1.0
20800011	KANGAL	KANGAL		PWSS	1983	BW	42.00	10.00	12.00	2000	3064	1440	232	1.8
20800012	KANGAL	KANGAL		MPWSSCHEME	1980	BW	36.00	10.00	12.00	500	519	1914	324	2.4
20800013	KANGAL	KANGAL		PWSS SCHEME	1983	BW	42.00	10.00	12.00	2000	892	1225	200	2.0
20801001	KANGAL	KANGAL	LACHUGUDEM	LACHUGUDEM	1978	BW	30.50	12.00	10.00	600	583	767	60	1.0
20802001	KANGAL	KANGAL	AMMAGUDEM	AMMAGUDEM	1980	BW	28.00	10.00	12.00	1000	580	1111	132	1.2
20803001	KANGAL	KANGAL	KUMMARIGUDA	KUMMARIGUDA	1978	BW	29.00	6.00	8.00	600	581	1183	124	1.0
20804001	KANGAL	KANGAL	THIMMAJIGUDA	THIMMAJIGUDA	1979	BW	30.50	8.00	10.00	400	584	995	128	1.0
20805001	KANGAL	KANGAL	TELAKONDIGUDEM	TELAKONDIGUDEM	1979	BW	30.50	10.00	12.00	350	591	670	40	1.0
20806001	KANGAL	KANGAL	CHELLAIGUDEM	CHELLAIGUDEM	1980	BW	30.50	8.00	10.00	800	582	1764	260	1.5
20807001	KANGAL	KANGAL	B. THIMMANNAGUDEM	B.THIMMANNAGUDEM	1979	BW	27.00	8.00	10.00	350	600	721	48	1.4
20900001	KANGAL	PARVATHAGIRI		PARVATHAGIRI	1979	BW	30.50	6.00	10.00	350	2250	2570	650	0.5
21000001	KANGAL	PONGODU		PONGODU	1978	BW	30.50	6.00	6.00	500	606	1779	196	2.6
21000002	KANGAL	PONGODU		MPWS SCHEME	1978	BW	30.50	6.00	6.00	1000	2408	703	52	0.8
21001001	KANGAL	PONGODU	RAMACHANDRAPURAM	RAMACHANDRAPUR	1981	BW	25.00	8.00	10.00	800	608	1154	120	2.2
21100001	KANGAL	REGATTA		REGATTA	1980	BW	35.00	6.00	10.00	250	617	1126	124	0.8
21200001	KANGAL	SHABUDULLAPUR		MPWS SCHEME		BW	0.00	0.00	0.00	0	2410	1003	116	3.6
21300001	KANGAL	KURMAPALLY		GOLLAWADA	1975	BW	28.00	8.00	12.00	1200	1635	1940	348	1.0
21300002	KANGAL	KURMAPALLY		ROAD SIDE	1990	BW	35.00	8.00	14.00	1000	1636	525	88	0.4
21300003	KANGAL	KURMAPALLY		@ LOKAIAH HOUSE	1972	BW	30.50	6.00	8.00	1000	1637	4340	870	0.4
21300004	KANGAL	KURMAPALLY		MPWS	1976	BW	35.00	8.00	12.00	1500	2409	960	108	1.0
21300005	KANGAL	KURMAPALLY		VAGU	1980	BW	25.50	8.00	10.00	1500	1388	472	68	1.8

DATA ON DRINKING WATER WELLS (PREP) ANNEX 5

WELL NO	MANDAL	VILLAGE	HAMLET	WELL NAME	CONSTR. DATE	WELL TYPE	DEPTH	CASING	WATER LEVEL	DISCHARGE l/h	LAB. NO	ELECT. COND. uS/cm	CHLORIDE mg/l	FLUORIDE mg/l
21500001	KANGAL	TURKAPALLY		BORE WELL 1	/	BW					959	1620	0	1.0
21500002	KANGAL	TURKAPALLY		BORE WELL 2	/	BW					960	2350	0	1.4
21500003	KANGAL	TURKAPALLY		BORE WELL 3	/	BW					961	840	0	1.2
30100001	MUNGODE	MUNGODE		PWSS	1989	PWS	55.00	12.00	10.00	1200	229	826	68	3.2
30100002	MUNGODE	MUNGODE		DY.E.E MUNGODE	1981	BW	41.15	14.00	12.00	1000	1705	3770	610	1.2
30100003	MUNGODE	MUNGODE		NEAR BUS STOP	1978	BW	28.00	12.00	10.00	2500	1706	960	72	3.6
30100004	MUNGODE	MUNGODE		ZPHSCHOOL	1979	BW	25.00	12.00	10.00	1000	1707	2380	380	0.8
30100005	MUNGODE	MUNGODE		P.H.C.	1977	BW	27.00	15.00	12.00	800	1708	3240	600	1.0
30100006	MUNGODE	MUNGODE		HARIJANAWADA	1984	BW	34.00	12.00	10.00	500	1709	2150	250	1.2
30100007	MUNGODE	MUNGODE		MALAWADA	1984	BW	36.00	12.00	10.00	500	1710	1390	140	1.4
30100008	MUNGODE	MUNGODE		BRAHAMGARI TEMPLE	1978	BW	30.50	12.00	10.00	2000	1711	2460	470	1.5
30100009	MUNGODE	MUNGODE		MUTYALU HOUSE	/	BW	0.00	0.00	0.00	0	1712	1297	168	1.2
30100010	MUNGODE	MUNGODE		PWSS	/	OW	0.00	0.00	0.00	0	1292	1170	112	2.4
30100011	MUNGODE	MUNGODE		PWSS	/	GBW	0.00	0.00	0.00	0	1293	1360	156	2.0
30101001	MUNGODE	MUNGODE	KAMMAGUDA	NEAR CHOURCH	1981	BW	43.50	12.00	10.00	2000	1713	3060	430	3.2
30101002	MUNGODE	MUNGODE	KAMMAGUDA	NEAR PUSPALM HOUSE	/	BW	0.00	0.00	0.00	0	1714	2240	350	2.0
30101003	MUNGODE	MUNGODE	KAMMAGUDA	KAMMAGUDA	/	BW	0.00	0.00	0.00	0	1715	2220	320	2.0
30102001	MUNGODE	MUNGODE	LAXMIDEVIGUDA	E.VENKU HOUSE	1980	BW	58.90	14.00	12.00	1000	1786	1391	116	4.0
30102002	MUNGODE	MUNGODE	LAXMIDEVIGUDA	NEAR B.KONDAIAH HOUS	/	BW	0.00	0.00	0.00	0	1787	1480	160	3.6
30103001	MUNGODE	MUNOGODE	JAKALONIGUDA	K.MARRAIALO HOUSE	/	BW	0.00	0.00	0.00	0	2310	630	84	1.6
30103002	MUNGODE	MUNOGODE	JAKALONIGUDA	J.RAJGOPAL HOUSE	/	BW	0.00	0.00	0.00	0	2311	900	96	2.0
30104001	MUNGODE	MUNOGODE	RAVIGUDA	A.RAMULU HOUSE	/	BW	0.00	0.00	0.00	0	2312	1468	216	2.4
30105001	MUNGODE	MUNUGODE	SANABANDA	S.VEERAIAH HOUSE	/	BW	0.00	0.00	0.00	0	2919	762	68	1.2
30105002	MUNGODE	MUNUGODE	SANABANDA	C.MARAIAH HOUSE	/	BW	0.00	0.00	0.00	0	2920	675	64	0.4
30200001	MUNGODE	KISTAPUR		AT YADAGIRI HOUSE	/	BW	0.00	0.00	0.00	0	2309	999	92	1.2
30200002	MUNGODE	KISTAPUR		AT BHUMMAIAH HOUSE	/	BW	0.00	0.00	0.00	0	2313	1086	112	2.4
30200003	MUNGODE	KISTAPUR		NEAR GP OFFICE	1974	BW	27.00	8.00	10.00	800	2314	1015	188	1.4
30200004	MUNGODE	KISTAPUR		NARSIMHA RAO HOUSE	/	BW	0.00	0.00	0.00	0	2315	1418	220	1.5
30200005	MUNGODE	KISTAPUR		AT GOPAIAH HOUSE	/	BW	0.00	0.00	0.00	0	2316	1263	180	1.2
30300001	MUNGODE	IPPARTHY		REDDYMALLARAM HOUSE	/	BW	0.00	0.00	0.00	0	2317	2490	490	2.4
30300002	MUNGODE	IPPARTHY		A.LAXMAIAH HOUSE	/	BW	0.00	0.00	0.00	0	2318	4190	1000	2.4
30300003	MUNGODE	IPPARTHY		GOWNDALAWADA	1971	BW	28.00	8.00	10.00	2000	2319	2580	560	2.4
30300004	MUNGODE	IPPARTHY		ANANTHAREDDY HOUSE	/	BW	0.00	0.00	0.00	0	2320	0	0	0.0
30400001	MUNGODE	SINGARAM		ANJAIAH HOUSE	/	BW	0.00	0.00	0.00	0	2303	1276	184	1.6
30400002	MUNGODE	SINGARAM		P.SAMBAIAH HOUSE	/	BW	0.00	0.00	0.00	0	2304	1110	208	0.4
30400003	MUNGODE	SINGARAM		MALAWADA	1985	BW	36.00	10.00	12.00	600	2305	876	136	0.8
30400004	MUNGODE	SINGARAM		N,RAMULU HOUSE	/	BW	0.00	0.00	0.00	0	2306	1263	144	1.8
30500001	MUNGODE	KATCHAPUR			1980		30.50	8.00	10.00	1200	0	0	0	0.0
30600001	MUNGODE	PALIWALA		AT BHIKSHAPATHI HOU	/	BW	0.00	0.00	0.00	0	1636	3340	1880	1.6
30600002	MUNGODE	PALIWALA		BUTCHIREDDY HOUSE	/	BW	0.00	0.00	0.00	0	1637	2180	710	1.0
30600003	MUNGODE	PALIWALA		Z.P.H.S.	1984	BW	48.00	10.00	12.00	400	1638	1334	300	0.8
30600004	MUNGODE	PALIWALA		GOVARDAN REDDY HOUSE	/	BW	0.00	0.00	0.00	0	1639	504	80	0.8
30700001	MUNGODE	CHALIMEDA		NEAR SCHOOL	1984	BW	39.63	8.53	10.00	1302	1741	1438	176	2.0
30700002	MUNGODE	CHALIMEDA		NEAR PEERALAKOTTAM	1970	BW	29.00	10.00	10.00	1500	1742	756	32	2.2
30700003	MUNGODE	CHALIMEDA		HARIJAWADA	1978	BW	31.00	12.00	10.00	1000	1743	1310	58	2.4
30700004	MUNGODE	CHALIMEDA		BUS STOP	1971	BW	31.00	12.00	10.00	500	1744	1708	100	2.4
30800001	MUNGODE	KOMPALLY		NEAR ANNAIAH HOUSE	/	OW	0.00	0.00	0.00	0	19	1480	160	0.8
30800002	MUNGODE	KOMPALLY		M.REEDY HOUSE	/	OW	0.00	0.00	0.00	0	20	2140	532	0.4
30800003	MUNGODE	KOMPALLY		NEAR SCHOOL	1979	OW	33.00	8.00	10.00	2500	21	820	80	0.4
30800004	MUNGODE	KOMPALLY		NEAR NARSAIAH HOUSE	1979	OW	31.00	8.00	10.00	1000	22	1350	260	0.4
30800005	MUNGODE	KOMPALLY		SCHOOL	1979	BW	31.00	8.00	10.00	1200	1750	884	136	0.6
30800006	MUNGODE	KOMPALLY		GANDLAWADA	1979	BW	31.00	6.00	10.00	1000	1751	1200	172	0.6
30800007	MUNGODE	KOMPALLY		P.REDDY HOUSE	1977	BW	25.00	6.00	10.00	2000	1752	2840	470	0.8
30800008	MUNGODE	KOMPALLY		NEAR GANDHI STATUE	/	BW	0.00	0.00	0.00	0	1753	2130	360	1.2

WELL NO	MANDAL	VILLAGE	HAMLET	WELL NAME	CONSTR. DATE	WELL TYPE	DEPTH	CASING	WATER LEVEL	DISCHARGE l/h	LAB. NO	ELECT. COND. uS/cm	CHLORIDE mg/l	FLUORIDE mg/l
30800009	MUNGODE	KOMPALLY		NEAR G.P.O.	1972	BW	27.00	6.00	8.00	2000	1754	1130	148	0.6
30800010	MUNGODE	KOMPALLY		HARIJANAWADA	1979	BW	31.00	8.00	10.00	1200	1755	953	128	0.8
30800011	MUNGODE	KOMPALLY		NEAR VET. HOSPITAL	/	BW	0.00	0.00	0.00	0	1756	1951	240	0.4
30801001	MUNGODE	KOMPALLY	TURUPUGUDA	THUIRUPUGUDA	1972	BW	30.50	8.00	10.00	1200	1757	1565	164	2.8
30802001	MUNGODE	KOMPALLY	PADMATIGUDA	PADMATIGUDA	1971	BW	30.50	8.00	10.00	1200	2921	2180	420	2.0
30900001	MUNGODE	CHIKATIMAMIDI		CHAKALIWADA	1985	BW	46.00	8.00	10.00	600	1762	1007	108	0.8
30900002	MUNGODE	CHIKATIMAMIDI		V.REDDY HOUSE	/	BW	0.00	0.00	0.00	0	1763	2170	420	0.6
30900003	MUNGODE	CHIKATIMAMIDI		REDDYWADA	1978	BW	31.00	8.00	11.00	1500	1764	815	80	1.2
30900004	MUNGODE	CHIKATIMAMIDI		SCHOOL	1985	BW	47.50	6.00	18.00	300	1765	5400	930	0.4
30900005	MUNGODE	CHIKATIMAMIDI		MAIN ROAD	1971	BW	30.50	8.00	12.00	1000	1766	4290	1090	0.6
30900006	MUNGODE	CHIKATIMAMIDI		HARIJANAWADA	1971	BW	31.00	8.00	12.00	1000	1767	1752	320	0.8
30901001	MUNGODE	CHIKATIMAMIDI	KAMMAGUDA	MAIN ROAD	1971	BW	30.50	8.00	10.00	1000	1768	2510	400	2.4
30901002	MUNGODE	CHIKATIMAMIDI	KAMMAGUDA	M.VENKATESH HOUSE	1978	BW	30.50	8.00	12.00	1200	1769	2460	280	2.8
30902001	MUNGODE	CHIKATIMAMIDI	ELGALGUDA	D.PENTAIAH HOUSE	1971	BW	30.50	8.00	12.00	1000	1640	2100	450	5.6
31000001	MUNGODE	KORATIKAL		PAPAIAH HOUSE	/	BW	0.00	0.00	0.00	0	2914	2400	340	1.8
31000002	MUNGODE	KORATIKAL		NEAR G.P.O.	1964	BW	37.00	10.00	8.00	800	2915	3410	680	0.8
31000003	MUNGODE	KORATIKAL		NEAR AGAIAH HOUSE	/	BW	0.00	0.00	0.00	0	2916	2550	470	1.5
31001001	MUNGODE	KORATIKAL	DUBBAKALWA	S.BABUMIA HOUSE	1976	BW	31.00	15.00	12.00	1800	1788	1336	112	4.0
31001002	MUNGODE	KORATIKAL	DUBBAKALWA	D.ESTHARI HOUSE	/	BW	0.00	0.00	0.00	0	1789	1347	80	3.6
31100001	MUNGODE	CHOLLEDU		V.LACHAIAH HOUSE	1985	BW	38.00	8.00	12.00	600	1758	2700	430	2.9
31100002	MUNGODE	CHOLLEDU		GOLLAWADA	1980	BW	30.50	10.00	12.00	1500	2922	1248	96	2.4
31200001	MUNGODE	KALVAKUNTA		NEAR G.P.O.	1981	BW	34.00	8.00	10.00	1000	1745	2100	310	1.8
31200002	MUNGODE	KALVAKUNTA		REDDYWADA	1972	BW	30.50	8.00	10.00	800	1746	2300	300	2.4
31300001	MUNGODE	VELMAKANNE		BUS STOP	1974	BW	30.50	12.00	10.00	2000	1732	1435	184	2.8
31300002	MUNGODE	VELMAKANNE		WADLAWADA	1975	BW	30.50	12.00	10.00	1500	1733	1563	180	2.4
31300003	MUNGODE	VELMAKANNE		REDDYWADA	1974	BW	30.50	10.00	10.00	1500	1734	1393	156	2.8
31300004	MUNGODE	VELMAKANNE		NEAR CHOURCH	1981	BW	44.60	10.00	10.00	2500	1735	1993	224	3.2
31300005	MUNGODE	VELMAKANNE		TELAGAWADA	1974	BW	31.00	10.00	9.00	3000	1736	1642	256	2.6
31300006	MUNGODE	VELMAKANNE		TELUGUBAZAR	1976	BW	31.00	10.00	9.00	1700	1737	2580	500	2.4
31300007	MUNGODE	VELMAKANNE		HARIJANAWADA	1971	BW	31.00	10.00	9.00	1000	1738	2290	370	4.0
31300008	MUNGODE	VELMAKANNE		MALAWADA	1976	BW	30.50	12.00	10.00	1500	1739	1504	172	2.4
31300009	MUNGODE	VELMAKANNE		KASIGUDEM	1976	BW	33.00	14.00	12.00	1800	1740	1668	220	4.8
31400001	MUNGODE	PULIPALUPULA		PWSS	/	BW	0.00	0.00	0.00	0	75	520	60	0.8
31400002	MUNGODE	PULIPALUPULA		@PALESHAM HOUSE H.W	/	BW	0.00	0.00	0.00	0	1720	882	80	1.0
31400003	MUNGODE	PULIPALUPULA		NEAR MUTYAM HOUSE	1971	BW	26.00	8.00	11.00	1500	1721	886	56	1.2
31400004	MUNGODE	PULIPALUPULA		GOLLAWADA	1981	BW	39.00	9.00	12.00	800	1722	608	24	1.0
31401001	MUNGODE	PULIPALUPULA	BEERALIGUDA	GOLLAWADA	1980	BW	27.00	8.00	12.00	1000	1723	1013	74	1.8
31401002	MUNGODE	PULIPALUPULA	BEERALIGUDA	MALAWADA	1962	BW	25.00	8.00	12.00	1000	1724	1108	84	1.6
31401003	MUNGODE	PULIPALUPULA	BEERALIGUDA	GANGURIGUDA	1975	BW	26.00	8.00	10.00	1200	2295	835	80	2.0
31500001	MUNGODE	KALVALAPALLY		NARSIMHA HOUSE	/	BW	0.00	0.00	0.00	0	1725	848	52	1.2
31500002	MUNGODE	KALVALAPALLY		KASIGUDA	1983	BW	30.00	8.00	10.00	1000	1726	934	52	1.4
31500003	MUNGODE	KALVALAPALLY		KUMMARIWADA	1980	BW	30.05	6.00	10.00	1000	1727	930	56	1.5
31500004	MUNGODE	KALVALAPALLY		@ONTIPAKA CHANDRAIAH	1983	BW	25.30	7.32	12.00	1605	1728	1643	184	1.6
31500005	MUNGODE	KALVALAPALLY		@0.NARSAIAH HOUSE	/	BW	0.00	0.00	0.00	0	1729	898	100	1.4
31500006	MUNGODE	KALVALAPALLY		@YELLAIAH HOUSE(G.W)	/	BW	0.00	0.00	0.00	0	1730	1657	164	2.0
31500007	MUNGODE	KALVALAPALLY		GOLLAWADA (G.W)	1984	BW	43.59	3.10	12.00	358	1731	1611	200	1.6
31600001	MUNGODE	JAMARATHUPALLY		HARIJANAWADA	1981	BW	36.40	6.00	10.00	1500	1717	870	44	1.4
31600002	MUNGODE	JAMARATHUPALLY		REDDYWADA	1978	BW	31.00	6.00	10.00	1000	1718	767	40	1.5
31600003	MUNGODE	JAMARATHUPALLY		SCHOOL	1982	BW	32.00	6.00	10.00	800	1719	706	48	1.5
31700001	MUNGODE	GUDAPUR		MALLAIAH HOUSE	/	BW	0.00	0.00	0.00	0	1644	1115	100	1.4
31700002	MUNGODE	GUDAPUR		G.P.O.	1984	BW	36.00	8.00	10.00	600	1645	1872	272	1.2
31700003	MUNGODE	GUDAPUR		SUDHAKAR HOUSE	/	BW	0.00	0.00	0.00	0	1646	1713	316	1.2
31700004	MUNGODE	GUDAPUR		MPWS	1989	BW	55.00	10.00	12.00	2000	1647	1086	96	1.4
31800001	MUNGODE	SOLIPUR		GOUNDLAWADA	1981	BW	30.50	6.00	10.00	800	2917	845	108	0.4

WELL NO	MANDAL	VILLAGE	HAMLET	WELL NAME	CONSTR. DATE	WELL TYPE	DEPTH	CASING	WATER LEVEL	DISCHARGE l/h	LAB. NO	ELECT. COND. uS/cm	CHLORIDE mg/l	FLUORIDE mg/l
31800002	MUNGODE	SOLIPUR		W.H.C.	1985	BW	33.00	6.00	10.00	700	2918	711	80	1.2
31900001	MUNGODE	KOTHLARAM		N.RAMAIAH HOUSE	1980	BW	30.50	15.00	15.00	1200	226	2260	252	5.6
31900002	MUNGODE	KOTHLARAM		P.SATHAIAH HOUSE	/	OW	0.00	0.00	0.00	0	227	1490	236	2.1
31900003	MUNGODE	KOTHLARAM		B.NARSIMHA HOUSE	/	OW	0.00	0.00	0.00	0	228	1340	112	4.3
31900004	MUNGODE	KOTHLARAM		V.GURAVAIAH HOUSE	/	BW	0.00	0.00	0.00	0	1641	1605	152	6.4
31900005	MUNGODE	KOTHLARAM		A.NARSIMHA HOUSE	/	BW	0.00	0.00	0.00	0	1642	2350	440	6.8
31901001	MUNGODE	KOTHLARAM	MUDUPUGUDEM	MUDUPUGUDEM.I	1982	BW	36.00	12.00	10.00	800	523	1480	88	4.8
31901002	MUNGODE	KOTHLARAM	MUDUPUGUDEM	MUDUPUGUDEM. II	1983	BW	36.00	12.00	10.00	600	524	2100	268	4.6
32000001	MUNGODE	RATHIPALLY		T.SHANKARAIAH HOUSE	/	BW	0.00	0.00	0.00	0	2296	842	132	0.8
32000002	MUNGODE	RATHIPALLY		K.REDDY HOUSE	1980	BW	31.00	10.00	12.00	1000	2297	673	108	0.4
32000003	MUNGODE	RATHIPALLY		G.MALLAIAH HOUSE	1980	BW	30.50	10.00	12.00	1200	2298	1031	160	0.8
32100001	MUNGODE	OOKONDI		NEAR G.P.O.	1971	BW	33.00	6.00	12.00	1800	2299	1243	180	1.0
32100002	MUNGODE	OOKONDI		KUMMARIWADA	1974	BW	30.50	6.00	10.00	1200	2300	1689	260	1.2
32100003	MUNGODE	OOKONDI		HARIJANAWADA	1977	BW	30.50	6.00	10.00	500	2301	761	104	1.0
32100004	MUNGODE	OOKONDI		K.LINGAIAH HOUSE	1979	BW	30.50	6.00	10.00	1500	2302	1096	156	1.4
40100001	CHANDOOR	CHANDOOR		SAWMILL	/	BW	0.00	0.00	0.00	0	692	1791	204	1.6
40100002	CHANDOOR	CHANDOOR		SEETHARAMA TEMPLE	1975	BW	30.50	10.00	12.00	2500	693	2360	490	1.6
40100003	CHANDOOR	CHANDOOR		SALIWADA	1975	BW	27.00	12.00	14.00	1200	694	3600	750	1.4
40100004	CHANDOOR	CHANDOOR		CHAVADI	1981	BW	29.00	12.00	14.00	1000	695	3670	710	0.8
40100005	CHANDOOR	CHANDOOR		KOMATIWADA	1983	BW	36.00	12.00	14.00	800	696	3550	790	0.8
40100006	CHANDOOR	CHANDOOR		GOWNDLAWADA	1980	BW	30.00	10.00	12.00	1500	697	4410	1010	0.8
40100007	CHANDOOR	CHANDOOR		H.W. TRANSFERMER	1980	BW	31.45	6.00	12.00	300	698	6770	1540	0.6
40100008	CHANDOOR	CHANDOOR		UMAMAHESHWARA TEMPLE	1985	BW	34.50	6.00	12.00	400	699	5140	1110	0.8
40100009	CHANDOOR	CHANDOOR		INDIRANAGAR COLONY	1985	BW	44.00	6.00	13.00	300	700	1348	180	0.8
40100010	CHANDOOR	CHANDOOR		G.JANGAIAH HOUSE	/	BW	0.00	0.00	0.00	0	701	1090	120	0.8
40100011	CHANDOOR	CHANDOOR		GOUNDALAVADA@SRIRAMU	/	BW	0.00	0.00	0.00	0	702	1364	156	0.8
40100012	CHANDOOR	CHANDOOR		TELEGUWADA	/	BW	0.00	0.00	0.00	0	703	2290	470	0.6
40100013	CHANDOOR	CHANDOOR		POLICE STATION	1980	BW	64.00	12.00	15.00	700	704	6000	1120	1.0
40100014	CHANDOOR	CHANDOOR		BORE WELL	/	BW	0.00	0.00	0.00	0	544	900	140	1.0
40101001	CHANDOOR	CHANDOOR	LAKINENIGUDA	BCCOLONY	1985	BW	35.00	8.00	12.00	700	739	635	60	1.2
40101002	CHANDOOR	CHANDOOR	LAKINENIGUDA	KANAKA DURGA TEMPLE	1986	BW	34.00	8.00	12.00	600	740	1106	368	1.5
40101003	CHANDOOR	CHANDOOR	LAKINENIGUDA	REDDIVADA	1987	BW	36.00	8.00	10.00	800	741	1597	392	1.2
40101004	CHANDOOR	CHANDOOR	LAKINENIGUDA	SCHOOL	1984	BW	33.00	8.00	10.00	800	742	1125	120	1.6
40101005	CHANDOOR	CHANDOOR	LAKINENIGUDA	IN FRONT OF SCHOOL	/	BW	0.00	0.00	0.00	0	1592	785	68	1.6
40101006	CHANDOOR	CHANDOOR	LAKINENIGUDA	REDDIVADA	/	BW	0.00	0.00	0.00	0	1593	909	104	1.2
40101007	CHANDOOR	CHANDOOR	LAKINENIGUDA	KANAKAMMA TEMPLE	/	BW	0.00	0.00	0.00	0	1594	616	64	1.2
40101008	CHANDOOR	CHANDOOR	LAKINENIGUDA	SCHOOL	/	BW	0.00	0.00	0.00	0	1595	527	52	1.0
40200001	CHANDOOR	THEROTPALLI		N.LAXMAIAH HOUSE	/	BW	0.00	0.00	0.00	0	727	733	80	0.6
40200002	CHANDOOR	THEROTPALLI		G.P. SCHOOL	1980	BW	27.00	6.00	10.00	1200	728	1596	232	1.4
40200003	CHANDOOR	THEROTPALLI		V.Y.GUDI	/	BW	0.00	0.00	0.00	0	730	933	140	1.6
40200004	CHANDOOR	THEROTPALLI		KUMMARIWADA	/	BW	0.00	0.00	0.00	0	732	746	100	1.0
40200005	CHANDOOR	THEROTPALLI		SALIWADA	/	BW	0.00	0.00	0.00	0	733	1382	196	1.0
40200006	CHANDOOR	THEROTPALLI		SHIVALAYAM	/	BW	0.00	0.00	0.00	0	734	1036	128	0.6
40200007	CHANDOOR	THEROTPALLI		B.A.REDDY HOUSE	/	BW	0.00	0.00	0.00	0	735	1300	220	1.4
40200008	CHANDOOR	THEROTPALLI		VENUGOPALA TEMPLE	/	BW	0.00	0.00	0.00	0	736	665	112	0.8
40200009	CHANDOOR	THEROTPALLI		KURMAWADA	/	BW	0.00	0.00	0.00	0	737	883	88	1.8
40200010	CHANDOOR	THEROTPALLI		H.C.P.VENKATESH H.	/	BW	0.00	0.00	0.00	0	738	806	92	1.0
40201001	CHANDOOR	THERATPALLI	SERIGUDA	PUTTA BAVI	/	BW	0.00	0.00	0.00	0	731	897	112	1.8
40201002	CHANDOOR	THERATPALLI	SERIGUDA	YADAVAVADA	/	BW	0.00	0.00	0.00	0	2923	2620	560	0.4
40202001	CHANDOOR	THERATPALLI	KAMMAGUDEM	SRINAIAH	/	BW	0.00	0.00	0.00	0	772	1236	132	2.4
40202002	CHANDOOR	THERATPALLI	KAMMAGUDEM	AT CHANDRAIAH CHURCH	/	BW	0.00	0.00	0.00	0	773	1380	140	2.2
40202003	CHANDOOR	THERATPALLI	KAMMAGUDEM	KAMMAVADA	1981	BW	30.50	10.00	8.00	1000	774	1370	140	4.0
40202004	CHANDOOR	THERATPALLI	KAMMAGUDEM	CHAKALIVADA	1975	BW	31.00	12.00	10.00	1800	775	1387	204	1.0
40300001	CHANDOOR	PULEMLA		B.C.REDDY HOUSE	1980	BW	30.50	12.00	8.00	1500	743	1258	192	2.4

WELL NO	MANDAL	VILLAGE	HAMLET	WELL NAME	CONSTR. DATE	WELL TYPE	DEPTH	CASING	WATER LEVEL	DISCHARGE l/h	LAB. NO	ELECT. COND. uS/cm	CHLORIDE mg/l	FLUORIDE mg/l
40300002	CHANDOOR	PULEMLA		M.PAPIREDDY HOUSE	/	BW	0.00	0.00	0.00	0	744	1037	148	2.0
40300003	CHANDOOR	PULEMLA		K.LAXMAIAH HOUSE	/	BW	0.00	0.00	0.00	0	745	2610	580	1.8
40300004	CHANDOOR	PULEMLA		H.CHANDRA RAO HOUSE	/	BW	0.00	0.00	0.00	0	746	4160	720	1.6
40300005	CHANDOOR	PULEMLA		B.C.COLONY	/	BW	0.00	0.00	0.00	0	747	823	80	2.2
40300006	CHANDOOR	PULEMLA		SC NEAR COLONY	/	BW	0.00	0.00	0.00	0	748	682	60	2.0
40300007	CHANDOOR	PULEMLA		RANGOLIWADA	/	BW	0.00	0.00	0.00	0	749	4630	970	2.8
40300008	CHANDOOR	PULEMLA		YADAVAWADA	/	BW	0.00	0.00	0.00	0	750	3030	630	1.2
40300009	CHANDOOR	PULEMLA		CH.VEERAIAH CHAVADI	/	BW	0.00	0.00	0.00	0	751	3770	700	1.0
40300010	CHANDOOR	PULEMLA		PWS SCHEME	/	BW	0.00	0.00	0.00	0	1630	1419	188	3.0
40400001	CHANDOOR	IDIKUDI		B.PENTAIAH HOUSE	/	BW	0.00	0.00	0.00	0	711	991	104	5.2
40400002	CHANDOOR	IDIKUDI		BUS STAND	/	BW	0.00	0.00	0.00	0	712	1639	200	3.2
40400003	CHANDOOR	IDIKUDI		KUMMARIWADA	1980	BW	27.00	12.00	10.00	1500	713	1644	180	3.2
40400004	CHANDOOR	IDIKUDI		PWS SCHEME	/	BW	0.00	0.00	0.00	0	1631	1841	128	3.2
40400005	CHANDOOR	IDIKUDI		IDIKUDA	1972	BW	31.00	15.00	10.00	1200	542	420	168	2.8
40401001	CHANDOOR	IDIKUDA	THASKANIGUDA	HARIJANAWADA	1971	BW	30.50	15.00	10.00	1000	714	2480	520	0.4
40401002	CHANDOOR	IDIKUDA	THASKANIGUDA	AT M.VENKAIAH HOUSE	1981	BW	30.50	6.00	10.00	1200	715	1550	192	2.4
40401003	CHANDOOR	IDIKUDA	THASKANIGUDA	RAGAVAIAH BC COLONY	1981	BW	29.00	6.00	10.00	1200	716	1939	320	1.6
40401004	CHANDOOR	IDIKUDA	THASKANIGUDA	YADAVAVADA	/	BW	0.00	0.00	0.00	0	717	983	152	1.2
40401005	CHANDOOR	IDIKUDA	THASKANIGUDA	YADAVAVADA	/	BW	0.00	0.00	0.00	0	718	3050	670	1.2
40401006	CHANDOOR	IDIKUDA	THASKANIGUDA	VELAMAVADA	1981	BW	29.00	8.00	10.00	1200	719	1638	264	1.4
40500001	CHANDOOR	ANGADIPET		D.PARTHAM HOUSE	/	BW	0.00	0.00	0.00	0	759	2490	550	1.0
40500002	CHANDOOR	ANGADIPET		KUMMARWADA	/	BW	0.00	0.00	0.00	0	760	1493	236	0.8
40500003	CHANDOOR	ANGADIPET		S.SWAMY TEMPLE	/	BW	0.00	0.00	0.00	0	761	733	64	1.2
40500004	CHANDOOR	ANGADIPET		KUMMARIWADA II	1971	BW	30.50	6.00	10.00	2000	762	1990	244	2.4
40500005	CHANDOOR	ANGADIPET		H.W.IN THE TREES	1978	BW	31.00	6.00	8.00	3000	763	2630	650	1.4
40500006	CHANDOOR	ANGADIPET		HANUMAN TEMPLE	1980	BW	31.00	6.00	10.00	1500	1629	1651	336	1.4
40600001	CHANDOOR	DONIPAMULA		CHAVADI	1980	BW	30.50	10.00	12.00	800	1613	1386	172	3.2
40600002	CHANDOOR	DONIPAMULA		V.MALLAIAH HOUSE	/	BW	0.00	0.00	0.00	0	1614	1207	156	1.2
40600003	CHANDOOR	DONIPAMULA		TELUGU WADA	1971	BW	30.50	10.00	12.00	500	1615	682	80	0.6
40700001	CHANDOOR	GUNDRAPALLY		OLD SCHOOL	1976	BW	31.00	6.00	10.00	2200	1596	0	0	0.0
40700002	CHANDOOR	GUNDRAPALLY		T.PULLAIAH HOUSE	1977	BW	30.50	6.00	10.00	2000	1597	2220	300	2.0
40700003	CHANDOOR	GUNDRAPALLY		G.B.REDDY HOUSE	/	BW	0.00	0.00	0.00	0	1598	728	88	2.2
40700004	CHANDOOR	GUNDRAPALLY		K.SARAIAH HOUSE	1972	BW	28.00	6.00	10.00	700	1599	665	68	1.2
40701001	CHANDOOR	GUNDRAPALLY	ALRAJBAVIGUDA	Y.MALLA RAO HOUSE	/	BW	0.00	0.00	0.00	0	1600	837	52	2.0
40701002	CHANDOOR	GUNDRAPALLY	ALRAJBAVIGUDA	ALRAJVAVIGUDAM	/	BW	0.00	0.00	0.00	0	519	870	104	0.8
40702001	CHANDOOR	GUNDRAPALLY	KOMATIBAVIGUDEM	KOMATIBAVIGUDEM	/	BW	0.00	0.00	0.00	0	520	680	96	0.6
40800001	CHANDOOR	GHATUPPAL		M.JANGAIAH HOUSE	/	BW	0.00	0.00	0.00	0	776	1289	196	4.4
40800002	CHANDOOR	GHATUPPAL		G.P.O.	1978	BW	30.50	6.00	12.00	1200	777	1361	180	2.8
40800003	CHANDOOR	GHATUPPAL		LIBRARY	1974	BW	30.50	6.00	10.00	1200	778	1608	228	1.8
40800004	CHANDOOR	GHATUPPAL		SALIWADA	1978	BW	30.50	8.00	10.00	800	779	730	112	0.8
40800005	CHANDOOR	GHATUPPAL		WADDORIWADA	1978	BW	30.50	10.00	12.00	600	780	1340	244	1.0
40800006	CHANDOOR	GHATUPPAL		HW CHANDRAIH	1976	BW	31.00	8.00	10.00	500	781	1279	200	1.6
40800007	CHANDOOR	GHATUPPAL		REDDYWADA	1978	BW	31.00	6.00	8.00	1200	782	2040	390	4.0
40800008	CHANDOOR	GHATUPPAL		HARIJANAVADA	1979	BW	30.00	6.00	10.00	700	783	2510	560	1.2
40800009	CHANDOOR	GHATUPPAL		KANAKADURGA TEMPLE	1978	BW	31.00	8.00	10.00	1000	784	1120	172	1.0
40800010	CHANDOOR	GHATUPPAL		KUMMARIVADA	1976	BW	26.00	8.00	12.00	1500	786	977	164	1.0
40800011	CHANDOOR	GHATUPPAL		SALIVADA	/	BW	0.00	0.00	0.00	0	787	5400	2730	1.0
40800012	CHANDOOR	GHATUPPAL		SCHOOL COMPOUND	1974	BW	25.00	6.00	12.00	1500	788	946	112	1.2
40800013	CHANDOOR	GHATUPPAL		@SANKARAIAH MALAVADA	1979	BW	30.50	6.00	11.00	1500	789	2070	440	3.0
40800014	CHANDOOR	GHATUPPAL		HARIJANAVADA	1975	BW	31.00	6.00	10.00	1600	790	2270	440	1.4
40801001	CHANDOOR	GHATUPPAL	DHARMATHANDA	THANDA	1980	BW	30.50	6.00	10.00	1500	765	943	72	4.8
40900001	CHANDOOR	KONDAPUR		@ BAKAIAH HOUSE	/	OW	0.00	0.00	0.00	0	23	740	56	0.4
40900002	CHANDOOR	KONDAPUR		PWSS	/	BW	0.00	0.00	0.00	0	77	580	68	0.8
40900003	CHANDOOR	KONDAPUR		HARIJANAVADA	1974	BW	26.00	6.00	8.00	2000	752	2930	720	0.8

DATA ON DRINKING WATER WELLS (PREP) ANNEX 5

WELL NO	MANDAL	VILLAGE	HAMLET	WELL NAME	CONSTR. DATE	WELL TYPE	DEPTH	CASING	WATER LEVEL	DISCHARGE l/h	LAB. NO	ELECT. COND. uS/cm	CHLORIDE mg/l	FLUORIDE mg/l
40900004	CHANDOOR	KONDAPUR		HARIJANAVADA	/	BW	0.00	0.00	0.00	0	753	3350	800	0.8
40900005	CHANDOOR	KONDAPUR		SCHOOL	/	BW	0.00	0.00	0.00	0	754	697	112	0.8
40900006	CHANDOOR	KONDAPUR		@ ATCHAIAH HOUSE	1974	BW	30.00	7.00	12.00	1200	755	817	120	0.8
40900007	CHANDOOR	KONDAPUR		GPO	1974	BW	31.00	6.00	10.00	1000	756	4050	880	0.6
40900008	CHANDOOR	KONDAPUR		@ V.LINGAIAH HOUSE	/	BW	0.00	0.00	0.00	0	757	559	68	0.8
41000001	CHANDOOR	BODANGAPARTHY		P.LINGAIAH HOUSE	1981	BW	41.00	7.00	6.00	300	765	684	112	0.4
41000002	CHANDOOR	BODANGAPARTHY		PUBLIC SANCHAR	1981	BW	40.00	6.00	10.00	2000	766	2680	570	0.8
41000003	CHANDOOR	BODANGAPARTHY		GPO	1981	BW	42.00	6.00	15.00	150	767	2900	650	0.8
41000004	CHANDOOR	BODANGAPARTHY		MUSLIMWADA	1981	BW	31.00	6.00	12.00	2200	768	1454	264	1.2
41000005	CHANDOOR	BODANGAPARTHY		BUS STAND	1981	BW	41.00	6.00	12.00	1500	769	850	108	2.0
41100001	CHANDOOR	BANGARIGADDA		PWS SCHEME	/	BW	0.00	0.00	0.00	0	1632	1929	284	2.8
41100002	CHANDOOR	BANGARIGADDA		BANGARIGADDA	1978	BW	30.50	10.00	8.00	3000	1633	3390	760	2.8
41100003	CHANDOOR	BANGARIGADDA		CROSS ROAD	1981	BW	41.50	12.00	16.00	1200	1634	1480	168	3.0
41100004	CHANDOOR	BANGARIGADDA		BANGARIGADDA	1971	BW	30.50	12.00	10.00	1300	543	720	360	2.4
41101001	CHANDOOR	BANGARIGADDA	PAPIREDDIGUDA	N.JOCHAIAH	1974	BW	30.50	12.00	10.00	1000	1609	1287	128	2.2
41200001	CHANDOOR	NERMETTA		@AGRICULTURE LAND	/	BW	0.00	0.00	0.00	0	76	1490	220	2.8
41200002	CHANDOOR	NERMETTA		@PAPIREDDY LAND	/	BW	0.00	0.00	0.00	0	97	1045	116	1.2
41200003	CHANDOOR	NERMETTA		KOTHABAVI	/	OW	0.00	0.00	0.00	0	98	1331	208	1.2
41200004	CHANDOOR	NERMETTA		B.C.COLONY	1983	BW	44.00	9.30	10.00	500	1610	1603	216	2.6
41200005	CHANDOOR	NERMETTA		HARIJANA COLONY	1984	BW	58.00	13.25	10.00	944	1611	1937	252	3.2
41200006	CHANDOOR	NERMETTA		HOUSING COLONY	1984	BW	58.20	12.20	10.00	964	1612	1376	124	3.0
41300001	CHANDOOR	THUMMALAPALLY		HARIJANAWADA	1971	BW	30.50	8.00	12.00	800	1601	455	52	1.2
41300002	CHANDOOR	THUMMALAPALLY		AT SATYALU HOUSE	1971	BW	30.50	8.00	12.00	800	1602	744	76	1.6
41300003	CHANDOOR	THUMMALAPALLY		GOLLAWADA	1984	BW	35.00	6.10	12.00	744	1603	668	52	1.8
41300004	CHANDOOR	THUMMALAPALLY		REDDYWADA	1981	BW	42.00	6.00	11.00	1500	1604	1160	172	1.2
41301001	CHANDOOR	THUMMALAPALLI	TUMMAREDDIGUDEM	REDDIVADA	1981	BW	31.00	6.00	10.00	1200	1607	1515	200	2.4
41301002	CHANDOOR	THUMMALAPALLI	TUMMAREDDIGUDEM	REDDIVADA	1974	BW	30.50	10.00	12.00	1000	1608	920	92	1.2
41400001	CHANDOOR	KASTALA		WADLAWADA	1984	BW	44.45	5.16	10.00	744	1625	1667	252	2.2
41400002	CHANDOOR	KASTALA		PADMASALIWADA	1983	BW	37.50	7.00	12.00	500	1626	2050	560	2.0
41400003	CHANDOOR	KASTALA		AT V.RAMREDDY HOUSE	1983	BW	35.00	6.00	10.00	600	1627	853	104	0.4
41400004	CHANDOOR	KASTALA		HARIJANAWADA	1983	BW	18.00	3.00	10.00	500	1628	1971	232	2.0
41401001	CHANDOOR	KASTHALA	MEDUVANIGUDA	YADAVAVADA	1985	BW	42.00	6.20	10.00	800	729	1053	108	3.2
41401002	CHANDOOR	KASTHALA	MEDUVANIGUDA	REDDIVADA	1977	BW	31.00	6.00	10.00	2000	1623	820	68	0.8
41401003	CHANDOOR	KASTHALA	MEDUVANIGUDA	SCHOOL	1972	BW	27.00	10.00	12.00	500	1624	1143	52	1.4
41402001	CHANDOOR	KASTHALA	VADLAVANIGUDA	PATHAWADA	1977	BW	30.50	6.00	12.00	1500	1622	654	68	0.8
41500001	CHANDOOR	SERIDEPALLY		SCHOOL BALRAJ	1983	BW	44.70	9.60	12.00	500	705	3040	730	2.0
41500002	CHANDOOR	SERIDEPALLY		CHAKALIWADA	/	BW	0.00	0.00	0.00	0	706	2900	630	1.8
41500003	CHANDOOR	SERIDEPALLY		GOLLAGUDA	/	BW	0.00	0.00	0.00	0	707	2380	470	1.6
41500004	CHANDOOR	SERIDEPALLY		KUMMARIWADA	/	BW	0.00	0.00	0.00	0	708	1611	220	0.8
41500005	CHANDOOR	SERIDEPALLY		HARIJANAWADA	/	BW	0.00	0.00	0.00	0	709	1227	200	0.6
41500006	CHANDOOR	SERIDEPALLY		@ C.BUTCHAIAH HOUSE	/	BW	0.00	0.00	0.00	0	710	955	168	0.6
41600001	CHANDOOR	UDTHAPALLY		TENEGUWADA	/	BW	0.00	0.00	0.00	0	720	1416	108	2.6
41600002	CHANDOOR	UDTHAPALLY		HARIJANAWADA	/	BW	0.00	0.00	0.00	0	721	943	152	1.0
41600003	CHANDOOR	UDTHAPALLY		TENUGUWADA	/	BW	0.00	0.00	0.00	0	722	1741	188	1.4
41600004	CHANDOOR	UDTHAPALLY		AT P.RAMULU HOUSE	/	BW	0.00	0.00	0.00	0	723	2950	500	2.2
41600005	CHANDOOR	UDTHAPALLY		AT G.MALLAIAH HOUSE	/	BW	0.00	0.00	0.00	0	724	3440	530	4.8
41600006	CHANDOOR	UDTHAPALLY		AT G.NARSIMHA HOUSE	/	BW	0.00	0.00	0.00	0	725	1060	116	2.0
41600007	CHANDOOR	UDTHAPALLY		AT S.MALLAIAH HOUSE	/	BW	0.00	0.00	0.00	0	726	1045	132	2.0
41600008	CHANDOOR	UDTHAPALLY		KUMMARIWADA	/	BW	0.00	0.00	0.00	0	2929	1396	192	1.4
41600009	CHANDOOR	UDTHAPALLY		HARIJANAWADA	/	BW	0.00	0.00	0.00	0	2930	1696	264	1.0
41600010	CHANDOOR	UDTHAPALLY		@ P.RAMULU HOUSE	/	BW	0.00	0.00	0.00	0	2931	2130	350	2.4
41601001	CHANDOOR	UDTHALAPALLI	KOTAGUDEM	VADDERVADA	/	BW	0.00	0.00	0.00	0	2932	1784	326	1.5
41601002	CHANDOOR	UDTHALAPALLI	KOTAGUDEM	TENUGUVADA	/	BW	0.00	0.00	0.00	0	2933	1244	100	2.4
41601003	CHANDOOR	UDTHALAPALLI	KOTAGUDEM	COLONY	/	BW	0.00	0.00	0.00	0	2934	1009	136	2.6

WELL NO	MANDAL	VILLAGE	HAMLET	WELL NAME	CONSTR. DATE	WELL TYPE	DEPTH	CASING	WATER LEVEL	DISCHARGE l/h	LAB. NO	ELECT. COND. uS/cm	CHLORIDE mg/l	FLUORIDE mg/l
51003001	NARAYANAPOOR	JANGAON	PALLGATTUTANDA	@CHIMAIAH HOUSE	1975	BW	30.50	7.00	10.00	1000	1584	924	108	1.8
51003002	NARAYANAPOOR	JANGAON	PALLGATTUTANDA	@K.RAMANA HOUSE	/	BW	0.00	0.00	0.00	0	1585	758	92	2.0
51004001	NARAYANAPOOR	JANGAON	AREGUDEM	NEAR SCHOOL	1979	BW	27.00	6.00	10.00	800	1586	826	60	2.8
51004002	NARAYANAPOOR	JANGAON	AREGUDEM	B.C.COLONY	1981	BW	31.70	6.00	10.00	2000	1587	863	76	2.8
51005001	NARAYANAPOOR	JANGAON	BOTIMEDITANDA	BOTIMEDITANDA	1975	BW	27.00	7.00	14.00	1200	1588	1793	260	2.4
51005002	NARAYANAPOOR	JANGAON	BOTIMEDITANDA	BOTIMEDITANDA	1984	BW	45.00	6.00	12.00	700	1589	1494	220	2.4
51005003	NARAYANAPOOR	JANGAON	BOTIMEDITANDA	BOTIMEDITANDA	1985	BW	47.00	7.00	12.00	800	538	680	112	2.5
51006001	NARAYANAPOOR	JANGAON	KONDAPPAGONITANDA	KONDAPPAGONITANDA	1983	BW	38.00	8.00	12.00	700	1590	579	44	2.6
51100001	NARAYANAPOOR	VOIPALLY		MARRIBAVI TANDA	/	BW	0.00	0.00	0.00	0	27	485	32	2.6
51100002	NARAYANAPOOR	VOIPALLY		B.NARSIMHA HOUSE	/	OW	0.00	0.00	0.00	0	28	660	40	2.4
51100003	NARAYANAPOOR	VOIPALLY		M.SATHAIAH REDDY	/	OW	0.00	0.00	0.00	0	78	720	68	2.8
51100004	NARAYANAPOOR	VOIPALLY		K.RAMULU HOUSE	/	OW	0.00	0.00	0.00	0	79	485	36	2.4
51100005	NARAYANAPOOR	VOIPALLY		M.RAMULU HOUSE	/	BW	0.00	0.00	0.00	0	1556	1161	64	7.0
51100006	NARAYANAPOOR	VOIPALLY		BUS STOP	/	BW	0.00	0.00	0.00	0	1557	1155	72	6.0
51100007	NARAYANAPOOR	VOIPALLY		HARIJANVADA	1979	BW	30.50	8.00	10.00	3000	1558	1022	68	5.8
51100008	NARAYANAPOOR	VOIPALLY		YERAKALAVADA	1980	BW	30.50	7.00	15.00	1000	1591	1086	56	5.6
51101001	NARAYANAPOOR	VOIPALLI	GOLLAGUDA	@V.BUGAIAH HOUSE	/	BW	0.00	0.00	0.00	0	1559	727	68	3.2
51101002	NARAYANAPOOR	VOIPALLI	GOLLAGUDA	GOLLAGUDA	1974	BW	30.50	6.00	15.00	1500	537	660	60	2.4
51102001	NARAYANAPOOR	VOIPALLI	PULLIGATTUTANDA	@V.SOMULA HOUSE	/	BW	0.00	0.00	0.00	0	1562	624	48	3.2
51102002	NARAYANAPOOR	VOIPALLI	PULLIGATTUTANDA	@ V.LUBI HOUSE	/	BW	0.00	0.00	0.00	0	1563	587	44	3.0
51103001	NARAYANAPOOR	VOIPALLI	RADHANAGAR TANDA	NEAR RICEMILL	/	BW	0.00	0.00	0.00	0	1564	634	60	3.2
51104001	NARAYANAPOOR	VOIPALLI	DUBBATANDA	DUBBATANDA	/	BW	0.00	0.00	0.00	0	541	820	44	3.0
51105001	NARAYANAPOOR	VOIPALLI	KORRATANDA	@K.RAMULU HOUSE	/	BW	0.00	0.00	0.00	0	1565	612	60	2.4
51105002	NARAYANAPOOR	VOIPALLI	KORRATANDA	@B.CHAKRU HOUSE	/	BW	0.00	0.00	0.00	0	1566	758	64	2.4
51106001	NARAYANAPOOR	VOIPALLI	MARRIBAVITANDA	MARRIBAVITANDA	1981	BW	29.00	6.00	10.00	1000	1567	616	60	3.0
51200001	NARAYANAPOOR	CHILLAPUR		MALLAIAH HOUSE	/	BW	0.00	0.00	0.00	0	2288	847	76	3.2
51200002	NARAYANAPOOR	CHILLAPUR		VADLAVADA	/	BW	0.00	0.00	0.00	0	2289	842	64	3.2
51200003	NARAYANAPOOR	CHILLAPUR		TENUGUVADA	1979	BW	27.00	7.00	10.00	1000	2290	661	72	2.8
51200004	NARAYANAPOOR	CHILLAPUR		HARIJANVADA	1972	BW	30.50	6.00	12.00	700	2291	775	64	2.8
51201001	NARAYANAPOOR	CHILLAPUR	LAKSHMMAGUDEM	@SARANAPPA HOUSE	1978	BW	30.50	6.00	10.00	1200	2284	886	116	2.8
51201002	NARAYANAPOOR	CHILLAPUR	LAKSHMMAGUDEM	VADDARIVADA	1980	BW	31.00	6.00	10.00	1000	2285	1218	120	4.8
51201003	NARAYANAPOOR	CHILLAPUR	LAKSHMMAGUDEM	@VANKAIAH HOUSE	/	BW	0.00	0.00	0.00	0	2286	1188	120	3.2
51201004	NARAYANAPOOR	CHILLAPUR	LAKSHMMAGUDEM	@T.SAIYANNA HOUSE	1980	BW	30.50	6.00	10.00	800	2287	836	84	3.2
51202001	NARAYANAPOOR	CHILLAPUR	KORRATANDA	@K.SOULU HOUSE	/	BW	0.00	0.00	0.00	0	2292	791	64	3.2
51202002	NARAYANAPOOR	CHILLAPUR	KORRATANDA	NEAR SCHOOL	/	BW	0.00	0.00	0.00	0	2293	777	64	2.8
51203001	NARAYANAPOOR	CHILLAPUR	DAKUTANDA	DAKUTANDA	1980	BW	27.00	6.00	10.00	1000	1570	632	80	2.6
51203002	NARAYANAPOOR	CHILLAPUR	DAKUTANDA	PUBLIC	/	BW	0.00	0.00	0.00	0	1571	493	60	2.4
51300001	NARAYANAPOOR	SERVOIL		S.CHANDRAIAH HOUSE	/	BW	0.00	0.00	0.00	0	2279	795	116	1.0
51300002	NARAYANAPOOR	SERVOIL		B.RAMAIAH HOUSE	/	BW	0.00	0.00	0.00	0	2280	1721	284	0.8
51300003	NARAYANAPOOR	SERVOIL		PWS SCHEME	/	BW	0.00	0.00	0.00	0	2281	1299	220	1.4
51300004	NARAYANAPOOR	SERVOIL		PWS SCHEME	1984	BW	42.00	8.00	12.00	2000	1294	1330	208	1.5
51300005	NARAYANAPOOR	SERVOIL		PWS SCHEME	1988	BW	40.00	10.00	12.00	2000	2087	1284	208	1.5
51300006	NARAYANAPOOR	SERVOIL		PEERLA KOTTAM	1983	BW	36.00	8.00	12.00	600	2088	975	104	1.0
51300007	NARAYANAPOOR	SERVOIL		BRAHMAM GARI GUDI	1982	BW	33.50	8.00	12.00	700	2089	803	88	1.0
51300008	NARAYANAPOOR	SERVOIL		HARIJANVADA	1979	BW	31.00	7.00	10.00	2000	2090	1225	176	0.8
51301001	NARAYANAPOOR	SERVAIL	MALLAREDDYGUDA	MAIN ROAD	1976	BW	30.50	6.00	10.00	2200	1783	1388	160	2.6
51301002	NARAYANAPOOR	SERVAIL	MALLAREDDYGUDA	@ R.REDDY HOUSE	/	BW	0.00	0.00	0.00	0	1784	1482	136	2.0
51301003	NARAYANAPOOR	SERVAIL	MALLAREDDYGUDA	KUMMARA BAZAR	/	BW	0.00	0.00	0.00	0	1785	2230	460	2.2
51301004	NARAYANAPOOR	SERVAIL	MALLAREDDYGUDA	@ G.R.REDDY HOUSE	/	BW	0.00	0.00	0.00	0	2282	1468	208	1.5
51301005	NARAYANAPOOR	SERVAIL	MALLAREDDYGUDA	@G.PAPAIAH HOUSE	/	BW	0.00	0.00	0.00	0	2283	1334	180	2.4
51302001	NARAYANAPOOR	SERVOIL	ALLENDEVEICHERUVU	@A.SAIYULU HOUSE	/	BW	0.00	0.00	0.00	0	1531	1648	196	2.4
51302002	NARAYANAPOOR	SERVOIL	ALLENDEVEICHERUVU	@MUSALAIAH HOUSE	/	BW	0.00	0.00	0.00	0	1532	1556	152	2.8
51302003	NARAYANAPOOR	SERVOIL	ALLENDEVEICHERUVU	@S.LACHAYYA HOUSE	1979	BW	30.50	6.00	10.00	1000	1533	1502	156	2.6
51303001	NARAYANAPOOR	SERVOIL	THURUKAGUDA	@S.AZIZ HOUSE	1979	BW	30.50	6.00	10.00	1000	1534	2010	380	3.2

DATA ON DRINKING WATER WELLS (PREP) ANNEX 5

WELL NO	MANDAL	VILLAGE	HAMLET	WELL NAME	CONSTR. DATE	WELL TYPE	DEPTH	CASING	WATER LEVEL	DISCHARGE l/h	LAB. NO	ELECT. COND. uS/cm	CHLORIDE mg/l	FLUORIDE mg/l
41602001	CHANDOOR	UDTHALAPALLI	DUBBAGUDEM	DUBBAGUDEM	/	BW	0.00	0.00	0.00	0	521	1100	168	1.0
50100001	NARAYANAPOOR	NARAYANAPOOR		PWS SCHEME	/	BW	0.00	0.00	0.00	0	2264	862	372	1.4
50100002	NARAYANAPOOR	NARAYANAPOOR		GOLLAWADA	1980	BW	34.00	6.00	10.00	2000	2265	740	88	1.4
50100003	NARAYANAPOOR	NARAYANAPOOR		GPO	1977	BW	31.00	8.00	12.00	2500	2266	1724	264	0.9
50200001	NARAYANAPOOR	GUJJA		TURUPU BAZAAR	1974	BW	31.00	8.00	12.00	1200	1770	2070	350	2.0
50200002	NARAYANAPOOR	GUJJA		KAMMAGUDA	1974	BW	29.00	8.00	12.00	1000	1771	1370	148	2.2
50200003	NARAYANAPOOR	GUJJA		HARIJANVADA	1980	BW	31.00	7.00	10.00	1400	1772	1271	152	2.0
50200003	NARAYANAPOOR	GUJJA		HARIJANVADA	1980	BW	31.00	7.00	10.00	1400	1773	1392	176	2.0
50200003	NARAYANAPOOR	GUJJA		NEAR TEMPLE	1980	BW	30.00	6.00	10.00	1200	1772	1271	152	2.4
50200003	NARAYANAPOOR	GUJJA		NEAR TEMPLE	1980	BW	30.00	6.00	10.00	1200	1773	1392	176	2.4
50200004	NARAYANAPOOR	GUJJA		HARIJANVADA	1980	BW	30.50	8.00	10.00	1200	1774	1900	264	2.0
50200005	NARAYANAPOOR	GUJJA		HARIJANVADA	1979	BW	31.00	6.00	12.00	1500	1775	1860	232	2.2
50200006	NARAYANAPOOR	GUJJA		SCHOOL	1980	BW	30.50	8.00	10.00	1300	1782	1802	264	2.6
50201001	NARAYANAPOOR	GUJJA	BADAMARKAGUDA	DAMODAR REDDY HOUSE	1981	BW	34.50	6.00	10.00	1200	1779	1322	96	4.0
50201002	NARAYANAPOOR	GUJJA	BADAMARKAGUDA	RAMCHANDRA REDDY HOU	1981	BW	34.50	8.00	10.00	1500	1780	1507	140	3.0
50300001	NARAYANAPOOR	MOHAMMADABAD		PWS SCHEME	/	BW	0.00	0.00	0.00	0	2267	717	88	1.8
50400001	NARAYANAPOOR	CHINNA MIRIYALA		NEAR SCHOOL	1980	BW	30.50	6.00	10.00	1000	2268	874	96	1.4
50400002	NARAYANAPOOR	CHINNA MIRIYALA		HARIJANVADA	1980	BW	27.00	6.00	10.00	2000	2269	1063	116	1.5
50401001	NARAYANAPOOR	CHINNA MIRIYALA	BALIJONI BAVI	BALIJONI BAVI	/	BW	0.00	0.00	0.00	0	532	880	56	1.6
50500001	NARAYANAPOOR	GUDDIMALKAPUR		AT PRATAPREDDI HOUSE	/	OW	0.00	0.00	0.00	0	29	780	60	1.4
50500002	NARAYANAPOOR	GUDDIMALKAPUR		KASIVARIGUDA	1979	BW	31.00	7.00	11.00	2000	30	955	80	2.4
50500003	NARAYANAPOOR	GUDDIMALKAPUR		AT TEMPLE	/	BW	0.00	0.00	0.00	0	31	905	64	2.6
50500004	NARAYANAPOOR	GUDDIMALKAPUR		BUS STAND	/	BW	0.00	0.00	0.00	0	2270	1237	160	1.4
50500005	NARAYANAPOOR	GUDDIMALKAPUR		NEAR R & B ROAD(PWS)	1971	BW	30.50	6.00	12.00	1300	2271	1000	100	3.6
50500006	NARAYANAPOOR	GUDDIMALKAPUR		BC COLONY	/	BW	0.00	0.00	0.00	0	2272	992	104	3.6
50500007	NARAYANAPOOR	GUDDIMALKAPUR		MUSLIM VADA	/	BW	0.00	0.00	0.00	0	2273	1023	116	2.0
50600001	NARAYANAPOOR	KOTHALAPUR		P.SARVAIAH HOUSE	1971	BW	30.50	7.00	12.00	1000	1527	1213	100	2.0
50600002	NARAYANAPOOR	KOTHALAPUR		C.YELLAIAH HOUSE	/	BW	0.00	0.00	0.00	0	1528	1371	128	2.2
50600003	NARAYANAPOOR	KOTHALAPUR		MUTHAIAH HOUSE	/	BW	0.00	0.00	0.00	0	1529	1396	192	1.8
50600004	NARAYANAPOOR	KOTHALAPUR		ABBAIAH HOUSE	/	BW	0.00	0.00	0.00	0	1530	1332	136	2.0
50700001	NARAYANAPOOR	PUTTAPAKA		BUS STAND	1972	BW	31.00	7.00	12.00	1200	2254	4700	1010	0.4
50700002	NARAYANAPOOR	PUTTAPAKA		DR.RAJANATH HOUSE	/	BW	0.00	0.00	0.00	0	2255	3670	890	0.6
50700003	NARAYANAPOOR	PUTTAPAKA		HARIJANVADA	1979	BW	30.50	6.00	10.00	1000	2256	2570	510	0.7
50700004	NARAYANAPOOR	PUTTAPAKA		CHAKALIVADA	1979	BW	30.50	6.00	10.00	1000	2257	4230	1060	0.8
50700005	NARAYANAPOOR	PUTTAPAKA		PADMAVATIVADA	/	BW	0.00	0.00	0.00	0	2258	5890	1600	0.5
50700006	NARAYANAPOOR	PUTTAPAKA		PADMASALIVADA	/	BW	0.00	0.00	0.00	0	2259	1790	360	0.8
50700007	NARAYANAPOOR	PUTTAPAKA		TENUGUVADA	/	BW	0.00	0.00	0.00	0	2260	785	132	1.0
50700008	NARAYANAPOOR	PUTTAPAKA		PADMASALI COLONY	/	BW	0.00	0.00	0.00	0	2261	783	88	1.4
50800001	NARAYANAPOOR	KANKHALAGUDEM		HARIJAN VADA	1978	BW	30.00	6.00	10.00	1000	2274	704	84	0.8
50801001	NARAYANAPOOR	KANKANLAGUDEM	SHERIGUDA	@M.SIVAIAH HOUSE	1978	BW	27.00	6.00	10.00	1000	2275	1140	156	2.6
50801002	NARAYANAPOOR	KANKANLAGUDEM	SHERIGUDA	@K.ATCHAIAH HOUSE	1979	BW	29.00	7.00	12.00	1500	2276	1093	124	2.4
50900001	NARAYANAPOOR	KOTHAGUDA		HARIJAN VADA	1981	BW	32.50	6.00	10.00	2500	2262	1416	148	2.4
50900002	NARAYANAPOOR	KOTHAGUDA		REDDI VADA	1981	BW	30.50	7.00	12.00	1500	2263	1544	168	3.2
51000001	NARAYANAPOOR	JANGAON		KASIVANIGUDA	1983	BW	38.50	8.00	12.00	600	24	1270	200	0.4
51000002	NARAYANAPOOR	JANGAON		V.MALLAIAH HOUSE	/	OW	0.00	0.00	0.00	0	25	665	36	2.0
51000003	NARAYANAPOOR	JANGAON		V.MUTHAYALU HOUSE	/	OW	0.00	0.00	0.00	0	26	565	24	2.4
51000004	NARAYANAPOOR	JANGAON		VADDERIVADA	1981	BW	30.50	6.00	10.00	500	1577	1211	172	1.6
51000005	NARAYANAPOOR	JANGAON		VADLAVADA	1983	BW	36.00	6.00	10.00	500	1578	1519	164	2.2
51000006	NARAYANAPOOR	JANGAON		SATTAIAH HOUSE	/	BW	0.00	0.00	0.00	0	1579	1321	232	2.2
51000007	NARAYANAPOOR	JANGAON		VADLA VADA	/	BW	0.00	0.00	0.00	0	1580	926	80	2.0
51001001	NARAYANAPOOR	JANGAON	PORLAKUNTA	K.P.REDDY HOUSE	/	BW	0.00	0.00	0.00	0	1573	768	100	1.0
51001002	NARAYANAPOOR	JANGAON	PORLAKUNTA	SCHOOL	1988	BW	39.00	6.00	10.00	700	1574	673	68	0.8
51001003	NARAYANAPOOR	JANGAON	PORLAKUNTA	KASIVADA	1981	BW	30.50	6.00	10.00	600	1575	1530	224	0.4
51002001	NARAYANAPOOR	JANGAON	WATCHYATANDA	WATCHYATANDA	/	BW	0.00	0.00	0.00	0	1581	655	56	1.4

WELL NO	MANDAL	VILLAGE	HAMLET	WELL NAME	CONSTR. DATE	WELL TYPE	DEPTH	CASING	WATER LEVEL	DISCHARGE l/h	LAB. NO	ELECT. COND. uS/cm	CHLORIDE mg/l	FLUORIDE mg/l
51304001	NARAYANAPOOR	SERVOIL	GOLLAGUDA	@D.L.REDDY HOUSE	1979	BW	28.00	6.00	10.00	800	1540	2020	230	2.8
51305001	NARAYANAPOOR	SERVOIL	YARRAKUNTA	@Y.YADAIAH HOUSE	1976	BW	30.50	6.00	10.00	800	1541	1201	136	1.2
51306001	NARAYANAPOOR	SERVOIL	CHITTARAMMA BAVI	VILLAGE OUTSIDE	1979	BW	31.00	7.00	9.00	1200	1542	1439	188	1.0
51307001	NARAYANAPOOR	SERVAIL	RAJANNABAVI	RAJANNABAVI	1976	BW	34.00	6.00	10.00	1500	2935	1451	216	2.6
60100001	NARKETPALLY	NARKETPALLY		R.T.C.	1980	BW	33.50	6.00	10.00	400	61	440	24	2.4
60100002	NARKETPALLY	NARKETPALLY		NEAR GOKILAPALLY	/	BW	0.00	0.00	0.00	0	62	630	48	0.8
60100003	NARKETPALLY	NARKETPALLY		RAMAMURTHY HOUSE	/	BW	0.00	0.00	0.00	0	1668	3160	720	2.4
60100004	NARKETPALLY	NARKETPALLY		MALLAWADA	1981	BW	33.50	6.00	10.00	400	1669	1018	84	3.2
60100005	NARKETPALLY	NARKETPALLY		KUMMARIVADA	/	BW	0.00	0.00	0.00	0	1670	7530	2720	1.5
60100006	NARKETPALLY	NARKETPALLY		CHAKILIWADA	/	BW	0.00	0.00	0.00	0	1671	1532	236	2.4
60100007	NARKETPALLY	NARKETPALLY		GOLLAWADA	/	BW	0.00	0.00	0.00	0	1672	2160	440	1.6
60100008	NARKETPALLY	NARKETPALLY		SK.LATHIFF ROAD SIDE	/	BW	0.00	0.00	0.00	0	1673	4170	960	2.8
60100009	NARKETPALLY	NARKETPALLY		HARIJANWADA	1972	BW	26.00	5.00	15.00	350	1674	718	56	2.6
60100010	NARKETPALLY	NARKETPALLY		RAJAIAH HOUSE	/	BW	0.00	0.00	0.00	0	1675	3190	580	3.2
60100011	NARKETPALLY	NARKETPALLY		D.P.KISHAN HOUSE	/	BW	0.00	0.00	0.00	0	1676	1264	172	2.0
60100012	NARKETPALLY	NARKETPALLY		VELMULA ROAD SIDE	/	BW	0.00	0.00	0.00	0	1677	1769	272	1.2
60100013	NARKETPALLY	NARKETPALLY		RLY GATE	/	BW	0.00	0.00	0.00	0	1678	715	60	2.2
60100014	NARKETPALLY	NARKETPALLY		LAKSHMAIAH ROAD SIDE	/	BW	0.00	0.00	0.00	0	1704	5550	330	1.5
60100015	NARKETPALLY	NARKETPALLY		PWS SCHEME (6")	/	BW	0.00	0.00	0.00	0	2403	842	128	3.0
60100016	NARKETPALLY	NARKETPALLY		PWS SCHEME	/	BW	0.00	0.00	0.00	0	35	1071	164	3.4
60100017	NARKETPALLY	NARKETPALLY		A.R.P.PWS.SCHEME	/	BW	0.00	0.00	0.00	0	517	665	48	3.2
60100018	NARKETPALLY	NARKETPALLY		PWS SCHEME	/	BW	0.00	0.00	0.00	0	888	339	24	3.2
60101001	NARKETPALLY	NARKETPALLY	GOPALI PALLY	GOPALI PALLY	1972	BW	30.50	6.00	10.00	1200	511	721	72	1.0
60102001	NARKETPALLY	NARKETPALLY	CHOUTABAVIGUDA	CHOUTABAVIGUDA	1974	BW	31.00	6.00	11.00	1000	510	1159	48	3.2
60200001	NARKETPALLY	B.YELEMLA		LINGAIAH HOUSE	/	BW	0.00	0.00	0.00	0	597	2300	232	1.6
60200002	NARKETPALLY	B.YELEMLA		NEAR PAPAIAH HOUSE	/	BW	0.00	0.00	0.00	0	598	950	80	1.8
60200003	NARKETPALLY	B.YELEMLA		NARSIMHA HOUSE	/	BW	0.00	0.00	0.00	0	599	881	64	1.2
60200004	NARKETPALLY	B.YELEMLA		DASARATH HOUSE	1980	BW	30.50	6.00	10.00	1000	607	1893	256	2.0
60200005	NARKETPALLY	B.YELEMLA		SHEKAR HOUSE	/	BW	0.00	0.00	0.00	0	608	1329	104	2.2
60200006	NARKETPALLY	B.YELEMLA		G.P.OFFICE	1980	BW	30.50	6.00	10.00	1200	610	1098	124	1.0
60200007	NARKETPALLY	B.YELEMLA		OPP.PWS TANK	/	BW	0.00	0.00	0.00	0	1679	877	80	1.4
60200008	NARKETPALLY	B.YELEMLA		V.RAMAKOTA HOUSE	/	BW	0.00	0.00	0.00	0	1680	704	56	0.8
60200009	NARKETPALLY	B.YELEMLA		L.NARSAIAH HOUSE	/	BW	0.00	0.00	0.00	0	1681	715	60	0.8
60200010	NARKETPALLY	B.YELEMLA		LAXMAIAH HOUSE	/	BW	0.00	0.00	0.00	0	1682	920	80	0.6
60200011	NARKETPALLY	B.YELEMLA		PRIMARY SCHOOL	1980	BW	31.00	6.00	10.00	1200	1683	1508	256	0.6
60200012	NARKETPALLY	B.YELEMLA		REDDY WADA	/	BW	0.00	0.00	0.00	0	1684	2510	520	2.2
60200013	NARKETPALLY	B.YELEMLA		HARIJANWADA	1972	BW	25.00	7.00	12.00	700	1685	2230	470	2.0
60200014	NARKETPALLY	B.YELEMLA		PADMASALIWADA	/	BW	0.00	0.00	0.00	0	1686	1966	316	2.4
60200015	NARKETPALLY	B.YELEMLA		P.YELAMLA	/	BW	0.00	0.00	0.00	0	2720	782	100	1.6
60201001	NARKETPALLY	B.YELEMLA	KOTHAGUDA	KOTHAGUDA	1974	BW	29.00	6.00	10.00	1200	514	927	60	0.4
60300001	NARKETPALLY	AURAVANI		GOUNDLAWADA	/	BW	0.00	0.00	0.00	0	1664	1786	256	2.2
60300002	NARKETPALLY	AURAVANI		PEERLAKATTAM	1971	BW	30.50	6.00	15.00	500	1665	1617	276	1.8
60300003	NARKETPALLY	AURAVANI		HARIJANWADA	1980	BW	31.00	6.00	12.00	800	1666	851	40	1.5
60300004	NARKETPALLY	AURAVANI		HARIJAN COLONY	/	BW	0.00	0.00	0.00	0	1667	743	36	1.6
60400001	NARKETPALLY	CHOUDAMPALLY		CHOUDAMPALLY	1980	BW	30.50	10.00	13.00	1000	513	1226	104	1.4
60500001	NARKETPALLY	A.P. LINGOTEM		A.P. LINGOTEM	1979	BW	30.50	7.00	12.00	1000	517	1144	184	0.4
60600001	NARKETPALLY	CHERUGATTA		HARIJAN COLONY	1980	BW	25.60	6.00	9.00	1600	1042	743	90	6.4
60600002	NARKETPALLY	CHERUGATTA		LINGAIAH HOUSE	1980	BW	23.00	8.00	10.00	1500	1043	768	60	6.4
60600003	NARKETPALLY	CHERUGATTA		REDDYWADA	1978	BW	26.00	9.00	6.00	1800	1044	3910	550	6.4
60600004	NARKETPALLY	CHERUGATTA		HARIJANWADA	/	BW	42.00	10.00	6.00	2000	1045	437	65	0.4
60600005	NARKETPALLY	CHERUGATTA		ROAD SIDE	1980	BW	0.00	0.00	0.00	0	1046	407	45	0.4
60600006	NARKETPALLY	CHERUGATTA		MPWS SCHEME	/	BW	0.00	0.00	0.00	0	2402	1064	136	2.6
60600007	NARKETPALLY	CHERUGATTA		MPWS SCHEME	/	BW	0.00	0.00	0.00	0	34	700	52	2.0
60600008	NARKETPALLY	CHERUGATTA		PWS SCHEME	/	BW	0.00	0.00	0.00	0	890	883	100	2.6

DATA ON DRINKING WATER WELLS (PREP) ANNEX 5

WELL NO	MANDAL	VILLAGE	HAMLET	WELL NAME	CONSTR. DATE	WELL TYPE	DEPTH	CASING	WATER LEVEL	DISCHARGE l/h	LAB. NO	ELECT. COND. uS/cm	CHLORIDE mg/l	FLUORIDE mg/l
60600009	NARKETPALLY	CHERUGATTA		D. PLANTRAW WATER	/	BW	0.00	0.00	0.00	0	513	1000	76	3.2
60600010	NARKETPALLY	CHERUGATTA		D. PLANTRAW WATER	/	BW	0.00	0.00	0.00	0	514	1100	88	2.4
60600011	NARKETPALLY	CHERUGATTA		D. PLANTRAW WATER	/	BW	0.00	0.00	0.00	0	515	940	64	4.0
60601001	NARKETPALLY	CHERUGATTA	GUMMALABAVI	CHAKALIWADA	1980	BW	19.85	8.00	7.00	800	588	1041	128	5.6
60601002	NARKETPALLY	CHERUGATTA	GUMMALABAVI	M.REDDY HOUSE	1980	BW	27.50	10.00	12.00	1000	595	1501	168	2.2
60601003	NARKETPALLY	CHERUGATTA	GUMMALABAVI	GUMMALABAVI	/	BW	0.00	0.00	0.00	0	515	2820	520	2.2
60602001	NARKETPALLY	CHERUGATTA	YENUGULADONI	YENUGULADONI	1980	BW	30.50	5.00	10.00	1000	510	526	60	3.2
60700001	NARKETPALLY	YELLAREDDYGUDA		IRRIGATION WELL	/	OW	0.00	0.00	0.00	0	63	582	20	2.8
60700002	NARKETPALLY	YELLAREDDYGUDA		PWS SCHEME	/	BW	0.00	0.00	0.00	0	162	1090	52	4.8
60700003	NARKETPALLY	YELLAREDDYGUDA		KUMMARIWADA	/	BW	0.00	0.00	0.00	0	1036	3320	550	6.4
60700004	NARKETPALLY	YELLAREDDYGUDA		HIGH SCHOOL	1978	BW	36.60	10.00	12.00	1200	1037	1934	190	6.8
60700005	NARKETPALLY	YELLAREDDYGUDA		HARIJANWADA	/	BW	0.00	0.00	0.00	0	1038	3690	730	6.4
60700006	NARKETPALLY	YELLAREDDYGUDA		NEAR G.P.O.	/	BW	0.00	0.00	0.00	0	1039	1778	330	2.4
60700007	NARKETPALLY	YELLAREDDYGUDA		OLD HARIJANWADA	1980	BW	24.50	8.00	10.00	1000	1040	1635	205	4.0
60700008	NARKETPALLY	YELLAREDDYGUDA		RAMULU HOUSE	/	BW	0.00	0.00	0.00	0	1041	1568	0	3.2
60700009	NARKETPALLY	YELLAREDDYGUDA		PWSSCHEME	/	BW	0.00	0.00	0.00	0	1816	762	56	2.2
60700010	NARKETPALLY	YELLAREDDYGUDA		SOUTH OF VILLAGE	/	BW	0.00	0.00	0.00	0	522	1015	88	2.4
60700011	NARKETPALLY	YELLAREDDYGUDA		PWS SCHEME	/	OW	0.00	0.00	0.00	0	512	890	68	2.4
60701001	NARKETPALLY	YELLAREDDYGUDA	KONDAPARAGUDA	KONDAPARAGUDA	1981	BW	33.00	5.00	10.00	1000	519	2850	480	1.2
60800001	NARKETPALLY	M.YEDAVELLY		REDDYWADA	/	BW	0.00	0.00	0.00	0	1606	1885	252	2.6
60800002	NARKETPALLY	M.YEDAVELLY		VEERAIAH HOUSE	/	BW	0.00	0.00	0.00	0	1607	4020	250	4.4
60800003	NARKETPALLY	M.YEDAVELLY		G.P.OFFICE	1977	BW	30.50	8.00	15.00	250	1608	1096	120	4.6
60800004	NARKETPALLY	M.YEDAVELLY		HARIJAN COLONY	1979	BW	28.00	6.00	12.00	500	1609	888	88	4.6
60800005	NARKETPALLY	M.YEDAVELLY		ROAD SIDE	/	BW	0.00	0.00	0.00	0	1610	1072	116	5.2
60800006	NARKETPALLY	M.YEDAVELLY		PWS SCHEME	/	BW	0.00	0.00	0.00	0	132	1040	96	4.8
60800007	NARKETPALLY	M.YEDAVELLY		PWS SCHEME	/	BW	0.00	0.00	0.00	0	891	480	44	2.6
60801001	NARKETPALLY	M.YEDAVELLY	NAIBAVI	HARIJANWADA	1979	BW	30.50	8.00	15.00	250	1034	560	65	2.8
60801002	NARKETPALLY	M.YEDAVELLY	NAIBAVI	VADDEWADA	/	BW	0.00	0.00	0.00	0	1035	567	35	3.2
60900001	NARKETPALLY	THIRMALAGIRI		THIRMALAGIRI	1980	BW	36.00	5.00	10.00	900	508	1107	100	1.4
61000001	NARKETPALLY	THONDLAVAI		THONDLAVAI	/	BW	0.00	0.00	0.00	0	505	2280	380	0.4
61000002	NARKETPALLY	THONDLAVAI		HARIJAN COLONY	1971	BW	24.80	9.00	6.00	3000	651	548	68	1.0
61100001	NARKETPALLY	NEMMANI		B.S.REDDY HOUSE	/	OW	0.00	0.00	0.00	0	104	735	80	1.6
61100002	NARKETPALLY	NEMMANI		H.REDDY HOUSE	1975	BW	30.50	10.00	6.00	800	105	580	24	2.0
61100003	NARKETPALLY	NEMMANI		AMRUTHA HOUSE	/	BW	0.00	0.00	0.00	0	1611	1566	236	1.6
61100004	NARKETPALLY	NEMMANI		VADDARIVADA	/	BW	0.00	0.00	0.00	0	1612	1072	120	1.5
61100005	NARKETPALLY	NEMMANI		GOUNDLAVADA	1978	BW	24.00	6.00	13.00	600	1613	1340	216	1.0
61100006	NARKETPALLY	NEMMANI		HARIJANVADA	1980	BW	26.00	7.00	12.00	1000	1614	799	78	1.2
61100007	NARKETPALLY	NEMMANI		G.P.OFFICE	1979	BW	30.50	6.00	10.00	1600	1615	889	144	2.0
61100008	NARKETPALLY	NEMMANI		NEAR TEMPLE	1978	BW	31.00	6.00	10.00	1800	1616	931	96	1.4
61200001	NARKETPALLY	POTHINENIPALLY		POTHINENIPALLY	1976	BW	32.00	7.00	15.00	500	509	850	96	3.2
61200002	NARKETPALLY	POTHINENIPALLY		POTHINENIPALLY	1971	BW	30.50	6.00	18.00	300	2718	525	68	3.0
61300001	NARKETPALLY	MANDRA		PRIMARY SCHOOL	1980	BW	27.90	7.00	10.00	1200	1047	1875	355	3.0
61300002	NARKETPALLY	MANDRA		GOLLAWADA	/	BW	0.00	0.00	0.00	0	1048	1800	300	2.6
61300003	NARKETPALLY	MANDRA		GOLLAWADA	/	BW	0.00	0.00	0.00	0	1049	2540	300	3.2
61300004	NARKETPALLY	MANDRA		CENTRAL BAZAR	1971	BW	36.50	8.00	12.00	855	1050	2540	300	3.4
61300005	NARKETPALLY	MANDRA		ENTRANCE OF VILLAGE	1976	BW	30.50	6.00	10.00	1500	1051	1202	300	1.2
61300006	NARKETPALLY	MANDRA		M.P.W.S.	/	BW	0.00	0.00	0.00	0	2404	601	68	2.2
61300007	NARKETPALLY	MANDRA		M.P.W.S.	/	BW	0.00	0.00	0.00	0	2719	636	76	4.0
61300008	NARKETPALLY	MANDRA		M.P.W.S.	/	BW	0.00	0.00	0.00	0	574	960	64	2.4
61300008	NARKETPALLY	MANDRA		M.P.W.S.	/	BW	0.00	0.00	0.00	0	36	609	40	2.4
61300009	NARKETPALLY	MANDRA		M.P.W.S.	/	BW	0.00	0.00	0.00	0	516	881	72	2.8
61300009	NARKETPALLY	MANDRA		M.P.W.S.	/	BW	0.00	0.00	0.00	0	596	2050	180	2.8
61300010	NARKETPALLY	MANDRA		P.W.S.	/	BW	0.00	0.00	0.00	0	606	1093	96	2.8
61300010	NARKETPALLY	MANDRA		P.W.S.	/	BW	0.00	0.00	0.00	0	689	582	68	2.8

DATA ON DRINKING WATER WELLS (PREP) ANNEX 5

WELL NO	MANDAL	VILLAGE	HAMLET	WELL NAME	CONSTR. DATE	WELL TYPE	DEPTH	CASING	WATER LEVEL	DISCHARGE l/h	LAB. NO	ELECT. COND. uS/cm	CHLORIDE mg/l	FLUORIDE mg/l
70100001	CHITYAL	CHITYAL		A.LAXMI HOUSE	/	BW	0.00	0.00	0.00	0	538	3050	600	1.0
70100002	CHITYAL	CHITYAL		MANGALIRAMULU HOUSE	/	BW	0.00	0.00	0.00	0	539	2750	550	1.4
70100003	CHITYAL	CHITYAL		R.R.REDDY HOUSE	/	BW	0.00	0.00	0.00	0	540	2060	300	2.4
70100004	CHITYAL	CHITYAL		PERALABASTI	1972	BW	27.00	6.00	10.00	1000	541	2500	400	3.2
70100005	CHITYAL	CHITYAL		M.LINGAIAH HOUSE	/	BW	0.00	0.00	0.00	0	542	1394	140	1.4
70100006	CHITYAL	CHITYAL		RLY STN.	/	BW	0.00	0.00	0.00	0	543	853	68	1.2
70100007	CHITYAL	CHITYAL		N.PITCHAIAH HOUSE	/	BW	0.00	0.00	0.00	0	544	2390	420	2.8
70100008	CHITYAL	CHITYAL		J.RAMULU HOUSE	/	BW	0.00	0.00	0.00	0	545	1570	220	3.2
70100009	CHITYAL	CHITYAL		KURMASAILAM	/	BW	0.00	0.00	0.00	0	600	1870	236	1.0
70100010	CHITYAL	CHITYAL		E.L.NRAYANA HOUSE	/	BW	0.00	0.00	0.00	0	601	2440	420	5.1
70100011	CHITYAL	CHITYAL		BIKSHMAIAH HOUSE	/	BW	0.00	0.00	0.00	0	602	1200	144	5.1
70100012	CHITYAL	CHITYAL		B.M.REDDY HOUSE	/	BW	0.00	0.00	0.00	0	603	2470	416	4.1
70100013	CHITYAL	CHITYAL		SIKH TEMPLE	1982	BW	43.00	6.00	10.00	2000	605	1037	84	1.5
70100014	CHITYAL	CHITYAL		M.ABBAS HOUSE	/	BW	0.00	0.00	0.00	0	661	3270	224	1.5
70100015	CHITYAL	CHITYAL		PWS SCHEME	/	BW	0.00	0.00	0.00	0	2476	1400	248	2.8
70101001	CHITYAL	CHITYAL	VENKATAPUR	NEAR SCHOOL	1983	BW	44.00	6.10	13.00	383	588	986	56	1.8
70101002	CHITYAL	CHITYAL	VENKATAPUR	MALAVADA	1972	BW	30.50	6.00	12.00	1000	590	642	40	1.0
70200001	CHITYAL	URUMADLA		KUMMARIVADA	/	BW	0.00	0.00	0.00	0	509	2340	256	1.0
70200002	CHITYAL	URUMADLA		ANJAIAH WARD	/	BW	0.00	0.00	0.00	0	510	938	76	1.0
70200003	CHITYAL	URUMADLA		H.COLONY	/	BW	0.00	0.00	0.00	0	511	1128	132	1.5
70200004	CHITYAL	URUMADLA		LIBRARY	/	BW	0.00	0.00	0.00	0	512	942	72	1.6
70200005	CHITYAL	URUMADLA		GOLLAVADA	1981	BW	30.50	6.00	10.00	1200	513	1000	88	1.0
70200006	CHITYAL	URUMADLA		HIGHSCHOOL	1983	BW	48.00	6.30	11.00	500	514	1506	212	2.0
70200007	CHITYAL	URUMADLA		VADLAVADA	1981	BW	31.00	6.00	10.00	1000	578	1179	120	0.8
70200008	CHITYAL	URUMADLA		VADDERAVADA	/	BW	0.00	0.00	0.00	0	582	984	76	1.0
70200009	CHITYAL	URUMADLA		HARIJANA COLONY	1985	BW	44.00	5.00	11.00	383	586	756	120	0.4
70200010	CHITYAL	URUMADLA		HOSPITAL	1981	BW	34.50	6.00	11.00	2500	609	681	56	1.5
70300001	CHITYAL	NEREDA		HANUMANTH VADA	/	BW	0.00	0.00	0.00	0	521	2190	336	2.0
70300002	CHITYAL	NEREDA		KANCHANIVADA	/	BW	0.00	0.00	0.00	0	522	2400	332	2.4
70300003	CHITYAL	NEREDA		@MALLESH HOUSE	/	BW	0.00	0.00	0.00	0	523	2020	360	1.6
70300004	CHITYAL	NEREDA		PADMASALIVADA	1971	BW	27.00	6.50	10.00	1000	524	789	78	1.0
70300005	CHITYAL	NEREDA		@ NARAYANA HOUSE	/	BW	0.00	0.00	0.00	0	525	1176	140	2.4
70300006	CHITYAL	NEREDA		C.RAMULU WARD NO.2	/	BW	0.00	0.00	0.00	0	526	721	44	1.2
70300007	CHITYAL	NEREDA		MUTHAIAH WARD NO.2	/	BW	0.00	0.00	0.00	0	527	0	0	0.0
70300008	CHITYAL	NEREDA		PADMASALIVADA	/	BW	0.00	0.00	0.00	0	528	712	72	1.1
70300009	CHITYAL	NEREDA		WATER TANK	/	BW	0.00	0.00	.0.00	0	529	688	60	0.8
70300010	CHITYAL	NEREDA		REDDY VADA	/	BW	0.00	0.00	0.00	0	530	3520	640	2.8
70300011	CHITYAL	NEREDA		HARIJANA VADA	1980	BW	31.00	6.00	10.00	800	531	1569	220	3.6
70300012	CHITYAL	NEREDA		VELAMAVADA	/	BW	0.00	0.00	0.00	0	532	630	40	2.8
70300013	CHITYAL	NEREDA		PWSS	/	BW	0.00	0.00	0.00	0	1816	1262	160	0.6
70301001	CHITYAL	NEREDA	GABIREDDY PALLY	C.R.CHANDRAIH HOUSE		BW	0.00	0.00	0.00	0	560	573	48	2.0
70400001	CHITYAL	T.VELLAMLA		GOUNDLAVADA	1984		31.70	7.00	9.00	944	0	0	0	1.2
70500001	CHITYAL	YELLIKATA		B.C.COLONY	/	BW	0.00	0.00	0.00	0	465	856	72	1.0
70500002	CHITYAL	YELLIKATA		RANGA RAO HOUSE	/	BW	0.00	0.00	0.00	0	466	1577	192	1.6
70500003	CHITYAL	YELLIKATA		GOUNDLA VADA	1983	BW	37.00	7.00	11.00	500	467	1208	128	1.6
70500004	CHITYAL	YELLIKATA		@ SANKARAIAH HOUSE	/	BW	0.00	0.00	0.00	0	468	686	56	1.0
70500005	CHITYAL	YELLIKATA		BC.COLONY	1982	BW	42.00	6.00	10.00	600	469	591	40	1.0
70500006	CHITYAL	YELLIKATA		HARIJANAVADA	1972	BW	25.00	6.00	10.00	1000	470	1473	184	1.6
70500007	CHITYAL	YELLIKATA		HARIJANAVADA	/	BW	0.00	0.00	0.00	0	471	1316	160	1.2
70500008	CHITYAL	YELLIKATA		GOUNDLAVADA	/	BW	0.00	0.00	0.00	0	472	1532	228	1.2
70600001	CHITYAL	GUNDRAMPALLI		NEW SCHOOL	1972	BW	30.00	6.00	10.00	800	458	1207	172	1.5
70600002	CHITYAL	GUNDRAMPALLI		VADLAVADA	1976	BW	40.00	8.00	12.00	500	459	1007	100	1.6
70600003	CHITYAL	GUNDRAMPALLI		PRIMARY SCHOOL	1982	BW	45.00	10.00	10.00	800	460	1178	80	1.0
70600004	CHITYAL	GUNDRAMPALLI		HARIJANAVADA	1984	BW	33.50	6.15	10.00	744	461	837	80	1.0

DATA ON DRINKING WATER WELLS (PREP) ANNEX 5

WELL NO	MANDAL	VILLAGE	HAMLET	WELL NAME	CONSTR. DATE	WELL TYPE	DEPTH	CASING	WATER LEVEL	DISCHARGE l/h	LAB. NO	ELECT. COND. uS/cm	CHLORIDE mg/l	FLUORIDE mg/l
70600005	CHITYAL	GUNDRAMPALLI		ZPH SCHOOL	1986	BW	36.00	6.00	12.00	800	462	1028	104	1.2
70600006	CHITYAL	GUNDRAMPALLI		KUMMARIVADA	/	BW	0.00	0.00	0.00	0	463	914	92	1.0
70600007	CHITYAL	GUNDRAMPALLI		TELEPHONE EXCHANGE	1990	BW	45.00	8.00	10.00	1200	464	1584	192	1.0
70600008	CHITYAL	GUNDRAMPALLI		MALAVADA	1982	BW	36.00	6.00	8.00	1600	550	2040	370	2.0
70600009	CHITYAL	GUNDRAMPALLI		@RAMESH HOUSE	/	BW	0.00	0.00	0.00	0	551	1221	192	2.0
70600010	CHITYAL	GUNDRAMPALLI		@G.P.LAKSHMAIAH HOU	1986	BW	44.70	7.30	10.00	2052	552	1805	280	1.4
70600011	CHITYAL	GUNDRAMPALLI		PWSS	/	BW	0.00	0.00	0.00	0	2478	1126	152	2.0
70600012	CHITYAL	GUNDRAMPALLI		MPWS	/	BW	0.00	0.00	0.00	0	1110	1650	336	2.0
70700001	CHITYAL	EAPOOR		@ MALLAIAH HOUSE	1986	BW	44.30	12.50	8.00	2052	473	2290	392	1.2
70700002	CHITYAL	EAPOOR		NEAR SCHOOL	1977	BW	30.00	10.00	8.00	1600	474	2280	324	1.2
70700003	CHITYAL	EAPOOR		GPO	1984	BW	31.80	6.40	10.00	760	475	2450	342	1.0
70700004	CHITYAL	EAPOOR		REDDYVADA	1986	BW	36.00	6.00	9.00	800	476	1398	108	1.2
70700005	CHITYAL	EAPOOR		POST OFFICE	/	BW	0.00	0.00	0.00	0	477	2240	320	0.8
70700006	CHITYAL	EAPOOR		@ MUTTAIAH HOUSE	1984	BW	25.60	6.10	8.60	3050	478	2060	288	2.0
70700007	CHITYAL	EAPOOR		VEERAIAH HOUSE	/	BW	0.00	0.00	0.00	0	479	1675	260	0.8
70700008	CHITYAL	EAPOOR		BC COLONY	1987	BW	35.00	4.40	12.00	800	575	1718	164	1.6
70700009	CHITYAL	EAPOOR		HARIJANAVADA	1984	BW	32.20	7.50	8.50	2000	576	2070	280	1.6
70700010	CHITYAL	EAPOOR		PWSS	/	BW	0.00	0.00	0.00	0	1817	1562	268	0.6
70800001	CHITYAL	CHINAKAPARTY		@N.NAGAIAH HOUSE	1989	BW	45.00	5.00	10.00	1600	448	2910	400	0.8
70800002	CHITYAL	CHINAKAPARTY		@RAJAIAH HOUSE	1979	BW	30.00	6.00	8.00	1100	449	745	68	1.0
70800003	CHITYAL	CHINAKAPARTY		GPO	1982	BW	36.50	3.00	6.00	1000	450	1468	160	2.0
70800004	CHITYAL	CHINAKAPARTY		VADLAVADA	1971	BW	30.00	6.00	7.00	1200	451	706	48	1.0
70800005	CHITYAL	CHINAKAPARTY		GOLLAVADA	1986	BW	40.00	3.50	8.16	600	452	1658	164	2.0
70800006	CHITYAL	CHINAKAPARTY		GPO	1984	BW	38.00	7.15	6.10	1000	453	1396	120	2.0
70800007	CHITYAL	CHINAKAPARTY		VILLAGE CENTRE	1984	BW	41.20	8.50	10.50	1002	454	1064	92	2.4
70800008	CHITYAL	CHINAKAPARTY		@ RAMULU HOUSE	/	BW	0.00	0.00	0.00	0	455	1007	68	2.4
70800009	CHITYAL	CHINAKAPARTY		VADDAVADA	1985	BW	30.00	7.04	0.00	700	456	882	76	1.0
70800010	CHITYAL	CHINAKAPARTY		MANGALAVADA	/	BW	0.00	0.00	0.00	0	519	1121	140	0.8
70800011	CHITYAL	CHINAKAPARTY		KUMMARIVADA	/	BW	0.00	0.00	0.00	0	520	1038	64	2.4
70800012	CHITYAL	CHINAKAPARTY		GOUNDLAVADA	1991	BW	45.60	8.45	10.00	700	612	1782	292	1.5
70801001	CHITYAL	CHINAKAPARTHY	BOYAGUBBA	GOWNDLAWADA	/	BW	0.00	0.00	0.00	0	457	806	72	1.0
70801002	CHITYAL	CHINAKAPARTHY	BOYAGUBBA	R.PAKIRAIAH HOUSE	/	BW	0.00	0.00	0.00	0	566	558	36	0.6
70801003	CHITYAL	CHINAKAPARTHY	BOYAGUBBA	MULIMWADA	/	BW	0.00	0.00	0.00	0	580	2450	320	1.0
70900001	CHITYAL	PEDDAKAPARTHY		PADMASALIWADA	1984	BW	39.10	4.40	12.00	1302	437	2900	504	2.0
70900002	CHITYAL	PEDDAKAPARTHY		J.RAMACHANDRAIH HOUS	1989	BW	45.18	6.15	10.00	1200	438	1088	144	2.0
70900003	CHITYAL	PEDDAKAPARTHY		KUMMARIWADA	1974	BW	30.02	5.80	8.00	1600	439	1720	212	1.4
70900004	CHITYAL	PEDDAKAPARTHY		REDDYWADA	1986	BW	40.00	7.00	10.00	800	440	2560	384	3.2
70900005	CHITYAL	PEDDAKAPARTHY		WATER TANK	1989	BW	45.00	6.00	11.00	600	441	1152	136	3.4
70900006	CHITYAL	PEDDAKAPARTHY		GOVINDAWADA	/	BW	0.00	0.00	0.00	0	442	1004	100	2.0
70900007	CHITYAL	PEDDAKAPARTHY		ALWAIAH HOUSE	1972	BW	30.60	6.16	10.00	1000	443	1038	142	3.2
70900008	CHITYAL	PEDDAKAPARTHY		NEAR HOSTEL	1986	BW	45.20	10.20	8.00	2000	444	2100	320	1.6
70900009	CHITYAL	PEDDAKAPARTHY		ANJIREDDY HOUSE	1982	BW	30.02	6.10	8.00	2500	445	3330	568	3.4
70900010	CHITYAL	PEDDAKAPARTHY		NEAR BUS STAND	1976	BW	36.90	11.00	6.00	1200	446	655	76	2.4
70900011	CHITYAL	PEDDAKAPARTHY		B.SATHAIAH HOUSE	/	BW	0.00	0.00	0.00	0	447	612	36	2.2
70900012	CHITYAL	PEDDAKAPARTHY		T.GOPAL HOUSE	1984	BW	23.80	3.80	12.00	533	515	1246	160	2.4
70900013	CHITYAL	PEDDAKAPARTHY		HARIJANAWADA	1991	BW	45.00	6.00	10.00	800	516	1485	272	1.8
70900014	CHITYAL	PEDDAKAPARTHY		PEDDASALIWADA	1987	BW	36.40	6.00	10.00	1000	517	1429	164	0.8
70900015	CHITYAL	PEDDAKAPARTHY		KOMASALIWADA	/	BW	0.00	0.00	0.00	0	583	1757	200	1.4
70900016	CHITYAL	PEDDAKAPARTHY		BUS STAND	1989	BW	45.06	6.00	8.00	0	604	1500	200	1.8
70900017	CHITYAL	PEDDAKAPARTHY		MALAVADA	1984	BW	32.70	3.90	10.00	1600	518	1006	116	1.6
70901001	CHITYAL	PEDDAKAPARTHY	ARREGUDEM	KUMMARIWADA	1981	BW	30.06	6.00	8.00	2500	533	923	60	1.6
70901002	CHITYAL	PEDDAKAPARTHY	ARREGUDEM	KUMMARIWADA	1986	BW	40.00	3.00	8.00	1100	534	799	60	1.6
70901003	CHITYAL	PEDDAKAPARTHY	ARREGUDEM	PADMASALIWADA	1972	BW	30.06	8.00	6.00	1000	535	926	64	1.5
70901004	CHITYAL	PEDDAKAPARTHY	ARREGUDEM	L.BUTCHAIAH HOUSE	1983	BW	35.00	5.00	8.00	1800	536	1410	146	2.0

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WELL NO	MANDAL	VILLAGE	HAMLET	WELL NAME	CONSTR. DATE	WELL TYPE	DEPTH	CASING	WATER LEVEL	DISCHARGE l/h	LAB. NO	ELECT. COND. uS/cm	CHLORIDE mg/l	FLUORIDE mg/l
70901005	CHITYAL	PEDDAKAPARTHY	ARREGUDEM	NEAR SHCOOL	1980	BW	30.00	8.00	10.00	1100	537	1038	80	1.5
70901006	CHITYAL	PEDDAKAPARTHY	ARREGUDEM	HARIJANAWADA	/	BW	0.00	0.00	0.00	700	594	904	72	1.5
70901007	CHITYAL	PEDDAKAPARTHY	ARREGUDEM	PWS SCHEME	/	BW	0.00	0.00	0.00	0	1819	791	88	2.2
71000001	CHITYAL	PITTAMPALLY		M.LACHAIAH HOUSE	/	BW	0.00	0.00	0.00	0	495	1472	76	1.9
71000002	CHITYAL	PITTAMPALLY		REDDYWADA	/	BW	0.00	0.00	0.00	0	496	888	44	1.8
71000003	CHITYAL	PITTAMPALLY		S.N.REDDY HOUSE	/	BW	0.00	0.00	0.00	0	497	782	76	1.0
71000004	CHITYAL	PITTAMPALLY		R.R.RAO HOUSE	/	BW	0.00	0.00	0.00	0	498	1167	84	1.7
71000005	CHITYAL	PITTAMPALLY		HARIJANAWADA	/	BW	0.00	0.00	0.00	0	499	622	96	0.8
71000006	CHITYAL	PITTAMPALLY		G.P.O.	/	BW	0.00	0.00	0.00	0	587	1738	340	1.0
71000007	CHITYAL	PITTAMPALLY		OLD HARIJANAWADA	/	BW	0.00	0.00	0.00	0	588	1694	184	1.2
71100001	CHITYAL	VELMINEDU		B.C.COLONY	/	BW	0.00	0.00	0.00	0	486	755	72	0.5
71100002	CHITYAL	VELMINEDU		P.RAMULU HOUSE	1982	BW	32.50	6.15	8.10	3016	487	700	60	0.8
71100003	CHITYAL	VELMINEDU		E.C.REDDY HOUSE	1986	BW	32.50	6.60	6.15	4212	488	1567	240	0.4
71100004	CHITYAL	VELMINEDU		O.KRISHNAIAH HOUSE	1982	BW	30.00	5.00	8.13	800	489	1298	176	0.5
71100005	CHITYAL	VELMINEDU		P.RAMULU HOUSE	1989	BW	45.00	8.00	10.00	1000	490	910	128	1.0
71100006	CHITYAL	VELMINEDU		Z.P. SCHOOL	1987	BW	40.00	6.00	9.00	600	491	2190	320	0.5
71100007	CHITYAL	VELMINEDU		D.ACHAIAH HOUSE	1983	BW	32.25	7.10	10.00	2052	492	0	0	0.0
71100008	CHITYAL	VELMINEDU		NEAR TEMPLE	1984	BW	36.00	8.00	10.00	1100	493	1028	72	1.4
71100009	CHITYAL	VELMINEDU		CHAKALIWADA	1984	BW	49.35	9.10	12.00	550	494	2500	504	0.4
71100010	CHITYAL	VELMINEDU		BUS STAGE	1986	BW	35.00	3.00	10.00	1000	592	706	56	1.8
71100011	CHITYAL	VELMINEDU		PWS SCHEME	/	BW	0.00	0.00	0.00	0	2477	615	56	0.8
71101001	CHITYAL	VELMINEDU	BONGANICHERUVU	HARIJANWADA	1987	BW	35.00	6.10	12.00	130	561	848	48	1.6
71101002	CHITYAL	VELMINEDU	BONGANICHERUVU	OPP: TO SCHOOL	1986	BW	39.00	5.00	10.00	900	577	840	96	1.0
71101003	CHITYAL	VELMINEDU	BONGANICHERUVU	HARIJANWADA	/	BW	0.00	0.00	0.00	0	613	1109	240	0.4
71200001	CHITYAL	VANIPAKALA		G.MARRIAH HOUSE	/	BW	0.00	0.00	0.00	0	505	792	140	1.0
71200002	CHITYAL	VANIPAKALA		HARIJANAWADA TEMPLE	1979	BW	43.00	6.00	10.00	950	506	0	0	0.0
71200003	CHITYAL	VANIPAKALA		KISHEN RAO HOUSE	1981	BW	30.50	5.00	12.00	2000	507	814	72	1.5
71200004	CHITYAL	VANIPAKALA		P.RAMAIAH HOUSE	1971	BW	38.00	8.00	10.00	800	508	1253	120	1.8
71200005	CHITYAL	VANIPAKALA		M.LINGAIAH HOUSE	1985	BW	45.00	8.00	10.00	1200	571	587	28	1.2
71200006	CHITYAL	VANIPAKALA		MPWS SCHEME	1982	BW	42.00	8.00	12.00	2000	2411	1124	138	2.4
71300001	CHITYAL	VATTIMARTHI		D.NARSAIAH HOUSE	1980	BW	28.90	8.00	10.00	600	500	796	60	1.6
71300002	CHITYAL	VATTIMARTHI		BEHIND PWD ROAD	1989	BW	45.00	6.00	10.00	900	501	516	40	1.5
71300003	CHITYAL	VATTIMARTHI		NEAR LIBRARY	/	BW	0.00	0.00	0.00	0	502	1119	84	1.8
71300004	CHITYAL	VATTIMARTHI		R.YADAIAH HOUSE	1960	BW	26.90	7.00	8.00	600	503	1777	176	1.8
71300005	CHITYAL	VATTIMARTHI		K.RAMULU HOUSE	1974	BW	30.50	6.00	8.00	800	504	1093	100	2.0
71300006	CHITYAL	VATTIMARTHI		NEAR SHCOOL	1981	BW	26.00	6.00	10.00	1500	572	1174	316	1.0
71300007	CHITYAL	VATTIMARTHI		NEAR NARSAIAH HOUSE	/	BW	0.00	0.00	0.00	0	573	2100	132	1.2
71300008	CHITYAL	VATTIMARTHI		NEAR ROAD	/	BW	0.00	0.00	0.00	0	584	1304	152	2.8
71300009	CHITYAL	VATTIMARTHI		SHEELA GANESH HOUSE	/	BW	0.00	0.00	0.00	0	591	1074	80	1.8
71300010	CHITYAL	VATTIMARTHI		C.PEDDALU HOUSE	/	BW	0.00	0.00	0.00	0	611	1036	100	2.0
71300011	CHITYAL	VATTIMARTHI		PWS SCHEME	/	BW	0.00	0.00	0.00	0	1820	880	80	1.8
71300012	CHITYAL	VATTIMARTHI		PWS SCHEME	/	BW	0.00	0.00	0.00	0	2185	970	100	1.8
71300013	CHITYAL	VATTIMARTHI		MPWSSCHEME	1975	BW	30.50	8.00	12.00	1000	2412	1307	172	4.8
71400001	CHITYAL	SHIVANENIGUDEM		UPPAIAH HOUSE	/	BW	0.00	0.00	0.00	0	480	963	56	2.4
71400002	CHITYAL	SHIVANENIGUDEM		G.P.O.	1980	BW	30.50	6.00	8.00	1000	481	1532	140	1.6
71400003	CHITYAL	SHIVANENIGUDEM		S.C.B.C.COLONY	/	BW	0.00	0.00	0.00	0	482	671	40	1.2
71400004	CHITYAL	SHIVANENIGUDEM		PRIMARY SCHOOL	/	BW	0.00	0.00	0.00	0	483	1781	256	1.6
71400005	CHITYAL	SHIVANENIGUDEM		KISTAIAH HOUSE	/	BW	0.00	0.00	0.00	0	484	757	72	1.6
71400006	CHITYAL	SHIVANENIGUDEM		D.V.REDDY HOUSE	1978	BW	30.50	6.00	8.00	500	485	1032	76	1.8
71400007	CHITYAL	SHIVANENIGUDEM		KOTESHWARAIAH HOUSE	/	BW	0.00	0.00	0.00	0	614	2550	444	1.0
71400008	CHITYAL	SHIVANENIGUDEM		WEST SIDE OF VILLAGE	/	BW	0.00	0.00	0.00	0	521	1182	72	0.4
80100001	NAMPALLY	NAMPALLY		AT HIGH SCHOOL	1980	BW	42.00	8.00	10.00	800	871	1016	96	1.2
80100002	NAMPALLY	NAMPALLY		NAMPALLY	1979	BW	41.00	10.00	14.00	400	924	483	24	1.2
80101001	NAMPALLY	NAMPALLY	UPPAR THANDA	UPPAR THANDA	1982	BW	35.00	7.00	11.00	500	923	1094	96	2.4

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WELL NO	MANDAL	VILLAGE	HAMLET	WELL NAME	CONSTR. DATE	WELL TYPE	DEPTH	CASING	WATER LEVEL	DISCHARGE l/h	LAB. NO	ELECT. COND. uS/cm	CHLORIDE mg/l	FLUORIDE mg/l
80200001	NAMPALLY	PEDDAPUR		PEDDAPUR	1984	BW	40.00	10.00	12.00	900	937	1390	144	2.8
80201001	NAMPALLY	PEDDAPUR	NARSIMHA GUDA		1978	BW	28.00	8.00	12.00	1200	867	881	108	1.2
80202001	NAMPALLY	PEDDAPUR	NIVILLAGUDA	NIVILLAGUDA	1976	BW	30.00	6.00	10.00	1000	948	1308	118	2.8
80203001	NAMPALLY	PEDDAPUR	BANDLAGUDA	BANDLAGUDA	1978	BW	30.50	6.00	10.00	1200	947	802	136	1.2
80300001	NAMPALLY	NEREDLAPALLY		NEREDLAPALLY	1977	BW	28.00	8.00	10.00	1000	907	595	60	1.5
80400001	NAMPALLY	DAMERA		MPWS	1981	BW	41.50	6.50	12.00	1200	860	1071	92	5.2
80400002	NAMPALLY	DAMERA		AT HARIJANWADA	1982	BW	44.50	7.50	12.50	1000	881	920	60	3.2
80500001	NAMPALLY	DEVATHPALLY		DEVATHPALLY	1982	BW	42.00	6.10	11.00	1200	920	688	32	1.5
80600001	NAMPALLY	S.W.LINGOTAM		S.W.LINGOTAM	1984	BW	41.50	6.20	8.90	800	926	855	76	3.2
80700001	NAMPALLY	YEDDAPALLY		WADDAPALLY	1984	BW	42.40	5.90	11.20	700	884	1248	68	3.2
80800001	NAMPALLY	CHITTAMPADU		HARIJANWADA	1985	BW	42.00	6.20	11.60	900	863	795	40	2.8
80900001	NAMPALLY	THIRMALGIRI		CHANDRAIAH HOUSE	1984	BW	39.50	6.30	10.50	800	878	2080	300	1.0
80900002	NAMPALLY	THIRMALGIRI		KUMMARIWADA	1981	BW	41.50	6.30	11.20	383	877	998	112	1.5
80900003	NAMPALLY	THIRMALGIRI		K.THIRMALGIRI	1981	BW	32.50	6.50	10.50	650	906	5900	1470	0.8
81000001	NAMPALLY	MALLAREDDYPALLY			1982	BW	38.50	7.00	11.00	750	958	790	0	2.4
81000001	NAMPALLY	MALLAREDDYPALLY			1982		38.50	7.00	11.00	750	0	0	0	0.0
81100001	NAMPALLY	PASNUR		KUMMARIWADA	1984	BW	40.50	8.00	10.50	1000	875	1302	100	2.4
81100002	NAMPALLY	PASNUR		PASUNUR	1985	BW	39.50	9.00	11.20	1500	908	1021	108	2.0
81101001	NAMPALLY	PASNUR	CHOLLANIKUNTA	CHOLLANIKUNTA	1987	BW	40.50	7.50	12.50	800	932	870	56	2.8
81200001	NAMPALLY	K.THIRMALGIRI			1981	BW	40.50	6.05	12.00	800	957	1050	0	1.6
81200001	NAMPALLY	K.THIRMALGIRI			1981		40.50	6.05	12.00	800	0	0	0	0.0
81300001	NAMPALLY	CHAMALAPALLY		AT KUMMARIWADA	1982	BW	39.80	6.50	11.50	700	862	1369	100	2.8
81300002	NAMPALLY	CHAMALAPALLY		CHAMALAPALLY	1981	BW	41.50	7.00	11.00	1000	948	837	88	1.0
81400001	NAMPALLY	GANUGUPALLY		NEAR A.REDDY HOUSE	1982	BW	39.50	6.05	12.00	750	858	4750	816	2.0
81400002	NAMPALLY	GANUGUPALLY		MPWS	1984	OW	40.00	6.05	11.50	800	859	998	104	1.6
81500001	NAMPALLY	MOHAMMADAPUR		AT BUS STAND	1984	BW	41.50	6.80	12.00	600	880	1264	152	1.0
81500002	NAMPALLY	MOHAMMADAPUR		MOHAMMADPUR	1981	BW	39.80	7.10	12.00	700	930	1099	136	1.2
81600001	NAMPALLY	G.MALLEPALLY		NEAR WATER TANK	1984	BW	36.89	5.30	12.00	500	869	1378	152	2.0
81600002	NAMPALLY	G.MALLEPALLY		AT REDDY WADA	1981	BW	34.81	4.50	12.00	350	870	1120	124	1.4
81700001	NAMPALLY	KATHAPALLY		KATHAPALLY	1984	BW	40.50	8.10	11.50	700	914	609	52	1.2
81800001	NAMPALLY	MEDLAVAI		MEDLAVAI	1984	BW	39.50	7.80	11.00	500	910	570	44	0.8
81900001	NAMPALLY	THUMMALAPALLY		AT ROAD SIDE	1981	BW	39.50	6.50	11.50	600	865	3061	400	2.8
81900002	NAMPALLY	THUMMALAPALLY		YELLAMMAWADA	1982		40.00	4.20	11.00	700	866	1550	184	1.2
82000001	NAMPALLY	B.THIMMAPUR		BANDA	1981	BW	40.50	5.20	11.50	500	913	687	76	1.2
82100001	NAMPALLY	REVALLY		AT HANUMAN TEMPLE	1984	BW	39.50	4.80	10.00	300	872	1743	272	1.2
82100002	NAMPALLY	REVALLY		PANTHULU	1984	BW	38.50	5.40	11.50	450	873	1045	128	1.0
82100003	NAMPALLY	REVALLY		REVALLY	1984	BW	39.50	4.40	11.00	550	945	682	56	1.2
82200001	NAMPALLY	SUNKISALA		SUNKISALA	1984	BW	40.00	4.50	12.00	650	912	933	100	2.0
82300001	NAMPALLY	FAKEERPUR		FAKEERPUR	1982	BW	42.00	6.00	12.00	800	911	1121	180	1.6
82400001	NAMPALLY	PAGIDIPLALLY		PAGIDIPALLY	1981	BW	40.50	7.00	10.00	1000	916	1913	316	2.8
82500001	NAMPALLY	MUSTIPALLY		MUSTIPALLY	1982	BW	40.54	5.00	11.00	750	917	2560	600	2.0
82600001	NAMPALLY	HYDALAPUR		HYDALAPUR	1981	BW	39.80	6.80	10.00	800	943	553	24	0.8
82700001	NAMPALLY	T.P.GOWRARAM		SCHOOL	1981	BW	40.50	7.90	12.00	900	868	930	96	1.6
82700002	NAMPALLY	T.P.GOWRARAM		T.P.GOWRARAM	1982	BW	42.00	8.50	12.00	800	941	1926	228	3.0
82701001	NAMPALLY	T.P.GOWRARAM	TUNGAPAHAD	TUNGAPAHAD	1982	BW	40.70	9.00	12.00	450	942	1122	88	3.6
82800001	NAMPALLY	SHARBANPUR		SHARBANPUR	1982	BW	38.90	6.50	12.00	650	949	1830	348	1.0
90100001	CHINTAPALLY	CHINTAPALLY		CHAKALIVADA	1982	BW	47.50	8.00	8.00	1000	857	1896	296	1.4
90200001	CHINTAPALLY	NASARLAPALLY		MPWS	1985	BW	48.70	6.50	12.00	980	835	590	30	1.2
90200002	CHINTAPALLY	NASARLAPALLY		PRIMARY SCHOOL	1988	BW	37.90	9.50	10.00	1500	2282	729	88	2.0
90300001	CHINTAPALLY	MALLAREDDIPALLI		J.BAKKAIAH HOUSE	1982	BW	54.00	7.90	8.00	1200	838	830	48	2.0
90300002	CHINTAPALLY	MALLAREDDIPALLI		HARIJAN WADA	1983	BW	48.00	6.70	10.00	900	839	1981	244	2.0
90400001	CHINTAPALLY	HUMANTHLAPALLY		HARIJAN WADA	1984	BW	38.00	7.00	11.00	950	836	980	92	1.6
90400002	CHINTAPALLY	HUMANTHLAPALLY		HANUMANTHLAPALLY	1983	BW	42.50	8.00	12.00	1000	837	684	28	1.2
90500001	CHINTAPALLY	THIRUMALAPUR		KONDAL RAO HOUSE	1982	BW	39.70	8.50	8.00	1200	841	870	68	1.8

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WELL NO	MANDAL	VILLAGE	HAMLET	WELL NAME	CONSTR. DATE	WELL TYPE	DEPTH	CASING	WATER LEVEL	DISCHARGE l/h	LAB. NO	ELECT. COND. uS/cm	CHLORIDE mg/l	FLUORIDE mg/l
90600001	CHINTAPALLY	NALVALPALLY		ESWARAIAH HOUSE	1982	BW	42.00	8.00	12.00	1500	854	772	76	1.2
90700001	CHINTAPALLY	UPPARPALLY		NARSIMHA HOUSE	1982	BW	39.50	7.00	10.00	1500	842	3000	650	2.8
90800001	CHINTAPALLY	GADIA GOWRARAM		CHANDRAIAH HOUSE	1984	BW	40.00	8.00	12.00	1800	855	1325	124	2.4
90801001	CHINTAPALLY	GADIA GOWRARAM	HARIJANPUR	HARIJANPUR	1985	BW	40.50	7.00	12.00	1200	853	528	36	2.0
90802001	CHINTAPALLY	GADIA GOWRARAM	MORSU		/		39.50	6.00	12.00	700	0	0	0	0.0
90900001	CHINTAPALLY	VARKALA		HANUMANTH REDDY HOUS	/	BW	42.00	6.00	10.00	800	843	1054	132	1.2
91000001	CHINTAPALLY	VINJAMOOR		BUS STAND	1981	BW	43.00	6.00	11.00	800	844	2250	304	2.8
91000002	CHINTAPALLY	VINJAMOOR		GURUVAIAH HOUSE	1982	BW	39.70	7.00	11.00	950	845	1533	176	2.2
91001001	CHINTAPALLY	VINJAMOOR	NARSIMHAPUR	GOLLA WADA	1985	BW	42.00	8.50	12.00	1000	2288	719	32	2.8
91002001	CHINTAPALLY	VINJAMOOR	RAINGUDA	GOLLA WADA	1981	BW	52.00	7.00	11.00	1200	2283	2130	520	5.2
91003001	CHINTAPALLY	VINJAMOOR	BATTUGUDA	BATTUGUDA	1982	BW	48.00	6.00	12.00	900	2284	1405	216	4.4
91004001	CHINTAPALLY	VINJAMOOR	BADDAM VARIGUDA	GOLLA WADA	1984	BW	42.00	7.00	12.00	750	2285	1159	96	3.0
91100001	CHINTAPALLY	P.K.MALLAPALLI		HARIJAN WADA	1985	BW	39.00	6.00	15.00	1000	846	1124	100	2.0
91200001	CHINTAPALLY	KURMAPALLY		PWS	1988	BW	52.00	9.00	18.00	800	81	895	72	2.4
91200002	CHINTAPALLY	KURMAPALLY		HARIJAN WADA	/	BW	0.00	0.00	0.00	0	2289	1563	220	2.6
91201001	CHINTAPALLY	KURMAPALLY	M.MALLEPALLY	COLONY	1981	BW	42.00	8.00	12.00	1000	2290	889	108	2.4
91202001	CHINTAPALLY	KURMAPALLY	SAIREDDY GUDA	NEAR CHAWADA	1982	BW	39.00	7.00	10.00	1200	2291	1951	248	6.2
91202002	CHINTAPALLY	KURMAPALLY	SAIREDDY GUDA	PWS SCHEME	1981	BW	40.00	6.00	12.00	1500	2302	694	56	2.4
91300001	CHINTAPALLY	KURMAID		PRIMARY SCHOOL	1983	BW	40.10	7.00	12.00	900	847	1057	96	2.6
91301001	CHINTAPALLY	KURMED	GOLLAPALLY		1984		39.50	8.00	10.00	1400	0	0	0	0.0
91400001	CHINTAPALLY	UMMAPUR		AT UMMAPUR	1981	BW	42.60	6.20	10.20	1000	848	1194	84	5.6
91500001	CHINTAPALLY	SAKALISERIPALLY		NARSIMHA'S HOUSE	1981	BW	42.00	8.00	12.00	1200	849	1104	88	2.4
91600001	CHINTAPALLY	TAKKELLAPALLY		GOWNDLA WADA	1985	BW	40.50	7.00	12.00	850	850	1590	136	3.2
91700001	CHINTAPALLY	GODAKONDLA		PWS SCHEME	1984	BW	48.00	6.00	11.00	900	80	390	24	2.8
91700002	CHINTAPALLY	GODAKONDLA		PWS SCHEME	1984	BW	39.50	8.10	12.00	1000	282	880	140	2.8
91700003	CHINTAPALLY	GODAKONDLA		PWS SCHEME	1985	BW	42.00	8.00	12.00	1700	2298	839	140	3.2
91700004	CHINTAPALLY	GODAKONDLA		RACHA BANDA	1981	BW	39.50	6.10	11.00	1000	3299	1528	212	4.0
91800001	CHINTAPALLY	VENKATES NAGAR(MALL)		NEAR TEMPLE	1981	OW	37.00	6.00	12.00	1200	2300	677	112	1.6
91800002	CHINTAPALLY	VENKATES NAGAR(MALL)		PWS SCHEME	1982	BW	42.00	8.10	11.00	1200	2301	285	68	2.4
91900001	CHINTAPALLY	POLEPALLY		RAMNAGAR	1984	BW	37.80	7.00	12.00	1000	2293	1437	168	4.6
91900002	CHINTAPALLY	POLEPALLY		NEAR HOSPITAL	1985	BW	39.50	6.00	11.00	1000	2294	1090	132	3.0
92000001	CHINTAPALLY	MADNAPUR		WODDERIWADA	1982	BW	42.00	6.50	12.00	1000	2297	1958	284	5.6
92100001	CHINTAPALLY	THEEDED		PWS SCHEME	1984	BW	48.50	6.50	10.00	1800	2303	1860	176	4.0
92100002	CHINTAPALLY	THEEDED		KUMMARI WADA	1983	OW	42.00	7.30	11.00	1200	2304	1908	2	4.0
92101001	CHINTAPALLY	THEEDED	GHASIRAM THANDA	GHASIRAM THANDA	1981	BW	42.00	8.00	10.00	1050	2305	902	120	1.4
92102001	CHINTAPALLY	THEEDED	K. THANDA		1981		39.50	7.00	12.00	1500	0	0	0	0.0
92300001	CHINTAPALLY	K.GOURARAM			/	OW					940	740	0	2.0
100100001	MARRIGUDA	K.B.PALLY		NEAR WATER TANK	1981	BW	39.70	6.00	10.00	800	159	885	20	4.5
100100002	MARRIGUDA	K.B.PALLY		KUDAKSHPALLY	1982	BW	30.80	11.20	8.00	750	2123	705	44	2.8
100101001	MARRIGUDA	K.B.PALLI	VENKATAPALLITANDA	VENKATAPALLI	1983	BW	34.50	6.10	12.00	900	2122	850	68	5.2
100200001	MARRIGUDA	ANTHAMPET		NEAR BUS STAND	1984	BW	36.70	6.70	11.50	1000	2139	1222	92	5.6
100300001	MARRIGUDA	SOMARAJGUDA		NEAR H.REDDY HOUSE	1985	BW	38.90	6.50	11.00	650	2140	1193	96	4.8
100301001	MARRIGUDA	SOMARAJUGUDA	ARJUNATANDA		1981		40.80	6.40	11.50	800	0	0	0	0.0
100302001	MARRIGUDA	SOMARAJUGUDA	THRMATHANALA		1982		41.50	6.30	10.50	1000	0	0	0	0.0
100400001	MARRIGUDA	NAMAPURAM		NEAR JANGAIAH HOUSE	1983	BW	40.50	6.20	12.50	750	2144	1300	144	3.6
100500001	MARRIGUDA	LENKALAPALLY		LENKALAPALLY	1982	BW	41.50	6.20	11.00	800	2147	1553	220	2.4
100600001	MARRIGUDA	METICHANDAPUR			1981		40.20	7.20	10.10	900	0	0	0	0.0
100601001	MARRIGUDA	METICHANDAPUR	KOTTALA	NEAR SCHOOL	1981	BW	39.80	8.20	10.50	750	2143	814	56	2.4
100700001	MARRIGUDA	VENKAPALLY		VENKAPALLY	1983	BW	37.80	9.00	11.00	900	2121	1258	104	6.0
100800001	MARRIGUDA	INDURTHY		VILLAGE OUTSIDE	1983	BW	36.50	8.50	11.00	1050	157	1070	72	5.1
100800002	MARRIGUDA	INDURTHY		CHINTAKINDI	1982	BW	38.40	8.40	11.00	1000	2135	1139	92	4.6
100801001	MARRIGUDA	INDURTHI	SIVANNAGUDA	SIVANNAGUDA	1982	BW	38.40	6.00	10.50	800	2159	957	124	4.4
100802001	MARRIGUDA	INDURTHI	THUNDEMPALLI	THUNDEMPALLY	1982	BW	40.20	6.50	11.00	750	2153	844	60	5.2
100803001	MARRIGUDA	INDURTHI	RAMREDDYPALLI	JANAKIRAMARAO HOUSE	1982	BW	39.70	8.00	12.00	800	158	975	68	4.2

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WELL NO	MANDAL	VILLAGE	HAMLET	WELL NAME	CONSTR. DATE	WELL TYPE	DEPTH	CASING	WATER LEVEL	DISCHARGE l/h	LAB. NO	ELECT. COND. uS/cm	CHLORIDE mg/l	FLUORIDE mg/l
100803002	MARRIGUDA	INDURTHI	RAMREDDYPALLI	RAMIREDDYPALLI	1982	BW	38.80	9.00	11.50	750	2156	954	96	4.8
100804001	MARRIGUDA	INDURTHI	NARSIREDDYGUDA	GOUNDALAVADA	1984	BW	37.50	7.00	10.50	950	2157	1076	100	5.6
100900001	MARRIGUDA	D.B.PALLI		D.B.PALLI	1984	BW	38.70	8.00	10.50	750	2150	1647	216	5.2
100900002	MARRIGUDA	D.B.PALLI		PWS	1984	BW	39.80	6.10	11.50	800	279	1085	96	2.2
101000001	MARRIGUDA	SARAMPET		GOLLAVADA	1981	BW	39.70	4.00	12.00	450	2154	1344	140	6.0
101100001	MARRIGUDA	VATTIPALLI		GOUNDLAVADA	1981	BW	38.70	8.00	11.50	380	2128	1015	100	4.4
101200001	MARRIGUDA	YERGANDLAPALLY		NEAR RAJAIAH HOUSE	1981	BW	36.80	6.00	12.00	400	2126	675	44	4.4
101201001	MARRIGUDA	YERAGANDLAPALLI	NARASIMHAPUR	GOLLAVADA	1981	BW	51.50	7.00	11.50	800	2129	388	0	0.0
101202001	MARRIGUDA	YERAGANDLAPALLI	AZILAPUR	AZILAPUR	1981	BW	39.80	4.00	12.50	750	2130	2730	416	2.0
101300001	MARRIGUDA	THIRGANDLAPALLY		WADLAVADA	1982	BW	37.50	6.00	11.50	400	2127	1291	196	2.8
101400001	MARRIGUDA	THAMMADAPALLY		YELLAREDDY HOUSE	1982	BW	38.60	6.00	11.00	800	2131	582	48	2.8
101500001	MARRIGUDA	KONDUR		HARIJANAVADA	1982	BW	37.50	7.00	12.00	450	2141	760	52	4.4
101600001	MARRIGUDA	MARRIGUDA		GOUNDLAVADA	1982	BW	31.50	5.50	11.50	800	2125	444	32	3.2
101700001	MARRIGUDA	BATTUPALLI			1981	BW	38.40	6.00	10.00	800	2132	668	40	2.8
101800001	MARRIGUDA	CHERLAGUDEM		REDDYVADA	1982	BW	40.20	7.00	12.00	750	2152	970	88	5.6
110100001	GURRAMPODE	GURRAMPODE		MANDAL OFFICE	1981	BW	39.50	6.00	10.00	800	2534	1071	124	4.0
110200001	GURRAMPODE	CHAMALAID		CHAMLAID	1982	BW	42.80	7.00	12.00	750	2532	1203	108	3.6
110201001	GURRAMPODE	CHAMLAID	KATTORIGUDA	KATTORIGUDA	1982	BW	34.50	7.10	10.00	1000	695	1058	164	1.8
110300001	GURRAMPODE	PITTAGUDA		PWSS	1982	BW	30.50	7.50	12.00	700	2519	758	92	1.4
110400001	GURRAMPODE	VATTIKODU			1982	BW	30.70	6.50	15.00	800	949	1550	0	0.0
110400001	GURRAMPODE	VATTIKODU			1982		30.70	6.50	15.00	800	0	0	0	0.0
110401001	GURRAMPODE	VATTIKODU	RANGONIBAVI	RANGONIBAVI	1982	BW	40.50	6.50	15.00	900	697	766	104	0.8
110400002	GURRAMPODE	VATTIKODU		BORE WELL 2	/	BW					950	940	0	0.8
110400003	GURRAMPODE	VATTIKODU		BORE WELL 3	/	BW					951	2350	0	1.0
110400004	GURRAMPODE	VATTIKODU		BORE WELL 4	/	BW					952	930	0	0.6
110500001	GURRAMPODE	CHAMALONIBAVI			1981		38.40	5.80	15.00	700	0	0	0	0.0
110600001	GURRAMPODE	KOPPALA			1981		40.20	6.70	10.00	800	0	0	0	0.0
110601001	GURRAMPODE	KOPPILE	BUDDAREDDIGUDA	BUDDAREDDIGUDA	1981	BW	38.40	7.00	12.00	900	896	1121	88	2.0
110602001	GURRAMPODE	KOPPILE			1982		39.40	8.00	15.00	800	0	0	0	0.0
110603001	GURRAMPODE	KOPPILE	AREGUDEM	VILLAGE CENTRE	1981	BW	39.70	6.00	10.80	750	895	674	64	1.0
110700001	GURRAMPODE	VENKATAPUR			1982		36.70	7.00	11.20	850	0	0	0	0.0
110800001	GURRAMPODE	LAXMIDEVIGUDA			1983		40.80	8.00	11.20	950	0	0	0	0.0
110900001	GURRAMPODE	ARULUR		ARLUR	1981	BW	41.20	9.00	10.50	750	945	1500	0	0.8
110900001	GURRAMPODE	ARULUR		ARLUR	1981	BW	41.20	9.00	10.50	750	694	1652	424	0.8
111000001	GURRAMPODE	BOLLARAM		BORE WELL 1	1982	BW	40.80	7.00	11.80	800	947	1250	0	1.2
111000001	GURRAMPODE	BOLLARAM			1982		40.80	7.00	11.80	800	0	0	0	0.0
111000002	GURRAMPODE	BOLLARAM		BORE WELL 2	/	BW					948	1250	0	0.8
111100001	GURRAMPODE	NADIKUDA		HARIJANWADA	1983	BW	39.70	8.00	9.10	950	2518	1166	98	2.0
111200001	GURRAMPODE	KOTHALAPUR		KOTHALAPUR	1981	BW	36.80	4.00	8.70	1000	700	982	68	2.4
111300001	GURRAMPODE	MOSANGI		PWS	1982	BW	41.20	4.00	11.50	750	1082	1100	80	2.0
111301001	GURRAMPODE	MOSANGI	YERGADLAGUDA	YERGADLAGUDA	1983	BW	36.70	4.00	12.50	850	701	181	112	2.4
111400001	GURRAMPODE	CHEPUR		MPWS SCHEME	1984	BW	36.80	7.00	11.50	900	966	1020	0	2.0
111400001	GURRAMPODE	CHEPUR			1984		36.80	7.00	11.50	900	0	0	0	0.0
111400002	GURRAMPODE	CHEPUR		BORE WELL	/	BW					967	1020	0	2.0
111401001	GURRAMPODE	CHEPUR	KONAIGUDEM	KONAIGUDEM	1985	BW	35.70	8.00	10.50	750	721	1807	276	2.0
111401002	GURRAMPODE	CHEPUR	KONAIGUDEM	KONAIGUDEM	1982	BW	37.70	6.00	11.20	800	899	521	44	1.2
111402001	GURRAMPODE	CHEPUR	BAPAVANIGUDA		1983		38.40	8.00	8.90	800	0	0	0	0.0
111403001	GURRAMPODE	CHEPUR	THERETIGUDA	THERETIGUDA	1981	BW	40.50	6.00	10.80	750	703	2140	330	1.6
111500001	GURRAMPODE	PALLEPAHAD		BORE WELL 1	1982	BW	40.20	7.00	11.20	850	944	800	0	1.6
111500001	GURRAMPODE	PALLEPAHAD			1982		40.20	7.00	11.20	850	0	0	0	0.0
111600001	GURRAMPODE	KACHARAM		KACHARAM	1984	BW	37.90	7.50	11.20	900	704	1183	172	1.5
111700001	GURRAMPODE	THANELAPALLI			1985	BW	39.90	6.50	10.50	800	954	1050	0	0.0
111700001	GURRAMPODE	THANELAPALLI			1985		39.90	6.50	10.50	800	0	0	0	0.0
111800001	GURRAMPODE	MALLAPUR		BORE WELL 1	1984	BW	38.60	9.00	7.50	750	953	1750	0	2.0

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WELL NO	MANDAL	VILLAGE	HAMLET	WELL NAME	CONSTR. DATE	WELL TYPE	DEPTH	CASING	WATER LEVEL	DISCHARGE l/h	LAB. NO	ELECT. COND. uS/cm	CHLORIDE mg/l	FLUORIDE mg/l
111800001	GURRAMPODE	MALLAPUR			1984		38.60	9.00	7.50	750	0	0	0	0.0
111900001	GURRAMPODE	PARLAPALLI		PARLAPALLI	1985	BW	40.50	7.50	8.50	800	718	577	72	1.0
112000001	GURRAMPODE	JUNUTHALA		JUNUTHALA	1982	BW	37.50	6.00	11.20	750	705	1155	136	2.2
112100001	GURRAMPODE	TENEPALLI		BORE WELL 1	1981	BW	32.40	7.50	10.00	900	955	2350	0	1.6
112100001	GURRAMPODE	TENEPALLI			1981		32.40	7.50	10.00	900	0	0	0	0.0
112100002	GURRAMPODE	TENEPALLI		BORE WELL 2	/	BW					956	1600	0	1.0
112200001	GURRAMPODE	UTTAPALLY		UTTAPALLY	1982	BW	31.50	8.10	11.20	850	710	1115	136	1.8
112300001	GURRAMPODE	SHAKAJIPUR		SHAKAJIPUR	/	BW	0.00	0.00	0.00	0	713	1707	300	1.8
112300002	GURRAMPODE	SHAKAJIPUR		PWS	1982	BW	36.70	7.50	10.00	1000	1081	660	36	1.0
112400001	GURRAMPODE	CHINTAGUDA			1982		38.40	8.00	10.00	800	0	0	0	0.0
112500001	GURRAMPODE	POCHAMPALLY			1982		39.40	6.50	10.00	900	0	0	0	0.0
112501001	GURRAMPODE	POCHAMPALLY	PAPPONIGUDA	PAPPONIGUDA	1984	BW	37.50	7.50	10.00	600	716	1462	284	1.2
112600001	GURRAMPODE	MULKAPALLI		MULKAPALLI	1982	BW	40.20	6.00	10.80	800	904	532	36	1.0
112700001	GURRAMPODE	SULTHANPUR		SULTHANAPUR	1982	BW	39.70	7.40	11.20	750	714	1781	316	1.0
112701001	GURRAMPODE	SULTHANPUR	PASHAMVARIGUDA	PASHAMVARIGUDA	1981	BW	36.60	7.50	12.00	1000	715	1995	348	1.7
112800001	GURRAMPODE	MAKKAPALLI		MAKKAPALLI	1982	BW	37.40	6.00	11.20	850	717	686	116	0.6
112800002	GURRAMPODE	MAKKAPALLI		PWS	1981	BW	36.70	4.50	10.80	750	1083	720	60	2.0
112900001	GURRAMPODE	KALVAPALLI		KALVAPALLI	1982	BW	40.50	5.60	10.50	1000	719	906	148	0.8
113000001	GURRAMPODE	PALVAI		PALVAI	1982	BW	39.40	7.00	10.50	450	720	5540	1260	0.6
113000002	GURRAMPODE	PALVAI		PALVAI	1982	BW	37.40	6.80	10.50	750	723	605	52	1.5
113000003	GURRAMPODE	PALVAI		NEAR SCHOOL	1983	BW	36.70	5.40	11.00	680	903	959	96	2.4
113001001	GURRAMPODE	PALVAI	MONDIKANIGUDA	MONDIKANIGUDA	1983	BW	40.10	6.00	11.50	740	707	988	128	1.5
113001002	GURRAMPODE	PALVAI	MONDIKANIGUDA	MONDIKANIGUDA	1984	BW	35.00	10.00	12.00	600	902	1110	140	1.8
113100001	GURRAMPODE	GOURARAM		BORE WELL 1	/	BW					962	1300	0	0.6
120100001	DEVARAKONDA	KOTHABAI		NEAR SCHOOL	1979	BW	28.00	6.00	10.00	300	1138	855	44	2.2
120200001	DEVARAKONDA	MYNAMPALLY		NEAR P.S.BUILDING	1978	BW	30.00	6.00	12.00	500	1143	700	60	1.8
120201001	DEVARAKONDA	MYNAMPALLY	CHERUKUNAIK TANDA		1987	BW	45.00	10.00	15.00	1000	1137	615	40	1.3
120202001	DEVARAKONDA	MYNAMPALLY	MADMADK		1988	BW	40.00	6.00	12.00	500	1226	2870	510	1.8
120300001	DEVARAKONDA	K.MALLEPALLY		NEAR BUS STOP	1979	BW	30.00	6.00	12.00	600	1139	1505	240	0.4
120400001	DEVARAKONDA	DEVARAKONDA		NEAR P.R.OFFICE	1973	BW	30.50	8.00	10.00	700	1146	954	96	2.2
120401001	DEVARAKONDA	DEVARAKONDA	MISSION COMPOUND	NEAR BURNUCLES HOUSE	1980	BW	33.00	8.00	12.00	700	1136	841	92	1.0
120500001	DEVARAKONDA	MUDIKONDA		B.RAMULU HOUSE	1976	BW	27.21	6.00	10.00	800	1219	2060	320	0.4
120600001	DEVARAKONDA	PENDLIPAKALA		BORE WELL 1	/	BW					968	2950	0	1.0
120600002	DEVARAKONDA	PENDLIPAKALA		BORE WELL 2	/	BW					969	1200	0	0.8
120600003	DEVARAKONDA	PENDLIPAKALA		BORE WELL 3	/	BW					970	1000	0	1.6
120600004	DEVARAKONDA	PENDLIPAKALA		BORE WELL 4	/	BW					971	990	0	2.0
120700002	DEVARAKONDA	CHANNARAM		BORE WELL 1	/	BW					930	2300	0	0.6
120700003	DEVARAKONDA	CHANNARAM		BORE WELL 2	/	BW					931	1600	0	0.6
120800001	DEVARAKONDA	DONIYAL		BORE WELL 1	/	BW					925	880	0	1.0
120800002	DEVARAKONDA	DONIYAL		BORE WELL 2	/	BW					926	1200	0	1.0
120800001	DEVARAKONDA	DONIYAL		BORE WELL 3	/	BW					927	870	0	0.8
120800003	DEVARAKONDA	KOLMUNTHALAPAD		BORE WELL 1	/	BW					928	1500	0	2.8
120900001	DEVARAKONDA	KOLMUNTHALAPAD		BORE WELL 2	/	BW					929	1150	0	1.6
120900002	DEVARAKONDA	SERIPALLY		BORE WELL 1	/	BW					932	1600	0	1.0
121000001	DEVARAKONDA	SERIPALLY		BORE WELL 2	/	BW					933	2000	0	1.8
121100001	DEVARAKONDA	GUMMADAVELLY		BORE WELL 1	/	BW					934	1520	0	1.0
121100002	DEVARAKONDA	GUMMADAVELLY		BORE WELL 2	/	BW					935	2700	0	1.6
121100003	DEVARAKONDA	GUMMADAVELLY		BORE WELL 3	/	BW					936	4400	0	0.6
130100001	PEDDAVOORA	PEDDAVOORA		BUS STAND	1976	BW	32.00	6.00	8.00	1000	211	1084	124	1.4
130100002	PEDDAVOORA	PEDDAVOORA		MEDICAL SHOP	1971	BW	40.00	5.00	8.00	800	212	7340	1780	1.5
130100003	PEDDAVOORA	PEDDAVOORA		HARIJANWADA	1973	BW	28.00	6.00	10.00	800	213	640	60	0.6
130100004	PEDDAVOORA	PEDDAVOORA		KUMMARIWADA	1981	BW	46.00	6.00	10.00	600	214	722	46	1.0
130100005	PEDDAVOORA	PEDDAVOORA		PRIMARY SCHOOL	1979	BW	24.00	5.00	8.00	350	220	1775	182	2.0
130200001	PEDDAVOORA	THUNGATURTHI		PUBLIC SCHOOL	1981	BW	32.00	6.00	10.00	1400	215	1207	68	0.8

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WELL NO	MANDAL	VILLAGE	HAMLET	WELL NAME	CONSTR. DATE	WELL TYPE	DEPTH	CASING	WATER LEVEL	DISCHARGE l/h	LAB. NO	ELECT. COND. uS/cm	CHLORIDE mg/l	FLUORIDE mg/l
130200002	PEDDAVOORA	THUNGATURTHI		HARIJANWADA	1977	BW	30.50	6.00	8.00	1400	216	1395	152	1.0
130200003	PEDDAVOORA	THUNGATURTHI		CHAKALIWADA	1972	BW	30.50	6.00	8.00	2000	217	2560	380	0.6
130200004	PEDDAVOORA	THUNGATURTHI		VILLAGE CENTER	1973	BW	30.50	6.00	10.00	2000	218	2500	390	0.8
130200005	PEDDAVOORA	THUNGATURTHI		POST OFFICE	1987	BW	35.00	10.00	12.00	600	219	1096	76	1.4
130201001	PEDDAVOORA	THUNGATHURTHI	RAMAMMAGUDA	SAGAR ROAD	1974	BW	25.00	5.00	8.00	400	945	1297	64	1.5
130201002	PEDDAVOORA	THUNGATHURTHI	RAMAMMAGUDA	PRIMARY SCHOOL	/	BW	0.00	0.00	0.00	0	957	1310	180	2.0
130202001	PEDDAVOORA	THUNGATHURTHI	POTTAVANITHANDA		1974	BW	30.00	4.00	8.00	200	950	1444	176	1.5
130203001	PEDDAVOORA	THUNGATHURTHI	NAYANIVANIKUNTATANDA		1975	BW	30.50	4.00	8.00	800	952	788	68	1.0
130203002	PEDDAVOORA	THUNGATHURTHI	NAYANIVANIKUNTATANDA	PRIMARY SCHOOL	1984	BW	35.00	6.00	10.00	800	959	620	60	1.2
130300001	PEDDAVOORA	POTHNUR		NEAR WELL	1979	BW	32.00	6.00	12.00	600	946	3210	510	2.4
130300002	PEDDAVOORA	POTHNUR			1979	BW	31.00	6.00	10.00	750	2064	764	80	0.9
130400001	PEDDAVOORA	PARVEDLA		HARIJANWADA	1981	BW	57.90	6.00	12.00	300	955	1695	180	1.5
130500001	PEDDAVOORA	SINGARAM		HARIJANWADA	1971	BW	33.00	6.00	10.00	700	958	1695	180	1.5
130501001	PEDDAVOORA	SINGARAM	YENIMIDIGUDEM	HARIJANAWADA	1979	BW	31.00	6.00	8.00	1500	953	3150	470	2.4
130501002	PEDDAVOORA	SINGARAM	YENIMIDIGUDEM		1981	BW	29.00	6.00	6.00	800	2252	1554	172	3.0
130502001	PEDDAVOORA	SINGARAM	POOLEPALLY		1981	BW	32.00	6.00	7.50	1500	2251	1546	164	3.0
130600001	PEDDAVOORA	PULICHERLA			1974	BW	31.00	6.00	12.00	1200	2071	470	64	1.4
130700001	PEDDAVOORA	VUTLAPALLY			1973	BW	30.50	6.00	8.00	900	2072	3200	570	2.2
130701001	PEDDAVOORA	VUTTAPALLY	JEMANAYAKTHANDA		1973	BW	30.50	6.00	8.00	800	2068	2920	520	2.2
130800001	PEDDAVOORA	PINNAVOORA			1982	BW	32.00	6.00	7.50	1000	2074	1025	88	1.2
130900001	PEDDAVOORA	BASIREDDYPALLI			1972	BW	32.00	6.00	10.00	2500	2693	776	72	1.0
131000001	PEDDAVOORA	ELLAMMAGUDEM			1972	BW	32.00	6.00	8.00	500	2694	1712	204	2.6
131100001	PEDDAVOORA	BANALAGUDEM			1973	BW	32.00	5.00	9.00	1000	2695	1752	208	2.8
131200001	PEDDAVOORA	GARNAKUNTA			1976	BW	33.00	5.00	8.00	600	2696	1724	208	2.6
131300001	PEDDAVOORA	BATTUGUDEM			1980	BW	15.00	6.00	6.00	900	2697	443	68	0.6
131400001	PEDDAVOORA	KOTHAGUDEM			1974	BW	32.00	5.00	6.00	2500	2698	1595	180	2.4
131500001	PEDDAVOORA	LINGAMPALLY			1980	BW	27.00	5.00	8.00	1500	2701	1706	216	2.2
131600001	PEDDAVOORA	CHINTAPALLY (ALWAL)		BORE WELL 1	/	BW					942	840	0	0.8
131600002	PEDDAVOORA	CHINTAPALLY (ALWAL)		BORE WELL 2	/	BW					943	840	0	2.4
140100001	P.A.PALLY	AZMAPUR		K.MURTHY HOUSE	1981	BW	38.35	6.00	8.00	800	153	1627	76	2.2
140101001	P.A.PALLY	AJMAPUR	NAKKALAPENTATANDA	_	1980	BW	33.00	6.00	8.00	600	2102	725	52	1.8
140200001	P.A.PALLY	WADDIPATLA			1976	BW	29.00	6.00	10.00	300	154	1278	124	3.2
140201001	P.A.PALLY	WADDIPATLA	GUMMADAM	_	1979	BW	39.65	6.00	8.00	1200	490	1193	132	1.6
140202001	P.A.PALLY	WADDIPATLA	CHINTALATANDA	_	1980	BW	30.00	6.00	8.00	400	1065	799	100	2.0
140203001	P.A.PALLY	WADDIPATLA	POTTAMGANDI		1981	BW	30.00	8.00	6.00	700	1067	1949	280	1.2
140204001	P.A.PALLY	WADDIPATLA	NARLONITANDA	_	1980	BW	35.00	6.00	10.00	800	2093	545	32	1.4
140300001	P.A.PALLY	MALLAPUR		NEAR SCHOOL	1981	BW	35.40	6.00	8.00	1000	155	2400	320	0.4
140301001	P.A.PALLY	MALLAPURAM	YERRAGUNTATANDA	_	1981	BW	35.90	6.00	6.00	3500	1068	1565	228	1.2
140400001	P.A.PALLY	P.A. PALLY		KUMMARIWADA	1979	BW	31.00	8.00	12.00	500	156	908	128	0.6
140401001	P.A.PALLY	P.A.PALLY	MUNNAVATH TANDA	NORTHSIDE OF TANDA	1975	BW	25.00	6.00	8.00	300	160	1780	244	0.9
140401002	P.A.PALLY	P.A.PALLY	MUNNAVATH TANDA	_	1973	BW	30.00	8.00	10.00	500	2099	975	120	1.2
140402001	P.A.PALLY	P.A.PALLY	MANGALI TANDA	ROAD SIDE	1973	BW	30.00	6.00	8.00	500	161	1248	104	2.0
140403001	P.A.PALLY	P.A.PALLY	POTHIREDDY PALLI	ROAD SIDE	1978	BW	35.00	6.00	10.00	400	478	1711	264	1.2
140404001	P.A.PALLY	P.A.PALLY	AKKAMPALLI	HARIJANAVADA	1978	BW	35.00	6.00	8.00	500	488	3320	570	1.4
140405001	P.A.PALLY	P.A.PALLY	GOSANITANDA	_	/	BW	0.00	0.00	0.00	0	1072	699	84	1.2
140406001	P.A.PALLY	P.A.PALLY	RAMAPURAM	_	/	BW	0.00	0.00	0.00	0	2096	606	48	0.8
140407001	P.A.PALLY	P.A.PALLY	POGAKANIGUDEM	_	/	BW	0.00	0.00	0.00	0	2097	815	52	1.4
140408001	P.A.PALLY	P.A.PALLY	PALAPATI TANDA	_	/	BW	0.00	0.00	0.00	0	2104	1403	172	1.2
140500001	P.A.PALLY	DUGYAL		G.P.G.HOUSE	1979	BW	29.00	6.00	8.00	800	157	8010	1760	0.3
140501001	P.A.PALLY	DUGYAL	PILLIGUDATANDA	_	1980	BW	35.00	6.00	10.00	600	1070	361	48	0.6
140600001	P.A.PALLY	ANGADIPET		W.S.H.C	1989	BW	38.00	6.00	8.00	600	158	1345	176	1.3
140700001	P.A.PALLY	CHILAKAMARRI		ROAD SIDE GATE	1972	BW	31.00	6.00	10.00	600	159	705	52	1.2
140701001	P.A.PALLY	CHILAKAMARRI	SUREPALLI	NEAR TEMPLE	1980	BW	30.50	6.00	10.00	400	162	683	52	0.7
140702001	P.A.PALLY	CHILAKAMARRI	PEDDABAVIGUDEM	_	/	BW	0.00	0.00	0.00	0	2106	2710	420	1.2

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WELL NO	MANDAL	VILLAGE	HAMLET	WELL NAME	CONSTR. DATE	WELL TYPE	DEPTH	CASING	WATER LEVEL	DISCHARGE l/h	LAB. NO	ELECT. COND. uS/cm	CHLORIDE mg/l	FLUORIDE mg/l
140800001	P.A.PALLY	TIRUMALAGIRI		HARIJANWADA	1971	BW	20.00	6.00	10.00	800	163	1055	100	2.0
140900001	P.A.PALLY	MEDARAM		VILLAGE CENTER	1980	BW	31.00	6.00	8.00	800	166	3090	460	0.6
140901001	P.A.PALLY	MADARAM	MADHURIGUDEM	NEAR TEMPLE	1973	BW	30.50	6.00	8.00	800	165	1761	232	1.5
140902001	P.A.PALLY	MADARAM	RANGAREDDY GUDEM	VADLAVADA	1971	BW	30.50	6.00	10.00	1000	167	1058	300	1.6
141000001	P.A.PALLY	KESHAMANENIPALLY		BESTAWADA	1979	BW	30.00	6.00	10.00	1000	476	1554	204	1.2
141100001	P.A.PALLY	GHANPUR		R.REDDY HOUSE	1980	BW	32.00	6.00	11.00	800	481	1147	104	2.8
141101001	P.A.PALLY	GANPUR	KONDAPUR	GOUNDLAVADA	1973	BW	30.00	6.00	10.00	600	480	961	64	0.6
141200001	P.A.PALLY	GUDIPALLY		W.S.H.C	1985	BW	42.00	6.00	12.00	600	462	1165	84	1.6
141201001	P.A.PALLY	GUDIPALLY	NADIMIBAIGUDEM	PADAMATA VADA	1973	BW	31.00	6.00	11.00	800	477	1192	88	1.5
141202001	P.A.PALLY	GUDIPALLY	SINGARAJUPALLI	PADAMATA VADA	1975	BW	28.00	6.00	11.00	800	489	1156	172	0.6
141203001	P.A.PALLY	GUDIPALLY	ROLLAKAL	VILLAGE CENTRE	1979	BW	29.00	6.00	8.00	1200	1073	742	88	1.2
141204001	P.A.PALLY	GUDIPALLY	BHARAT PUR	VILLAGE CENTRE	1976	BW	30.50	6.00	8.00	1000	1074	996	124	2.4
141300001	P.A.PALLY	G.BHEEMANAPALLY		SCHOOL	1980	BW	35.00	6.00	8.00	400	483	2450	400	0.8
141301001	P.A.PALLY	G.BHEEMANAPALLY	GANPALLI	_	1978	BW	28.00	6.00	8.00	1200	485	1607	240	1.2
141302001	P.A.PALLY	G.BHEEMANAPALLY	RAMPALEM	VILLAGE CENTRE	1979	BW	30.50	6.00	10.00	400	486	1706	252	1.2
141302002	P.A.PALLY	G.BHEEMANAPALLY	RAMPALEM	ROAD SIDE	1972	BW	28.00	10.00	12.00	500	487	1425	124	2.0
141303001	P.A.PALLY	G.BHEEMANAPALLY	JENUKALONIGUDEM	_	1974	BW	38.00	8.00	12.00	500	2105	2410	470	1.2
141400001	P.A.PALLY	LAMBAPUR		COLONY	1982	BW	36.00	8.00	10.00	1000	493	2630	530	0.5
141401001	P.A.PALLY	LAMBAPUR	YELLAPUR	ROAD SIDE	1979	BW	30.50	6.00	8.00	500	491	744	96	1.2
141500001	P.A.PALLY	POLKAMPALLY		VADDERAVADA	1981	BW	37.50	8.00	12.00	800	494	1414	184	0.6
141501001	P.A.PALLY	POLKAMPALLI	G.NAMLIPUR	VADLAVADA	1976	BW	31.00	8.00	10.00	600	479	3660	770	1.4
141600001	P.A.PALLY	C.A.PALLY		BORE WELL 1	/	BW					937	2000	0	0.4
141600002	P.A.PALLY	C.A.PALLY		BORE WELL 2	/	BW					938	4200	0	0.8
141600003	P.A.PALLY	C.A.PALLY		BORE WELL 3	/	BW					939	660	0	1.0
141700001	P.A.PALLY	MADHAPUR		BORE WELL 1	/	BW					941	1500	0	1.6
150100001	ANUMALA	YACHARAM		HARIJANA COLONY	1981	BW	28.68	8.00	12.00	800	931	709	76	0.4
150200001	ANUMALA	VENKATADRIPALEM		HARIJANA COLONY	1973	BW	33.50	6.00	8.00	500	932	2430	400	0.8
150300001	ANUMALA	ANNARAM		WSHC	1981	BW	30.50	6.00	8.00	1000	936	3650	680	2.4
150400001	ANUMALA	MUKKAMALA		VELAMAVADA	1972	BW	31.50	6.00	8.00	500	942	1691	228	2.0
150500001	ANUMALA	MAREPALLI		HARIJANAVADA	1974	BW	32.94	8.00	10.00	1000	944	1467	216	0.6
150500002	ANUMALA	MAREPALLI		KUMIKUNTAKALVA	1978	BW	30.00	8.00	10.00	700	2085	549	72	0.8
150600001	ANUMALA	KESALAMARRI		_	1972	BW	38.00	6.00	10.00	500	2080	704	76	0.4
150700001	ANUMALA	ALWAL		SC COLONY	1973	BW	33.00	8.00	10.00	800	930	2230	240	0.6
150700002	ANUMALA	ALWAL		GOLLAVADA	1980	BW	33.00	8.00	10.00	1300	2081	424	68	0.6
160100001	CHOUTUPPAL	S.LINGOTEM		KUMMARAVADA	1980	BW	38.00	6.00	10.00	600	1984	4380	770	1.8
160100002	CHOUTUPPAL	S.LINGOTEM		PATHAHARIJANAVADA	1980	BW	30.00	6.00	8.00	1600	1985	695	84	2.0
160100003	CHOUTUPPAL	S.LINGOTEM		S.C.COLONY	1979	BW	28.00	8.00	10.00	1000	1986	581	52	0.6
160100004	CHOUTUPPAL	S.LINGOTEM		PADMASALIVADA	1972	BW	28.00	6.00	10.00	1200	1987	865	100	0.6
160100005	CHOUTUPPAL	S.LINGOTEM		BUSSTATION	1980	BW	28.60	6.00	8.00	1000	1988	4510	880	0.8
160100006	CHOUTUPPAL	S.LINGOTEM		B.C.COLONY	1984	BW	34.00	8.00	12.00	600	1989	792	84	0.7
160100007	CHOUTUPPAL	S.LINGOTEM		B.C.COLONY ROAD SIDE	1983	BW	37.00	6.00	8.00	1400	1990	720	72	0.6
160100008	CHOUTUPPAL	S.LINGOTEM		TEMPLE	1981	BW	38.00	8.00	10.00	500	1991	1629	232	1.0
160100009	CHOUTUPPAL	S.LINGOTEM		KATUKAVADA	1980	BW	39.00	8.00	10.00	500	1992	1383	204	0.6
160100010	CHOUTUPPAL	S.LINGOTEM		GOUNDLAVADA	1979	BW	41.00	8.00	10.00	500	1993	1778	280	1.2
160100011	CHOUTUPPAL	S.LINGOTEM		VADLAVADA	1984	BW	39.00	10.00	12.00	400	1994	1002	136	0.4
160100012	CHOUTUPPAL	S.LINGOTEM		S.RAJU HOUSE	1984	BW	32.30	6.90	12.00	500	1995	1880	176	2.8
160100013	CHOUTUPPAL	S.LINGOTEM		EX.SARPANCH HOUSE	1984	BW	41.00	7.20	10.00	1302	1996	1925	328	1.5
160100014	CHOUTUPPAL	S.LINGOTEM		HIGH SCHOOL	1975	BW	30.50	10.00	15.00	800	1997	851	100	0.8
160200001	CHOUTUPPAL	CHOUTUPPAL		LINGAIAH HOUSE	1981	BW	30.08	6.06	10.00	1200	1998	2920	500	2.6
160200002	CHOUTUPPAL	CHOUTUPPAL		MAIN ROAD	1986	BW	36.00	5.07	9.00	1100	1999	3410	620	2.4
160200003	CHOUTUPPAL	CHOUTUPPAL		POLICE STATION	1985	BW	30.00	4.08	10.00	800	2000	3910	790	1.6
160200004	CHOUTUPPAL	CHOUTUPPAL		VADLA VADA	1989	BW	45.00	6.15	9.00	1000	2001	2290	500	2.2
160200005	CHOUTUPPAL	CHOUTUPPAL		G.P.O.	1987	BW	36.00	5.15	8.00	800	2002	1247	140	2.4
160200006	CHOUTUPPAL	CHOUTUPPAL		BC & SC COLONY	1980	BW	33.10	8.00	10.00	1200	2003	1426	280	0.4

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WELL NO	MANDAL	VILLAGE	HAMLET	WELL NAME	CONSTR. DATE	WELL TYPE	DEPTH	CASING	WATER LEVEL	DISCHARGE l/h	LAB. NO	ELECT. COND. uS/cm	CHLORIDE mg/l	FLUORIDE mg/l
160200007	CHOUTUPPAL	CHOUTUPPAL		RATNALA BHAVI	/	BW	0.00	0.00	0.00	0	2004	1244	160	1.2
160200008	CHOUTUPPAL	CHOUTUPPAL		MUSLIM WADA	1986	BW	45.00	10.00	8.00	600	2005	978	104	1.0
160200009	CHOUTUPPAL	CHOUTUPPAL		REDDY WADA	1985	BW	30.15	8.15	10.00	600	2006	3130	770	2.4
160200010	CHOUTUPPAL	CHOUTUPPAL		GOUNDLA WADA	1991	BW	45.10	8.00	8.00	1000	2007	1720	248	0.8
160200011	CHOUTUPPAL	CHOUTUPPAL		POLICE COLONY	1987	BW	36.00	6.00	10.00	550	2008	1250	204	0.6
160200012	CHOUTUPPAL	CHOUTUPPAL		MOSQUE	1981	BW	36.00	6.15	10.00	500	2009	949	104	1.0
160200013	CHOUTUPPAL	CHOUTUPPAL		GURUKULA COLONY	1985	BW	30.00	7.00	12.00	700	2010	1011	124	1.5
160200014	CHOUTUPPAL	CHOUTUPPAL		PWS SCHEME	/	BW	0.00	0.00	0.00	0	2011	2230	320	2.8
160200015	CHOUTUPPAL	CHOUTUPPAL		PADMASHALIWADA	1990	BW	45.15	8.00	10.00	900	2012	613	60	1.2
160200016	CHOUTUPPAL	CHOUTUPPAL		RAJAIAH HOUSE	1984	BW	40.60	7.20	8.00	1002	2013	4450	920	2.0
160200017	CHOUTUPPAL	CHOUTUPPAL		KAJAMIA HOSE	/	BW	0.00	0.00	0.00	0	2014	739	64	1.0
160200018	CHOUTUPPAL	CHOUTUPPAL		GOWNDALA WADA	1982	BW	36.10	10.00	8.00	1200	2015	2290	400	1.5
160200019	CHOUTUPPAL	CHOUTUPPAL		LINGAIAH HOUSE	1984	BW	36.00	6.15	10.00	1100	2016	3280	600	1.2
160200020	CHOUTUPPAL	CHOUTUPPAL		PREMLAL HOUSE	1989	BW	45.00	8.00	12.00	600	2017	1463	208	1.0
160200021	CHOUTUPPAL	CHOUTUPPAL		OLD BUS STOP	1972	BW	30.00	5.00	10.00	1200	2018	2540	430	2.4
160200022	CHOUTUPPAL	CHOUTUPPAL		BANGARUGUDA	1981	BW	30.00	6.00	10.00	1100	730	1497	200	1.6
160200023	CHOUTUPPAL	CHOUTUPPAL		PWS	/	BW	0.00	0.00	0.00	0	731	1960	348	2.8
160200024	CHOUTUPPAL	CHOUTUPPAL		ROAD SIDE PWSS	/	BW	0.00	0.00	0.00	0	732	1558	252	1.8
160201001	CHOUTUPPAL	CHOUTUPPAL	REDDYGUDEM	OLD PWS	/	BW	0.00	0.00	0.00	0	2019	1542	212	1.8
160201002	CHOUTUPPAL	CHOUTUPPAL	REDDYGUDEM	GOUNDLAWADA	1983	BW	35.00	6.15	8.00	600	2020	4250	1000	2.0
160201003	CHOUTUPPAL	CHOUTUPPAL	REDDYGUDEM	CHERUKUBAI	1986	BW	40.00	8.15	10.00	1000	2021	1643	244	0.8
160201004	CHOUTUPPAL	CHOUTUPPAL	REDDYGUDEM	HARIJANAWADA	1981	BW	36.00	6.15	10.00	900	2022	3500	620	1.0
160201005	CHOUTUPPAL	CHOUTUPPAL	REDDYGUDEM	REDDYWADA	/	BW	0.00	0.00	0.00	0	2023	1098	158	1.2
160201006	CHOUTUPPAL	CHOUTUPPAL	REDDYGUDEM	BUS STAND	1986	BW	45.00	8.00	8.00	1100	2024	734	80	1.5
160201007	CHOUTUPPAL	CHOUTUPPAL	REDDYGUDEM	REDDYGUDEM PWSS	/	BW	0.00	0.00	0.00	0	2025	1200	143	1.3
160201008	CHOUTUPPAL	CHOUTUPPAL	REDDYGUDEM	GUNDLAVADA	1974	BW	30.16	6.15	6.00	2000	2026	760	96	1.2
160202001	CHOUTUPPAL	CHOUTUPPAL	TOOPRANPET	HARIJANWADA	1976	BW	30.50	6.00	10.00	600	2027	1306	144	0.8
160202002	CHOUTUPPAL	CHOUTUPPAL	TOOPRANPET	HARIJANAWADA - II	1984	BW	36.00	3.00	12.00	500	2028	648	80	2.0
160202003	CHOUTUPPAL	CHOUTUPPAL	TOOPRANPET	NATIONAL HIGH WAY	1991	BW	45.00	10.20	10.00	600	2029	950	140	1.0
160202004	CHOUTUPPAL	CHOUTUPPAL	TOOPRANPET	KURMAWADA	1988	BW	50.00	9.00	11.00	800	2030	2720	230	0.8
160202005	CHOUTUPPAL	CHOUTUPPAL	TOOPRANPET	GOLLAWADA	1987	BW	59.20	9.15	12.00	1302	471	4850	1140	1.2
160300001	CHOUTUPPAL	LAKKARAM		SC COLONY NO.I	/	BW	0.00	0.00	0.00	0	2031	677	208	0.8
160300002	CHOUTUPPAL	LAKKARAM		SCHEME NO. SIX	1984		33.10	7.00	10.00	5320	2032	1348	212	2.2
160300003	CHOUTUPPAL	LAKKARAM		PUBLIC NO. FIVE	1986	BW	45.00	6.15	10.00	1600	2033	618	52	0.6
160300004	CHOUTUPPAL	LAKKARAM		HARIJANAWADA NO.4	1983	BW	38.15	6.15	15.00	1000	2034	1297	176	1.2
160300005	CHOUTUPPAL	LAKKARAM		PWS SCHEME	1987	BW	48.00	9.00	10.00	1158	1079	625	40	0.8
160300006	CHOUTUPPAL	LAKKARAM		HARIJANAWADA	1985	BW	28.60	2.60	15.00	300	1080	1276	188	1.8
160301001	CHOUTUPPAL	LAKKARAM	DHARMAGIGUDEM	REDDYVADA NO.4	/	BW	0.00	0.00	0.00	0	2072	1659	240	2.2
160301002	CHOUTUPPAL	LAKKARAM	DHARMAGIGUDEM	SC COLONY NO.2	1987	BW	30.00	3.90	13.00	800	2073	1067	156	1.0
160301003	CHOUTUPPAL	LAKKARAM	DHARMAGIGUDEM	PUBLIC NO.3	1979	BW	30.00	6.95	10.00	1000	2074	2370	212	2.8
160301004	CHOUTUPPAL	LAKKARAM	DHARMAGIGUDEM	PRIMARY SCHOOL NO.1	1986	BW	40.20	2.10	15.00	363	2075	645	48	0.6
160400001	CHOUTUPPAL	TANGADAPALLY		HARIJANAWADA NO-1	1979	BW	30.06	6.15	10.00	800	649	966	92	1.2
160400001	CHOUTUPPAL	TANGADAPALLY		HARIJANAWADA NO-1	1979	BW	30.06	6.15	10.00	800	2045	1620	200	1.2
160400002	CHOUTUPPAL	TANGADAPALLY		PWSS NO - 6	1984	BW	36.50	19.10	12.00	7540	850	1168	124	1.2
160400002	CHOUTUPPAL	TANGADAPALLY		PWSS NO - 6	1984		36.50	19.10	12.00	7540	2046	990	120	1.2
160400003	CHOUTUPPAL	TANGADAPALLY		SC COLONY NO-3	1984	BW	35.00	12.00	10.00	1200	851	1003	76	1.4
160400003	CHOUTUPPAL	TANGADAPALLY		SC COLONY NO-3	1984	BW	35.00	12.00	10.00	1200	2047	1322	192	1.4
160400004	CHOUTUPPAL	TANGADAPALLY		KUMMARAVADA NO - 4	/	BW	0.00	0.00	0.00	0	2048	1604	268	0.6
160400005	CHOUTUPPAL	TANGADAPALLY		CHAKALIVADA NO - 5	1979	BW	30.00	7.00	8.00	800	2049	1709	300	0.9
160400006	CHOUTUPPAL	TANGADAPALLY		BESIDE TEMPLE NO-2	/	BW	0.00	0.00	0.00	0	2050	823	152	1.0
160402001	CHOUTUPPAL	TANGADAPALLY	DAMERA	HARIJANAVADA	1980	BW	40.00	15.00	10.00	1600	852	933	68	2.4
160402002	CHOUTUPPAL	TANGADAPALLY	DAMERA	TEMPLE	/	BW	0.00	0.00	0.00	0	853	805	56	2.4
160402003	CHOUTUPPAL	TANGADAPALLY	DAMERA	BC,SC COLONY	1989	BW	35.00	12.00	10.00	1200	854	949	92	2.2
160500001	CHOUTUPPAL	LINGOJIGUDEM		S.C.WADA NO.5	1985	BW	36.06	10.00	8.00	800	2051	677	64	1.5

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WELL NO	MANDAL	VILLAGE	HAMLET	WELL NAME	CONSTR. DATE	WELL TYPE	DEPTH	CASING	WATER LEVEL	DISCHARGE l/h	LAB. NO	ELECT. COND. uS/cm	CHLORIDE mg/l	FLUORIDE mg/l
160500002	CHOUTUPPAL	LINGOJIGUDEM		OLD SC COLONY NO-7	1990	BW	45.08	8.00	10.00	1000	2052	895	76	1.8
160500003	CHOUTUPPAL	LINGOJIGUDEM		PWS SCHEME NO - 10	1988	BW	54.40	9.00	12.00	1402	2053	2120	520	1.0
160500004	CHOUTUPPAL	LINGOJIGUDEM		KATTOMIDE BORINGNO.9	/	BW	0.00	0.00	0.00	0	2054	788	80	1.0
160500005	CHOUTUPPAL	LINGOJIGUDEM		SC COLONY NO-8	1984	BW	30.06	9.00	8.00	800	2055	857	104	2.4
160500006	CHOUTUPPAL	LINGOJIGUDEM		PUBLIC NO - 6	1991	BW	45.10	8.15	10.00	1200	2056	1050	116	1.2
160500007	CHOUTUPPAL	LINGOJIGUDEM		REDDYVADA	/	BW	0.00	0.00	0.00	0	2057	657	136	0.8
160500008	CHOUTUPPAL	LINGOJIGUDEM		GOUNDLAVADA	1982	BW	30.00	8.15	8.00	1600	2103	482	32	0.6
160500009	CHOUTUPPAL	LINGOJIGUDEM		REDDYVADA NO 3	1986	BW	35.00	6.00	7.00	1100	2104	1151	128	0.5
160500010	CHOUTUPPAL	LINGOJIGUDEM		FLAG NO.2	1984	BW	0.00	0.00	0.00	0	2105	983	88	0.5
160501001	CHOUTUPPAL	LINGOJIGUDEM	JILLED CHELKA	REDDYVADA	1986	BW	43.70	5.45	15.00	1310	433	675	32	2.8
160502001	CHOUTUPPAL	LINGOJIGUDEM	ANKIREDDYGUDEM	REDDYVADA	1984	BW	30.00	10.00	12.00	1000	481	4910	1130	1.5
160600001	CHOUTUPPAL	PANTHANGI		REDDYVADA	1984	BW	38.80	6.85	12.00	1050	2058	1229	204	0.9
160600002	CHOUTUPPAL	PANTHANGI		PUSALAVADA	1979	BW	30.06	6.15	10.00	800	2059	2480	680	1.0
160600003	CHOUTUPPAL	PANTHANGI		REDDYBAVI	/	BW	0.00	0.00	0.00	0	2060	4060	1200	1.0
160600004	CHOUTUPPAL	PANTHANGI		GOUNDLAVADA	1985	BW	44.20	7.60	10.00	1302	2061	3500	920	0.4
160600005	CHOUTUPPAL	PANTHANGI		KUMMARAVADA	/	BW	0.00	0.00	0.00	0	2062	863	96	1.5
160600006	CHOUTUPPAL	PANTHANGI		REDDYVADA NO - 5	1976	BW	30.00	6.15	8.00	1600	2063	5250	1360	0.6
160600007	CHOUTUPPAL	PANTHANGI		BC COLONY NO.4	1983	BW	32.09	7.00	10.00	900	2064	580	100	1.0
160600008	CHOUTUPPAL	PANTHANGI		SC COLONY NO.3	1984	BW	19.00	15.00	15.00	750	2065	676	64	0.6
160600009	CHOUTUPPAL	PATANGI		NO 2 REDDI BAVI	1982	BW	30.00	7.00	12.00	700	2066	2690	750	0.8
160600009	CHOUTUPPAL	PATANGI		NO 2 REDDI BAVI	1982	BW	30.00	7.00	12.00	700	2066	2690	750	0.8
160600009	CHOUTUPPAL	PANTHANGI		REDDYBAVI NO.2	1986	BW	30.52	6.15	10.00	1000	2066	2690	750	0.8
160600009	CHOUTUPPAL	PANTHANGI		REDDYBAVI NO.2	1986	BW	30.52	6.15	10.00	1000	2066	2690	750	0.8
160600010	CHOUTUPPAL	PATANGI		MAIN ROAD NO 1	1989	BW	40.09	3.00	8.00	1600	2067	1494	256	1.3
160600010	CHOUTUPPAL	PATANGI		MAIN ROAD NO 1	1989	BW	40.09	3.00	8.00	1600	2067	1494	256	1.3
160600010	CHOUTUPPAL	PANTHANGI		MAINROAD NO.1	1986	BW	35.06	6.00	10.00	1800	2067	1494	256	1.3
160600010	CHOUTUPPAL	PANTHANGI		MAINROAD NO.1	1986	BW	35.06	6.00	10.00	1800	2067	1494	256	1.3
160601001	CHOUTUPPAL	PANTINGI	SAIDABAD	GOUNDLAVADA	/	BW	0.00	0.00	0.00	0	855	540	64	0.4
160601002	CHOUTUPPAL	PANTINGI	SAIDABAD	REDDYVADA	/	BW	0.00	0.00	0.00	0	856	1693	272	0.4
160601003	CHOUTUPPAL	PANTINGI	SAIDABAD	SCHOOL	1984	BW	36.04	5.00	10.00	1000	857	635	88	0.4
160700001	CHOUTUPPAL	PEPHALPAHAD		PWSS(OLD)	/	BW	0.00	0.00	0.00	0	2100	685	80	1.6
160700002	CHOUTUPPAL	PEPHALPAHAD		PANGADITHANDA	1983	BW	30.00	6.00	10.00	800	2101	727	40	2.8
160700003	CHOUTUPPAL	PEPHALPAHAD		DUBBAGANDI	1986	BW	35.00	5.00	12.00	1200	2102	760	80	1.8
160800001	CHOUTUPPAL	TALASINGARAM		HARIJANAVADA	1982	BW	30.00	8.00	10.00	800	2106	1661	64	2.0
160800002	CHOUTUPPAL	TALASINGARAM		GOUNDLAVADA NO.2	1979	BW	32.00	10.00	8.00	1100	2107	816	140	1.2
160800003	CHOUTUPPAL	TALASINGARAM		EDDAMMAGUDA	/	BW	0.00	0.00	0.00	0	2108	480	60	1.1
160900001	CHOUTUPPAL	D.NAGARAM		SC,BC COLONY	1987	BW	35.10	3.00	12.00	744	865	1151	148	1.0
160900002	CHOUTUPPAL	D.NAGARAM		PEERLA KATTAM	/	BW	0.00	0.00	0.00	0	866	1973	260	0.4
160900003	CHOUTUPPAL	D.NAGARAM		GRAM PANCHAYAT	1983	BW	40.00	5.18	10.00	1600	867	920	104	0.6
160900004	CHOUTUPPAL	D.NAGARAM		MANGALIVADA	/	BW	0.00	0.00	0.00	0	868	701	48	0.4
160900005	CHOUTUPPAL	D.NAGARAM		SC COLONY	1985	BW	36.20	7.40	10.00	3000	869	1630	104	1.0
160900006	CHOUTUPPAL	D.NAGARAM		NEAR LINGAYYA HOUSE	/	BW	0.00	0.00	0.00	0	870	2920	540	0.4
160900007	CHOUTUPPAL	D.NAGARAM		BESIDE GIRIVI	/	BW	0.00	0.00	0.00	0	871	1815	248	0.6
160900008	CHOUTUPPAL	D.NAGARAM		NEAR HARIJANAVADA	1984	BW	30.80	3.40	8.00	800	872	2510	520	1.0
160900009	CHOUTUPPAL	D.NAGARAM		GOLLAVADA	/	BW	0.00	0.00	0.00	0	873	570	64	0.4
160901001	CHOUTUPPAL	D.NAGARAM	KOYYALAGUDEM	HANDLOOM SOCIETY 3.	/	BW	0.00	0.00	0.00	0	881	696	72	0.8
160901001	CHOUTUPPAL	D.NAGARAM	KOYYALAGUDEM	HANDLOOM SOCIETY 3.	/	BW	0.00	0.00	0.00	0	2042	1160	176	0.8
160901002	CHOUTUPPAL	D.NAGARAM	KOYYALAGUDEM	HANDLOOM SOCIETY2.	/	BW	0.00	0.00	0.00	0	2044	890	116	1.0
160901002	CHOUTUPPAL	D.NAGARAM	KOYYALAGUDEM	HANDLOOM SOCIETY2.	/	BW	0.00	0.00	0.00	0	862	1975	324	1.0
160901003	CHOUTUPPAL	D.NAGARAM	KOYYALAGUDEM	JOYTHI NAGAR	1986	BW	59.00	9.10	12.00	500	884	2110	380	0.8
160901003	CHOUTUPPAL	D.NAGARAM	KOYYALAGUDEM	JOYTHI NAGAR	1986	BW	59.00	9.10	12.00	500	2085	1404	200	0.6
160901004	CHOUTUPPAL	D.NAGARAM	KOYYALAGUDEM	Z.P.H.S.NO.1	1985	BW	40.00	5.00	0.00	800	461	761	80	0.7
160901004	CHOUTUPPAL	D.NAGARAM	KOYYALAGUDEM	Z.P.H.S.NO.1	1985	BW	40.00	5.00	0.00	800	2086	598	70	0.7
160901005	CHOUTUPPAL	D.NAGARAM	KOYYALAGUDEM	JOYTHINAGAR NO.2	1987	BW	40.50	4.90	15.00	383	2087	1579	244	0.6

DATA ON DRINKING WATER WELLS (PREP) ANNEX 5

WELL NO	MANDAL	VILLAGE	HAMLET	WELL NAME	CONSTR. DATE	WELL TYPE	DEPTH	CASING	WATER LEVEL	DISCHARGE l/h	LAB. NO	ELECT. COND. uS/cm	CHLORIDE mg/l	FLUORIDE mg/l
160902001	CHOUTUPPAL	D.NAGARAM	YALLEMBAI	KUMMARI COLONY	1984	BW	34.70	6.10	0.00	0	863	585	64	0.4
161000001	CHOUTUPPAL	YELLAGIRI		SCHOOL	1982	BW	28.50	4.80	12.00	600	882	620	92	0.8
161000002	CHOUTUPPAL	YELLAGIRI		HARIJAN WADA	1986	BW	30.70	6.15	10.00	700	883	765	100	0.4
161000003	CHOUTUPPAL	YELLAGIRI		KUMMARIVADA	/	BW	0.00	0.00	0.00	0	884	916	104	2.0
161001001	CHOUTUPPAL	YELLAGIRI	YELLAMBAI	REDDYVADA	/	BW	0.00	0.00	0.00	0	885	1820	260	2.2
161002001	CHOUTUPPAL	YELLAGIRI	MUKKIDONIBAVI	REDDYVADA	1988	BW	38.07	6.18	15.00	900	475	1458	170	0.8

Appendix 5.6

Data irrigation wells IDC

DATA ON IRRIGATION WELLS (IDC) ANNEX 6

WELL NO	MANDAL	VILLAGE	HAMLET	WELL NAME	WELL TYPE	DEPTH m.b.s.	CASING m	DISCHARGE (l/h) DRILLING	PRESENT	SAMPLING DATE	LAB. REF NO	ELEC COND	FLUORIDE
	Peddavoora		Jal tanda	Jal tanda II	BW	45.00	6.00	18175		02/14/92	811	1500	0.8
	Peddavoora		Jal tanda	Jal tanda II	BW	45.00	7.00	11360	9088	02/14/92	811	1500	0.8
			K.B.Tanda	K.B.Tanda I	BW	45.00	8.00	16812		02/14/92		651	2.4
	Peddavoora		Jal tanda	Jal tanda II	BW	45.00	8.00	16812		02/14/92	811	1500	0.8
	Peddavoora	Nellikal		Nellikal I	BW	45.00	8.00	16812		02/14/92	818	820	1.2
	Peddavoora	Nellikal		Nellikal I	BW	45.00	6.00	18175		02/14/92	818	820	1.2
	Peddavoora	Nellikal		Nellikal I	BW	45.00	7.00	11360	9088	02/14/92	818	820	1.2
			K.B.Tanda	K.B.Tanda I	BW	45.00	7.00	11360	9088	02/14/92		651	2.4
			K.B.Tanda	K.B.Tanda I	BW	45.00	6.00	18175		02/14/92		651	2.4
10600009	Nalgonda	Kanchanpally		Kanchanpally III	BW	60.00	10.00	16640	11814	02/14/92		667	2.0
10600010	Nalgonda	Kanchanpally		Kanchanpally IV	BW	45.00	10.00	11360	9088	02/14/92		671	1.8
10601002	Nalgonda	Kanchanpally	Depakunta	Depakunta I	BW	45.00	8.00	45438	36350	02/14/92		961	2.0
11200002	Nalgonda	Donkal		Donkal I	BW	42.00	6.00	14540	9088	02/14/92		706	1.8
11300002	Nalgonda	Appajipet		Appajipet III	BW	32.00	8.00	22719	11814	02/14/92		1495	1.6
11300003	Nalgonda	Appajipet		Appajipet V	BW	32.00	9.00	90876	36350	02/14/92		1160	2.0
11300004	Nalgonda	Appajipet		Appajipet VI	BW	32.00	10.00	16358	11814	02/14/92		1187	1.8
11300005	Nalgonda	Appajipet		Appajipet VIII	BW	32.00	8.00	13631	13631	02/14/92		1207	2.4
11400001	Nalgonda	Dandampally		Dandampally I	BW	33.00	9.00	9088	9088	02/14/92		701	1.0
11400002	Nalgonda	Dandampally		Dandampally III	BW	32.92	10.50	9088	6816	02/14/92		820	1.2
11400003	Nalgonda	Dandampally		Dandampally V	BW	45.00	10.50	11360	9088	02/14/92		892	1.2
11400004	Nalgonda	Dandampally		Dandampally VI	BW	45.00	9.25	21810	11360	02/14/92		980	1.2
11400005	Nalgonda	Dandampally		Dandampally VIII	BW	45.00	9.15	7952	7952	02/14/92		823	3.2
11501001	Nalgonda	P.Dommalapally	M.Domalapally	M.Domalapally	BW	45.00	12.00	13631	11814	02/14/92		1561	1.8
20900002	Kangal	Parvathgiri		Parvathgiri II	BW	32.00	10.00	9996	9088	02/14/92		988	1.4
21400001	Kangal	Darveshpur		Darveshpur I	BW	33.00	8.00	45438	7952	02/14/92		1138	2.0
30100012	Munugode	Munugode		Munugode II	BW	35.00	14.00	18175	9086	02/14/92			1.8
30100013	Munugode	Munugode		Munugode IV	BW	35.00	10.00	9088	9088	02/14/92		1811	3.6
30106001	Munugode	Munugode	Gollagudem	Gollagudem I	BW	32.00	12.00	29535	13631	02/14/92		881	1.2
30106002	Munugode	Munugode	Gollagudem	Gollagudem II	BW	31.00	12.00	17085	9088	02/14/92			1.2
31001003	Munugode	Koratikal	Dubbakalva	Dubbakalva II	BW	7.30	13.00	32715	16358	02/14/92		822	2.0
31001004	Munugode	Koratikal	Dubbakalva	Dubbakalva III	BW	7.50	14.00	32715	16358	02/14/92			2.0
31200003	Munugode	Kalwakuntla		Kalwakuntla I	BW	35.00	12.00	22265	13631	02/14/92		2150	1.2
31300010	Munugode	Velmakanne		Velmakanne I	BW	42.70	9.00	9088	6816	02/14/92		2180	4.6
31300011	Munugode	Velmakanne		Velmakanne II	BW	47.03	9.00	11360	9088	02/14/92		1366	2.8
31300012	Munugode	Velmakanne		Velmakanne III	BW	30.00	10.00	16358	11360	02/14/92		2150	2.8
40200011	Chandur	Teratpally		Teratpally III	BW	45.00	12.00	22719	16358	02/14/92		611	1.8
40200012	Chandur	Teratpally		Teratpally IV	BW	45.00	11.00	9088	9088	02/14/92		502	0.8
40400006	Chandur	Idikuda		Idikuda VII	BW	33.00	21.00	36350	16358	02/14/92		1543	6.0
40400007	Chandur	Idikuda		Idikuda I	BW	23.72	12.00	25445	18175	02/14/92	786	1650	4.0
40400008	Chandur	Idikuda		Idikuda IV	BW	37.00	11.00	16358	16358	02/14/92	785	1600	4.0
40800015	Chandur	Gattuppal		Gattuppal I	BW	40.00	13.00	16358	11814	02/14/92		1334	4.2
41100005	Chandur	Bangarigadda		Bangarigadda	BW	32.60	12.00	9088	9088	02/14/92	787	1600	3.6
50100004	Narayanpur	Narayanpur		Narayanpur III	BW	38.00	13.00	16358	11360	02/14/92		496	2.0
50100005	Narayanpur	Narayanpur		Narayanpur IV	BW	45.00	15.00	11814	9088	02/14/92		1241	2.0
50100006	Narayanpur	Narayanpur		Narayanpur V	BW	40.00	8.00	6816	6816	02/14/92		848	4.6
50100007	Narayanpur	Narayanpur		Narayanpur VI	BW	45.60	9.00	7088	6816	02/14/92		1242	2.0
50300002	Narayanpur	Mohammadabad		Mohammadabad III	BW	37.00	11.20	12268	8179	02/14/92		3380	2.4
50300003	Narayanpur	Mohammadabad		Mohammadabad IV	BW	45.00	10.83	11360	9088	02/14/92		1241	2.4
50300004	Narayanpur	Mohammadabad		Mohammadabad V	BW	50.00	12.00	21810	16356	02/14/92		1446	1.4
50400003	Narayanpur	Chimiryala		Chimiryala I	BW	40.00	10.70	22719	13631	02/14/92		956	2.0
50400004	Narayanpur	Chimiryala		Chimiryala II	BW	38.00	12.40	17039	13631	02/14/92		1113	3.2
50400005	Narayanpur	Chimiryala		Chimiryala III	BW	40.00	11.70	16812	9088	02/14/92		1462	5.2
50400006	Narayanpur	Chimiryala		Chimiryala IV	BW	50.00	12.10	11360	9088	02/14/92		956	2.6
50400007	Narayanpur	Chimiryala		Chimiryala V	BW	45.00	10.80	11360	9088	02/14/92		813	2.6
50700009	Narayanpur	Puttapaka		Puttapaka I	BW	50.00	10.80	20447	16358	02/14/92		2160	2.2

DATA ON IRRIGATION WELLS (IDC) ANNEX 6

WELL NO	MANDAL	VILLAGE	HAMLET	WELL NAME	WELL TYPE	DEPTH m.b.s.	CASING m	DISCHARGE (l/h) DRILLING	PRESENT	SAMPLING DATE	LAB. REF NO	ELEC COND	FLUORIDE
50700010	Narayanpur	Puttapaka		Puttapaka II	BW	60.00	11.00	11909	9088	02/14/92		2150	2.0
50700011	Narayanpur	Puttapaka		Puttapaka IV	BW	41.10	10.00	20447	13631	02/14/92		2160	2.0
51000008	Narayanpur	Jangoan		Jangoan II	BW	40.00	13.00	22719	13631	02/14/92		861	5.2
51000009	Narayanpur	Jangoan		Jangoan IV	BW	50.00	12.70	9088	9088	02/14/92		1243	2.0
51001004	Narayanpur	Jangoan	Porlagadda tanda	Porlagadda tanda I	BW	21.30	12.00	9833	9088	02/14/92		1243	2.4
51001005	Narayanpur	Jangoan	Porlagadda tanda	Porlagadda tanda III	BW	35.00	16.00	22719	13631	02/14/92		349	2.8
51002002	Narayanpur	Jangoan	Watchya tanda	Watchya tanda I	BW	45.75	18.00	22719	18175	02/14/92		941	4.4
51002003	Narayanpur	Jangoan	Watchya tanda	Watchya tanda II	BW	45.00	18.00	22719	18175	02/14/92		941	4.4
51002004	Narayanpur	Jangoan	Watchya tanda	Watchya tanda III	BW	36.00	22.00	29535	22719	02/14/92		943	4.8
51002005	Narayanpur	Jangoan	Watchya tanda	Watchya tanda IV	BW	32.00	20.00	18175	16358	02/14/92		943	4.4
51002006	Narayanpur	Jangoan	Watchya tanda	Watchya tanda V	BW	45.00	15.71	11360	11360	02/14/92		1240	3.4
51003003	Narayanpur	Jangoan	Pallagattu tanda	Pallagattu tanda IV	BW	32.00	12.00	12041	9088	02/14/92		1242	2.4
51004003	Narayanpur	Jangoan	Aregudem	Aregudem I	BW	40.00	14.30	11814	9088	02/14/92		1244	2.0
51100009	Narayanpur	Wallpally		Wallpally II	BW	30.00	16.71	8179	8179	02/14/92		852	4.4
51100010	Narayanpur	Wallpally		Wallpally III	BW	42.00	14.00	4544	4544	02/14/92		1121	4.8
51100011	Narayanpur	Wallpally		Wallpally IV	BW	50.00	16.00	12268	9088	02/14/92		1422	5.2
51105003	Narayanpur	Wallpally	Korra tanda	Korra tanda II	BW	45.00	17.00	11814	9088	02/14/92		1240	2.0
51200005	Narayanpur	Chillapur		Chillapur I	BW	32.00	12.00	46320	22719	02/14/92		938	4.8
51200006	Narayanpur	Chillapur		Chillapur II	BW	40.00	14.00	14540	13631	02/14/92		938	4.4
51200007	Narayanpur	Chillapur		Chillapur III	BW	32.00	20.00	9088	9088	02/14/92		1243	2.2
51200008	Narayanpur	Chillapur		Chillapur IV	BW	45.00	12.00	9088	6816	02/14/92		1241	2.0
51200009	Narayanpur	Chillapur		Chillapur V	BW	32.00	15.00	36350	22719	02/14/92		1241	2.0
51200010	Narayanpur	Chillapur		Chillapur VI	BW	32.00	15.00	27263	16358	02/14/92		1240	2.0
51200011	Narayanpur	Chillapur		Chillapur VIII	BW	40.00	17.00	11360	9088	02/14/92		808	3.6
51200012	Narayanpur	Chillapur		Chillapur X	BW	40.00	13.00	11360	9088	02/14/92		740	3.8
51200013	Narayanpur	Chillapur		Chillapur XI	BW	45.00	13.00	11360	9088	02/14/92		946	4.4
51200014	Narayanpur	Chillapur		Chillapur XI	BW	45.00	13.00	11360	9088	02/14/92		939	4.4
51204001	Narayanpur	Chillapur	K.P.Tanda	K.P.Tanda I	BW	33.50	14.00	9088	9088	02/14/92		563	3.6
51204002	Narayanpur	Chillapur	K.P.Tanda	K.P.Tanda II	BW	26.60	12.80	11360	9088	02/14/92		1244	3.6
51204003	Narayanpur	Chillapur	K.P.Tanda	K.P.Tanda III	BW	27.50	13.00	8406	8406	02/14/92		594	2.6
51300009	Narayanpur	Sarvail		Sarvail I	BW	40.00	10.80	29535	11360	02/14/92		2270	5.2
51301006	Narayanpur	Sarvail	Mallareddigudem	Mallareddigudemm I	BW	35.00	12.80	36350	22719	02/14/92		1264	2.4
51301007	Narayanpur	Sarvail	Mallareddigudem	Mallareddigudemm II	BW	40.00	12.00	11814	9088	02/14/92		1566	2.8
60200016	Narkatpally	B.Vellemula		B.Vellemula I	BW	32.92		25445	11360	02/14/92		1935	1.4
60500002	Narkatpally	A.P.Lingotam		A.P.Lingotam I	BW	62.00	10.80	36350	13631	02/14/92		1352	2.2
60500003	Narkatpally	A.P.Lingotam		A.P.Lingotam II	BW	46.00	11.20	90876	22719	02/14/92		1307	3.6
60602002	Narkatpally	Cheruvugattu	Yenuguladori	Yenuguladori II	BW	42.00	10.80	27263	18175	02/14/92		976	1.8
60602003	Narkatpally	Cheruvugattu	Yenuguladori	Yenuguladori III	BW	45.00	12.00	29535	13631	02/14/92		564	3.6
60602004	Narkatpally	Cheruvugattu	Yenuguladori	Yenuguladori IV	BW	52.00	13.00	13631	9088	02/14/92		1456	5.6
60800008	Narkatpally	M.Yedavalli		M.Yedavalli I	BW	55.00	6.00	13631	9088	02/14/92		1276	6.0
61000003	Narkatpally	Thondlaval		Thondlaval I	BW	36.00	9.40	9088	6816	02/14/92		718	3.6
61100009	Narkatpally	Nemmani		Nemmani I	BW	37.49	10.70	9542	6816	02/14/92		615	1.2
70200011	Chityala	Urumadla		Urumadla I	BW	42.00	8.80	4544	4544	02/14/92		1619	2.0
70200012	Chityala	Urumadla		Urumadla II	BW	30.00	7.90	11360	4544	02/14/92		2240	2.8
70400007	Chityala	T.Vellemmula		T.Vellemula III	BW	38.00	11.00	9088	9088	02/14/92		1486	1.6
70500009	Chityala	Elikatta		Elikatta I	BW	42.00	11.10	29535	18175	02/14/92		1106	2.6
70500010	Chityala	Elikatta		Elikatta II	BW	22.00	12.70	36350	22719	02/14/92		1353	1.6
70900018	Chityala	Peddakaparthy		Peddakaparthy I	BW					02/14/92		616	0.8
70900019	Chityala	Peddakaparthy		Peddakaparthy II	BW	45.00	11.40	29535	22719	02/14/92		617	0.8
70901008	Chityala	Peddakaparthy	Aregudem	Aregudem I	BW	50.00	10.25	9088	4544	02/14/92		534	0.8
70901009	Chityala	Peddakaparthy	Aregudem	Aregudem II	BW	36.00	12.70	9088	9088	02/14/92		574	0.8
70901010	Chityala	Peddakaparthy	Aregudem	Aregudem III	BW	36.00	12.10	11905	11360	02/14/92		1556	1.8
70901011	Chityala	Peddakaparthy	Aregudem	Aregudem IV	BW	40.00	13.15	29080	13631	02/14/92		524	0.8
70901012	Chityala	Peddakaparthy	Aregudem	Aregudem V	BW	50.00	12.65	11909	9088	02/14/92		768	1.8
71100012	Chityala	Velimineedu		Velimineedu I	BW	41.10	9.70	9088	9088	02/14/92		323	1.2

DATA ON IRRIGATION WELLS (IDC) ANNEX 6

WELL NO	MANDAL	VILLAGE	HAMLET	WELL NAME	WELL TYPE	DEPTH m.b.s.	CASING m	DISCHARGE (l/h) DRILLING	DISCHARGE (l/h) PRESENT	SAMPLING DATE	LAB. REF NO	ELEC COND	FLUORIDE
71500001	Chityala	Sunkenapally		Sunkenapally I	BW	48.51	11.90	9088	9088	02/14/92		686	0.8
71500002	Chityala	Sunkenapally		Sunkenapally II	BW	37.50	8.20	12495	9088	02/14/92		730	0.8
80600002	Nampally	S.Lingotam		S.Lingotam I	BW	30.00	8.00	54526	18176	02/14/92		1226	2.0
80600003	Nampally	S.Lingotam		S.Lingotam II	BW	30.00	10.00	29535	16358	02/14/92		939	3.2
80600004	Nampally	S.Lingotam		S.Lingotam III	BW	30.00	8.00	29535	18175	02/14/92		926	3.2
80600005	Nampally	S.Lingotam		S.Lingotam IV	BW	30.00	8.00	35542	11814	02/14/92		1130	3.2
82600002	Nampally	Harizanapuram		Harizanapuram I	BW	35.00	8.50	18175		02/14/92	810	1600	4.0
82600003	Nampally	Harizanapuram		Harizanapuram III	BW	50.00	12.00	16356		02/14/92	815	1600	4.0
82600004	Nampally	Harizanapuram		Harizanapuram IV	BW	26.00	12.00	7725		02/14/92	814	680	1.2
82600005	Nampally	Harizanapuram		Harizanapuram V	BW	26.00	12.00	11360		02/14/92	807	590	1.2
82600006	Nampally	Harizanapuram		Harizanapuram VI	BW		12.25	7725		02/14/92	812	670	4.8
82600007	Nampally	Harizanapuram		Harizanapuram VII	BW	25.00	12.70	38622		02/14/92	824	2550	1.2
82600008	Nampally	Harizanapuram		Harizanapuram VIII	BW		12.00	22719		02/14/92	820	1100	4.0
90900002	Chinthapally	Varkala		Varkala I	BW	40.00	10.00	13631		02/14/92	808	1200	4.0
91700005	Chinthapally	Godakondla		Godakondla I	BW	30.00	8.00	22719		02/14/92	809	1900	0.8
92100001	Chinthapally	Narsurathpally		Narsurathpally	BW	32.00	6.00	16812	11360	02/14/92	751	770	2.6
100802002	Marriguda	Indurthy	Thanedarpally	Thanedarpally II	BW	30.00	9.00	11360	9088	02/14/92	767	880	4.0
100802003	Marriguda	Indurthy	Thanedarpally	Thanedarpally IV	BW	45.00	11.00	11360	9088	02/14/92	769	700	3.6
100802004	Marriguda	Indurthy	Thanedarpally	Thanedarpally V	BW	45.00	10.00	16358	11360	02/14/92	768	1050	4.0
100802005	Marriguda	Indurthy	Thanedarpally	Thanedarpally VII	BW	45.00	12.00	11360	11360	02/14/92	770	980	3.2
100803003	Marriguda	Indurthy	Ramireddypally	Ramireddypally II	BW	27.00	6.00	9088	9088	02/14/92	760	720	2.8
100803004	Marriguda	Indurthy	Ramireddypally	Ramireddypally IV	BW	36.00	6.00	20447	18175	02/14/92	761	840	3.8
100803005	Marriguda	Indurthy	Ramireddypally	Ramireddypally V	BW	30.00	10.00	9088	9088	02/14/92	762	660	3.6
100803006	Marriguda	Indurthy	Ramireddypally	Ramireddypally VII	BW	36.57	10.00	18175	13631	02/14/92	763	840	2.8
100900003	*Marriguda*	*D.Bheemanpally*		*D.Bheemanpally III*	BW	*30.00*	*11.10*	13631		02/14/92	813	1500	2.4
101100002	Marriguda	Vattipally		Vattipally X	BW	45.00	8.00	11360	9088	02/14/92	759	1350	2.8
101100003	Marriguda	Vattipally		Vattipally XIII	BW	45.00	8.00	9088	9088	02/14/92	758	940	3.6
101101001	Marriguda	Vattipally	Rajapath tanda	Rajapath tanda I	BW					02/14/92	752	840	3.6
101101002	Marriguda	Vattipally	Rajapath tanda	Rajapath tanda II	BW	40.00	10.00	18175	13631	02/14/92	753	580	3.2
101101003	Marriguda	Vattipally	Rajapath tanda	Rajapath tanda V	BW	40.00	9.00	9088	9088	02/14/92	754	1350	3.6
101101004	Marriguda	Vattipally	Rajapath tanda	Rajapath tanda VI	BW	37.00	8.00	9088	8179	02/14/92	755	1050	4.0
101101005	Marriguda	Vattipally	Rajapath tanda	Rajapath tanda IX	BW	40.00	9.00	9088	9088	02/14/92	756	780	3.6
101101006	Marriguda	Vattipally	Rajapath tanda	Rajapath tanda X	BW	40.00	9.00	9088	9088	02/14/92	757	960	4.0
101200002	Marriguda	Yeragandlapally		Yeragandlapally	BW	21.33	6.00	18175	15903	02/14/92	771	1400	3.6
101202002	Marriguda	Yeragandlapally	Azilapur	Azilapur I	BW	37.00	6.00	20196	18175	02/14/92	784	600	4.0
101202003	Marriguda	Yeragandlapally	Azilapur	Azilapur X	BW	37.00	8.00	20197	18175	02/14/92	766	640	3.0
101600002	Marriguda	Marriguda		Marriguda IX	BW	45.00	8.00	13631	9088	02/14/92	764	620	2.6
101600003	Marriguda	Marriguda		Marriguda X	BW	45.00	8.00	11360	9088	02/14/92	765	880	3.4
101600004	Marriguda	Marriguda		Marriguda II	BW	37.00	7.00	29534	22179	02/14/92	781	790	3.0
101600005	Marriguda	Marriguda		Marriguda III	BW	40.00	6.00	22179	18175	02/14/92	782	670	4.0
101700002	Marriguda	Batlapally		Batlapally I	BW	40.00	6.00	22719	18175	02/14/92	775	640	3.2
101700003	Marriguda	Batlapally		Batlapally III	BW	40.00	8.00	45438	36350	02/14/92	776	1000	3.4
101700004	Marriguda	Batlapally		Batlapally V	BW	35.00	8.00	11360	9088	02/14/92	777	720	3.2
101700005	Marriguda	Batlapally		Batlapally VII	BW	40.00	8.00	20447	18175	02/14/92	778	940	3.2
101700006	Marriguda	Batlapally		Batlapally VIII	BW	40.00	6.00	20447	18175	02/14/92	779	750	4.0
101700007	Marriguda	Batlapally		Batlapally X	BW	40.00	6.00	16358	16358	02/14/92	780	740	3.2
110100002	Gurrampode	Gurrampode		Gurrampode I	BW	45.00	8.00	6816	6816	02/14/92		819	1.8
110600002	Gurrampode	Koppole		Koppole I	BW	36.39	13.40	72701	19084	02/14/92		1033	2.6
110600003	Gurrampode	Koppole		Koppole II	BW	30.48	12.00	10451	9088	02/14/92		700	2.6
110600004	Gurrampode	Koppole		Koppole III	BW	32.00	12.00	13631	11360	02/14/92		1060	3.2
110600005	Gurrampode	Koppole		Koppole IV	BW	59.75	14.00	45438	27263	02/14/92		1077	2.6
110600006	Gurrampode	Koppole		Koppole V	BW	45.00	7.00	11360	11360	02/14/92		1064	4.0
111100002	Gurrampode	Nadikuda		Nadikuda I	BW	40.00	6.00	9996	9088	02/14/92		1480	2.0
120301001	Devarakonda	K.Mallepally	Chennamuni tanda	Chennamuni tanda I	BW	47.00	6.00	12495	11360	02/14/92	773	720	0.8
120302001	Devarakonda	K.Mallepally	Turpu tanda	Turpu tanda	BW	50.00	10.00	22719		02/14/92	821	850	2.0

DATA ON IRRIGATION WELLS (IDC)

WELL NO	MANDAL	VILLAGE	HAMLET	WELL NAME	WELL TYPE	DEPTH m.b.a.	CASING m	DISCHARGE (l/h)		SAMPLING DATE	LAB. REF NO	ELEC COND	FLUORIDE
								DRILLING	PRESENT				
120600001	Devarakonda	Pendlipakala		Pendlipakala I	BW	50.00	6.00	15903	13631	02/14/92	774	1050	1.0
120601001	Devarakonda	Pendlipakala	Gazinagar	Gazinagar	BW	47.00	6.00	18175	16358	02/14/92	783	830	2.0
120700001	Devarakonda	Chennaram		Chennaram	BW	31.39	8.00	35405		02/14/92	822	540	1.2
140100002	P.A.Pally	Azmapur		Azmapur I	BW	24.00	8.00	4544	4544	02/14/92	772	940	0.8
140400002	P.A.Pally	P.A.Pally		P.A.Pally I	BW	67.00	6.00	6816		02/14/92	816	690	1.2
140400003	P.A.Pally	P.A.Pally		P.A.Pally II	BW		10.25	18175		02/14/92	823	930	1.2
140500002	P.A.Pally	Dugyala		Dugyala II	BW	69.50	12.00	72701		02/14/92	819	830	1.2
140501002	P.A.Pally	Dugyala	Pilligudla tanda	Pilligudla tanda I	BW	45.00	6.00	12268		02/14/92	805	900	0.8
140900002	P.A.Pally	Medaram		Medaram I	BW	31.39	6.00	14990		02/14/92	817	1250	1.2
140900003	P.A.Pally	Medaram		Medaram II	BW	31.80	6.00	21788		02/14/92	806	540	2.4
160400007	Chowtuppal	Tangadapally		Tangadapally I	BW	34.50	8.00	19084	16358	02/14/92		1011	2.6
160400008	Chowtuppal	Tangadapally		Tangadapally II	BW	43.60	8.10	20447	16358	02/14/92		997	2.4
160400009	Chowtuppal	Tangadapally		Tangadapally III	BW	46.50	8.00	15449	13631	02/14/92		1045	2.0
160400010	Chowtuppal	Tangadapally		Tangadapally V	BW	48.00	7.00	9088	9088	02/14/92		489	2.4
160402004	Chowtuppal	Tangadapally	Damera	Damera I	BW	50.00	12.00	9089	9088	02/14/92		959	2.6
160600011	Chowtuppal	Panthangi		Panthangi II	BW	45.00	8.00	9088	9088	02/14/92		1188	3.2
160600012	Chowtuppal	Panthangi		Panthangi IV	BW	32.00	10.00	18175		02/14/92		1311	1.8

IRRIGATION WELLS IN PROJECT VILLAGES

ANNEX 7

					FLUORIDE IDC WELLS (mg/l)				
NO.	MANDAL	VILLAGE	ELEV. MASL	PROJ. PHASE	NO. of WELLS	MIN.	MED.	MAX.	NO. of F <= 1.5
10100001	NALGONDA	ANNAPARTHY	251.52	1					
10300001	NALGONDA	BUDDHARAM	249.99	1					
10400001	NALGONDA	CHERLAPALLI	245.32	1					
10600001	NALGONDA	KANCHANPALLY		1	3	1.6	2.0	2.0	
10700001	NALGONDA	K.KONDARAM	236.53	1					
10900001	NALGONDA	MARRIGUDA		1					
11200001	NALGONDA	DONAKAL	228.16	1	1	1.8	1.8	1.8	
11300001	NALGONDA	APPAJIPET	249.60	1	4	1.6	1.8	2.4	
11500001	NALGONDA	P.DOMALAPALLY	238.73	1	1	1.8	1.8	1.8	
21000001	KANGAL	PONGODU	226.24	1					
21100001	KANGAL	REGATTA	223.53	1					
21500001	KANGAL	TURKAPALLY	187.00	2					
30100001	*MUNGODE*	*MUNGODE*	*247.23*	*1*	*4*	*1.2*	*1.5*	*3.6*	*2*
30200001	MUNGODE	KISTAPUR	288.66	1					
30300001	MUNGODE	IPPARTHY	274.94	1					
30400001	MUNGODE	SINGARAM	251.40	1					
30500001	MUNGODE	KATCHAPUR	258.28	1					
30600001	MUNGODE	PALIWALA	280.66	1					
30700001	MUNGODE	CHALIMEDA	292.09	1					
30800001	MUNGODE	KOMPALLY	273.65	1					
30900001	MUNGODE	CHIKATIMAMIDI	267.72	1					
31000001	MUNGODE	KORATIKAL	232.10	1	2	2.0	2.0	2.0	
31100001	MUNGODE	CHOLLEDU	267.27	1					
31200001	MUNGODE	KALVAKUNTA	277.45	1	1	1.2	1.2	1.2	1
31300001	MUNGODE	VELMAKANNE	290.43	1	3	2.8	2.8	3.6	
31400001	MUNGODE	PULIPALUPULA	254.75	1					
31500001	MUNGODE	KALVALAPALLY		1					
31600001	MUNGODE	JAMISTHANPALLY	248.88	1					
31700001	MUNGODE	GUDAPUR		1					
31800001	MUNGODE	SOLIPUR		1					
31900001	MUNGODE	KOTHLARAM	297.06	1					
32000001	MUNGODE	RATHIPALLY	264.01	1					
32100001	MUNGODE	OOKONDI	261.42	1					
40100001	CHANDOOR	CHANDOOR	250.03	1					
40200001	CHANDOOR	THEROTPALLI		1	2	0.8	1.3	1.8	1
40300001	CHANDOOR	PULEMLA	268.13	1					
40400001	CHANDOOR	IDIKUDI	263.25	1	3	4	4	6	
40500001	CHANDOOR	ANGADIPET	258.26	1					
40600001	CHANDOOR	DONIPAMULA		1					
40700001	CHANDOOR	GUNDRAPALLY	250.00	2					
40800001	CHANDOOR	GHATUPPAL		1	1	4.2	4.2	4.2	
40900001	CHANDOOR	KONDAPUR	276.15	1					
41000001	CHANDOOR	BODANGAPARTHY	252.97	1					
41100001	CHANDOOR	BANGARIGADDA	260.13	1	1	3.6	3.6	3.6	
41200001	CHANDOOR	NERMETTA		1					
41300001	CHANDOOR	THUMMALAPALLY	280.00	2					
41400001	CHANDOOR	KASTALA	238.09	1					
41500001	CHANDOOR	SERIDEPALLY	246.16	1					
41600001	CHANDOOR	UDTHAPALLY		1					
50100001	NARAYANAPOOR	NARAYANAPOOR	355.53	1	4	2	2	4.6	
50200001	NARAYANAPOOR	GUJJA	303.70	1					
50300001	NARAYANAPOOR	MOHAMMADABAD	350.85	1	3	1.4	2.4	2.4	1
50400001	NARAYANAPOOR	CHINNA MIRIYALA	334.95	1	5	2.6	2.9	5.2	

IRRIGATION WELLS IN PROJECT VILLAGES ANNEX 7

					FLUORIDE IDC WELLS (mg/l)				
NO.	MANDAL	VILLAGE	ELEV. MASL	PROJ. PHASE	NO. of WELLS	MIN.	MED.	MAX.	NO. of F <= 1.5
50500001	NARAYANAPOOR	GUDDIMALKAPUR	348.91	1					
50600001	NARAYANAPOOR	KOTHALAPUR		1					
50700001	NARAYANAPOOR	PUTTAPAKA	312.07	1	3	2	2.1	2.2	
50800001	NARAYANAPOOR	KANKHANALAGUDA		1					
50900001	NARAYANAPOOR	KOTHAGUDA	338.11	1					
51000001	NARAYANAPOOR	JANGAON		1	11	2	3.4	4.8	
51100001	NARAYANAPOOR	VOIPALLY		1	4	2	4.8	5.2	
51200001	NARAYANAPOOR	CHILLAPUR		1	13	2	3.8	4.8	
51300001	NARAYANAPOOR	SERVOIL	320.69	1	3	2.4	2.8	5.2	
60100001	NARKETPALLY	NARKETPALLY	278.96	1					
60200001	NARKETPALLY	B.YELEMLA	277.57	1	1	1.4	1.4	1.4	1
60300001	NARKETPALLY	AURAVANI	262.21	1					
60400001	NARKETPALLY	CHOUDAMPALLY	280.00	1					
60600001	NARKETPALLY	CHERUGATTA	265.22	1	3	1.8	3.6	5.6	
60700001	NARKETPALLY	YELLAREDDYGUDA	256.57	1					
60800001	NARKETPALLY	M.YEDAVELLY	274.93	1	1	6	6	6	
61100001	NARKETPALLY	NEMMANI		1	1	1.2	1.2	1.2	1
61300001	NARKETPALLY	MANDRA	298.74	1					
70100001	CHITYAL	CHITYAL	314.42	1					
70200001	CHITYAL	URUMADLA	295.80	1	2	2	2.3	2.6	
70300001	CHITYAL	NEREDA	292.39	1					
70400001	CHITYAL	THALVELEMALA	274.13	1	1	1.8	1.8	1.8	
70500001	CHITYAL	YELLIKATA	276.78	1	2	1.8	2.2	2.6	
70600001	CHITYAL	GUNDRAMPALLI	319.38	1					
70700001	CHITYAL	EAPOOR		1					
70800001	CHITYAL	CHINAKAPARTY	297.41	1					
70900001	CHITYAL	PEDDAKAPAPRTHY		1	7	0.8	0.8	1.8	5
71000001	CHITYAL	PITTAMPALLY		1					
71200001	CHITYAL	VANIPAKALA	245.62	1					
71300001	CHITYAL	VATTIMARTHI	296.19	1					
71400001	CHITYAL	SHIVANENIGUDEM	317.27	1					
71600001	CHITYALA	PEREPALLY	299.06	1					
71700001	CHITYALA	BONGONICHERUVU	314.13	1					
80100001	NAMPALLY	NAMPALLY	290.00	2					
80200001	NAMPALLY	PEDDAPUR	290.00	2					
80300001	NAMPALLY	NEREDLAPALLY		1					
80400001	NAMPALLY	DAMERA		1					
80500001	NAMPALLY	DEVATHPALLY	290.00	2					
80600001	NAMPALLY	S.W.LINGOTAM		1	4	2	3.2	3.2	
80700001	NAMPALLY	WADDEPALLY	ERR	1					
80800001	NAMPALLY	CHITTAMPADU	320.00	2					
80900001	NAMPALLY	THIRMALGIRI	291.00	2					
81000001	NAMPALLY	MALLAPURAJPALLY	360.00	2					
81100001	NAMPALLY	PASNUR	302.00	2					
81200001	NAMPALLY	K.THIRMALGIRI	305.00	2					
81300001	NAMPALLY	CHAMALAPALLY	245.00	2					
81400001	NAMPALLY	GANUGUPALLY	275.00	2					
81500001	NAMPALLY	MOHAMMADAPUR	245.00	2					
81600001	NAMPALLY	G.MALLEPALLY	293.00	2					
81700001	NAMPALLY	KETHEPALLY	300.00	2					
81800001	NAMPALLY	MEDLAVAI		2					
81900001	NAMPALLY	THUMMALAPALLY	290.00	2					
82000001	NAMPALLY	B.THIMMAPUR	290.00	2					

IRRIGATION WELLS IN PROJECT VILLAGES

ANNEX 7

NO.	MANDAL	VILLAGE	ELEV. MASL	PROJ. PHASE	FLUORIDE IDC WELLS (mg/l) NO. of WELLS	MIN.	MED.	MAX.	NO. of F <= 1.5
82100001	NAMPALLY	REVALLY	290.00	2					
82200001	NAMPALLY	SUNKISALA	295.00	2					
82300001	NAMPALLY	FAKEERPUR	299.00	2					
82400001	NAMPALLY	PAGIDIPLALLY	290.00	2					
82500001	NAMPALLY	MUSTIPALLY	290.00	2					
82600001	NAMPALLY	HYDALAPUR	ERR	1	7	1.2	4	4.8	3
82700001	NAMPALLY	T.P.GOWRARAM		1					
82800001	NAMPALLY	SHARBAPUR	290.00	2					
90100001	CHINTAPALLY	CHINTAPALLY	367.00	2					
90200001	CHINTAPALLY	NASARLAPALLY	360.00	2					
90300001	CHINTAPALLY	MALLAREDDIPALLI	354.00	2					
90400001	CHINTAPALLY	HUMANTHLAPALLY	360.00	2					
90500001	CHINTAPALLY	THIRUMALAPUR	350.00	2					
90600001	CHINTAPALLY	NALVALPALLY	260.00	2					
90800001	CHINTAPALLY	GADIA GOWRARAM	350.00	2					
90900001	CHINTAPALLY	VARKALA	360.00	2	1	4	4	4	
91000001	CHINTAPALLY	VINJAMOOR		1					
91100001	CHINTAPALLY	P.K.MALLAPALLI		1					
91200001	CHINTAPALLY	KURMAPALLY		1					
91300001	CHINTAPALLY	KURMAID		1					
91400001	CHINTAPALLY	UMMAPUR		1					
91500001	CHINTAPALLY	SUKILISERIPALLY	ERR	1					
91600001	CHINTAPALLY	TAKKELLAPALLY		1					
91700001	CHINTAPALLY	GODAKONDLA		1	1	0.8	0.8	0.8	1
91900001	CHINTAPALLY	POLEPALLY		1					
92000001	CHINTAPALLY	MADNAPUR		1					
92100001	CHINTAPALLY	VENKATAMPET	304.00	2	1	2.6	2.6	2.6	
92300001	CHINTAPALLY	K.GOURARAM	355.00	2					
100100001	MARRIGUDA	K.B.PALLY		1					
100200001	MARRIGUDA	ANTHAMPET		1					
100300001	MARRIGUDA	SOMARAJGUDA		1					
100400001	MARRIGUDA	NAMAPURAM		1					
100500001	MARRIGUDA	LENKALAPALLY		1					
100600001	MARRIGUDA	METICHANDAPUR		1					
100700001	MARRIGUDA	VENKAPALLY		1					
100800001	MARRIGUDA	INDURTHY		1	8	2.6	3.6	4	
100900001	MARRIGUDA	D.B.PALLI		1	1	2.4	2.4	2.4	
101000001	MARRIGUDA	SARAMPET		1					
101100001	MARRIGUDA	VATTIPALLI		1	8	2.8	3.6	4	
101200001	MARRIGUDA	YERGANDLAPALLY		1	3	3	3.6	4	
101300001	MARRIGUDA	THIRGANDLAPALLY		1					
101400001	MARRIGUDA	THAMMADAPALLY		1					
101500001	MARRIGUDA	KONDUR		1					
101600001	MARRIGUDA	MARRIGUDA		1	4	2.6	3.2	4	
101700001	MARRIGUDA	BATLAPALLI		1	6	3.2	3.2	4	
110100001	GURRAMPODE	GURRAMPODE	223.00	2	1	1.8	1.8	1.8	
110200001	GURRAMPODE	CHAMALAID	220.00	2					
110400001	GURRAMPODE	VATTIKODU	255.00	2					
110600001	GURRAMPODE	KOPPOLE	208.00	2	5	2.6	2.6	4	
110900001	GURRAMPODE	AMLUR	210.00	2					
111000001	GURRAMPODE	BOLLARAM	200.00	2					
111100001	GURRAMPODE	NADIKUDA	180.00	2	1	2	2	2	
111200001	GURRAMPODE	KOTHALAPUR	188.00	2					

IRRIGATION WELLS IN PROJECT VILLAGES

ANNEX 7

NO.	MANDAL	VILLAGE	ELEV. MASL	PROJ. PHASE	FLUORIDE IDC WELLS (mg/l) NO. of WELLS	MIN.	MED.	MAX.	NO. of F <= 1.5
111300001	GURRAMPODE	MOSANGI	180.00	2					
111400001	GURRAMPODE	CHEPUR	210.00	2					
111500001	GURRAMPODE	PALLEPAHAD	222.00	2					
111600001	GURRAMPODE	KACHARAM	240.00	2					
111700001	GURRAMPODE	TANDARPALLI(JUVIGU	240.00	2					
111800001	GURRAMPODE	MYLAPUR	238.00	2					
111900001	GURRAMPODE	PARLAPALLI	258.00	2					
112000001	GURRAMPODE	JUNUTHALA		2					
112100001	GURRAMPODE	TENEPALLI	230.00	2					
112200001	GURRAMPODE	UTLAPALLY	260.00	2					
112300001	GURRAMPODE	SHAKAJIPUR	260.00	2					
112400001	GURRAMPODE	CHINTAGUDA	272.00	2					
112500001	GURRAMPODE	POCHAMPALLY	247.00	2					
112600001	GURRAMPODE	MULKAPALLI	245.00	2					
112700001	GURRAMPODE	SULTHANPUR	270.00	2					
112800001	GURRAMPODE	MAKKAPALLI	260.00	2					
112900001	GURRAMPODE	KALVAPALLI	260.00	2					
113000001	GURRAMPODE	PALVAI	280.00	2					
113100001	GURRAMPODE	GOURARAM	180.00	2					
113200001	GURRAMPODE	KONDAPUR	280.00	2					
120300001	DEVARAKONDA	K.MALLEPALLY	275.00	2	2	0.8	1.3	2	1
120600001	DEVARAKONDA	PENDLIPAKALA	248.00	2	1	2	2	2	
120700001	DEVARAKONDA	CHENNARAM	290.00	2	1	1.2	1.2	1.2	1
120800001	DEVARAKONDA	DONIYAL	244.00	2					
120900001	DEVARAKONDA	KOLMUNTHALAPAD	276.00	2					
121000001	DEVARAKONDA	SERIPALLY	290.00	2					
121100001	DEVARAKONDA	GUMMADAVELLY	271.00	2					
121200001	DEVARAKONDA	CHINTHAKUNTLA	250.00	2					
121300001	DEVARAKONDA	FAKEERPUR	250.00	2					
130100001	PEDDAVOORA	PEDDAVOORA	183.00	2					
130300001	PEDDAVOORA	POTHNUR	213.00	2					
130400001	PEDDAVOORA	PARVEDLA	220.00	2					
130500001	PEDDAVOORA	SINGARAM	205.00	2					
130600001	PEDDAVOORA	PULICHERLA	230.00	2					
130700001	PEDDAVOORA	VUTLAPALLY	218.00	2					
130800001	PEDDAVOORA	PINNAVOORA	209.00	2					
131600001	PEDDAVOORA	CHINTAPALLY	165.00	2					
140200001	P.A.PALLY	WADDIPATLA	228.00	2					
140300001	P.A.PALLY	MALLAPUR	250.00	2					
140400001	P.A.PALLY	P.A. PALLY	245.00	2	2	1.2	1.2	1.2	2
140500001	P.A.PALLY	DUGYAL	233.00	2	2	0.8	1	1.2	2
140700001	P.A.PALLY	CHILAKAMARRI	260.00	2					
140800001	P.A.PALLY	TIRUMALAGIRI	237.00	2					
140900001	P.A.PALLY	MEDARAM	239.00	2	2	1.2	1.8	2.4	1
141000001	P.A.PALLY	KESHAMANENIPALLY	239.00	2					
141100001	P.A.PALLY	GHANPUR	226.00	2					
141200001	P.A.PALLY	GUDIPALLY	235.00	2					
141300001	P.A.PALLY	G.BHEEMANAPALLY	240.00	2					
141500001	P.A.PALLY	POLKAMPALLY	235.00	2					
141501001	P.A.PALLY	G.NEMLIPUR	215.00	2					
141600001	P.A.PALLY	C.A.PALLY	271.00	2					
150100001	ANUMALA	YACHARAM	190.00	2					
150200001	ANUMALA	VENKATADRIPALEM	185.00	2					

IRRIGATION WELLS IN PROJECT VILLAGES

ANNEX 7

NO.	MANDAL	VILLAGE	ELEV. MASL	PROJ. PHASE	FLUORIDE IDC WELLS (mg/l) NO. of WELLS	MIN.	MED.	MAX.	NO. of F <= 1.5
150400001	ANUMALA	MUKKAMALA	178.00	2					
150500001	ANUMALA	MAREPALLI	185.00	2					
150600001	ANUMALA	KESALAMARRI	186.00	2					
150700001	ANUMALA	ALWAL		2					
160200001	CHOUTUPPAL	CHOUTUPPAL	358.91	1					
160300001	CHOUTUPPAL	LAKKARAM	374.03	1					
160400001	CHOUTUPPAL	TANGADAPALLY	366.61	1	5	2	2.4	2.6	
160500001	CHOUTUPPAL	LINGOJIGUDEM	340.49	1					
160600001	CHOUTUPPAL	PANTHANGI	332.28	1	2	1.8	2.5	3.2	
160800001	CHOUTUPPAL	TALASINGARAM	353.52	1					

APPENDIX 6

Legend of thematic maps

6.1 Geology and structure
6.2 Soils
6.3 Landuse - land cover
6.4 Hydrogeomorphology

1. GEOLOGY AND STRUCTURE

Geology and Structure mapping was carried out to delineate various lithological boundaries and structural features based on colour, tone, texture, pattern, shape, size, etc., using satellite images (Landsat TM and IRS-1A). The boundaries of various rock units were demarcated on 1:100,000 scale and presented in Plate-2, Map Volume.

The topographic information such as elevation and drainage from Survey of India toposheets along with other collateral information available was utilized for drawing inferences.

GENERAL GEOLOGY

The rock units in the study area have been grouped by earlier workers, under the precambrian granite complex. The predominant rock types are biotite rich gray granites, porphyritic granites and granite gneisses. Migmatitic rocks are also found which usually enclose biotite rich Xenoliths with considerable effects of interaction in the marginal zones. Dolerite dikes extending in length to as much as 30 to 40 km cut across the rocks which shows a NNW-SSE foliation. Veins of Quartz are also present. Along Prominent major fissures in the granites the dolerites have been emplaced. The vertical joints in the granites are also aligned parallel or sub-parallel to these directions.

The southern portion of the study area is a plateau terrain. It is covered by rocks representing marine sediments deposited in a shallow sea between 1,100 to 600 m/y age. The hard quartzites being resistant to weathering, form the plateau tops.

The following is the geological succession.

FORMATION	AGE
Alluvium Kankar (Lime concretions covered by black soils)	Quaternary
Quartz reef Dolerite dike Quartzite Granites (massive, porphyritic, pink and gray variety) Meta basalt (Schist)	Precambrian
Peninsular gneissic complex Biotite gneiss Biotite schist	Archaean

DESCRIPTION OF THE ROCK UNITS

Archaeans
Gray migmatitic gneisses and gray granitic gneisses are the predominant rock types in the area in which the inclusions of older schists and rarely granulites occur. These were later intruded by the pink granites, followed by injections of quartz. Dolerites mark the last period of igneous activity in the area and they cut across all the above rocks.

Among the older rocks that occur as inclusions in the migmatitic gneisses, biotite-schists and less frequently horn-blend schists are noticed at places.

Biotite schists

The inclusions of biotite schists are seen in the gray migmatitic gneisses can be described as streaks, schlirens, bands, lenses etc. The rock is fine grained with the biotite flakes aligned parallel to the gneissosity of the enclosing rocks. The arrangement represent the original schistosity of the rocks which have served as channels for the later granitic injections.

Typical exposures of the biotite schist inclusions are noticed ENE of Gurrampod and west of Gurrampod, etc. In hand specimen the rock is seen to consist of fine flaky biotite, quartz, feldspar, magnatite, etc.

Peninsular gneissic complex

Gray gneisses occupy the major part of the area and occur as sheet like exposures or as gentle dome like hills in flat country. In outcrop they look quite fresh, except for the surface stains due to weathering. Wide lithological and structural variations are noticeable in the vast area examined. They correspond to granite or granodiorite in overall composition depending on the composition of the rock migmatised and the degree of assimilation achieved in the process by granitic injections. The rocks are medium to coarse grained, gneissic or porphyritic in texture.

Meta basalt

The low grade schists or green schists comprise quartz-schist, chlorite-schist and meta basalt. They are unaltered where they are in contact with migmatite and are devoid of pegmatite intrusions. The green schist assemblage is younger than the high grade assemblage.

Pink granites and pink migmatitic gneisses

In contrast to the gray gneisses, the pink granites constitute high rugged hills with bouldery outcrops and they form the major N-S trending hill ranges. They also occur as isolated rounded hillocks in the plains formed by the gray gneisses. Occurrence of narrow bands and veins of regular or irregular nature and of variable dimensions, often with cross cutting relations of the pink granites in the migmatitic gneisses, clearly suggest their emplacement across foliations in the later. Extreme textural variations are observable in the pink granites. The characteristic pink colour is due to the pink or flesh coloured feldspar which forms its dominant constituent. In hand specimen, a typical pink granite is medium grained, and is composed of potash and plagioclase feldspar, biotite, quartz and opaques.

Quartzites

Quartzites are occupying southern parts of the study area and are underlined by the shales and lime stones. Basing on their sharp boundaries (escarpment) and plateau type nature, these formations are separated from peninsular gneissic complex. It comprises white or brownish massive / platy quartzite.

Quartz veins

Quartz veins are frequently seen along N-S direction and traversing all the rocks described above. But few are demarcated. In hand specimen the rock is pure white and transparent big crystals are also observed. Three sets of joints are noticed.

Dolerites
Dolerites, normally dark gray and black in appearance bouldery of massive and well jointed occur as dikes emplaced along major N-S, E-W and WNW-ESE fractures and cut across all the rocks in the area. They range upto 30 to 40 km long and at places more than 100 m in width. A hand specimen of dolerite showed an assemblage of augite, amphiboles, plagioclase and magnatite.

Kankar (Limes concretions covered by black soils)
Basing on colour, tone, pattern, shape, texture etc., of the satellite imagery the areas with thick kankar/Lime concretions with black soils cover are separated. In the present study area these kankar deposits are associated with black soils and alkaline soils. It is formed by the deposition of calcium carbonate into nodular masses around some nuclei. The extent of kankar formation is extensive and got eroded at places where white reflectance is obtained.

Alluvium
River alluvial deposits are mapped along the major rivers such as Kongal, Haldia and Pedda Vagu rivers. Detrital material transported by the rivers, commonly composed of sands and gravels.

2. SOILS

The soil map of the study area has been prepared using satellite images through visual interpretation, field survey and profile information on 1:100,000 scale.

Initially, the boundaries of landforms were delineated and the soil characteristics of the each representative land forms of the area have been studied in the field.

The relationship between physiography and soils has been widely recognized as the factors involved in geomorphic processes correspond close to that of soil formation.

The study area has been divided primarily into three landscapes based on geology / geomorphology viz., granite gneisses landscape, buried pediplains and valley lands. The remaining problem areas due to excess salts and erosion severities were recognized. Each landscape has been further sub-divided into different mapping units based on physiography, slope, severity of problems due to excess salts and present soil erosion. Various site and soil parameters were taken into consideration for placing the different mapping units into different land capability classes, and sub-classes. The parameters taken into consideration are present erosion, slope, drainage, soil depth, soil texture, rockiness, stoniness, calcareousness and risk of overflow.

The different soil mapping units are recognized from the satellite data visual analysis in conjunction with the other data are described below. The soil map of the study area is presented in Plate-4, Map Volume.

G: LANDSCAPES ON GRANITE AND GRANITIC GNEISS

G1: STEEP HILLS

These are mainly distributed in west and north west of the study area. These are low hills of granites with steep to very steep slopes. Sub-strata exposed exfoliation domes, tors and bornhards. These are severely eroded and pockets of shallow gravelly soils encountered here and there which supports sparse vegetation. This unit goes to class VIII s according to land capability.

G2: MODERATELY STEEP HILL (Lithic Ustorthents)

They are distributed in west and southern parts of the study area. These are moderately steep to steep hills. The soils are yellowish red in colour and very shallow to shallow gravelly loamy sands and are excessively drained and skeletal in nature. Moderate to severe erosion is being seen in this unit. The land capability class and sub-class are VII se.

G3: RESIDUAL HILL (Lithic Ustorthents)

These are scatterely distributed in the study area and are residual hills, rocky pediments and rockout crops with reddish brown, shallow gravelly loamy sands and well drained. Severe erosion has been observed in this unit. These are classified into VI se land capability class.

D: DIKE

This unit is elongated bare rocky ridges of dolerite which could be identified by their very dark tone, high relief and its linearity. These are steep sloping ridges covered by very huge rocks and boulders. Very shallow to shallow reddish brown soils are found along the foot slopes. However, little or no soil cover has been observed in the crest. These are well drained to excessively drained. This unit is classified into VIII s according to the land capability classification.

G4: FOOT SLOPES (Lithic / Typic Ustochrepts)

This unit is gently to moderately sloping foot hills. The soils are moderately deep to deep reddish brown gravelly loamy sands in the surface and sandy clay loam in sub-surface. Coarse rock fragments occupy most on the surface of these lands. These are well drained. Moderately to severe erosion is seen in the areas. The land capability of this unit comes under IV se class.

G51: UPPER PEDIPLAIN (Typic Haplustalfs / Ustochrepts)

This is the most extensive covered unit of the study area. It borders with foot hills at the upper end and valleys in the lower end. These are associated with the shallow weathered pediplains. These are gently sloping upper pediplains with occasionally rockout crops in the crests.

The soils are deep to very deep and light reddish brown with texture ranging from gravelly sandy loam at surface to sand clay loam in sub-surface. It has been observed that the lower parts of this unit, texture ranges from loamy sands in the surface to sandy clay loam in sub-surface. They are well drained. This unit is classified into class III es land capability.

G52: MIDDLE PEDIPLAIN (Typic Haplustalfs)

They are gently to very gently sloping middle pediplains. The soils are deep to very deep, dark reddish brown, sandy clay loam to clay loam. These are well drained. Slight erosion has been seen in this unit. This unit is recognized in the tank command and weathered pediplain areas. These are mostly cultivated areas. Land capability of this unit is III s.

BURIED PEDIPLAIN (B)

Black soil occurrence is found in these landforms. These are occurrence wise nearer to th relief areas in the valley bottoms whereas at the upper reaches in the pediplains. This has been subdivided into three mapping units on the basis of thickness of black soil cover and its physiographic position. This unit is distinguished on image by its darkness.

B1: SHALLOW BURIED PEDIPLAIN (Vertic Ustochrepts)

They are found in gently to very gently sloping buried pediplain near foot hills and fringes of valleys. They are deep to very deep with dark greyish brown at surface and reddish brown at sub-surface. Coarse loamy sand at surface and sandy clay loam at sub-surface and are well drained slight erosion has been noticed in them. Lime nodules are observed in the sub-surface. The land capability of this unit is III se.

B2: MODERATELY BURIED PEDIPLAIN (Vertic / Udic Ustochrepts)

This unit is distinguished from the other units of the fringe by its lighter tone. They are very gently sloping buried pediplain with very deep and light gray to gray coloured clay loam to clay soils. These are moderately well drained and are with slight erosion. Lime nodules are found in the subsoils. The land capability class of this soils comes under II s.

B3: NEARLY LEVEL MODERATELY BURIED PEDIPLAIN (Vertic Ustochrepts)

They are nearly levelled buried pediplains. These soils are very deep and colour ranges from gray to dark gray, with clay texture. These are moderately well drained. Lime nodules are found in the sub soil. Lands are classified as land capability II sw.

P: VALLEY FILLS (Fluventic Ustochrepts)

They are narrow elongated and curvilinear units occurring along the valley bottoms of the pediplains. The soils are very deep, gray to dark gray colours and are sandy clay to clay loam. They are nearly level lands with nil to slight erosion. levelling and land shaping operations have been carried out to bring the lands under irrigation, mostly for paddy cultivation. This unit is being classified to II w according to the land capability.

SALINE / ALKALINE SOILS

The association of salt affected (saline and alkaline) and eroded soils were demarcated on the basis of tonal variation and their locations. It has been observed that four types of salt affected soils are occurring in the study area. The parameters like the areal extent of salt encrustation, parcelling pattern, tone and land use were taken into consideration for further sub-division of this group into various mapping units as described below.

A: SEVERELY SALT AFFECTED AREAS

These soils are severely salt affected barren areas identified along the borders of black soils (B1 and B2 mapping units). Salt encrustation with calcarious kankar has been notices on the surface. This unit is seen on imagery as very light (white) and light gray tones along the fringes of black soils. The very light tone (white) areas are dominant compared to gray tones which indicates the severity of the salt concentration.

These lands are having a thick layer of salts and calcarious nodules on the surface at the margins of black soils. These are mostly uncultivated areas. These soils are having low permeability and poor physical conditions. These are moderately well drained. This unit goes into land capability class VII s.

A1: SEVERELY SALT AFFECTED AREAS (Low Lands)

This unit has been observed all along the stream courses, tank command and foreshore areas. These are covered with thin layer of salts accumulation at the surface. This unit is seen on imagery as light tones with parcelling patterns. Encrustation of salts cover about more than 35% area on the surface. This unit is also seen in recently dried up irrigation tanks. The soils are of low permeability and poor physical conditions. The important observation is that the severe salt affectedness is confined to the narrow elongated stream rather than broad flood plains.

M: MODERATELY SALT AFFECTED AREAS

Moderately salt affected areas are found along the stream courses. This unit is being delineated from the imagery on the basis of white and mixed gray tones while bright white patches are also often seen in this unit. The salt encrustation covers about 5-35% of the area. Sparse scrub vegetation and partly cultivated areas are observed in the units.

S: SLIGHTLY SALT AFFECTED AREAS

These areas are slightly salt affected. These will be seen on the imagery as reddish brown mottling and dull white patterns along the stream courses. Little quantities of salts are seen in pockets in this unit. These are moderately well drained.

ERODED AREAS

The problem of erosion has been found in the piedmont zone. Based on the intensity of land dissection by ephemeral streams. The following two types of erosion is dominantly seen in the study area.

E1: SEVERELY ERODED AREAS

Soil erosion severity is seen by the development of deep cuts at the foot slopes and upper crests of shallow weathered pediplains. This erosion is expressed by way of light yellow tone in patches on the image. The unit comes under the land capability class VII e.

E2: MODERATELY ERODED AREAS

This type of erosion has been seen as a sheet wash and rill erosion in zones of foot hills and rocky pediment areas including the crests and fringes of shallow weathered pediplains. These areas are covered with sparse scrub vegetation. These can be seen as reddish yellow patches on the images. The land capability class of this unit is VI e.

3. LAND USE / LAND COVER

Land use / land cover mapping of the study area was carried out on 1:100,000 scale by visual interpretation techniques using PROCOM-II equipment. Different land use / land cover classes, based on image characteristics like tone, size, shape, pattern, texture and location, association, etc., were identified and mapped. Ancillary data like Survey of India topographical maps on 1:50,000 scale were utilised. These are reduced to 1:100,000 scale to prepare a Base map of the study area. The area under study is classified into ten (10) land use / land cover classes (Plate-5, Map Volume). The details of each class is given below.

LAND USE / LAND COVER CATEGORIES

The major land use / land cover categories that are identified in the study area are built-up land, agricultural land, forest, waste lands and water bodies.

Built-up land
Major settlements like Choutuppal, Narayanapur, Davarakonda are delineated. Some bigger villages are identified but could not be mapped due to scale limitations.

Crop land of Kharif season
The satellite imagery pertaining to October 1989, has been selected to identify the crop land under Kharif season. The crop cover is seen in full vigour as most of the area is rainfed. In this season crops like paddy, bajra, jowar, sugarcane, redgram and groundnut are grown.

Double cropped area
As evident from the multi-date data most of the double cropped area is seen under tank command areas and wells and a small part is seen under canal area. The cropping intensity is high in north-western and north-eastern parts of the study area.

Fallow land
Fallow land includes the land that is uncropped in both the seasons. An analysis of the two season data has revealed that the area under this category is limited in extent.

Degraded forest or scrub land
This category is confined mostly in the notified forest areas. This type has been much influenced by biotic factors resulting in irregular open patches and thorny scrub species. Most of the notified forest areas are devoid of forest cover, hence showing barren rocky exposures as seen near Krishtampalli area.

Salt affected land
This category of land is mostly confined near stream courses, tanks and are mostly associated with irrigated agricultural lands.

Land with or without scrub
This type is mostly confined to the foot hills and upland areas of the study area. These lands are supporting grasses and scrubs.

Barren rocky / stony waste / sheet rock area
These are found extensively in the study area. These are located in the western, north-western and southern parts of the study area.

River / stream
The area is drained by the river Krishna, Musi, Haldia, Konagal.

Lake / tank / canal
A good number of tanks cover the area where most of the double cropped areas are concentrated.

OBSERVATIONS

Based on the analysis of multi-data with limited field checks and supported by other ancillary information, the following observations were made about the study area.

A large part of the study area is under Kharif unirrigated. The important crops grown during Kharif season are paddy, jowar, bajra, sugarcane and pulses. Non-food crops like groundnut and castor are also grown extensively.

Paddy is grown as a second crop during Rabi season where assured irrigation is available through tanks, wells and canals. Most of the double crops are seen along the valley floors, Fallow land have been observed in many parts of the study area. The cropping intensity is high in the area because of extensive development of groundwater resources in certain parts.

The entire forest area in the study area is in degraded condition showing thorny scrub species and barren rocky exposures.

4. HYDROGEOMORPHOLOGY

The approach adopted is Remote Sensing based Hydrogeomorphological mapping to identify various land forms and their groundwater prospects for tapping groundwater with less fluoride content. Initially Landsat (TM); IRS-IA data of the study areas was interpreted on 1:100,000 scale to derive geomorphological information. The geologic structure and tectonic phenomenon that has caused development of secondary porosity was also identified. The details derived from Remote Sensing data has been coupled with elevation and drainage information from the Survey of India toposheets to delineate potential zones for groundwater development which were further verified in the field.

1. Preliminary interpretation was carried out on 1:100,000 scale covering the study area using Landsat TM 143-48 of 13 October 1989; IRS 25-56-L2A2, L2B2 dated 17 March 1991 and 23 February 1991; and hydrogeomorphological map was prepared using Procom - II and Large Format Optical Enlarger.

2. Hydrogeomorphology map was verified with limited field checks.

3. Field information has been incorporated and final hydrogeomorphological map was prepared.

4. Groundwater potential zones were delineated from hydrogeomorphology, structural information and from the field inventory data.

GEOMORPHOLOGY AND GROUNDWATER PROSPECTS

The study area can be divided into the 18 Geomorphic units based on landform, genesis, lithology, soils etc., and are presented in Plate-6, Map Volume.

Flood plain
It is a flat surface adjacent to a stream / river composed of unconsolidated fluvial sediments (alluvium) like gravel sand and silt. This unit is seen along Kongal river near Kongal village. Groundwater prospects in this flood plain area are good to very good. The yield ranges from 2 to 3.5 l/s.

Valley fill
It is an unconsolidated sediment (cobbles pebbles, sand and silt) deposited by stream / river normally in a narrow fluvial valley. The valleys are mostly controlled by fractures which are in NNW-SSE, NE-SW directions.

Moderate to good yields are expected depending upon the thickness of the fill. The yields ranges from 2 to 3 l/s.

Cuesta
The unit is characterized by a flat topped hill of precambrian quartzites with steep slopes on one side and gentle slopes on the other side. They are found at the SE part of the study area near Nagarjuna Sagar reservoir. The groundwater prospects are poor in this unit.

Mesa / butte
This is a flat topped hill of precambrian quartzites with gentle slope at the base and steep slope at the top. A single unit is observed at southern boundary of the study area near Pedda Vagu. The groundwater prospects are poor in this unit.

Moderately weathered / buried pediplain (Sch)
This is a flat and smooth surface of weathered pediplain of schist with 5-15 m thick over burden/weathered material covered with black soils.

Moderate to good yields are expected along fracture/lineament. The yields ranges from 2 to 3 l/s.

Shallow weathered / buried pediplain (Sch)
This is a flat and smooth surface of weathered pediplain of schist with 0-5 m thick overburden/ weathered material covered with black soil. These units are found along the schist belt.

Groundwater prospects are poor to moderate. Moderate yields are expected along fracture/ lineament. The yields ranges from 1 to 2 l/s.

Structural hill (Sch)
This is a linear to accurate hill of schist with definite trend. It is found NW of Peddavura and Gonipally village. Its strike direction is NW, SE. Groundwater prospects in a structural hill are poor.

Moderately weathered / buried pediplain
This is a flat and smooth surface of weathered pediplain with 5-15 m thick overburden/ weathered material of Archaean gneissic complex, generally covered with black soils. These pockets are spread all over the area, predominantly near Munugod and Gujja.

Groundwater prospects are moderate to good. Good yields are expected along fracture/ lineament. The yield ranges from 2 to 3 l/s.

Moderately weathered pediplain
It is a flat and smooth surface of weathered pediplain with 5-15 m thick weathered material of Archaean gneissic complex, generally covered with red soils. Fractures are found in different directions, NW-SE, NNE-SSW, NE-SW, WWN-ESE. Among these, NW-SE direction form about 26% of the total fractures.

Groundwater prospects are moderate to good. Very good yields are expected along fracture/ lineament. Yields ranges from 2 to 3 l/s.

Moderately weathered pediplain with alkaline soils
Flat and smooth surface of weathered pediplain with 5-15 m thick weathered Archaean gneissic complex, generally covered with alkaline soils.

Groundwater prospects are moderate to good. Moderate yields are expected along fracture/ lineament. Yield ranges from 2 to 3 l/s. Generally, quality of water is not suitable for drinking and irrigation purposes.

Shallow weathered / buried pediplain
This is a flat and smooth surface of weathered pediplain of Archaean gneissic complex with 0-5 m thick weathered material covered with black soil.

Groundwater prospects are poor to moderate. Moderate yields are expected along fracture/ lineament. Yields ranges from 1 to 2 l/s.

Shallow weathered pediplain
This is a flat and smooth surface of weathered pediplain with 0-5 m thick weathered material covered with red soils.

Groundwater prospects are poor to moderate. Moderate yields are expected along fracture/ lineament. Yields ranges from 1 to 2 l/s.

Shallow weathered pediplain alkaline
This is a flat and smooth surface of weathered pediplain with 0-5 m thick weathered material covered with alkaline soils.

Poor to moderate yields can be expected. Moderate yields are expected along fracture/ lineament. Yields ranges from 1 to 2 l/s. Normally, the water is not suitable for drinking and irrigation purposes.

Pediment inselberg complex
This is an isolated low relief hill surrounded by gently sloping smooth erosional bedrock with veneer of detritus. Groundwater prospects are poor.

Pediment
This is a gently sloping smooth surface of erosional bedrock between hill and plain with veneer of detritus. Groundwater prospects are negligible to poor. Poor yields are expected along fracture/lineament.

Tor complex
Group of spheroidally weathered boulders rooted in bedrock which are exposed as sheet rock surface. Groundwater prospects are poor.

Residual hill
This is an isolated hill occupying considerable small area. Groundwater prospects are poor.

Denudational hill
This is formed due to differential erosion and weathering so that a more resistant formation or intrusion stand as hill occupying large areas. Groundwater prospects are poor.

APPENDIX 7

Field observations

7.1 Field fluoride measurement
7.2 APSRAC data
7.3 Geophysical survey
7.4 Water quality data

GOVERNMENT OF INDIA

CENTRAL GROUND WATER BOARD

MINISTRY OF WATER RESOURCES

Preliminary Geophysical Surveys for Ground Water in Nalgonda District, Andhra Pradesh

By

A. N. BHOWMICK
K.V. KUMAR
S. N. TATA
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SOUTHERN REGION
HYDERABAD
APRIL, 1992

PRELIMINARY GEOPHYSICAL SURVEY FOR GROUND WATER INVESTIGATION IN NALGONDA DISTRICT, ANDHRA PRADESH.

Nalgonda district, falling in the granitic terrain of the State of Andhra Pradesh, India, faces serious water scarcity for domestic as well as irrigation need. The **ground water** is thought a viable means of water supply in the district but, in hard rocks, its occurrence is highly complex. Information on subsurface lithology including extent of fracturing in rocks is essential for the selection of suitable sites of ground water structures. Further, fluoride concentration in ground water causes serious health hazard in the district.

Under the Indo - Dutch bilateral agreement for providing safe drinking water in 226 villages including 337 hamlets in the district with the aid from Netherlands Government, application of geophysical techniques was thought an essential component of ground water investigation for the purpose envisaged. The Central Ground Water Board, Ministry of Water Resources, Government of India, is well equipped in this regard and was approached to arrange a preliminary geophysical survey by the Panchayat Raj Department, Government of Andhra Pradesh which in turn is entrusted with the responsibility of organizing the ground water investigation in the district under the bilateral agreement as enumerated above,

To test the efficacy of different geophysical techniques in a limited time schedule for deciding the future wide application, preliminary geophysical surveys were organized between 1 and 8 April,1992. along few selected profiles. The techniques employed were **Shallow Refraction Seismic, Electrical Resistivity and VLF EM.** The equipments used were VLF EM equipment of BRGM, France; Terrameter of ABEM, Sweden and Facsimile Seismograph of Huntec, Canada. The field data were analyzed by available software with the Board in Laptop Toshiba 1600 Computer.The profiles were chosen in consultation with the visiting Dutch Expert,Mr. J. Van der Sommen of IWACO, The Netherlands. The results of the geophysical survey are described below

2.Objective

The objective of the geophysical survey was two fold, viz, detecting fractures in rocks favourable for ground water occurrence,and study whether the associated c 'micals with fluoride concentration have a bearing or influence over the electrical resistivity value.

3. Geophysical Methods

The refraction Seismic, Electrical Resistivity and VLF EM methods were used for this purpose. The refraction seismic technique was used to find out the compressional wave velocity through different subsurface layers which is a diagnostic property to differentiate fractured rock from fresh rock. The medium with P wave velocity of over 4000 m/sec indicates fresh rock where as velocity of the order of 2000-3000 m/sec indicates presence of fractured rock system. The VLF EM profile was conducted across possible lineament to ascertain its subsurface disposition. Electrical resistivity soundings were very useful in finding out the relative variation of fracturing in rocks, fractured rock indicating conspicuously low resistivity value with respect to fresh rock. The electrical resistivity value for fractured rock varied generally from 200 to 500 ohm m. where as fresh rock resistivity exceeded 1000 ohm m. value.

Regarding fluoride concentration in ground water, it was observed from chemical analysis of well water samples that the electrical conductivity value does not bear a definite relationship with fluoride concentration. Therefore it looked difficult to form an idea of fluoride concentration in ground water based on electrical resistivity measurements.

4 Location

The location of the geophysical survey profiles,including locations of electrical resistivity and refraction seismic sounding points and VLF profiles has been shown in Plates I to IV. All the electrical resistivity sounding curves with interpreted results and refraction seismic sections are appended with the report.

5 Discussion of the Results

Based on field measurements, following ranges of seismic wave velocity and electrical resistivity values have been estimated for different litho units:

Lithology	Electrical Resistivity Value (Ohm m.)	Compressional Wave Velocity (m/sec)
Top weathered layer	Less than 50	Less than 500
Fractured Rock	100-500	1000-3000
Compact(Fresh) Rock	Greater than 1000	Greater than 4000

i) <u>Profile AA'(Between Koppol and Gurrampodu)</u>

Schlumberger electrical resistivity sounding was conducted at three locations (Resistivity sounding points NLG-1,2 & 3).

Refraction seismic survey however could not be conducted here to supplement the resistivity data. An idea can be formed from these three sounding points' data. The fractured rock thickness increases appreciably while moving from Koppol towards Gurampodu (from 2 m to 20 m). It may be observed that Schlumbeger VES curves clearly indicated the subsurface existance of highly fractured rock.

The VLF response of In-phase and Quadrature components along the profile AA',of 4.2 km length, and interpreted resistivity sounding results of NLG-1,2 & 3 have been shown in Plate V. Except some minor cross-overs, the VLF response did not indicate any significant feature. It is believed to be mostly due to poor response of the VLF field,the orientation of major fractures may not be favourable to polarize the VLF field effectively. Another reason may be the time of measurement(day time from 09=00 Hrs to 16=00 Hrs. during April with ground atmospheric temperature exceeding 40 deg. Celcius)when the VLF response is likely to be affected by extraneous noises. Probably the VLF response may improve markedly during winter time when the measurments may indicate some prominent features.

ii) <u>Profile BB'(Road joining Potunur & State Highway)</u>

VLF profile along BB' of 1.1 km length showed a prominent feature of higher response at locations where the hard rock exists at shallow depth(VLF profile station from 450 to 650).This observation is supported by refraction seismic and resistivity VES data.Sudden change in VLF response from this location may indicate existence of a prominent discontinuity. Topographically, the side B of the profile BB'is on higher ground compared to B'.

In Plate VI is presented VLF response and the subsurface lithologic section, based on resistivity and seismic measurements.(NLG-4,5,6,7 and 8) It may be observed here that also on higher ground side(towards side B in BB' profile) there is existence of significant thickness of fractured rock, exceeding 10 m. There is a divide near VLF station No. 600 where the fresh rock exists almost at the ground surface.

iii) <u>Profile CC'(Road joining Singawaram & State Highway)</u>

Along this profile the VLF response is relatively prominent from C upto VLF station 500 after which the response is low. This feature , as earlier, signifies the presence of fresh rock at shallower level from C to VLF station 500 compared to that beyond this station upto C'.

Both seismic refraction and resistivity measurements (NLG 9 and 10 and an additional seismic point in between) indicated a gradual slope of fractured/fresh rock interface from VLF station 500 towards village Singawaram in confirmity with VLF measurements, the thicknes of fractured rock varying from 10 m to higher values which could not be estimated due to limited current electrode separation. This is shown in Plate VII.

iv) Profile DD'(Between Motabayegudem & Ramulabanda)

The VLF response monotonously varies and does not show presence of any discontinuity. Some of the prominent responses are due to the power line presence across the profile. Refraction seismic survey could not be conducted here . The electrical resistivity VES measurements (NLG 11, 12 and 13)indicated the thickness of fractured rock layer along this profile to be about 20 m (Plate VIII).

V) Profile EE'(Between Appajipet & Budharam) And A Small Parallel Profile FF' North of it.

The VLF profile has been chosen here across a dyke where the VLF cross overs are indicated. The fractured rock thickness along this profile varies between 10 m and 30 m ,the maximum occuring at the centre of the profile as observed from resistivity VES measurements(NLG 14, 15 and 16). This is shown in Plate IX.

VI) Electrical Resistivity Measurements at 3 Locations Near Village Wachatanda

To have an idea regarding thickness of colluvium in the above locations, electrical resistivity soundings were organized(NLG 17, 18 and 19) . Several layers have been found to occur above the high resistivity sub stratum (fresh rock). However the resistivity values for all these layers above the fresh rock were found to vary mostly between 15 and 40 ohm m. and this low resistivity value is indicative of the presence of saturated and unconsolidated layer rather than fractured rock system. These layers may be indicative of colluvium.

6.Conclusion And Recommendation

The VLF measurements at 6 selected profiles and electrical resistivity soundings and refraction seismic observations at 19 locations have proved that the subsurface features like extent of fracturing in hard rocks can very well be deciphered. The VLF responses have mostly been poor but this may be a seasonal effect and it is expected that the response will significantly improve if measurements are conducted during winter months. Albeit the electrical resistivity measurements indicated the presence of fractured rock system, the thickness estimation many a times was well off the mark, the problem of equivalence in hard rocks adversely affects the results of interpretation.For this purpose the refraction seismic results were combinely taken into account to arrive at a correct depth/thickness estimation. It is seen that in the district mostly the thickness of the fractured rock, wherever present, varied between 10 and 25 m.

The results of present geophysical investigation opens up the possibility of its wide scale appliication in the district which is essential primarily for the selection of suitable sites for drilling of tube/bore wells. The electrical resistivity survey alone may not be sufficient for the reason that the thickness/depth estimation of different subsurface layers may not be correct and refraction seismic measurements may also be essential for this reason. However the shallow refraction seismic will serve the purpose quite well, the survey is speedier than the electrical resistivity survey and the cost of survey is also relatively less except the equipment which may be relatively expensive.

Since Nalgonda district is dyke infested, It may be essential to concentrate the geophysical investigation more near the locations where dykes are exposed. As a barrier to the flow of ground water, these dykes may act as very favourable locations of potential ground water aquifers provided the sites are located at the proper side of the dyke. This would demand geophysical measurements in a closed grid on either side of dykes. Organizing VES in different directions,employing techniques like differential resistivity sounding, Misse-la-Masse, coverage of both up dip and down dip refraction seismic measurements may also be necessary.

The equipments which may be essential for this purpose may be SAS 300 Terrameter with 2000 booster of ABEM, Sweden or R40 Resistivity system of Scintrex, Canada; the Hammer shallow seismograph of either EGG, Geometrix, Scintrex or any of such sensitive equipments and, of course, the VLF EMR equipments of either BRGM, France or Geonics,

A nice computing system like portable laptop Toshiba T1600 computer with portable printer type Parallel Kodak 150 plus, used in processing present field data, may also be necessary.The one available with the Central Ground Water Board may not be used exclusively for the future survey in Nalgonda district, procurement of such a system may be necessary.

It is also known that some superior equipments,software facilities etc. are available in Netherlands. Thus, in anticipation of wide scale application of geophysical survey in Nalgonda district, , fellowships to the geophysicists of the Board, in visiting Netherlands may be necessary for a better processing of field data.

Acknowledgements

The authors place on record their sincere thanks to the Chairman, Central Ground Water Board, for providing the opportunity to conduct the present geophysical survey. The facilities provided by the Scientist D(D), Central Ground Water Board, Southern Region, Hyderabad, for smooth field operation are also highly acknowledged.

(* Appended are 19 Nos. of Schlumberger VES curves and 10 Nos. of refraction seismic sections with computer interpreted results.)

VIMTA LABS PVT. LTD.

Regd. Office & Branch : B-302, MAY FAIR, 1-8-303/34, Sardar Patel Road, Secunderabad-500 003.
☎ 843399 Telex : 425-6841 TEST IN
Main Laboratory : 2-2-18/46, Deshmukh Colony, Bagh Amberpet, Hyderabad-500 013.
☎ 864229

nidamanur

TEST CERTIFICATE

Issued to : NIDAMANUR

SUPERINTENDING ENGINEER
P.R., NAP CIRCLE
12 TH FLOOR, GAGAN VIHAR
NAMPALLY, HYDERABAD

No. : VLL/92/HW-5641

Date : 1992-02-17

Your ref : AE/NAP/AP-III/358/92

Date : 1992-02-11

Sample Particulars : WATER-SAMPLE

Qty: 1 No IN PLASTIC BOTTLE
Tests reqd: COMPLETE ANALYSIS AS PER IS-10500

TEST RESULTS

1.	Colour	: <5 HU
2.	Odour	: Odourless
3.	Taste	: Agreeable
4.	Turbidity	: 5 NTU
5.	pH	: 8.1
	The following parameters are expressed in mg/l	
6.	Total Dissolved Solids	: 430
7.	Total Hardness as $CaCO_3$	: 156
8.	Calcium	: 38
9.	Magnesium	: 15
10.	Total Alkalinity as $CaCO_3$	: 220
11.	Phenolphthalein Alkalinity	: 15
12.	Methyl Orange Alkalinity	: 205
13.	Chlorides as Cl	: 36
14.	Sulphates as SO_4	: nil
15.	Nitrates as NO_3	: 1.6
16.	Fluorides	: 0.8
17.	Cyanide as CN	: Nil
18.	Phenolic Compounds	: <0.005
19.	Mineral Oil	: Nil
20.	Residual Free Chlorine	: Nil
21.	Pesticidal Residue	: <2 ng/l
22.	Polynuclear Aromatic Hydrocarbons	: Nil
23.	Copper as Cu	: 0.03
24.	Iron as Fe	: 0.04
25.	Manganese as Mn	: 0.09
26.	Mercury as Hg	: <0.001
27.	Cadmium as Cd	: <0.006
28.	Selenium as Se	: <0.005
29.	Arsenic as As	: <0.005
30.	Lead as Pb	: <0.030
31.	Zinc as Zn	: <0.005

ANALYST AUTHORISED SIGNATORY

NOTE : 1. Sample(s) not drawn by us, unless otherwise stated.
2. The results listed refer only to the tested samples and applicable parameters. Endorsement of products is neither inferred nor implied.
3. Perishable samples will be destroyed after testing, others after one month from the date of issue of Test Certificates.

Laboratory Accredited
by National Co-ordination
of Testing and Calibration
Facilities, Dept. of Science &
Technology, Government of India,
in the fields of:
Chemical and Mechanical testing.

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Office : 1-8-303/34, "MAYFAIR", Sardar Patel Road,
P.B. No. 2045, Secunderabad-500 003.
Phone: 843399, 843388
Laboratory : Plots No. 141/2, 142, IDA, Phase II,
Cherlapally, Rangareddy Dt., Hyderabad-500 762.
Phone: 853657 Grams: VIMTA

TEST CERTIFICATE

Issued to :

SUPERINTENDING ENGINEER
P.R., NAP CIRCLE
12 TH FLOOR, GAGAN VIHAR
NAMPALLY, HYDERABAD
~~ATTN: Mr.G.Narayana Reddy,B.E.~~

No. : VLL/92/HW-5758

Date : 1992 03 09

Your ref : AE/NAP/AP-III/358/92

Date : 1991 02 24

Sample Particulars :

WATER SAMPLES

Qty: 8 No IN PLASTIC BOTTLE CODED 1 TO 8
Tests reqd: ANALYSIS OF PESTICIDES ONLY

TEST RESULTS

The samples provided for analysis were as follows:

1. Sivanna guda Near Temple
2. Munugode Narayanpur Road H.No 97
3. Sivanna guda Bus stand
4. Sivanna Guda Bantuwada
5. Munugode Bore DF Plant
6. Munugode Junction
7. Sivanna Guda Village Begin
8. Munugode PR SD Office

The levels of pesticides in all the above samples were below detectable limits of 1 ng/litre (1 ng= 10^{-9} g)

ANALYST

AUTHORISED SIGNATORY

NOTE
1. Sample(s) not drawn by us, unless otherwise stated.
2. The results listed refer only to the tested samples and applicable parameters. Endorsement of products is neither inferred nor implied.
3. Perishable samples will be destroyed after testing, others after one month from the date of issue of Test Certificates
4. Test Certificate in full or part shall not be used for promotional or publicity purposes.

Laboratory Accredited by National Co-ordination of Testing and Calibration Facilities, Dept. of Science & Technology, Government of India, in the fields of: Chemical and Mechanical testing.

VIMTA LABS LTD.

Office : 1-8-303/34, "MAYFAIR", Sardar Patel Road, P.B. No. 2045, Secunderabad-500 003. Phone: 843399, 843388
Laboratory : Plots No. 141/2 142, IDA, Phase II, Cherlapally, Rangareddy Dt., Hyderabad-500 762. Phone: 853657 Grams: VIMTA

TEST CERTIFICATE

Issued to :

SUPERINTENDING ENGINEER
P.R., NAP CIRCLE
12 TH FLOOR, GAGAN VIHAR
NAMPALLY, HYDERABAD
ATTN: Mr.G.Narayana Reddy,B.E.

No. : VLI/92/HW-5874
Date : 1992 03 17
Your ref : AE/NAP/AP-III/358/92
Date : 1991 03 09

Sample Particulars : WATER SAMPLES

Qty: 9 No IN PLASTIC BOTTLE CODED 1 TO 9
Tests reqd: ANALYSIS OF PESTICIDES ONLY

TEST RESULTS

The levels of pesticides in all the samples given below were below detectable limits of 1 ng/litre (1 ng= 10^{-9} g)

The samples provided for analysis were as follows:

1. Chepur MPWSS
2. Chepur Tank
3. Pendlipakala BW 1
4. Pendlipakala BW 2
5. Pendlipakala BW 3
6. Pendlipakala BW 4
7. Kurmapally IW-1
8. Kurmapally BW -2
9. Kurmapally BW-3

ANALYST

AUTHORISED SIGNATORY

NOTE : 1. Sample(s) not drawn by us, unless otherwise stated.
2. The results listed refer only to the tested samples and applicable parameters. Endorsement of products is neither inferred nor implied.
3. Perishable samples will be destroyed after testing, others after one month from the date of issue of Test Certificates
4. Test Certificate in full or part shall not be used for promotional or publicity purposes.

Pagina	: 1 / 1
Opdrachtnummer	: 922423
Produktiedatum	: 19/06/92
Projektnummer	: 8000003

Omschrijving : India AP III
Analyseresultaten Grondwatermonster(s)

Monsterkode: 1 121 Nidanamur
2 86 Wacha Tanda

Monsterkode			1	2
Parameter	eenheid	rapportage-grens	1)	1)
Monsternamedatum			07/04/92	07/04/92
<u>fysisch chemisch onderzoek</u>				
Geleidingsvermogen (20°C)	µS/cm	-	386	570
Fluoride	mg/l	0,05	0,85	0,74

1) Analyseresultaten kunnen beinvloed zijn door de lange tijd tussen de monstername en het afleveren van het monster bij het laboratorium.

APPENDIX 8

Spreadsheet models of village water supply systems

WELL NO.	MANDAL	VILLAGE	ELEV. masl	POP. 1991	Deman 55 lc 2007 m3/da	Deman 2007 l/s	Deman 2007 categ	Deman 2022 m3/da	Deman 2022 l/s	Deman 2022 categ	PHASE	Exist PWS/MWSS	Stage o gr.wat develop	Hydro quant zon	Water quali categ
*******	NALGONDA	ANNAPARTHY	*****	1784	133	1,5	3	178	2,1	4	1	Y	3	1	2
*******	NALGONDA	BUDDHARAM	*****	3304	247	2,9	5	329	3,8	6	1	N	3	2	1
*******	NALGONDA	CHERLAPALLI	*****	4768	357	4,1	6	475	5,5	6	1	Y	3	1	1
*******	NALGONDA	KANCHANPALLY	*****	2217	166	1,9	4	221	2,6	4	1	Y	3	1	1
*******	NALGONDA	K.KONDARAM	*****	1747	131	1,5	3	174	2	4	1	Y	3	2	1
*******	NALGONDA	MARRIGUDA	*****	2743	205	2,4	4	273	3,2	5	1	Y	3	1	2
*******	NALGONDA	DONAKAL	*****	754	56	0,7	2	75	0,9	2	1	Y	3	1	1
*******	NALGONDA	APPAJIPET	*****	3325	249	2,9	5	331	3,8	6	1	N	3	2	3
*******	NALGONDA	P.DOMALAPALLY	*****	1272	95	1,1	3	127	1,5	3	1	Y	3	2	1
*******	KANGAL	PONGODU	*****	2774	207	2,4	4	276	3,2	5	1	N	3	1	3
*******	KANGAL	REGATTA	*****	3607	270	3,1	5	359	4,2	6	1	Y	3	1	1
*******	KANGAL	TURKAPALLY	*****	683	51	0,6	2	68	0,8	2	2	N	3	1	1
*******	MUNGODE	MUNGODE	*****	8005	599	6,9	6	797	9,2	6	1	Y	3	1	2
*******	MUNGODE	KISTAPUR	*****	1425	107	1,2	3	142	1,6	3	1	N	3	2	2
*******	MUNGODE	IPPARTHY	*****	1238	93	1,1	3	123	1,4	3	1	Y	3	1	3
*******	MUNGODE	SINGARAM	*****	1142	85	1	3	114	1,3	3	1	N	3	1	2
*******	MUNGODE	KATCHAPUR	*****	463	35	0,4	1	46	0,5	2	1	Y	3	2	1
*******	MUNGODE	PALIWALA	*****	2379	178	2,1	4	237	2,7	4	1	Y	3	1	2
*******	MUNGODE	CHALIMEDA	*****	893	67	0,8	2	89	1	3	1	N	3	1	3
*******	MUNGODE	KOMPALLY	*****	2310	173	2	4	230	2,7	4	1	N	3	1	1
*******	MUNGODE	CHIKATIMAMIDI	*****	2389	179	2,1	4	238	2,8	4	1	N	3	1	3
*******	MUNGODE	KORATIKAL	*****	3193	239	2,8	4	318	3,7	5	1	Y	3	1	2
*******	MUNGODE	CHOLLEDU	*****	1358	102	1,2	3	135	1,6	3	1	Y	3	2	3
*******	MUNGODE	KALVAKUNTA	*****	916	69	0,8	2	91	1,1	3	1	N	3	1	3
*******	MUNGODE	VELMAKANNE	*****	2232	167	1,9	4	222	2,6	4	1	N	3	1	3
*******	MUNGODE	PULIPALUPULA	*****	2495	187	2,2	4	248	2,9	5	1	Y	3	2	1
*******	MUNGODE	KALVALAPALLY	*****	1962	147	1,7	3	195	2,3	4	1	N	3	2	2
*******	MUNGODE	JAMISTHANPALL	*****	345	26	0,3	1	34	0,4	1	1	N	3	2	1
*******	MUNGODE	GUDAPUR	*****	1342	100	1,2	3	134	1,5	3	1	N	3	1	1
*******	MUNGODE	SOLIPUR	*****	384	29	0,3	1	38	0,4	1	1	N	3	1	1
*******	MUNGODE	KOTHLARAM	*****	851	64	0,7	2	85	1	3	1	N	3	1	3
*******	MUNGODE	RATHIPALLY	*****	735	55	0,6	2	73	0,8	2	1	Y	3	2	1
*******	MUNGODE	OOKONDI	*****	1942	145	1,7	3	193	2,2	4	1	N	3	2	1
*******	CHANDOOR	CHANDOOR	*****	8862	663	7,7	6	882	10,2	6	1	Y	3	1	2
*******	CHANDOOR	THEROTPALLI	*****	3421	256	3	5	341	3,9	6	1	N	3	1	2
*******	CHANDOOR	PULEMLA	*****	2270	170	2	4	226	2,6	4	1	Y	3	2	2
*******	CHANDOOR	IDIKUDI	*****	1785	134	1,5	3	178	2,1	4	1	Y	3	1	3
*******	CHANDOOR	ANGADIPET	*****	1485	111	1,3	3	148	1,7	3	1	N	3	1	2
*******	CHANDOOR	DONIPAMULA	*****	2162	162	1,9	4	215	2,5	4	1	N	3	2	2
*******	CHANDOOR	GUNDRAPALLY	*****	1752	131	1,5	3	174	2	4	2	N	3	1	2
*******	CHANDOOR	GHATUPPAL	*****	6022	450	5,2	6	599	6,9	6	1	Y	3	1	2
*******	CHANDOOR	KONDAPUR	*****	1583	118	1,4	3	158	1,8	3	1	Y	3	1	1

m specificati		water supply		water supply system cost estimate (GROUND WATER OPTION 1)					GROUND WATER OPTION 1		water supply system specification (GROUND WATER OPTION 2)					
									2007	2022		SOURCE 2				
syste code	no. o wells	Round RS sc	gener appra	Inves Rp 10	Reinv Rp 10	OM Rp 10	TPV Rp 10	TPV l Rp 10	TPV Rp 10	TPV Rp 10E6	quali	type	dischar	dista	gener apprais.	syste code
3321	2	2	1	1,64	0,22	0,93	2,76	1,5	2,32	3,08	1	4	1	1	1	3411
5131	3	2	1	2,81	0,22	1,47	4,49	1,22	3,49	4,64	1	4	2	2	1	5422
6131	4	3	1	2,9	0,38	1,62	4,89	1,17	4,83	6,43	1	3	3	1	1	6331
4422	3	3	1	2,52	0,35	1,2	4,07	1,48	2,84	3,78	1	3	3	1	1	4331
3132	1	2	1	1,65	0,04	0,9	2,59	1,4	2,12	2,82	1	4	2	1	1	3421
4432	2	2	1	2,06	0,22	1,17	3,45	1,25	2,97	3,95	1	4	2	1	1	4421
2422	1	2	1	1,4	0,09	0,6	2,15	2,34	1,53	2,03	1	3	3	2	1	2332
5312	8	5	1	6,19	1,19	1,7	9,09	2,47	7,11	9,46	1	3	3	2	1	5332
3421	2	2	1	1,64	0,22	0,91	2,76	1,49	1,64	2,18	1	3	3	2	1	3332
4421	3	3	1	2,83	0,35	1,23	4,4	1,59	3,82	5,08	1	1	2	2	1	4122
5422	4	3	2	4	0,55	1,55	6,11	1,66	5,19	6,9	1	1	1	2	2	5112
2121	1	1	1	1,2	0,04	0,6	1,82	1,98	1,17	1,56	1	3	2	1	1	2321
6332	4	3	1	4,07	0,54	2,47	7,07	0,99	6,86	9,13	1	4	2	2	1	6422
3121	2	2	1	1,7	0,13	0,9	2,79	1,52	1,88	2,5	1	4	2	2	1	3422
3412	4	3	1	3,34	0,55	1,02	4,91	2,67	2,86	3,81	1	4	2	3	1	3423
3122	2	2	1	1,93	0,13	0,9	2,97	1,62	1,6	2,13	1	4	2	2	1	3422
1411	1	2	2	1,1	0,09	0,5	1,69	3,67	1,47	1,96	1	4	2	2	2	1422
4122	2	2	1	2,33	0,13	1,19	3,65	1,32	2,72	3,62	1	4	2	2	1	4422
2412	2	2	2	1,8	0,22	0,7	2,66	2,89	2,23	2,97	1	3	2	2	2	2322
4121	2	2	1	2,14	0,13	1,18	3,45	1,25	2,5	3,33	1	4	2	1	1	4421
4121	2	2	1	2,14	0,13	1,18	3,45	1,25	2,59	3,44	1	4	2	1	1	4421
4411	6	4	1	4,27	0,75	1,33	6,35	2,29	6,33	8,42	1	4	2	2	1	4422
3412	4	3	2	3,34	0,55	1,02	4,91	2,67	3,14	4,18	1	4	2	3	2	3423
2132	1	1	1	1,3	0,04	0,6	1,99	2,16	1,71	2,28	1	4	2	2	1	2422
4411	6	4	2	4,27	0,75	1,33	6,35	2,29	4,43	5,89	1	4	2	2	2	4422
4121	2	2	1	2,14	0,13	1,18	3,45	1,25	2,7	3,59	1	4	2	2	1	4422
3121	2	2	1	1,7	0,13	0,9	2,79	1,52	2,58	3,44	1	4	2	1	1	3421
1121	1	2	1	1,1	0,04	0,5	1,52	3,31	0,99	1,32	1	4	1	1	1	1411
3121	2	2	1	1,7	0,13	0,9	2,79	1,52	1,77	2,35	1	1	2	2	1	3122
1121	1	1	1	1,1	0,04	0,5	1,52	3,31	1,1	1,46	1	4	2	2	1	1422
2121	1	1	1	2,57	0,59	1,34	4,5	4,89	3,6	4,79	2	1	3	2	1	2132
2121	1	2	1	1,2	0,04	0,6	1,82	1,98	1,26	1,68	1	4	2	2	1	2422
3121	2	2	1	1,7	0,13	0,9	2,79	1,52	2,56	3,4	1	4	2	2	1	3422
6421	6	4	2	15,25	4,52	5,83	25,57	3,46	26,55	35,33	1	1	2	2	2	6122
5132	3	2	1	3,01	0,22	1,48	4,71	1,28	3,79	5,05	1	1	2	1	1	5121
4411	6	4	2	4,27	0,75	1,33	6,35	2,29	4,5	5,99	1	4	2	3	2	4423
3423	2	2	2	2	0,22	0,92	3,14	1,71	2,64	3,52	1	3	2	3	2	3323
3411	4	3	2	3,16	0,55	1,01	4,72	2,57	3,31	4,4	1	4	2	2	2	3422
4411	6	4	2	4,27	0,75	1,33	6,35	2,29	4,29	5,7	1	4	2	2	2	4422
3121	2	2	1	1,7	0,13	0,9	2,79	1,52	2,31	3,07	1	4	2	1	1	3421
6121	6	3	1	3,7	0,49	1,9	6,14	1,18	6,15	8,19	1	4	2	1	1	6421
3131	1	1	1	1,46	0,04	0,9	2,4	1,31	1,8	2,39	1	1	2	1	1	3121

			GROUND WATER			SURFACE WATER ALTERNATIF		
			OPTION 2					
cost estimate			2007	2022	Dista from	Elevat dif. w	Pumping stage	
[illegible]V	TPV l	TPV l/s	TPV	TPV	sourc	source		
[illegible] 10	Rp 10	categories	Rp 10	Rp 10E6	km			
4,29	2,33	2	3,6	4,79	39	112	2	
[illegible],11	1,66	1	4,75	6,32	37	110	2	
[illegible],51	1,34	1	5,53	7,36	34	105	2	
3,25	1,18	1	2,27	3,01	34	90	2	
3,12	1,69	1	2,56	3,4	41	97	2	
[illegible],87	1,4	1	3,33	4,42	32	104	2	
[illegible],15	2,34	2	1,53	2,03	43	88	2	
5,2	1,41	1	4,06	5,4	40	110	2	
2,32	1,26	1	1,39	1,85	43	99	2	
[illegible],65	1,32	1	3,17	4,22	76	86	2	
[illegible],24	1,42	1	4,44	5,9	75	84	2	
1,98	2,15	2	1,27	1,69	43	44	1	
9,99	1,44	1	9,98	13,28	52	107	2	
[illegible],38	1,84	1	2,27	3,02	66	149	2	
[illegible],57	1,94	1	2,08	2,77	62	135	2	
[illegible],38	1,84	1	1,82	2,42	65	111	2	
1,85	4,02	3	1,61	2,14	55	118	2	
4,6	1,67	1	3,44	4,58	59	141	2	
[illegible],15	2,34	2	1,81	2,41	65	152	3	
4,4	1,59	1	3,18	4,23	60	134	2	
4,4	1,59	1	3,29	4,38	57	128	2	
4,6	1,67	1	4,62	6,14	67	92	2	
[illegible],57	1,94	1	2,28	3,03	61	127	2	
2,15	2,34	2	1,86	2,47	64	137	3	
4,6	1,67	1	3,23	4,29	66	150	3	
4,6	1,67	1	3,61	4,8	48	115	2	
[illegible],12	1,69	1	2,87	3,82	46	120	2	
[illegible],69	3,67	2	1,1	1,46	51	109	2	
2,97	1,62	1	1,88	2,5	47	103	2	
[illegible],85	4,02	3	1,34	1,78	55	104	2	
[illegible],67	5,08	3	3,74	4,98	69	157	3	
2,15	2,34	2	1,49	1,98	59	124	2	
3,38	1,84	1	3,09	4,12	62	121	2	
[illegible],68	1,25	1	9,59	12,76	69	110	2	
[illegible],24	1,42	1	4,21	5,6	70	175	3	
4,82	1,75	1	3,44	4,58	61	128	2	
3,14	1,71	1	2,64	3,52	95	123	3	
[illegible],38	1,84	1	2,37	3,15	95	118	3	
4,6	1,67	1	3,13	4,16	88	198	3	
[illegible],12	1,69	1	2,56	3,41	72	110	2	
8,46	1,62	1	8,45	11,24	73	175	3	
[illegible],79	1,52	1	2,08	2,77	66	136	3	

WELL NO.	MANDAL	VILLAGE	ELEV. masl	POP. 1991	Deman 55 lc 2007 m3/da	Deman 2007 l/s	Deman 2007 categ	Deman 2022 m3/da	Deman 2022 l/s	Deman 2022 categ	PHASE	Exist PWS/MWSS	Stage o gr.wat develop	Hydro quant zon	Wate qual cate
*******	CHANDOOR	BODANGAPARTHY	*****	1135	85	1	3	113	1,3	3	1	N	3	2	
*******	CHANDOOR	BANGARIGADDA	*****	2515	188	2,2	4	250	2,9	5	1	Y	3	1	
*******	CHANDOOR	NERMETTA	*****	1577	118	1,4	3	157	1,8	3	1	Y	3	2	
*******	CHANDOOR	THUMMALAPALLY	*****	1440	108	1,2	3	143	1,7	3	2	N	3	1	
*******	CHANDOOR	KASTALA	*****	2616	196	2,3	4	260	3	5	1	Y	3	1	
*******	CHANDOOR	SERIDEPALLY	*****	1125	84	1	3	112	1,3	3	1	N	3	2	
*******	CHANDOOR	UDTHAPALLY	*****	956	72	0,8	2	95	1,1	3	1	N	3	2	
*******	NARAYANAPOOR	NARAYANAPOOR	*****	8224	615	7,1	6	819	9,5	6	1	Y	3	2	
*******	NARAYANAPOOR	GUJJA	*****	2887	216	2,5	4	287	3,3	5	1	Y	3	1	
*******	NARAYANAPOOR	MOHAMMADABAD	*****	958	72	0,8	2	[illegible]	1,1	3	1	Y	3	2	
*******	NARAYANAPOOR	CHINNA MIRIYA	*****	1195	89	1	3	119	1,4	3	1	Y	3	2	
*******	NARAYANAPOOR	GUDDIMALKAPUR	*****	858	64	0,7	2	85	1	3	1	Y	3	2	
*******	NARAYANAPOOR	KOTHALAPUR	*****	632	47	0,5	2	[illegible]	0,7	2	1	N	3	2	
*******	NARAYANAPOOR	PUTTAPAKA	*****	3111	233	2,7	4	310	3,6	5	1	N	3	1	
*******	NARAYANAPOOR	KANKHANALAGUD	*****	1405	105	[illegible]	[illegible]	140	1,6	3	1	N	3	2	
*******	NARAYANAPOOR	KOTHAGUDA	*****	1454	109	[illegible]	3	145	1,7	3	1	N	3	2	
*******	NARAYANAPOOR	JANGAON	*****	4834	362	4,2	6	481	5,6	6	1	Y	3	2	
*******	NARAYANAPOOR	VOIPALLY	*****	3982	298	3,4	5	396	4,6	6	1	Y	3	2	
*******	NARAYANAPOOR	CHILLAPUR	*****	3251	243	2,8	5	324	3,7	6	1	N	3	2	
*******	NARAYANAPOOR	SERVOIL	*****	8159	610	7,1	6	812	9,4	6	1	Y	3	1	
*******	NARKETPALLY	NARKETPALLY	*****	1221	91	1,1	3	122	1,4	3	1	Y	3	2	
*******	NARKETPALLY	B.YELEMLA	*****	3094	231	2,7	4	308	3,6	5	1	Y	3	1	
*******	NARKETPALLY	AURAVANI	*****	1449	108	1,3	3	144	1,7	3	1	Y	3	2	
*******	NARKETPALLY	CHOUDAMPALLY	*****	433	32	0,4	1	43	0,5	2	1	N	3	2	
*******	NARKETPALLY	CHERUGATTA	*****	3373	252	2,9	5	336	3,9	6	1	Y	3	2	
*******	NARKETPALLY	YELLAREDDYGUD	*****	3107	232	2,7	4	309	3,6	5	1	Y	3	1	
*******	NARKETPALLY	M.YEDAVELLY	*****	1336	100	1,2	3	133	1,5	3	1	Y	3	2	
*******	NARKETPALLY	NEMMANI	*****	2221	166	1,9	4	221	2,6	4	1	Y	3	2	
*******	NARKETPALLY	MANDRA	*****	1484	111	1,3	3	148	1,7	3	1	Y	3	2	
*******	CHITYAL	CHITYAL	*****	9824	735	8,5	6	978	11,3	6	1	Y	3	2	
*******	CHITYAL	URUMADLA	*****	7226	541	6,3	6	719	8,3	6	1	Y	3	1	
*******	CHITYAL	NEREDA	*****	3732	279	3,2	5	372	4,3	6	1	Y	3	1	
*******	CHITYAL	THALVELEMALA	*****	2358	176	2	4	235	2,7	4	1	Y	3	1	
*******	CHITYAL	YELLIKATA	*****	1888	141	1,6	3	188	2,2	4	1	Y	3	1	
*******	CHITYAL	GUNDRAMPALLI	*****	3128	234	2,7	4	311	3,6	5	1	Y	3	2	
*******	CHITYAL	EAPOOR	*****	2188	164	1,9	4	218	2,5	4	1	Y	3	1	
*******	CHITYAL	CHINAKAPARTY	*****	3613	270	3,1	5	360	4,2	6	1	Y	3	1	
*******	CHITYAL	PEDDAKAPAPRTH	*****	4131	309	3,6	5	411	4,8	6	1	Y	3	2	
*******	CHITYAL	PITTAMPALLY	*****	1280	96	1,1	3	127	1,5	3	1	N	3	2	
*******	CHITYAL	VANIPAKALA	*****	2242	168	1,9	4	223	2,6	4	1	Y	3	2	
*******	CHITYAL	VATTIMARTHI	*****	1839	138	1,6	3	183	2,1	4	1	Y	3	1	
*******	CHITYAL	SHIVANENIGUDE	*****	1092	82	0,9	3	109	1,3	3	1	Y	3	2	

'specificati		water supply		water supply system cost estimate (GROUND WATER OPTION 1)					(GROUND WATER OPTION 1) 2007	2022		water supply system specification (GROUND WATER OPTION 2) SOURCE 2				syste	no
s .te c le	no. o wells	Round RS sc	gener appra	Inves Rp 10	Reinv Rp 10	OM Rp 10	TPV Rp 10	TPV l Rp 10	TPV Rp 10	TPV Rp 10E6	quali	type	dischar	dista	gener apprais.	code	we
3121	2	2	1	1,7	0,13	0,9	2,79	1,52	1,49	1,99	1	4	2	1	1	3421	
ı22	2	2	2	6,05	1,57	2,61	10,22	3,71	8,08	10,75	2	4	2	2	2	4422	
·22	2	2	2	4,79	1,21	2	8	4,35	5,94	7,9	2	4	1	2	2	3412	
3411	4	3	2	3,16	0,55	1,01	4,72	2,57	3,2	4,26	1	4	2	2	2	3422	
4421	3	3	2	2,83	0,35	1,23	4,4	1,59	3,6	4,79	1	3	2	2	2	4322	
,21	2	2	1	1,97	0,22	0,93	3,12	1,69	1,65	2,19	1	1	2	2	1	3122	
21	1	2	2	1,2	0,04	0,6	1,82	1,98	1,64	2,18	1	4	2	1	2	2421	
6121	7	4	1	4,71	0,76	2,3	7,77	1,23	8,76	11,66	1	1	2	2	1	6122	
4421	3	3	1	6,55	1,78	2,65	10,98	3,98	9,95	13,24	2	1	2	2	1	4122	
.21	1	2	1	1,2	0,04	0,6	1,82	1,98	1,64	2,19	1	1	3	2	1	2132	
!21	2	2	1	1,7	0,13	0,9	2,79	1,52	1,57	2,09	1	4	2	1	1	3421	
2411	2	2	2	1,6	0,22	0,7	2,48	2,7	2,01	2,67	1	4	2	2	2	2422	
2412	2	2	2	1,8	0,22	0,7	2,66	2,89	1,58	2,1	1	4	2	3	2	2423	
.22	2	2	1	2,33	0,13	1,19	3,65	1,32	3,56	4,73	1	4	2	2	1	4422	
ı21	2	2	1	1,7	0,13	0,9	2,79	1,52	1,85	2,46	1	1	2	2	1	3122	
3421	2	2	1	4,61	1,21	2	7,82	4,25	5,35	7,12	2	4	2	2	1	3422	
6122	4	3	1	4,15	0,54	1,68	6,37	1,55	6,49	8,63	1	2	4	3	1	6243	
:43	2	2	1	2,86	0,13	1,47	4,46	1,21	4,17	5,55	1	2	3	3	1	5233	
,12	8	5	2	10,86	3,07	3,46	17,39	4,73	13,32	17,72	2	4	1	3	2	5413	
6131	5	3	1	4,07	0,54	2,47	7,07	0,99	7	9,31	1	1	2	1	1	6121	
3321	2	2	2	1,64	0,22	0,93	2,76	1,5	1,59	2,11	1	1	2	3	2	3123	
121	2	2	1	1,65	0,13	1,15	2,92	1,06	2,84	3,78	1	4	2	2	1	4422	
;11	4	3	1	3,16	0,55	1,01	4,72	2,57	3,22	4,29	1	4	2	2	1	3422	
ı221	1	2	1	1,1	0,04	0,5	1,52	3,31	1,24	1,65	1	4	2	2	1	1422	
5412	8	5	2	6,19	1,19	1,7	9,09	2,47	7,21	9,6	1	1	3	3	2	5133	
;12	6	4	2	3,96	0,75	1,31	6,02	2,18	5,87	7,8	1	1	3	3	2	4133	
;12	4	3	2	3,34	0,55	1,02	4,91	2,67	3,09	4,11	1	3	3	2	2	3332	
4142	1	2	1	1,98	0,04	1,17	3,19	1,16	2,23	2,97	1	1	3	2	1	4132	
3412	4	3	2	5,9	1,54	2,08	9,53	5,18	6,66	8,86	2	4	2	3	2	3423	
232	6	4	2	15,7	4,69	6,49	26,88	3,16	26,88	35,77	1	1	3	3	2	6133	
121	7	4	1	4,71	0,76	2,3	7,77	1,23	7,7	10,24	1	4	2	2	1	6422	
5121	4	3	1	2,77	0,38	1,47	4,62	1,26	4,07	5,42	1	4	2	2	1	5422	
4411	6	4	1	4,27	0,75	1,33	6,35	2,29	4,68	6,22	1	4	2	2	1	4422	
;21	2	2	1	1,64	0,22	0,91	2,76	1,49	2,44	3,24	1	1	2	2	1	3122	
122	2	2	2	2,33	0,13	1,19	3,65	1,32	3,58	4,76	1	4	2	2	2	4422	
4121	2	2	1	2,14	0,13	1,18	3,45	1,25	2,37	3,15	1	1	3	2	1	4132	
5411	8	5	2	5,99	1,19	1,69	8,88	2,41	7,54	10,03	1	4	2	2	2	5422	
¯242	2	2	1	2,66	0,13	1,46	4,25	1,15	4,11	5,47	1	1	3	2	1	5132	
121	2	2	1	1,7	0,13	0,9	2,79	1,52	1,68	2,24	1	4	2	1	1	3421	
4222	2	2	2	2,33	0,13	1,19	3,65	1,32	2,56	3,41	1	2	3	3	2	4233	
3222	2	2	2	1,6	0,13	0,9	2,61	1,42	2,26	3,01	1	4	2	1	2	3421	
¯232	1	2	2	1,65	0,04	0,9	2,59	1,4	1,32	1,76	1	1	2	1	2	3121	

GROUND WATER SURFACE WATER ALTERNATIF

OPTION 2

cost estimate TPV Rp 10	TPV l Rp 10	TPV l/s categories	2007 TPV Rp 10	2022 TPV Rp 10E6	Dista from sourc km	Elevat dif. w source	Pumping stage
3,12	1,69	1	1,66	2,21	58	113	2
10,98	3,98	2	8,67	11,53	92	120	3
9,53	5,18	3	7,07	9,41	91	190	3
3,38	1,84	1	2,29	3,05	65	137	2
4,6	1,67	1	3,78	5,03	72	98	2
2,97	1,62	1	1,58	2,1	63	106	2
1,98	2,15	2	1,78	2,37	70	110	2
9,03	1,27	1	9,04	12,03	73	216	3
10,22	3,71	2	9,28	12,34	67	164	3
1,99	2,16	2	1,79	2,38	81	211	3
3,12	1,69	1	1,75	2,33	77	195	3
2,15	2,34	2	1,74	2,31	82	207	3
2,33	2,53	2	1,38	1,84	85	222	3
4,6	1,67	1	4,5	5,99	66	172	3
2,97	1,62	1	1,97	2,62	75	220	3
8	4,35	3	5,48	7,29	71	198	3
4,82	1,15	1	4,81	6,4	82	203	3
4,31	1,17	1	4,03	5,37	80	200	3
17,83	4,84	3	13,63	18,13	77	190	3
9,72	1,38	1	9,75	12,97	80	181	3
2,81	1,53	1	1,62	2,15	48	139	2
4,07	1,48	1	3,97	5,28	48	138	2
3,38	1,84	1	2,31	3,07	44	122	2
1,85	4,02	3	1,51	2,01	52	140	2
4,94	1,34	1	3,91	5,21	46	125	2
3,34	1,21	1	3,26	4,33	43	117	2
2,8	1,52	1	1,76	2,34	50	135	2
3,65	1,32	1	2,54	3,38	52	140	2
8,2	4,46	3	5,73	7,62	58	159	2
7,02	0,83	1	7,06	9,39	61	174	2
9,25	1,48	1	9,26	12,32	60	156	2
5,48	1,49	1	4,82	6,41	55	152	2
4,6	1,67	1	3,41	4,54	62	134	2
2,61	1,42	1	2,32	3,09	56	137	2
4,6	1,67	1	4,52	6,02	102	179	3
3,65	1,32	1	2,5	3,33	71	155	2
6,11	1,66	1	5,19	6,91	69	157	2
4,71	1,28	1	4,58	6,09	111	107	3
3,12	1,69	1	1,87	2,49	78	210	2
3,86	1,4	1	2,72	3,62	65	106	2
2,76	1,49	1	2,37	3,16	65	156	2
2,79	1,52	1	1,44	1,91	65	177	2

WELL NO.	MANDAL	VILLAGE	ELEV. masl	POP. 1991	Deman 55 lc 2007 m3/da	Deman 2007 l/s	Deman 2007 categ	Deman 2022 m3/da	Deman 2022 l/s	Deman 2022 categ	PHASE	Exist PWS/MWSS	Stage o gr.wat develop	Hydro quant zon	Water quali categ
*******	CHITYALA	PEREPALLY	*****	1450	108	1,3	3	144	1,7	3	1	Y	3	1	1
******	CHITYALA	BONGONICHERUVU	*****	516	39	0,4	1	51	0,6	2	1	N	3	1	1
******	NAMPALLY	NAMPALLY	*****	3501	262	3	5	349	4	6	2	Y	1	1	1
******	NAMPALLY	PEDDAPUR	*****	3592	269	3,1	5	358	4,1	6	2	N	1	1	3
*******	NAMPALLY	NEREDLAPALLY	*****	1452	109	1,3	3	145	1,7	3	1	N	1	2	1
******	NAMPALLY	DAMERA	*****	1730	129	1,5	3	172	2	4	1	Y	1	1	3
******	NAMPALLY	DEVATHPALLY	*****	1486	111	1,3	3	148	1,7	3	2	N	1	2	1
******	NAMPALLY	S.W.LINGOTAM	*****	1946	146	1,7	3	194	2,2	4	1	Y	1	2	3
*******	NAMPALLY	WADDEPALLY	*****	1242	93	1,1	3	124	1,4	3	1	N	1	2	1
******	NAMPALLY	CHITTAMPADU	*****	948	71	0,8	2	94	1,1	3	2	N	1	2	3
******	NAMPALLY	THIRMALGIRI	*****	1004	75	0,9	2	100	1,2	3	2	N	1	1	1
******	NAMPALLY	MALLAPURAJPAL	*****	1188	89	1	3	118	1,4	3	2	Y	1	2	3
*******	NAMPALLY	PASNUR	*****	3531	264	3,1	5	352	4,1	6	2	Y	1	2	3
******	NAMPALLY	K.THIRMALGIRI	*****	127	9	0,1	1	13	0,1	1	2	N	1	2	3
******	NAMPALLY	CHAMALAPALLY	*****	1401	105	1,2	3	139	1,6	3	2	N	1	1	1
******	NAMPALLY	GANUGUPALLY	*****	647	48	0,6	2	64	0,7	2	2	Y	1	1	3
*******	NAMPALLY	MOHAMMADAPUR	*****	1403	105	1,2	3	140	1,6	3	2	N	1	2	1
******	NAMPALLY	G.MALLEPALLY	*****	1275	95	1,1	3	127	1,5	3	2	Y	1	1	2
******	NAMPALLY	KETHEPALLY	*****	626	47	0,5	2	62	0,7	2	2	N	1	1	1
******	NAMPALLY	MEDLAVAI	*****	1351	101	1,2	3	134	1,6	3	2	Y	1	1	1
*******	NAMPALLY	THUMMALAPALLY	*****	790	59	0,7	2	79	0,9	2	2	N	1	3	2
******	NAMPALLY	B.THIMMAPUR	*****	583	44	0,5	2	58	0,7	2	2	N	1	2	1
******	NAMPALLY	REVALLY	*****	835	62	0,7	2	83	1	3	2	N	1	3	1
******	NAMPALLY	SUNKISALA	*****	526	39	0,5	1	52	0,6	2	2	N	1	3	3
*******	NAMPALLY	FAKEERPUR	*****	324	24	0,3	1	32	0,4	1	2	N	1	3	3
******	NAMPALLY	PAGIDIPLALLY	*****	380	28	0,3	1	38	0,4	1	2	N	1	2	3
******	NAMPALLY	MUSTIPALLY	*****	2244	168	1,9	4	223	2,6	4	2	Y	1	3	3
******	NAMPALLY	HYDALAPUR	*****	168	13	0,1	1	17	0,2	1	1	N	1	1	1
*******	NAMPALLY	T.P.GOWRARAM	*****	1527	114	1,3	3	152	1,8	3	1	N	1	2	3
******	NAMPALLY	SHARBAPUR	*****	258	19	0,2	1	26	0,3	1	2	N	1	3	1
******	CHINTAPALLY	CHINTAPALLY	*****	3815	285	3,3	5	380	4,4	6	2	Y	1	2	1
******	CHINTAPALLY	NASARLAPALLY	*****	1962	147	1,7	3	195	2,3	4	2	N	1	1	2
*******	CHINTAPALLY	MALLAREDDIPAL	*****	1530	114	1,3	3	152	1,8	3	2	N	1	2	3
*******	CHINTAPALLY	HUMANTHLAPALL	*****	1514	113	1,3	3	151	1,7	3	2	Y	1	2	2
******	CHINTAPALLY	THIRUMALAPUR	*****	286	21	0,2	1	28	0,3	1	2	N	1	2	3
******	CHINTAPALLY	NALVALPALLY	*****	1411	106	1,2	3	140	1,6	3	2	Y	1	2	1
*******	CHINTAPALLY	GADIA GOWRARA	*****	2464	184	2,1	4	245	2,8	5	2	Y	1	2	3
*******	CHINTAPALLY	VARKALA	*****	1047	78	0,9	2	104	1,2	3	2	N	1	1	1
******	CHINTAPALLY	VINJAMOOR	*****	5694	426	4,9	6	567	6,6	6	1	Y	1	2	3
******	CHINTAPALLY	P.K.MALLAPALL	*****	918	69	0,8	2	91	1,1	3	1	N	1	2	3
*******	CHINTAPALLY	KURMAPALLY	*****	4769	357	4,1	6	475	5,5	6	1	N	1	2	3
*******	CHINTAPALLY	KURMAID	*****	3348	250	2,9	5	333	3,9	6	1	Y	1	2	3

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GROUND WATER OPTION 1 | GROUND WATER OPTION 1 | GROUND WATER OPTION 2

m specificati		water supply		water supply system cost estimate								water supply system specification					
									2007	2022		SOURCE 2					
syste code	no. o wells	Round RS sc	gener appra	Inves Rp 10	Reinv Rp 10	OM Rp 10	TPV Rp 10	TPV l Rp 10	TPV Rp 10	TPV Rp 10E6	quali	type	dischar	dista	gener apprais.	syste code	no we
3121	2	2	2	1,7	0,13	0,9	2,79	1,52	1,91	2,54	1	4	2	1	2	3421	
1121	1	1	1	1,1	0,04	0,5	1,52	3,31	1,48	1,97	1	4	2	1	1	1421	
5411	8	5	2	5,41	1,19	1,65	8,25	2,24	6,79	9,04	1	4	2	2	2	5422	
5411	8	5	2	5,99	1,19	1,69	8,88	2,41	7,5	9,97	1	3	1	1	2	5311	
3411	4	3	2	3,16	0,55	1,01	4,72	2,57	3,23	4,3	1	3	1	1	2	3311	
3413	4	3	2	6,1	1,54	2,09	9,73	5,29	7,93	10,54	2	4	1	3	2	3413	
3411	4	3	2	3,16	0,55	1,01	4,72	2,57	3,31	4,4	1	4	2	2	2	3422	
3412	4	3	2	3,34	0,55	1,02	4,91	2,67	4,5	5,99	1	4	1	3	2	3413	
3412	4	3	2	3,34	0,55	1,02	4,91	2,67	2,87	3,82	1	4	1	3	2	3413	
2412	2	2	2	1,8	0,22	0,7	2,66	2,89	2,37	3,16	1	4	1	3	2	2413	
2421	1	2	2	1,3	0,09	0,6	1,98	2,15	1,87	2,49	1	4	1	1	2	2411	
3412	4	3	2	3,34	0,55	1,02	4,91	2,67	2,75	3,65	1	2	3	3	2	3233	
5321	4	3	2	8,67	2,43	3,31	14,14	3,92	11,99	15,95	2	4	2	1	2	5421	
1411	1	2	2	1,1	0,09	0,5	1,69	3,67	0,4	0,54	1	4	2	2	2	1422	
3412	4	3	2	3,34	0,55	1,02	4,91	2,67	3,24	4,31	1	4	2	3	2	3423	
2412	2	2	2	1,8	0,22	0,7	2,66	2,89	1,62	2,15	1	4	2	3	2	2423	
3121	2	2	2	1,7	0,13	0,9	2,79	1,52	1,85	2,46	1	4	2	2	2	3422	
3421	2	2	2	1,97	0,22	0,93	3,12	1,69	1,87	2,48	1	4	2	2	2	3422	
2411	2	2	2	1,6	0,22	0,7	2,48	2,7	1,46	1,95	1	4	2	2	2	2422	
3121	2	1	2	1,7	0,13	0,9	2,79	1,52	1,78	2,37	1	4	2	1	2	3421	
2411	2	3	2	1,6	0,22	0,7	2,48	2,7	1,85	2,46	1	4	2	2	2	2422	
2411	2	2	2	1,6	0,22	0,7	2,48	2,7	1,36	1,81	1	4	2	2	2	2422	
2122	1	2	1	1,3	0,04	0,6	1,99	2,16	1,56	2,08	1	4	2	2	1	2422	
1412	1	2	2	1,3	0,09	0,5	1,85	4,02	1,83	2,44	1	4	2	2	2	1422	
1122	1	2	2	1,1	0,04	0,5	1,68	3,66	1,03	1,37	1	4	2	2	2	1422	
1411	1	2	2	1,1	0,09	0,5	1,69	3,67	1,21	1,61	1	4	2	2	2	1422	
4411	6	4	2	4,27	0,75	1,33	6,35	2,29	4,45	5,92	1	4	2	2	2	4422	
1141	1	1	1	1,1	0,04	0,5	1,52	3,31	0,48	0,64	1	1	3	1	1	1131	
3411	4	3	2	3,16	0,55	1,01	4,72	2,57	3,4	4,52	1	4	2	2	2	3422	
1121	1	2	2	1,1	0,04	0,5	1,52	3,31	0,74	0,98	1	4	2	2	2	1422	
5121	4	3	1	3,35	0,38	1,51	5,24	1,42	4,69	6,24	1	3	3	2	1	5332	
3121	2	1	2	1,7	0,13	0,9	2,79	1,52	2,58	3,44	1	4	2	2	2	3422	
3332	1	2	2	1,8	0,09	0,9	2,8	1,52	2,01	2,68	1	4	2	2	2	3422	
3121	2	2	2	1,4	0,13	0,9	2,43	1,32	1,73	2,3	1	4	2	1	2	3421	
1122	1	1	2	1,1	0,04	0,5	1,68	3,66	0,91	1,21	1	4	2	2	2	1422	
3121	2	2	2	1,7	0,13	0,9	2,79	1,52	1,86	2,47	1	4	2	2	2	3422	
4412	6	4	2	4,46	0,75	1,34	6,55	2,37	5,06	6,73	1	1	3	3	2	4133	
2121	1	1	2	1,2	0,04	0,6	1,82	1,98	1,8	2,39	1	4	2	2	2	2422	
6422	6	4	2	11,67	3,09	4,35	19,13	3,68	18,15	24,14	2	1	2	3	2	6123	
2411	2	2	2	3,14	0,77	1,38	5,29	5,75	4,57	6,08	2	4	2	2	2	2422	
6121	5	3	1	4,15	0,54	1,68	6,37	1,55	6,4	8,52	3	1	3	2	1	6132	
5411	8	5	2	10,86	3,07	3,46	17,39	4,73	13,71	18,25	2	4	2	2	2	5422	

GROUND WATER — SURFACE WATER ALTERNATIF

OPTION 2

cost estimate √ 10	TPV l Rp 10	TPV l/s categories	2007 TPV Rp 10	2022 TPV Rp 10E6	Dista from sourc km	Elevat dif. w source	Pumping stage
3,12	1,69	1	2,12	2,82	68	159	2
,69	3,67	2	1,64	2,18	76	174	2
,48	1,49	1	4,52	6,01	56	147	2
,88	2,41	2	7,5	9,97	58	147	2
4,72	2,57	2	3,23	4,3	94	155	3
,73	5,29	3	7,93	10,54	92	162	3
,38	1,84	1	2,37	3,15	90	147	3
,11	2,78	2	4,68	6,23	90	180	3
5,11	2,78	2	2,99	3,98	93	178	3
,83	3,08	2	2,53	3,36	60	177	2
,48	2,7	2	2,35	3,12	66	148	2
,79	1,51	1	1,55	2,07	70	217	2
14,41	3,92	2	11,99	15,95	62	159	2
,85	4,02	3	0,44	0,59	64	162	2
,57	1,94	1	2,35	3,13	66	102	2
,33	2,53	2	1,42	1,89	67	132	2
3,38	1,84	1	2,24	2,97	50	102	2
,38	1,84	1	2,03	2,7	54	150	2
,15	2,34	2	1,27	1,69	68	157	2
,12	1,69	1	1,98	2,63	58	156	2
2,15	2,34	2	1,6	2,13	64	147	2
,15	2,34	2	1,18	1,57	64	147	2
,15	2,34	2	1,69	2,25	61	147	2
,85	4,02	3	1,83	2,44	63	152	2
1,85	4,02	3	1,13	1,5	60	156	2
,85	4,02	3	1,32	1,76	68	147	2
4,6	1,67	1	3,25	4,32	65	147	2
,52	3,31	2	0,48	0,64	121	210	4
3,38	1,84	1	2,43	3,24	97	205	3
,85	4,02	3	0,9	1,19	68	147	2
5,2	1,41	1	4,66	6,2	130	227	4
,38	1,84	1	3,13	4,16	127	220	4
3,38	1,84	1	2,44	3,24	131	214	4
,76	1,49	1	1,95	2,6	134	220	4
,85	4,02	3	1	1,32	125	210	4
,38	1,84	1	2,25	2,99	66	117	2
3,86	1,4	1	2,99	3,97	121	210	4
,15	2,34	2	2,12	2,82	119	220	4
,42	3,74	2	18,44	24,53	116	227	4
,83	5,25	3	4,17	5,55	104	244	4
14,01	3,39	2	14	18,62	112	254	4
,62	3,97	2	11,51	15,31	109	280	4

WELL NO.	MANDAL	VILLAGE	ELEV. masl	POP. 1991	Deman 55 lc 2007 m3/da	Deman 2007 l/s	Deman 2007 categ	Deman 2022 m3/da	Deman 2022 l/s	Deman 2022 categ	PHASE	Exist PWS/MWSS	Stage o gr.wat develop	Hydro quant zon	Water quali categ
*******	CHINTAPALLY	UMMAPUR	*****	517	39	0,4	1	51	0,6	2	1	N	1	3	3
*******	CHINTAPALLY	SUKILISERIPAL	*****	792	59	0,7	2	79	0,9	2	1	N	1	3	[illegible]
*******	CHINTAPALLY	TAKKELLAPALLY	*****	1512	113	1,3	3	151	1,7	3	1	N	1	3	[illegible]
*******	CHINTAPALLY	GODAKONDLA	*****	3105	232	2,7	4	309	3,6	5	1	Y	1	3	[illegible]
*******	CHINTAPALLY	POLEPALLY	*****	2332	174	2	4	232	2,7	4	1	Y	1	3	3
*******	CHINTAPALLY	MADNAPUR	*****	885	66	0,8	2	88	1	3	1	N	1	3	[illegible]
*******	CHINTAPALLY	VENKATAMPET	*****	1939	145	1,7	3	193	2,2	4	2	N	1	2	[illegible]
*******	CHINTAPALLY	K.GOURARAM	*****	792	59	0,7	2	79	0,9	2	2	N	1	2	[illegible]
*******	MARRIGUDA	K.B.PALLY	*****	3006	225	2,6	4	299	3,5	5	1	Y	1	2	3
*******	MARRIGUDA	ANTHAMPET	*****	1118	84	1	3	111	1,3	3	1	Y	1	2	[illegible]
*******	MARRIGUDA	SOMARAJGUDA	*****	1275	95	1,1	3	127	1,5	3	1	N	1	2	[illegible]
*******	MARRIGUDA	NAMAPURAM	*****	1355	101	1,2	3	135	1,6	3	1	N	1	1	[illegible]
*******	MARRIGUDA	LENKALAPALLY	*****	1776	133	1,5	3	177	2	4	1	Y	1	1	3
*******	MARRIGUDA	METICHANDAPUR	*****	1260	94	1,1	3	125	1,5	3	1	N	1	2	[illegible]
*******	MARRIGUDA	VENKAPALLY	*****	846	63	0,7	2	84	1	3	1	N	1	3	[illegible]
*******	MARRIGUDA	INDURTHY	*****	6036	451	5,2	6	601	7	6	1	N	1	1	[illegible]
*******	MARRIGUDA	D.B.PALLI	*****	3673	275	3,2	5	366	4,2	6	1	Y	1	2	3
*******	MARRIGUDA	SARAMPET	*****	1246	93	1,1	3	124	1,4	3	1	N	1	1	[illegible]
*******	MARRIGUDA	VATTIPALLI	*****	1822	136	1,6	3	181	2,1	4	1	Y	1	2	[illegible]
*******	MARRIGUDA	YERGANDLAPALL	*****	3381	253	2,9	5	337	3,9	6	1	Y	1	3	[illegible]
*******	MARRIGUDA	THIRGANDLAPAL	*****	1455	109	1,3	3	145	1,7	3	1	Y	1	3	3
*******	MARRIGUDA	THAMMADAPALLY	*****	792	59	0,7	2	79	0,9	2	1	N	1	3	[illegible]
*******	MARRIGUDA	KONDUR	*****	1141	85	1	3	114	1,3	3	1	N	1	2	[illegible]
*******	MARRIGUDA	MARRIGUDA	*****	3334	249	2,9	5	332	3,8	6	1	Y	1	2	[illegible]
*******	MARRIGUDA	BATLAPALLI	*****	344	26	0,3	1	34	0,4	1	1	N	1	2	3
*******	GURRAMPODE	GURRAMPODE	*****	1831	137	1,6	3	182	2,1	4	2	N	1	2	[illegible]
*******	GURRAMPODE	CHAMALAID	*****	2696	202	2,3	4	268	3,1	5	2	N	1	2	[illegible]
*******	GURRAMPODE	VATTIKODU	*****	2455	184	2,1	4	244	2,8	5	2	N	1	2	[illegible]
*******	GURRAMPODE	KOPPOLE	*****	5489	411	4,8	6	546	6,3	6	2	Y	1	1	1
*******	GURRAMPODE	AMLUR	*****	677	51	0,6	2	67	0,8	2	2	N	1	1	[illegible]
*******	GURRAMPODE	BOLLARAM	*****	787	59	0,7	2	78	0,9	2	2	N	1	1	[illegible]
*******	GURRAMPODE	NADIKUDA	*****	1529	114	1,3	3	152	1,8	3	2	Y	1	1	[illegible]
*******	GURRAMPODE	KOTHALAPUR	*****	473	35	0,4	1	47	0,5	2	2	N	1	1	3
*******	GURRAMPODE	MOSANGI	*****	1525	114	1,3	3	152	1,8	3	2	Y	1	2	[illegible]
*******	GURRAMPODE	CHEPUR	*****	4040	302	3,5	5	402	4,7	6	2	Y	1	1	[illegible]
*******	GURRAMPODE	PALLEPAHAD	*****	440	33	0,4	1	44	0,5	2	2	N	1	2	[illegible]
*******	GURRAMPODE	KACHARAM	*****	417	31	0,4	1	42	0,5	2	2	Y	1	2	[illegible]
*******	GURRAMPODE	TANDARPALLI(J	*****	2072	155	1,8	3	206	2,4	4	2	Y	1	2	[illegible]
*******	GURRAMPODE	MYLAPUR	*****	622	47	0,5	2	62	0,7	2	2	N	1	3	[illegible]
*******	GURRAMPODE	PARLAPALLI	*****	143	11	0,1	1	14	0,2	1	2	N	1	2	[illegible]
*******	GURRAMPODE	JUNUTHALA	*****	1401	105	1,2	3	139	1,6	3	2	Y	1	3	3
*******	GURRAMPODE	TENEPALLI	*****	1458	109	1,3	3	145	1,7	3	2	Y	1	2	[illegible]

GROUND WATER OPTION 1 | GROUND WATER OPTION 1 | GROUND WATER OPTION 2

specificati	water supply			water supply system cost estimate							water supply system specification						
									2007	2022		SOURCE 2				syste	no
ste	no. o	Round	gener	Inves	Reinv	OM	TPV	TPV l	TPV	TPV	quali	type	dischar	dista	gener	code	we
de	wells	RS sc	appra	Rp 10	Rp 10	Rp 10	Rp 10	Rp 10	Rp 10	Rp 10E6					apprais.		
1122	1	2	2	1,99	0,37	1,04	3,39	7,38	3,3	4,4	3	4	1	2	1	1412	
411	2	3	2	3,14	0,77	1,38	5,29	5,75	3,94	5,25	2	4	2	2	2	2422	
411	4	3	1	5,73	1,54	2,08	9,35	5,08	6,65	8,85	3	4	2	2	1	3422	
412	6	4	2	8,18	2,18	2,75	13,12	4,75	12,77	16,99	2	4	2	3	2	4423	
4412	6	4	2	8,18	2,18	2,75	13,12	4,75	9,59	12,76	2	4	2	3	2	4423	
422	1	2	1	2,85	0,63	1,35	4,83	5,25	4,02	5,35	3	4	2	3	1	2423	
321	2	2	2	1,97	0,22	0,93	3,12	1,69	2,84	3,78	1	4	1	2	2	3412	
412	2	2	2	1,8	0,22	0,7	2,66	2,89	1,98	2,64	1	4	1	3	2	2413	
4422	3	3	2	6,24	1,78	2,62	10,65	3,86	10,05	13,37	2	3	2	1	2	4321	
423	2	2	2	2,41	0,22	0,95	3,57	1,94	1,88	2,5	2	4	1	3	2	3413	
423	2	2	2	2,41	0,22	0,95	3,57	1,94	2,14	2,85	2	4	1	3	2	3413	
423	2	2	2	2,41	0,22	0,95	3,57	1,94	2,28	3,03	1	4	1	2	2	3412	
3411	4	3	2	3,16	0,55	1,01	4,72	2,57	3,95	5,26	1	4	1	2	2	3412	
122	2	2	2	4,56	1,12	2	7,68	4,17	4,55	6,05	3	1	2	3	2	3123	
122	1	2	2	2,73	0,59	1,35	4,67	5,08	3,72	4,95	3	1	2	3	2	2123	
123	6	3	2	11,67	3,09	4,35	19,13	3,68	19,24	25,59	3	1	2	3	2	6123	
5422	4	3	2	8,29	2,43	3,28	14,01	3,81	12,12	16,12	2	3	2	1	2	5321	
412	4	3	1	5,9	1,54	2,08	9,53	5,18	5,59	7,44	3	4	2	3	1	3423	
412	4	3	1	5,9	1,54	2,08	9,53	5,18	8,17	10,87	3	4	2	3	1	3423	
132	3	2	2	8,65	2,26	3,29	14,19	3,86	11,3	15,04	3	4	2	2	2	5422	
3411	4	3	2	5,73	1,54	2,08	9,35	5,08	6,4	8,52	2	4	1	2	2	3412	
411	2	3	2	3,14	0,77	1,38	5,29	5,75	3,94	5,25	2	4	1	2	2	2412	
412	4	3	2	5,9	1,54	2,08	9,53	5,18	5,12	6,81	2	4	1	2	2	3412	
412	8	5	2	10,48	3,07	3,43	16,98	4,62	13,34	17,75	2	4	2	3	2	5423	
1413	1	2	2	2,26	0,41	1,05	3,72	8,09	2,41	3,21	2	4	1	3	2	1413	
412	4	3	2	3,34	0,55	1,02	4,91	2,67	4,23	5,63	1	4	2	3	2	3423	
412	6	4	2	4,46	0,75	1,34	6,55	2,37	5,53	7,36	1	4	2	3	2	4423	
121	2	2	1	2,14	0,13	1,18	3,45	1,25	2,66	3,54	1	4	2	2	1	4422	
6331	4	3	1	4,15	0,54	1,68	6,37	1,55	7,37	9,8	1	1	2	2	1	6122	
422	1	2	2	1,4	0,09	0,6	2,15	2,34	1,37	1,83	1	4	1	2	2	2412	
121	1	1	2	1,2	0,04	0,6	1,82	1,98	1,35	1,8	1	3	2	2	2	2322	
411	4	3	2	3,16	0,55	1,01	4,72	2,57	3,4	4,53	1	3	2	1	2	3321	
1411	1	2	2	1,1	0,09	0,5	1,69	3,67	1,5	2	1	4	1	2	2	1412	
412	4	3	2	3,34	0,55	1,02	4,91	2,67	3,53	4,69	1	4	1	3	2	3413	
413	8	5	2	6,41	1,19	1,71	9,32	2,53	8,85	11,78	1	3	2	1	2	5321	
411	1	2	2	1,1	0,09	0,5	1,69	3,67	1,4	1,86	1	4	2	2	2	1422	
1411	1	2	2	1,1	0,09	0,5	1,69	3,67	1,33	1,76	1	4	2	2	2	1422	
412	4	3	2	3,34	0,55	1,02	4,91	2,67	4,79	6,37	1	4	2	3	2	3423	
411	2	3	2	1,6	0,22	0,7	2,48	2,7	1,45	1,94	1	4	2	2	2	2422	
421	1	2	2	1,1	0,09	0,5	1,69	3,67	0,45	0,6	1	4	1	1	2	1411	
3412	4	3	2	3,34	0,55	1,02	4,91	2,67	3,24	4,31	1	4	1	3	2	3413	
121	2	2	2	1,7	0,13	0,9	2,79	1,52	1,92	2,55	1	4	2	2	2	3422	

GROUND WATER SURFACE WATER ALTERNATIF

OPTION 2

cost estimate TPV Rp 10	TPV l Rp 10	TPV l/s categories	2007 TPV Rp 10	2022 TPV Rp 10E6	Dista from sourc km	Elevat dif. w source	Pumping stage
3,72	8,09	4	3,62	4,82	99	280	4
4,83	5,25	3	3,6	4,79	103	300	4
8	4,35	3	5,7	7,58	98	285	4
11,39	4,13	3	11,11	14,77	109	350	4
11,39	4,13	3	8,34	11,1	107	340	4
5,01	5,45	3	4,18	5,56	105	325	4
4,91	2,67	2	4,48	5,96	67	161	2
2,83	3,08	2	2,11	2,81	72	212	2
9,82	3,56	2	9,27	12,33	82	180	3
9,73	5,29	3	5,12	6,81	82	197	3
9,73	5,29	3	5,84	7,77	81	195	3
4,91	2,67	2	3,13	4,17	73	170	3
4,91	2,67	2	4,11	5,46	84	165	3
7,87	4,28	3	4,67	6,21	78	215	3
4,85	5,27	3	3,86	5,14	85	217	3
17,76	3,39	2	17,72	23,57	76	195	3
13,79	3,75	2	11,93	15,87	89	178	3
8,2	4,46	3	4,81	6,4	79	196	3
8,2	4,46	3	7,04	9,36	88	205	3
14,62	3,97	2	11,62	15,46	89	300	4
9,53	5,18	3	6,53	8,68	94	340	4
5,46	5,93	3	4,07	5,41	96	342	4
9,53	5,18	3	5,12	6,81	86	185	3
14,23	3,87	2	11,17	14,86	84	225	3
3,72	8,09	4	2,41	3,21	87	200	3
3,57	1,94	1	3,08	4,09	39	80	2
4,82	1,75	1	4,09	5,44	41	77	2
4,6	1,67	1	3,55	4,72	74	112	2
6,89	1,45	1	6,89	9,17	50	65	1
2,66	2,89	2	1,69	2,25	42	67	2
2,15	2,34	2	1,59	2,12	41	57	1
3,12	1,69	1	2,24	2,98	37	37	1
1,85	4,02	3	1,65	2,19	44	45	1
5,11	2,78	2	3,67	4,88	22	37	1
5,9	1,6	1	5,6	7,45	32	67	1
1,85	4,02	3	1,53	2,04	35	79	1
1,85	4,02	3	1,45	1,93	40	97	1
3,57	1,94	1	3,48	4,63	65	97	2
2,15	2,34	2	1,26	1,68	65	95	2
1,69	3,67	2	0,45	0,6	64	115	2
5,11	2,78	2	3,37	4,49	63	111	2
3,38	1,84	1	2,32	3,09	45	87	2

WELL NO.	MANDAL	VILLAGE	ELEV. masl	POP. 1991	Deman 55 lc 2007 m3/da	Deman 2007 l/s	Deman 2007 categ	Deman 2022 m3/da	Deman 2022 l/s	Deman 2022 categ	PHASE	Exist PWS/MWSS	Stage o gr.wat develop	Hydro quant zon	Water quali categ
*******	GURRAMPODE	UTLAPALLY	*****	615	46	0,5	2	61	0,7	2	2	N	1	2	3
*******	GURRAMPODE	SHAKAJIPUR	*****	540	40	0,5	2	54	0,6	2	2	N	1	2	2
*******	GURRAMPODE	CHINTAGUDA	*****	724	54	0,6	2	72	0,8	2	2	N	1	2	1
*******	GURRAMPODE	POCHAMPALLY	*****	1610	120	1,4	3	160	1,9	4	2	N	1	1	1
*******	GURRAMPODE	MULKAPALLI	*****	404	30	0,3	1	40	0,5	2	2	N	1	1	1
*******	GURRAMPODE	SULTHANPUR	*****	777	58	0,7	2	77	0,9	2	2	N	1	2	1
*******	GURRAMPODE	MAKKAPALLI	*****	1198	90	1	3	119	1,4	3	2	N	1	2	2
*******	GURRAMPODE	KALVAPALLI	*****	819	61	0,7	2	82	0,9	3	2	Y	1	2	1
*******	GURRAMPODE	PALVAI	*****	3074	230	2,7	4	306	3,5	5	2	Y	1	1	2
*******	GURRAMPODE	GOURARAM	*****	739	55	0,6	2	74	0,9	2	2	N	1	1	1
*******	GURRAMPODE	KONDAPUR	*****	62	5	0,1	1	6	0,1	1	2	N	1	2	1
*******	DEVARAKONDA	K.MALLEPALLY	*****	3309	248	2,9	5	329	3,8	6	2	Y	1	2	1
*******	DEVARAKONDA	PENDLIPAKALA	*****	2051	153	1,8	3	204	2,4	4	2	Y	1	2	2
*******	DEVARAKONDA	CHENNARAM	*****	1761	132	1,5	3	175	2	4	2	N	1	2	1
*******	DEVARAKONDA	DONIYAL	*****	756	57	0,7	2	75	0,9	2	2	N	1	1	1
*******	DEVARAKONDA	KOLMUNTHALAPA	*****	2130	159	1,8	3	212	2,5	4	2	N	1	2	3
*******	DEVARAKONDA	SERIPALLY	*****	2357	176	2	4	235	2,7	4	2	N	1	2	2
*******	DEVARAKONDA	GUMMADAVELLY	*****	1567	117	1,4	3	156	1,8	3	2	N	1	2	2
*******	DEVARAKONDA	CHINTHAKUNTLA	*****	2969	222	2,6	4	296	3,4	5	2	Y	1	1	1
*******	DEVARAKONDA	FAKEERPUR	*****	244	18	0,2	1	24	0,3	1	2	N	1	2	1
*******	PEDDAVOORA	PEDDAVOORA	*****	3331	249	2,9	5	332	3,8	6	2	Y	1	2	2
*******	PEDDAVOORA	POTHNUR	*****	1397	104	1,2	3	139	1,6	3	2	N	1	1	2
******	PEDDAVOORA	PARVEDLA	*****	2518	188	2,2	4	251	2,9	5	2	N	1	2	1
******	PEDDAVOORA	SINGARAM	*****	1153	86	1	3	115	1,3	3	2	N	1	1	1
*******	PEDDAVOORA	PULICHERLA	*****	3490	261	3	5	347	4	6	2	N	1	1	1
*******	PEDDAVOORA	VUTLAPALLY	*****	2041	153	1,8	3	203	2,4	4	2	N	1	1	3
******	PEDDAVOORA	PINNAVOORA	*****	502	38	0,4	1	50	0,6	2	2	N	1	2	1
******	PEDDAVOORA	CHINTAPALLY	*****	1075	80	0,9	3	107	1,2	3	2	N	1	1	2
*******	P.A.PALLY	WADDIPATLA	*****	2982	223	2,6	4	297	3,4	5	2	N	1	2	3
*******	P.A.PALLY	MALLAPUR	*****	1530	114	1,3	3	152	1,8	3	2	N	1	1	1
******	P.A.PALLY	P.A. PALLY	*****	8452	632	7,3	6	841	9,7	6	2	Y	1	2	1
******	P.A.PALLY	DUGYAL	*****	1757	131	1,5	3	175	2	4	2	N	1	2	1
*******	P.A.PALLY	CHILAKAMARRI	*****	856	64	0,7	2	85	1	3	2	N	1	1	1
1,4E+08	P.A.PALLY	SUREPALLY	255		0	0	1	0	0	1	2	N	1		1
******	P.A.PALLY	TIRUMALAGIRI	*****	1176	88	1	3	117	1,4	3	2	N	1	1	3
******	P.A.PALLY	MEDARAM	*****	2477	185	2,1	4	247	2,9	5	2	N	1	2	1
*******	P.A.PALLY	KESHAMANENIPA	*****	1023	77	0,9	2	102	1,2	3	2	N	1	2	1
*******	P.A.PALLY	GHANPUR	*****	1942	145	1,7	3	193	2,2	4	2	N	1	1	3
******	P.A.PALLY	GUDIPALLY	*****	2965	222	2,6	4	295	3,4	5	2	Y	1	2	3
4E+08			256		0	0	1	0	0	1	2	N	1		1
*******	P.A.PALLY	G.BHEEMANAPAL	*****	2107	158	1,8	3	210	2,4	4	2	N	1	2	1
1,4E+08		GHANPALLY	240		0	0	1	0	0	1	2	N	1		1

				GROUND WATER OPTION 1					GROUND WATER OPTION 1			GROUND WATER OPTION 2					
m specificati		water supply		water supply system cost estimate								water supply system specification					
									2007	2022		SOURCE 2					
syste code	no. o wells	Round RS sc	gener appra	Inves Rp 10	Reinv Rp 10	OM Rp 10	TPV Rp 10	TPV l Rp 10	TPV Rp 10	TPV Rp 10E6	quali	type	dischar	dista	gener apprais.	syste code	n w
2411	2	2	2	1,6	0,22	0,7	2,48	2,7	1,44	1,91	1	3	2	1	2	2321	
2121	1	1	2	1,2	0,04	0,6	1,82	1,98	0,93	1,23	1	4	1	2	2	2412	
2411	2	2	2	1,6	0,22	0,7	2,48	2,7	1,69	2,25	1	4	2	2	2	2422	
3411	4	3	2	3,16	0,55	1,01	4,72	2,57	3,58	4,77	1	4	2	2	2	3422	
1411	1	2	2	1,1	0,09	0,5	1,69	3,67	1,28	1,71	1	4	2	2	2	1422	
2411	2	2	2	1,6	0,22	0,7	2,48	2,7	1,82	2,42	1	4	2	2	2	2422	
3411	4	3	2	3,16	0,55	1,01	4,72	2,57	2,67	3,55	1	4	2	2	2	3422	
2121	1	1	1	1,2	0,04	0,6	1,82	1,98	1,4	1,87	1	4	2	2	1	2422	
4121	2	1	1	2,14	0,13	1,18	3,45	1,25	3,33	4,43	1	1	3	2	1	4132	
2131	1	1	1	1,2	0,04	0,6	1,82	1,98	1,27	1,69	1	1	2	2	1	2122	
1411	1	2	2	1,1	0,09	0,5	1,69	3,67	0,2	0,26	1	4	2	2	2	1422	
5141	2	2	1	2,46	0,14	1,45	4,04	1,1	3,15	4,19	1	4	2	1	1	5421	
3141	1	1	1	1,46	0,04	0,9	2,4	1,31	2,33	3,1	1	3	3	1	1	3331	
3141	1	1	1	1,46	0,04	0,9	2,4	1,31	2	2,66	1	1	2	1	1	3121	
2131	1	1	1	1,2	0,04	0,6	1,82	1,98	1,3	1,72	1	1	2	1	1	2121	
3132	1	1	2	1,65	0,04	0,9	2,59	1,4	2,58	3,44	1	4	2	2	2	3422	
4121	2	2	2	2,14	0,13	1,18	3,45	1,25	2,55	3,39	1	4	2	2	2	4422	
3121	2	2	2	1,7	0,13	0,9	2,79	1,52	2,06	2,74	1	4	1	2	2	3412	
4121	2	1	2	2,14	0,13	1,18	3,45	1,25	3,21	4,28	1	2	2	3	2	4223	
1122	1	1	2	1,1	0,04	0,5	1,68	3,66	0,77	1,03	1	4	2	2	2	1422	
5123	4	3	2	3,19	0,38	1,49	5,06	1,37	3,95	5,26	1	4	2	3	2	5423	
3131	1	1	1	1,46	0,04	0,9	2,4	1,31	1,58	2,11	1	4	2	2	1	3422	
4122	2	2	2	2,33	0,13	1,19	3,65	1,32	2,88	3,83	1	4	2	2	2	4422	
3221	2	2	1	1,7	0,13	0,9	2,79	1,52	1,52	2,02	1	4	1	2	1	3412	
5122	4	2	2	3,55	0,38	1,52	5,45	1,48	4,47	5,95	1	4	2	2	2	5422	
3122	2	1	2	1,93	0,13	0,9	2,97	1,62	2,86	3,81	1	4	1	3	2	3413	
1121	1	1	1	1,1	0,04	0,5	1,52	3,31	1,44	1,91	1	4	1	2	1	1412	
3131	1	1	1	1,46	0,04	0,9	2,4	1,31	1,22	1,62	1	1	2	1	1	3121	
4121	2	2	1	2,14	0,13	1,18	3,45	1,25	3,23	4,29	1	4	2	2	1	4422	
3131	1	1	1	1,46	0,04	0,9	2,4	1,31	1,74	2,31	1	1	3	2	1	3132	
6131	5	3	1	4,12	0,54	2,52	7,18	0,98	7,17	9,54	1	1	2	2	1	6122	
3131	1	1	1	1,46	0,04	0,9	2,4	1,31	1,99	2,65	1	1	3	2	1	3132	
2121	1	1	1	1,2	0,04	0,6	1,82	1,98	1,47	1,95	1	4	2	1	1	2421	
1121	1	1	1	1,1	0,04	0,5	1,52	3,31	0	0	1	4	2	1	1	1421	
3122	2	1	2	1,93	0,13	0,9	2,97	1,62	1,65	2,2	1	4	2	2	2	3422	
4131	2	2	1	2,14	0,13	1,18	3,45	1,25	2,68	3,57	1	1	3	2	1	4132	
2421	1	2	2	1,3	0,09	0,6	1,98	2,15	1,9	2,53	1	1	2	2	2	2122	
3132	1	1	2	1,65	0,04	0,9	2,59	1,4	2,35	3,13	1	4	2	2	2	3422	
4132	2	2	1	2,33	0,13	1,19	3,65	1,32	3,39	4,51	1	1	2	2	1	4122	
1121	1	1	1	1,1	0,04	0,5	1,52	3,31	0	0	1	4	2	1	1	1421	
3421	2	2	1	4,61	1,21	2	7,82	4,25	7,75	10,32	2	3	3	1	1	3331	
1421	1	1	1	1,95	0,41	1,04	3,4	7,38	0	0	2	3	3	1	1	1331	

cost estimate			GROUND WATER OPTION 2		SURFACE WATER ALTERNATIF		
V 10	TPV l Rp 10	TPV l/s categories	2007 TPV Rp 10	2022 TPV Rp 10E6	Dista from sourc km	Elevat dif. w source	Pumping stage
1,98	2,15	2	1,15	1,52	62	117	2
,66	2,89	2	1,35	1,8	65	117	2
,15	2,34	2	1,47	1,95	64	129	2
,38	1,84	1	2,57	3,41	68	104	2
1,85	4,02	3	1,41	1,87	45	102	2
,15	2,34	2	1,57	2,09	59	127	2
,38	1,84	1	1,91	2,54	61	117	2
,15	2,34	2	1,66	2,21	70	117	2
3,65	1,32	1	3,51	4,67	70	137	2
,99	2,16	2	1,38	1,84	43	37	1
,85	4,02	3	0,22	0,29	65	117	2
5,9	1,6	1	4,58	6,1	71	132	2
2,61	1,42	1	2,52	3,36	78	105	2
,79	1,52	1	2,32	3,08	75	147	2
,82	1,98	1	1,3	1,72	73	101	2
,38	1,84	1	3,39	4,51	73	133	2
4,6	1,67	1	3,41	4,53	75	147	2
,91	2,67	2	3,62	4,82	75	128	2
,86	1,4	1	3,6	4,79	78	107	2
,85	4,02	3	0,85	1,13	80	107	2
5,71	1,55	1	4,47	5,95	66	40	1
,38	1,84	1	2,23	2,96	62	70	1
4,6	1,67	1	3,64	4,84	73	77	1
,91	2,67	2	2,67	3,55	64	62	1
6,11	1,66	1	5,02	6,67	67	87	1
,11	2,78	2	4,91	6,54	72	75	1
,85	4,02	3	1,75	2,32	64	66	1
,79	1,52	1	1,42	1,88	6	22	1
4,6	1,67	1	4,31	5,74	65	85	1
,59	1,4	1	1,85	2,47	85	107	2
,14	1,25	1	9,15	12,17	80	102	2
,59	1,4	1	2,13	2,83	83	90	2
1,98	2,15	2	1,59	2,12	80	117	2
,69	3,67	2	0	0	80	112	2
,38	1,84	1	1,87	2,49	62	94	1
,65	1,32	1	2,83	3,77	66	96	1
1,99	2,16	2	1,91	2,55	41	96	1
,38	1,84	1	3,09	4,12	53	83	1
,65	1,32	1	3,39	4,51	75	92	2
,69	3,67	2	0	0	75	113	2
7,2	3,91	2	7,13	9,49	46	97	1
3,4	7,38	4	0	0	46	97	1

(-1

WELL NO.	MANDAL	VILLAGE	ELEV. masl	POP. 1991	Deman 55 lc 2007 m3/da	Deman 2007 l/s	Deman 2007 categ	Deman 2022 m3/da	Deman 2022 l/s	Deman 2022 categ	PHASE	Exist PWS/MWSS	Stage o gr.wat develop	Hydro quant zon	Wate. quali cate
*******	P.A.PALLY	POLKAMPALLY	*****	960	72	0,8	2	96	1,1	3	2	N	1	3	
*******	P.A.PALLY	G.NEMLIPUR	*****	333	25	0,3	1	33	0,4	1	2	N	1	1	
*******	P.A.PALLY	C.A.PALLY	*****	1107	83	1	3	110	1,3	3	2	N	1	2	
1,4E+08	P.A.PALLY	MADHAPUR	235		0	0	1	0	0	1	2	N	1		
*******	ANUMALA	YACHARAM	*****	1633	122	1,4	3	163	1,9	4	2	N	1	2	
*******	ANUMALA	VENKATADRIPAL	*****	193	14	0,2	1	19	0,2	1	2	N	1	1	
*******	ANUMALA	MUKKAMALA	*****	577	43	0,5	2	57	0,7	2	2	N	1	2	
*******	ANUMALA	MAREPALLI	*****	1781	133	1,5	3	177	2,1	4	2	N	1	2	
*******	ANUMALA	KESALAMARRI	*****	139	10	0,1	1	14	0,2	1	2	N	1	1	
*******	ANUMALA	ALWAL	*****	2532	189	2,2	4	252	2,9	5	2	N	1	1	
*******	CHOUTUPPAL	CHOUTUPPAL	*****	8529	638	7,4	6	849	9,8	6	1	Y	2	2	
*******	CHOUTUPPAL	LAKKARAM	*****	2540	190	2,2	4	253	2,9	5	1	Y	2	2	
*******	CHOUTUPPAL	TANGADAPALLY	*****	5700	426	4,9	6	567	6,6	6	1	Y	2	2	
*******	CHOUTUPPAL	LINGOJIGUDEM	*****	3074	230	2,7	4	306	3,5	5	1	N	2	2	
*******	CHOUTUPPAL	PANTHANGI	*****	5264	394	4,6	6	524	6,1	6	1	Y	2	2	
*******	CHOUTUPPAL	TALASINGARAM	*****	1401	105	1,2	3	139	1,6	3	1	Y	2	2	
sum				457733	34234	396,2 396,4		45559	527,9					weighted qu	

average

				GROUND WATER OPTION 1					GROUND WATER OPTION 1			GROUND WATER OPTION 2					
specificati		water supply		water supply system cost estimate								water supply system specification					
									2007	2022		SOURCE 2				syste	no
ite de	no. o wells	Round RS sc	gener appra	Inves Rp 10	Reinv Rp 10	OM Rp 10	TPV Rp 10	TPV l Rp 10	TPV Rp 10	TPV Rp 10E6	quali	type	dischar	dista	gener apprais.	code	we
2421	1	2	2	1,3	0,09	0,6	1,98	2,15	1,79	2,38	1	4	2	3	2	2423	
132	1	1	2	1,1	0,04	0,5	1,68	3,66	1,06	1,4	1	4	2	2	2	1422	
131	1	1	1	1,46	0,04	0,9	2,4	1,31	1,26	1,67	1	4	2	2	1	3422	
121	1	1	1	1,1	0,04	0,5	1,52	3,31	0	0	1	4	2	2	1	1422	
3331	1	2	1	1,62	0,09	0,9	2,61	1,42	2,01	2,67	1	1	3	2	1	3132	
21	1	2	2	1,1	0,09	0,5	1,69	3,67	0,61	0,82	1	4	2	3	2	1423	
11	2	2	2	1,6	0,22	0,7	2,48	2,7	1,35	1,8	1	3	3	2	2	2332	
421	2	2	1	1,97	0,22	0,93	3,12	1,69	2,61	3,47	1	3	3	2	1	3332	
1331	1	1	1	1,1	0,09	0,5	1,69	3,67	0,44	0,59	1	1	2	2	1	1122	
131	2	1	1	2,14	0,13	1,18	3,45	1,25	2,74	3,65	1	1	2	1	1	4121	
122	8	4	2	15,25	4,52	5,83	25,57	3,46	25,56	34	1	4	2	3	2	6423	
4121	2	2	1	2,14	0,13	1,18	3,45	1,25	2,75	3,66	1	4	2	2	1	4422	
6121	6	4	1	4,33	0,5	1,9	6,73	1,37	6,76	9	1	4	2	2	1	6422	
121	2	2	1	2,14	0,13	1,18	3,45	1,25	3,33	4,43	1	1	3	2	1	4132	
121	5	3	1	4,18	0,54	1,8	6,51	1,45	6,61	8,79	1	1	3	2	1	6132	
3121	2	2	1	1,7	0,13	0,9	2,79	1,52	1,84	2,45	1	1	3	2	1	3132	
				684,1	117,48	284,66	1085,24		872,52	1160,93							
ighted reliability score																	
								average	1 2,2	2,2							
								average	0,0300	0,0300							

GROUND WATER SURFACE WATER ALTERNATIF

OPTION 2

cost estimate							
TPV Rp 10	TPV l Rp 10	TPV l/s categories	2007 TPV Rp 10	2022 TPV Rp 10E6	Dista from sourc km	Elevat dif. w source	Pumping stage
2,33	2,53	2	2,1	2,8	50	92	1
1,85	4,02	3	1,16	1,54	59	72	1
3,38	1,84	1	1,76	2,35	74	128	2
1,85	4,02	3	0	0	57	92	1
2,59	1,4	1	1,98	2,63	45	47	1
2,01	4,38	3	0,73	0,97	41	42	1
2,15	2,34	2	1,17	1,56	40	35	1
2,8	1,52	1	2,34	3,12	48	52	1
1,68	3,66	2	0,44	0,59	42	43	1
3,45	1,25	1	2,74	3,65	0	0	0
10,77	1,46	1	10,78	14,35	87	219	3
4,6	1,67	1	3,67	4,89	89	234	3
7,83	1,59	1	7,85	10,44	85	227	3
3,65	1,32	1	3,51	4,67	98	200	3
4,11	0,9	1	4,1	5,46	100	192	3
2,59	1,4	1	1,7	2,26	98	214	3
1043,09	572,39		827,86	1101,32			
			2,0900	2,0900			
			0,0200				

APPENDIX 9

Economic groundwater model

1. DESCRIPTION OF THE MODEL

In this chapter the computer model is discussed in detail. The costs variables, the design assumptions and the unit rates are discussed in the following paragraphs. They have been obtained from the estimates by the PRED of a 100 m^3/day capacity system and from the cost estimates of the AP-III surface water system.

1.1 COST VARIABLES

Investments

The investments are differentiated into two types of investments:

- Initial investments. Investments which are made at the start of the water supply system.
- Re-investments. Investments to replace components which are worn out.

The initial investments are subdivided in the following categories:

- pipe materials (only Asbestos cement pipes are in use);
- power cables;
- wells (deep well - shallow well);
- water treatment (chlorination and defluorination);
- buildings (utility building, power house);
- power supply (electricity connection);
- land acquisition;
- storage reservoirs (OHSR; GLSR):
- distribution system.

The lifetime for the different components are assumed to be as follows:

- pumps and site piping = 10 years
- E/M works of treatment = 10 years
- structures = 30 years
- pipes and power cables = 30 years

The re-investments are taken into account until year 25 to cover the full lifetime of the system (30 years).

Operation and Maintenance costs

The O/M costs in the present model are defined as those costs which are directly related to the production unit, transport mains and to the distribution system. These costs consist of:

- energy costs;
- maintenance costs;
- manpower costs;
- chemicals costs.

The different costs are elaborated hereafter.

- Energy -

Power requirements are calculated with the following formula:

$$P = \frac{\rho . g \times Q \times H}{1000 \times \eta p \times \eta m}$$

in which:

Q	=	flow rate	(m^3/s)
ρ	=	specific weight of water	(1000 kg/m^3)
p	=	required power	(Kwh)
g	=	gravitational acceleration	(m/s^2)
H	=	required pump head	(m)
p	=	pump efficiency	(1)
m	=	motor efficiency	(1)

Multiplying the required power P with the number of operation hours and the price of 1 Kwh results in the energy costs. Although the Kwh price changes over the day, for the subject calculations an average of Rp 1.61/Kwh is assumed (price level April 1991). If necessary, the price can be adapted to a new situation.

- Maintenance -

Maintenance costs are estimated as a percentage of the investment costs and have been assumed as follows:

- pipelines 0,5%
- structures 1%
- E/M works 3,0%

- Manpower -

The manpower requirements are: 2 operators in case of any system without defluoridation and 4 if a defluoridation plant is present.

- Chemicals -

The chemical requirements depend on the type of source and thus on the type of treatment. For safety chlorination a dose of 75 mg/l is taken. In case of defluoridation aluminium sulphate at 375 mg/l and lime 20 mg/l are applied.

Discount rate

The interest rate to be applied in economic cost comparison should be the rate on the local market cleared from inflation, which is about 10%. TO stress the sensibility for the interest rate the economic calculations are made for three rates of 5%, 10% and 15% respectively.

Additional costs

The total of investment is subject to 10% contingencies, PS and TP changes 12,5% and a tender premium of 15%.

1.2 DESIGN ASSUMPTIONS

In the following the design assumptions for the different components in the model are described. Design assumptions are based on standard designs of the PRED groundwater systems and based on a model-design as prepared by PRED staff. The average day system requirements represent the average daily demand.

Distribution system

The costs of a distribution system are estimated at Rp 175,000 l/s of production capacity. Not included are the costs of house connections. If a distribution system is present the user can decided not to incorporate the costs in the model.

Wells

Two types of wells can be chosen that fit the four hydrogeological standard situations that prevail in the area. Type and well discharge depend on the hydrogeological situation as does the distance between well and the village.

A standard deep well design has been assumed with a depth of 60 m. The number of deep wells to be drilled and the average distance between the wells is determined by the yield per well. In general the 500 m is taken between two sources.

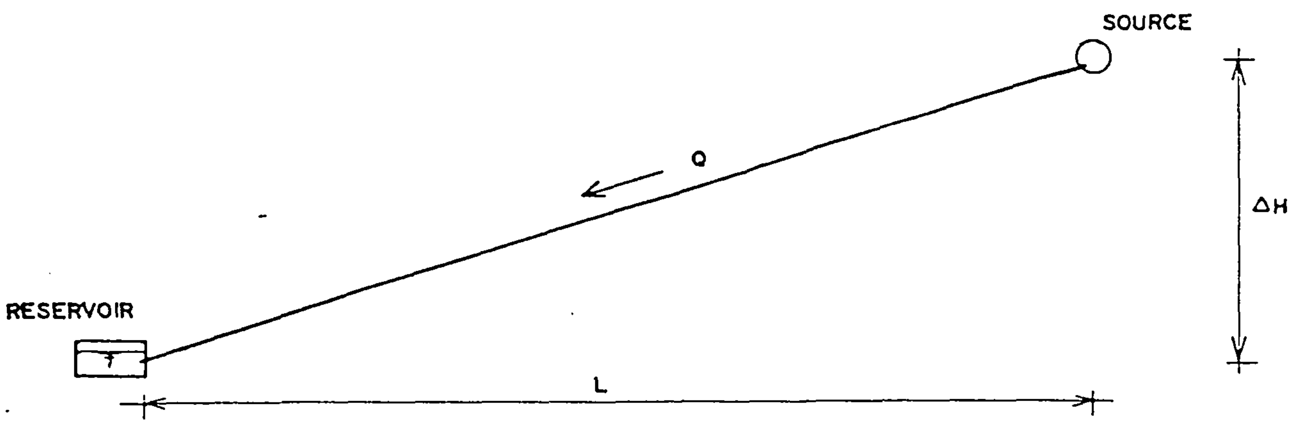
A standard shallow well has a depth of 20 m. The hydrogeological conditions, type of well discharge, distance from village water wells and elevation has to be given by the user of the model. For each villages these parameters are determined.

Water treatment

Water treatment include chlorination and if necessary defluoridation. Standard designs for defluoridation plants, as installed in the area by the National Drinking water mission are adopted.

Storage reservoirs

The volume of reservoirs, overhead or ground level is designed at 40% of the daily water production. In most cases it is assumed that the location of the reservoir is near the wells. From the reservoir the water flows under gravity to the supply area. If not sure if a ground level storage reservoir is feasible a overhead storage reservoir has been assumed. In case a OHSR or GLSR is present no additional reservoirs has assumed to be required.



$$H' = \frac{\Delta H}{L}$$

$$\frac{\Delta H}{L} = \frac{\lambda}{\varnothing} \cdot \frac{V^2}{2g} = \frac{\lambda}{2g \cdot \varnothing} \cdot \left(\frac{Q}{\frac{\pi}{4} \cdot \varnothing^2} \right) = H' \Longrightarrow \boxed{\varnothing = f\,(Q . H')}$$

ITERATION :

While $\varnothing_1 - \varnothing > 0{,}001$

$$\lambda = \frac{0{,}25}{\left(\log 3{,}7 \cdot \frac{\varnothing}{K} \right)^2} \quad \text{(NIKURADSE)}$$

$$\varnothing_1 = \sqrt[5]{\frac{\lambda \cdot L \cdot Q^2 \cdot 0{,}08267}{\Delta H}} \quad \text{(DARCY WEISBACH)}$$

Next ($\varnothing_1$)

Where : ΔH = Available head (m)
Q = System capacity (l/s)
λ = Friction coefficient
V = Velocity (m/s)
L = Pipe length (m)
g = Gravitational acceleration (m/s^2)
$\varnothing$ = Diameter (mm)
K = Wall roughness factor (mm)
Assumed (0,3 mm)

Figure 2.1: Calculation of pipe diameters for gravity mains

Buildings

They include staff quarters, utility buildings for storages, operation room, workshop and have a surface of 65 m². A power house of 12 m² is needed for accommodation of electrical equipment near the wells.

Land acquisition

For each well at least 100 m² land need to be purchased. Additional land to be acquired for protection of well intake areas can be introduced in the model. Standard 500 m² is introduced at 30 Rp/m². If required adopted value may be used.

Power connection

It is assumed that for each well on the average 500 m cable needs to be installed for power connection. Also this value can be adopted to the local situation.

Water transmission system

A large part of the investment- and energy costs (in pumped systems) depends on the **selected pipe diameter** of the water transmission system. The hydraulic head losses in transport mains are presented in table 1.1.

The numbers between brackets represent optimum hydraulic losses for pumped transport mains, based on experience. The selection of optimum diameters is based on these numbers. The hydraulic losses are calculated for the given system requirements and the selected pipe diameters (asbestos cement, class 10).

Table 1.1: Hydraulic losses in transport mains

DEMAND (l/s)	HYDRAULIC LOSSES												
	PIPE DIAMETERS (mm)												
	ND 110	ND 160	ND 200	ND 250	ND 300	ND 350	ND 400	ND 450	ND 500	ND 550	ND 600	ND 650	ND 700
5	5.6	(0.8)											
10	21.2	(2.8)	0.9										
20		10.8	(3.3)	1.1									
30			7.3	(2.3)									
40			12.9	(4.1)	1.3								
50				6.3	(1.9)								
60				9.0	(2.7)								
70				12.4	(3.7)	1.5							
80					4.8	2.0							
90					6.0	2.5	1.3						
100					7.4	3.1	1.6	0.9					
150						6.8	(3.6)	2.0	1.2				
200							6.3	(3.5)	2.1	1.4			
250								5.4	(3.2)	2.2	1.4		
300								7.8	(4.6)	3.2	2.0	1.3	
350									6.3)	4.3	(2.7)	1.8	1.2
400										5.6	(3.5)	2.3	1.6
450										7.1	4.5	(2.9)	2.0
500											5.5	(3.6)	2.4

For gravity mains the model calculates the theoretically required pipe diameter which uses the total given head for a given pipe length and system capacity. However, to minimize the risk of water hammer a maximum velocity of 2 m/s is assumed in the pipe lines. The calculation method is shown in figure 2.1.

To determine the **total required pump head**, the following input data are required:

- outflow level treatment station;
- level supply area;
- residual required head at supply area;
- hydraulic losses of clear water transport main.

The following formula is used to calculate the pump head:

$$H_{pump} = h_{el} + H_h * L + 10$$

in which:

H_{pump}	=	required pump head	(mwc)
H_{el}	=	difference of water levels	(m)
H_h	=	head losses transport main	(m/km)
L	=	length transport main	(km)
10	=	assumed residual head at supply area	(mwc)

1.3 UNIT RATES

The assumed unit rates are shown in tables 1, 2, 3 and 4 of the model output. The unit rates are based on recent tender prices and are subdivided in the following categories:

A. Pipes
B. Power cables
C. Wells
D. Water treatment
E. Buildings
F. Power supply
G. Land acquisition
H. Running costs

Unit rates for defluoridation are graphically shown in figure 2.2.

Unit rates for storage reservoirs are presented in figure 2.3 and 2.4.

2. DESIGN ASPECTS AND COST CALCULATIONS FOR SPECIFIC COMPONENTS

2.1 INTRODUCTION

All cost variables which have been discussed sofar are directly influenced by the total required capacity. There are two items however which depend on more variables and are therefore presented separately in this chapter. The two items are:

A. Piping between sources.
B. Power cables between wells.

2.2 PIPING BETWEEN SOURCES

If the number of sources is more than one, the model assumes these sources to be located in one line perpendicular to the flow direction of the aquifer. The transport main toward the treatment is assumed to start from the center of the source field as shown in figure 3.1 (deep wells). The variables which influence the design of the piping between wells are:

- the number of sources;
- the capacity per source;
- the average distance between sources.

A spreadsheet has been made which calculates the total costs of piping between sources with the abovementioned variables.

The pipe diameters depend on the flow through each section and are calculated using optimal hydraulic losses in pumped transport mains. The spreadsheet is also linked to the unit rates.

2.3 POWER CABLES BETWEEN WELLS

For the design of power cables between wells the model assumes a maximum length of the power cable of 1,000 m. As the diameter of the cable increases linear with the length, above 1,000 m it becomes more economic to increase the number of power houses with independent electricity connections.

The variables that influence the design of power cables between wells are:

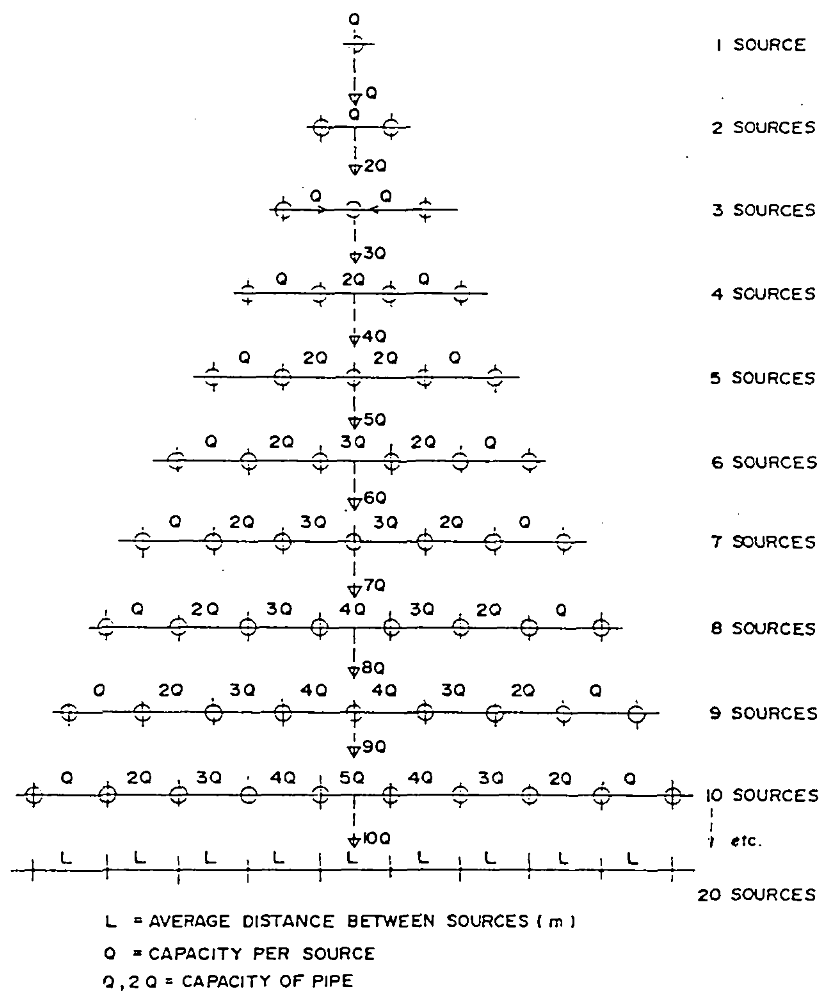
- the number of wells;
- the capacity per well;
- the average distance between wells;
- the total length of the well field.

The following power cable diameters are assumed for different well capacities and power cable lengths:

Well capacity power motor		Length power cable		
l/s	kW	0 - 400 m	400 - 800 m	800 - 1,000 m
2,5	3,7	4 * 6	4 * 10	4 * 25
5,0	5,6	4 * 10	4 * 16	4 * 35
10,0	11,0	4 * 16	4 * 35	4 * 70
20,0	22,0	4 * 35	4 * 70	4 * 120

The number of power houses is calculated by dividing the total length of the well field by 2,000 m, which is assumed maximum well field length per power house. The possible power cable configurations per power house are shown in figure 3.2. The type of cable applied is NFYGBY.

The total costs of power cables are calculated with abovementioned assumptions in a separate spreadsheet. The spreadsheet is also linked to the unit rate tables.



SCHEMATIZATION PIPING BETWEEN SOURCES

3. USE OF THE MODEL

3.1 INPUT DATA

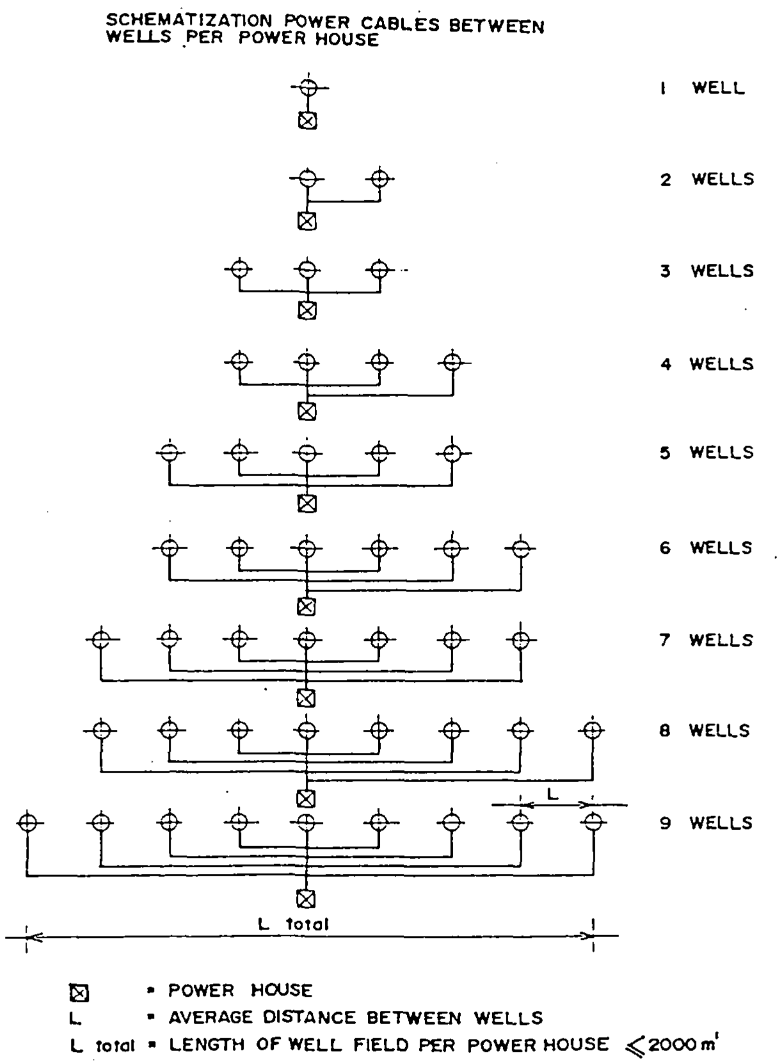
As input data, the model asks for certain variables to be given by the user input datasheet. Thereafter the computer automatically computes design parameters and cost calculations up to the present values.

3.2 OUTPUT DATA

The output consists of the following:

- summary of system characteristics;
- initial investments;
- reinvestment;
- operation and maintenance costs;
- present values.

After calculating several alternatives, the source with the lowest present value is chosen as the most favourable one from economic point of view.



WATER RESOURCES STUDY AP III

- VILLAGE : NALGONDA
- CODE : 1605000
- DATE : 16-6-1992

- AVERAGE DAY SYSTEM REQUIREMENTS : 1.87 l/s

- TYPE OF SYSTEM : 1 RURAL (1)

- CLEAR WATER DISTRIBUTION : y (Yes/No)

- TYPE OF SOURCE : 5 DEEP WELL (5)
  SHALLOW WELL (6)

- NUMBER OF SOURCES : 2

- AVERAGE DISTANCE BETWEEN SOURCES : 500 m

- RAW WATER TRANSMISSION : 8 PUMPED (8)
  (SOURCE -> TREATMENT) GRAVITY (9)

- TREATMENT : 10 CHLORINATION (10)
  CHL./DEFLUORIDATION(11)

- CLEAR WATER STORAGE : 12 ELEVATED - OHRS - (12)
  GROUND LEVEL - GLRS - (13)
- WATERLEVEL SOURCE : 0 m +REF
- INFLOWLEVEL TREATMENT : 35 m +REF

- DISTANCE SOURCE -> TREATMENT : 100 m

- CLEAR WATER TRANSMISSION : 15 PUMPED (14)
  (TREATMENT -> SUPPLY AREA) GRAVITY (15)

- OUTFLOWLEVEL TREATMENT : 30 m +REF
- ELEVATION SUPPLY AREA : 20 m +REF

- DISTANCE TREATMENT-> SUPPLY AREA : 1000 m
- LENGTH REQUIRED POWER LINE : 1000 m
- ADDITIONAL LAND AQUISITION : 2000 m^2 (30 Rs/m^2)

CALCULATED DESIGN INPUT :

Diam. Pipe Source -> Treatment	:	83	mm
Head loss	:	2.68	m/km
Pipe material	:	AC	
Price of pipesupply+acc.20% & laying	:	131	Rs/m^1
Required pumphead Source	:	45	mwc
Diam. Pipe Treatment-> Supply Area	:	65	mm
Head loss	:	10.00	m/km
Pipe material	:	AC	
Price of pipesupply+acc.20% & laying	:	120	Rs/m^1
Required pumphead transmission	:	-	mwc

Table 1 : Unit Rates for pipe line materials and power cables — price level 1992*

ITEM	DESCRIPTION	DIAMETER ext./int mm	CLASS	UNIT	supply Rs	accessories 20% supply Rs	UNIT RATE install. Rs	total Rs
A	PIPES							
A-1	Galvanized steel (GS)	89/81	B (medium)	m	0	0	0	0
	Standard : SII 0161-81	114/105	B (medium)	m	0	0	0	0
A-2	Steel	168/157	St. 37.2	m	0	0	0	0
	Standard : AWWA	219/208	St. 37.2	m	0	0	0	0
	Pipe : C 200	273/260	St. 37.2	m	0	0	0	0
	Inside : C 205	324/311	St. 37.2	m	0	0	0	0
	Outside : C 203	356/343	St. 37.2	m	0	0	0	0
		406/394	St. 37.2	m	0	0	0	0
		457/443	St. 37.2	m	0	0	0	0
		509/493	St. 37.2	m	0	0	0	0
		559/541	St. 37.2	m	0	0	0	0
		610/592	St. 37.2	m	0	0	0	0
		660/641	St. 37.2	m	0	0	0	0
		711/692	St. 37.2	m	0	0	0	0
A-3	Asbestos cement	250	CL-10	m	0	0	0	360
	Standard : CLASS 10	300	CL-10	m	0	0	0	459
		350	CL-10	m	0	0	0	617
		400	CL-10	m	0	0	0	746
		450	CL-10	m	0	0	0	901
		500	CL-10	m	0	0	0	1,122
A-4	Asbestos cement	80	CL-10	m	0	0	0	118
	Standard : CLASS 10	100	CL-10	m	0	0	0	137
		150	CL-10	m	0	0	0	202
		200	CL-10	m	0	0	0	292
		250	CL-10	m	0	0	0	360
		300	CL-10	m	0	0	0	459
B	POWER CABLES							
	Cable NYFGBY	4*6 mm^2		m	0	0	0	70
		4*10 mm^2		m	0	0	0	85
		4*16 mm^2		m	0	0	0	140
		4*25 mm^2		m	0	0	0	170
		4*35 mm^2		m	0	0	0	190
		4*50 mm^2		m	0	0	0	270
		4*70 mm^2		m	0	0	0	320
		4*95 mm^2		m	0	0	0	410
		4*120 mm^2		m	0	0	0	500

Table 2 : Unit Rates for Major System Components — price level 1992

ITEM	DESCRIPTION	REMARKS/ SPECIFICATIONS	UNIT	UNIT RATE CIVIL WORKS Rs ,000,000	UNIT RATE E&M WORKS Rs ,000,000
C	RAW WATER INTAKES				
C-2	Deep well				
	- Borehole and piping	depth 60 m	number	.021	-
	- Pumps , site piping and electrical equipment	cap. 0-2.5 l/s	number	-	.036
		cap. 2.6-5.0 l/s	number	-	.038
		cap. 5.1-10.0 l/s	number	-	.040
		cap. 10.1-20.0 l/s	number	-	.042
C-3	Shallow well				
	- Main stucture	depth 20 m	number	.100	-
	- Pumps and site piping	cap. 0-2.5 l/s	number	-	.036
		cap. 2.6-5.0 l/s	number	-	.038
		cap. 5.1-10.0 l/s	number	-	.040
		cap. 10.1-20.0 l/s	number	-	.042

Table 3 : Unit Rates for Major System Components price level 1992*

ITEM	DESCRIPTION	REMARKS/ SPECIFICATIONS	UNIT	UNIT RATE CIVIL WORKS Rs ,000,000	UNIT RATE E&M WORKS Rs ,000,000
D	WATER TREATMENT				
D-1	Chlorination (safety chlorination)	cap. 0-20 l/s	number	.020	-
		cap. 21-100 l/s	number	.020	-
		cap. 101-500 l/s	number	.020	-
F	BUILDINGS				
F-1	- Utility building	65 m2	number	.158	-
		65 m2	number	.158	-
		65 m2	number	.158	-
	- Power house	12 m2	number	.024	-

Table 4 : Unit Rates for Major System Components price level 1992 *

ITEM	DESCRIPTION	SPECIFICATIONS	UNIT	UNIT RATE Rs ,000,000
G	POWER SUPPLY			
H	LAND ACQUISITION			
		- Deep & Shallow well (100m2)	m2	.000030
I	RUNNING COSTS			
I-1	Manpower	- Operator / guard	Rs/year	.015000
I-2	Energy	- Electricity	KWH	.00000161
I-3	Chemicals	- Bleaching powder	Kg	.00000620
		- aluminium sulfate	Kg	.00000050
		- lime	Kg	.00000050

COST CALCULATIONS PIPING BETWEEN SOURCES

number of sources	PIPING BETWEEN SOURCES capacity per source (l/s) 0 Rs 000,000	4 Rs 000,000	7.50 Rs 000,000	16 Rs 000,000	30 Rs 000,000	80 Rs 000,000	125 Rs 000,000	175 Rs 000,000	225 Rs 000,000
1	.00	.00	.00	.00	.00	.00	.00	.00	.00
2	.06	.07	.10	.15	.18	.23	.31	.37	.45
3	.12	.14	.20	.29	.36	.46	.62	.75	
4	.19	.24	.35	.47	.59	.83	1.07		
5	.25	.34	.49	.65	.82	1.20			
6	.36	.48	.67	.83	1.13				
7	.46	.63	.85	1.01	1.44				
8	.56	.78	1.03	1.24	1.81				
9	.66	.92	1.21	1.47	2.18				
10	.76	1.07	1.39	1.70	2.63				
11	.91	1.25	1.57	1.93					
12	1.05	1.43	1.75	2.16					
13	1.20	1.61	1.93	2.39					
14	1.34	1.79	2.11	2.70					
15	1.49	1.97	2.29	3.00					
16	1.64	2.15	2.52	3.31					
17	1.78	2.33	2.75	3.62					
18	1.93	2.51	2.98	3.99					
19	2.07	2.69	3.21	4.37					
20	2.22	2.87	3.44	4.74					

Total required capacity	:	1.87	l/s
Number of wells	:	2	
Capacity per well	:	.94	l/s
Average distance between wells	:	500.00	m
Total length well field	:	500.00	m
Costs piping between wells	:	.06	Rs ,000,000

(Pipe materials : AC / PVC)

COST CALCULATIONS POWER CABLES BETWEEN SOURCES

POWER CABLES BETWEEN SOURCES PER GENERATOR SET

	AVERAGE DIST. BETWEEN WELLS 0-399 M				AVERAGE DIST. BETWEEN WELLS 400-699 M				AVERAGE DIST. BETWEEN WELLS 700-1000 M			
	CAPACITY PER WELL (l/s)				CAPACITY PER WELL (l/s)				CAPACITY PER WELL (l/s)			
nr of:	0	4	7.50	16	0	4	7.50	16	0	4	7.50	16
wells:	Rs 000,000	Rs 000,000	Rs 000,000	Rs 000,000	Rs 000,000	Rs 000,000	Rs 000,000	Rs 000,000	Rs 000,000	Rs 000,000	Rs 000,000	Rs 000,00(
1	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
2	.04	.04	.07	.10	.04	.07	.10	.16	.09	.10	.16	.25
3	.07	.09	.14	.19	.09	.14	.19	.32	.17	.19	.32	.50
4	.16	.23	.33	.51	.26	.33	.51	.82				
5	.24	.37	.52	.83	.43	.52	.83	1.32				
6	.50	.65	1.00	1.45								
7	.75	.94	1.48	2.06								
8	1.09	1.32	2.12	3.06								
9	1.43	1.70	2.76	4.06								

Total required capacity	:	1.87	l/s
Number of wells	:	2	
Capacity per well	:	.94	l/s
Total length well field	:	500.00	m
Number of gensets	:	1	
Number of wells per genset	:	2.0	
Average distance between wells	:	500.00	m
Costs power cables per genset	:	.04	Rs ,000,000
Total costs power cables	:	.04	Rs ,000,000

ECONOMIC COST ANALYSIS SOURCE SELECTION

System characteristics :

Average day system requirements	:	1.87 l/s
Type of system	:	RURAL
Type of source	:	DEEP WELL
Number of sources	:	2
Aver. distance between sources	:	500 meter
Raw water transmission	:	PUMPED
- Length	:	100 meter
- Diameter	:	83 mm
- Material	:	AC
Clear water transmission	:	GRAVITY
- Length	:	1000 meter
- Diameter	:	65 mm
- Material	:	AC
Clear water distribution	:	YES
Clear water storage	:	ELEVATED - OHRS -

A INITIAL INVESTMENTS

ITEM	DESCRIPTION	SPECIFICATIONS	UNIT	QUANTITY	UNIT RATE Rs ,000,000	COSTS Rs ,000,000
1	Raw water transmission	supply/acces.20%/laying	m^1	100	.000131	.013
2	Clear water transmission	supply/acces.20%/laying	m^1	1000	.000120	.120
3	Clear water distribution	"all in"	l/s	1.87	.175000	.327
4	Raw water abstraction					
4-1	Deep well	- borehole and piping	number	2	.021000	.042
		- pumps & site piping	number	2	.036000	.072
		- piping between wells	number	1	.059050	.059
		- power cables between wells	number	1	.042500	.043
4-2	Shallow well	- borehole and piping	number	0	.000000	.000
		- pumps & site piping	number	0	.000000	.000
		- piping between wells	number	0	.000000	.000
		- power cables between wells	number	0	.000000	.000
5	Water treatment					
5-1	Chlorination	- in line dosing	number	1	.020000	.020
5-2	Defluoridation plant - coag. ,floc. ,sedim. , filtr.& pump stage	- "all in" (based on 12 hrs operation)	l/s	.00	.000000	.000
6	Clear water storage					
6-2	Elevated (OHSR)	- cap. 40% of daily delivery	m3	65	.004456	.288
6-2	Ground level (GLSR)	- cap. 40% of daily delivery	m3	0	.000000	.000
7	Buildings	- utility building	number	1	.158000	.158
		- power house	number	1	.024000	.024
8	Power supply	- power connection	m^1	1000	.000100	.100
9	Land acquisition		m2	2700	.000030	.081
						1.347
		CONTINGENCIES 10% + PS&TP CHARGES 12.5% + TENDER PREMIUM 15% Rs				.570
		TOTAL INITIAL INVESTMENTS Rs				**1.916**

C REINVESTMENTS

Reinvestments in Rs 000,000	Initial	Total
- Year 10	.24	.236
- Year 15		
- Year 20	.24	.236
- Year 25		

Notes :		
Lifetime pumps & site piping	10	years
Lifetime E&M works treatment	10	years
Lifetime Pipes & power cabl.	30	years
Lifetime Structures	30	years

D OPERATION AND MAINTENANCE COSTS

Description required manpower , and power & chemicals consumption		1	2	3	4	5	6	7	8	9	10
Average day demand	(l/s)	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9
Required total pumphead	(m)	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0
Required power	(KWH)	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7
Required chemicals/year											
- bleaching powder(75 mg/l)	(ton)	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4
- aluminium sulfate(375 mg/l)	(ton)	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
- lime(20 mg/l)	(ton)	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
Required manpower	number	2	2	2	2	2	2	2	2	2	2

(YEARS)

Power costs	Rs. 000,000	.0233	.0233	.0233	.0233	.0233	.0233	.0233	.0233	.0233	.0233
Chemicals costs											
- bleaching powder	Rs. 000,000	.0274	.0274	.0274	.0274	.0274	.0274	.0274	.0274	.0274	.0274
- aluminium sulfate	Rs. 000,000	0	0	0	0	0	0	0	0	0	0
- lime	Rs. 000,000	0	0	0	0	0	0	0	0	0	0
Manpower costs	Rs. 000,000	.0300	.0300	.0300	.0300	.0300	.0300	.0300	.0300	.0300	.0300
Maintenance costs											
- Pipelines(0.5%)	Rs. 000,000	.0026	.0026	.0026	.0026	.0026	.0026	.0026	.0026	.0026	.0026
- Structures(1%)	Rs. 000,000	.0065	.0065	.0065	.0065	.0065	.0065	.0065	.0065	.0065	.0065
- E/M works(3%)	Rs. 000,000	.0028	.0028	.0028	.0028	.0028	.0028	.0028	.0028	.0028	.0028
TOTAL O/M COSTS	Rs. 000,000	.0926	.0926	.0926	.0926	.0926	.0926	.0926	.0926	.0926	.0926

E PRESENT VALUES

	Discount rate [%] 5	10	15
Initial investments	1.916	1.916	1.916
Reinvestments	.238	.129	.075
Operation and Maintenance costs	1.235	.930	.729
TOTAL PRESENT VALUE IN Rs 10^6	3.389	2.976	2.721
TOTAL PRESENT VALUE IN Rs/l/s 10^6	1.8124	1.5913	1.4549

WATER RESOURCES STUDY AP III

- VILLAGE	:	NALGONDA		
- CODE	:	1605000		
- DATE	:	16-6-1992		
- AVERAGE DAY SYSTEM REQUIREMENTS	:	1.87	l/s	
- TYPE OF SYSTEM	:	1	RURAL	(1)
- CLEAR WATER DISTRIBUTION	:	y	(Yes/No)	
- TYPE OF SOURCE	:	5	DEEP WELL	(5)
			SHALLOW WELL	(6)
- NUMBER OF SOURCES	:	2		
- AVERAGE DISTANCE BETWEEN SOURCES	:	500	m	
- RAW WATER TRANSMISSION (SOURCE -> TREATMENT)	:	8	PUMPED	(8)
			GRAVITY	(9)
- TREATMENT	:	11	CHLORINATION	(10)
			CHL./DEFLUORIDATION	(11)
- CLEAR WATER STORAGE	:	12	ELEVATED - OHRS -	(12)
			GROUND LEVEL - GLRS -	(13)
- WATERLEVEL SOURCE	:	0	m +REF	
- INFLOWLEVEL TREATMENT	:	35	m +REF	
- DISTANCE SOURCE -> TREATMENT	:	100	m	
- CLEAR WATER TRANSMISSION (TREATMENT -> SUPPLY AREA)	:	15	PUMPED	(14)
			GRAVITY	(15)
- OUTFLOWLEVEL TREATMENT	:	30	m +REF	
- ELEVATION SUPPLY AREA	:	20	m +REF	
- DISTANCE TREATMENT-> SUPPLY AREA	:	1000	m	
- LENGTH REQUIRED POWER LINE	:	1000	m	
- ADDITIONAL LAND AQUISITION	:	2000	m^2	(30 Rs/m^2)

CALCULATED DESIGN INPUT :

Diam. Pipe Source -> Treatment	:	83	mm
Head loss	:	2.68	m/km
Pipe material	:	AC	
Price of pipesupply+acc.20% & laying	:	131	Rs/m^1
Required pumphead Source	:	45	mwc
Diam. Pipe Treatment-> Supply Area	:	65	mm
Head loss	:	10.00	m/km
Pipe material	:	AC	
Price of pipesupply+acc.20% & laying	:	120	Rs/m^1
Required pumphead transmission	:	-	mwc

Table 1 : Unit Rates for pipe line materials and power cables price level 1992*

ITEM	DESCRIPTION	DIAMETER ext./int mm	CLASS	UNIT	supply Rs	accessories 20% supply Rs	UNIT RATE install. Rs	total Rs
A	PIPES							
A-1	Galvanized steel (GS)	89/81	B (medium)	m	0	0	0	0
	Standard : SII 0161-81	114/105	B (medium)	m	0	0	0	0
A-2	Steel	168/157	St. 37.2	m	0	0	0	0
	Standard : AWWA	219/208	St. 37.2	m	0	0	0	0
	Pipe : C 200	273/260	St. 37.2	m	0	0	0	0
	Inside : C 205	324/311	St. 37.2	m	0	0	0	0
	Outside : C 203	356/343	St. 37.2	m	0	0	0	0
		406/394	St. 37.2	m	0	0	0	0
		457/443	St. 37.2	m	0	0	0	0
		509/493	St. 37.2	m	0	0	0	0
		559/541	St. 37.2	m	0	0	0	0
		610/592	St. 37.2	m	0	0	0	0
		660/641	St. 37.2	m	0	0	0	0
		711/692	St. 37.2	m	0	0	0	0
A-3	Asbestos cement	250	CL-10	m	0	0	0	360
	Standard : CLASS 10	300	CL-10	m	0	0	0	459
		350	CL-10	m	0	0	0	617
		400	CL-10	m	0	0	0	746
		450	CL-10	m	0	0	0	901
		500	CL-10	m	0	0	0	1,122
A-4	Asbestos cement	80	CL-10	m	0	0	0	118
	Standard : CLASS 10	100	CL-10	m	0	0	0	137
		150	CL-10	m	0	0	0	202
		200	CL-10	m	0	0	0	292
		250	CL-10	m	0	0	0	360
		300	CL-10	m	0	0	0	459
B	POWER CABLES							
	Cable NYFGBY	4*6 mm^2		m	0	0	0	70
		4*10 mm^2		m	0	0	0	85
		4*16 mm^2		m	0	0	0	140
		4*25 mm^2		m	0	0	0	170
		4*35 mm^2		m	0	0	0	190
		4*50 mm^2		m	0	0	0	270
		4*70 mm^2		m	0	0	0	320
		4*95 mm^2		m	0	0	0	410
		4*120 mm^2		m	0	0	0	500

Table 2 : Unit Rates for Major System Components — price level 1992

ITEM	DESCRIPTION	REMARKS/ SPECIFICATIONS	UNIT	UNIT RATE CIVIL WORKS Rs ,000,000	UNIT RATE E&M WORKS Rs ,000,000
C	RAW WATER INTAKES				
C-2	Deep well				
	- Borehole and piping	depth 60 m	number	.021	-
	- Pumps , site piping and electrical equipment	cap. 0-2.5 l/s	number	-	.036
		cap. 2.6-5.0 l/s	number	-	.038
		cap. 5.1-10.0 l/s	number	-	.040
		cap. 10.1-20.0 l/s	number	-	.042
C-3	Shallow well				
	- Main stucture	depth 20 m	number	.100	-
	- Pumps and site piping	cap. 0-2.5 l/s	number	-	.036
		cap. 2.6-5.0 l/s	number	-	.038
		cap. 5.1-10.0 l/s	number	-	.040
		cap. 10.1-20.0 l/s	number	-	.042

Table 3 : Unit Rates for Major System Components — price level 1992*

ITEM	DESCRIPTION	REMARKS/ SPECIFICATIONS	UNIT	UNIT RATE CIVIL WORKS Rs ,000,000	UNIT RATE E&M WORKS Rs ,000,000
D	WATER TREATMENT				
D-1	Chlorination (safety chlorination)	cap. 0-20 l/s	number	.020	-
		cap. 21-100 l/s	number	.020	-
		cap. 101-500 l/s	number	.020	-
F	BUILDINGS				
F-1	- Utility building	65 m2	number	.158	-
		65 m2	number	.158	-
		65 m2	number	.158	-
	- Power house	12 m2	number	.024	-

Table 4 : Unit Rates for Major System Components — price level 1992 *

ITEM	DESCRIPTION	SPECIFICATIONS	UNIT	UNIT RATE Rs ,000,000
G	POWER SUPPLY			
G-1	PLN connection		METER	.000100
H	LAND ACQUISITION			
		- Deep & Shallow well (100m2)	m2	.000030
I	RUNNING COSTS			
I-1	Manpower	- Operator / guard	Rs/year	.015000
I-2	Energy	- Electricity	KWH	.00000161
I-3	Chemicals	- Bleaching powder	Kg	.00000620
		- aluminium sulfate	Kg	.00000050
		- lime	Kg	.00000050

COST CALCULATIONS PIPING BETWEEN SOURCES

number of sources	PIPING BETWEEN SOURCES capacity per source (l/s) 0 Rs 000,000	4 Rs 000,000	7.50 Rs 000,000	16 Rs 000,000	30 Rs 000,000	80 Rs 000,000	125 Rs 000,000	175 Rs 000,000	225 Rs 000,000
1	.00	.00	.00	.00	.00	.00	.00	.00	.00
2	.06	.07	.10	.15	.18	.23	.31	.37	.45
3	.12	.14	.20	.29	.36	.46	.62	.75	
4	.19	.24	.35	.47	.59	.83	1.07		
5	.25	.34	.49	.65	.82	1.20			
6	.36	.48	.67	.83	1.13				
7	.46	.63	.85	1.01	1.44				
8	.56	.78	1.03	1.24	1.81				
9	.66	.92	1.21	1.47	2.18				
10	.76	1.07	1.39	1.70	2.63				
11	.91	1.25	1.57	1.93					
12	1.05	1.43	1.75	2.16					
13	1.20	1.61	1.93	2.39					
14	1.34	1.79	2.11	2.70					
15	1.49	1.97	2.29	3.00					
16	1.64	2.15	2.52	3.31					
17	1.78	2.33	2.75	3.62					
18	1.93	2.51	2.98	3.99					
19	2.07	2.69	3.21	4.37					
20	2.22	2.87	3.44	4.74					

Total required capacity	:	1.87	l/s
Number of wells	:	2	
Capacity per well	:	.94	l/s
Average distance between wells	:	500.00	m
Total length well field	:	500.00	m
Costs piping between wells	:	.06	Rs ,000,000

(Pipe materials : AC / PVC)

OST CALCULATIONS POWER CABLES BETWEEN SOURCES

	POWER CABLES BETWEEN SOURCES PER GENERATOR SET											
	AVERAGE DIST. BETWEEN WELLS 0-399 M				AVERAGE DIST. BETWEEN WELLS 400-699 M				AVERAGE DIST. BETWEEN WELLS 700-1000 M			
	CAPACITY PER WELL (l/s)				CAPACITY PER WELL (l/s)				CAPACITY PER WELL (l/s)			
nr of:	0	4	7.50	16	0	4	7.50	16	0	4	7.50	16
wells:	Rs 000,000	Rs 000,000	Rs 000,000	Rs 000,000	Rs 000,000	Rs 000,000	Rs 000,000	Rs 000,000	Rs 000,000	Rs 000,000	Rs 000,000	Rs 000,00
1	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
2	.04	.04	.07	.10	.04	.07	.10	.16	.09	.10	.16	.25
3	.07	.09	.14	.19	.09	.14	.19	.32	.17	.19	.32	.50
4	.16	.23	.33	.51	.26	.33	.51	.82				
5	.24	.37	.52	.83	.43	.52	.83	1.32				
6	.50	.65	1.00	1.45								
7	.75	.94	1.48	2.06								
8	1.09	1.32	2.12	3.06								
9	1.43	1.70	2.76	4.06								

Total required capacity	:	1.87	l/s
Number of wells	:	2	
Capacity per well	:	.94	l/s
Total length well field	:	500.00	m
Number of gensets	:	1	
Number of wells per genset	:	2.0	
Average distance between wells	:	500.00	m
Costs power cables per genset	:	.04	Rs ,000,000
Total costs power cables	:	.04	Rs ,000,000

ECONOMIC COST ANALYSIS SOURCE SELECTION

System characteristics :

Average day system requirements	:	1.87	l/s
Type of system	:	RURAL	
Type of source	:	DEEP WELL	
Number of sources	:	2	
Aver. distance between sources	:	500	meter
Raw water transmission	:	PUMPED	
- Length	:	100	meter
- Diameter	:	83	mm
- Material	:	AC	
Clear water transmission	:	GRAVITY	
- Length	:	1000	meter
- Diameter	:	65	mm
- Material	:	AC	
Clear water distribution	:	YES	
Clear water storage	:	ELEVATED - OHRS -	

A INITIAL INVESTMENTS

ITEM	DESCRIPTION	SPECIFICATIONS	UNIT	QUANTITY	UNIT RATE Rs ,000,000	COSTS Rs ,000,000
1	Raw water transmission	supply/acces.20%/laying	m^1	100	.000131	.013
2	Clear water transmission	supply/acces.20%/laying	m^1	1000	.000120	.120
3	Clear water distribution	"all in"	l/s	1.87	.175000	.327
4	Raw water abstraction					
4-1	Deep well	- borehole and piping	number	2	.021000	.042
		- pumps & site piping	number	2	.036000	.072
		- piping between wells	number	1	.059050	.059
		- power cables between wells	number	1	.042500	.043
4-2	Shallow well	- borehole and piping	number	0	.000000	.000
		- pumps & site piping	number	0	.000000	.000
		- piping between wells	number	0	.000000	.000
		- power cables between wells	number	0	.000000	.000
5	Water treatment					
5-1	Chlorination	- in line dosing	number	1	.020000	.020
5-2	Defluoridation plant - coag. ,floc. ,sedim. , filtr.& pump stage	- "all in" (based on 12 hrs operation)	l/s	1.87	.980392	1.833
6	Clear water storage					
6-2	Elevated (OHSR)	- cap. 40% of daily delivery	m3	65	.004456	.288
6-2	Ground level (GLSR)	- cap. 40% of daily delivery	m3	0	.000000	.000
7	Buildings	- utility building	number	1	.158000	.158
		- power house	number	1	.024000	.024
8	Power supply	- power connection	m^1	1000	.000100	.100
9	Land acquisition		m2	2700	.000030	.081
						3.180
	CONTINGENCIES 10% + PS&TP CHARGES 12.5% + TENDER PREMIUM 15% Rs					1.346
	TOTAL INITIAL INVESTMENTS Rs					4.526

C REINVESTMENTS

Reinvestments in Rs 000,000	Initial	Total
- Year 10	2.07	2.069
- Year 15		
- Year 20	2.07	2.069
- Year 25		

Notes :Lifetime pumps & site piping	10	years
Lifetime E&M works treatment	10	years
Lifetime Pipes & power cabl.	30	years
Lifetime Structures	30	years

D OPERATION AND MAINTENANCE COSTS

Description required manpower, and power & chemicals consumption		YEARS 1	2	3	4	5	6	7	8	9	10
Average day demand	(l/s)	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9
Required total pumphead	(m)	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0
Required power	(KWH)	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
Required chemicals/year											
- bleaching powder(75 mg/l)	(ton)	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4
- aluminium sulfate(375 mg/l)	(ton)	22.1	22.1	22.1	22.1	22.1	22.1	22.1	22.1	22.1	22.1
- lime(20 mg/l)	(ton)	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Required manpower	number	4	4	4	4	4	4	4	4	4	4

Power costs	Rs. 000,000	.0336	.0336	.0336	.0336	.0336	.0336	.0336	.0336	.0336	.0336
Chemicals costs											
- bleaching powder	Rs. 000,000	.0274	.0274	.0274	.0274	.0274	.0274	.0274	.0274	.0274	.0274
- aluminium sulfate	Rs. 000,000	.0111	.0111	.0111	.0111	.0111	.0111	.0111	.0111	.0111	.0111
- lime	Rs. 000,000	.0006	.0006	.0006	.0006	.0006	.0006	.0006	.0006	.0006	.0006
Manpower costs	Rs. 000,000	.0600	.0600	.0600	.0600	.0600	.0600	.0600	.0600	.0600	.0600
Maintenance costs											
- Pipelines(0.5%)	Rs. 000,000	.0026	.0026	.0026	.0026	.0026	.0026	.0026	.0026	.0026	.0026
- Structures(1%)	Rs. 000,000	.0065	.0065	.0065	.0065	.0065	.0065	.0065	.0065	.0065	.0065
- E/M works(3%)	Rs. 000,000	.0578	.0578	.0578	.0578	.0578	.0578	.0578	.0578	.0578	.0578
TOTAL O/M COSTS	Rs. 000,000	.1996	.1996	.1996	.1996	.1996	.1996	.1996	.1996	.1996	.1996

E PRESENT VALUES

	Discount rate [%] 5	10	15
Initial investments	4.526	4.526	4.526
Reinvestments	2.089	1.136	.657
Operation and Maintenance costs	2.662	2.004	1.572
TOTAL PRESENT VALUE IN Rs 10^6	9.276	7.666	6.754
TOTAL PRESENT VALUE IN Rs/l/s 10^6	4.9604	4.0993	3.6120

APPENDIX 10

Financial analysis of supply alternatives

ALTERNATIVE I, OPTION 1: SURFACE WATER - OLD LAYOUT I-1 2007

Population 1.021		Initial Investment (Rs. mln)	Re-investment (Rs. mln)	O&M cost (Rs. mln)	Total Cost (Rs. mln)	Production demanded (in m3)	Production available (in m3)	Actual Production (in m3)
467345	1992	168.6		0.0	168.6	9381959	0	0
477160	1993	56.4		0.0	56.4	9578980	0	0
487180	1994	37.7		0.0	37.7	9780138	0	0
497411	1995	247.5		0.0	247.5	9985521	0	0
507856	1996	75.2		18.2	93.4	10195217	6149520	6149520
518521	1997	28.1		18.2	46.3	10409317	6149520	6149520
529410	1998	13.0		18.2	31.2	10627913	6149520	6149520
540528	1999			32.1	32.1	10851099	13213584	10851099
551879	2000			32.8	32.8	11078972	13213584	11078972
563469	2001			33.5	33.5	11311630	13213584	11311630
575301	2002			34.2	34.2	11549174	13213584	11549174
587383	2003			34.9	34.9	11791707	13213584	11791707
599718	2004			35.6	35.6	12039333	13213584	12039333
612312	2005		68.8	36.4	105.1	12292159	13213584	12292159
625170	2006			37.1	37.1	12550294	13213584	12550294
638299	2007			37.9	37.9	12813850	13213584	12813850
651703	2008		87.9	38.7	126.6	13082941	13213584	13082941
665389	2009			39.1	39.1	13357683	13213584	13213584
679362	2010			39.1	39.1	13638194	13213584	13213584
693629	2011			39.1	39.1	13924597	13213584	13213584
708195	2012			39.1	39.1	14217013	13213584	13213584
723067	2013			39.1	39.1	14515570	13213584	13213584
738251	2014			39.1	39.1	14820397	13213584	13213584
753755	2015		68.8	39.1	107.9	15131626	13213584	13213584
769584	2016			39.1	39.1	15449390	13213584	13213584
785745	2017			39.1	39.1	15773827	13213584	13213584
802245	2018		87.9	39.1	127.0	16105077	13213584	13213584
819093	2019			39.1	39.1	16443284	13213584	13213584
836294	2020			39.1	39.1	16788593	13213584	13213584
853856	2021			39.1	39.1	17141153	13213584	13213584
871787	2022			39.1	39.1	17501118	13213584	13213584
	NPC	513.1	246.9	217.2	784.4			73409878
			10.35	2.96			Net present cost per m3	10.68

I-2 2007

ALTERNATIVE I, OPTION 2: SURFACE WATER - NEW LAYOUT

Population 1.021		Initial Investment (Rs. mln)	Re-investment (Rs. mln)	O&M cost (Rs. mln)	Total Cost (Rs. mln)	Production demanded (in m3)	Production available (in m3)	Actual Production (in m3)
467345	1992	233.7		0.0	233.7	9381959	0	0
477160	1993	78.1		0.0	78.1	9578980	0	0
487180	1994	52.2		0.0	52.2	9780138	0	0
497411	1995	159.6		0.0	159.6	9985521	0	0
507856	1996	45.6		24.4	69.9	10195217	8230896	8230896
518521	1997	17.0		24.4	41.4	10409317	8230896	8230896
529410	1998	7.9		24.4	32.3	10627913	8230896	8230896
540528	1999			32.1	32.1	10851099	12488256	10851099
551879	2000			32.8	32.8	11078972	12488256	11078972
563469	2001			33.5	33.5	11311630	12488256	11311630
575301	2002			34.2	34.2	11549174	12488256	11549174
587383	2003			34.9	34.9	11791707	12488256	11791707
599718	2004			35.7	35.7	12039333	12488256	12039333
612312	2005		198.6	36.4	235.0	12292159	12488256	12292159
625170	2006			37.0	37.0	12550294	12488256	12488256
638299	2007			37.0	37.0	12813850	12488256	12488256
651703	2008		92.4	37.0	129.4	13082941	12488256	12488256
665389	2009			37.0	37.0	13357683	12488256	12488256
679362	2010			37.0	37.0	13638194	12488256	12488256
693629	2011			37.0	37.0	13924597	12488256	12488256
708195	2012			37.0	37.0	14217013	12488256	12488256
723067	2013			37.0	37.0	14515570	12488256	12488256
738251	2014			37.0	37.0	14820397	12488256	12488256
753755	2015		198.6	37.0	235.6	15131626	12488256	12488256
769584	2016			37.0	37.0	15449390	12488256	12488256
785745	2017			37.0	37.0	15773827	12488256	12488256
802245	2018		92.4	37.0	129.4	16105077	12488256	12488256
819093	2019			37.0	37.0	16443284	12488256	12488256
836294	2020			37.0	37.0	16788593	12488256	12488256
853856	2021			37.0	37.0	17141153	12488256	12488256
871787	2022			37.0	37.0	17501118	12488256	12488256
	NPC	513.9	469.2	224.9	846.4			75912186
			12.95	2.96			Net present cost per m3	11.15

ALTERNATIVE I, OPTION 1: SURFACE WATER - OLD LAYOUT   I-1 2007

Population 1.021		Initial Investment (Rs. mln)	Re-investment (Rs. mln)	O&M cost (Rs. mln)	Total Cost (Rs. mln)	Production demanded (in m3)	Production available (in m3)	Actual Production (in m3)
467345	1992	168.6		0.0	168.6	9381959	0	0
477160	1993	56.4		0.0	56.4	9578980	0	0
487180	1994	37.7		0.0	37.7	9780138	0	0
497411	1995	247.5		0.0	247.5	9985521	0	0
507856	1996	75.2		18.2	93.4	10195217	6149520	6149520
518521	1997	28.1		18.2	46.3	10409317	6149520	6149520
529410	1998	13.0		18.2	31.2	10627913	6149520	6149520
540528	1999			32.1	32.1	10851099	13213584	10851099
551879	2000			32.8	32.8	11078972	13213584	11078972
563469	2001			33.5	33.5	11311630	13213584	11311630
575301	2002			34.2	34.2	11549174	13213584	11549174
587383	2003			34.9	34.9	11791707	13213584	11791707
599718	2004			35.6	35.6	12039333	13213584	12039333
612312	2005		68.8	36.4	105.1	12292159	13213584	12292159
625170	2006			37.1	37.1	12550294	13213584	12550294
638299	2007			37.9	37.9	12813850	13213584	12813850
651703	2008		87.9	38.7	126.6	13082941	13213584	13082941
665389	2009			39.1	39.1	13357683	13213584	13213584
679362	2010			39.1	39.1	13638194	13213584	13213584
693629	2011			39.1	39.1	13924597	13213584	13213584
708195	2012			39.1	39.1	14217013	13213584	13213584
723067	2013			39.1	39.1	14515570	13213584	13213584
738251	2014			39.1	39.1	14820397	13213584	13213584
753755	2015		68.8	39.1	107.9	15131626	13213584	13213584
769584	2016			39.1	39.1	15449390	13213584	13213584
785745	2017			39.1	39.1	15773827	13213584	13213584
802245	2018		87.9	39.1	127.0	16105077	13213584	13213584
819093	2019			39.1	39.1	16443284	13213584	13213584
836294	2020			39.1	39.1	16788593	13213584	13213584
853856	2021			39.1	39.1	17141153	13213584	13213584
871787	2022			39.1	39.1	17501118	13213584	13213584
	NPC	513.1	246.9	217.2	784.4			73409878
			10.35	2.96			Net present cost per m3	10.68

III - 3 2022

ALTERNATIVE III, OPTION 2: GROUNDWATER AND DFL WEST SURFACE WATER (AWAL)

In this alternative, it is assumed that both water sources are equally used to satisfy demand.

Population 1.021		Initial Investment (Rs. mln)	Re-investment (Rs. mln)	O&M cost (Rs. mln)	Total Cost (Rs. mln)	Production demanded (in m3)	Production available GW	Production available surface water	Actual Production (in m3)
467345.4	1992	221		0	221	9381958.76	0	0	0
477159.6	1993	221		0	221	9578979.9	0	0	0
487180	1994	221		0	221	9780138.48	0	0	0
497410.8	1995	221		0	221	9985521.38	0	0	0
507856.4	1996			19.24335	19.24334648	10195217.3	14569632	0	10195217
518521.4	1997			19.64746	19.64745676	10409316.9	14569632	0	10409317
529410.3	1998			20.06005	20.06005335	10627912.6	14569632	0	10627913
540528	1999			20.48131	20.48131447	10851098.7	14569632	0	10851099
551879	2000			20.91142	20.91142207	11078971.8	14569632	0	11078972
563468.5	2001			21.35056	21.35056194	11311630.2	14569632	0	11311630
575301.3	2002			21.79892	21.79892374	11549174.4	14569632	0	11549174
587382.7	2003			22.2567	22.25670114	11791707.1	14569632	0	11791707
599717.7	2004			22.72409	22.72409186	12039332.9	14569632	0	12039333
612311.8	2005		221	23.2013	244.2012978	12292158.9	14569632	0	12292159
625170.3	2006			23.68853	23.68852504	12550294.3	14569632	0	12550294
638298.9	2007			24.18598	24.18598407	12813850.5	14569632	0	12813850
651703.2	2008			24.69389	24.69388973	13082941.3	14569632	0	13082941
665388.9	2009			25.21246	25.21246142	13357683.1	14569632	0	13357683
679362.1	2010	70.2		25.74192	95.94192311	13638194.4	14569632	0	13638194
693628.7	2011	22.5		26.2825	48.78250349	13924596.5	14569632	0	13924597
708194.9	2012	8.4		26.83444	35.23443607	14217013	14569632	0	14217013
723067	2013	3.9		27.39796	31.29795922	14515570.3	14569632	0	14515570
738251.4	2014			30.35284	30.35284471	14820397.3	14569632	2617488	14820397
753754.7	2015		221	30.99025	251.9902544	15131625.6	14569632	2617488	15131626
769583.5	2016			31.64105	31.64104979	15449389.8	14569632	2617488	15449390
785744.8	2017			32.30551	32.30551184	15773826.9	14569632	2617488	15773827
802245.4	2018		26.3	32.98393	59.28392759	16105077.3	14569632	2617488	16105077
819092.6	2019			33.67659	33.67659007	16443283.9	14569632	2617488	16443284
836293.5	2020			34.3838	34.38379846	16788592.9	14569632	2617488	16788593
853855.7	2021			35.10586	35.10585822	17141153.4	14569632	2617488	17141153
871786.7	2022			35.2	35.2	17501117.6	14569632	2617488	17187120
	NPC	839.255462	403.3133	160.4961	1040.074476				83979369
			14.796119	1.911138			Net present cost per m3		12.38

II-1 2007

ALTERNATIVE II, GROUNDWATER -

Population 1.021		Initial Investment (Rs. mln)	Re-investment (Rs. mln)	O&M cost (Rs. mln)	Total Cost (Rs. mln)	Production demanded (in m3)	Production available (in m3)	Actual Production (in m3)
467345	1992	138.0		0.0	138.0	9381959	0	0
477160	1993	138.0		0.0	138.0	9578980	0	0
487180	1994	138.0		7.9	145.9	9780138	4162752	4162752
497411	1995	138.0		7.9	145.9	9985521	4162752	4162752
507856	1996	138.0		15.7	153.7	10195217	8325504	8325504
518521	1997	138.0		15.7	153.7	10409317	8325504	8325504
529410	1998			20.1	20.1	10627913	12488256	10627913
540528	1999			20.5	20.5	10851099	12488256	10851099
551879	2000			20.9	20.9	11078972	12488256	11078972
563469	2001			21.4	21.4	11311630	12488256	11311630
575301	2002			21.8	21.8	11549174	12488256	11549174
587383	2003		69.0	22.3	91.3	11791707	12488256	11791707
599718	2004			22.8	22.8	12039333	12488256	12039333
612312	2005		69.0	23.2	92.2	12292159	12488256	12292159
625170	2006			23.6	23.6	12550294	12488256	12488256
638299	2007		69.0	23.6	92.6	12813850	12488256	12488256
651703	2008			23.6	23.6	13082941	12488256	12488256
665389	2009			23.6	23.6	13357683	12488256	12488256
679362	2010			23.6	23.6	13638194	12488256	12488256
693629	2011			23.6	23.6	13924597	12488256	12488256
708195	2012			23.6	23.6	14217013	12488256	12488256
723067	2013		69.0	23.6	92.6	14515570	12488256	12488256
738251	2014			23.6	23.6	14820397	12488256	12488256
753755	2015		69.0	23.6	92.6	15131626	12488256	12488256
769584	2016			23.6	23.6	15449390	12488256	12488256
785745	2017		69.0	23.6	92.6	15773827	12488256	12488256
802245	2018			23.6	23.6	16105077	12488256	12488256
819093	2019			23.6	23.6	16443284	12488256	12488256
836294	2020			23.6	23.6	16788593	12488256	12488256
853856	2021			23.6	23.6	17141153	12488256	12488256
871787	2022			23.6	23.6	17501118	12488256	12488256
	NPC	661.1	300.5	158.7	903.9			83956430
			11.45	1.89			Net present cost per m3	10.77

III-1 2007

ALTERNATIVE III, OPTION 1: PHASE 1 GROUNDWATER, PHASE 2 SURFACE WATER

In this alternative, it is assumed that both water sources are equally used to satisfy demand.

Population 1.021		Initial Investment (Rs. mln)	Re-investment (Rs. mln)	O&M cost (Rs. mln)	Total Cost (Rs. mln)	Production demanded (in m3)	Production available GW	Production available surface water	Actual Production (in m3)
467345	1992	87.3		0.0	87.3	9381959	0	0	0
477160	1993	87.3		0.0	87.3	9578980	0	0	0
487180	1994	87.3		0.0	87.3	9780138	0	0	0
497411	1995	292.1		0.0	292.1	9985521	0	0	0
507856	1996	68.5		10.9	79.4	10195217	5771088	0	5771088
518521	1997	45.8		10.9	56.7	10409317	5771088	0	5771088
529410	1998	15.0		10.9	25.9	10627913	5771088	0	5771088
540528	1999			26.8	26.8	10851099	5771088	6717168	10851099
551879	2000			27.3	27.3	11078972	5771088	6717168	11078972
563469	2001			27.9	27.9	11311630	5771088	6717168	11311630
575301	2002			28.5	28.5	11549174	5771088	6717168	11549174
587383	2003			29.1	29.1	11791707	5771088	6717168	11791707
599718	2004			29.7	29.7	12039333	5771088	6717168	12039333
612312	2005		87.3	30.3	117.6	12292159	5771088	6717168	12292159
625170	2006			30.8	30.8	12550294	5771088	6717168	12488256
638299	2007			30.8	30.8	12813850	5771088	6717168	12488256
651703	2008		83.5	30.8	114.3	13082941	5771088	6717168	12488256
665389	2009			30.8	30.8	13357683	5771088	6717168	12488256
679362	2010			30.8	30.8	13638194	5771088	6717168	12488256
693629	2011			30.8	30.8	13924597	5771088	6717168	12488256
708195	2012			30.8	30.8	14217013	5771088	6717168	12488256
723067	2013			30.8	30.8	14515570	5771088	6717168	12488256
738251	2014			30.8	30.8	14820397	5771088	6717168	12488256
753755	2015		87.3	30.8	118.1	15131626	5771088	6717168	12488256
769584	2016			30.8	30.8	15449390	5771088	6717168	12488256
785745	2017			30.8	30.8	15773827	5771088	6717168	12488256
802245	2018		83.5	30.8	114.3	16105077	5771088	6717168	12488256
819093	2019			30.8	30.8	16443284	5771088	6717168	12488256
836294	2020			30.8	30.8	16788593	5771088	6717168	12488256
853856	2021			30.8	30.8	17141153	5771088	6717168	12488256
871787	2022			30.8	30.8	17501118	5771088	6717168	12488256
	NPC	541.8	271.0	169.7	771.7				71316260
							Net present cost per m3		
			11.40	2.38					10.82

III-3 2007

ALTERNATIVE III, OPTION 2: GROUNDWATER AND DFL WEST SURFACE WATER (AWAL)

In this alternative, it is assumed that both water sources are equally used to satisfy demand.

Population 1.021		Initial Investment (Rs. mln)	Re-investment (Rs. mln)	O&M cost (Rs. mln)	Total Cost (Rs. mln)	Production demanded (in m3)	Production available GW	Production available surface water	Actual Production (in m3)
467345	1992	221.0		0.0	221.0	9381959	0	0	0
477160	1993	221.0		0.0	221.0	9578980	0	0	0
487180	1994	221.0		0.0	221.0	9780138	0	0	0
497411	1995	221.0		0.0	221.0	9985521	0	0	0
507856	1996	52.1		25.5	77.7	10195217	10974528	0	10195217
518521	1997	16.7		26.1	42.8	10409317	10974528	0	10409317
529410	1998	6.2		26.6	32.9	10627913	10974528	0	10627913
540528	1999	2.9		27.2	30.1	10851099	10974528	0	10851099
551879	2000			28.5	28.5	11078972	10974528	1955232	11078972
563469	2001			29.1	29.1	11311630	10974528	1955232	11311630
575301	2002			29.7	29.7	11549174	10974528	1955232	11549174
587383	2003			30.4	30.4	11791707	10974528	1955232	11791707
599718	2004			31.0	31.0	12039333	10974528	1955232	12039333
612312	2005		221.0	31.7	252.7	12292159	10974528	1955232	12292159
625170	2006			32.3	32.3	12550294	10974528	1955232	12550294
638299	2007			33.0	33.0	12813850	10974528	1955232	12813850
651703	2008			33.3	33.3	13082941	10974528	1955232	12929760
665389	2009		19.5	33.3	52.8	13357683	10974528	1955232	12929760
679362	2010			33.3	33.3	13638194	10974528	1955232	12929760
693629	2011			33.3	33.3	13924597	10974528	1955232	12929760
708195	2012			33.3	33.3	14217013	10974528	1955232	12929760
723067	2013			33.3	33.3	14515570	10974528	1955232	12929760
738251	2014			33.3	33.3	14820397	10974528	1955232	12929760
753755	2015		221.0	33.3	254.3	15131626	10974528	1955232	12929760
769584	2016			33.3	33.3	15449390	10974528	1955232	12929760
785745	2017			33.3	33.3	15773827	10974528	1955232	12929760
802245	2018			33.3	33.3	16105077	10974528	1955232	12929760
819093	2019		19.5	33.3	52.8	16443284	10974528	1955232	12929760
836294	2020			33.3	33.3	16788593	10974528	1955232	12929760
853856	2021			33.3	33.3	17141153	10974528	1955232	12929760
871787	2022			33.3	33.3	17501118	10974528	1955232	12929760
	NPC	821.5	396.4	206.5	1122.1				80857713
							Net present cost		
			15.06	2.55			per m3		13.88

III-5 2007

ALTERNATIVE III, OPTION 3: GROUNDWATER AND DFL WEST SURFACE WATER HYDRABAD

In this alternative, it is assumed that both water sources are equally used to satisfy demand.

Population 1.021		Initial Investment (Rs. mln)	Re-investment (Rs. mln)	O&M cost (Rs. mln)	Total Cost (Rs. mln)	Production demanded (in m3)	Production available GW	Production available surface water	Actual Production (in m3)
467345	1992	221.0		0.0	221.0	9381959	0	0	0
477160	1993	221.0		0.0	221.0	9578980	0	0	0
487180	1994	221.0		0.0	221.0	9780138	0	0	0
497411	1995	221.0		0.0	221.0	9985521	0	0	0
507856	1996			25.5	25.5	10195217	10974528	0	10195217
518521	1997			26.1	26.1	10409317	10974528	0	10409317
529410	1998			26.6	26.6	10627913	10974528	0	10627913
540528	1999	42.1		27.2	69.3	10851099	10974528	0	10851099
551879	2000			37.6	37.6	11078972	10974528	1482192	11078972
563469	2001			38.4	38.4	11311630	10974528	1482192	11311630
575301	2002			39.2	39.2	11549174	10974528	1482192	11549174
587383	2003			40.0	40.0	11791707	10974528	1482192	11791707
599718	2004			40.9	40.9	12039333	10974528	1482192	12039333
612312	2005		221.0	41.7	262.7	12292159	10974528	1482192	12292159
625170	2006			42.3	42.3	12550294	10974528	1482192	12456720
638299	2007			42.3	42.3	12813850	10974528	1482192	12456720
651703	2008			42.3	42.3	13082941	10974528	1482192	12456720
665389	2009		10.5	42.3	52.8	13357683	10974528	1482192	12456720
679362	2010			42.3	42.3	13638194	10974528	1482192	12456720
693629	2011			42.3	42.3	13924597	10974528	1482192	12456720
708195	2012			42.3	42.3	14217013	10974528	1482192	12456720
723067	2013			42.3	42.3	14515570	10974528	1482192	12456720
738251	2014			42.3	42.3	14820397	10974528	1482192	12456720
753755	2015		221.0	42.3	263.3	15131626	10974528	1482192	12456720
769584	2016			42.3	42.3	15449390	10974528	1482192	12456720
785745	2017			42.3	42.3	15773827	10974528	1482192	12456720
802245	2018			42.3	42.3	16105077	10974528	1482192	12456720
819093	2019		10.5	42.3	52.8	16443284	10974528	1482192	12456720
836294	2020			42.3	42.3	16788593	10974528	1482192	12456720
853856	2021			42.3	42.3	17141153	10974528	1482192	12456720
871787	2022			42.3	42.3	17501118	10974528	1482192	12456720
	NPC	799.3	382.8	248.9	1132.7				79886250
			14.80	3.12			Net present cost per m3		14.18

I-1 2022

ALTERNATIVE I, OPTION 1: SURFACE WATER - OLD LAYOUT

Population 1.021		Initial Investment (Rs. mln)	Re-investment (Rs. mln)	O&M cost (Rs. mln)	Total Cost (Rs. mln)	Production demanded (in m3)	Production available (in m3)	Actual Production (in m3)
467345.4	1992	222.75		0	222.75	9381958.76	0	0
477159.6	1993	74.25		0	74.25	9578979.9	0	0
487180	1994	49.5		0	49.5	9780138.48	0	0
497410.8	1995	325.83375		0	325.83375	9985521.38	0	0
507856.4	1996	99		24.17953	123.1795332	10195217.3	8167824	8167824
518521.4	1997	37.125		24.17953	61.30453321	10409316.9	8167824	8167824
529410.3	1998	17.0775		24.17953	41.25703321	10627912.6	8167824	8167824
540528	1999			32.12294	32.12293774	10851098.7	17565552	10851099
551879	2000			32.79752	32.79751943	11078971.8	17565552	11078972
563468.5	2001			33.48627	33.48626734	11311630.2	17565552	11311630
575301.3	2002			34.18948	34.18947895	11549174.4	17565552	11549174
587382.7	2003			34.90746	34.90745801	11791707.1	17565552	11791707
599717.7	2004			35.64051	35.64051463	12039332.9	17565552	12039333
612311.8	2005		198.6	36.38897	234.9889654	12292158.9	17565552	12292159
625170.3	2006			37.15313	37.15313371	12550294.3	17565552	12550294
638298.9	2007			37.93335	37.93334952	12813850.5	17565552	12813850
651703.2	2008		92.4	38.72995	131.1299499	13082941.3	17565552	13082941
665388.9	2009			39.54328	39.5432788	13357683.1	17565552	13357683
679362.1	2010			40.37369	40.37368766	13638194.4	17565552	13638194
693628.7	2011			41.22154	41.2215351	13924596.5	17565552	13924597
708194.9	2012			42.08719	42.08718734	14217013	17565552	14217013
723067	2013			42.97102	42.97101827	14515570.3	17565552	14515570
738251.4	2014			43.87341	43.87340966	14820397.3	17565552	14820397
753754.7	2015		198.6	44.79475	243.3947513	15131625.6	17565552	15131626
769583.5	2016			45.73544	45.73544103	15449389.8	17565552	15449390
785744.8	2017			46.69589	46.6958853	15773826.9	17565552	15773827
802245.4	2018		92.4	47.6765	140.0764989	16105077.3	17565552	16105077
819092.6	2019			48.67771	48.67770536	16443283.9	17565552	16443284
836293.5	2020			49.69994	49.69993718	16788592.9	17565552	16788593
853855.7	2021			50.74364	50.74363586	17141153.4	17565552	17141153
871786.7	2022			51.80925	51.80925221	17501117.6	17565552	17501118
	NPC	676.2726497	469.23065	236.3304	1020.171441			79832180
			14.348892	2.96034			Net present cost per m3	12.78

I-2 2022

ALTERNATIVE I, OPTION 2: SURFACE WATER - NEW LAYOUT

Population 1.021		Initial Investment (Rs. mln)	Re-investment (Rs. mln)	O&M cost (Rs. mln)	Total Cost (Rs. mln)	Production demanded (in m3)	Production available (in m3)	Actual Production (in m3)
467345.4	1992	310.6540909		0	310.6540909	9381958.76	0	0
477159.6	1993	103.5978409		0	103.5978409	9578979.9	0	0
487180	1994	69.01875		0	69.01875	9780138.48	0	0
497410.8	1995	213.961069		0	213.961069	9985521.38	0	0
507856.4	1996	61.17679961		30.34474	91.52154236	10195217.3	10942992	10195217
518521.4	1997	22.90604482		30.98198	53.88802717	10409316.9	10942992	10409317
529410.3	1998	10.55777268		31.6326	42.19037666	10627912.6	10942992	10627913
540528	1999			32.29689	32.29688866	10851098.7	17470944	10851099
551879	2000			32.97512	32.97512333	11078971.8	17470944	11078972
563468.5	2001			33.6676	33.66760092	11311630.2	17470944	11311630
575301.3	2002			34.37462	34.37462054	11549174.4	17470944	11549174
587382.7	2003			35.09649	35.09648757	11791707.1	17470944	11791707
599717.7	2004			35.83351	35.83351381	12039332.9	17470944	12039333
612311.8	2005		198.6	36.58602	235.1860176	12292158.9	17470944	12292159
625170.3	2006			37.35432	37.35432396	12550294.3	17470944	12550294
638298.9	2007			38.13876	38.13876477	12813850.5	17470944	12813850
651703.2	2008		92.4	38.93968	131.3396788	13082941.3	17470944	13082941
665388.9	2009			39.75741	39.75741208	13357683.1	17470944	13357683
679362.1	2010			40.59232	40.59231774	13638194.4	17470944	13638194
693628.7	2011			41.44476	41.44475641	13924596.5	17470944	13924597
708194.9	2012			42.3151	42.31509629	14217013	17470944	14217013
723067	2013			43.20371	43.20371332	14515570.3	17470944	14515570
738251.4	2014			44.11099	44.1109913	14820397.3	17470944	14820397
753754.7	2015		198.6	45.03732	243.6373221	15131625.6	17470944	15131626
769583.5	2016			45.98311	45.98310588	15449389.8	17470944	15449390
785744.8	2017			46.94875	46.9487511	15773826.9	17470944	15773827
802245.4	2018		92.4	47.93467	140.3346749	16105077.3	17470944	16105077
819092.6	2019			48.9413	48.94130305	16443283.9	17470944	16443284
836293.5	2020			49.96907	49.96907041	16788592.9	17470944	16788593
853855.7	2021			51.01842	51.01842089	17141153.4	17470944	17141153
871786.7	2022			52	52	17501117.6	17470944	17470944
	NPC	684.5933699	469.23065	250.0021	1042.163911			83995634
			13.736714	2.97637			Net present cost per m3	12.41

II-1

ALTERNATIVE II, GROUNDWATER

Population 1.021		Initial Investment (Rs. mln)	Re-investment (Rs. mln)	O&M cost (Rs. mln)	Total Cost (Rs. mln)	Production demanded (in m3)	Production available (in m3)	Actual Production (in m3)
467345.4	1992	183.5		0	183.5	9381958.76	0	0
477159.6	1993	183.5		0	183.5	9578979.9	0	0
487180	1994	183.5		10.46667	193.9666667	9780138.48	5550336	5550336
497410.8	1995	183.5		10.46667	193.9666667	9985521.38	5550336	5550336
507856.4	1996			19.22585	19.22585253	10195217.3	11100672	10195217
518521.4	1997			19.6296	19.62959543	10409316.9	11100672	10409317
529410.3	1998			20.04182	20.04181694	10627912.6	11100672	10627913
540528	1999	183.5		20.4627	203.9626951	10851098.7	11100672	10851099
551879	2000	183.5		20.89241	204.3924117	11078971.8	11100672	11078972
563468.5	2001			21.33115	21.33115233	11311630.2	16651008	11311630
575301.3	2002			21.77911	21.77910653	11549174.4	16651008	11549174
587382.7	2003		85.2	22.23647	107.4364678	11791707.1	16651008	11791707
599717.7	2004			22.70343	22.70343359	12039332.9	16651008	12039333
612311.8	2005		85.2	23.18021	108.3802057	12292158.9	16651008	12292159
625170.3	2006			23.66699	23.66699002	12550294.3	16651008	12550294
638298.9	2007			24.164	24.16399681	12813850.5	16651008	12813850
651703.2	2008			24.67144	24.67144074	13082941.3	16651008	13082941
665388.9	2009			25.18954	25.189541	13357683.1	16651008	13357683
679362.1	2010		85.2	25.71852	110.9185214	13638194.4	16651008	13638194
693628.7	2011			26.25861	26.25861031	13924596.5	16651008	13924597
708194.9	2012			26.81004	26.81004112	14217013	16651008	14217013
723067	2013		85.2	27.37305	112.573052	14515570.3	16651008	14515570
738251.4	2014			27.94789	27.94788608	14820397.3	16651008	14820397
753754.7	2015		85.2	28.53479	113.7347917	15131625.6	16651008	15131626
769583.5	2016			29.13402	29.13402231	15449389.8	16651008	15449390
785744.8	2017			29.74584	29.74583678	15773826.9	16651008	15773827
802245.4	2018			30.3705	30.37049935	16105077.3	16651008	16105077
819092.6	2019			31.00828	31.00827984	16443283.9	16651008	16443284
836293.5	2020		85.2	31.4	116.6	16788592.9	16651008	16651008
853855.7	2021			31.4	31.4	17141153.4	16651008	16651008
871786.7	2022			31.4	31.4	17501117.6	16651008	16651008
	NPC	879.1093722	371.06821	174.7456	1091.153192			92665310
			13.491323	1.885772			Net present cost per m3	11.78

III-1 2022

ALTERNATIVE III, OPTION 1: PHASE 1 GROUNDWATER, PHASE 2 SURFACE WATER

In this alternative, it is assumed that both water sources are equally used to satisfy demand.

Population 1.021		Initial Investment (Rs. mln)	Re-investment (Rs. mln)	O&M cost (Rs. mln)	Total Cost (Rs. mln)	Production demanded (in m3)	Production available GW	Production available surface water	Actual Production (in m3)
467345.4	1992	116		0	116	9381958.76	0	0	0
477159.6	1993	116		0	116	9578979.9	0	0	0
487180	1994	116		0	116	9780138.48	0	0	0
497410.8	1995	415.475		0	415.475	9985521.38	0	0	0
507856.4	1996	99		14.5	113.5	10195217.3	7694784	0	7694784
518521.4	1997	37.125		14.5	51.625	10409316.9	7694784	0	7694784
529410.3	1998	17.0775		14.5	31.5775	10627912.6	7694784	0	7694784
540528	1999			26.70421	26.70421404	10851098.7	7694784	8924688	10851099
551879	2000			27.265	27.26500253	11078971.8	7694784	8924688	11078972
563468.5	2001			27.83757	27.83756759	11311630.2	7694784	8924688	11311630
575301.3	2002			28.42216	28.4221565	11549174.4	7694784	8924688	11549174
587382.7	2003			29.01902	29.01902179	11791707.1	7694784	8924688	11791707
599717.7	2004			29.62842	29.62842125	12039332.9	7694784	8924688	12039333
612311.8	2005		116	30.25062	146.2506181	12292158.9	7694784	8924688	12292159
625170.3	2006			30.88588	30.88588108	12550294.3	7694784	8924688	12550294
638298.9	2007			31.53448	31.53448458	12813850.5	7694784	8924688	12813850
651703.2	2008		198.6	32.19671	230.7967088	13082941.3	7694784	8924688	13082941
665388.9	2009			32.87284	32.87283964	13357683.1	7694784	8924688	13357683
679362.1	2010			33.56317	33.56316927	13638194.4	7694784	8924688	13638194
693628.7	2011			34.268	34.26799583	13924596.5	7694784	8924688	13924597
708194.9	2012			34.98762	34.98762374	14217013	7694784	8924688	14217013
723067	2013			35.72236	35.72236384	14515570.3	7694784	8924688	14515570
738251.4	2014			36.47253	36.47253348	14820397.3	7694784	8924688	14820397
753754.7	2015		116	37.23846	153.2384567	15131625.6	7694784	8924688	15131626
769583.5	2016			38.02046	38.02046427	15449389.8	7694784	8924688	15449390
785744.8	2017			38.81889	38.81889402	15773826.9	7694784	8924688	15773827
802245.4	2018		198.6	39.63409	238.2340908	16105077.3	7694784	8924688	16105077
819092.6	2019			40.46641	40.4664067	16443283.9	7694784	8924688	16443284
836293.5	2020			40.9	40.9	16788592.9	7694784	8924688	16619472
853855.7	2021			40.9	40.9	17141153.4	7694784	8924688	16619472
871786.7	2022			40.9	40.9	17501117.6	7694784	8924688	16619472
							0.4629981	0.537002	
	NPC	729.7846707	492.38577	185.7659	1021.991026				78853208
							Net present cost		
			15.499312	2.355844			per m3		12.96

III - 3 2022

ALTERNATIVE III, OPTION 2: GROUNDWATER AND DFL WEST SURFACE WATER (AWAL)

In this alternative, it is assumed that both water sources are equally used to satisfy demand.

Population 1.021		Initial Investment (Rs. mln)	Re-investment (Rs. mln)	O&M cost (Rs. mln)	Total Cost (Rs. mln)	Production demanded (in m3)	Production available GW	Production available surface water	Actual Production (in m3)
467345.4	1992	221		0	221	9381958.76	0	0	0
477159.6	1993	221		0	221	9578979.9	0	0	0
487180	1994	221		0	221	9780138.48	0	0	0
497410.8	1995	221		0	221	9985521.38	0	0	0
507856.4	1996			19.24335	19.24334648	10195217.3	14569632	0	10195217
518521.4	1997			19.64746	19.64745676	10409316.9	14569632	0	10409317
529410.3	1998			20.06005	20.06005335	10627912.6	14569632	0	10627913
540528	1999			20.48131	20.48131447	10851098.7	14569632	0	10851099
551879	2000			20.91142	20.91142207	11078971.8	14569632	0	11078972
563468.5	2001			21.35056	21.35056194	11311630.2	14569632	0	11311630
575301.3	2002			21.79892	21.79892374	11549174.4	14569632	0	11549174
587382.7	2003			22.2567	22.25670114	11791707.1	14569632	0	11791707
599717.7	2004			22.72409	22.72409186	12039332.9	14569632	0	12039333
612311.8	2005		221	23.2013	244.2012978	12292158.9	14569632	0	12292159
625170.3	2006			23.68853	23.68852504	12550294.3	14569632	0	12550294
638298.9	2007			24.18598	24.18598407	12813850.5	14569632	0	12813850
651703.2	2008			24.69389	24.69388973	13082941.3	14569632	0	13082941
665388.9	2009			25.21246	25.21246142	13357683.1	14569632	0	13357683
679362.1	2010	70.2		25.74192	95.94192311	13638194.4	14569632	0	13638194
693628.7	2011	22.5		26.2825	48.78250349	13924596.5	14569632	0	13924597
708194.9	2012	8.4		26.83444	35.23443607	14217013	14569632	0	14217013
723067	2013	3.9		27.39796	31.29795922	14515570.3	14569632	0	14515570
738251.4	2014			30.35284	30.35284471	14820397.3	14569632	2617488	14820397
753754.7	2015		221	30.99025	251.9902544	15131625.6	14569632	2617488	15131626
769583.5	2016			31.64105	31.64104979	15449389.8	14569632	2617488	15449390
785744.8	2017			32.30551	32.30551184	15773826.9	14569632	2617488	15773827
802245.4	2018		26.3	32.98393	59.28392759	16105077.3	14569632	2617488	16105077
819092.6	2019			33.67659	33.67659007	16443283.9	14569632	2617488	16443284
836293.5	2020			34.3838	34.38379846	16788592.9	14569632	2617488	16788593
853855.7	2021			35.10586	35.10585822	17141153.4	14569632	2617488	17141153
871786.7	2022			35.2	35.2	17501117.6	14569632	2617488	17187120
	NPC	839.255462	403.3133	160.4961	1040.074476				83979369
			14.796119	1.911138			Net present cost per m3		12.38

III-5 2022

ALTERNATIVE III, OPTION 3: GROUNDWATER AND DFL WEST SURFACE WATER HYDRABAD

In this alternative, it is assumed that both water sources are equally used to satisfy demand.

Population 1.021		Initial Investment (Rs. mln)	Re-investment (Rs. mln)	O&M cost (Rs. mln)	Total Cost (Rs. mln)	Production demanded (in m3)	Production available GW	Production available surface water	Actual Production (in m3)
467345.4	1992	221		0	221	9381958.76	0	0	0
477159.6	1993	221		0	221	9578979.9	0	0	0
487180	1994	221		0	221	9780138.48	0	0	0
497410.8	1995	221		0	221	9985521.38	0	0	0
507856.4	1996			19.24335	19.24334648	10195217.3	14569632	0	10195217
518521.4	1997			19.64746	19.64745676	10409316.9	14569632	0	10409317
529410.3	1998			20.06005	20.06005335	10627912.6	14569632	0	10627913
540528	1999			20.48131	20.48131447	10851098.7	14569632	0	10851099
551879	2000			20.91142	20.91142207	11078971.8	14569632	0	11078972
563468.5	2001			21.35056	21.35056194	11311630.2	14569632	0	11311630
575301.3	2002			21.79892	21.79892374	11549174.4	14569632	0	11549174
587382.7	2003			22.2567	22.25670114	11791707.1	14569632	0	11791707
599717.7	2004			22.72409	22.72409186	12039332.9	14569632	0	12039333
612311.8	2005		221	23.2013	244.2012978	12292158.9	14569632	0	12292159
625170.3	2006			23.68853	23.68852504	12550294.3	14569632	0	12550294
638298.9	2007			24.18598	24.18598407	12813850.5	14569632	0	12813850
651703.2	2008			24.69389	24.69388973	13082941.3	14569632	0	13082941
665388.9	2009			25.21246	25.21246142	13357683.1	14569632	0	13357683
679362.1	2010	38.05472		25.74192	63.79664311	13638194.4	14569632	0	13638194
693628.7	2011	12.1766		26.2825	38.45910349	13924596.5	14569632	0	13924597
708194.9	2012	4.552		26.83444	31.38643607	14217013	14569632	0	14217013
723067	2013	2.1053		27.39796	29.50325922	14515570.3	14569632	0	14515570
738251.4	2014			42.34701	42.34701425	14820397.3	14569632	1986768	14820397
753754.7	2015		221	43.2363	264.2363016	15131625.6	14569632	1986768	15131626
769583.5	2016			44.14426	44.14426388	15449389.8	14569632	1986768	15449390
785744.8	2017			45.07129	45.07129342	15773826.9	14569632	1986768	15773827
802245.4	2018			46.01779	46.01779059	16105077.3	14569632	1986768	16105077
819092.6	2019			46.98416	46.98416419	16443283.9	14569632	1986768	16443284
836293.5	2020			47.30738	47.307376	16788592.9	14569632	1986768	16556400
853855.7	2021			47.30738	47.307376	17141153.4	14569632	1986768	16556400
871786.7	2022			47.30738	47.307376	17501117.6	14569632	1986768	16556400
	NPC	807.7967235	383.55372	170.2527	1039.340252				83890260
			14.201296	2.029469			Net present cost per m3		12.39

APPENDIX 11

Weights of indicators and alternatives scores

RELIABILITY KLASSEN

		1	2	3	4	5	6	7	8	9		
Surface klasse 1	1	1.0	3.0	5.0	7.0	9.0	0.3	1.0	3.0	5.0	2.56	0.20
Surface klasse 2	2	0.3	1.0	3.0	5.0	7.0	0.3	0.5	2.0	4.0	1.48	0.12
Surface klasse 3	3	0.2	0.3	1.0	3.0	5.0	0.2	0.3	1.0	3.0	0.84	0.07
Surface klasse 4	4	0.1	0.2	0.3	1.0	3.0	0.2	0.3	0.5	2.0	0.47	0.04
Surface klasse 5	5	0.1	0.1	0.2	0.3	1.0	0.1	0.2	0.3	1.0	0.28	0.02
Groundwater 1	6	3.0	4.0	5.0	6.0	7.0	1.0	3.0	5.0	7.0	4.00	0.31
Groundwater 2	7	1.0	2.0	3.0	4.0	5.0	0.3	1.0	3.0	5.0	2.04	0.16
Groundwater 3	8	0.3	0.5	1.0	2.0	3.0	0.2	0.3	1.0	3.0	0.84	0.07
Groundwater 4	9	0.2	0.3	0.3	0.5	1.0	0.1	0.2	0.3	1.0	0.35	0.03
		2.56	1.4844	0.836	0.473	0.278	4.0041	2.036	0.836	0.35	12.8566123	1
1		0.199	0.1154	0.065	0.037	0.022	0.3114	0.158	0.065	0.027		

		1	2	3	4	5	6	7	8	9		
Surface klasse 1	1	1.0	2.0	3.0	4.0	5.0	0.5	1.0	3.0	5.0	2.13	0.19
Surface klasse 2	2	0.5	1.0	2.0	3.0	4.0	0.3	1.0	2.0	3.0	1.42	0.13
Surface klasse 3	3	0.3	0.5	1.0	2.0	3.0	0.3	0.5	2.0	2.0	0.96	0.09
Surface klasse 4	4	0.3	0.3	0.5	1.0	2.0	0.3	0.3	1.0	2.0	0.62	0.06
Surface klasse 5	5	0.2	0.3	0.3	0.5	1.0	0.2	0.2	1.0	2.0	0.44	0.04
Groundwater 1	6	2.0	3.0	3.0	4.0	5.0	1.0	2.0	3.0	5.0	2.81	0.25
Groundwater 2	7	1.0	1.0	2.0	3.0	5.0	0.5	1.0	3.0	5.0	1.83	0.16
Groundwater 3	8	0.3	0.5	0.5	1.0	1.0	0.3	0.3	1.0	3.0	0.67	0.06
Groundwater 4	9	0.2	0.3	0.5	0.5	0.5	0.2	0.2	0.3	1.0	0.36	0.03
		2.129	1.4235	0.956	0.622	0.444	2.8065	1.825	0.672	0.364	11.241287	1
		0.189	0.1266	0.085	0.055	0.039	0.2497	0.162	0.06	0.032		

		1	2	3	4	5	6	7	8	9		
Surface klasse 1	1	1.0	3.0	5.0	7.0	9.0	0.3	3.0	7.0	9.0	3.39	0.23
Surface klasse 2	2	0.333	1.0	3.0	5.0	7.0	0.2	0.3	3.0	5.0	1.48	0.10
Surface klasse 3	3	0.2	0.3	1.0	3.0	5.0	0.1	0.2	1.0	3.0	0.76	0.05
Surface klasse 4	4	0.1	0.2	0.3	1.0	3.0	0.1	0.1	1.0	2.0	0.47	0.03
Surface klasse 5	5	0.1	0.1	0.2	0.3	1.0	0.1	0.1	0.3	1.0	0.26	0.02
Groundwater 1	6	3.0	5.0	7.0	8.0	9.0	1.0	4.0	6.0	9.0	4.90	0.34
Groundwater 2	7	0.3	3.0	5.0	7.0	8.0	0.3	1.0	4.0	6.0	2.28	0.16
Groundwater 3	8	0.1	0.3	1.0	1.0	3.0	0.2	0.3	1.0	4.0	0.66	0.05
Groundwater 4	9	0.1	0.2	0.3	0.5	1.0	0.1	0.2	0.3	1.0	0.30	0.02
		3.393	1.4844	0.761	0.465	0.257	4.9015	2.282	0.66	0.295	14.4897601	1
		0.234	0.1024	0.052	0.032	0.018	0.338	0.157	0.046	0.02		

		1	2	3	4	5	6	7	8	9		
Surface klasse 1	1	1.0	3.0	5.0	7.0	9.0	3.0	5.0	7.0	9.0	4.58	0.33
Surface klasse 2	2	0.333	1.0	3.0	5.0	7.0	1.0	3.0	5.0	7.0	2.49	0.18
Surface klasse 3	3	0.2	0.3	1.0	3.0	5.0	0.3	1.0	3.0	5.0	1.20	0.08
Surface klasse 4	4	0.1	0.2	0.3	1.0	3.0	0.2	0.3	1.0	3.0	0.58	0.04
Surface klasse 5	5	0.1	0.1	0.2	0.3	1.0	0.1	0.2	0.3	1.0	0.28	0.02
Groundwater 1	6	0.3	1.0	5.0	7.0	9.0	1.0	3.0	5.0	7.0	2.81	0.20
Groundwater 2	7	0.2	0.3	1.0	3.0	5.0	0.3	1.0	3.0	5.0	1.20	0.09
Groundwater 3	8	0.1	0.2	0.3	1.0	3.0	0.2	0.3	1.0	3.0	0.56	0.04
Groundwater 4	9	0.1	0.1	0.2	0.3	1.0	0.1	0.2	0.3	1.0	0.28	0.02
		4.584	2.4897	1.13	0.543	0.271	2.4697	1.196	0.563	0.278	13.9614618	1
1		0.316	0.1717	0.078	0.037	0.019	0.1717	0.082	0.039	0.019		

		1	2	3	4	5	6	7	8	9		
Surface klasse 1	1	1.0	5.0	7.0	9.0	9.0	0.1	0.2	0.3	1.0	1.40	0.09
Surface klasse 2	2	0.2	1.0	5.0	7.0	9.0	0.1	0.1	0.2	0.3	0.72	0.04
Surface klasse 3	3	0.1	0.2	1.0	5.0	7.0	0.1	0.1	0.1	0.2	0.40	0.03
Surface klasse 4	4	0.1	0.1	0.2	1.0	5.0	0.1	0.1	0.1	0.1	0.24	0.01
Surface klasse 5	5	0.1	0.1	0.1	0.2	1.0	0.1	0.1	0.1	0.1	0.18	0.01
Groundwater 1	6	9.0	9.0	9.0	9.0	9.0	1.0	3.0	5.0	7.0	5.68	0.35
Groundwater 2	7	5.0	9.0	9.0	9.0	9.0	0.3	1.0	3.0	5.0	3.80	0.24
Groundwater 3	8	3.0	5.0	9.0	9.0	9.0	0.2	0.3	1.0	3.0	2.35	0.15
Groundwater 4	9	1.0	3.0	5.0	9.0	9.0	0.1	0.2	0.3	1.0	1.31	0.08
		1.403	0.7198	0.402	0.238	0.156	5.6847	3.797	2.35	1.313	16.0621995	1
		0.087	0.0498	0.028	0.016	0.011	0.3921	0.262	0.162	0.081		

		1	2	3	4	5	6	7	8	9		
Surface klasse 1	1	1.0	3.0	5.0	7.0	9.0	0.3	1.0	2.0	3.0	2.31	0.18
Surface klasse 2	2	0.333	1.0	3.0	5.0	7.0	0.3	0.5	1.0	2.0	1.31	0.10
Surface klasse 3	3	0.2	0.3	1.0	3.0	5.0	0.2	0.3	0.3	1.0	0.68	0.05
Surface klasse 4	4	0.1	0.2	0.3	1.0	3.0	0.1	0.2	0.3	0.3	0.36	0.03
Surface klasse 5	5	0.1	0.1	0.2	0.3	1.0	0.1	0.1	0.2	0.2	0.21	0.02
Groundwater 1	6	3.0	3.0	5.0	7.0	9.0	1.0	3.0	5.0	7.0	4.06	0.31
Groundwater 2	7	1.0	3.0	3.0	5.0	7.0	0.3	1.0	3.0	5.0	2.27	0.17
Groundwater 3	8	0.5	1.0	3.0	3.0	5.0	0.2	0.3	1.0	3.0	1.18	0.09
Groundwater 4	9	0.3	0.5	1.0	3.0	5.0	0.1	0.2	0.3	1.0	0.66	0.05
		2.312	1.256	0.655	0.356	0.208	4.0569	2.186	1.182	0.66	13.0078392	1
		0.158	0.0966	0.045	0.025	0.014	0.2798	0.148	0.082	0.046		

Map 1

Administration map

Map 2

Data Base location map

Map 3

Fluoride data

Map 4

Hydrogeomorphological map