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GOVERNMENT OF INDIA
MINISTRY OF WATER RESOURCES,
RIVER DEVELOPMENT & GANGA REJUVENATION
CENTRAL GROUND WATER BOARD

PLAN ON
ARTIFICIAL RECHARGE TO GROUNDWATER AND WATER CONSERVATION IN VEMULA MANDAL, KADAPA DISTRICT, ANDHRA PRADESH STATE

SOUTHERN REGION
HYDERABAD
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PLAN ON
ARTIFICIAL RECHARGE TO GROUNDWATER AND WATER CONSERVATION IN VEMULA MANDAL, KADAPA DISTRICT, ANDHRA PRADESH STATE

CONTENTS

AT A GLANCE

Name of the Mandal	VEMULA
District	KADAPA
State	ANDHRA PRADESH
Total Area sq.km.	207
Area suitable for Artificial Recharge (sq.km.)	192
Latitude and Longitude	14.283810 to 14.490810 and 78.238260 to 78.400580.
Average Annual Rainfall (mm)	501
Geology	Shale, Limestone and Quartzite
Average Depth To Water Level (Decadal) (Pre Monsoon)	16.1
Average Depth To Water Level (Decadal) (Post Monsoon)	12.9
Ground Water Resources (2011)	
Annual Replenishable Ground Water Resources (MCM/yr)	14.36
Net Annual Ground Water Availability(MCM)/yr	13.51
Net Annual Ground Water Draft(MCM)/yr	14.05
Projected Demand for Domestic and Industrial Use(MCM)/yr	1.00
Stage of Ground Water Development (%)	104
Surface Run-Off (MCM/yr)	9.80
Total Storage Created in the Mandal by Various Agencies (MCM)/yr	1.332
Artificial Recharge/Conservation Measures	
Recharge Structures Proposed (No.s)	Percolation Tanks: 6, Check Dams: 13 Farm ponds: 280, Recharge Shafts: 95
Improving Water use Efficiency	Micro Irrigation System: 1400 ha
Tentative Total Cost in Lakhs (Rs.)	1183.245
Expected Recharge/Savings (MCM)/yr	6.0

1. INTRODUCTION

Vemula Mandal is one of over-exploited mandal in Kadapa district, Andhra Pradesh State, which is economically backward and chronically drought affected. The mandal has 12 inhabited villages and 1 un inhabited village with 14 gram panchayats.

2. LOCATION

The mandal lies between north latitudes 14.283810 to 14.490810 and between east longitudes 78.238260 to 78.400580. The mandal occupies the western part of the Kadapa district and is bounded on the north by Thondur mandal, on the east by Vempalle mandal, on the south by Anantapur district and west by Pulivendula mandal. (Fig.1) The geographical area of the mandal is 207 sq.km.

3. PHYSIOGRAPHY AND DRAINAGE:

The area is drained by streams which are tributaries of Pennar river. The streams are mostly ephemeral in nature. The drainage pattern is dendritic, rectangular to sub rectangular due to the influence of geological structures. (Fig.2)

4. RAINFALL

The average rainfall in the mandal is 501 mm. The rainfall during the South-west monsoon season i.e., June-September accounts for about 85% of the total rainfall.

5. LAND USE PATTERN

Out of the total geographical area of 207 sq.km, the area covered by forest is 16.96 sq.km and the net area sown is 99.80 sq.km. Barren and uncultivable land is 34.03 sq.km. The land for non agricultural use accounts for 12.67 sq.km.(Fig.3)

6. HYDROGEOLOGY

The area is underlain byMeta sedimentary rock formations comprising of Shales, Lime stones and Quartzites of pre Cambrian age (Fig.4). Ground water occurs in weathered and fractured zones under water table and semi- confined conditions. The weathered zone thickness as per the GEC report is 15 m. The weathered zone has been extensively tapped by dug and dug cum bore wells upto20 m depth, which are mostly dry now. Ground water occurs in the fractured rock formations up to 200 m bgl. However, the potential fractures are encountered between 50-100 m bgl. The cumulative yield varies from 2-5 lps.

7. GROUND WATER LEVEL SCENARIO

The depth to water level during the pre-monsoon and post-monsoon varies from 5 to 20 m. The average depth to water level (decadal) during pre and post monsoon is 16.9 and 12.1 m bgl respectively. The depth to water levels maps for pre and post monsoon period

(2014) are shown in Fig 5 & 6 respectively. The decadal mean water level trend during post monsoon is depicted in the Fig.7.

8. DYNAMIC GROUND WATER RESOURCES

The Ground water availability, Utilization and stage of Development in Vemula Mandal Kadapa District is given in Table-1.

Table-1: Ground water resources of Vemula mandal, Kadapa district.

Annual Replenishable Ground water resources (MCM)	14.36
Net Annual Ground Water Availability(MCM)/yr	13.51
Net Annual Ground Water Draft(MCM)/yr	14.05
Projected Demand for Domestic and Industrial use up to 2025. (MCM)	1.00
Stage of Ground water development (%).	104
Whether notified or not with year of notification.	Yes, 2005

9. NEED FOR ARTIFICIAL RECHARGE AND CONSERVATION METHODS

The ground water withdrawal is more than the recharge with a stage of development above hundred percent. The long term water level trend mostly shows a declining trend and the water levels are very deep ranging upto20 m. The sustainability of bore wells has become questionable as many bore wells are either drying up or have recorded reduced yields. There is no surface water irrigation facility in the area. All these factors indicate that there is an urgent need for artificial recharge and water conservation in the Mandal.

10. JUSTIFICATION OF THE ARTIFICIAL RECHARGE PROJECT

Vemula Mandal falls under high stage of ground water development i.e., 104 % and with sufficient amount of uncommitted surface runoff. The area is completely dependent on ground water for domestic, industrial and irrigation purposes. During the monsoons runoff quickly flows out of the area without natural recharge to ground water. It is necessary to apply artificial recharge techniques to allow more and more recharge through check dams, PTs, MPTs, farm ponds, recharge shafts to cope up with the withdrawal pattern and also to improve ground water situation through various interventions including on farm activities and micro irrigation systems (Sprinkler-Drip-HDPE).

11. AVAILABILITY OF SURPLUS, SURFACE WATER FOR ARTIFICIAL RECAHRGE OR CONSERVATION

The runoff was calculated by taking into account of normal rainfall of the mandal and corresponding runoff yield from Strangers table. The existing storage created by various artificial recharge structures constructed by the State Government, if any, was deducted for calculating the runoff yield to recommend new AR structures.

Total Geographical area (Sq.kms)	207
Hilly Area (Sq.kms)	15
Area suitable for Artificial Recharge (sq.km.)	192
Runoff Yield in MCM/yr	9.80
Existing No. of Check Dams	165
Storage created MCM/yr	1.17
Existing No. of Percolation Tanks	23
Storage created MCM/yr	0.163
Total Existing Storage Created	1.332

12. FEASIBLE ARTIFICIAL RECHARGE STRUCTURES

Since the mandal is categorized as over exploited, there is an immediate need for improving ground water scenario and to ensure sustainability of ground water sources. It is also suggested to create additional storage capacity of surface water bodies which would result in supplementing irrigation thereby reducing the ground water draft. The run off available in the mandal has been assessed as 8.468 MCM/yr, which could be considered for further planning of artificial recharge. However, the number of artificial recharge structures feasible has been recommended in areas, by considering the utilizable yield, number of existing structures, land use, drainage pattern and also where the post monsoon water levels (decadal mean) are more than 5 m bgl., and or decadal trends are either falling or showing insignificant raising trend.

A) Check dams and Percolation Tanks

The area is covered by seasonal nalas – drains, which carry discharge during monsoon period debauched into the water bodies within a short duration. It is proposed to identify such nalas for construction of check dams/Percolation tank with recharge shafts, so as to harness ground water and to increase soil moisture content.

- The site selected for check dam/Percolation Tank should have sufficient thickness of permeable soils or weathered material to facilitate recharge of stored water within a short span of time. The water stored in these structures is mostly confined to the stream course and height is normally less than 2m.

- These are designed based on stream width and excess water is allowed to flow over the crest wall. In order to avoid scouring from excess runoff water cushions are provided on the downstream side. To harness maximum runoff in the stream, a series of such check dams can be constructed to have recharge on a regional scale.

- Considering the annual monsoon rainfall of 501 mm, sufficient rain water can be harnessed. This will improve ground water regime as well as delaying the instant flow into the main river.

- The flow in these seasonal rivers can be sustained up to about 2 to 3 months after monsoon.
- Recharge trenches can also be constructed along upstream side of the check dam/Percolation Tank in the impoundment area for enhancing the ground water recharge rate.

Thus, a total of 13 **Check dams and 6 Percolation tanks** are recommended.

B). Recharge Shafts

The existing check dams and percolation tanks lose their storage capacity as well as recharge capacity due to siltation. Hence, Recharge shafts are recommended in the existing Check dams and Percolation tanks to enhance the ground water recharge. During the heavy downpours, there will be sufficient accumulation of runoff, which can also effectively be utilized for recharge by constructing recharge shafts. Hence, it is proposed to construct 83 and 12 recharge shafts of 165 mm dia with 30 m depth in the existing check dams and percolation tanks respectively.

C). Farm Ponds

A farm pond is a large dug out in the earth, usually square or rectangular in shape, which harvests rain water and stores it for future use. It has an inlet to regulate inflow and an outlet to discharge excess water. The pond is surrounded by a small bund, which prevents erosion on the banks of the pond. The size and depth depend on the amount of land available; the type of soil water from the farm pond is conveyed to the fields manually, by pumping, or by both methods.

Advantages of Farm Ponds

- They provide water to start growing crops, without waiting for rain to fall.
- They provide irrigation water during dry spells between rainfalls. This increases the yield, the number of crops in one year, and the diversity of crops that can be grown.
- Bunds can be used to raise vegetables and fruit trees, thus supplying the farm household with an additional source of income and of nutritious food.
- Farmers are able to apply adequate farm inputs and perform farming operations at the appropriate time, thus increasing their productivity and their confidence in farming.
- They check soil erosion and minimize siltation of waterways and reservoirs.
- They supplies water for domestic purposes and livestock.
- They promote fish rearing.
- They recharge the ground water.

- They improve drainage.
- The excavated earth has a very high value and can be used to enrich soil in the fields, levelling land, and constructing farm roads.

As per the Land use classification, majority of the area is covered by the agricultural field. Hence, it is proposed to construct 280 farm ponds in 14 villages of the Mandal @ 20 farm ponds in each village.

D). Micro Irrigation System (Sprinkler /drip/HDPE pipes)

Micro irrigation is defined as the frequent application of small quantities of water directly above and below the soil surface; usually as discrete drops, continuous drops or tiny streams through emitters placed along a water delivery line.

In flood/furrow irrigation method more than 50% of applied water is wasted through seepage to deeper level, localized inundation causes loss through evaporation and it leaches out the nutrients from the plant. While through drip & sprinkler irrigation wastages of irrigational water could be minimized. The studies on different crops, has revealed that irrigation water is saved drastically. The conveyance losses (mainly seepage & evaporation) can be saved up to 25 to 40% through utilization of HDPE pipes. Initially the scheme is proposed to be implemented in worst affected areas showing deepest water levels and significant declining trends. It is proposed to take up micro irrigation system in 1400 ha @ 100 ha per village.

13. TENTATIVE COST ESTIMATES (VEMULA MANDAL)

S.No.	Feasible Artificial Recharge & Water Conservation structures/	No. of Structures/ Quantity	Total Volume (MCM)	Tentative unit cost (in Rs lakh)	Total tentative cost (in Rs Lakh)	Expected Annual GW recharge/savings (MCM)
1	Proposed Masonry Check dams Crest Length -10-15 m, Height-1-2 m) (0.007 MCM*4 fillings)	13	0.364	5	65	0.273
2	Recharge shaft in Check dam (50% of the existing Check dams)	83	0.913	0.5	41.5	0.913
3	Proposed Percolation Tanks (100*100*2.5)* 4 fillings)	6	0.6	15	90	0.45
4	Renovation Desilting, Repairs and installation of Recharge Shafts in existing PTS (50% of the existing PTS)	12	0.132	1	12	0.132
5	Proposed Farm Pond (6 filling) 5*5*1.5 dimension @ 20 farm ponds per each village	280	0.04032	0.25	70	0.036288
6	Proposed Sprinkler/drip/HDPE pipes for 100 ha in each village	1400	8.4	0.6	840	4.2
7	Proposed Piezometers up to 50 mbgl @ one PZ per Village	14	0	0.6	8.4	0
8 (i)	Total (No. of AR Structures)	408	2.05		286.9	1.804
8 (ii)	Total (ha)	1400			840	4.2
	Total (8(i) + 8 (ii))				**1126.9**	**6.004**
9	Impact Assessment & O & M -5 % of Total cost of the Scheme				**56.345**	
	Grand Total				**1183.245**	

*(Expected annual GW Recharge/Savings MCM - CDS& PTS: 75%, Farm ponds - 90%, Sprinklers-50%, Recharge shafts in existing CDS and PTS-100%)

Note: The type, number and cost of structure may vary according to site, after the ground truth verification.

14. TIME SCHEDULE

Steps	Quarters							
	1st	2nd	3rd	4th	5th	6th	7th	8th
Identification of line department/implementing agency and preparation of DPR								
Approval of Scheme and releases of sanction of funds								
Implementation of ARS								

Phase = one quarter or 3 months or equivalent to financial quarter

A). Operation and Maintenance

In all projects impact assessment has to be carried out to ensure that project is economically viable, socially equitable and environmentally sustainable by inter-related socio-economic, cultural and human-health impacts, both beneficial and adverse. Accordingly it is proposed to have impact assessment as well as operation & Maintenance at the rate of 5% of the total cost of the project for 5 years from the completion of artificial recharge project.

B). Expected Benefits

The benefits of the project are:

1. The implementation of the project would result in additional recharge/Ground water savings to the tune of 6.0 MCM.
2. Ground water recharge will help in arresting the rapid decline in ground water resources and will also ensure improvement in quality of ground water by dilution.
3. Proposed structures and measures will also enhance the ground water potential and would ensure sustainability of ground water resources. It is estimated that the stage of ground water development may likely to be reduced from the present 104% to 72% (32%)
4. It will also help in controlling soil erosion.

Acknowledgements

The data received from the Director Ground Water Department Andhra Pradesh in respect of the basic inputs is duly acknowledged. The information on existing Artificial Recharge Structures has been taken from the EMUSTER, Department of Rural Development, Government of Andhra Pradesh

EXISTING ARTIFICIAL RECHARGE STRUCTURES
VEMULA MANDAL, KADAPA DISTRICT, AP

S.no	Gram Panchayat	Habitation	Structure Type	Longitude	Latitude	Scheme
1	Chintalajutur	Chintalajutur	Check Dam	78.2961	14.4200	NREGS
2	Chintalajutur	Chintalajutur	Check Dam	78.2942	14.4211	NREGS
3	Chintalajutur	Chintalajutur	Check Dam	78.2997	14.4124	NREGS
4	Chintalajutur	Chintalajutur	Check Dam	78.2922	14.4234	NREGS
5	Chintalajutur	Chintalajutur	Check Dam	78.2980	14.4095	NREGS
6	Chintalajutur	Chintalajutur	Check Dam	78.3119	14.4170	NREGS
7	Chintalajutur	Chintalajutur	Check Dam	78.3092	14.4197	NREGS
8	Kanamkindakottalu	KanamkindaKottalu	Check Dam	78.2435	14.3589	NREGS
9	Kanamkindakottalu	KanamkindaKottalu	Check Dam	78.2414	14.3523	NREGS
10	Kanamkindakottalu	KanamkindaKottalu	Check Dam	78.2422	14.3516	NREGS
11	Kanamkindakottalu	KanamkindaKottalu	Check Dam	78.2352	14.3538	NREGS
12	Kanamkindakottalu	KanamkindaKottalu	Check Dam	78.2316	14.3539	NREGS
13	Kanamkindakottalu	KanamkindaKottalu	Check Dam	78.2313	14.3517	NREGS
14	Kanamkindakottalu	KanamkindaKottalu	Check Dam	78.2485	14.3606	NREGS
15	Kanamkindakottalu	KanamkindaKottalu	Check Dam	78.2501	14.3642	NREGS
16	Kanamkindakottalu	KanamkindaKottalu	Check Dam	78.2328	14.3453	NREGS
17	Kanamkindakottalu	KanamkindaKottalu	Check Dam	78.2358	14.3458	NREGS
18	Kanamkindakottalu	KanamkindaKottalu	Check Dam	78.2343	14.3476	NREGS
19	Kanamkindakottalu	KanamkindaKottalu	Check Dam	78.2370	14.3500	NREGS
20	Kanamkindakottalu	KanamkindaKottalu	Check Dam	78.2460	14.3584	NREGS
21	N.cheruvupalle	N.CheruvuPalle	Check Dam	78.3492	14.4678	NREGS
22	N.cheruvupalle	N.CheruvuPalle	Check Dam	78.3633	14.4880	NREGS
23	N.cheruvupalle	N.CheruvuPalle	Check Dam	78.3664	14.5012	NREGS
24	Pendluru	Pendluru	Check Dam	78.3550	14.4302	NREGS
25	V.kothapalle	V.Kothapalle	Check Dam	78.3496	14.3582	NREGS
26	V.kothapalle	V.Kothapalle	Check Dam	78.3513	14.3546	NREGS
27	V.kothapalle	V.Kothapalle	Check Dam	78.3551	14.3565	NREGS
28	V.kothapalle	V.Kothapalle	Check Dam	78.3537	14.3688	NREGS
29	V.kothapalle	V.Kothapalle	Check Dam	78.3513	14.3689	NREGS
30	V.kothapalle	V.Kothapalle	Check Dam	78.3608	14.3538	NREGS
31	V.kothapalle	V.Kothapalle	Check Dam	78.3613	14.3521	NREGS
32	V.kothapalle	V.Kothapalle	Check Dam	78.3565	14.3509	NREGS
33	V.kothapalle	V.Kothapalle	Check Dam	78.3573	14.3515	NREGS
34	V.kothapalle	V.Kothapalle	Check Dam	78.3584	14.3550	NREGS
35	Velpula	BestaVariPalle	Check Dam	78.2604	14.3864	NREGS
36	Velpula	BestaVariPalle	Check Dam	78.2585	14.3838	NREGS

37	Velpula	BestaVariPalle	Check Dam	78.2572	14.3809	NREGS
38	Velpula	BestaVariPalle	Check Dam	78.2544	14.3773	NREGS
39	Velpula	BestaVariPalle	Check Dam	78.2537	14.3751	NREGS
40	Velpula	BestaVariPalle	Check Dam	78.2537	14.3732	NREGS
41	Velpula	BestaVariPalle	Check Dam	78.2534	14.3697	NREGS
42	Velpula	BestaVariPalle	Check Dam	78.2512	14.3692	NREGS
43	Velpula	Velpula	Check Dam	78.2826	14.3666	NREGS
44	Velpula	Velpula	Check Dam	78.2870	14.3543	NREGS
45	Velpula	Velpula	Check Dam	78.2875	14.3524	NREGS
46	Velpula	Velpula	Check Dam	78.2876	14.3557	NREGS
47	Velpula	Velpula	Check Dam	78.2861	14.3582	NREGS
48	Velpula	Velpula	Check Dam	78.2867	14.3510	NREGS
49	Velpula	Velpula	Check Dam	78.2853	14.3663	NREGS
50	Velpula	Velpula	Check Dam	78.2878	14.3617	NREGS
51	Velpula	Velpula	Check Dam	78.2908	14.3487	NREGS
52	Velpula	Velpula	Check Dam	78.2916	14.3501	NREGS
53	Velpula	Velpula	Check Dam	78.2867	14.3663	NREGS
54	Velpula	Velpula	Check Dam	78.2792	14.3665	NREGS
55	Velpula	Velpula	Check Dam	78.2745	14.3651	NREGS
56	Velpula	Velpula	Check Dam	78.2612	14.3595	NREGS
57	Mobbuchintalapalle	MobbuchintalaPalle	Check Dam	78.2438	14.3264	NREGS
58	Mobbuchintalapalle	MobbuchintalaPalle	Check Dam	78.2456	14.3269	NREGS
59	Mobbuchintalapalle	MobbuchintalaPalle	Check Dam	78.2759	14.3269	NREGS
60	Mobbuchintalapalle	MobbuchintalaPalle	Check Dam	78.2750	14.3295	NREGS
61	Mobbuchintalapalle	MobbuchintalaPalle	Check Dam	78.2693	14.3329	NREGS
62	Mobbuchintalapalle	MobbuchintalaPalle	Check Dam	78.2668	14.3305	NREGS
63	Mobbuchintalapalle	MobbuchintalaPalle	Check Dam	78.2565	14.3427	NREGS
64	Mobbuchintalapalle	MobbuchintalaPalle	Check Dam	78.2606	14.3500	NREGS
65	Mobbuchintalapalle	MobbuchintalaPalle	Check Dam	78.2731	14.3302	NREGS
66	Mobbuchintalapalle	MobbuchintalaPalle	Check Dam	78.2511	14.3303	NREGS
67	Mobbuchintalapalle	MobbuchintalaPalle	Check Dam	78.2626	14.3327	NREGS
68	Mobbuchintalapalle	MobbuchintalaPalle	Check Dam	78.2601	14.3342	NREGS
69	Mobbuchintalapalle	MobbuchintalaPalle	Check Dam	78.2578	14.3332	NREGS
70	Mobbuchintalapalle	MobbuchintalaPalle	Check Dam	78.2518	14.3413	NREGS
71	Mobbuchintalapalle	MobbuchintalaPalle	Check Dam	78.2485	14.3509	NREGS
72	Mobbuchintalapalle	MobbuchintalaPalle	Check Dam	78.2624	14.3427	NREGS
73	Konareddipalle	KondreddiPalle	Check Dam	78.3773	14.4669	NREGS
74	Konareddipalle	KondreddiPalle	Check Dam	78.3745	14.4772	NREGS
75	Konareddipalle	KondreddiPalle	Check Dam	78.3696	14.4784	NREGS
76	Konareddipalle	Narepalle	Check Dam	78.3835	14.4839	NREGS

77	Gollalagudur	Gollalagudur	Check Dam	78.3252	14.4179	NREGS
78	Gollalagudur	Gollalagudur	Check Dam	78.3116	14.4079	NREGS
79	Gollalagudur	Gollalagudur	Check Dam	78.3106	14.4083	NREGS
80	Gollalagudur	Gollalagudur	Check Dam	78.3162	14.4171	NREGS
81	Gollalagudur	Gollalagudur	Check Dam	78.3171	14.4182	NREGS
82	Gollalagudur	Gollalagudur	Check Dam	78.3312	14.4186	NREGS
83	Gollalagudur	Gollalagudur	Check Dam	78.3420	14.4109	NREGS
84	Gollalagudur	Pernapadu	Check Dam	78.3520	14.4251	NREGS
85	Gollalagudur	Pernapadu	Check Dam	78.3513	14.4077	NREGS
86	Gollalagudur	Pernapadu	Check Dam	78.3522	14.4056	NREGS
87	Gollalagudur	Pernapadu	Check Dam	78.3548	14.4073	NREGS
88	Gollalagudur	Pernapadu	Check Dam	78.3547	14.4088	NREGS
89	Gollalagudur	Pernapadu	Check Dam	78.3481	14.4101	NREGS
90	Gollalagudur	Pernapadu	Check Dam	78.3483	14.4077	NREGS
91	Gondi palle	Gondipalle	Check Dam	78.3186	14.3670	NREGS
92	Gondi palle	Gondipalle	Check Dam	78.3509	14.3830	NREGS
93	Gondi palle	Gondipalle	Check Dam	78.3419	14.3810	NREGS
94	Gondi palle	Gondipalle	Check Dam	78.3376	14.3803	NREGS
95	Gondi palle	Gondipalle	Check Dam	78.3301	14.3853	NREGS
96	Gondi palle	Gondipalle	Check Dam	78.3354	14.3871	NREGS
97	Gondi palle	Gondipalle	Check Dam	78.3344	14.3878	NREGS
98	Gondi palle	Rangoripalle	Check Dam	78.3443	14.3843	NREGS
99	Gondi palle	Rangoripalle	Check Dam	78.3406	14.3877	NREGS
100	Gondi palle	Rangoripalle	Check Dam	78.3461	14.3883	NREGS
101	Meedipentla	BhumaiahgariPalle	Check Dam	78.3178	14.3374	NREGS
102	Meedipentla	BhumaiahgariPalle	Check Dam	78.3191	14.3333	NREGS
103	Meedipentla	BhumaiahgariPalle	Check Dam	78.3287	14.3139	NREGS
104	Meedipentla	BhumaiahgariPalle	Check Dam	78.3286	14.3103	NREGS
105	Meedipentla	BhumaiahgariPalle	Check Dam	78.3293	14.3127	NREGS
106	Meedipentla	BhumaiahgariPalle	Check Dam	78.3104	14.3275	NREGS
107	Meedipentla	BhumaiahgariPalle	Check Dam	78.3098	14.3270	NREGS
108	Meedipentla	BhumaiahgariPalle	Check Dam	78.3138	14.3337	NREGS
109	Meedipentla	BhumaiahgariPalle	Check Dam	78.3157	14.3358	NREGS
110	Chagaleru	Chagaleru	Check Dam	78.3489	14.3897	NREGS
111	Chagaleru	Chagaleru	Check Dam	78.3490	14.3905	NREGS
112	Chagaleru	Chagaleru	Check Dam	78.3531	14.3865	NREGS
113	Chagaleru	Chagaleru	Check Dam	78.3543	14.3890	NREGS
114	Chagaleru	Chagaleru	Check Dam	78.3554	14.3892	NREGS
115	Chagaleru	Chagaleru	Check Dam	78.3673	14.3991	NREGS
116	Chagaleru	Chagaleru	Check Dam	78.3609	14.3950	NREGS

117	Chagaleru	Chagaleru	Check Dam	78.3636	14.3968	NREGS
118	Chagaleru	DugganagariPalle	Check Dam	78.3709	14.3802	NREGS
119	Chagaleru	DugganagariPalle	Check Dam	78.3703	14.3882	NREGS
120	Chagaleru	DugganagariPalle	Check Dam	78.3820	14.3923	NREGS
121	Chagaleru	Gundlapalle	Check Dam	78.3743	14.4021	NREGS
122	Peddajutur	Peddajutur	Check Dam	78.2843	14.3984	NREGS
123	Peddajutur	Peddajutur	Check Dam	78.2837	14.4021	NREGS
124	Peddajutur	Peddajutur	Check Dam	78.2825	14.4023	NREGS
125	Peddajutur	SiddamreddiPalle	Check Dam	78.2783	14.4019	NREGS
126	Peddajutur	SiddamreddiPalle	Check Dam	78.2753	14.4021	NREGS
127	Peddajutur	SiddamreddiPalle	Check Dam	78.2692	14.4022	NREGS
128	Peddajutur	Yaddulayeni	Check Dam	78.2643	14.4041	NREGS
129	Peddajutur	Yaddulayeni	Check Dam	78.2667	14.4031	NREGS
130	Vemula	BanchayagariPalle	Check Dam	78.3193	14.3594	NREGS
131	Vemula	BanchayagariPalle	Check Dam	78.3175	14.3566	NREGS
132	Vemula	BanchayagariPalle	Check Dam	78.3167	14.3542	NREGS
133	Vemula	Vemula	Check Dam	78.3188	14.3659	NREGS
134	Vemula	Vemula	Check Dam	78.3160	14.3634	NREGS
135	Vemula	Vemula	Check Dam	78.3129	14.3630	NREGS
136	Vemula	Vemula	Check Dam	78.3194	14.3666	NREGS
137	Vemula	Vemula	Check Dam	78.3195	14.3615	NREGS
138	Vemula	Vemula	Check Dam	78.3225	14.3671	NREGS
139	Vemula	Vemula	Check Dam	78.3248	14.3683	NREGS
140	Vemula	Vemula	Check Dam	78.3088	14.3615	NREGS
141	Vemula	Vemula	Check Dam	78.3157	14.3752	NREGS
142	Vemula	VenkateswaraPuram	Check Dam	78.3186	14.3769	NREGS
143	Chintalajutur	Chintalajutur	Check Dam	78.2961	14.4200	IWMP
144	Chintalajutur	Chintalajutur	Check Dam	78.2942	14.4211	IWMP
145	Chintalajutur	Chintalajutur	Check Dam	78.2997	14.4124	IWMP
146	Chintalajutur	Chintalajutur	Check Dam	78.2922	14.4234	IWMP
147	Chintalajutur	Chintalajutur	Check Dam	78.2980	14.4095	IWMP
148	Chintalajutur	Chintalajutur	Check Dam	78.3119	14.4170	IWMP
149	Chintalajutur	Chintalajutur	Check Dam	78.3092	14.4197	IWMP
150	Gollalagudur	Gollalagudur	Check Dam	78.3252	14.4179	IWMP
151	Gollalagudur	Gollalagudur	Check Dam	78.3116	14.4079	IWMP
152	Gollalagudur	Gollalagudur	Check Dam	78.3106	14.4083	IWMP
153	Gollalagudur	Gollalagudur	Check Dam	78.3162	14.4171	IWMP
154	Gollalagudur	Gollalagudur	Check Dam	78.3171	14.4182	IWMP
155	Gollalagudur	Gollalagudur	Check Dam	78.3312	14.4186	IWMP
156	Gollalagudur	Gollalagudur	Check Dam	78.3420	14.4109	IWMP

157	Peddajutur	Peddajutur	Check Dam	78.2843	14.3984	IWMP
158	Peddajutur	Peddajutur	Check Dam	78.2837	14.4021	IWMP
159	Peddajutur	Peddajutur	Check Dam	78.2825	14.4023	IWMP
160	Peddajutur	SiddamreddiPalle	Check Dam	78.2783	14.4019	IWMP
161	Peddajutur	SiddamreddiPalle	Check Dam	78.2753	14.4021	IWMP
162	Peddajutur	SiddamreddiPalle	Check Dam	78.2692	14.4022	IWMP
163	Peddajutur	Yaddulayeni	Check Dam	78.2643	14.4041	IWMP
164	Peddajutur	Yaddulayeni	Check Dam	78.2667	14.4031	IWMP
165	Kanamkindakottalu	KanamkindaKottalu	Check Wall	78.2345	14.3454	NREGS
166	V.kothapalle	V.Kothapalle	MPT	78.3639	14.3524	NREGS
167	V.kothapalle	V.Kothapalle	MPT	78.3646	14.3532	NREGS
168	V.kothapalle	V.Kothapalle	MPT	78.3632	14.3557	NREGS
169	V.kothapalle	V.Kothapalle	MPT	78.3580	14.3543	NREGS
170	Konareddipalle	KondreddiPalle	MPT	78.3716	14.4707	NREGS
171	Konareddipalle	KondreddiPalle	MPT	78.3720	14.4714	NREGS
172	Konareddipalle	KondreddiPalle	MPT	78.3693	14.4727	NREGS
173	Gollalagudur	Gollalagudur	MPT	78.3096	14.4019	NREGS
174	Chagaleru	Chagaleru	MPT	78.3532	14.3858	NREGS
175	Chagaleru	Chagaleru	MPT	78.3578	14.3932	NREGS
176	Chagaleru	Chagaleru	MPT	78.3579	14.3954	NREGS
177	Chagaleru	Chagaleru	MPT	78.3532	14.3858	NREGS
178	Chagaleru	DugganagariPalle	MPT	78.3856	14.3925	NREGS
179	Gollalagudur	Gollalagudur	MPT	78.3096	14.4019	IWMP
180	Konareddipalle	KondreddiPalle	PT	78.3597	14.4717	NREGS
181	Konareddipalle	Narepalle	PT	78.3876	14.4971	NREGS
182	Gollalagudur	Pernapadu	PT	78.3526	14.4191	NREGS
183	Gollalagudur	Pernapadu	PT	78.3501	14.4145	NREGS
184	Chagaleru	Chagaleru	PT	78.3567	14.3917	NREGS
185	Chagaleru	Gundlapalle	PT	78.3778	14.4039	NREGS
186	Peddajutur	Yaddulayeni	PT	78.2577	14.4119	NREGS
187	Vemula	BanchayagariPalle	PT	78.3158	14.3470	NREGS
188	Peddajutur	Yaddulayeni	PT	78.2577	14.4119	IWMP

PROPOSED ARTIFICIAL RECHARGE STRUCTURES
VEMULA MANDAL, KADAPA DISTRICT, AP

S.No.	Mandal	Lattiutude	Longitude	Structure type
1	Vemula	14.3243	78.3122	Checkdam
2	Vemula	14.3131	78.3129	Checkdam
3	Vemula	14.3028	78.2984	Checkdam
4	Vemula	14.3036	78.3259	Checkdam
5	Vemula	14.3043	78.3406	Checkdam
6	Vemula	14.3324	78.3566	Checkdam
7	Vemula	14.3675	78.3800	Checkdam
8	Vemula	14.3782	78.3931	Checkdam
9	Vemula	14.3761	78.3063	Checkdam
10	Vemula	14.4026	78.3144	Checkdam
11	Vemula	14.3183	78.2777	Checkdam
12	Vemula	14.3280	78.2549	Checkdam
13	Vemula	14.3214	78.3056	Checkdam
14	Vemula	14.3939	78.3123	Percolation Tank
15	Vemula	14.3897	78.3943	Percolation Tank
16	Vemula	14.3692	78.3304	Percolation Tank
17	Vemula	14.3061	78.3546	Percolation Tank
18	Vemula	14.3203	78.2907	Percolation Tank
19	Vemula	14.3534	78.3054	Percolation Tank

Fig.1

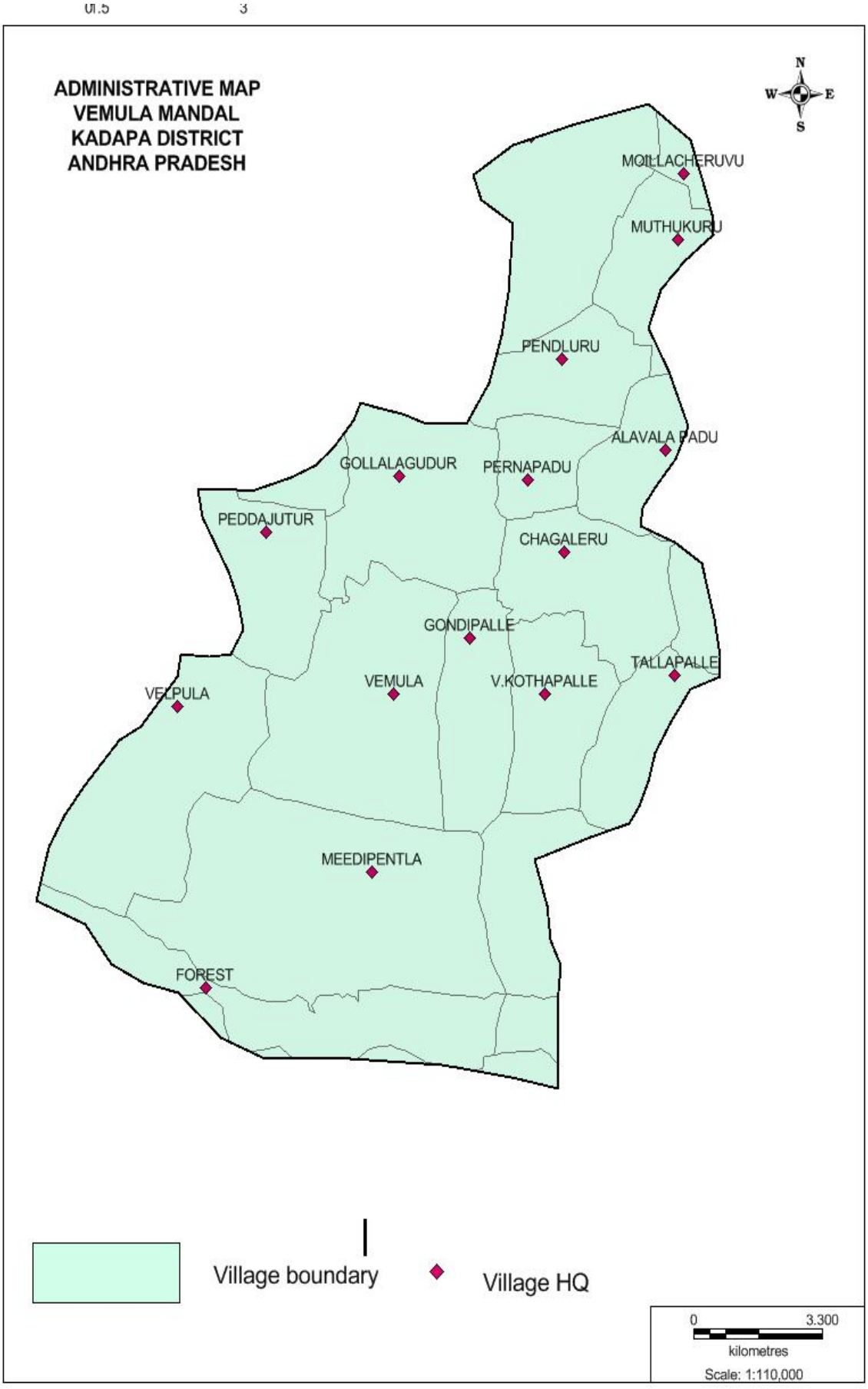
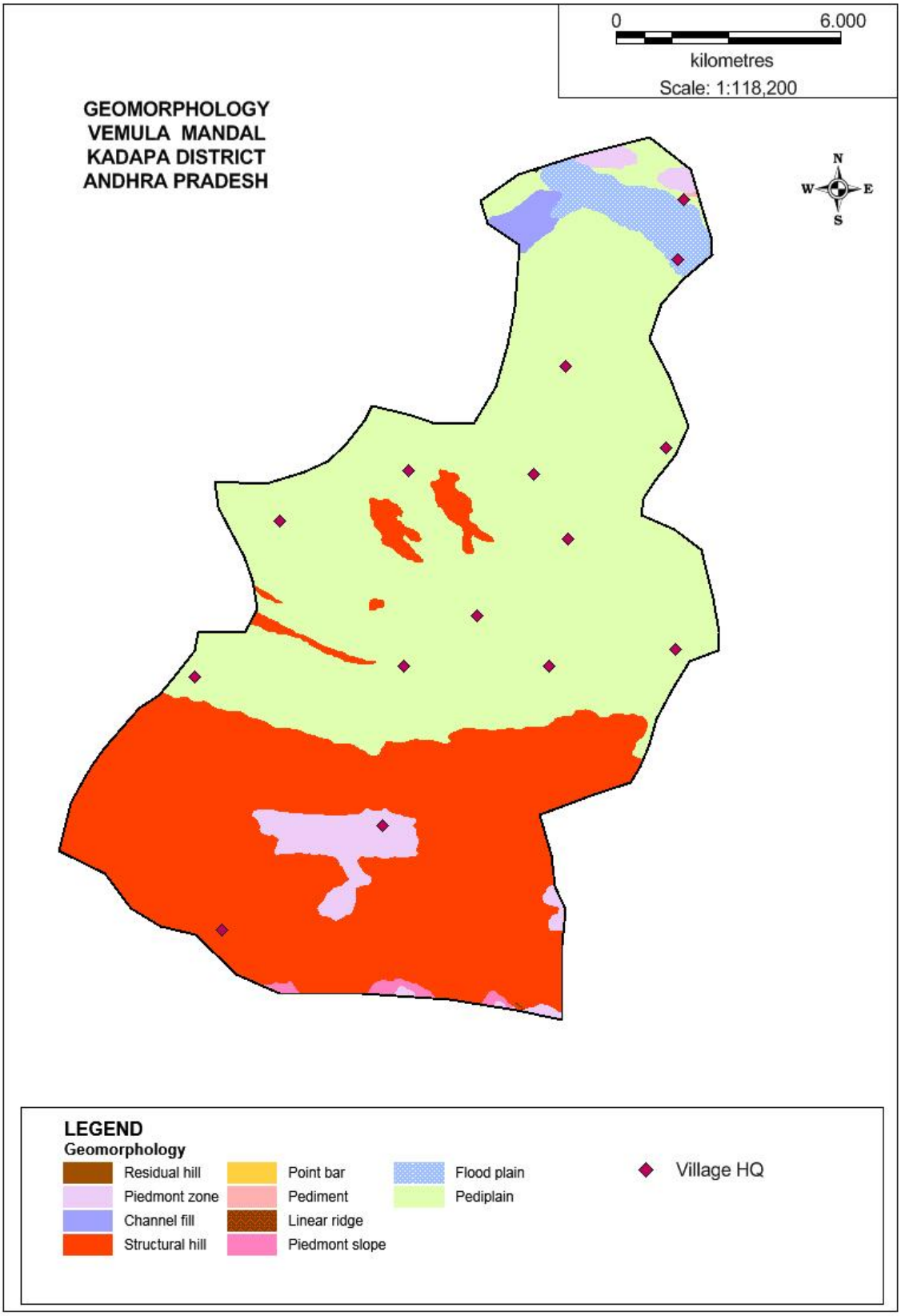

ADMINISTRATIVE MAP
VEMULA MANDAL
KADAPA DISTRICT
ANDHRA PRADESH
N
W
E
S
MOLLACHERUVU
MUTHUKURU
PENDLURU
ALAVALA PADU
GOLLALAGUDUR
PERNAPADU
PEDDAJUTUR
CHAGALERU
GONDIPALLE
TALLAPALLE
VEMULA
V.KOTHAPALLE
VEMPULA
MEEDIPENTLA
FOREST
Village boundary
Village HQ
0
3.300
kilometres
Scale: 1:110,000

Fig.2


0
6.000
kilometres
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GEOMORPHOLOGY
VEMULA MANDAL
KADAPA DISTRICT
ANDHRA PRADESH
N
W
E
S
LEGEND
Geomorphology
Residual hill
Piedmont zone
Channel fill
Structural hill
Point bar
Pediment
Linear ridge
Piedmont slope
Flood plain
Pediplain
Village HQ

Fig.3

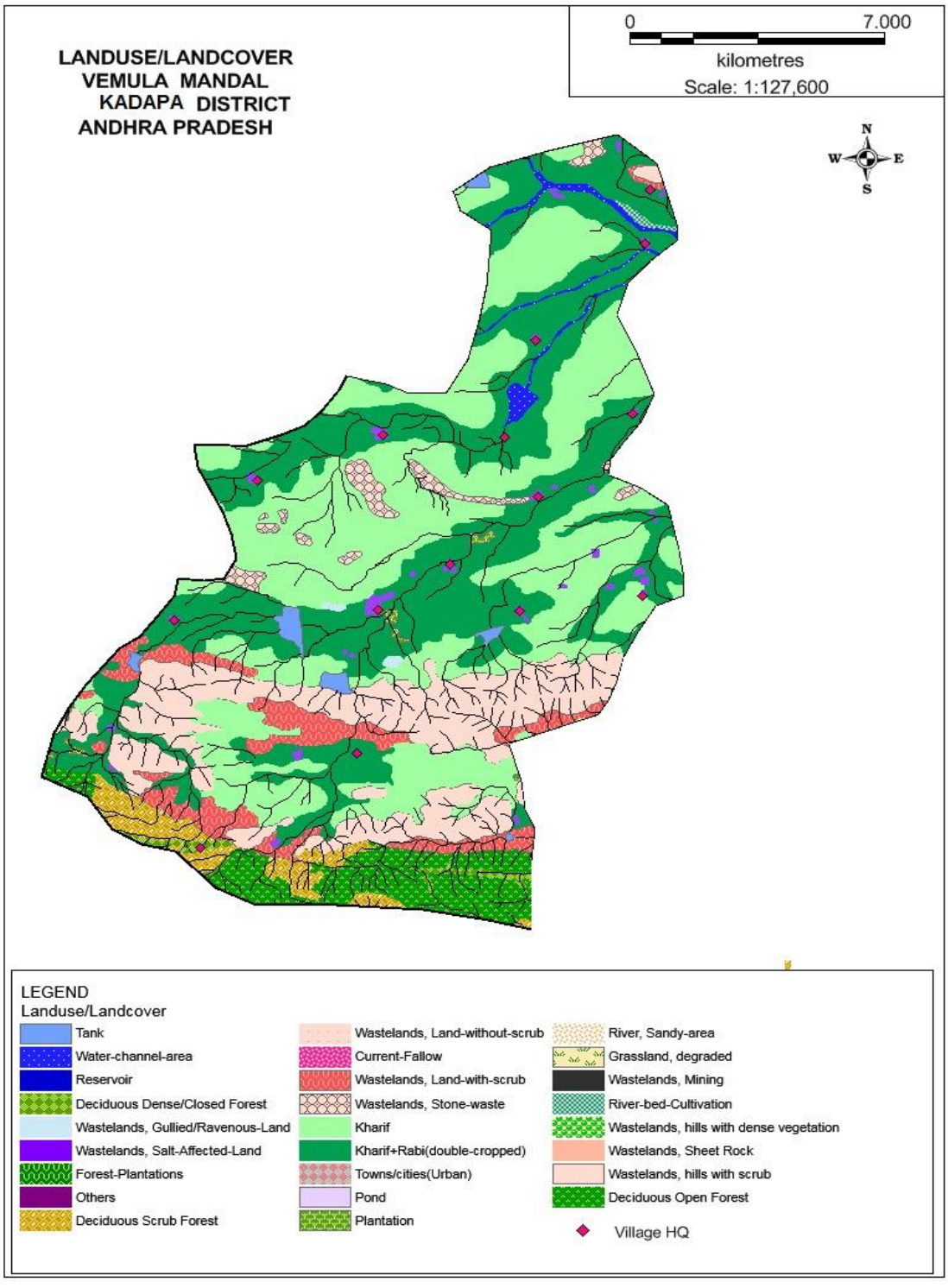

LANDUSE/LANDCOVER
VEMULA MANDAL
KADAPA DISTRICT
ANDHRA PRADESH
0
7.000
kilometres
Scale: 1:127,600
N
W
E
S
LEGEND
Landuse/Landcover
Tank
Water-channel-area
Reservoir
Deciduous Dense/Closed Forest
Wastelands, Gullied/Ravenous-Land
Wastelands, Salt-Affected-Land
Forest-Plantations
Others
Deciduous Scrub Forest
Wastelands, Land-without-scrub
Current-Fallow
Wastelands, Land-with-scrub
Wastelands, Stone-waste
Kharif
Kharif+Rabi(double-cropped)
Towns/cities(Urban)
Pond
Plantation
River, Sandy-area
Grassland, degraded
Wastelands, Mining
River-bed-Cultivation
Wastelands, hills with dense vegetation
Wastelands, Sheet Rock
Wastelands, hills with scrub
Deciduous Open Forest
Village HQ

Fig.4

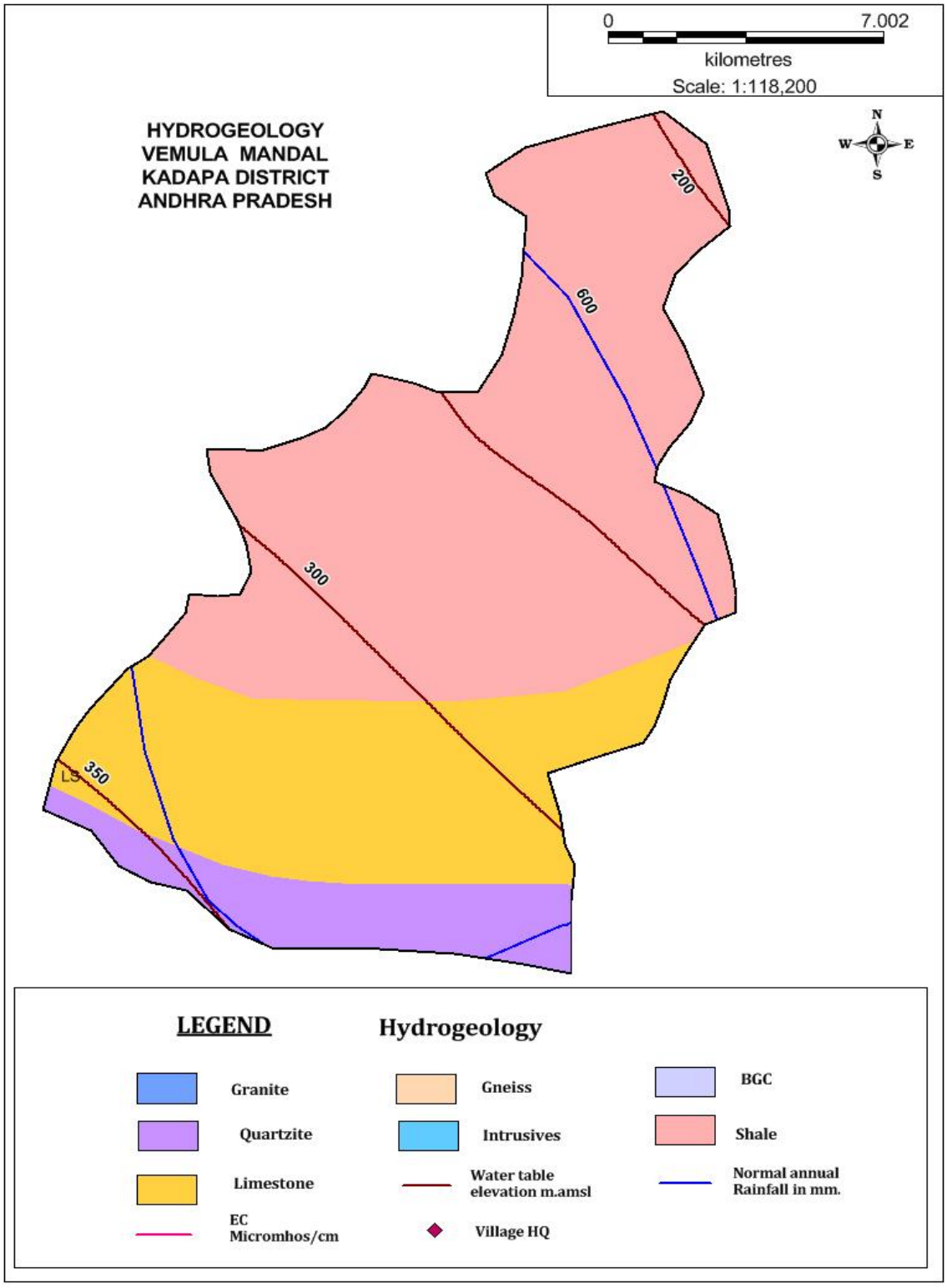

0
7.002
kilometres
Scale: 1:118,200
HYDROGEOLOGY
VEMULA MANDAL
KADAPA DISTRICT
ANDHRA PRADESH
N
W
E
S
200
600
300
350
LEGEND
Hydrogeology
Granite
Gneiss
BGC
Quartzite
Intrusives
Shale
Limestone
Water table elevation m.amsl
Normal annual Rainfall in mm.
EC Micromhos/cm
Village HQ

Fig.5

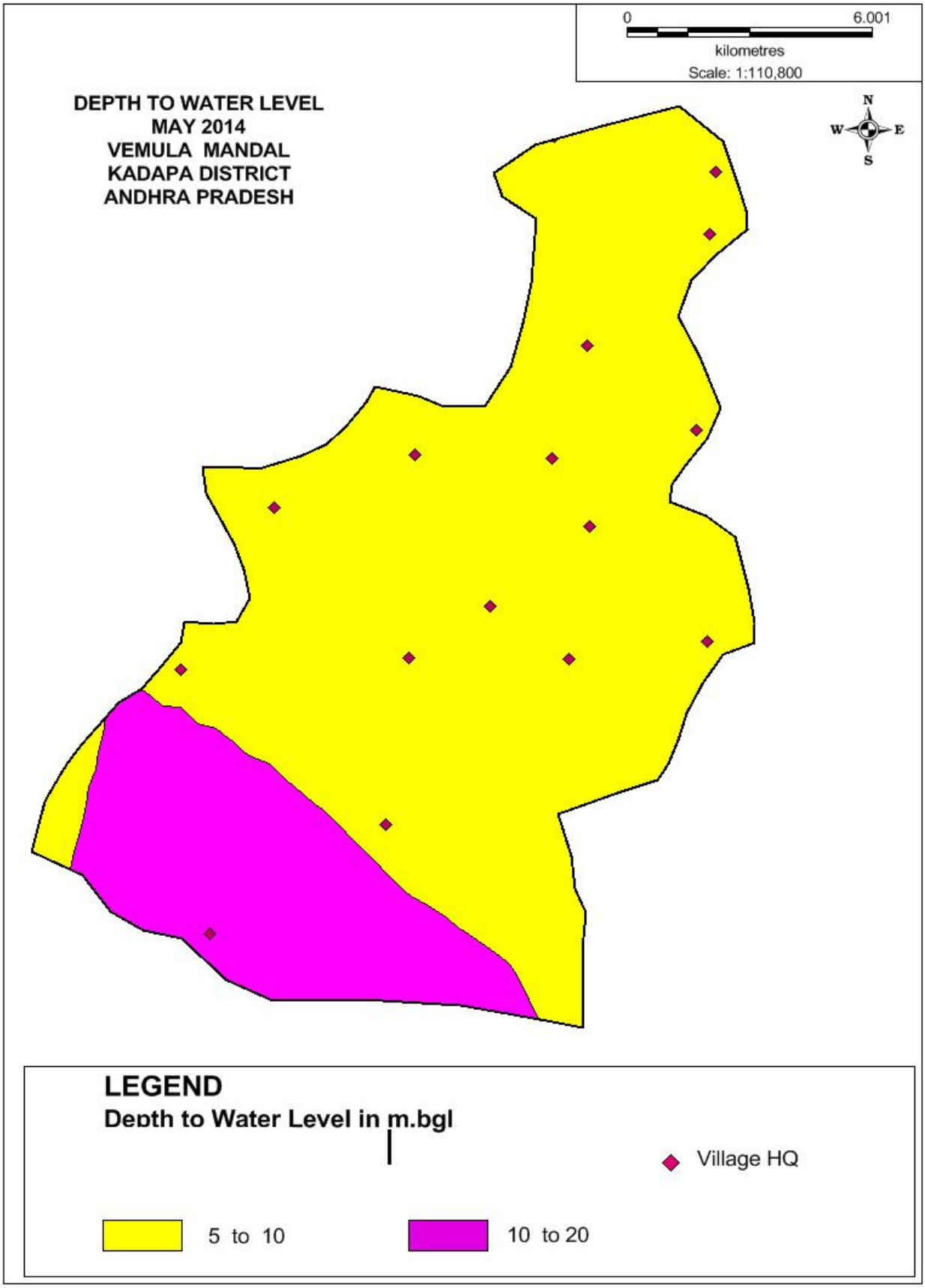

0
6.001
kilometres
Scale: 1:110,800
DEPTH TO WATER LEVEL
MAY 2014
VEMULA MANDAL
KADAPA DISTRICT
ANDHRA PRADESH
N
W
E
S
LEGEND
Depth to Water Level in m.bgl
Village HQ
5 to 10
10 to 20

Fig.6

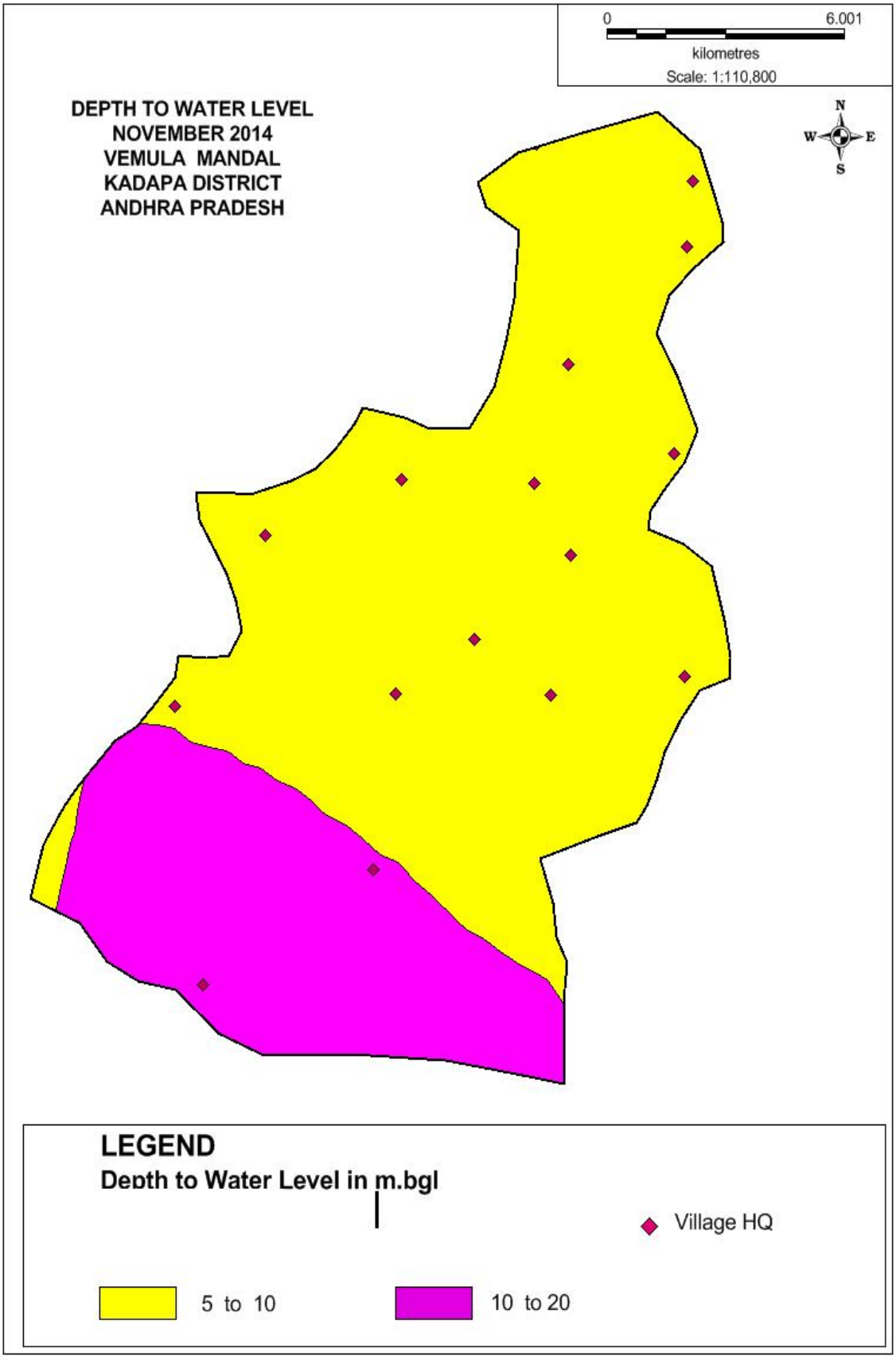
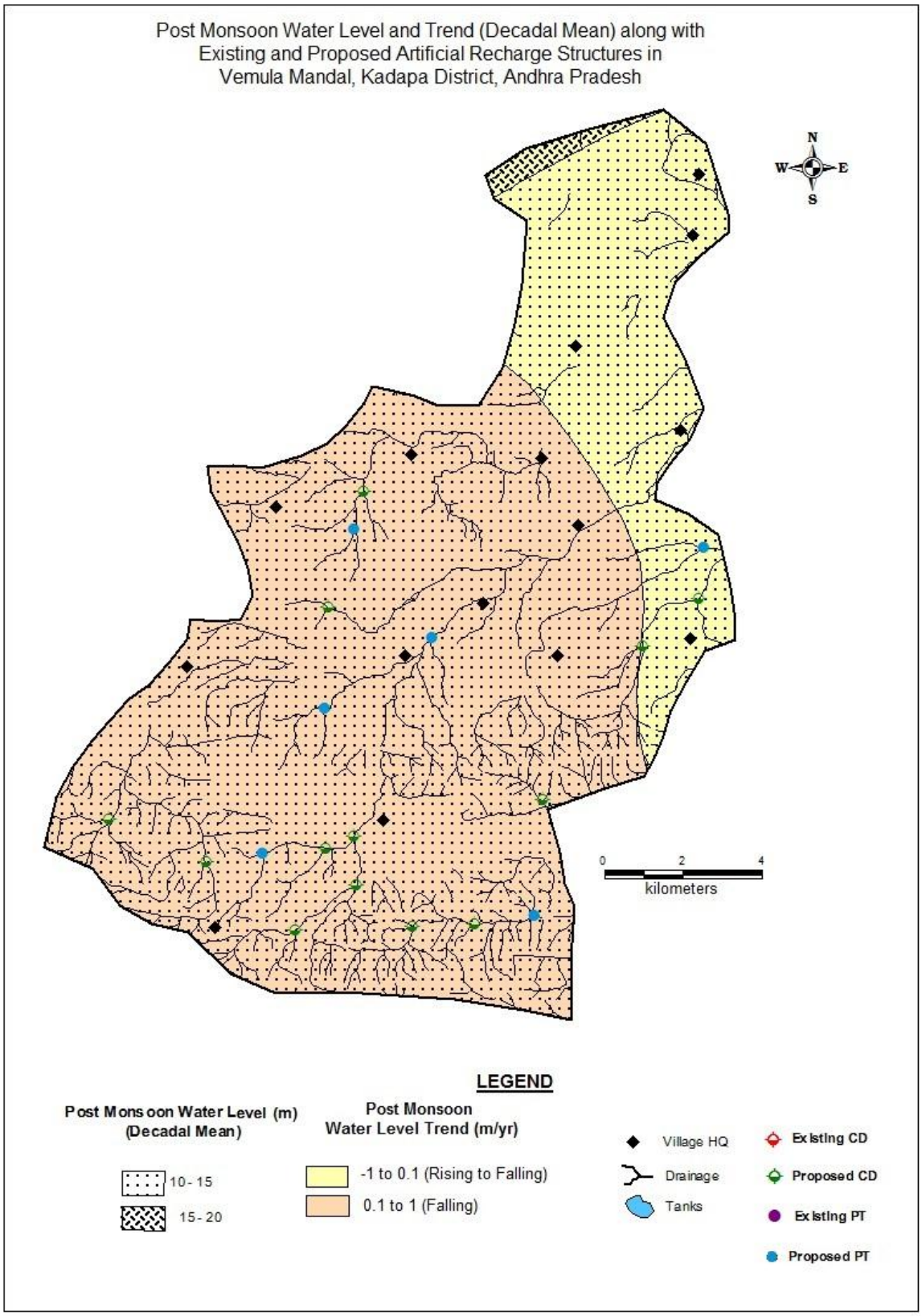

0
6.001
kilometres
Scale: 1:110,800
DEPTH TO WATER LEVEL
NOVEMBER 2014
VEMULA MANDAL
KADAPA DISTRICT
ANDHRA PRADESH
N
W
E
S
LEGEND
Depth to Water Level in m.bgl
Village HQ
5 to 10
10 to 20

Fig.7


Post Monsoon Water Level and Trend (Decadal Mean) along with
Existing and Proposed Artificial Recharge Structures in
Vemula Mandal, Kadapa District, Andhra Pradesh
N
W
E
S
0
2
4
kilometers
LEGEND
Post Monsoon Water Level (m)
(Decadal Mean)
10 - 15
15 - 20
Post Monsoon
Water Level Trend (m/yr)
-1 to 0.1 (Rising to Falling)
0.1 to 1 (Falling)
Village HQ
Drainage
Tanks
Existing CD
Proposed CD
Existing PT
Proposed PT