

# Contents

ACKNOWLEDGEMENT .....	5
EXTENDED SUMMARY .....	6
1. INTRODUCTION .....	8
1.1 Background of the Study .....	8
1.2 Project Objectives .....	9
1.3 Location and Accessibility .....	9
1.4 Population and Settlement .....	11
1.5 Water Demand .....	11
1.6 Existing Water Supply Sources .....	12
1.7 Review of Previous Work .....	12
1.8 Methodology, Data, Material and Software .....	13
2. GEOMORPHOLOGY, SOIL and VEGETATION .....	15
2.1 Geomorphology .....	15
2.2 Soil .....	16
2.3 Land Use and Land Cover .....	17
2.4 Vegetation .....	18
3. CLIMATE and HYDROLOGY .....	19
3.1 Climate .....	19
3.2 Hydrology .....	22
3.2.1 Surface Water Network of the Area .....	22
3.2.2 Baseflow .....	24
4. GEOLOGICAL SETTINGS .....	25
4.1 Regional Geology .....	25
4.2 Lithology .....	25
4.3 Geological History of the Area .....	26
4.4 Structures .....	27
5. HYDROGEOLOGICAL SETTINGS .....	29
5.1 General .....	29
5.2 Hydrogeological Characterization .....	29
5.3 Classification of Aquifers of the Area .....	31
5.3.1 Moderately or Locally Highly Productive Porous Aquifers .....	32

5.3.2 Moderately Productive Fissured Aquifers .....	32
5.3.3 Moderately Productive Aquifers with Mixed Permeability .....	34
5.3.4 Aquitards - Minor Aquifers with Local and Limited Groundwater Resources .....	34
5.4 Surface Water and Groundwater Points.....	34
5.4.1 Surface Water Points .....	35
5.4.2 Groundwater Points.....	37
5.5 Groundwater Flow, Recharge and Discharge .....	40
5.5.1 Groundwater Flow .....	40
5.5.2 Groundwater Recharge.....	41
5.5.3 Groundwater Discharge .....	42
5.5.4 Hydrogeological Conceptual Model.....	43
6. HYDROCHEMISTRY .....	44
6.1 General Hydrochemistry .....	44
6.2 Sampling and Analysis.....	44
6.3 Classification and Graphical Presentation .....	45
6.4 Major and Minor Constituents of Groundwater.....	47
6.5 Hydrochemistry of Groundwater.....	48
6.6 Water Quality.....	48
6.6.1 Temperature .....	49
6.6.2 pH.....	49
6.6.3 Hardness .....	50
6.6.4 Electrical Conductivity (EC) and Total Dissolved Solids (TDS) .....	51
6.6.5 Fluoride .....	53
6.6.6 Nitrates.....	53
6.6.7 Sodium .....	54
6.6.8 Calcium.....	54
6.7 Water Quality Standards and Water Use.....	54
6.7.1 Domestic Use .....	55
6.7.2 Irrigation Use.....	56
6.7.3 Industrial Use .....	57
7. GROUND RESOURCES AND WATER DEVELOPMENT .....	59
7.1 Groundwater Resources .....	59
7.2 Groundwater Development.....	61

7.3 Recommended Sites for Well Siting .....	61
8. CONCLUSIONS AND RECOMMENDATIONS .....	64
8.1 Conclusions .....	64
8.2 Recommendations .....	64
REFERENCES .....	65