

# Contents

ACKNOWLEDGMENT.....	1
EXTENDED SUMMARY .....	2
<b>1 INTRODUCTION .....</b>	<b>4</b>
1.1 BACKGROUND .....	4
1.2 WATER PROBLEMS IN THE AREA .....	5
1.3 OBJECTIVE AND SCOPE OF THE PROJECT.....	5
1.3.1 <i>General Objective</i> .....	5
1.3.2 <i>Specific Objectives of the Project</i> .....	5
1.3.3 <i>Scope of the Work</i> .....	5
1.4 LOCATION AND AREAL EXTENT.....	6
1.5 ACCESSIBILITY.....	8
1.6 POPULATION .....	8
1.7 PREVIOUS WORKS .....	9
1.8 WATER DEMAND .....	9
1.9 METHODOLOGIES AND PROCEDURES .....	9
<b>2 PHYSIOGRAPHY, CLIMATE, VEGETATION AND WILD LIFE.....</b>	<b>10</b>
2.1 PHYSIOGRAPHY.....	10
2.2 VEGETATION AND WILDLIFE .....	12
2.3 SOIL TYPE .....	12
<b>3 HYDROMETEOROLOGY .....</b>	<b>14</b>
3.1 CLIMATIC CHARACTERISTICS .....	14
3.2 PRECIPITATION .....	15
3.3 TEMPERATURE.....	17
3.4 POTENTIAL EVAPOTRANSPIRATION (PET / ETO).....	18
<b>4 HYDROLOGY .....</b>	<b>21</b>
4.1 DRAINAGE OF THE ABBAY AND OMO-GIBE RIVER BASINS.....	21
4.2 DRAINAGE PATTERN.....	21
4.3 RIVER FLOW REGIME .....	22
<b>5 GEOLOGY.....</b>	<b>26</b>
5.1 REGIONAL GEOLOGICAL SETTINGS .....	26
5.2 LOCAL GEOLOGY AND STRATIGRAPHY.....	27
5.2.1 <i>Precambrian basement rocks</i> .....	28
5.2.2 <i>Precambrian Intrusive Rocks</i> .....	30
5.2.3 <i>Paleozoic and Mesozoic sedimentary rocks</i> .....	30
5.2.4 <i>Tertiary volcanic rocks</i> .....	33
5.2.5 <i>Quaternary Sediments</i> .....	37
5.3 STRUCTURES .....	37
5.3.1 <i>Faults</i> .....	37
5.3.2 <i>Lineaments</i> .....	37
<b>6 HYDROGEOLOGY .....</b>	<b>39</b>
6.1 GENERAL DESCRIPTION .....	39
6.2 HYDROGEOLOGICAL CHARACTERIZATION OF THE AREA.....	39
6.3 AQUIFER CLASSIFICATION .....	39
6.3.1 <i>Extensive aquifers in unconsolidated material with shallow groundwater</i> .....	40
6.3.2 <i>Extensive and moderately productive fissured aquifers</i> .....	41

6.3.3	<i>Extensive and low productive aquifer in basement</i> .....	43
6.3.4	<i>Aquitards</i> .....	45
6.3.5	<i>Aquiclude</i> .....	45
6.4	GROUNDWATER POINTS .....	45
6.4.1	<i>Boreholes</i> .....	46
6.4.2	<i>Dug wells</i> .....	46
6.4.3	<i>Springs</i> .....	46
6.5	GROUNDWATER FLOW, RECHARGE AND DISCHARGE – CONCEPTUAL HYDROGEOLOGICAL MODEL .....	47
6.5.1	<i>Groundwater Flow and Discharge</i> .....	47
6.5.2	<i>Groundwater Recharge</i> .....	48
6.5.3	<i>Hydrogeological Conceptual Model</i> .....	48
<b>7</b>	<b>HYDROCHEMISTRY</b> .....	<b>50</b>
7.1	GENERAL .....	50
7.2	IONIC RELATIONSHIPS AND GROUNDWATER CHEMISTRY.....	51
7.3	MAJOR IONIC COMPOSITIONS AND GROUNDWATER CHEMISTRY .....	54
7.4	TOTAL DISSOLVED SOLIDS .....	55
7.5	THE PH .....	56
7.6	WATER HARDNESS.....	56
7.7	HYDROCHEMICAL CLASSIFICATION AND GRAPHICAL PRESENTATION .....	57
7.8	WATER QUALITY .....	59
7.8.1	<i>Drinking water quality</i> .....	59
7.8.2	<i>Irrigation water quality</i> .....	60
7.8.3	<i>Industrial Water Quality</i> .....	62
<b>8</b>	<b>GROUNDWATER RESOURCES ASSESSMENT</b> .....	<b>64</b>
8.1	WATER RESOURCES .....	64
8.2	RECOMMENDED SITES FOR WELL SITING .....	65
<b>9</b>	<b>CONCLUSIONS AND RECOMMENDATIONS</b> .....	<b>77</b>
9.1	CONCLUSIONS .....	77
9.2	RECOMMENDATIONS.....	77
<b>10</b>	<b>REFERENCE</b> .....	<b>78</b>