

Contents

	Page
Title	i
Declaration	ii
Abstract	iii
Acknowledgements	v
Contents	vi
List of figures	xi
List of Tables	xiii
List of abbreviations	xiv
Chapter 1. Introduction	01
1.1 General overview of the research	01
1.2 Difficulties in groundwater location using different methods	04
1.3 Geological and Structural back ground of Sri Lanka	06
1.3.1 Highland Complex	08
1.3.2 Vijayan Complex	10
1.3.3 Wanni Complex	10
1.3.4 Kadugannawa Complex	11
1.3.5 Sedimentary formations	12
1.3.6. Igneous Intrusive	13
1.4 Physical environment of the study area	15
1.4.1 Location	15
1.4.2 Geology and structures	15
1.4.3 Soil	18
1.4.4 Climate and rainfall	18

1.4.5 Drainage	19
1.4.6 Population and land uses	19
1.5 Importance of groundwater resources in Sri Lanka	19
1.6 Aims and objectives of the research	22
1.7 Organization of the thesis	22
Chapter 2. Literature Review	24
2.1 Groundwater resources in Sri Lanka	24
2.2 Water bearing properties of some rocks in Sri Lankan rocks	24
2.3 Physical and chemical properties of groundwater in Sri Lanka	25
2.4 Possible groundwater formations in Sri Lanka	26
2.4.1 North –western and northern coastal belt	26
2.4.2 Southeastern and eastern coastal belts	27
2.4.3 Laterites	27
2.4.4 Narrow faulted Basins	28
2.4.5 Wet zone crystalline aquifers	28
2.4.6 Crystalline aquifers in dry zone	29
2.5 Different uses of geophysical methods in detection of structures	29
2.5.1 Magnetic method	29
2.5.2 Resistivity imager method	32
2.5.3 Self- Potential method	34
2.6 Some uses of geophysical methods	35
Chapter 3. Methodology	38
3.1 Geographic Positioning	38
3.2 Geological, Topographical map study and air photo interpretation	39

3.3 Very Low Frequency (VLF) Applications	39
3.4 Magnetic surveys	40
3.4.1 Field Survey	43
3.5 Resistivity surveys	44
3.5.1 Theory	45
3.5.2 Different resistivity methods	46
3.5.3 Multi-electrode imager array	48
3.5.4 Field survey	49
3.6 Self Potential (SP) surveys	49
3.6.1 Field procedure	50
Chapter 4. Results and discussion	52
4.1 Study area 1	52
4.1.1 Geological Methods	52
4.1.2 Very Low frequency (VLF) method	53
4.1.3 Magnetic method	53
4.1.4 Resistivity and self potential method	58
4.1.4.1 2-D resistivity profile at Timbiriya area (T_3W_1)	56
4.1.4.2 Resistivity and SP survey W_4W_1	59
4.1.4.3 Resistivity and SP survey W_4W_2	60
4.1.4.4 Resistivity and SP survey W_4W_3	60
4.1.4.5 Resistivity and SP survey T_5W_1	62
4.1.4.6 Resistivity and SP survey T_5W_2	63
4.1.4.7 Resistivity survey F_6W_1	64
4.1.4.8 Resistivity survey F_6W_2	65
4.1.4.9 Resistivity survey S_7W_1	65

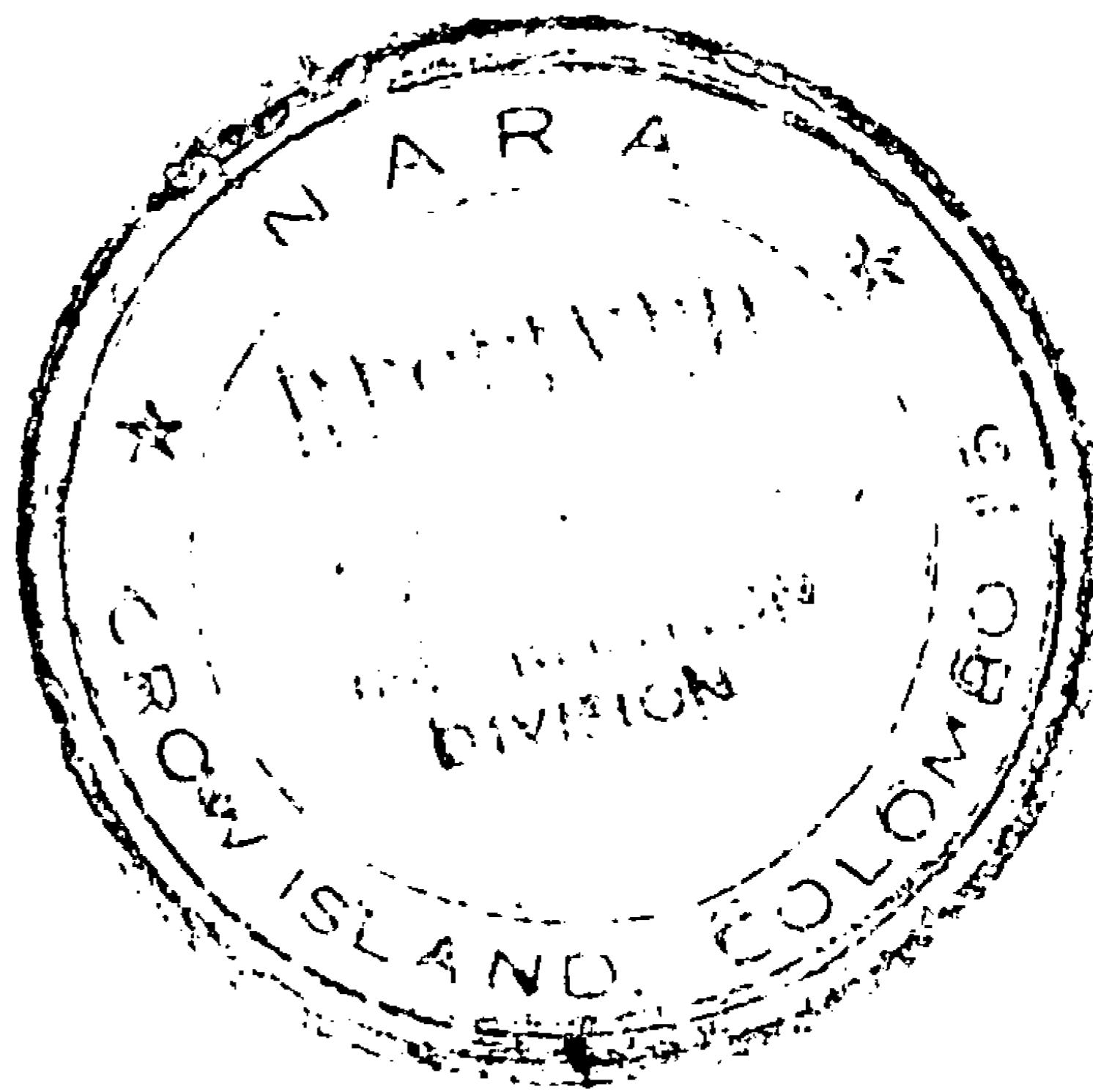
<i>4.1.4.10 Resistivity and SP survey S₇W₂</i>	66
<i>4.1.4.11 Resistivity survey S₇W₃</i>	66
<i>4.1.4.12 Resistivity survey S₇W₄</i>	67
<i>4.1.4.13 Resistivity survey F₁₃W₁</i>	68
<i>4.1.4.14 Resistivity survey F₁₃W₂</i>	69
<i>4.1.4.15 Resistivity survey F₁₃W₃</i>	69
<i>4.1.4.16 Horizontal resistivity variation in study area 1</i>	70
4.2 Study area 2	73
<i>4.2.1 Geological Methods</i>	73
<i>4.2.2 Magnetic method</i>	74
<i>4.2.3 Resistivity and SP method</i>	76
<i>4.2.3.1 Resistivity and SP survey S₈W₂</i>	76
<i>4.2.3.2 Resistivity and SP survey S₈W₃</i>	77
<i>4.2.3.3 Resistivity and SP survey S₈W₄</i>	77
<i>4.2.3.4 Resistivity survey S₈W₅</i>	78
<i>4.2.3.5 Resistivity survey M₉W₁</i>	79
<i>4.2.3.6 Resistivity survey M₉W₂</i>	80
<i>4.2.3.7 Resistivity survey M₉W₃ and M₉W₄</i>	81
<i>4.2.3.8 Resistivity survey M₉W₅</i>	82
<i>4.2.3.9 Resistivity survey T₁₀ W₁</i>	82
<i>4.2.3.10 Resistivity survey T₁₀W₂</i>	82
<i>4.2.3.11 Resistivity survey T₁₀W₃</i>	83
<i>4.2.3.12 Resistivity survey W₁₁W₁</i>	84
<i>4.2.3.13 Resistivity survey W₁₁W₂</i>	84
<i>4.2.3.14 Resistivity survey W₁₁W₃</i>	86

	x
<i>4.2.3.15 Resistivity survey W₁₁W₄</i>	86
<i>4.2.3.16 Resistivity survey T₁₂ W₁</i>	87
<i>4.2.3.17 Resistivity survey T₁₂ W₂</i>	87
<i>4.2.3.18 Resistivity survey T₁₂ W₃</i>	87
<i>4.2.3.22 Horizontal resistivity variation study area 2</i>	88
Chapter 5. Conclusion	90
5.1 Suggestions for future works	91
Chapter 6. References	92

List of figures

Fig. 1.1. Main features of hydrologic cycle	02
Fig 1.2. Mean annual rainfall and areas in climatic zones of Sri Lanka	03
Fig 1.3. Geological and Structural map of Sri Lanka	09
Fig 1.4. Arena structures	11
Fig.1.5. Location map of the study area 1	16
Fig.1.6. Location map of the study area 2	17
Fig1.7. Rainfall distribution in Sri Lanka	21
Fig.2.1. Magnetic anomaly across the mineralised fault zone	30
Fig.2.2. Magnetic anomaly along the fault layer	30
Fig.2.3. Comparison of magnetic and Gradiometric method	31
Fig.2.4. Magnetic survey along the drainpipe	32
Fig.2.5. Resistivity imager survey for groundwater exploration	33
Fig.2.6. Resistivity imager survey for leakage detection	33
Fig.2.7. Resistivity imager application for environmental survey	33
Fig.2.8. Resistivity imager survey for fault structure detection	33
Fig.2.9. Self-potential anomaly at water discharge and infiltrations	35
Fig.2.10. Groundwater accumulation in top layer	36
Fig.2.11. Groundwater accumulation in fractured rocks	36
Fig.2.12. Saline water accumulation in coastal overburdens	37
Fig.2.13. Demarcation of seawater fresh water boundary at Kalpitiya	37
Fig 3.1. Equipment placing for resistivity measurements	45
Fig. 3.2. Electrode arrays for different configurations	47
Fig.3.3. Instrumentation for building up a resistivity pseudosection	48

Fig. 3.4. The field techniques of measuring self-potential	51
Fig.4.1. Magnetic Survey results at Timbiriya area (area 1)	54
Fig.4.2. 2-D resistivity survey profile at Timbiriya area (T_3W_1)	58
Fig.4.3. Resistivity survey W_4W_1	59
Fig.4.4. SP survey W_4W_1	60
Fig.4.5. Resistivity survey W_4W_2	60
Fig.4.6. SP survey W_4W_2	61
Fig.4.7. Resistivity survey S_7W_4	67
Fig.4.8. SP survey S_7W_4	68
Fig.4.9. Resistivity survey $F_{13}W_1$	68
Fig.4.10. Area 1: Horizontal resistivity maps	70
Fig.4.11. Magnetic survey at area 2	75
Fig.4.12. Resistivity survey S_8W_2	76
Fig.4.13. SP survey S_8W_2	76
Fig.4.14. Resistivity survey S_8W_5	78
Fig.4.15. SP survey S_8W_5	79
Fig.4.16. Resistivity survey M_9W_1	80
Fig.4.17. Resistivity survey $W_{11}W_2$	85
Fig.4.18. SP survey $W_{11}W_2$	85
Fig.4.19. Resistivity survey profile $W_{11}W_3$	86
Fig.4.20. Resistivity variation in horizontal direction at area 2	88



List of Tables

Table 1.1. Formations present in Sri Lanka	07
Table 1.2. Distribution of annual rainfall and their climatic zones	20
Table 2.1. Porosities of some formations in Sri Lanka	24
Table 2.2. Specific yield of some formations in Sri Lanka	25
Table 2.3. Chemical analysis of Groundwater in Sri Lanka	25
Table 2.4. Resistivity and conductivity of some rocks and chemicals	26
Table 4.1. Depths of horizontal resistivity variations	57

List of abbreviations

VLF	Very Low Frequency
SP	Self Potential
UK	United Kingdom
MatLab	Matrices Laboratory
T1W1	Tuesday 1 st Wenner 1
HC	Highland Complex
Ma	Million annum
VC	Vijayan Complex
WC	Wanni Complex
KC	Kadugannawa Complex
NWS&DB	National Water Supply and Drainage Board
WRB	Water Resources Board
GPS	Global Positioning System
NAV	Navigation
2D	Two dimensional
3D	Three dimensional
NT	Nano Tesla
PPM	Proton Precession Magnetometer
DC	Direct Current
W ₁ W ₁	Wednesday the first Wenner one
MV	Milli Volt