

## LIST OF CONTENT

|  |     |
|--|-----|
| TITLE.....   | i   |
| APPROVAL.....  | ii  |
| STATEMENT OF PRONOUNCEMENT FREE .....                    | iii |
| ACKNOWLEDGEMENTS .....                                   | iv  |
| LIST OF CONTENT.....                                     | vi  |
| LIST OF FIGURES.....                                     | ix  |
| LIST OF TABLES .....                                     | xii |
| ABSTRACT.....  | xiv |
| INTISARI.....  | xv  |
| CHAPTER I INTRODUCTION .....                             | 1   |
| I.1 Background.....                                      | 1   |
| I.2 Problem formulation.....                             | 2   |
| I.3 Research Objectives .....                            | 3   |
| I.4 Research Benefits .....                              | 3   |
| I.5 Scopes of Research.....                              | 3   |
| I.5.1 Location of Research Area.....                     | 3   |
| I.5.2 Scope of work.....                                 | 6   |
| I.6 Research limitations .....                           | 6   |
| I.7 Previous Researchers and Research Authenticity ..... | 6   |
| CHAPTER II LITERATURE REVIEW.....                        | 9   |
| II.1 Regional Physiography .....                         | 9   |
| II.2 Regional Stratigraphy .....                         | 9   |
| II.3 Structural Geological .....                         | 10  |
| II.4 Regional Hydrogeology.....                          | 11  |

|             |   |    |
|-------------|---|----|
| II.5        | Theoretical Background .....                                | 12 |
| II.5.1      | The Groundwater vulnerability concept .....                 | 12 |
| II.5.2      | Groundwater contaminants.....                               | 13 |
| II.5.3      | Groundwater Vulnerability Map.....                          | 14 |
| II.5.4      | Groundwater Vulnerability assessment.....                   | 15 |
| II.5.5      | The Hazard of Groundwater Pollution.....                    | 19 |
| II.5.6      | The Groundwater Vulnerability Validation.....               | 20 |
| II.5.7      | The Total Organic Carbon in Groundwater<br>Contaminant..... | 22 |
| II.5.8      | Statistical analysis of Correlation. ....                   | 24 |
| II.6        | Hypothesis.....   | 24 |
| CHAPTER III | RESEARCH METHODOLOGY .....                                  | 26 |
| III.1       | Materials and Equipment .....                               | 26 |
| III.2       | Stages of Research.....                                     | 28 |
| III.2.1     | Preparation and proposal planning Stage .....               | 28 |
| III.2.2     | Collection of secondary data.....                           | 30 |
| III.3       | Stage of fieldwork.....                                     | 30 |
| III.4       | Laboratory work stages .....                                | 32 |
| III.5       | Data Evaluation.....  | 37 |
| III.5.1     | Groundwater vulnerability assessment.....                   | 37 |
| III.5.2     | Statistical Analysis.....                                   | 37 |
| III.6       | Final stage conclusion and Report Writing.....              | 38 |
| CHAPTER IV  | RESULTS AND DISCUSSION.....                                 | 39 |
| IV.1        | The Groundwater vulnerability of the research area.....     | 39 |
| IV.1.1      | Depth to Groundwater Table of Research area.....            | 39 |

|            |   |    |
|------------|---|----|
| IV.1.2     | Groundwater Table elevation and                             |    |
|            | Groundwater Flow patterns .....                             | 42 |
| IV.1.3     | Lithology of shallow groundwater aquifer.....               | 44 |
| IV.1.4     | Overlying Materials .....                                   | 51 |
| IV.1.5     | The Intrinsic groundwater vulnerability .....               | 54 |
| IV.2       | Physicochemical characteristic of Groundwater Quality ..... | 57 |
| IV.3       | The levels of concentration and distribution of TOC .....   | 62 |
| IV.4       | The Relationship between TOC and Groundwater                |    |
|            | vulnerability .....   | 65 |
| CHAPTER V  | CONCLUSIONS AND SUGGESTIONS.....                            | 71 |
| V.1        | Conclusions.....  | 71 |
| V.2        | Recommendation .....  | 72 |
| REFERENCES | .....   | 73 |