

TABLE OF CONTENTS

Executive Summary	iii
Acknowledgements	x
List of Boxes	xiii
List of Figures	xiv
List of Tables	xv
List of Annexures	xv
Abbreviations	xvi
1 INTRODUCTION	
1.1 Motivation	1
1.2 Aims	2
1.3 Implementation process and structure of report	2
2 LITERATURE SURVEY	
2.1 Introduction	3
2.2 VLOM approach to handpump design and use	3
2.2.1 Introduction	3
2.2.2 International experience	4
2.2.3 Extending the benefits to high head applications	5
2.2.4 Using uPVC for high head applications	10
2.2.5 Direct action pumps	12
2.2.6 Corrosion	13
2.2.7 Wear and abrasion	13
2.3 Health issues related to the use of groundwater	14
2.3.1 Bacteria and viruses	14
2.3.2 Fluorides and nitrates	15
2.3.3 Bad taste, colour or smell: hydrogen sulphide, manganese and iron	16
2.3.4 Preventable bad taste and colour: zinc and iron contamination caused by corrosiveness	16
2.3.5 Bad taste and hardness: dissolved salts and other solids	17
2.3.6 Water storage	17
2.4 Management and social issues	17
2.5 Recommendations abstracted from the literature	18
3 ANALYSIS OF SOUTH AFRICAN HANDPUMP INSTALLATION AND GROUNDWATER RECORDS	
3.1 Introduction	20
3.2 Importance of handpump installations with respect to community water supplies	20
3.3 Groundwater static depths	22
3.4 Changes in groundwater static depths with time	23
3.5 Borehole yields and recovery rates	24
3.5.1 Borehole yields	24
3.5.2 Borehole recovery rates	26
3.5.3 Shallow well recovery rates	30
3.6 Corrosiveness of groundwater	30

3.7	Handpump maintenance and the effectiveness of installations	33
3.8	Cost recovery	34
4	SURVEY OF HANDPUMP STAKEHOLDERS	
4.1	Introduction	35
4.2	Handpump manufacturers	35
4.3	Handpump purchasers	35
4.3.1	The handpump purchasers' questionnaire	35
4.3.2	How the survey was carried out and the response	36
4.3.3	Details of pumps purchased	37
4.3.4	Purchasing practice in South Africa	38
4.3.5	Purchasing practice in the rest of the world	39
4.3.6	Operation and maintenance support in South Africa	39
4.3.7	Operation and maintenance support in the rest of the world	41
4.3.8	Purchasers' evaluation of statements about handpump systems	46
4.3.9	Examination of the two statements which elicited the greatest divergence between South Africa and "rest of the world" respondents	50
4.4	User communities	51
4.4.1	The handpump users' questionnaire	51
4.4.2	How the survey was carried out	52
4.4.3	Description of sample	52
4.4.4	Pumps used and preferences	53
4.4.5	Problems preventing handpumps from being truly effective	57
4.4.6	Attitudes to handpumps	58
4.4.7	How pumps are cared for	59
4.4.8	Pump breakdowns and repairs	60
4.4.9	Village structures and users' ideas on how systems can be improved	61
5	PLANNED TEST-RIG EVALUATION OF HANDPUMPS	
5.1	Introduction	63
5.2	Background to the test-rig evaluation of handpumps	63
5.3	Preliminary commissioning of the test-rig	63
5.4	Why the test programme was abandoned	66
5.5	Current status of the test-rig	66
5.6	Outline handpump test specification	67
6	DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS	
6.1	Overview of the world situation	70
6.2	Major project findings and recommendations	71
6.2.1	Borehole development and measurement of recovery rates	71
6.2.2	Selection and installation of suitable handpumps	72
6.2.3	Institutional requirements	74
6.3	Decision support and workflow guidelines	77
6.4	Draft plan of action for implementing recommendations	85
6.4.1	Specifications	85
6.4.2	Demonstration projects	85
6.4.3	National support	86
6.4.4	Filling knowledge gaps	86
	REFERENCES	88

LIST OF BOXES

6.1	Flowchart for initial community consultation and planning	77
6.2	Flowchart for borehole drilling, development and casing	79
6.3	Guidelines for the selection of VLOM human-powered pumps	82
6.4	Guidelines for the installation of human-powered pumps	83
6.5	Guidelines for setting up ongoing management procedures	84