Copyright is owned by the Author of the thesis. Permission is given for a copy to be downloaded by an individual for the purpose of research and private study only. The thesis may not be reproduced elsewhere without the permission of the Author.
VALUING THE BENEFITS OF A SMALL COMMUNITY SEWERAGE SYSTEM IN THE COASTAL ENVIRONMENT

A Thesis submitted in partial fulfilment of the requirements for the Degree of Masters of Applied Economics at Massey University New Zealand

RICHARD RALPH MOORE
1999
Abstract

A community sewerage system is a public good which society derives a wide range of benefits from. Because a community sewerage system is a public good, it is normally provided under the direction and control of a local authority. A local authority contemplating providing a community sewerage system in a small coastal community, must consider whether the welfare of the community will increase as a result. To do this it needs to consider the total economic costs and benefits that the community might incur or gain from building a small community sewerage system. In the coastal environment the value of many of the benefits a community sewerage system would provide can not be observed in commercial markets.

This research aimed to provide local authority decision-makers with a way to value the benefits of a small community sewerage system in the coastal environment. To achieve this the contingent valuation method was used in the form of a mail questionnaire with specific reference to the circumstances of small coastal communities. Application of the questionnaire was illustrated using three small New Zealand coastal communities, Russell, Tapeka and Horeke. The questionnaire was mailed to households and businesses in these communities to solicit their willingness to pay for the benefits of a proposed community sewerage system. An average return rate of 50% was obtained.

The information and results obtained from the questionnaires showed that they can provide valuable information. In particular, information for a decision-maker wishing to determine if community sewerage is economically efficient in a small coastal community. The average value per fortnight that respondents from Russell, Tapeka, and Horeke placed on the benefits of a community sewerage system was $16.60, $15.97 and $9.75 respectively. For each community, the average value was not sufficient to cover the cost of the proposed community sewerage system. Nevertheless, the authority managing the sewerage issues in Russell, Tapeka, and Horeke gained beneficial insights to adopt the best plan of action for sewerage in each community.
Acknowledgements

May I acknowledge the following people for helping to make this thesis a reality:

Professor A.D. Meister and Dr. R.R. Alexander at the Department of Applied and International Economics, Massey University, for their supervision and guidance.

The New Zealand Counties Trust for their financial assistance.

The Far North District Council for their financial assistance and practical support.

My friends and colleagues for their support and assistance in the research.

My family, especially my mother and father for their assistance, tolerance and understanding during the duration of this research.
# Table of Contents

ABSTRACT ............................................................................................................................................ ii

ACKNOWLEDGEMENTS ................................................................................................................................ iii

TABLE OF CONTENTS ................................................................................................................................... iv

LIST OF FIGURES ........................................................................................................................................ vii

LIST OF TABLES ........................................................................................................................................ viii

1 THE NEW ZEALAND SCENE ................................................................................................................ 1

1.0 INTRODUCTION ................................................................................................................................... 1

1.1 CASE STUDIES ....................................................................................................................................... 2

1.1.1 Russell .................................................................................................................................................. 2

1.1.2 Horeke .................................................................................................................................................. 3

1.2 NEW ZEALAND LEGISLATION ............................................................................................................. 4

1.2.1 The Resource Management Act 1991 ................................................................................................. 4

1.2.2 The Influence of Maori Cultural Values ............................................................................................... 9

1.2.3 Health Act 1956 .................................................................................................................................. 12

1.2.4 The Local Government Act 1974 ........................................................................................................ 12

1.3 SUMMARY ............................................................................................................................................. 14

2 SEWERAGE SCHEMES: PHYSICAL AND FINANCIAL ISSUES ................................................................ 15

2.0 INTRODUCTION ................................................................................................................................... 15

2.1 PHYSICAL INFRASTRUCTURE ............................................................................................................. 15

2.1.1 Septic Tank Soil Absorption Systems ................................................................................................. 15

2.1.1a The Septic Tank ................................................................................................................................ 16

2.1.1b The Drainfield .................................................................................................................................. 19

2.1.2 Reticulated Systems ............................................................................................................................ 20

2.1.3 Alternative Systems ............................................................................................................................ 22

2.1.3a Effluent Drainage Servicing ............................................................................................................ 22

2.1.3b Wetlands .......................................................................................................................................... 22

2.2 ENVIRONMENTAL EFFECTS ............................................................................................................. 23

2.2.1 Ecological .......................................................................................................................................... 24

2.2.2 Aesthetic ............................................................................................................................................ 27

2.2.3 Health ................................................................................................................................................ 27

2.3 THE EQUITY OF GOVERNMENT POLICY AND FINANCING ARRANGEMENTS .................................. 29

2.3.1 Government Policy ............................................................................................................................ 29

2.3.2 Financing Arrangements ................................................................................................................... 31

2.4 THE ROLE OF THE DECISION MAKER ............................................................................................. 33

2.4.1 The National Level ............................................................................................................................. 33

2.4.2 The Regional Level ............................................................................................................................ 36

2.4.3 Territorial Authorities ......................................................................................................................... 37

2.4.3a The value of the Proposal ............................................................................................................... 37

2.4.3b The Best Practical Option ............................................................................................................. 38
List of Figures

FIGURE 2.1 A TYPICAL SEPTIC TANK SOIL ABSORPTION SYSTEM ............................................. 16
FIGURE 2.2 POLLUTION OF GROUNDWATER/SURFACE WATER BY ON-SITE SEWAGE DISPOSAL ................................................................. 25
FIGURE 3.1 PARETO OPTIMALITY IN A PERFECTLY COMPETITIVE MARKET ............................................. 47
FIGURE 3.2 A PARETO RELEVANT EXTERNALITY ........................................................................... 53
FIGURE 3.3 THE TYPES OF VALUE THAT CONSTITUTE THE TOTAL ECONOMIC VALUE OF A RESOURCE ........................................................................... 60
FIGURE 5.1 AGE DISTRIBUTION OF RESPONDENT SEWERAGE SYSTEMS IN RUSSELL, TAPEKA AND HOREKE ..... 92
FIGURE 5.2 RESPONDENT ENGAGEMENT IN COASTAL ACTIVITIES ............................................. 93
FIGURE 5.3 COMPARING WILLINGNESS TO PAY TO THE COST OF COMMUNITY SEWERAGE ............................................. 95
FIGURE 5.4 AVERAGE RESPONDENT INCOME IN RUSSELL, TAPEKA AND HOREKE ............................................. 97
FIGURE 5.5 SCATTER PLOT OF WILLINGNESS TO PAY VERSUS EXPENDITURE ON CURRENT SYSTEMS ........................................................................... 99
FIGURE 5.6 CONSTANT VARIANCE PLOT OF STANDARDISED RESIDUALS AGAINST FITTED VALUE ........................................................................... 109
FIGURE 5.7 NORMAL PROBABILITY PLOT OF STANDARDISED RESIDUALS ............................................. 110
FIGURE 5.8 PERCENTAGE OF RUSSELL RESPONDENTS WILLING TO PAY VARIOUS AMOUNTS FOR A COMMUNITY SEWERAGE SYSTEM ........................................................................... 112
FIGURE 5.9 PERCENTAGE OF TAPEKA RESPONDENTS WILLING TO PAY VARIOUS AMOUNTS FOR A COMMUNITY SEWERAGE SYSTEM ........................................................................... 112
FIGURE 5.10 PERCENTAGE OF HOREKE RESPONDENTS WILLING TO PAY VARIOUS AMOUNTS FOR A COMMUNITY SEWERAGE SYSTEM ........................................................................... 113
List of Tables

TABLE 2.1 RECOMMENDED SEPTIC TANK CAPACITIES ......................................................... 18
TABLE 3.1 POTENTIAL MEASUREMENT BIASES THAT CAN BE PRESENT IN CONTINGENT VALUATION STUDIES ................................................................. 69
TABLE 4.1 THE BENEFITS OF A COMMUNITY SEWERAGE SYSTEM ..................................... 74
TABLE 5.1 FORWARD SELECTION OUTPUT ........................................................................ 101
TABLE 5.2 BEST SUBSETS REGRESSION AND MALLOWS $C_p$ ........................................... 102
TABLE 5.3 REGRESSION EQUATION WITH THE SEVEN MOST SIGNIFICANT EXPLANATORY VARIABLES ........................................... 103
TABLE 5.4 THE REGRESSION WITH THE HEALTH EXPLANATORY REMOVED ................ 105
TABLE 5.5 DUMMY VARIABLES FOR THE CONSTANT TERM ........................................... 106
TABLE 5.6 FULL OUTPUT AND STATISTICS FOR THE CHOSEN MODEL ......................... 107
TABLE 5.7 EQUATION AND STATISTICS FOR THE DIFFERENT MEANS TEST ................ 110