

THE UNIVERSITY OF ZAMBIA

**SCHOOL OF NATURAL
SCIENCES**

GEO 474

WATER SUPPLY SITUATION IN CHELSTONE

BY

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**A GEO 474 RESEARCH PROJECT SUBMITTED TO THE GEOGRAPHY
DEPARTMENT AT THE UNIVERSITY OF ZAMBIA IN PARTIAL
FULFILMENT OF THE BACHELOR OF SCIENCE DEGREE IN
NATURAL RESOURCES.**

NOVEMBER, 2004

DEDICATION

To my Bejoved late Mother, for having sacrificed diligently for my education from my grade one through to my final year at the University, and to my late Father and to my Brothers and Sisters for their support.

DECLARATION

" I, SIMATAA MANYANDO, declare that the work submitted in this report was collected and compiled by me alone. All maps were drawn by me and all quoted information has been appropriately acknowledged. This work has not been previously submitted for any academic award."

Signed: MS

Date: 02/11/04

ACKNOWLEDGEMENT

I am deeply indebted to the following people who helped me successfully complete this report. My sincere thanks go to Dr. G.P.A. Banda, my supervisor, for his patient scrutiny of the manuscript and his valuable advice and contribution. My sincere thanks are also due to Mrs. C. Muzyamba for her encouragement during the research.

I also owe my deepest gratitude to my Dear friends Owen Simwanda and Glendah Sokontwe for whole heartedly enabling me use their Personal Computers for typing the manuscript. I am also deeply and forever grateful to my Dear friends Chanda Kunda and Vincent Lukali for extending a hand of generosity during my time of need. I am also deeply grateful to my course mates and friends for making my stay at campus a memorable one.

I would also like to thank the staff at the Cartographic Section of the Geography Department for providing the materials needed for the completion of Maps. Lastly but not the least, I would like to thank all members staff at the Geography Department for their help.

ABSTRACT

This research is concerned with the water supply situation in Chelstone. The study area Chelstone is about 7 km east of the central business district of Lusaka. Chelstone Township like other urban areas in Lusaka has experienced an increase in population. The expansion in population has led to an increased demand of water. This has led to water rationing in Chelstone in order to cater for the different sections of the township. Some residents have resorted to sinking boreholes in order to ensure an adequate water supply.

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CHAPTER ONE

INTRODUCTION

1.1: General Overview

Water is essential to sustain life, development and the environment. This basic yet profound truth is not easy to drive home. As the world population increases and urbanisation and industrialisation take hold, the demand for water will keep rising while the quality of the water may continue to deteriorate, (Phiri, 2003)

According to the Central Statistical Office, [CSO](1999), in 1996, 50% of Zambian households had access to clean water. Of these only six percent use boreholes and protected wells while 47% had their own taps and 29% used public stand pipes

At present approximately 60% of the total raw water is supplied from the Kafue River by pumping through a 48 km long pipeline. The remaining 40% are ground water sources from boreholes, (Hoyer, 1978)

Unauthorised squatter compounds have no water supply by the city and depend on hand dug wells for drinking water and for washing. Pit latrines pollute many wells and evidence shows they are a continual source of infection, (Hoyer, 1978)

1.2: Statement of the Problem

Saunders and Warford, (1976:3) define water supply as encompassing everything from a relatively sophisticated pumping, storage, and distribution system to a simple protected well with no storage treatment or extensive distribution system.

In most urban areas experiencing inadequate water supply, women and children are exposed to long distances in search for water. This means women are distracted from other productive activities as they spend a lot of time

fetching water. Children are distracted from productive academic and other activities.

Chelstone like most residential areas in Lusaka experiences an erratic water supply. This means that at certain times water is not available. The erratic supply is as a result of water rationing due to a high demand. The high demand is as a result of an increasing population. The population has increased to 38,670 between 1990-2000 in Munalu Constituency where Chelstone lies (CSO, 2000). The high demand is also as a result of lack of use of appropriate technologies such as the sinking of borehole to tap the ground water reservoir. For this reason the study aims at trying to highlight how the residents of Chelstone strive to meet their daily domestic water needs and prospects of improving water supply in the area.

1.3: Objectives of the Study

1.3.1: Overall Objective

The overall aim/objective of this study is to find out about the water supply situation in Chelstone.

1.3.2: Specific Objectives

The specific objectives are as follows:

- (i) To find out if there is a significant difference in water supply between houses and apartments in Chelstone.
- (ii) To find out the main sources of water for domestic consumption in Chelstone.
- (iii) To find out the average distance covered by residents in Chelstone to fetch water.

1.4: Hypotheses

In order to attain the above specific objectives, the following specific hypotheses were tested:

- (i) There is no significant difference in water supply between houses and apartments.
- (ii) The main sources of water for domestic consumption in Chelstone is piped water.

- (iii) The average distance covered by Chelstone residents to fetch water is more than 100m.

1.5: Report Organisation

This project has seven chapters. Chapter Two looks at the Literature Review whereas Chapter Three looks at the Location and Description of the study area. Chapter Four contains the Methodology while Chapter Five deals with the Research findings. Chapter Six discusses the findings whereas Chapter Seven looks at the Conclusions and Recommendations of this research.

CHAPTER TWO

LITERATURE REVIEW

2.0: Introduction

Water is a vital resource, which must reach every individual, household and the entire human community in required quantities and usable form. Accessibility to this resource varies from one place to another and different methods for its abstraction exist. Whatever system in water supply is adopted in any given locality materially depends on the local hydrology, topography, geology and other climatological factors, Government of the Republic of Zambia [G R Z](1994)

2.1: Role of Water in National Development

The water sector is one the principal sectors with vital links to other sectors in the economy. The government has for the past years made massive investments in water supply and sanitation schemes throughout the country. However, it is sad to note that 90% of the investment was contributed by donors and other cooperating partners, (G R.Z, 1994).

Water is critical to agriculture, health, energy, transport and tourism. It also provides formal employment to many people involved in water management and the various water supply and sanitation scheme in the country, (GRZ, 1994) Below are some of the roles water plays in various is sectors.

2.2: Water and Food & Agriculture

In the food and agriculture sector, water is a prime factor in the production of adequate food for the country. Water makes the soil productive. It is also important in the sustenance of the fishing industry, which has an important role to play in the provision of a certain level of nutrition needed by the people. Furthermore, the government's repeated call for the diversification from mining dependent to one based on agriculture puts water on an even much greater demand. In general water may be used for irrigation, livestock watering and fresh water aquaculture, (G R.Z., 1994).

2.3: Water and Health

The amount and quality of water consumed by a community determines its standard of living. The benefits from supply of sufficient quantities and good quality and sanitation are important in as far as the sustenance of health is concerned. Improved access to water and sanitation also yields direct economic benefits. For many people (particularly in rural areas), obtaining water is time-consuming and heavy work, taking up most of women's time. It is evident therefore that water resources management to bring safe drinking water within reach of all communities and the provision of facilities to dispose waste in a sanitary manner, would greatly improve human health and also release time and energy to produce more for development, (G.R.Z., 1994).

2.4: Water and Industry

Water plays an important role in many industries upon which the economic development of the country is largely dependent. It is mainly used in steam generation/or heating, cooling, constituent of the product, product dilution, reagent make-up, product or safe washing and transport of materials or waste. The water quality requirements vary depending on the intended use, (GRZ, 1994)

2.5: Water and Energy

Energy is the life blood of any economy. Over 90% of the Zambia's electricity is hydro-power (G.R.Z., 1994). Currently electricity contributes 12% to the national energy mix. Water is therefore an important natural resource required for the generation of electricity which is not only a vital input to the mining industrial commercial and increasing activities, but the operation of the industry also provide employment to over 4000 people, which is about 1% of total formal employment. Zambia at present earns a monthly average income of about US\$2 million in exports of electricity to neighbouring countries, (GRZ, 1994).

2.6: Water and Transport

In a country like Zambia which is faced with economic and social effects of escalating oil import bills, water transportation turns out to be an important

alternative to other forms of transportation like road, air and rail in areas with navigable rivers and lakes. Current statistics show that in 1992, a total cargo of about 296 tonnes and 8,669 passengers used the water transport through Mpulungu port (G.R.Z., 1994). The main advantage of water transport lies in its ability to move goods in bulk. Water transport has proved to be most suitable and convenient in area with large surface water bodies such as lake Bangweulu and its swamps, Lukanga swamps and part of Western province where the floods are a recurrent event, (G.R.Z., 1994).

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2.7: Water Availability and Distribution in Southern African Development Community (SADC).

The SADC region has a total land area of nearly 6.8 million square kilometres, at an average altitude of 1000 metres above sea level, and has 16 main river basins. Of the regions total land area:

- three percent is humid, receiving more than 1000mm of rain per year;
- 40 percent is moist sub-humid, receiving between 1,200-1,500mm/yr;
- 19 percent dry sub-humid, receiving 600-1200mm/yr;
- 16 percent semi-arid, receiving 400-600mm/yr;
- 15 percent arid, receiving 100-400mm/yr; and
- seven percent desert, receiving less than 100mm/yr (Chenje et al, 1996)

Unfortunately, the distribution, occurrence and availability of water resources is uneven in the region as well as in individual countries; and availability depends on rainfall. Much of the region is arid or semi-arid and rainfall is variable, often unreliable. The SADC region is mainly wet in the north and east and extremely dry in the southwest. The region is periodically by severe and prolonged droughts, which may be affected by equally devastating floods (Chenje *et al*, 1996).

2.8: Sources of Water Supply

Water used by human beings is abstracted from various sources. The selection of sources of water supply is greatly dependent on the bounty nature. Todd *et al* (1974), categorises sources of water at man's disposal into the broad groups as follows: Surface water, Ground water, and Reclaimed water.

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2.8.1: Ground Water

Apart from surface water resources, Zambia enjoys favourable ground water conditions compared to most countries in the Southern African Region with regard to depth, storage capacity, available yields and storage potential. The total ground water storage is estimated at 1, 740, 380 MCM and ground water recharge of 160, 080 MCM per annum, (Mac Donald, 1990). Other studies of ground water resources of Zambia have come up with four major drainage basins and the findings are as shown below

Table 2.1: Ground Water Potential in Zambia

(All values in million cubic metres)

	Drainage Basin	Luapula Tanganyika	Luangwa	Kafue	Zambezi	Total
1.	Basin area Km ²	194,000	147,500	155,000	256,000	752,000
2.	Total Mean Annual Rainfall(mm)	214.1	122.3	149.72	228.69	714.85
3.	Ground water through flow	0.83	1.634	0.96	0.22	3.65
4.	Vertical Recharge	41.5	33.02	24.45	64.03	160.08
5.	Ground Water storage	377.7	242.76	252.06	86.82	1,740.4

(G R.Z., 1994)

2.8.2: Overview of the Water and Sanitation Sector

The water supply and sanitation sector in Zambia has been undergoing restructuring since early 1993. The sector reform are closely linked to the Public Sector Reform Programme, (PRSP), which aims at the devolution of power from central government to local authorities as a basis for improving the efficiency and effectiveness of the public sector, (CSO, 1996). The main objective of the Water Sector Reform is to reorganise the water supply and

sanitation sector so as to create new institution that can provide cost-effective, equitable and sustainable water supply sanitation services in Zambia. The water sector reforms are as a result of the realisation by policy makers, water sector professionals, donor agencies and even consumers that the main constraint to water and sanitation services delivery in the country is weaknesses in the institutional legal and organisational framework of the sector, (CSO, 1996).

The reform programme is implemented by the Programme Coordination Unit (PCU), an inter-ministerial and inter-sectoral committee. The water sector reform support unit (RSU), is its secretariat. Since the start of the water sector reform programme a national water policy was promulgated in November, 1994 and a legal framework established (Water Supply and Sanitation Act November, 1997). Strategies for more effective and sustainable service delivery based on an overall water sector strategy and institutional framework proposed in 1994, are underdevelopment, (CSO, 1996).

2.8.3: History of Lusaka's Water Supply

In the past, boreholes of relatively small diameter were drilled to provide a water supply to Lusaka. Between the years 1954 and 1959 two large diameter boreholes were drilled and the supply was increased to approximately 22,800m³ per day. These are boreholes No.1 and No.2 situated inside the water works pumping plant well No.9901 and 9902, (Hoyer, 1978). As the rate of consumption increased in subsequent years the first augmentation scheme was implemented in 1964 to increase the water supply by another 11,400 cubic metres per day. This was achieved by the construction of a 3m diameter and a 61m deep shaft (Shaft No.5, Well No.9904) (Hoyer, 1978).

Further to hydrological report by Jordan, (1963) and Tange, (1965) which suggested very limited possible expansion of ground water abstraction, consultants were appointed to design a scheme based on the pumping of water from the Kafue river, (Hoyer, 1978).

Construction commenced in 1968. The rapidly increasing demand however exceeded the maximum available supply from existing sources and it became

obvious that additional water would be required before the commissioning of the Kafue scheme. Hence under an emergence programme new boreholes were drilled throughout the city and a scheme for utilising the surplus water from the quarries, (Well No 9907) was implemented, (Hoyer, 1978). By the end of 1968, the total quantity from underground sources was in the order of 78180 cubic metres per day. In September 1970, Kafue stage 1 was commissioned to cope with increasing demand construction of Kafue stage 2 was commenced in June 1971, followed by stage 2A in 1972, (Hoyer, 1978).

CHAPTER THREE

LOCATION AND DESCRIPTION OF STUDY AREA

3.0: Introduction

This chapter describes the geographical location and description of the important features in Chelstone.

3.1: General Description

Zambia is a land locked country lying south of the equator at an altitude of between 1000 and 1 600 metres above sea level. It's total surface area is about 752 972 square kilometres. Most of it is plateau (NCS, 1985). Lusaka city, in which Chelstone lies, has a total surface area of 360 square kilometres.

3.2: Location of Chelstone in Lusaka

Chelstone is located in the city of Lusaka, Zambia. It is about 7 km east of the Central Business District of Lusaka in the Great East Road and shares borders with Kamanga compound, Esther compound, Mtendere and Avondale.

Fig 3.1 shows the location of Lusaka in Zambia

Fig 3.2 shows the location of Chelstone in Lusaka.

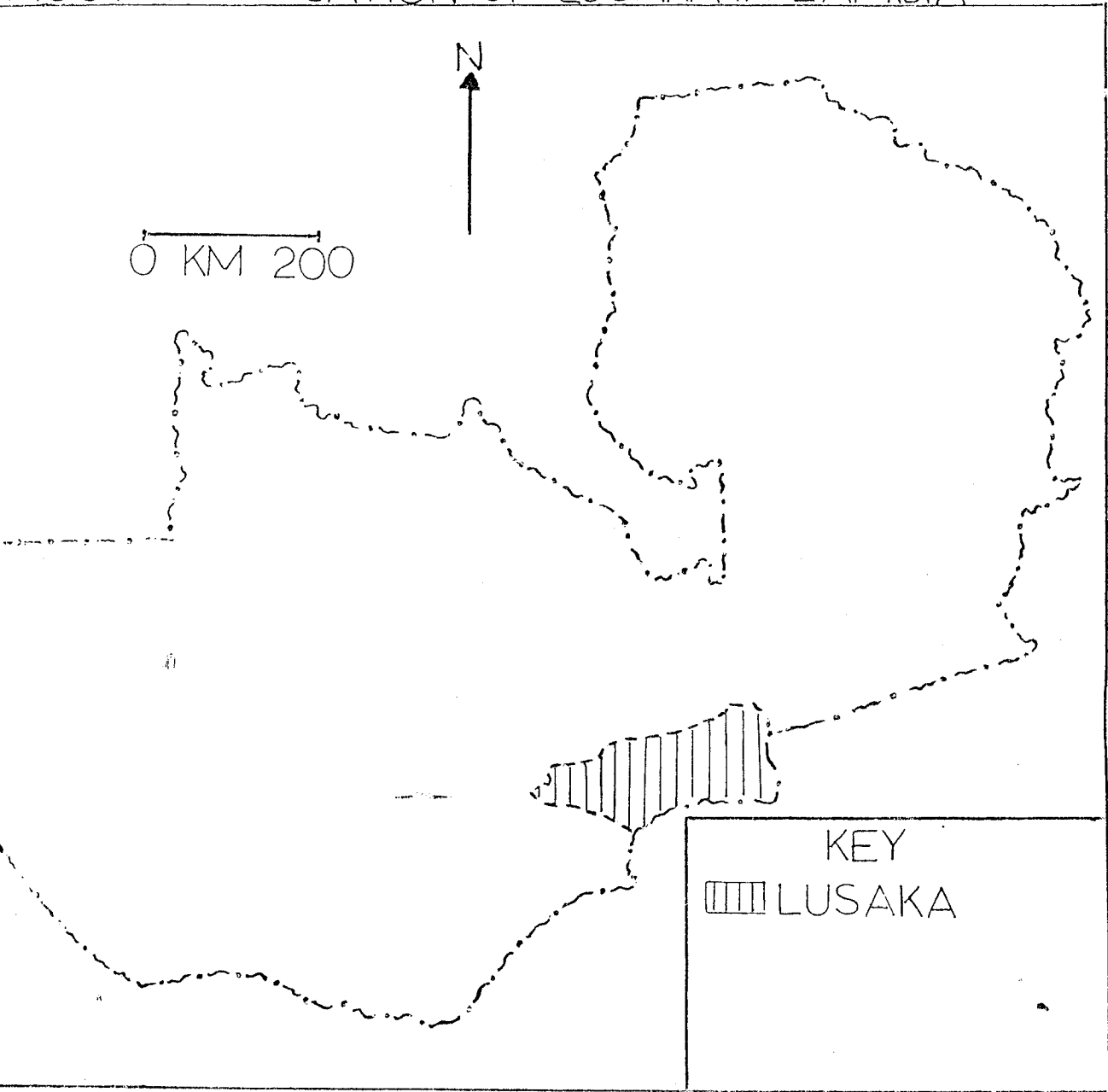
3.3: Population

In 1980, the population of Lusaka was 538 469 (Williams, 1984). In 1990, the population of Lusaka was 1.1 million (CSO, 1990). Chelstone has 2 361 households and a total population of 12 574 residents comprising 6 055 males and 6 519 females (CSO, 2004).

3.4: Climate

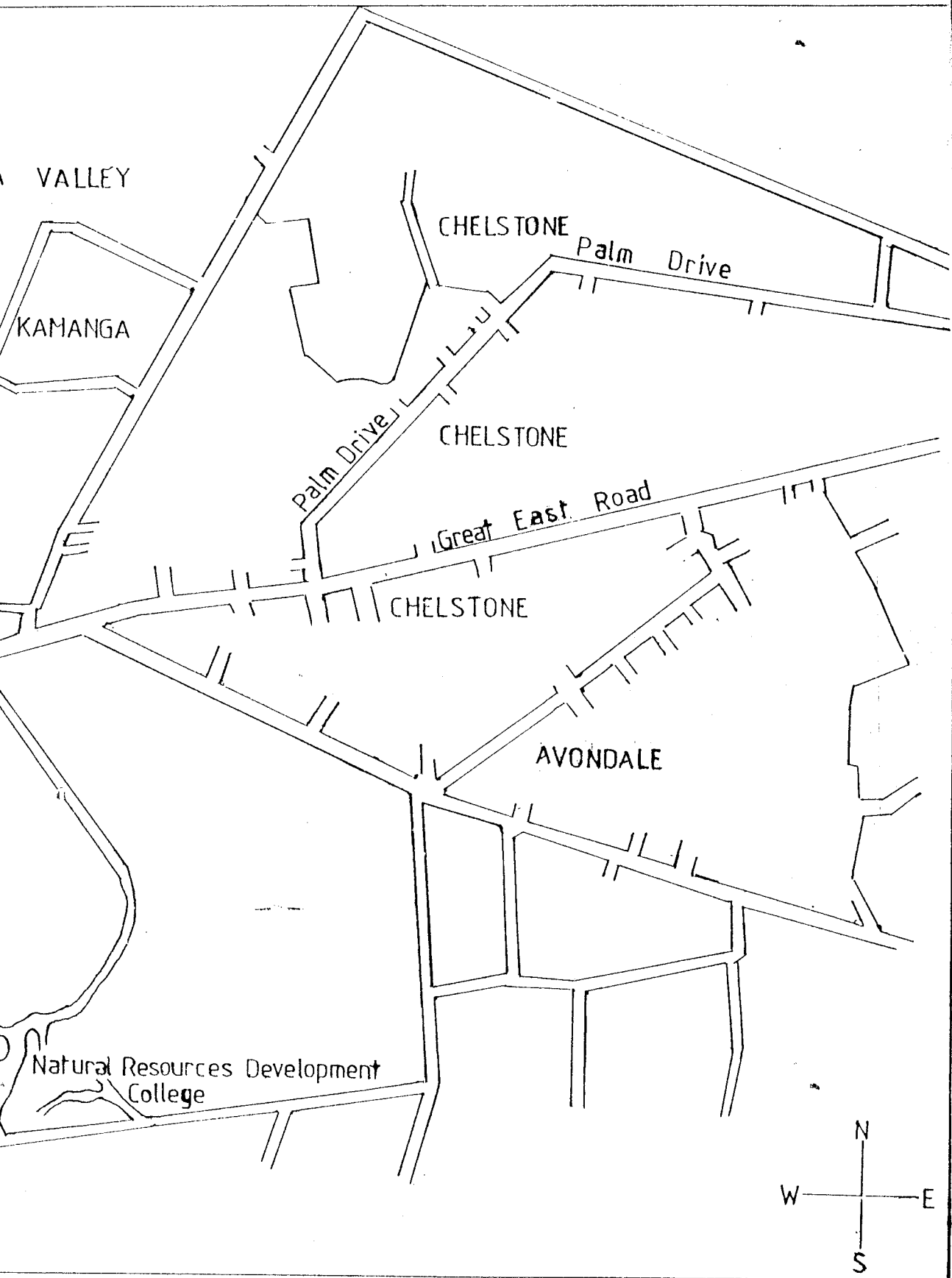
The city of Lusaka is in the tropics and so is Chelstone. Its altitude is about 1 300m above sea level. Three major seasons are observed in Chelstone; the hot dry season, the cool dry season and the hot wet season. The average temperature ranges from 10 degrees Celsius in the cold season, to about 25 degrees Celsius in the hot season. The annual rainfall is about 800mm.

FIG 3.1 THE LOCATION OF LUSAKA IN ZAMBIA



SOURCE: Siddle(1971)

2 LOCATION OF STUDY AREA-CHELSTONE



LUSAKA CITY COUNCIL-PLANNING DEPARTMENT

SCALE: 1:20 000

CHAPTER FOUR

METHODOLOGY

4.0: Introduction

This chapter looks at the research methodology, which includes data collection activities during the process of the research. Data collection activities fall basically into three categories. These are; data from the residents; data from Lusaka Water and Sewerage Company and data from the libraries. The chapter will also look at the data collection techniques and data analysis

4.1.0: Data Collection Techniques

4.2.1: The Questionnaire

The main method used in obtaining information from the residents in Chelstone was the use of the questionnaires. The selected residents provided information on how they rate the water supply in the area; what distance they cover to fetch water ; their main source of water supply ; how long it takes for them to draw water. Refer to Appendix I for items included in the questionnaire.

The questionnaire was also used to obtain the data from the Lusaka Water and Sewerage Company pertaining to Chelstone. The questionnaire yielded information on the major objective of the company; the total labour force and the challenges the company faces in supplying water to Chelstone. For more information on the items included in the questionnaire to the Lusaka Water and Sewerage Company official, see Appendix II

4.2.2: Interview schedule

Interview schedules were conducted randomly to get the view from the residents on the water supply situation in Chelstone.

4.3: Sampling Procedure and Sample Size

The study was undertaken in Chelstone on houses and apartments near the Police station and near the Chelstone-Catholic church. The research was restricted to these parts of Chelstone due to the vastness of the area and the limited time at hand for doing

the research. The areas were chosen purposely because they are affected by an erratic water supply.

A sampling frame of 54 houses in each of the four areas was considered i.e Apartments and houses in the two areas. A sample size of 10 houses was selected in each of the four areas using the interval sampling method $i=N/n$ where N is the total number of houses in each sampling area and n is the sample size. In this case the interval was five Houses. The starting household was selected randomly between 1 and 2 by toasting a coin labelled 1 and 2 on its faces. The interval sampling method was used because it is systematic, simpler and quicker to use than use of random numbers.

4.4: Data Collection Activities

Collection of data from residents in Chelstone through the distribution of questionnaires started on 13th July 2004 and ended on 16th July, 2004.

On 23rd July 2004, the current researcher went to see the Water Supply Manager for the Lusaka Water and Sewerage Company but did not find him, as he was busy in the field attending to other issues. The purpose of the visit was to collect data from him pertaining to the water supply situation in Chelstone. The current researcher went back to the Lusaka Water and Sewerage Company the following day and distributed the questionnaire to him. He did not answer the questionnaire immediately as he needed to get permission from his boss. Then on 30th July 2004, the current researcher managed to get the answered questionnaire.

4.5: Secondary Data

The other information for the project came from the following institution;

- (1) The Central Statistical Office-Lusaka particularly the data on the population for the study area.
- (2) The Environmental Council of Zambia provided data on the water supply in the Southern African Development Community (SADC)
- (3) The Council (Civic centre) provided the map for the study area.
- (4) The University of Zambia Library provided data particularly on the history of water supply in Lusaka.

4.6: Data Analysis

4.6.1: Coding

After the questionnaires were answered, the responses were coded by giving each possible response a numerical code.

4.6.2: Analysing

The data was analysed manually. Different responses from particular questions were used to construct tables. This was done by computing percentages for different responses for a particular question.

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CHAPTER FIVE

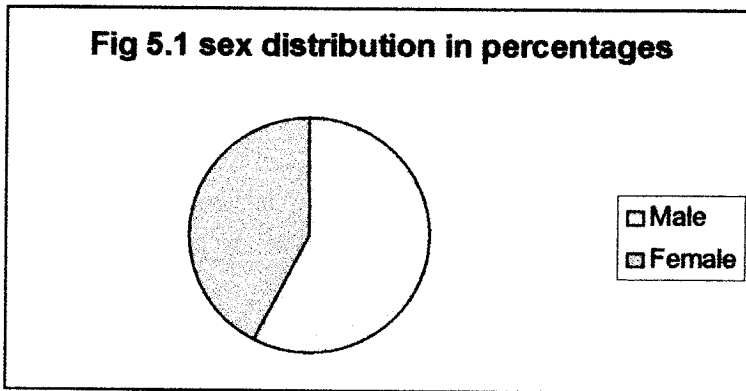
RESEARCH FINDINGS

5.0: Introduction

This chapter presents the research findings of this study. The analysis was done with the aid of tables and pie charts.

5.1: Sex Distribution of Respondents

The pie-chart below shows the sex distribution of the respondents. As depicted in the Chart below, Females constituted a slightly greater proportion to that of Males.



The sample constituted 57.5% males and 42.5% females

5.2: Age Distribution of Respondents in Percentages

The table below shows the age distribution of respondents.

Table 5.1 Age distribution of respondents in percentages

	Number	Percentage (%)
<25	22	57.9
25-35	13	34.2
36-45	2	5.3
>46	1	2.6
Total	40	100

(Source; Field data, 2004)

Of the respondents, 57.5% were aged less than 25 years; 34.2%, 25-35 years; 5.3% between 36-45% and 2.6% were aged above 46 years.

5.3: Distribution of Respondents by the Level of Education Attained.

Table 5.2 below shows the education of respondents attained

Table 5.2 Education of respondents attained in percentages

	Number	Percentage (%)
Primary	2	5
Secondary	16	40
Tertiary	19	47.5
None	3	7.5
Total	40	100

(Source; Field data, 2004)

Five percent of the respondents had attained primary level of education; 40% secondary level; 47.5% tertiary level and seven and a half percent had not been to school.

5.4: Distribution of Respondents by Marital Status

Table 5.3 below shows the distribution of respondents by marital status.

Table 5.3 Marital status of respondents in percentages

	Number	Percentage (%)
Single	30	75
Married	10	25
Separated	0	0
Divorced	0	0
Total	40	100

(Source; Field data, 2004)

Of the respondents 75% were single; 25% were married; 0% separated and 0% divorced.

5.5: Distribution of Respondents by Occupation

Table 5.4 below the distribution of respondents by occupation

Table 5.4 Occupation of respondents in percentages

	Number	Percentage (%)
Employed	16	40
Unemployed	14	35
Student	9	22.5
Retired	1	2.5
Total	40	100

(Source; Field data, 2004)

The figure above shows that 40% of the respondents were employed; 35% were unemployed; 22.5% were students and two and a half were retired.

5.6: Distribution of Respondents by Number in Household

Table 5.5 below shows the distribution of respondents by number in households.

Table 5.5 Number of respondents in household in percentages

	Number	Percentage (%)
<5	11	27.5
5-10	29	72.5
>10	0	0
Total	40	100

(Source; Field data, 2004)

Twenty seven and a half percent of the households had less than five people and 72.5% had between five to ten people.

5.7: Distribution of Respondents by Source of Water.

Table 5.6 below shows the distribution of respondents by the source of water.

Table 5.6 Source of water in percentages.

Source	Number	Percentage (%)
Home tap	26	65
Borehole	7	17.5
Both	7	17.5
	40	100

(Source; Field data, 2004)

Of the respondents, 65% source their water from home taps; 17.5% access the water from boreholes and 17.5% from both boreholes and home taps.

5.8: Distribution of Respondents by the Number of Litres of Water Stored

Table 5.7 below shows the distribution of respondents by the number of litres of water stored.

Table 5.7 Number of litres stored in percentages

Litres	Number	Percentage
<200	21	65.6
201-400	5	15.6
401-600	2	6.3
>600	4	12.5
	32	100

(Source; Field data, 2004)

About sixty five percent of the respondents store less than 200litres of water; 15.6% store between 201-400 litres; 6.3% store between 401-600 litres and 12.5% store more than 600 litres.

5.9: Distribution of Respondents by the Time taken to Draw Water

Table 5.8 below shows the distribution of respondents by the time taken to draw water.

Table 5.8 Time taken to draw water in percentages.

Time/minutes	Number	Percentage (%)
<30	14	60.9
31-60	2	8.7
61-90	0	0
>91	7	30.4
Total	23	100

(Source; Field data, 2004)

The table above shows that 60.9% of the respondents took less than 30 minutes to draw water; eight and a seventh percent took between 31-60 minutes; 30.4% took more than 91 minutes.

5.9.1: Distribution of Respondents by the Distance moved to Fetch Water

Table 5.9.1 below, shows the distance moved by the respondents to fetch water.

Table 5.9.1 Distance moved to fetch water in percentages

Distance/m	Number	Percentage (%)
<50	21	56.8
50-100	3	8.1
>100	13	35.1
Total	37	100

(Source; Field data, 2004)

About fifty six percent of the respondents moved a distance less than 50 metres; about eight percent moved a distance between 50-100 metres and 35.1% moved a distance more than 100 metres.

5.9.1: Distribution of Respondents by the Rating of Water Supply in their Areas

Table 5.9.2 below shows the distribution of respondents by the way they rate the water supply in their areas.

Table 5.9.2. Rate of water supply in percentages.

Rating	Number	Percentage (%)
Very adequate	3	7.5
Adequate	12	30
Meagre	11	27.5
Inadequate	11	27.5
Very inadequate	3	7.5
Total	40	100

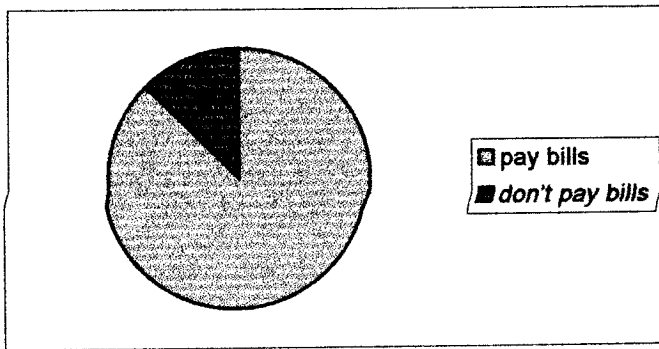
(Source; Field data, 2004).

The above table shows that seven and a half percent of the respondents rated the water supply as being very adequate; 30% as adequate; 27.5% as meagre; 27.5% as inadequate and seven and a half percent as very inadequate.

5.9.2: Distribution of respondents by the payment of water bills

Figure 5.2 below shows the distribution of respondents by the payment of water bills

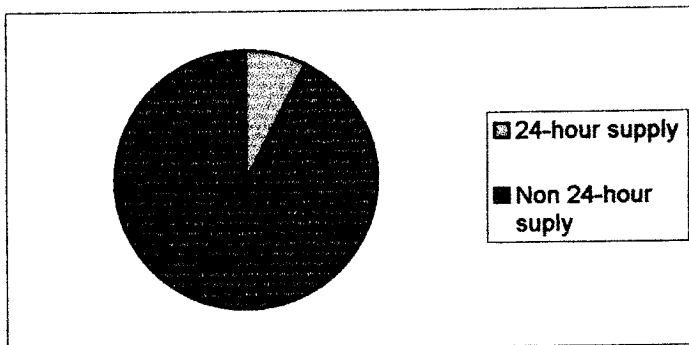
Fig 5.2 Payment of water bills in percentage



The pie chart above shows that 87.5% of the respondents pay water bills whereas 12.5% don't.

5.9.3: Distribution of Respondents by Period of Water Supply

Fig 5.3 Pie-chart showing period of water supply

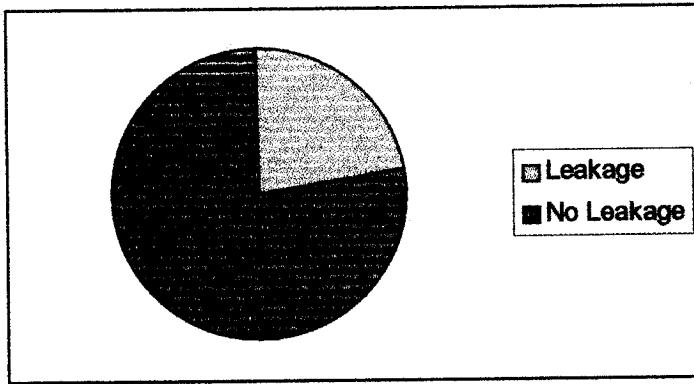


The above Pie chart shows that 92.5% of the households did not have a 24-hour water supply whereas seven and a half percent had.

5.9.4: Distribution of Households by leaking Taps

Figure 5.4 below shows the distribution of respondents by leaking taps.

Fig 5.4 Percentage of leaking Taps



77.5% of the household had no leaking tap whereas 22.5% of the households had.

5.9.5: Distribution of Respondents by the Time taken to Repair Broken Pipes

Table 6.0 below shows the distribution of respondents by the time taken by the service provider to repair broken pipes.

Table 5.93 Time taken to repair broken pipes in percentages

Time (days)	Number	Percentage (%)
<1 day	2	7.4
1-7 days	7	25.5
8-14 days	9	33.3
>14 days	9	33.3
Total	27	100

(source: field data, 2004).

Seven and a quarter percent of the respondents indicated that it takes about a day for the service provider to repair broken pipes; 25.5% indicated 1-7 days; 33.3% indicated 8-14 days and 33.3% indicated more than 14 days.

5.9.6: Questionnaire to the Lusaka Water and Sewerage Company Official

The questionnaire distributed to the Water Supply Manager revealed the following information.

The Lusaka Water and Sewerage Company was established in April 1988. The total labour force as at June 2004, was 508.

The major objective of the company was to meet water and sewerage service requirements of customers in the city of Lusaka and satellite towns in both quantity and quality at a commercially sustainable level.

The company makes both profits and losses. Some houses in Chelstone are metre whereas others are not. The monthly charge on metre houses is arrived at through the metre reading whereas for the unmetred houses the monthly charge is arrived at through estimated consumption; In the case of installing a metre the company incurs the cost. There are about five metre readers per area

The company faces various challenges in supplying water to Chelstone including; the increasing demand; mis-use of water despite the water being inadequate; low groundwater levels which in turn affect production levels; local perception that water is free. See appendix II for the items included in the questionnaire.

DISCUSSION

6.0: Introduction

This chapter discusses the research findings.

6.1: Sex and Age Distribution of Respondents

As in many researches, the number of males and females that constituted the sample were not the same. The males comprised a relatively larger proportion to that of the females with the males constituting 57.5% and females 34.2%. This seems to have been a well-balanced sample in terms of sex distribution.

The age ranges <25 and 25-35 years comprised the majority of the respondents with 57.5% and 34.2% respectively. Only a few respondents were above the age of 36 years. This is a reflection of the general trend of the population of Zambia that is said to be young. This is due to the low life expectancy, which is at thirty-five years.

6.2: Education Level and Occupation of Respondents

The majority of the respondents comprising 47.5% had attained tertiary level of education. Secondary level of education comprised the second biggest proportion of respondents constituting 40% of the total respondents. Five percent had attained primary education. Only 7.5% had not been to school. Thus, the sample had a well-educated population.

The majority of the respondents were employed. The employed constituted 40% of the respondents. The unemployed also constituted a bigger proportion of the sample comprising 35%. A fairly small percentage, were students, comprising 22.5% of the respondents.

6.3: Sources of Water Supply

The inadequate water supply is manifest in that about 35% of the respondents had alternative sources of water. These include water from other homes and boreholes. This entails that the availability of water in Chelstone, in different areas, is varies with

the time of the day. This is due to the water rationing by the service provider. Sixty five percent of the respondents sourced their water from their home taps.

The residents of Chelstone near Universal Bakery in Palm Drive Road sometimes draw water from the Bakery, which has a bore-hole while the residents in the vicinity of Chelstone Clinic sometimes draw their water from the Clinic, which has a borehole. The residents of Chelstone near Chakunkula Primary School draw their water from the School, which has a borehole. However, the water from these boreholes is not always available as the pumps are sometimes switched off to allow the build up of the water in the reservoirs.

The time taken draw water from respective sources varies. This is dependant on the distance moved to fetch water, the congestion at the source and the pressure of flow of water. About sixty one percent of the respondents indicated that it takes less than 30 minutes to draw water; 8.7% indicated that it takes between 31-60 minutes to fetch water whereas, 30.4% indicated that it takes more than 91. The above findings point to the fact that a lot of time is spent in fetching water. This time could be spent in other productive areas of life if the water supply was adequate.

The distance moved to fetch water is quiet substantial. About 43.2% of the respondents move a distance more than 50 metres to water sources.

6.4: Rating of Water Supply

The respondents living in apartments and houses in the vicinity were asked to indicate how they rate the water supply in their respective residences on a scale of 1-5 ranging from very adequate to very inadequate. The sign test revealed that there is a significant difference in water supply between houses and apartments, (see appendix III). The difference in water supply between houses and apartments could be attributed to the differences in altitude between houses and apartment. Apartments being on a higher altitude require a higher water pressure for the water to reach them.

The overall rating of the water supply between on apartments and houses was as follows; Only 7.5% of the respondents indicated having a very adequate water supply while 30% indicated having an adequate water supply; Those who indicated meagre,

inadequate and very inadequate water supply comprised 62.5% in total. Thus the majority of the respondents were not happy with the water supply.

6.5: Water bills

The research established that some of the respondents don't pay water bills to the service provider. This comprised 12.5% of the respondents. The reason being that their houses are not metred. However, some of the respondents on unmetred houses do pay for water. These pay a fixed amount based on estimated consumption by the service provider.

6.6: Leaking Taps and Repair

Like in most urban areas, the research established that some houses in Chelstone have leaking taps. 22.5% of the respondents alluded to having leaking taps. Unfortunately, the respondents indicated that it takes long for the service provider to attend to this problem

CHAPTER SEVEN

CONCLUSION AND RECOMMENDATIONS

7.0: Introduction

This is the last section of this report, which summarises the research findings and puts forward suggestions as to what should be done in the future to overcome the problems therein. This chapter comprises two parts. The first part comprises the conclusion while the second part deals with the recommendations.

6.1: Conclusion

Life on earth depends on water. Unfortunately, the water supply in most cases does not sufficiently meet the demands of the population as revealed by this research.

Water consumption demand exceeds the available water supply in Chelstone. This is as a result of increasing demand due to population growth without a corresponding increase in water supply infrastructure. Water leakages in the supply system though minor, also contribute to the inadequacy of water supplied to Chelstone.

6.2: Recommendations

- (I) From the findings of the research, it is highly recommended that there is need to invest in ground water if a sustainable supply of water is to be achieved. The private sector should be encouraged to invest in the sinking of boreholes. A single borehole can cater for a number of houses.
- (II) If a sustainable water supply is to be achieved, there is need to monitor land use activities in Chelstone. Therefore it is recommended that land use activities such as the cutting down of trees be monitored and controlled to encourage infiltration and percolation of precipitation in the area.
- (III) It is also recommended that water leakages be reported quickly and handled effectively to avoid water losses from the supply system.
- (IV) The Service Provider must install metres on the Houses and Apartments that are not metred so as to realise the appropriate revenue to enable the Service Provider, provide quality service to the area.

9. How would you rate the water supply in your area?

Very adequate () Adequate () Meagre () Inadequate () Very inadequate ()

10. Do you pay for water?

Yes () No ()

11. If the answer to question 10. is no, why not?.....

12. Do you have a 24-hour water supply?

Yes () No ()

13. If the answer to question 12. is No, how many hours a day does the company provide water?.....

14. Which company is responsible for the provision of water supply in Chelstone?
.....

15. Does the company provide water for 24 hours a day?

Yes () No ()

16. If the answer to question 15. is No, for how many hours a day does the company provide water?.....

17. Do you have any water leakages?

Yes () No ()

18. Does the company repair broken Pipes within 24 hours after this has been reported?

Yes () No ()

19. If the answer to question 18. is No, how long does it take the company to repair broken Pipes?.....

20. What action does the company take against the clients who default on the payment of water bills?.....

APPENNDIX II

QUESTIONNAIRE TO THE LUSAKA WATER AND SEWERAGE OFFICIAL

1. Position held by Official _____

2. When was the Lusaka Water and Sewerage Company formed?

3. What was the major objective of the company?

4. What is the total labour force?

5. Does the company make profits?

Yes () No ()

6. Are all the houses you supply water to metered?

Yes () No ()

7. If the answer to question 6 is No, how do you arrive at the monthly charge?

8. If the answer to question 6 is No, who incurs the cost of installing the meter?

The Customer () The Company ()

9. Approximately how much does it cost to install a meter?

10. Do you send bills to customers on a monthly basis in Chelstone?

Yes () No ()

11. How many Meter Readers do you have?

12. What challenges do you face in supplying water to Chelstone?

APPENDIX III
THE SIGN TEST

Sign test for determining the difference in the rating of water supply between Apartments (A) and Houses (H).

Chelstone residents in Apartments (A) and Houses (H) were asked to rank the adequacy of water supply in their respective areas on a scale of 1-5 and the following were the results.

A	3	4	3	4	2	4	4	1	3	3	3	2	1	4	2	3	4	2	3	2
H	3	2	2	4	2	4	3	1	2	2	4	3	1	2	2	2	3	2	2	1
Sign	0	+	+	0	0	0	+	0	+	+	-	-	0	+	0	+	+	0	+	+

Hypotheses

H_0 : There is no significant difference in water supply between Apartments (A) and Houses (H).

H_1 : There is a significant difference in water supply between Apartments (A) and Houses (H).

Decision rules

$\alpha=0.05$

Reject H_0 , if $d_{cal} > d_{critical} (1.96)$

Reject H_1 , if $d_{cal} < d_{critical} (1.96)$

Computation

$n = 12, n_+ = 10, n_- = 2$

Therefore, we test the Null hypothesis that n_- is distributed as the binomial with

$$\text{Mean} = np = 12 \times 1/2 = 6$$

$$\text{Variance} = npq = 12 \times \frac{1}{2} \times \frac{1}{2} = 3$$

i.e. $N(6, 3)$

$$d = \frac{x - \mu}{\sqrt{\sigma^2}} = \frac{2 - 6}{\sqrt{3}} = \frac{-4}{\sqrt{3}} = -2.309$$

Conclusion

Reject H_0 as d -calculated $>$ d -critical. Therefore, there is a significant difference in water supply between Houses and Apartments

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