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WATER SUPPLY SYSTEMS – DEMAND FIGURES FOR DESIGN - Guidelines

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The preparation of this Zambian Standard was undertaken by the Water & Environmental Pollution Technical Committee (TC4/7-3) upon which the following organizations were represented:

Association of Consulting Engineers (RANKIN Engineering Consultants & BCHOD)

Engineering Institute of Zambia

Kafubu Water & Sewerage Company

Lukanga Water & Sewerage Company

Lusaka Water & Sewerage Company

Ministry of Local Government & Housing

National Council for Construction

National Water Supply& Sanitation Council

Nkana Water & Sewerage Company

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FOREWORD

This Zambian Standard has been prepared by the Water & Environmental Pollution Technical Committee, TC4/7-3 in accordance with the procedures of the Zambia Bureau of Standards.

This Second Edition replaces the First Edition of the "Water Supply Systems – Consumption Figures for Design – Guidelines" published on 1997-04-30. The preparation of this standard was necessitated by the need to be abreast with Regional & International trends. This standard aims at provision of information to design water reticulation relating to certain developments within cities, towns and villages by giving basic water demands.

In the preparation of this standard, reference was made to the following publications:

Alan C. Twort et al, Water Supply, 5th Edition (2002)

Kilkenny Fire & Rescue Service, Report: Guidance Specification for Fire Hydrants & Fire Fighting, (2008)

Public Health Engineering-A lecture Note Book Compiled by Dr Wolfram Schaefer (Senior Lecturer-UNZA), Lusaka, Zambia 1992.

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ZAMBIA BUREAU OF STANDARDS

Zambian Standard

WATER SUPPLY SYSTEMS – DEMAND FIGURES FOR DESIGN - Guidelines

1. SCOPE

This Zambian Standard covers water demand figures for consumers in various residential housing categories, educational institutions, health institutions, hotels, recreational facilities, and also demands for industry, commercial and administrative uses. Water demand for livestock is also covered.

2. TERMS & DEFINITIONS

For the purpose of this Zambian Standard, the following definitions shall apply:

2.1 Demand
Projected water consumption of a consumer or consumer group

2.2 Cooking & Cleaning:
Refers to water demand for cooking, washing food, washing utensils and general household cleaning.

2.3 Gardening
Water demand for all greens

2.4 High Cost housing
Means low density housing with plot area greater than 900 square metres with multiple taps, more than one Water Closet (W.C) and water borne sanitation

2.5 Medium Cost Housing
Means medium density housing with plot area 400 – 900 square metres with multiple taps, one or more Water .Closet (W.C) and water borne sanitation

2.6 Low Cost Housing
Means high density housing with plot area of 324 - 400 square metres with reduced number of taps, one W.C and water borne sanitation.

2.7 Peri-urban or Rural Housing
Means housing with communal or shared standpipe or one tap in a plot with no water borne sanitation (pit latrines).

3. DEMAND FIGURES FOR DESIGN OF WATER SUPPLY SYSTEMS

3.1. Adoption of design values

The total water demand in each category of user (Residential, Institutional, Commercial, Hotel, etc) is made up of several water activities – drinking, washing, gardening, etc. thus the designer has more flexibility to make judicious modifications to the proposed total demand on the basis of prevailing socio-economic conditions. For example if gardening is prohibited by law (or otherwise) then the total water demand for each use category can be reduced proportionately.

The figures do not include losses within the system and other design factors. It should be noted that about 70-80 % of the water used is generated as waste water (effluent) into the sewer system.

3.2. Residential Water Demand

Residential water demand is dependent upon the cost classification of housing. Housing categories in Zambia are generally classified as 'High Cost', 'Medium Cost', 'Low Cost' and 'Peri-urban' housing, though there is no universally accepted definition of these categories.

TABLE 1: RESIDENTIAL WATER DEMAND

REQUIREMENTS	PERI-URBAN OR RURAL HOUSING (l/c/d)	LOW COST HOUSING (l/c/d)	MEDIUM COST HOUSING (l/c/d)	HIGH COST HOUSING (l/c/d)
Drinking	3	3	3	3
Bathing & Washing	15	25	50	90
W.C	-	30	30	40
Cooking & Cleaning	5	10	17	22
Laundry	5	10	20	30
Gardening	7	12	20	60
Other Uses	5	5	10	10
TOTAL	**40**	**95**	**150**	**255**

NOTES

1. The demand is expressed in litres per capita per day (l/c/d)
2. High and Medium Cost Housing based on main house occupants excluding servants quarters
3. For servants quarters, allow for Low Cost Housing demand figures
4. Water demand in Rural Areas is not explicitly covered, however the demand figures for Peri-urban Housing are recommended.
5. 'Other uses'inlude car washing, pet washing, etc

3.3. Demand figures for Educational Institutions

For educational institutions, the highest levels of water service are provided in universities and colleges. These institutions, invariably located in large urban areas, have water borne sanitation, big gardens and/or landscape surroundings; other institutions may have swimming pools and farms. The lowest levels of service are for primary schools with one or two standpipes and pit latrines.

The demand figures are shown in Table 2 below for all ranges of educational institutions. Special facilities such as swimming pools must specifically be added to the figures shown. Demand by teachers' houses within the school area must specifically be added to the demand figures provided.

TABLE 2: EDUCATION INSTITUTIONS

REQUIREMENTS	UNIVERSITY COLLEGE (l/c/d)	SECONDARY SCHOOL BOARDERS (l/c/d)	SECONDARY SCHOOL NON BOARDERS (l/c/d)	PRIMARY SCHOOL (with WC) (l/c/d)	PRIMARY SCHOOL (pit latrine) (l/c/d)
Drinking	3	3	1	1	1
Bathing & Washing	25	25	3	3	3
W.C	30	30	10	10	-
Cooking & Cleaning	15	10	-	-	-
Laundry	10	10	-	-	-
Gardening	10	10	10	5	5
Other Uses	32	12	6	6	6
TOTAL	**125**	**105**	**30**	**25**	**15**

NOTES

1. All Figures are in litres per capita per day (l/c/d).
2. Nursery schools are assumed to have same demand as primary schools.
3. Universities/ Colleges are assumed to have self catering facilities
4. 'other uses' may include water used by laboratories, teaching staff while directly on the school premises
5. Primary School boarders will utilize figures for Secondary School Boards

3.4. Demand figures for Health Institutions

For the purpose of estimating water demand, health institutions have been classified into four categories; urban hospitals, rural hospitals, clinics with beds, and clinic without beds. The demand figures are given in Table 3.

TABLE 3: DEMAND FIGURES FOR HEALTH INSTITUTIONS

REQUIREMENTS	URBAN HOSPITAL (L/bed/d)	RURAL HOSPITAL (L/bed/d)	CLINIC WITH BEDS (L/bed/d)	CLINIC WITHOUT BEDS (L/c/d)
Drinking	3	3	3	1
Bathing & Washing	100	100	100	4
W.C	40	40	40	10
Cooking & Cleaning	15	15	10	-
Laundry	50	50	30	-
Gardening	27	12	7	-
Other Uses	115	85	50	15
TOTAL	**350**	**305**	**240**	**30**

NOTES

1. Design values include all hospital duty staff and out patients
2. The demand figures for hospitals or clinics with beds are given in litres per bed per day (l/bed/d)

For **Hospitals** in **Urban** and **Rural** areas the water demand by out-patients and hospital staff are included in the demand per hospital bed. These estimates have been made on the basis of **1.5** out-patients and 2 staff members per hospital bed; the water demand for these two categories of users are 10 litres per capita per day and 30 litres per capita per day (l/c/d) for out-patients and for staff respectively. The total demand of these users is included in the 'Other Uses' requirements.

For **Clinics** with beds, the 'Other Uses' requirement allows for duty staff at 1 staff per bed per day at 30 litres per bed per day; the demand by out-patients should be included as an extra demand on the basis of 10 litres per out-patient per day.

In all categories of health institutions the water demand by residential housing units of hospital staff, (including those on training), should be added to the estimates for the institution.

3.5. Water demand for Hotels and Recreational Facilities

The water demand for hotels depends on the type of hotel, service provided in the hotel and other water uses such as swimming pools, water for gardens and lawns. For the basis of estimating water demand, hotels have been classified into three categories as follows:

HIGH COST 5 – Star, 4 - Star hotels

MEDIUM COST 3 – Star, 1 – Star hotels

LOW COST Ungraded hotels, Guest houses, Lodges, Rest houses etc.

The demand figures are shown in Table 4 below. For high cost hotels the usage rate of 35 litres per bed per day has been added for hotel staff, and a rate of 50 litres per bed per day for non-resident guests. The total amount of this extra demand is reflected in the 'Other Uses' category. For medium cost hotels, the water demand for staff and non-resident guests is taken to be 50 litres per bed per day; this amount is also shown in the 'Other Uses' category.

TABLE 4: HOTELS AND RECREATIONAL FACILITIES WATER DEMAND

REQUIREMENTS	HIGH COST HOTEL (L/bed/d)	MEDIUM COST HOTEL (L/bed/d)	LOW COST HOTEL (L/bed/d)	RESTAURANT l/seat/d	RECREATION CLUB l/member/d
Drinking	3	3	3	-	-
Bathing & Washing	200	150	100	-	-
W.C	30	30	30	-	-
Cooking & Cleaning	60	40	25	-	-
Laundry	60	40	25	-	-
Gardening	50	35	25	-	-
Other Uses	97	47	12	100	50
TOTAL	**500**	**345**	**220**	**100**	**50**

NOTES

1. All figures for hotels are in litres per bed per day (l/bed/d).
2. For recreation centres and social clubs, the minimum water demand is taken to be 50 litres per member per day (l/member/day). This includes water used for drinking, W.C, and bathing.
3. For restaurants, the minimum water demand is taken to be 100 litres per seat per day (l/seat/day). This includes water used for drinking, W.C, etc.
4. 'Other Uses' include water used by hotel staff, non-resident guests, cleaning, car washing etc.

3.6. Office, Industrial, Commercial and Administrative water uses

Table 5 displays water demand for offices, for parks and road washing, markets, commercial areas, light and heavy industrial areas, and for public conveniences (toilets)

TABLE 5: INDUSTRIAL, COMMERCIAL, ADMINISTRATIVE WATER DEMAND

REQUIREMENTS	ADMINISTATIVE OFFICES l/c/d	PARKS & ROAD WASHING l/c/d	MARKETS l/stall	COMMERCIAL AREA l/ha/d	INDUSTRIAL l/ha/d	PUBLIC CONVENIENCE l/c/d
Drinking	2					
Bathing & Washing	3					
W.C	30					
Cooking & Cleaning	-					
Laundry	-					
Gardening	5					
Other Uses	5					
TOTAL	**45**	**10**	**250**	**30,000**	**30,000 (L) 90,000 (H)**	**–10**

The water demand for parks and road washing is estimated on the basis of open spaces in the city. The following allowance for open spaces is recommended:

Public open space: 0.6 ha/ 1000 population

Playing fields: 0.2 ha/ 1000 population

Parks: 0.10 ha/ 100 population

The water demand for markets is estimated on the basis of water demand per stall (l/stall)

The water demand for industrial and commercial areas will vary with the type of industry. Design figures must be worked out on the basis of each specific industry where possible. However, where this is not possible the following guidelines have been used to define industrial demand.

Light Industry (L): 1 litre/ second/ hectare, which is equivalent to 30, 000 l/ha/day of 8 hour shift

Commercial Area: Same as light industry

Heavy Industry (H): 2-3 litres/second/hectare, which is equivalent to 60,000 – 90,000 l/ha/day of 8 hours

3.7. Miscellaneous Requirements

3.7.1 Fire Fighting

The designer should consult the Fire Brigade for the figures, in its absence the following recommendation should be used"

The amount of water required for fire control will be dependent on the character of construction or development and the total population being served in the area being considered (see Table 6).

The demand figure is not the fire demand at a point (fire hydrant point) in the distribution system, but is an average rate that should be included in the water distribution system demand. In order to determine the maximum water demand during a fire, the water for fire fighting purposes must be added to the maximum daily demand. The water for fire fighting purposes must be maintained for a minimum of two hours.

TABLE 6: FIRE FIGHTING WATER DEMAND

CATEGORY	DESCRIPTION	WATER DEMAND l/s
Housing	Detached or semidetached houses of not more than two floors	8 l/s through a single hydrant
	Multi-occupied housing with units of not more than two floors	20-35 l/s through a single hydrant
Transport	Lorry or Coach parks – multi-storey car parks-service stations	25 l/s minimum from a single hydrant on site or within 90 m
Industry		Site mains normally at least 150 mm diameter
	Up to 1 ha	Supply – 20 l/s
	1 – 2 ha	35 l/s
	2 – 3 ha	50 l/s
	Over 3 ha	75 l/s
Commercial	Shopping, offices, recreation and tourism development	20 – 75 l/s
Institutional	Village halls	15 l/s through any single hydrant on site/ within 100m
	Primary schools and single storey health centres	20 l/s through any single hydrant on site/ within 70m
	Secondary schools, colleges, large health and community	35 l/s through any single hydrant on site/ within 70m

NOTE

1. The main residue pressure in the main should preferably be 0.7 bar but not less than zero.
2. Multi-occupied housing with units of more than two floors should be 35 litres/second or above.

3.7.2 Livestock

Guidelines for water demand for livestock are given in Table 7 below:

TABLE 7: LIVESTOCK WATER DEMAND

LIVESTOCK	WATER DEMAND litres/ animal/ day
Cattle, Horses, Mules	40
Pigs (including drinking and cleaning)	100
Sheep, Goats	10
Poultry (litres/ 100 birds/ day)	20