WATER SUPPLY AND WASTEWATER SOURCES

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1. Water Supply

1.1 Water Demand and Sources of Supply

- The following should be considered in designing water supply schemes:

(a) The design period: no. of years during which the project will be expected to meet the community requirements.

(b) Estimates of the population & of the types & magnitudes of commercial, industrial & agricultural under takings.

(c) The level of service in terms of the rate of supply & reliability of supply & water quality provided during the design period.

(d) The selection of the supply source.

(e) Capacities of engineering works for storage, treatment, transportation and distribution of water including provisions for supply & demand fluctuations.

1.1.1 THE USE OF WATER

Domestic Use	• Accounts for 40% to 60% of most urban supplies. • 70% is returned to sewer-Daily domestic use.
Commercial Use	• water used in business areas shops, offices, etc. • 20% of the domestic consumption per employee.
Industrial Use	• Varies according to the type of industry • About 2/3 of the industrial requirements for cooling.
Agricultural Use	• Includes water supplied to farms, markets, gardens, greenhouses & diaries within the supply area.
Public Use	• Includes water sued for public schools, hospitals, etc. • This may amount to 50 L/cap.
Losses	• 10 to 30% of the total supply. • Due to leakage, evaporation, misuse.

1.1.2 QUANTITY OF WATER

- The demand may be classified in the following categories:

i) Domestic water need

ii) Institutional demand.

iii) Industrial need.

iv) Fire demand

v) Water unaccounted-for.

1.1.2 QUANTITY OF WATER

i) Domestic water need

- Such as bathing, drinking, cooking, flushing toilets, washing etc.
- The population of a city or town will be most important factor.
- A minimum rate of 70 to 100 liters per capita per day should be allowed for domestic need.

1.1.2 QUANTITY OF WATER

- The breakup of domestic demands per day for a town:

(1) Water required for drinking = 2 l/d.

(2) Cooking, washing etc. = 10 to 12 l/d

(3) For bathing, washing clothes = 40 to 60 l/d

(4) Flushing water closets = 25 l

(5) Other needs = 10 l

Total = 70 to 100 l/d

- In case of rural communities, the service connection is not available, and the supply through hand pumps or stand posts, the rate shall not be less than 40 *l*/c/d.

1.1.2 QUANTITY OF WATER

Population Forecast

- To forecast water demand for a community, population forecast could be estimated by one of the following methods:

1) Arithmetical Method.
2) Geometrical Method.
3) Growth Rate Method.

1.1.2 QUANTITY OF WATER

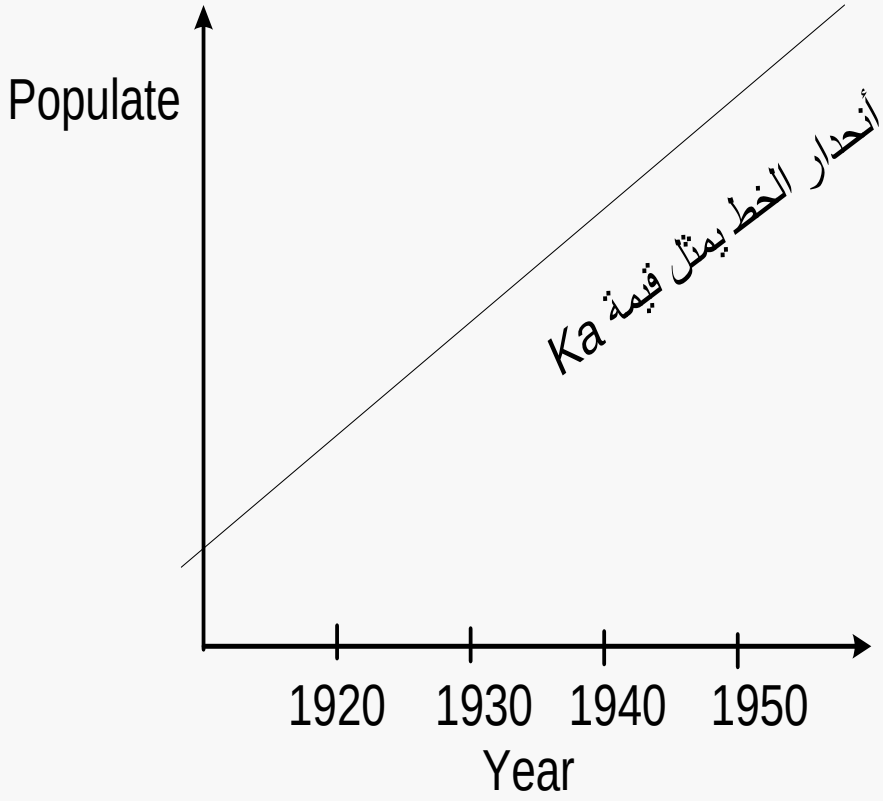
1) Arithmetical Method:

$$\frac{dp}{dt} = constat = k_a$$

$$Ka = \frac{p_f - p_i}{t_f - t_i}$$

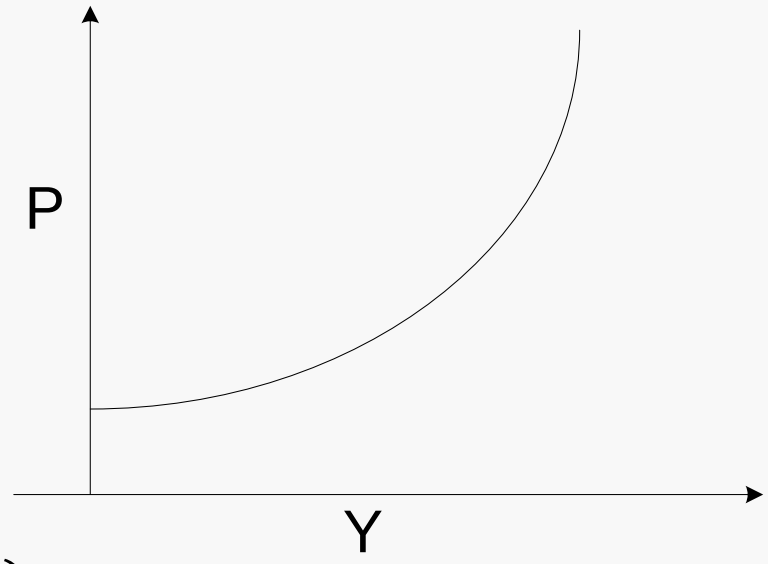
p_f= future population

p_i= initial population



1.1.2 QUANTITY OF WATER

2) *Geometrical Method:*



$$\frac{dp}{dt} = k_g p$$

$$\int_1^2 \frac{dp}{p} = \int K_g \, dt$$

$$\text{Lnp}_2\text{-lnp}_1 = K_g \int dt = k_g(t_2 - t_1)$$

$$K_g = \frac{lnP_2 - lnP_1}{t_2 - t_1}$$

1.1.2 QUANTITY OF WATER

3) Growth Rate Method:

$$p_n = p_o(1 + r)^n$$

Where;

r = growth rate i.e. 2.5%

n = Number of years (design period).

P_o = initial population

P_n = population after years at the end of design period.

1.1.2 QUANTITY OF WATER

Fluctuation in Demand

- The annual average rate is used for an assessing the adequacy of possible sources of supply, capacity of reservoirs & setting water charges.
- Varying rates of consumption for hr. to hr. during the day are used for fixing the capacities of various components of the water supply system.

1.1.2 QUANTITY OF WATER

Fluctuation in Demand

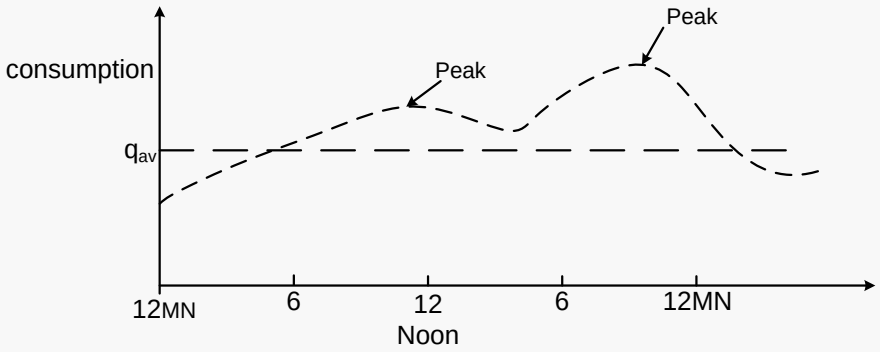


Table 1: *Variation of Water Consumption*

	Max. consumption Ratio	
	Warm Temperate	Dry Temperate
(Network) max hr./ann. Average	3.5	2.5
(storage) max. Daly/ann. Average	2.5	1.5
Max. weekly/ ann. average	2.0	1.2

- Min. day consumption between 2am & 4am; max cons. between 8am & noon. and at evening during sprinkling of gardens & evening meal preparation.

1.1.2 QUANTITY OF WATER

ii) Institutional:

- water needs for various public utility:

Utility	Water Needs
Hospital	(300-450 l/bed)
hotel	(180 l/bed)
Hostel	(135l/bed)
restaurant	(70 l/seat)
Air ports and sea ports	(75 l/seat)
Day school or college	(45/student)
offices, factories	(45l/c)
Cinemas/ Theaters	(15l/c).

1.1.2 QUANTITY OF WATER

iii) Industrial Demand:

- The quantity required as per time of industry (diary, textile, oil, ...etc.).

iv) Fire Demand:

- The minimum fire flow for building is estimated as 32 l/s at a residual pressure of 20psi = 14m head of water for fire duration of (1 hrs.) (60 minutes) fire requirement $\frac{32\ x\ 3600}{1000} = 115 m^3$/hour fire incidence duration.

1.1.2 QUANTITY OF WATER

v) Water unaccounted-for

- amount of water due to leakage from water network, overflow from storage tanks, …etc.
- Considered unaccounted-for water (Min. losses from new network is about 5% to 10% of the total quantity of water used).
- In old network the unaccounted water may be more than 20%.

1.2 DRINKING WATER QUALITY GUIDELINES

The following are the guidelines for the quality parameters of drinking water as outlined by World Health Organization (WHO) in 1993.

Table 2: *Guide Lines for Physical and Chemical Drinking Water Parameters (WHO)*

Parameter	Guideline	Unit /remark
Color	15	TCU (Time Color Units)
Taste and Odour	-	To be acceptable
Turbidity	5	NTU
Aluminum	0.2	Mg/l
Ammonia	1.5	Mg/l
Chloride	250	Mg/l
Copper	1.0	Mg/l
Hardness as $CaCo_3$	500	Mg/l
Hydrogen sulphide	0.05	Mg/l
Iron	0.3	Mg/l
Manganese	0.1	Mg/l
pH	6.5-8.5	-
Sodium	200	Mg/l
Sulphate	250	Mg/l
TDS	1000	Mg/l
Zinc	3.0	Mg/l
Antimony	0.005	Mg/l
Arsenic	0.01	Mg/l
Barium	0.7	Mg/l
Boron	0.3	Mg/l
Cadmium	0.003	Mg/l
Chromium	0.05	Mg/l
Cyanide	0.07	Mg/l
Fluoride	1.5	Mg/l
Lead	0.01	Mg/l

1.2 DRINKING WATER QUALITY GUIDELINES

The following are the guidelines for the quality parameters of drinking water as outlined by World Health Organization (WHO) in 1993.

Table 3: *Guideline Values of Microbiological Water Quality*

Organisms	Guideline Value
1. All water intended for drinking	
A. E.coli or thermos tolerant coliform bacteria.	Must not be detectable in any 100 ml sample (absent in 100ml)
B. Pathogenic intestinal protozoa	
1. Treated water entering the distribution system	
A. E.coli or thermos tolerant coliform bacteria .	Must not be detectable in any 100 ml sample (absent in 100 ml)
B. Total coliform bacteria .	
C. Pathogenic intestinal protozoa	
1. Treated water in the distribution system	
A. E.coli or thermos tolerant coliform bacteria	Must not be detectable in any 100 ml sample.
B. Total coliform	Must not be detectable in any 100 ml sample. In the case of large supplies where sufficient samples are examined, must not be detectable in 95% of samples examined throughout any 12 months period.
C. Pathogenic intestinal protozoa	Must not be detectable in any 100 ml sample (absent in 100ml).

1.2 DRINKING WATER QUALITY GUIDELINES

The following are the guidelines for the quality parameters of drinking water as outlined by World Health Organization (WHO) in 1993.

Table 4: *Maximum Levels Likely to Give Rise to Consumers Complain*

Parameter	Levels likely to give rise to consumer complains
Physical Parameters:	
Colour	15 TCU
Taste and Odour	Acceptable
Temperature	Acceptable
Turbidity	5 NTU
pH	6.5 to
Inorganic constituents	
Aluminum	0.2 mg/l
Ammonia	1.5mg/l
Chloride	250 mg/l
Hydrogen sulfide	0.05 mg/l
Iron	0.3 mg/l
Sodium	200 mg/l
Sulfate	250 mg/l
Total Dissolved Solids (TDS)	1000 mg/l
Zinc	3 mg/l
Organic constituents	
2- Chlorophenol	5µg/l
2,4- Dichlorophenol	2µg/l

2. Wastewater sources

2.1 Water Pollution Control

- There is difference between words pollution and contamination.
- Pollution means impure water or water containing various types of impurities, in the presence of whom the water may be or unsafe for use by the people.
- Contamination used to denote the polluted water which is unsafe and unreliable for use. The colored water, foul smelling water, water containing oil, grease, floating bodies, saline water, etc., are example of polluted water.
- There is a need for water pollution control (water management).

2.1.1 WATER POLLUTION SOURCES

- The main water pollution sources are:

- Domestic sewage.
- Industrial sewage.
- Miscellaneous pollution sources: surface water runoff, faulty joints and cracks, navigation ships, storage reservoirs, etc.

2.1.2 CLASSIFICATION OF POLLUTION

1. Physical pollution

- Color. temp., taste and odor, suspended matter, turbidity, foam.

2. Chemical pollution

- Organic and inorganic.

3. Bacteriological pollution

- Presence of microorganisms

2.1.3 BIOCHEMICAL OXYGEN DEMAND (B.O.D)

- Is the quantity of oxygen required for the biochemical oxidation of the decomposable organic at specified temperature within the specified time.
- During natural decomposition the life activities of organisms are stimulated by high temperatures and decreased at low temperatures. The standard time and temperature for this test is 5 days and 20oC respectively.

2.1.3 BIOCHEMICAL OXYGEN DEMAND (B.O.D)

- Tests revealed that the aerobic decomposition of organic matter is done in two stages. The carbonaceous matters are first oxidized and the oxidation of nitrogenous matters takes place in the latter stages.
- The B.O.D of sewage for the first stage is about 90% of the total B.O.D. Therefor, the sanitary engineers are mostly concerned with this first stage B.O.D.

2.1.4 CHEMICAL OXYGEN DEMAND (C.O.D)

- This test is a measure of the amount of carbon in organic matter of sewage.
- Useful in identifying the performance of the various steps of treatment plants.
- Also useful in determining the strength of industrial waters in sewage, which cannot be determined by B.O.D test.

2.1.4 CHEMICAL OXYGEN DEMAND (C.O.D)

- Determines the oxygen required for chemical oxidation of organic matter with help of strong chemical oxidant.
- C.O.D determination has an advantage over BOD, that it takes only 5 hours as compared with B.O.D which requires 5 days.
- Easy and is not affected by interferences as in B.O.D test.

THANK YOU