



Abdelhafid Boussouf University Center - Mila

2019-2020 Semester 1

Drinking water supply

– Lesson 2 –

Chapter 2 : Assessment of Drinking Water Needs



teaching staff		
Name	Institute Grade	E-mail address
Boumessenegh Amel	MCB Science and Technology	a.boumessenegh@centre-univ-mila.dz

Students concerned			
Institute	Department	Year	Speciality
GC Science and Technology		License 3	Hydraulics Urban hydraulics

Course Objectives 2

The objectives of the course on assessing drinking water needs are:

1. **Understanding the parameters influencing water demand** : analyzing the factors Demographic, economic, climatic and industrial factors that determine consumption drinking water.
2. **Learn methods for calculating water needs** : using formulas and models for estimating consumption at different scales (households, industries, communities).
3. **Assess available water resources** : compare water needs with capacities sources of supply (groundwater, dams, treatment plants).
4. **Anticipate changes in demand** : integrate urban growth forecasts and impacts of climate change on water availability and consumption.
5. **Optimize drinking water management** : identify water conservation strategies, reduction of losses and improvement of the efficiency of distribution networks.

1. Introduction

Assessing the drinking water needs of an urban area is necessary for the implementation of a drinking water supply project because it has a major influence on the flow rates drawn, on the consumption flow rate on the sizing of the distribution network and on the reservoir.

To accurately assess the drinking water needs of any given urban area, a accurate and complete inventory of all socio-economic facilities that characterize The agglomeration is necessary.

This census is supplemented by a monographic study focusing on:

- Demographic and urban planning data (population, growth rate, plan) (development of the town centre, different types of housing...)
- Economic data (agriculture, trade, industry, existing infrastructure, etc.)
- Socio-economic facilities (education, health, sports facilities, services) administrative...)

Before planning a drinking water supply network, it is necessary to study population trends, and to analyze the planned urban and socio-economic development in order to finally to make a choice regarding the satisfaction of needs in the short, medium or long term.

In general, the drinking water needs to be met are assessed in two phases:

Phase 1:

- Assessment of current unit requirements for each consumption category.

- Assessment of the current overall needs of the development area.

Phase 2:

- Forecasting future water needs across different time horizons.

Note that the study of forecasts must take into account a double increase:

- That of unit needs.
- That of the number of inhabitants.

2. Population estimate

The study of population trends in urban areas is based on statistics from National censuses. Thus, the average year-on-year population growth rate.

The demographic evolution of countries generally follows one of the following laws:

• Law of compound interest (geometric increment):

It is the most widely used method for projecting future population. It is given by the following formula:

$$P_f = P_o(1 + \tau)^n$$

With :

P_f : future population.

P_o : current population.

τ : growth rate in %

n : number of years separating two horizons.

• Law of simple interest (linear increments)

$$P_f = P_o (1 + n\tau)$$

• Law for urban divisions where the population remains constant because

The details are subject to change:

In the case of housing allowances (urban divisions) where the population is stable, one can determine the number of people based on how many NL retail pieces and the average national for members of the T national family, which is 6 to 8 people, depending on the relationship:

$$P_0 = N_1 T$$

3. Needs assessment

Water consumption in an urban area is neither constant nor uniform; it differs from one area to another. from one agglomeration to another, from one period to another, and from one category to another.

3.1. The endowment:

The availability of drinking water varies from one time period to another for the same locality, and this is due to reason for:

- Population growth.
- Lifestyle.
- Progress due to hygiene.

3.2. Domestic needs:

The water needs of an urban area depend on the size of its population.

area to be studied and the quantity of water needed per person per day (supply), according to the relationship:

$$Q_{moyj} = \frac{P_f d}{1000} \quad \left(\frac{m^3}{j} \right)$$

With :

Q_{moyj} : the average daily flow rate in (l/s) or (m³/s).

d: the allocation (the water requirement per inhabitant). l/day/inhabitant

In Algeria, the allocation varies between 150 and 200 liters per day per inhabitant, regardless of the population size.

For a rural agglomeration of 2000 inhabitants, we can take the allocation $d = 125$ l/day/inhabitant,

If the livestock farming is intensive, we take $d = 150$ l/day/inhabitant and we can carry out a more detailed assessment. detailed:

Table 2 – 1: Value of the endowment

The nature of the need	Value of d
1. Livestock farming:	
Horse	14 l/day/ head
Little horse	9 l/j/ head
Cow 160 kg	(5 – 18) l/j/ head
Cow 340 kg	(36 – 55) l/j/ head
Cow 450 kg	72 l/day/ head
Goats and sheep 9 kg	2 l/day/ head
Goats and sheep 25 kg	5 l/day/head
Goats and sheep 75 kg	10 l/day/head
2. Watering gardens:	
Dry region	9 l/day/ m ²
Wetland	3.6 l/d/ m ²

For urban areas with more than 2000 inhabitants, the following can be used as a basis for calculation.

Table 2 – 2: Endowment value for P>5000

Number of inhabitants	Allocation l/day/inhabitant
5000 – 20,000	150 – 200
20,000 – 50,000	200 – 300
50,000 – 100,000	300 – 400
> 100,000	> 400

3.3. Equipment requirements:

The equipment requirements are calculated in the same way, namely, based on knowledge of the Type of equipment and the quantity of water required by each piece of equipment. Table 2-3 provides the requirements for some equipment.

Table 2-3: Equipment requirements

Type of needs Equipment	Quantity of water	
Culture and school	Primary and middle schools, without the system internal	100 l/day/student
	Daycare centers, schools, on average, schools secondary schools, universities (internal system)	120 liters/day/student
	Cultural center, cinema, stadium	(5 – 10) l/d/m2
The equipment administrative	Headquarters (municipalities, post office, national gendarmerie, police, civil protection, the courthouse) or of any other management	(5 – 10) l/d/m2
The equipment Health	Health centers, pharmacies, centers medical, multi-service	10 l/day/m2
	Hospital	300 – 400 l/day/bed
	Maternity	500 l/j/lit
The equipment Commercial	Hotel	125 – 200 l/day/bed
	Market cleaning	5 l/day/m2
	Shower	150 – 200
	Camping	l/j/post
	Swimming pools	100 l/day/camper
	Car wash stations	20 liters/day/swimmer
	Slaughterhouses	1200 l/day/car
Bakeries	500 l/day/head	

	coffee	1200 l/day/unit
	Restaurants	1500 l/day/unit
	mosque	12 liters/day meals
		50 l/d/uid

Therefore, the average daily consumption is the sum of the daily requirements of the entire population and current and future infrastructure for an urban area.

$$Q_{moyj} = Q_{moyjpopulation} + Q_{moyjequipement}$$

Generally, distribution networks are subject to the phenomenon of aging, thus that of possible accidents that cause considerable water losses that cannot be controlled which occur during operation and management (canal ruptures, repairs, losses, poor sealing inside the building's valve).

In order to ensure the population has the necessary amount of water, the calculated value is increased. previously (average daily consumption) with varying degrees (20%-50%), in depending on the nature and maintenance methods of the network.

- Network maintenance is good: 20%
- Network maintenance is average: (25 – 30)%
- Old network: 50%

$$Q_{moyjmaj} = Q_{moyj} + \alpha Q_{moyj}$$

With :

$Q_{moyj maj}$: the increased average daily flow rate.

Q_{moyj} : the average daily flow rate.

α : markup coefficient

3.4. Flow rate variation:

Water consumption varies greatly over time; these variations in flow rate can

The following exist:

• *Time zone variations*: which depend on the population's consumption patterns

• *Daily variations*: which depend on the day of the week or when consumption is higher important.

• *Monthly variations*: which depend on the size of the city

• *Annual variations*: which depend on the population's standard of living

Due to all these variations, a coefficient of

increase, to obtain the value of the peak flow rate of the busiest day of the year.

3.4.1 Daily irregularity coefficient K_j :

It is defined as the ratio between the consumption of the busiest day (maximum) and the average daily consumption.

$$K_j = \frac{\text{Consommation maximale journalière}}{\text{Consommation moyenne journalière}}$$

$K_j = (1.1 - 1.3)$ we generally take $K_j = 1.2$

3.4.1 Timetable irregularity coefficient K_h :

It is the ratio between the maximum hourly flow rate and the average hourly flow rate.

$$K_h = \frac{Q_{\max h}}{Q_{\text{moy h}}} K_h = (1.1 - 3)$$

It can also be calculated using the following formula:

$$K_h = \alpha \beta$$

With :

β : coefficient varies according to the level of comfort. Coefficient (the nature of the buildings, hotels, departments etc...) 1.2 β β 1.4 we take a value $\beta = 1.3$

α : coefficient varies depending on the population (see table 2 – 4).

Table 2-4: α values

Population	500	1000	1500	2500	4,000	6,000	50,000	100.00
α	2.5	2	1.8	1.6	1.5	1.4	1.15	1.1

The aim of studying the variation in flow rate is to determine:

- The maximum daily flow rate $Q_{\max j}$.
- The flow rate at point Q_p .

3.4.1. The maximum daily flow rate $Q_{\max j}$:

The maximum daily flow rate is defined as the flow rate over a day where consumption is at its maximum during a year.

$$Q_{\max j} = K_j Q_{\text{moy j maj habitant}} + Q_{\text{moy j maj équipement}}$$

With :

$Q_{\max j}$: maximum daily flow rate (l/s)

$Q_{\text{moy j maj}}$: the increased average daily flow rate (l/s)

K_j : Daily irregularity coefficient

3.4.2. Point flow rate Q_p :

This is the required flow rate at the peak hour; it is calculated using the following formula:

$$Q_p = K_p Q_{\text{moyjma}} \text{jhabitant} + Q_{\text{moyjma}} \text{jéquipement}$$

K_p : Irregularity coefficient of a point. It can be calculated from one of the following relationships:

a- First method:

$$K_p = K_h K_j$$

K_j : Daily irregularity coefficient

K_h Time zone irregularity coefficient

b- Second method:

$$K_p = 1.5 + \frac{2.5}{\sqrt{Q_{\text{moyjma}} \text{jdom estique}}} \quad (\text{l/s})$$

$Q_{\text{moyjma}} \text{jdom estique}$: the average daily flow rate increased by the population

c- Third method:

$$K_p = 2.6 - 0.4 \log_{10} \frac{N_p}{1000}$$

N_p : number of inhabitants.

Note :

- For rural populations we take $K_p = 3$.
- In general $k_p \geq 3$.

4. Conclusion

The purpose of calculating:

- The maximum daily flow rate $Q_{\text{max j}}$.
- The flow rate at point Q_p .

And :

- Sizing of the distribution network and hydraulic calculations with the flow rate of point.
- The sizing of the supply pipe with a flow rate equal to the maximum flow rate daily and proposed supply regime (continuous 24h/24h or discontinuous).
- The sizing of the reservoir after comparing the maximum daily flow rate with the supply flow rate (borehole, dam, spring, etc.).

Useful links

<https://youtu.be/XCtBzfTkC6M>

References

- [1] https://staff.univ-batna2.dz/sites/default/files/gali_belkacem/files/chapitre_03_besoins_en_eau.pdf
- [2] <https://www.africmemoire.com/part.5-chap-iii-evaluation-des-besoins-en-eau-potable-721.html>
- [3] <https://insp-eniv.online/wp-content/uploads/2023/10/Cours-4.-Besoins-en-eau-potable.pdf>
- [4] https://insp-eniv.online/wp-content/uploads/2023/10/TD-n%C2%B04_Besoins-en-eau-potable.pdf
- [5] <https://infoterre.brgm.fr/rapports/RP-62463-FR.pdf>
- [6] https://staff.univ-batna2.dz/sites/default/files/messaid_belkacem/files/chapitre_1-ha.pdf
- [7] https://www.pseau.org/outils/ouvrages/fsc_alimentation_en_eau_potable_chapitre_1_generalites_2017.pdf