

SANITATION:
THE BASICS OF SANITATION

Kátia Mara Ribeiro de Castro Purcina

Denise Celeste Godoy de Andrade Rodrigues

Marcello Silva e Santos

Kátia Mara Ribeiro de Castro Purcina
Denise Celeste Godoy de Andrade Rodrigues
Marcelo Silva e Santos

SANITATION:
The Basics of Sanitation

Volta Redonda

2019

FICHA CATALOGRÁFICA
Bibliotecária: Alice Tacão Wagner - CRB 7/RJ 4316

P985s Purcina, Kátia Mara Ribeiro de Castro.
Saneamento básico: o básico do saneamento. / Kátia Mara Ribeiro de Castro Purcina - Volta Redonda: UniFOA, 2019.

133 p. : Il

Orientador (a): Denise Celeste Godoy de Andrade Rodrigues

Produto (Mestrado) – UniFOA / Mestrado Profissional em Ensino em Ciências da Saúde e do Meio Ambiente, 2019.

1. Ciências da saúde - produto. 2. Saneamento básico. 3. Meio ambiente. 4. Engenharia. I. Rodrigues, Denise Celeste Godoy de Andrade. II. Centro Universitário de Volta Redonda. III. Título.

CDD – 610

PRESENTATION

This book was developed as a product of the Professional Master's in Teaching in Health and Environmental Sciences at the University Center of Volta Redonda-UniFOA. The objective is to be used as a teaching and learning tool by students of the civil engineering course, aiming to contribute to a greater understanding of the various aspects that involve sanitation and the environment.

The idealization of this book is based on discussing the history of sanitation up to the present day, conceptualizing sanitation highlighting its importance for the environment and public health.

https://pxhere.com/pt/photo/670379

Each topic is addressed separately by chapter, facilitating reading and understanding, basing material for quick and effective consultation. The PDF format will also be adopted due to its ease of use in gadgets.

Investment in Basic Sanitation is of fundamental importance in order to improve the public health of the population and should be a priority of public policies. Among the policies, the National Sanitation Policy, established by Federal Law No. 11,445, of 2007, stands out; the 1988 Constitution of the Federative Republic of Brazil; Constitutional Amendment No. 19, 1998; the National Basic Sanitation Plan - Plansab; the National Sanitation Information System: SNIS; the creation of the Ministry of Cities and the National Secretariat for Environmental Sanitation, concomitant with the creation of the National Council of Cities and the holding of City Conferences that guided government actions allowing the various segments to dialogue.

However, it should be noted that the efforts of both federal and state governments are far from guaranteeing the population the right to basic sanitation. The great challenge is to guarantee universal and quality access to basic sanitation services for the entire Brazilian population.

The purpose of this material is to awaken in readers an understanding of the importance of basic sanitation for society, highlighting the importance of environmental preservation and the responsibility of each one to the environment. Such considerations lead us to recognize the importance of training and developing undergraduate civil engineering students essential skills so that they can understand sanitation through reflection on the principles of citizenship education, expanding their critical and sustainable thinking in building skills .

SUMÁRIO

INTRODUCTION

Socio-environmental issues should not be separated from issues related to people's quality of life. This search for better living conditions contributed to deforestation, pollution, and the extinction of plant and animal species.

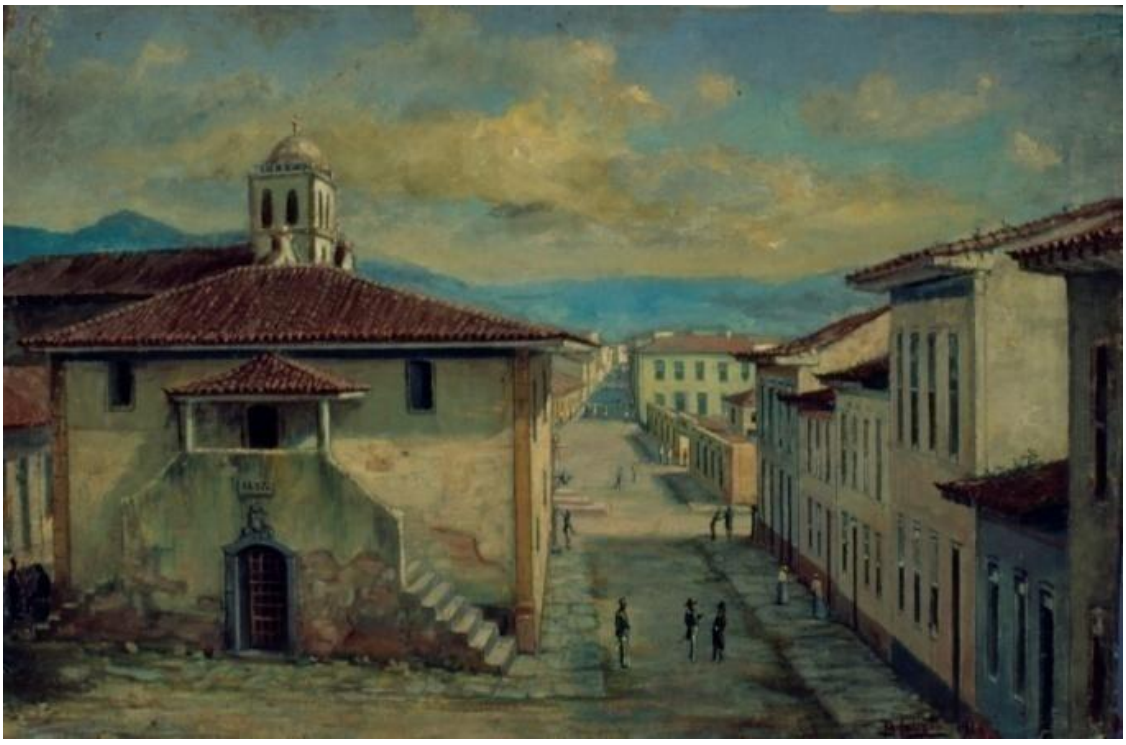
In this context, Education focused on sanitation and the environment is a pedagogical activity that aims to reach all citizens through participatory and permanent processes, which aim to discuss with educating the socio-environmental problem that the lack of sanitation can generate such as pollution of water resources, contamination of food, the transmission of diseases and the increase in the infant mortality rate.

To preserve the quality of life of the population and intervene positively in the environment in which we live, we must have conscious actions and attitudes committed to society, respecting above all the right to life.

So, in order to contribute to this education, we created this material, with the intention of making students aware of preservation, stimulating their critical sense so that it has a defensive and proactive stance in relation to the environment and sanitation, intervening in improving the population's quality of life. It is expected that through the texts, new social values will be developed as well as the development of critical, reflective and participatory environmental awareness, aimed at the conservation of the environment and the improvement of the quality of life. With practical activities, students will be able to reflect and transform the socio environmental reality, becoming agents of transformation in the pursuit of improving environmental quality.

History Sanitation

1



Courtyard of the Santos Prison , 1875. https://bit.ly/2Bn4eeD

Estamos vivendo mais uma epidemia, tal qual ocorriam na idade média e até no inócio do século XX. Estamos no século XXI e ainda vemos uma população que não se preocupa com hábitos higiênicos preventivos. O pior de tudo é que os governos federal, estaduais e municipais não estão fazendo as suas partes: a maioria da população brasileira ainda não dispõe de saneamento básico; temos esgotos a céu aberto; não há tratamento e fornecimento de água adequado; a coleta de lixo é precária ou inexistente; e outros."

Sebastião wandeley

History Sanitation

GOAL

Understand how sanitation has developed over time.

A CHALLENGE FOR YOU

After reading the text, elaborate a conceptual map on the development of sanitation throughout history, from the beginning to the present day. This activity must be developed between pairs or groups.

TALKING ABOUT THE THEME

PRE HISTORY

Men in prehistory were nomads, hunters, lived in packs and survival was associated with the availability of water and food.

According to Fernandes (2002), those who changed this way of life were the inhabitants of the Middle East, where the first villages appeared, in some regions of Mesopotamia, around 8500 B.C. We realize that the search for water goes back to the origin of civilization. They used simple methods to collect rainwater, rivers and lakes.

https://museudasaguasdeportoalegre.files.wordpress.com/2011/02/d-2.ipg?w=300&h=265-

Illustration of a tribe of prehistoric men at the British coastline.

NEOLYTIC PERIOD

The beginning of river pollution was still in prehistory in the Neolithic period due to the development of agriculture and consequently the emergence of the first villages, and with them came the mice and insects and also the increase in the production of waste and wastewater.

The first hydraulic civilizations, those that developed in ancient times on the banks of rivers, are the Egyptian, Mesopotamian, Indian and Chinese. According to Creder (1991), people of all times have always been concerned with water supply. That is why the development of civilizations has always occurred close to watercourses, since without water, human beings do not subsist.

Sanitation appeared at the moment when man started to take up residence, using natural soil to produce food and to raise animals necessary for his survival.

The first wells, fountains, aqueducts and dams were built by the peoples of Egypt, Greece and Mesopotamia, the latter using since 4000 BC irrigation systems, the Sumerians between 5000 and 4000 BC, they built irrigation channels, galleries, settlements, cisterns, reservoirs, wells, tunnels and aqueducts.

Stay tuned!!!

Based on what you were presented with, what can you say about the development of sanitation throughout prehistory?

OLD AGE

Ancient age civilizations sought to organize themselves around rivers and seas, as water was a vital element for their survival.

The first civilizations to use rational scientific thought were the Greco-Romans, in the search for health, the Romans developed great works of Sanitary Engineering, being pioneers in the actions of sanitation. It was necessary to develop engineering projects for conducting and storing water due to the emergence of cities and population growth. During this period, important techniques, such as irrigation, dyke construction and surface and underground pipes.

At this time philosophers like Plato and Aristotle were already concerned with water quality and sanitary measures. Hippocrates' treatise "Ares, Waters and Places", which discusses how much the physical environment influenced health and disease, was an example of this concern.

The Romans built public fountains on streets with plumbing for use by the population and, to avoid diseases, separated the wastewater used by the population from the water to be used. For water supply, they created several aqueducts such as the Aqua Apia aqueduct, which was about 17 km long, in addition to the reservoirs, large spas and public bathrooms.

There are reports that in ancient Greece, it was customary to bury the feces or to move them away to a place far from the residences.

In Babylon, more specifically in Nipur, around 3750 B.C., sewage collectors already existed. These collectors were known as "maximum cloaca", it resembled the current sewage trunk collector. At this time, Babilônia had a good basic sanitation infrastructure, but even so it was not possible to prevent the degradation of water and the environment, only the sewage and garbage hid from people before throwing them into water courses, (AZEVEDO NETTO, 1959/1998).

The Sumerians around 3500 B.C. developed irrigated agriculture, motivated by access to the Tigris and Euphrates rivers, diverting their waters through irrigation channels and the Egyptians mastered irrigation techniques and water storage, as they depended on the Nile River floods. Due to the constant search for water sources since ancient times, there are records of wells that were dug hundreds of meters deep like those dug by the Chinese. (FERNANDES, 2002; AZEVEDO NETTO,1998, BUFF,2009).

In India, around 3,200 B.C., there was a sewer gallery in Nipur and water drainage systems in the Valley of the Hindus. The land reservoirs, on the other hand, were created by the eastern people as well as the abstraction of underground water. In 2500 B. C. the Egyptians and Chinese used drilling methods to obtain water from the subsoil.

Around 2600 to 1900 B. C., one of the characteristics of the old cities of the Indus River Valley, according to Buff (2009), was the improved piping system by which the wastewater was led to the central sewer that was covered, built in masonry, located half a meter below the level of the streets that were wide, paved and drained.

In 2,000 B. C., the Persians punished those who polluted water resources, the Egyptians used aluminum sulfate to clarify water and in India, they were already concerned with the care that should be taken with the water to be consumed, which defined that the water should be stored in copper vessels, undergo filtration with charcoal, and be purified by boiling using fire, solar heating or introducing a heated iron bar into the liquid, followed by filtration in sand and coarse gravel.

To obtain clean water, in the Far East, capillary filtration was used, which consisted of passing the liquid from one vessel to another, removing the dirt, which remained in the fabric strips. Sanskrit documents dated from 2,000 B. C. were discovered advising the conditioning of water in copper vessels, its exposure to the sun and filtering through coal, or even by immersing a heated iron bar, as well as the use of sand and gravel for water filtration. Around 1500 BC, the Egyptians already used the practice of decantation for water purification (AZEVEDO NETTO 1984).

And, around 1700 B.C., there was a latrine with a water reservoir that collected rainwater for discharge. We can see that at that time sanitation was well developed.

The first works that were successful in controlling the flow of water were made in Mesopotamia and Egypt, where ruins of prehistoric irrigation channels still exist (MAYS, 2000; TSUTIYA, 2006).

Water was transported through constructions called aqueducts. Possibly the first tubes used to transport water, according to Tsutiya (2006), occurred around 1700 to 1450 B. C., in the city of Knossos, on the island of Crete, which at this time was at its height and while other civilizations were only used of surface channels, it developed a water transport system that used circular ducts and distributed water to the city and the palace in pressurized pipes.

In 1500 BC, the Egyptians began the process of decanting for the filtration of water. In 950 B. C., between Bethlehem and Hebron, large cisterns were built to accumulate rainwater and to supply the temple and the city of Jerusalem, reservoirs supplied by masonry tunnels were also built.

In 691 B.C., in Assyria the first water supply system was created, the Jerwan aqueduct. The aqueducts are grandiose constructions destined to the transport of water, and they supplied the public fountains, dozens of thermal baths, besides supplying the lakes and artificial fountains in the homes of the most affluent.

In Egypt, dikes were built to store water to be consumed during the dry season, the control of the water flow of the Nile river was started, thus improving the irrigation system, taking water to all areas including the most remote areas and tubes were used copper in the royal palace of Pharaoh Keóps.

With the objective of supplying water for both human consumption and leisure, several hydraulic works were built, such as the famous Roman swimming pools, built during the time of Roma dos Césares; the aqueduct in the city of Segovia, Spain, built at the time of Christ and still in operation; the Tívoli Fountains, which make use of hydrostatic pressure to spout waters at great heights; the artificial lake Méris, designed to regulate the waters of the lower Nile; the Jerwan aqueduct which was the first public water supply system, built in Assyria in 691 B.C. (CREDER, 1991; AZEVEDO NETTO, 1998).

The Romans had a water distribution system formed by aqueducts where many were built above the ground, with free flow in channels, and also by means of buried conduits for transporting water to reservoirs and to points of use, especially sources and bathrooms. These tubes were usually lead or ceramic and were placed under the main streets of the city.

Although lead pipes were quite common, by this time it was already known by the Romans that the water carried by these pipes was a health hazard (TSUTIYA, 2006).

Ruins of ancient water supply systems, built between 2000-200 B. C., are still found in the Anatolia region, also called Asia Minor, now part of Turkey. These ruins include pipes, channels, tunnels, inverted siphons, aqueducts, reservoirs, cisterns and dams. One such example is that of the city of Ephesus, which for the water supply built from 4 to 14 AD, a water distribution system composed of a dam, from which the water was withdrawn and transported to the city by a pipeline of 6 km, of ceramic material (TSUTIYA, 2006).

Stay tuned!!!

Through reading, we perceive the development of sanitation throughout the Middle Ages, what considerations you and your group would like to expose in relation to the theme.

Leonardo da Vinci, according to Creder (1991), came to design the "ideal city" that was surrounded by canals, in view of the water supply and sewage networks.

The Egyptians developed techniques for filtering water for domestic use, since sanitary waste was thrown on the ground and water was dragged into the river. They used to store water in large clay or porcelain pots for about a year, long enough for dirt to settle to the bottom of the container. During this period, construction began on the first sewer gallery in history in Nippur, Babylon.

In the Vale do Indo, streets were created with sewage channels covered by bricks, bathtubs and toilets with the discharge of waste into the canals. They stored the water in copper vessels, exposed it to the sun, and the filtration was done using coal or gravel and immersed a heated iron bar.

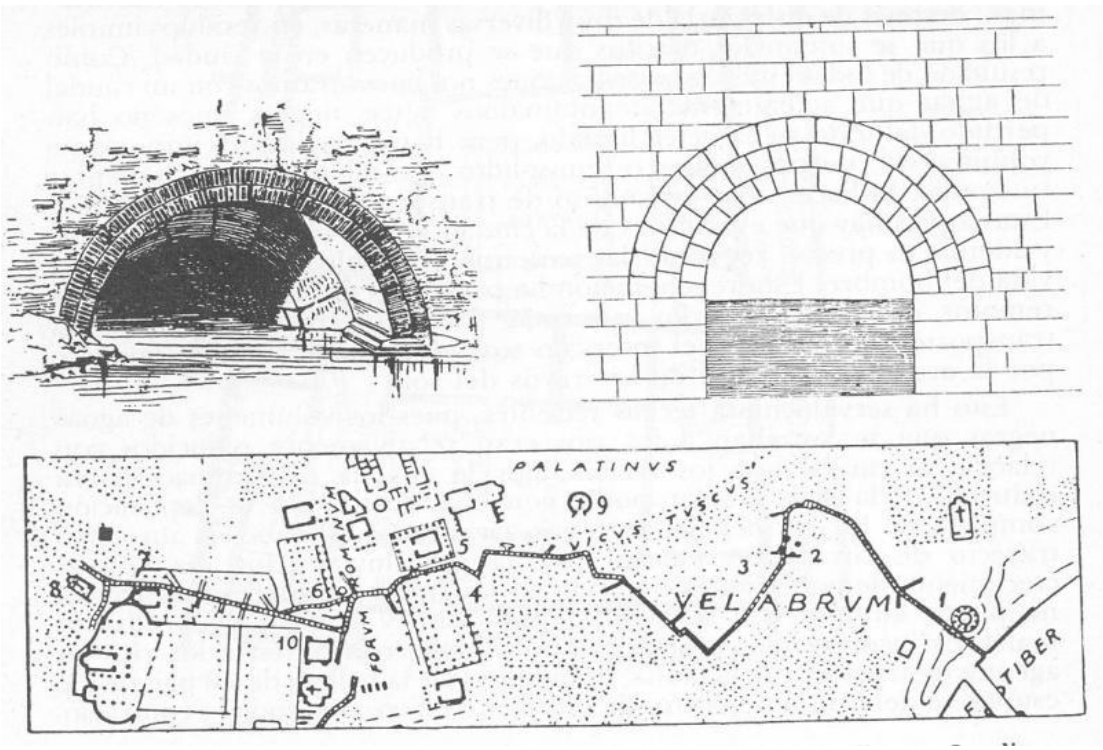
SANITATION DEVELOPMENT

The emergence and growth of cities, influenced the development of sanitation. With the increase and settlement of the population in cities, some factors become essential for its maintenance, such as obtaining drinking water for human consumption, the control of rainwater and the removal and treatment of sewage and solid waste.

Syrian crusader knights krak

https://bit.ly/2SnoMOI

One of the oldest sewage networks in the world is Cloaca Máxima, built in Ancient Rome for the purpose of draining the local marshes and removing sewage from the city, transporting the effluents to the river that flowed near the city. Cloaca Máxima was kept in good condition throughout the imperial age.



http://www.romanaqueducts.info/aquasite/romacloaca/foto4.html

The spas were sophisticated buildings with pools of hot, warm or cold water, next to rooms for sports and massage.

Roman baths of São Pedro do Sul -

Construction known as Piscina D. Afonso Henriques.

By João Carvalho - Own work, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=16395374

Public baths could serve several purposes, including body hygiene and water therapy with medicinal properties; the baths were meeting points for the life of the cities of the Roman Empire.

Throughout history there have been times when greater emphasis has been placed on sanitation, others less, but there is no denying that man's concern with sanitation goes back a long way.

SANITATION IN MEDIEVAL CITIES

The concepts related to water resources, sanitation and public health conditions regressed long after the fall of the Roman Empire, reaching deplorable conditions, with polluted water, waste in the streets and waste water thrown out the windows giving rise to various epidemics (MAYS, 2000).

http://paginawebleon.mx/wp/habitos-extranos-de-la-edad-media/

The Black Death, an epidemic that killed a third of Europe's population due to the filth of medieval European cities, is a significant example of the chaos that affected sanitation at this time

https://i2.wp.com/manualdoturista.com.br/wp-content/uploads/2015/12/peste-negra1.jpg

https://pixabay.com/pt/fonte-stone-esculpido-idade-m%C3%A9dia-2515648/

In the Middle Ages there was a decline in the public health process with the splintering of Greco-Roman civilization by the barbarians. The people consumed a low volume of water, reaching in some less than a liter a day per inhabitant, reducing the possibility of bathing which generated serious consequences to the health of the population. This period was marked by two major epidemics: the plague of Justinian and the Black Death.

A jumble of buildings in a maze of narrow streets, so were medieval cities, small, densely populated, noisy and dirty. The garbage was abandoned at the doors of the houses. Most of its streets had no pavement or drainage works, and received all sorts of refuse and filth. The urinals were emptied through the window and the stench was unbearable.

https://www.ucm.es/amcytme-historiamedieval/jerarquizacion-urbana-de-villas-y-ciudades-en-castilla-1400-11

The people lived huddled in tenements, among chickens, dunghills and dogs and cats that made the "use" of the remains they found. The water was obtained through the construction of cisterns, dug wells and natural sources.

At this time, in order to prevent diseases from spreading, environmental protection measures were adopted in order to preserve water resources. The oldest British law on water and air pollution was enacted in 1388 which prohibited the dumping of excrement, garbage and debris into pits, rivers and other waters. In 1453, in Augsburg, laws were created with the purpose of controlling the contamination of rivers that served the public supply.

Water supply and sanitation did not develop as expected, so they created private water supply companies that, through pumping, expanded distribution, but due to the constant epidemics, a new concern arose, with water quality since no type of treatment was used.

Stay tuned!!!

What happened to sanitation in the Middle Ages. Present your position and justify with your group.

MODERN AGE

At the end of the Modern Age and the beginning of the Contemporary Age, epidemics still threatened western countries, thus emerging the need to adopt policies aimed at basic sanitation. In large cities in Europe and North America, after several cholera epidemics, the sewage system emerges (REGULATORY AND SUPERVISORY BOARD REGULATORY AGENCY - ITU, 2016).

The creation of schools and the development of sciences gave rise to an intellectual class that boosted the development of knowledge about the relationship between health and sanitation. At that time there was the Industrial Revolution: wage labor became the essential element for the generation of national wealth and the search for mechanisms that minimized workers' health problems was stimulated by the market.

At this time, the paving of the streets and the construction of drainage channels began to transport the waste from the streets towards the rivers and lakes, producing bad odors. The infiltration of seals and cemeteries contaminated the fountains and wells.

Stay tuned!!!

Point out the main epidemics, the year they occurred and what measures were taken to prevent the.

SANITATION IN THE INDUSTRIAL SOCIETY

Living conditions in the cities of England, France, Belgium and Germany were dire. The houses were overcrowded and without the minimum hygiene conditions, the debris was accumulated in containers, from where they were transferred to public reservoirs monthly.

Since the Industrial Revolution in the 18th century, due to the accelerated growth of cities and human settlements that industrialization has promoted, the need for public basic sanitation systems has grown, as it was believed that the receiving body would not be able to provide water and receive and purify the waste that is would concentrate on the water body. Generating the need to think about a structured system that distributes these needs in a structured, coherent and permanent way, in the best possible way, avoiding the bankruptcy of the system and leading the community to decline due to the lack of water.

Europeans were not very adept at daily bathing. In our culture, the daily bath was introduced by the indigenous people.

European cities took advantage of the urban drainage structure, which came from the advent of paving, to conduct waste. At this time, the bathroom as we know it and the unitary water drainage systems emerged. But the danger remains of contamination of the receiving body.

Stay tuned!!!

This unitary system worked and still works in Europe because the average precipitation volume is consistent with the size of the facilities.

What are unitary flow systems? Do you know another drainage system? In Brazil what type and flow is used and why?

CONTEMPORARY AGE

The living conditions of the population began to improve, with the introduction of iron pipes and steam pumps. Throughout the 19th century, around 1830, there began to be a concern about the occurrence of epidemics in several regions of Europe and the United States, and there arises the first evolution of the unitary system, which is the partial separator system that was only concerned with the water that falls inside the land.

Around 1860 to 1870, the absolute separator system appears in the United States, which is the system that has been used in Brazil for more than a century, which is an exclusive system for sewage. Thus separating a pipe for sewage and another for rainwater.

This system arrived in Brazil at the end of the 18th century, through the greatest sanitary engineer in Brazil, Saturnino de Brito.

Stay tuned!!!

Do some research on Saturnino de Brito's main achievements, who he was and his importance for the development of sanitation in Brazil.

CURRENT AGE

With the development of science and technology in the 20th century, contaminated sources were able to become potable after proper treatment.

In Brazil, as of 1912, the absolute separator system was adopted where sewage networks are designed and built separate from rainwater drainage, making this mandatory in urbanization projects.

Although sanitation has developed, there is still a lot to do. Only with law 11445/2007 did national guidelines for sanitation have been established. Sanitation conditions in Brazil, both in the rural and urban areas of some regions, remain precarious, especially with regard to the low-income population.

RETURNING TO THE CHALLENG

Now the Light of acquired knowledge will resolve the issue.

SUMMING UP

Prepare a text that summarizes the main issues developed in this chapter and brings some curious and relevant information to be presented to your colleagues.

Concepts and Definitions 2

Favela Jaqueline, São Paulo
https://upload.wikimedia.org/wikipedia/commons/5/57/Favela_Jaqueline_%28Vila_S%C3%B4nia%29_01.jpg

"A healthy city is one that continuously implements the improvement of its physical and social environment, using the resources of its community in order to allow its citizens a mutual aptitude in all human activities that lead to their full realization. "

DUHL e HANCOCK (1996)

Sanitation - atc or effect of sanitize.
Sanitize – make healthy, hygienic or healthy; remedy, repair.

GOAL

Train students to become future active citizens and committed to the search for viable solutions to sanitation problems. For this you will need to take them to:

- Understand the concepts and definitions about sanitation
- Identify causes and consequences of lack of sanitation.
- Identify and comment on problems related to the disposal of sewage and domestic waste.
- Identify and comment on personal, collective and governmental initiatives to protect the environment.
- Develop positive attitudes related to the preservation of natural resources and the environment

A CHALLENGE FOR YOU

It was published in a prestigious newspaper in the country that “Lack of basic sanitation has a direct impact on the classroom”, there is a child who spends the whole year with diarrhea, says a teacher. Diarrhea, vomiting affect the child's nutrition and leave sequelae. Do you know how Sanitation is in your neighborhood? In your city? In your country? After all, what is the importance of Sanitation for your life? And for the life of your community? Survey these issues with your team and present your findings to the class. Also presenting a solution to any sanitation problem found in your neighborhood.

TALKING ABOUT THE THEME

DEFINITIONS

According to the World Health Organization (WHO), basic sanitation is the set of measures to improve the quality of life of the inhabitants of a region, thus contributing to the improvement of the population's health, which comes to be the complete physical, mental well-being and social of man.

By using water in inadequate conditions, we risk our health, exposing ourselves to disease-transmitting organisms.

LAW No. 11445 OF 01/05/2007

This Federal Law establishes national guidelines for basic sanitation as well as public policies for basic sanitation defining, in its art. 3, page 2, public basic sanitation services such as the set of services, infrastructures and operational facilities of:

a) drinking water supply: consisting of the activities, infrastructures and facilities necessary for the public supply of drinking water, from collection to building connections and respective measuring instruments;

b) sanitary sewage: constituted by the activities, infrastructures and operational facilities for the collection, transportation, treatment and final disposal of sanitary sewage, from building connections to their final release into the environment;

c) urban cleaning and solid waste management: set of activities, infrastructures and operational facilities for the collection, transportation, transhipment, treatment and final destination of domestic waste and waste originating from sweeping and cleaning of public places and roads;

d) rainwater drainage and management, cleaning and preventive inspection of the respective urban networks: set of activities, infrastructures and operational installations for urban rainwater drainage, transportation, detention or retention for the damping of flood flows, treatment and disposal end of rainwater drained in urban areas (FEDERAL LAW 11445-2007, p.2).

Your objective
greater is the promotion of men's health, as many diseases can proliferate due to the lack of sanitation measures.

Sanitation is of fundamental importance for people's lives, taking into account that when a population has an adequate water treatment, sewage collection and treatment service, their quality of life improves considerably, especially with regard to children's health, improving their educational attainment and reducing the infant mortality rate.

Although this enumeration of services exists, the search for health security and the environmental well-being of the population should not be restricted to just these activities (KOBIYAMA, MOTA AND CORSEUIL, 2008).

This law, in addition to establishing national guidelines and federal sanitation policy, also determines that basic sanitation planning is the responsibility of the municipality, and that the provision of services can be done by a municipal public institution or by a public concessionaire and / or toilet. Even though the Union is the one that receives the most resources, executive obligations are attributed to the municipalities, which do not have enough investments, and for this reason, it is possible to somehow justify the current precariousness of the Brazilian basic sanitation network (Instituto Trata Brasil - 2015).

In order to achieve the universalization of basic sanitation in the country, greater mobilization by municipal, state and, above all, federal governments is necessary in order to reduce the degradation of the urban environment, and thus providing better living conditions. life and well-being for the population, especially with regard to children's health. In Brazil, investments in the sewage network are much lower when compared to other public services, such as water supply, garbage collection or electricity (JusBrasil 2015).

LAW No. 8080 OF 9/19/1990

Federal Law No. 8,080 (BRAZIL, 1990) provides for the functioning of health services in the country, in its article 3 recognizes that health has as determinant and conditioning factors, among others, basic sanitation, with legal recognition of the existence of a relationship between inadequate basic sanitation conditions and the existing epidemiological picture.

CONSTITUTION OF THE FEDERTIVE REPUBLIC OF BRAZIL OF 10/05/1988

Health is provided as a fundamental social right and is present in Article 6 of the 1988 Federal Constitution. In Art. 196, p. 118/119 she says that “health is the right of all and the duty of the State, guaranteed through social and economic policies aimed at reducing the risk of disease and other diseases and universal and equal access to actions and services for their promotion, protection and recovery ”.

As well as the concern with the Environment is provided for in Art. 170, inc. VI, in constitutional amendment nº 42 of 2003, where the following principles are observed: “defense of the environment, including by means of different treatment according to the environmental impact of products and services and their elaboration and rendering processes”.

In art. 23. The Federal Constitution says that it is the common competence of the Union, the States, the Federal District and the Municipalities, in its item VI "to protect the environment and fight pollution in any of its forms"; and in IX "to promote housing construction programs and the improvement of housing conditions and basic sanitation";

Article 225 says that everyone has the right to an ecologically balanced environment, a common use of the people and essential to a healthy quality of life, imposing on the Public Power and the community the duty to defend and preserve it for people. present and future generations.§ 1 To ensure the effectiveness of this right, it is incumbent on the Public Power in the VI “to promote environmental education at all levels of education and public awareness for the preservation of the environment”.

STATE CONSTITUTION

The State Constitution in Chapter 1 talks about individual and collective rights and duties, according to the New wording given by Constitutional Amendment No. 51 of 2011, in its sole paragraph it says “the State's duty to guarantee everyone a compatible quality of life with the dignity of the human person, ensuring education, health services, food, housing, transportation, basic sanitation, energy supply, drainage, paid work, leisure, economic activities and accessibility, budget allocations should include preferably such activities, according to government plans and programs “.

LAW No. 8080 OF 9/19/1990

The Municipal Organic Law that, according to Law 11.445 (2007), gives municipalities the management of basic sanitation, which involves the areas of water supply, sanitation, management of urban solid waste and urban drainage, is not clear the role of states in the conduct of this important sector, which reflects on the quality of life of citizens and the protection of the environment.

THE NEED FOR SANITATION FOR PUBLIC HEALTH

A global problem

The situation of basic sanitation in the world is far from ideal. Without this service, the population is exposed to various health risks, which hinder education and especially the development of a country, both in social and economic matters.

Data from the United Nations Children's Fund (UNICEF) point out that in Latin America and the Caribbean the second cause of infant mortality, after respiratory diseases, is diarrhea caused by infections transmitted by bringing dirty hands to the mouth, due to lack of water drinking and the situation is more serious in the case of babies between six and 11 months and, in rural areas, where more than half of the population has a complete lack of drinking water and an adequate sanitation system.

Hundreds of millions of people around the world still live without access to clean drinking water, and the vast majority live in rural areas. The problem mainly affects the poorest countries, but it is also present in some major economies in the world. Climate change, accompanied by extreme weather phenomena, such as cyclones, floods and prolonged droughts, significantly increase the problem, resulting in diseases such as cholera, granulomatous conjunctivitis, malaria and dengue. In addition, cases of malnutrition will increase, as agricultural communities face problems in growing food and raising animals in the midst of high temperatures.

The deterioration of swamps in the world is reducing the ecosystem's ability to purify waters. Clean water is not a privilege, it is a basic human right that must be respected.

Stay tuned!!!

Find out how the development of sanitation is in the world today, based on research by official agencies indicated by the

A Brazilian problem

Although Basic Sanitation is of great importance for Health and the environment, in Brazil the deficit in this sector is very high, especially with regard to sanitation. In the peripheries is where we find the greatest deficiencies, where the poorest population of the country is concentrated. Despite the improvements made in the last 40 years, the general situation of sanitation, both in rural and urban areas, remains precarious for low-income populations. There are several factors responsible for the deficiency of these services in the country, among them, they can be mentioned by Nascimento and Heller (2005) the lack and misuse of public resources, the fragmentation of public policies, the lack of regulatory instruments and regulation.

According to the Water Resources Secretariat of the Ministry of the Environment, the Brazilian territory contains about 12% of all fresh water on the planet. The country has 200,000 micro basins spread across 12 hydrographic regions. However, this abundance does not mean that the resource is inexhaustible. One reason is that its availability is uneven across the country.

Let's see:

REGION	DEMOGRAPHIC DENSITY (hab/km²)	CONCENTRATION OF THE COUNTRY'S WATER RESOURCES (%)
North	4,12	68,5
Northeast	34,15	3,3
Midwest	8,75	15,7
Southeast	86,92	6,0
South	48,58	6,5
Source: IBGE / National Water Agency (2010)		

Sanitation services have been seriously compromised due to a lack of resources and a shortage of qualified labor. This data may be influenced not only by the absence of a sewage network in many households, but also by the situation of population expansion in areas of precarious public health, such as slums and tenements.

In municipalities with greater access to sewage collection, the incidence of gastrointestinal infections is significantly lower, especially among children and young people up to 14 years old. With universal access, there will therefore be a general improvement in the quality of life in the municipality.

If access to sewage collection is given to a worker who does not have access to this service, it is expected that the general improvement in their quality of life will result in a 13.3% higher productivity, enabling their income to grow in equal proportion.

In Brazil 49% of the population does not have sewage collection, and only 44% of the collected sewage is treated. In the northern region less than 10% of the population has sewage collection.

Why has basic sanitation become a public health issue in today's world?

Basic sanitation is one of the most important means of disease prevention, among all public health activities.

According to FUNASA, they are examples of the health effects of sanitation actions:

Good quality water for human consumption, its continuous supply ensures the reduction and control of: diarrhea, cholera, dengue, yellow fever, trachoma, hepatitis, conjunctivitis, polio, scabies, leptospirosis, typhoid, schistosomiasis and malaria

https://cdn.pixabay.com/photo/2016/01/20/15/07/dengue-fever-1151682_960_720.png

Regular collection, packaging and proper final destination of solid waste decrease the incidence of cases of: plague, yellow fever, dengue, toxoplasmosis, leishmaniasis, cysticercosis, salmonellosis, teniasis, leptospirosis, cholera, typhoid fever;

https://bit.ly/2LN7JP7

Adequate sanitation is a factor that contributes to the elimination of vectors of: malaria, diarrhea, worms, schistosomiasis, cysticercosis, teniasis.

Home health improvements are directly related to the reduction of: Chagas disease, schistosomiasis, diarrhea, worms, scabies, trachoma, conjunctivitis**.**

https://bit.ly/2MW0rti

RETURNING TO THE CHALLENGE

Now the Light of the acquired knowledge will solve the proposed question.

SUMMING UP

Prepare a text that summarizes the main issues developed in this chapter and brings some curious and relevant information to be presented to your colleagues.

System of Water supply 3

Spain - Mérida - The aqueduct of miracles. Tallest aqueduct in the entire ancient Roman empire. Founded by order of the emperor Augustus, in the year 25 B. C.

Water springs from the ground, pure and without contamination
Run, descend, water the plantation Continue your road until you reach the brook Then go to the river where the lament begins. Sewage, rubble and poison reach your heart And in the vein of this river that was meant to lead life
It only leads to destruction.

Odilon Euzébio

GOAL:

- Understand what parts make up the system.
- Determine the type and appropriate location for the source
- Determine the factors that change the water quality of a source

A CHALLENGE FOR YOU

With the knowledge that will be acquired in this chapter, as a group, elaborate a project involving the choice of the source, determining its characteristics, how to preserve it and what is the importance of this preservation, presenting a survey of what possible sources exist in your region.

TALKING ABOUT THE THEME

Quantification of Water in Nature

Water is the simplest and most abundant substance on the planet, and can be found in the terrestrial atmosphere in liquid, gaseous or solid state, on and under the terrestrial surface, in oceans, seas, rivers and lakes. It is also the most inorganic constituent in living matter. Scientists estimate that our planet has three quarters of its mass of water alone 1.36 x 10^{18} m^3 according to (SPERLING, 1996).

Much of the groundwater is in conditions unsuitable for consumption or in depths that make its exploitation unfeasible. In view of this situation, it is of fundamental importance for the future of humanity, that the preservation of the planet's water resources in its natural conditions is valued.

Underground water

https://bit.ly/2SDkl1l

The world is made up of about 3% fresh water and, of these, 70% is in the form of ice or on the ground. About 12% of this water is found in Brazil, stored in its aquifers.

https://bit.ly/2rqrS2q

Tietê River and the Dam in the city of Barra Bonita

Author: José Reynaldo da Fonseca – REFON

Stay tuned!!!

1. “The body of an adult man is made up of more than 70% water, whereas in a newborn this rate increases to more than 78%”. Based on the information, find out what percentage of water exists in the various organs of the human body.

2. Justify the expression “Water Planet” as a reference to Planet Earth.

3. Do research on the main aquifers found in Brazil. Highlighting its scope and importance.

About 2/3 of the world's water is used in food production, with emphasis on agriculture and livestock.

Let's see how water is distributed in the Globe:

WATER SOURCE	WATER VOLUME (km³)	PERCENTAGE FRESH WATER	PORCENTAGEM TOTAL DE ÁGUA
Oceans, Seas and Bays	1.338.000.000	--	96,5
Ice sheet, Glaciers and Snow Perennial	24.064.000	68,7	1,74
Underground Water	23.400.000	--	1,7
Doce	10.530.000	30,1	0,76
Salgado	12.870.000	--	0,94
Soil Moisture	16.500	0,05	0,001
Soil Ice and Permafrost	300.000	0,86	0,022
Lagos	176.400	--	0,013
Doce	91.000	0,26	0,007
Salgado	85.400	--	0,006
Atmosphere	12.900	0,04	0,001
Swamp water	11.470	0,03	0,0008
Rivers	2.120	0,006	0,0002
Biological Water	1.120	0,003	0,0001
TOTAL	1.386.000.000	--	100

Source: Gleick, P. H., 1996: Water resources. In the Encyclopedia of climate and weather, ed. By Superlogo H.
Schneider, Oxford University Press, New York, vol. 2, pag. 817-823

The hydrological cycle

Knowing the distribution of water on Earth, it is also important to know how it moves on the planet. Its permanent movement of changes in state (solid, liquid or gaseous) or position (superficial, underground or atmospheric) in relation to the Earth's surface, has been called the hydrological cycle. By definition, then, the hydrological cycle is the description of the natural behavior of water around the globe.

https://pixabay.com/pt/desmatamento-floresta-madeira-corte-405749/

The fast pace of deforestation in the last decades, and urban and industrial growth, which always needs more water, has been changing this hydrological cycle. Studies have shown that deforestation and overgrazing decrease the soil's ability to act as a large sponge, absorbing rainwater and slowly releasing its contents.

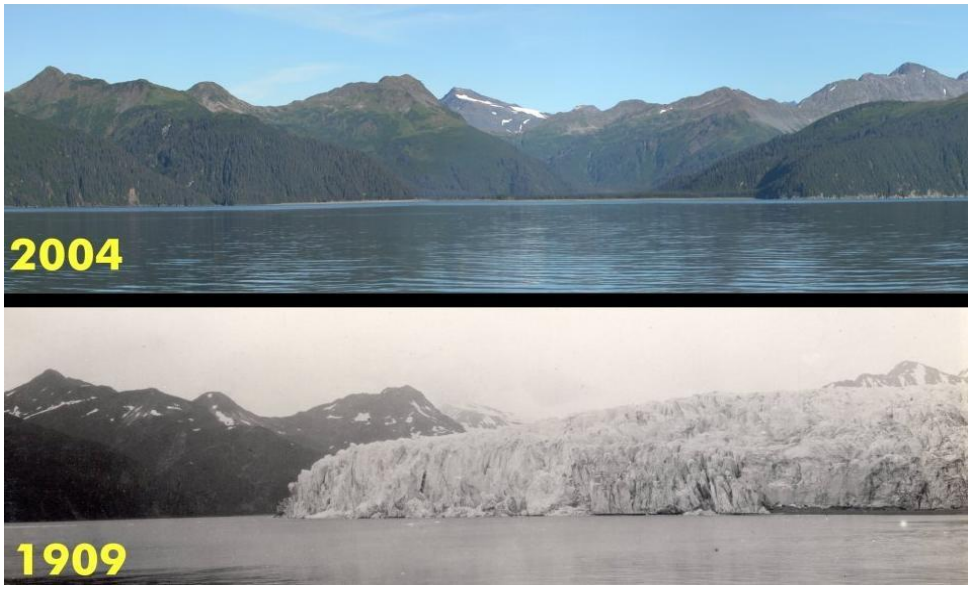
In the absence of vegetation cover, and with compacted soils, the tendency of the rains is to run down the surface and drain quickly through water courses, which results in floods, acceleration in the erosion process and reduced stability of water courses, which they are reduced outside the flood period, thus compromising agriculture and fishing. There is no lack of fresh water. Groundwater levels drop steadily, many lakes shrink and swamps dry up.

https://pixabay.com/pt/inunda%C3%A7%C3%A3o-inunda%C3%A7%C3%B5es-natureza-63832/

In agriculture, industry and domestic life, water needs are constantly increasing, in parallel with population growth and rising living standards, which multiply water use. In the 1950s, for example, the water demand per person was 400 m3 per year, on average on the planet, whereas today this demand is already 800 m3 per individual. In increasingly populous countries, or with a shortage of water resources, the water use limit has already been reached.

It was found that currently 26 countries, the majority located on the African continent, totaling 235 million people, suffer from water scarcity.

Generalized retreat of polar and mountain glaciers



https://pt.wikipedia.org/wiki/Impactos_do_aquecimento_global_no_Brasil

The other regions of the world are also spared. Crisis symptoms are already manifesting in countries with good reserves. In places where the level of groundwater pumping is more intense than its natural renewal, there is a decrease in the level of groundwater, which, for this reason, requires greater investments to be explored and at the same time become more saline.

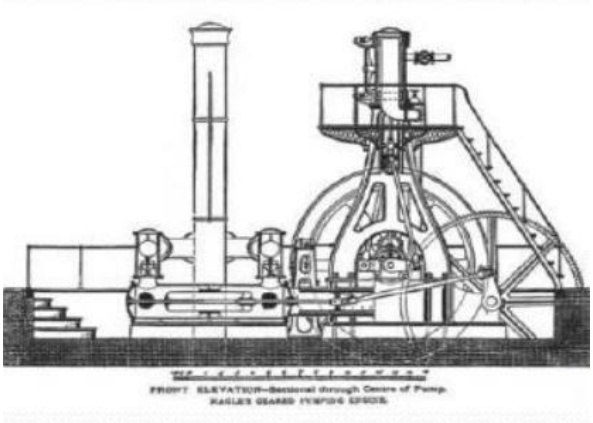
Around 1237, London's first piped water supply system was built, built with lead pipes. In 1652 a cast iron pipeline was built in Boston, USA, in 1455 the first cast iron pipe was used in Dillenburgh Castle in Germany and in 1664 a pipeline of over 22 km was built in France, also in cast iron for supply the Palace of Versailles, becoming the largest line of pipes of the time and even today part of that pipe remains in service (AZEVEDO NETTO, 1984).

http://www.conhecimentohoje.com.br/Recentes711.ht m

Drop - induced by lead contamination. Disease characterized by the accumulation of uric acid in the body, especially in the joints, which causes painful inflammatory attacks.

Although the lead pipe is not the ideal material for the distribution of water, the use of cast iron pipes on a large scale was slow to happen and was a fact of great importance for the development of water supply systems.

The first water supply system using horse-powered pumps and cast iron pipes for water distribution, was built in the State of Pennsylvania in 1755. After the first half of the 20th century, ductile iron pipes were used and later other materials. When steam-powered pumps for water elevators began to be used, initially in 1764, in Bethlehem, Pennsylvania, supply systems were closer to those currently known (MAYS, 2000; TSUTIYA, 2006).



The first city to have water supply in Brazil, was Rio de Janeiro in 1561, according to Azevedo Netto (1984), through a well dug by Estácio de Sá and, around 1673, the water supply works for the city began In 1723 the first aqueduct in Rio de Janeiro was built, which in 1860 distributed eight million liters of water per day, finally in 1876 the project for the first piped water supply system in Rio de Janeiro was contracted.

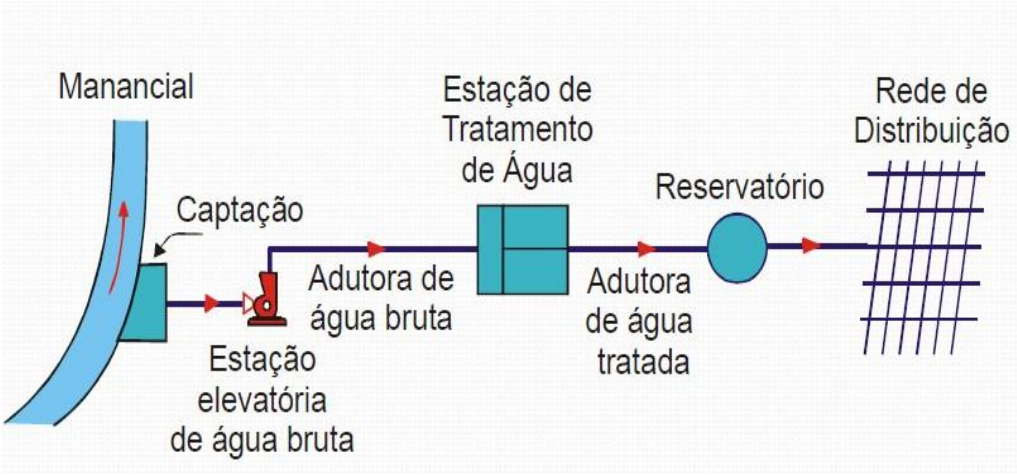
https://ama2345decopacabana.wordpress.com/planejamento-urbano/a-historia-do-abastecimento-comeca-no-rio-de-janeiro/#jp-carousel-2307

According to Tsutiya (2006), the first water supply and distribution project was developed around 1842 for the city of São Paulo. At the end of the 9th century and the beginning of the 20th century, the development of sanitation began in Brazil, between 1849 and 1891, the Central Commission for Public Health and the Engineering Commission of the Board of Public Hygiene were created, through the constituent of 1891 States gained autonomy to provide health surveillance services. In 1892 the Bacteriological Institute was created, in 1901 the Butantã Institute and in 1903 the Pasteur Institute, which were important milestones for Sanitation and Health. In 1934 the Ministry of Education and Health was created (COUNCIL OF REGULATION AND SUPERVISION AGENCY REGULATOR - ITU, 2016).

Reservatório da Liberdade, s.d. Acervo Fundação Energia e Saneamento

http://revistadae.com.br/artigos/artigo_edicao_196_n_1566.pdf

CONSTITUENT PARTS OF A WATER SUPPLY SYSTEM



Scheme of a simple water supply system.
Source: Tsutiya (2006)

SOURCE

They are all sources of water, surface and underground, used for public supply. Including rivers, lakes, dams and groundwater.

When choosing a source, we must take into account the quality and quantity of water it has and analyze it from its economic aspect. We can count on the following types of springs:

a) **rainwater** (cisterns);

https://c2.staticflickr.com/2/1560/25889982051_0b93f5449a_b.jpg

b) **subsoil** or **sub-ground** waters (wells, cacimbas, sources);

Old well. Public domain

https://cdn.pixabay.com/photo/2015/01/31/14/14/well-618531_960_720.jpg

https://cdn.pixabay.com/photo/2015/08/04/14/42/garden-874795_960_720.jpg

c) **surface water** (dams, rivers, lagoons).

https://cdn.pixabay.com/photo/2014/01/25/20/38/lagoons-of-ruidera-251804_960_720.jpg

RAINWATER

Rainwater can be stored in cisterns, which are small individual reservoirs built close to, in general, our homes.

The cistern is used both in areas of high rainfall (areas where it rains a lot) and in dry areas, where it seeks to add rainy season water to use during the dry season in order to guarantee at least water for drink.

UNDERGROUND OR UNDERGROUND WATERS

Groundwater is that which accumulates below the surface, usually in the pores in the composition of the rocks.

Groundwater or unconfined

Free Aquifer

It is limited at the top by a permeable layer and at the bottom by an impermeable layer. The water pressure is equal to atmospheric pressure. The recharge is quick and is done along the entire length of the land, due to precipitation. Safe variations accentuated with the seasons.

Confined Aquifer

Limited at the top and bottom by impermeable layers. The water pressure induced by the waterproof cover is higher than atmospheric pressure. Recharge is slow, done laterally in a limited area exposed to the surface. It varies little with the seasons.

.

SURFACE WATER

These are the waters that drain or accumulate on the surface of the soil, such as rivers, streams, lakes, ponds, swamps.

Superficial Source

Minimum stock requirements:

ASPECTS	
QUANTITATIVES	**QUALITATIVE**
Flow rates	Physicist
	Chemical
	Biological
	Bacteriological

WATER QUALITY

Drinking water: water for human consumption whose microbiological, physical, chemical and radioactive parameters meet the potability standard and does not offer health risks

Potability standard: defines maximum values allowed for physical, chemical and bacteriological parameters - *Ordinance No. 2914, of 12/12/2011 - Ministry of Health*

Water quality standards: According to CONAMA 357/2005, as waters are classified according to their degree of salinity in fresh, brackish and saline waters, it also determines the conditions and patterns of effluent releases.

Main factors that alter the water quality of the springs:

Urbanization, erosion and silting up, deforestation and suppression of riparian forest, recreation and leisure, industries and mining, solid waste, agricultural waste and activities, domestic sewage, diffuse loads, accidents.

Portal da copa/ME (victoria.camara)
Copa 2014.imprensa@esporte.gov.br

Control Measures

Corrective character: measures aimed at correcting an existing situation, to improve water quality.

Preventive character: measures that prevent or minimize the deterioration in water quality

Corrective Control

1. Implementation of ETEs in polluting sources located in the watershed basin

2. Measures applied to the stock, such as removing algae, fighting insects, crustaceans and molluscs, removing sludge and sediment, aerating water, eliminating pathogenic microorganisms and higher aquatic vegetation.

3. Installation of ETA appropriate to the quality of raw water

Seaweed. Public domain
https://c1.staticflickr.com/6/5652/30712939556_5e4a680640_b.jpg

Preventive Control

- Implementation of sewage collection, transport and treatment systems
- Removal of nutrients and pathogens in sewage treatment systems
- Land use and occupation planning
- Control of erosion, runoff and vegetation.
- Control of water quality in dams
- Prior assessment of environmental impacts
- Installation and expansion of effluent treatment systems according to new demands

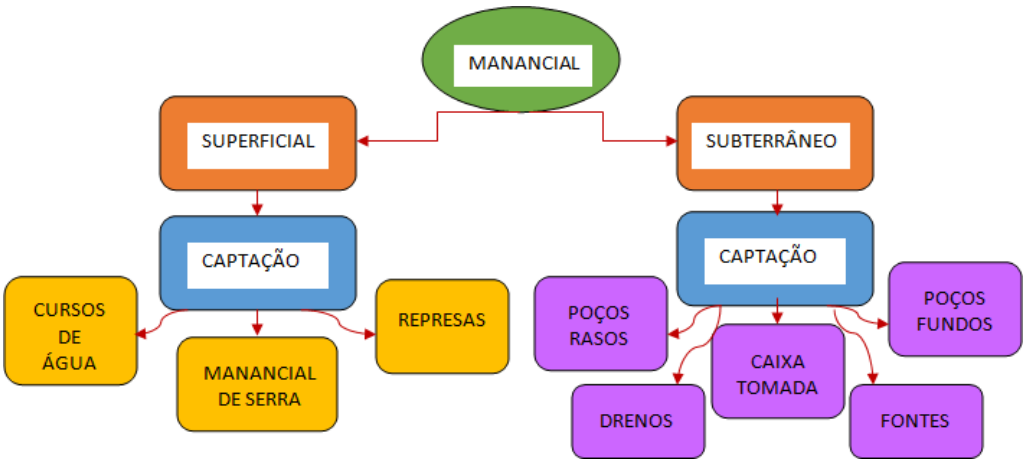
SOURCE SELECTION

Some Factors influence the selection of water sources such as: Guarantee of water supply in adequate quantity and quality, close to the place of consumption, Unevenness that may disadvantage the choice, Favorable places for the construction of the collection (access, infrastructure, etc.), Transport sediment through the watercourse.

Attention!!!

The choice of the source constitutes the most important decision in the implementation of a water supply system, be it individual or collective. For this selection it is necessary to carry out technical, economic and environmental studies.

CONCEPTION OF WATER SUPPLY SYSTEMS



Your definition should take into account the following criteria:

1st criterion: previously it is essential to carry out analyzes of organic, inorganic and bacteriological components of the waters of the spring, to check the contents of harmful substances, limited by the National Environment Council resolution.

Conama Resolution 357-2005 replacing 20-1986, Provides for the **classification of bodies of water and environmental guidelines for their classification**, as well as establishing the conditions and standards for the discharge of effluents, and other measures.

2nd criterion:

Check the minimum flow rates of the source, necessary to meet the demand for the project period; This information is found in regional regulatory agencies.

3rd criterion: Take into account springs that do not require treatment such as groundwater not subject to any possibility of contamination;

4th criterion: Consider springs that require only disinfection such as groundwater and certain well-protected surface waters, subject to a low degree of contamination;

5th criterion: springs that require simplified treatment such as protected springs, with low levels of color and turbidity, subject only to slow filtration and disinfection;

6th criterion: And finally, springs that require conventional treatment that basically comprise surface water, with high turbidity, that require treatment with coagulation, flocculation, decantation, filtration and disinfection.

Choosing the Source and Location for the Implementation of the Funding

Studies such as: survey of the geographic map of the planialtimetric type should be used; Estimate of the minimum flow of the sources, at the most suitable points for abstraction, as well as the knowledge of the flows available for abstraction according to the agency responsible for the management of water resources; Sanitary survey of the hydrographic basin upstream of the possible catchment points, including the characterization of the main uses of land and water, with special attention to the degrading activities of vegetation and polluters of water, soil and air; Choice of the source and location for the implantation of possible catchment points; Knowledge of the uses of water downstream from the survey points under study; Physical, chemical and biological characteristics of the water and evaluation of the transport of solids, at representative times of the year, at the points considered for the location of the abstraction; Evaluation of sediment transport, among others.

Catchment site conditions

- Present demanded flow and residual flow, necessary;
- Be located upstream of sources of pollution;
- Be located at an elevation higher than the location to be supplied; and that results in a smaller geometric gap in relation to the location;
- Ensuring easy water entry conditions at any time of the year;
- Perform the minimum alteration in the watercourse;

Basic Purposes

- Ensure water supply to the supply system in sufficient quantities to the requested (demand) at any time of the year
- Ensure, as much as possible, the best quality of water from the source to be used.
- To be the best alternative in technical, economic, environmental, social and operation and maintenance terms over time.

RETURNING TO THE CHALLENGE

Now the Light of the acquired knowledge solve the question.

SUMMING UP

Write a text, in partnership with a colleague, that summarizes the main issues developed in this chapter

Capture 4

https://bit.ly/2E3zdyd

“Good quality water is like health or freedom: it only has value when it ends.”

Guimarães Rosa

GOAL:

Know the parts that make up a collection and define the types of existing collection and the best place to install it; specify the grid and the grit to be adopted justifying its use, dimension a socket unit, a grid and a grit.

A CHALLENGE FOR YOU

With the knowledge that will be acquired in this chapter, choose the appropriate location for the implantation of a fundraising including all the variants necessary for the realization of the same.

TALKING ABOUT THE THEME

CAPTURE

It is a set of structures and devices, built or assembled next to a spring, for the withdrawal of water destined for a supply system.

Superficial: Streams, Rivers, Lakes, Dams

Underground: Phreatic and artesian aquifers

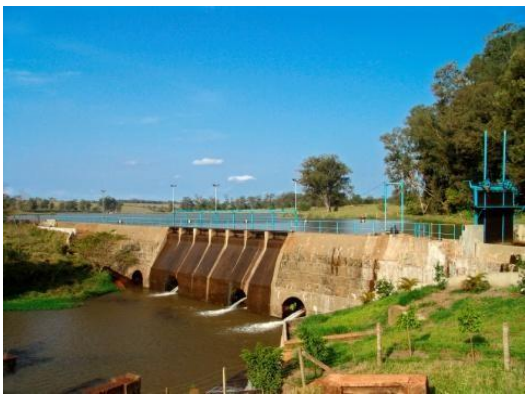
A capture consists of the following parts:

When there is a need to regulate flows or raise the water level, a dam, spillway or rockfill is used

Water inlet Railing
Sandblasting

Control devices
Channels and pipes

DAM

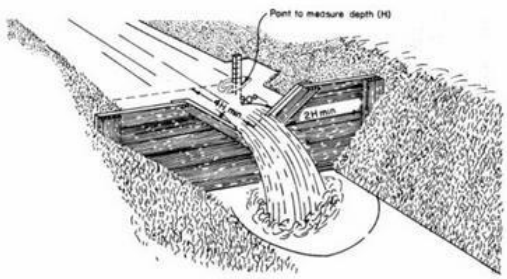


Dam of HPP Rio Novo, Avaré

A dam, weir or dam, is an artificial barrier, made in water courses to retain large amounts of water. Its use is mainly for water supply in residential, agricultural, industrial areas, production of electric and hydraulic energy or regularization of a flow.

SPILLWAY

Spillways are hydraulic instruments whose purpose is to measure the flow in natural water courses and in built channels, as well as to control the flow in galleries, channels and dams.



https://bit.ly/2RSN9P8

ROCKFILL

Nova Orla de Olinda - Rockfill works (sea containment).

https://c1.staticflickr.com/1/290/18674543742_3bc0426f1f_b.jpg

Rockfill is a damping device formed by a structure made of stone, designed to protect slopes and channels against erosion or undermining effects caused by water flows. In some cases it also serves to raise the water level of a spring.

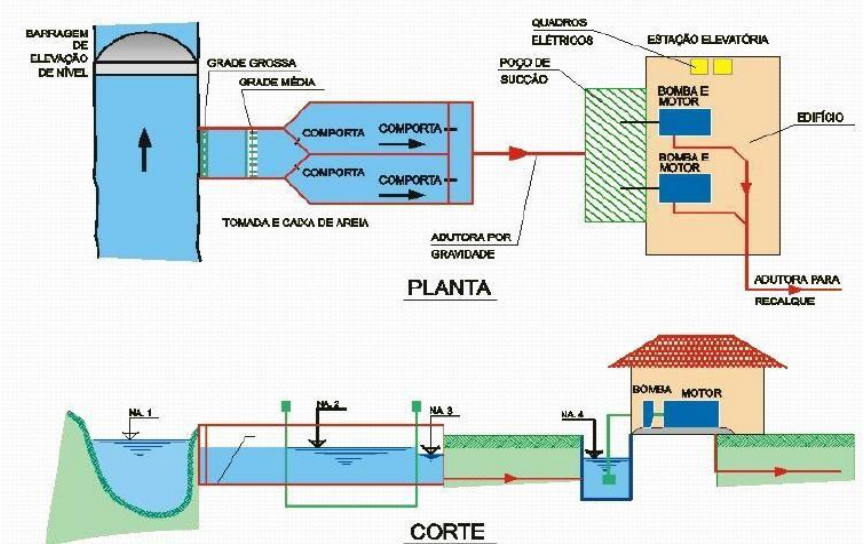
SURFACE WATER COLLECTION

The abstraction works must be designed and built with the purpose of operating uninterruptedly at any time of the year, the withdrawal of water to the supply system must be in sufficient quantity and of the best possible quality, in addition to enabling access for the operation and system maintenance.

https://bit.ly/2vVz7TG, via Wikimedia Commons

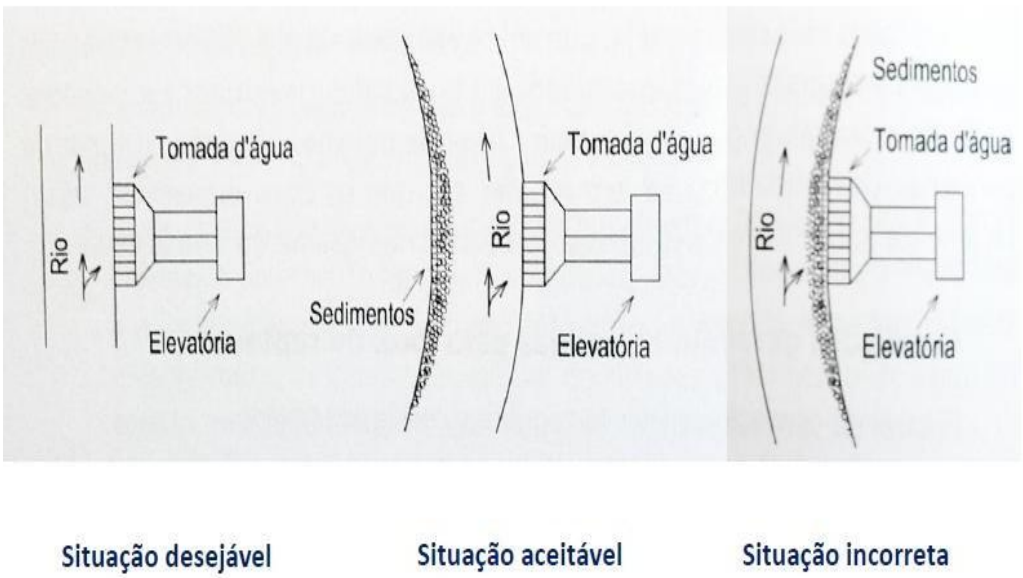
CAPTURE IN WATER COURSES

Water intake can be done through level dam, railing, sandbox and lifting station.



Source: TSUTYA (2006)

Attention!!!
Care must be taken in choosing the catchment location, such as avoiding places subject to the formation of sandbanks, places with unstable banks, giving preference to places not subject to flooding, guaranteeing access at any time and with favorable topographic and geotechnical conditions. In relation to the capture in water courses, the ideal is that it has the shortest route with the lowest transposition heights.



Source: TSUTYA (2006)

AMOUNT OF WATER

When referring to the amount of water to be captured, it should be taken into account that the ideal situation is one whose flow is sufficient in the dry season, which can be done directly from the current.

LEVELING DAMS

It is one of the solutions used when direct capture cannot be used, simply because the stream has a small water depth, that is, the flow is sufficient but the level is low. The purpose of the dam is nothing more than to raise the water level at the catchment site, thus allowing a blade of satisfactory height. This procedure does not regulate flow rates.

REGULARIZATION DAMS

The regularization of flows consists of storing water reserves during the rainy season to use them, gradually, in the complementation of water demands in the dry season. It is used When the minimum flows of the watercourse are lower and the averages are higher than the consumption needs, that is, this flow is insufficient in the dry season, but on average it is sufficient

ATTENTION!!!
When there is a flow, but it is lower than the expected consumption, another source should be sought or the flow of another source should be used in a complementary way.

https://commons.wikimedia.org/wiki/File:Barragem_de_Itaipu_(8155763889).jpg

WATER QUALITY

In order to guarantee water quality, when it comes to rivers, attention must be paid to the fact that the catchment must be installed upstream of the polluting discharges. In reservoirs, the catchment must be installed in a way that does not occur either as superficial or deep, since physical, chemical and biological problems may occur.

When we refer to problems involving Physical Nature, we must pay attention to the fact that they can occur both on the surface and in depth.

When the problems are on the surface, they deal with harmful physical actions such as winds, currents, impacts of bodies affluent, already when we refer to problems that occur in depth it is observed that a larger amount of suspended sediments is generated

As for the Chemical Nature problems, it appears that they tend to have a higher content of hardness, iron and manganese on their surface and, when we refer to the Biological Nature problems, in the upper layers of the water body a greater proliferation of algae, thus generating an unpleasant odor and a bad taste; in depth it will depend on the photic zone, that is, on the presence of light, and a biological mass of planktons can be found.

OPERATION GUARANTEE

In order to guarantee the proper functioning of a catchment, we must pay attention to:

- the minimum level at the catchment location so that the section entrance remains always drowned;
- the maximum level so that there is no harmful flooding to the collection facilities.
- the flow rate;
- the stability of the structures;
- current protection;
- protection against landslides;
- protection against obstructions using grids, screens or screens.

WATER OUTLET

It is the set of devices designed to carry the water from the source to the other constituent parts of the catchment. Occurs in all types of capture.

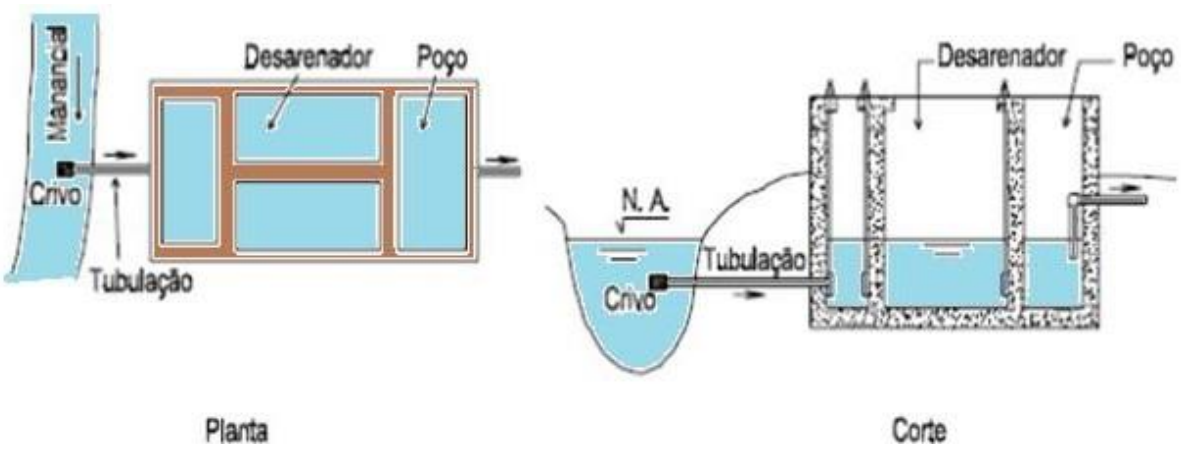
IMPORTANT!!!
(according to NBR 12213 - Surface water collection project for public supply) the speed in the pipes / channels of the water intake must be greater **than or equal to 0.60 m/s** and an anti-vortex device must always be provided.

We will highlight some types of water intake according to their degree of complexity: intake pipe; outlet box; bypass channel; bypass well; water intake with cantilever structure; floating capture; outlet tower

OUTLET PIPING

It is a device consisting of simple piping, which conducts water from the source to the next unit. The outlet pipe is provided with a sieve at its upstream end, located within the watercourse.

SOCKET OUTLET PIPE

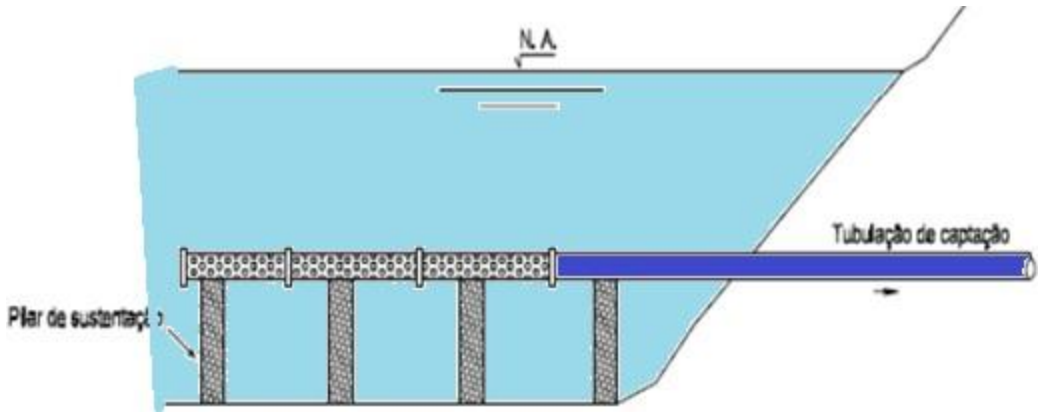


Source: Haddad 1997

The sieve piping can be discharged into a sand extractor, in a through-box, in a suction pit of a lift, directly connected to the suction of a pump.

OUTLET PIPE WITH PERFORATED PIPES

It is used when the watercourse has a small slope or when the water blade is thin.

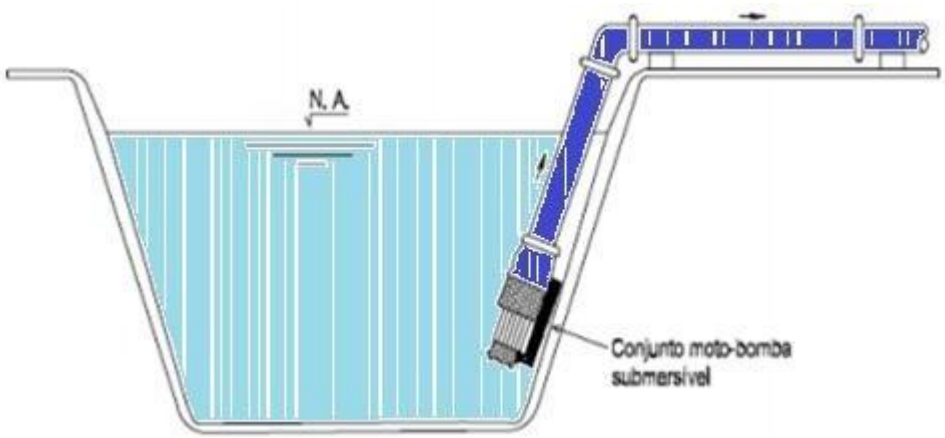


DACACH (1975)

OUTLET PIPING WITH AMPHIBIC PUMPS

It is used when the water intake is made directly by means of a motor-pump set, in this case with amphibious pumps, which are equipment installed inside the watercourse.

This is a solution that dispenses with the construction of the pump house, thus minimizing works on the margins of the spring, requiring a minimum height of water level for its installation, however they are not limited to problems of maximum suction height



HIGRA INDUSTRIAL LTDA (2003)

SIZE OF A OUTLET UNIT

HAZEN-WILLIAMS FORMULA: Calculation of pressure drop in the outlet pipe.

$$J = 10{,}643 \cdot Q^{1{,}85} \cdot C^{-1{,}85} \cdot D^{-4{,}87}$$

$$Hf = J \cdot L$$

J = Unit head loss (m/m)
Q = Flow rate (m^3/s)
C = Dimensional material coefficient
D = Diameter (m)

HAZEN-WILLIAMS METHOD

The table below shows the coefficient C values for the most used tubes today:

TUBE TYPE	C
Welded steel with 30 years of use	75
Welded steel with 20 years of use	90
Cast iron, used	90
Cast iron, with 15 years of use	100
Cast iron, with cement mortar	130
Galvanized steel, used	100
Galvanized steel, seamed	125
Seamless galvanized steel, new	130
Copper and brass	130
PVC plastic, up to 75 mm	125
PVC plastic, up to 100 mm	135
PVC plastic, more than 100 mm	140

GENERAL EQUATION: For the calculation of localized losses.

$$Hf = \sum K \cdot (v^2 / 2g)$$

Hf = Cargo loss (m)
K = Accessory head loss coefficient (dimensionless)
V = average flow velocity in the duct (m/s)
g = gravity acceleration (m/s^2)

$$Q = (P.\ qpm.\ K1) / T.3600$$

Q = Flow rate (m^3/s)
P = Project population (inhabitants))
K1= Reinforcement coefficient of the day of greatest consumption
T = Operating time (h / day) qpm = average per capita consumption

PIPE DIAMETER

$$D = (4Q) / \pi v)^{0,5}$$

D = Diameter (mm)
Q = Flow rate (m^3/s)
v = velocity (m/s)

PUMP WATER SPEED

$$v = (4\,Q)/(\pi\,D^2)$$

D = Diameter (mm)
Q = Flow rate (m^3/s)
v = velocity (m/s)

TOTAL HEAD LOSS

Hft= Hf1+Hf2+...

Hft= Total head loss (m)
Hf1=Hf2= Head loss on accessory (localized)

K COEFFICIENT FOR ACCESSORIES

PIECE	K	PIECE	K
GRADUAL ENLARGEMENT	0,30*	JUNCTION	0,40
NOZZLES	2,75	VENTURI METER	2,50**
OPEN FLOODGATE	1,00	GRADUAL REDUCTION	0,15*
FLOW CONTROLLER	2,50	OPEN ANGLE LOG	5,00
90º ELBOW	0,90	OPEN DRAWER REGISTRATION	0,20
45º ELBOW	0,40	GLOBE REGISTRATION OPEN	10,00
SIEVE	0,75	CHANNEL OUTPUT	1,00
90º CURVE	0,40	TE DIRECT PASS	0,60
40º CURVE	0,20	TÊ SIDE OUTPUT	1,30
22.5º CURVE	0,10	TÊ BILATERAL OUTPUT	1,80
NORMAL ENTRY IN CHANNELING	0,50	FOOT VALVE	1,75
EDGE ENTRY	1,00	RETENTION VALVE	2,50
EXISTENCE OF SMALL DERIVATION	0,03	VELOCITY	1,00
(*)BASED ON HIGHER SPEED (smaller section)		(**)RELATING TO SPEED IN THE CHANNELING	

OUTLET PIPING

EXERCISE 01

Dimension a surface water intake pipe intended for a community with a project population of 2000 inhabitants, average per capita water consumption macro-measured of 150 L / inhab.day and coefficient of the day of greatest consumption (k1) equal to 1.2. Water production units should be designed to operate a maximum of 16 hours a day. The length of the inlet pipe is 5 m and it discharges into a outlet well.

USE:

C= cast iron tube coated internally with cement mortar. (TABLE)
commercial sieve: (TABLE)
gate valve: (TABLE)
pipe outlet: (TABLE)
ETA flow = 3%

EXERCISE 02

Dimension a surface water intake pipe intended for a community with a project population of 19420 inhabitants, average per capita consumption of water measured at 200 L / hab.day and coefficient of the day of greatest consumption (k1) equal to 1.2. Water production units should be designed to operate a maximum of 20 hours a day.

The length of the inlet pipe is 150 m and it discharges into a outlet well.

Use:

PVC pipe, commercial sieve, gate valve, pipe outlet:

ETA flow = 4%

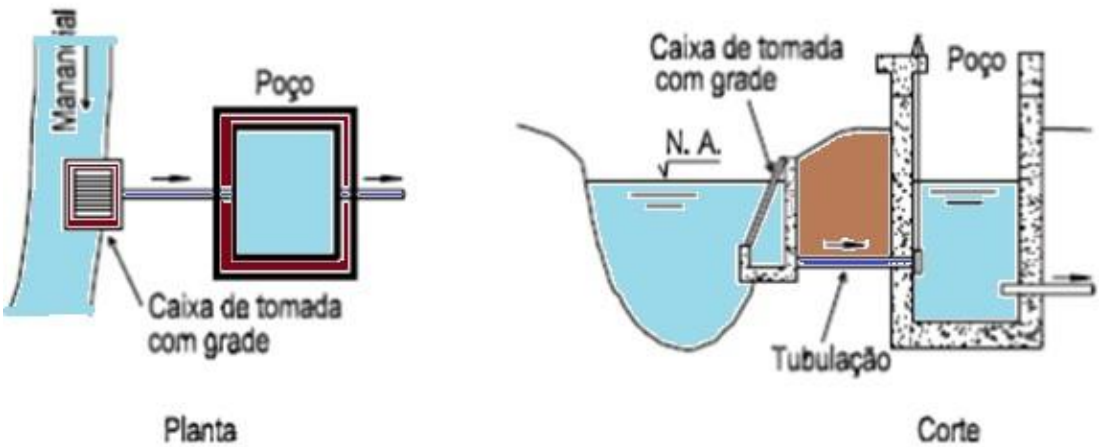
Large Consumer = 7L/s

b) OUTLET BOX

It is used when the watercourse has a torrential or rapid flow regime. This puts the stability of pipelines at risk, due to the possibility of their collision with solids carried by the watercourse during times of heavy rains.

In these situations, it is better to replace the outlet piping with a socket box installed on the edge of the watercourse.

The outlet boxes are fitted with a grid at their entrance.



Fonte: Haddad 1997

c) DERIVATION CHANNEL

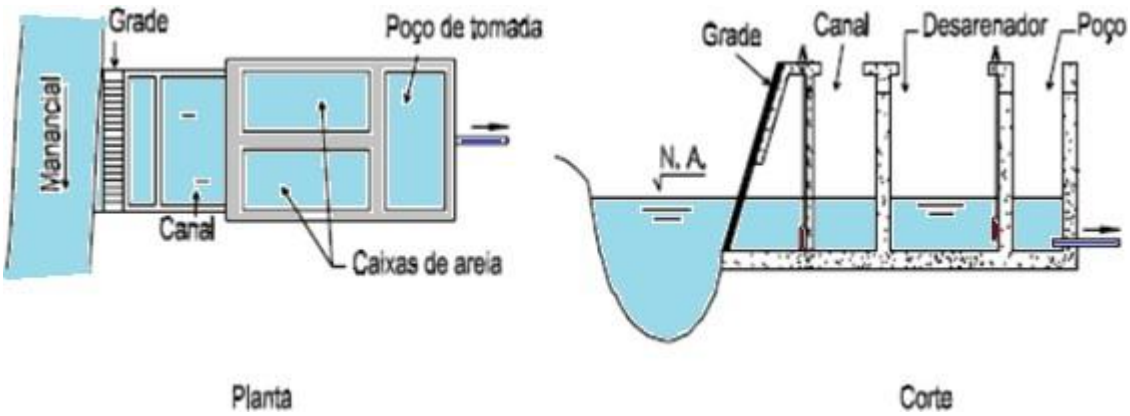
It is used in medium or large scale captures, while fulfilling the functions of the socket box and the channel that connects the subsequent unit.

It does not apply to small flow abstractions due to the prescription of the minimum speed of 0.60 m/s.

Channels for small flows with this speed would have small dimensions to make their construction and maintenance feasible.

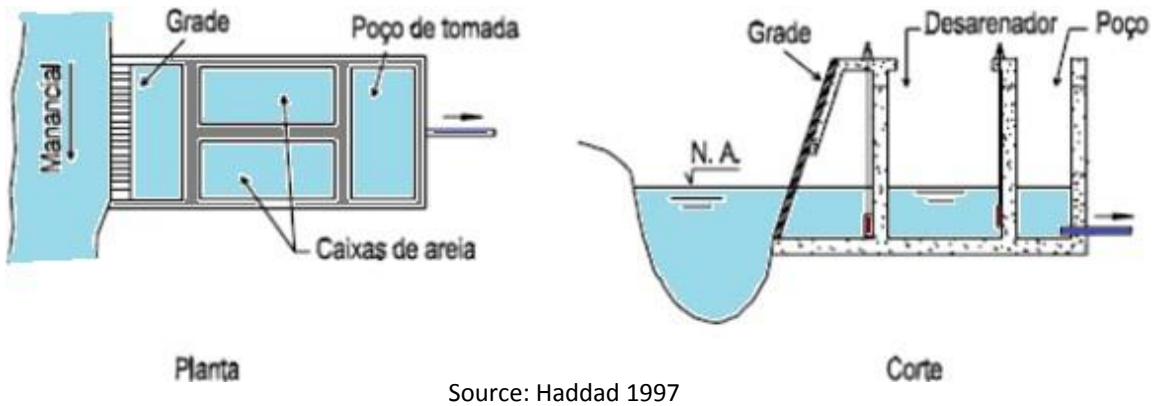
The bypass channels are usually equipped with a grid at their entrance.

Bypass channel and sand separator away from the watercourse margin



Source: Haddad 1997

Bypass channel and sand separator positioned next to the watercourse

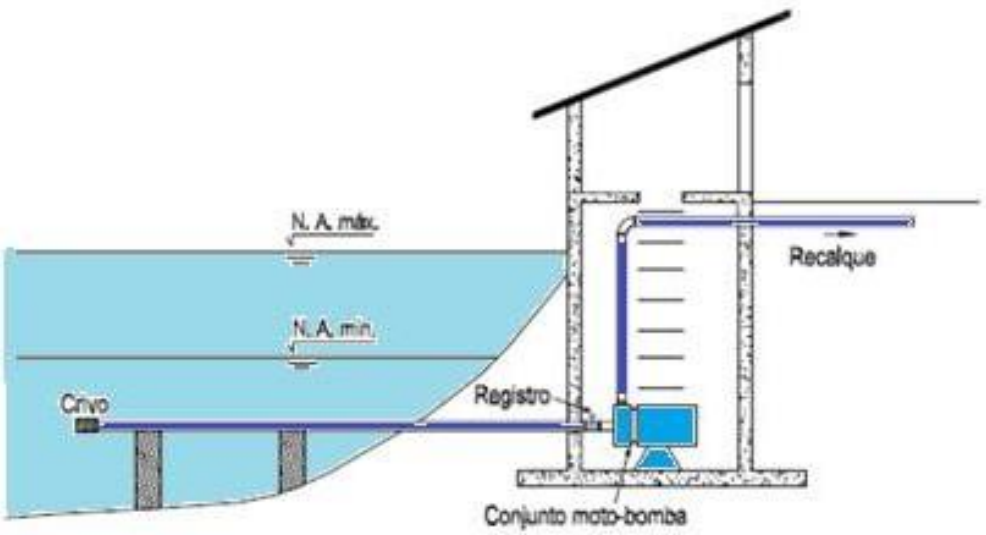


Source: Haddad 1997

d) DERIVATION WELL

It consists of a pipe built on the banks of rivers or streams that is floodable and has steep slopes. .

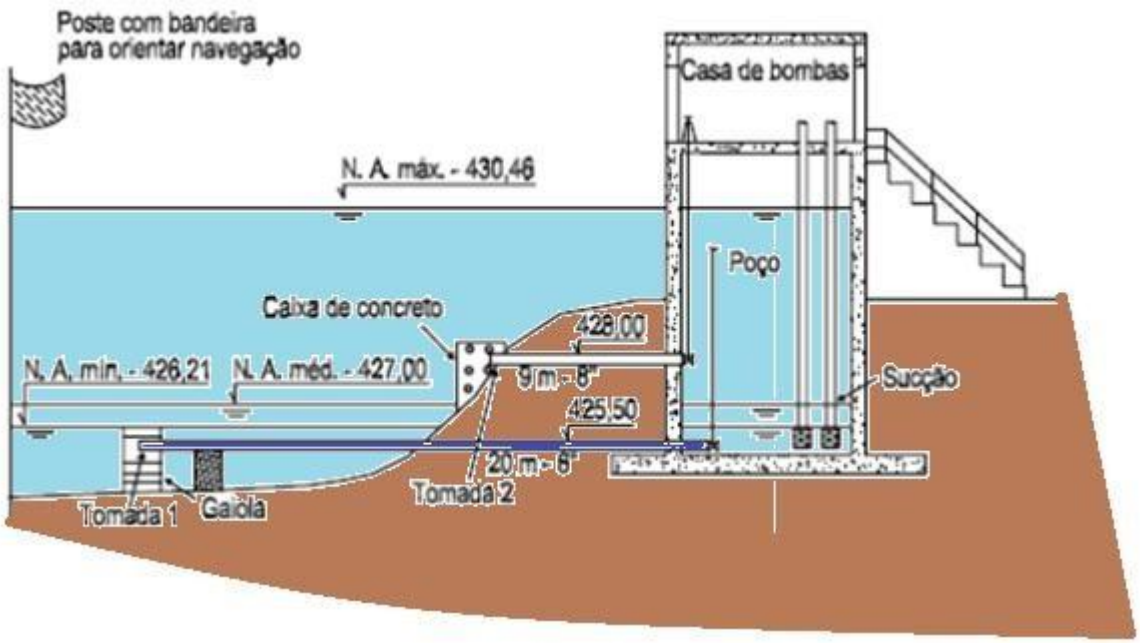
Bypass well with only one water outlet



Source: Haddad 1997

When the variation in the water level of the river is accentuated, more than one outlet pipe can be adopted.

Bypass well with two outlet pipes

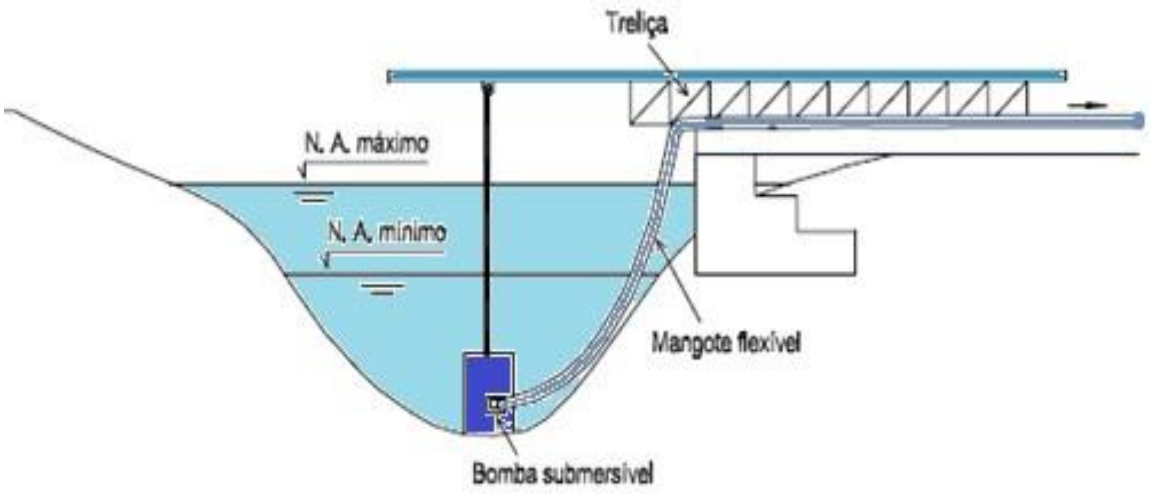


Source: TSUTYA (2006)

e) WATER INTAKE WITH BALANCE STRUCTURE

The water intake is made by a motor pump set, Resistant to abrasion, which is suspended inside the watercourse, by means of a chain integrated to a hoist that can move along a cantilever beam.

Applies to rivers with great water level fluctuation, both in depth and in spacing from the margins.

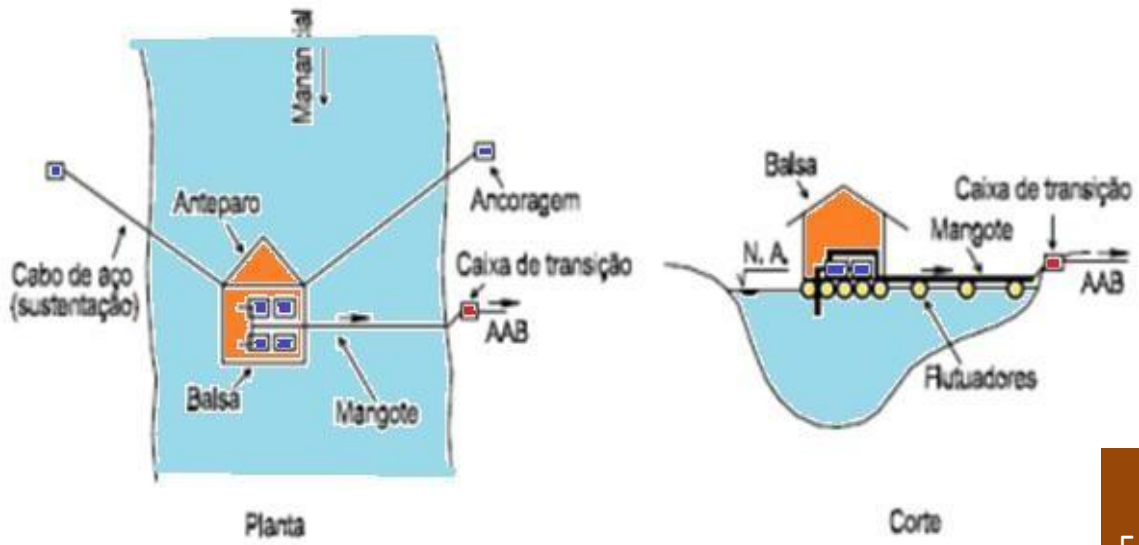


Source: TSUTYA (2006)

f) FLOATING CAPTURE

It is applied in lakes and dams or in rivers with a smooth flow regime, without frequent dragging of large floating solids. outlet tower), higher cost.

It has been used more in systems of small and medium communities (as a more economical alternative to the socket tower), of higher cost.



Source: TSUTYA 2006

It can be of three different types:

• with non-submersible motor and / or pump, installed on raft.

•with submersible pump set suspended by floats.

• with floating water outlet.

Capture with a non-submersible motor pump set installed on a raft it applies to situations in which the use of submersible sets is not economically indicated.

On the other hand, it has to be said that the set alternative **submersible motor pump suspended by floats** tends to be less expensive than building the ferry.

The adoption of one or the other of the first two alternatives will depend on a comparative technical-economic study.

There is a tendency that the alternative with raft is more advantageous in larger systems (with higher flow rates), while the modality that uses floats is more suitable for catchments with lower flow rates.

The third modality, in which only the water intake is floating, has its economic viability depends on the variation of the level of the source; topography; geology and the extent of the floodable area where the well that will receive the water from the floating outlet will be.

Whichever type of floating catchment is chosen, special attention should be paid to the anchoring of the floating structure, especially when it is installed in rivers, where the dragging action by water is more significant.

Another characteristic: the need for the piping to be flexible, which is facilitated by the existence of tubes of plastic material with high resistance to internal and external stresses.

g) OUTLET TOWER

It is the modality in which the water intake is made through a large tower, with water inlets at different levels.

Due to its higher cost, it is indicated for large water supply systems (abstraction is done in lakes, in flow-regulating reservoirs or in large rivers) with great variation in the positioning of the water level.

NBR 12213 establishes that its use must be preceded by a technical-economic study that also considers other technically viable alternatives.

ATTENTION !!!

Water intake in rivers or dams with great variation in the water level we must use a floating tower or capture tower.

GRILLING

Grids and screens are devices for holding larger floating or suspended materials.

The grids are made up of parallel bars and are intended to prevent the passage of coarse materials.

The screens are formed by threads forming meshes that have the purpose of retaining floating materials not retained in the grid. That is, the screens must always be installed after the grids.

There are two types of grids: *coarse and fine grids.*

In water courses subject to torrential flow and when large floating bodies may cause damage to the installations of fine grids or screens, provision should be made for coarse grating installations.

Coarse grid: intended for the retention of material larger than 7.5 cm (water courses subject to torrential regime).

The **spacing** between the parallel bars is 7.5 cm to 15 cm.

Fine grid: it is used for the retention of material smaller than 7.5 cm.

The **distance** between its parallel bars varies between 2 cm and 4 cm.

Screens must have 8 to 16 wires per decimeter.

Bar thickness

Coarse grid: 3/8" (0,95 cm), 7/16" (1,11 cm) ou 1/2" (1,27 cm);
Fine grid: 1/4" (0,64 cm), 5/16" (0,79 cm) ou 3/8" (0,95 cm).

The greater the height of the grid, the greater its thickness must be, to give it greater rigidity.

The grills or screens subject to manual cleaning require a downward slope of 70 ° to 80 ° in relation to the horizontal and walkway for easy execution of maintenance services.

In the passage section, corresponding to the minimum water level, the area of the grid openings must be equal to or greater than 1.7 cm^2 per liter per minute, so that the resulting speed is equal to or less than 10 cm / s , the head losses being evaluated admitting 50% obstruction of the passage section.

CARGO LOSS

The head loss on the grids and screens can be determined using the equation:

$h= k(v^2/2g)$
Where:
h = cargo loss (m)
V = average approach speed (m/s)
G = gravity acceleration (m/s^2)
K = head loss coefficient, function of the geometric parameters of the grids and screens (dimensionless).

LOAD LOSS COEFFICIENT

In grids, the pressure drop coefficient can be determined by:

$K = \beta (s/b)^{1,33} \text{sen}\alpha$

- β = coefficient, function of bar shape;
- s = bar thickness;
- b = free distance between bars
- α = grid angle to the horizontal

In screens, the pressure drop coefficient can be determined by the equation:

$K = 0,55 ((1 - \varepsilon^2) / \varepsilon^2)$

ε = porosity, ratio between the free area and the total area of the screen, being:

For square mesh screen: $\varepsilon = (1 - nd)^2$

For rectangular mesh fabric: $\varepsilon = (1 - n_1 d_1) (1 - n_2 d_2)$

n, n_1, n_2 = number of wires per unit length;

d, d_1, d_2 = wire diameter.

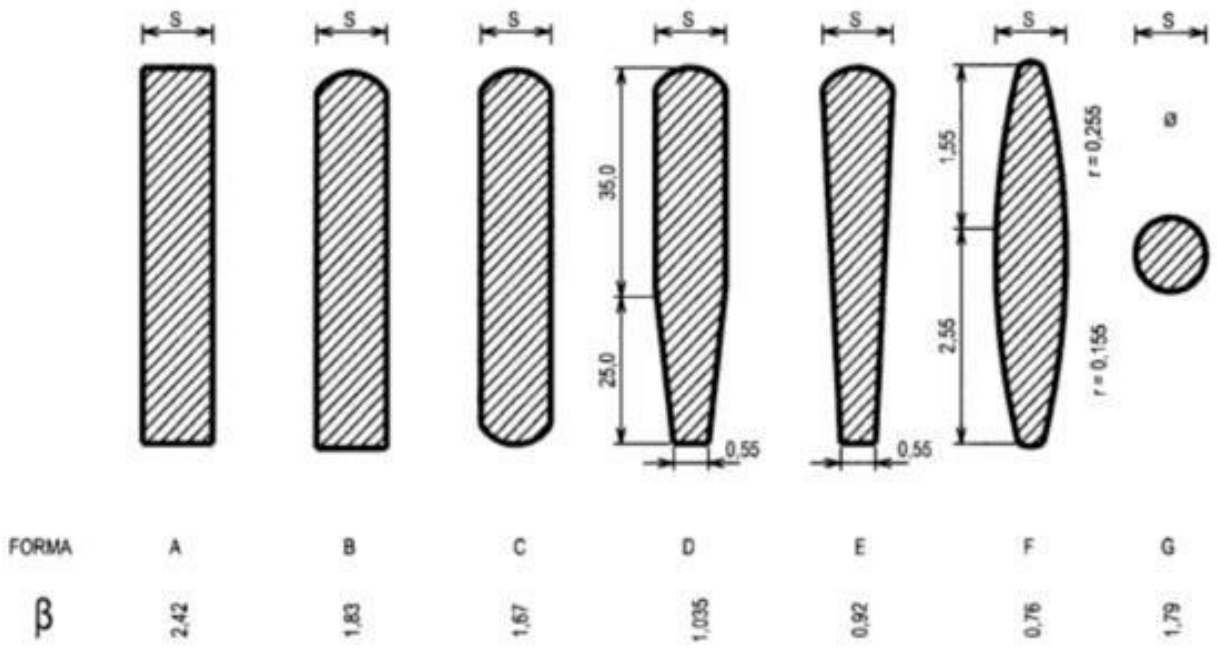
CLEANING GRILLS

In abstraction works with a flow rate greater than 500 l / s, or in springs that, due to their characteristics, require frequent cleaning of the fine grids, the possibility of using mechanical equipment should be studied.

The bars and wires that make up the grids and screens must be made of anticorrosive material or protected by appropriate treatment.

Grilles and screens can be manually or mechanically cleaned. Mechanized cleaning equipment, due to its high cost, is restricted to capturing large flows (>1m^3/s).

GRIDS: GEOMETRIC SHAPE ACCORDING TO THE CROSS SECTION OF THE BARS

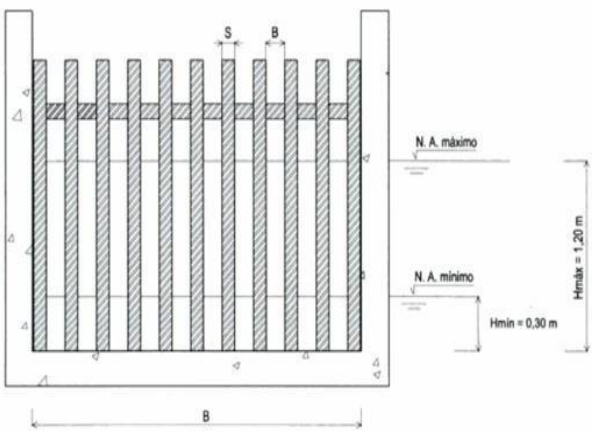


Geometric shapes and b coefficient of the cross sections of the grid bars

Source: ABNT (1992)

EXERCISE 3

Dimension a grid to capture 200 l / s in a stream using a plug box. The spring has a torrential flow regime during periods of rain, with large floating solids transported. The heights of the minimum and maximum water depths of the stream over the bottom slab of the outlet box (placed 0.40m above the watercourse bed) are respectively 0.30m and 1.20m.



EXERCISE 4

Dimension a grid to capture 150 l/s in a stream using a socket box. The spring has a torrential flow regime during periods of rain, with large floating solids transported. The heights of the minimum and maximum water depths of the stream over the bottom slab of the outlet box (placed at 0,50m above the watercourse bed) are respectively 0,4m and 1,50m

DISHARGER – SANDBOX

They are devices where the water passes with reduced speed, with a process of sedimentation.

It is a complementary installation whose purpose is to remove sand of a given particle size from the captured water.

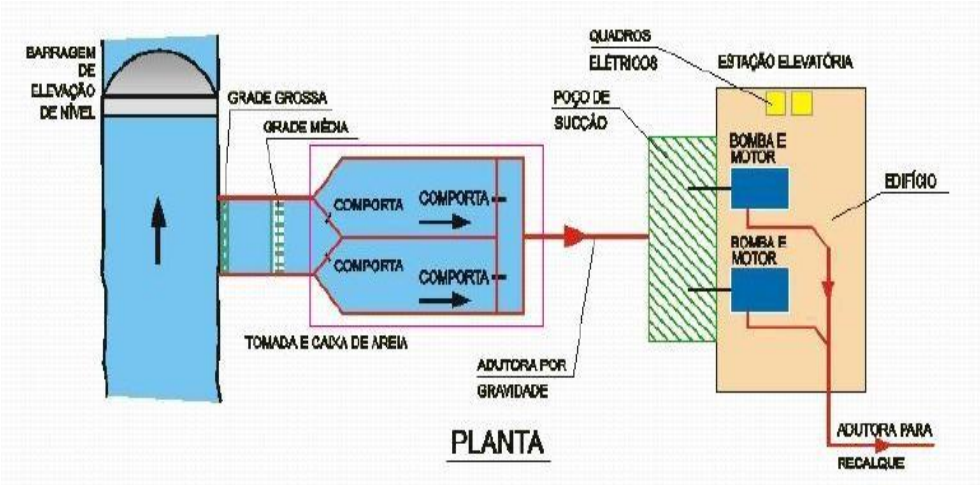
According to NBR 12213, it must be used when the watercourse presents intense transport of solids (concentration ≥ 1,0 g/L).

They are generally designed with a rectangular plan section. Its length is at least 3 times greater than its width.

The dimensioning consists in determining the length L, necessary so that the grain of sand that is entering the upper part of the sandblast (most unfavorable situation) is retained in it at the end of its downward movement to the bottom of the sandblaster.

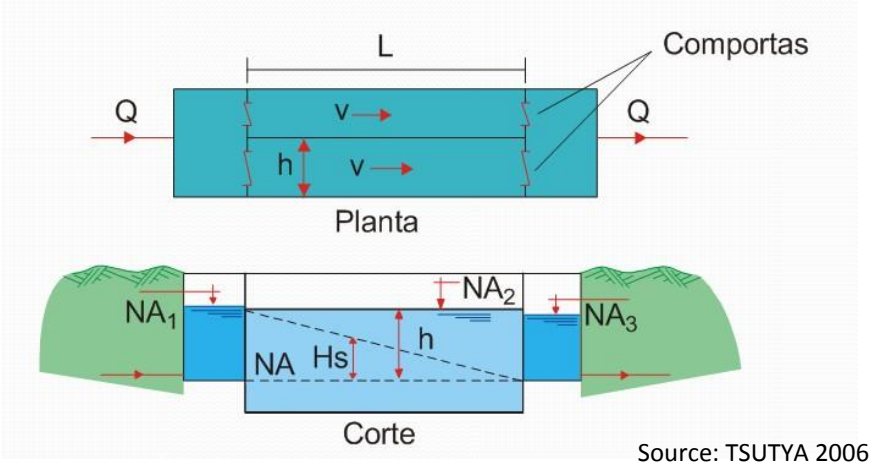
Conditions for sandblasting project (NBR 12213)

The sandblast must be installed between the water inlet and the mains;



Source: TSUTYA 2006

There should preferably be two sand-breakers, sized, each one, for the total flow, that is, one of them must function as a reserve unit;



Source: TSUTYA 2006

The sand extractor can be dispensed when it is proven that the transport of sedimentable solids is not harmful to the system. Must be dimensioned for sedimentation of sand particles with sedimentation speed (vs)

less than or equal to 0,021m/s, with

purpose of retaining particles with diameter (d) greater than or equal to 0,2 mm and, horizontal flow velocity (vh) less than or equal to 0,30 m/s.

The length of the sand grinder obtained in the theoretical calculation must be multiplied by a safety factor greater than or equal to 1,5;

The sandblast can be of constant or variable level. Since the dimensioning of the variable level sand grinder, the operating conditions for maximum and minimum levels must be considered.

The sand grinder with removal by manual process must have:

a) deposit capable of accumulating the minimum equivalent to 10% of the sand grinder volume;

b)minimum width (B) that facilitates the construction and cleaning of the sand grinder (and also allows vh ≤ 0,30 m/s)

SIZING A SANDBOX (DISHARGER)

CALCULATION OF THE AREA:

A = Q/Vs
A= area (m)
Q= flow rate (m^3/s)
Vs= Sedimentation rate

DETERMINATION OF LENGTH (L)

L = A/b

L = length (m)
A = area (m^2)
b = width (m) (adopted)
To compensate for turbulence at the entrance and exit of the litter box, a safety factor of 50% is applied to the length of the litter box.
L/b ≥ 4

DETERMINATION OF DEPTH (h)

h = A/b

h = depth (m)
A = area (m^2) Transverse area
b = width (m) (adopted)
VL = longitudinal speed = 0,3 m/s

To compensate for turbulence at the entrance and exit of the litter box, a safety factor of 50% is applied to the length of the litter box..

EXERCISE 5

Calculate the dimensions of the sandbox with the following data:

- Project flow
  1st Stage: 350 l/s
  2nd Stage: 490 l/s
- Particle characteristics to be removed:
- Average diameter ≥ 0,2 mm

- Sedimentation speed ≤ 0,0211 m/s

EXERCISE 6

Dimension the sandbox of a water outlet with a maximum flow of 0,5 m^3/s. It is estimated a quantity of suspended solids of 0,1 ml per m^3 of water and it is desired that the sandbox has a minimum autonomy of three days. Adopt a safety factor s=1,4.

EXERCISE 7

Dimension the sandbox of a water outlet with a maximum flow of 200 liters/s. It is estimated a quantity of suspended solids and 0.075 ml per m3 of water and it is desired that the sandbox has a minimum autonomy of one week. Adopt a safety factor s=1,5.

EXERCÍCIO 8

Dimension the sandbox of a water outlet with a maximum flow of 3,0 m3/s. It is estimated an amount of suspended solids of 0,005 ml per m3 of water and it is desired that the sandbox has a minimum autonomy of one week. Adopt a safety factor s=1,4.

RETURNING TO THE CHALLENGE

Now the Light of the acquired knowledge solve the question.

SUMMING UP

Make a synthesis addressing the Catchment System, studied in this chapter

Control Devices 5

https://pxhere.com/pt/photo/1287888

"The future of humanity depends on water and the future of water depends on humanity".

Kayky Santos de Almeida, 6th year student at Marina Bragança de Mendonça Municipal School

GOAL:

Know some control devices and understand their operation.

A CHALLENGE FOR YOU

Would you know to say which devices we use in a capture system? With your group, make a diagram showing the collection system as well as the devices used in them, after a visit to the water and sewage utility in your city.

TALKING ABOUT THE THEME

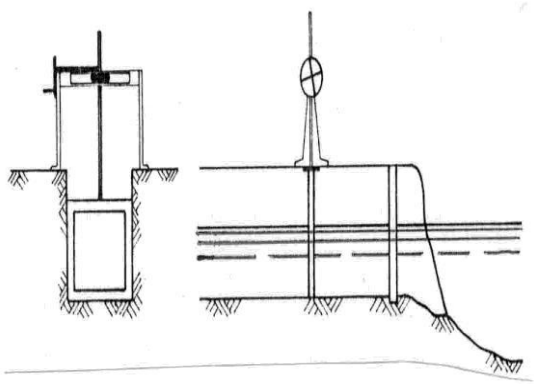
CONTROL DEVICES

The main devices used in catchments are the pans, the floodgates, the screens, the records, the automatic entry records, etc.

ACCESSORIES

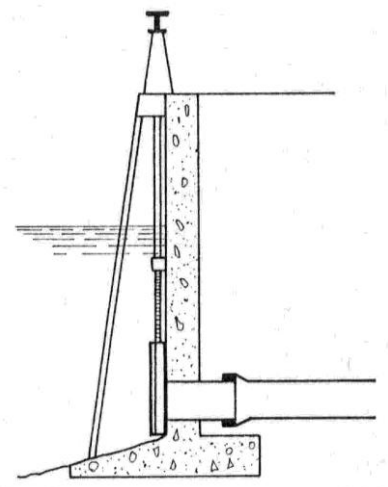
a) Floodgates

They are sealing devices, consisting essentially of a moving plate, which slides in grooves or vertical channels. Installed in most cases in channels and in large diameter pipe inlets.



b) Aduves

They are parts similar to the floodgates and are connected to a pipe segment.

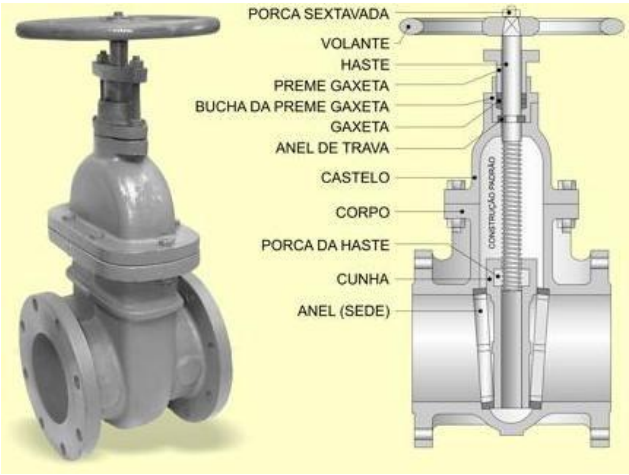


c) Sieve

Sieve is a noun that names several objects that have a kind of sieve, that have holes in different points used to separate grains, according to the volume and thickness.

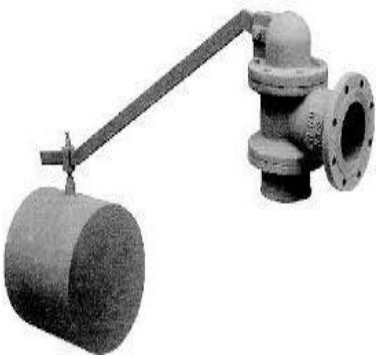
d) Record

Valves or registers are devices that allow regulating or interrupting water flow in closed conduits. They are used when it is intended to establish a seal in the middle of the stretch formed by a long pipe.



e) Automatic check-in

They are used to maintain a pre-established level in reservoirs. Registration opens progressively as the level lowers.



f) Level control valve

The Level Control Valve is a hydraulically controlled valve, which controls the filling of the reservoir to keep the water level constant, regardless of demand, if installed at the outlet of the reservoir, maintains the minimum level of the reservoir.

g) Control panel

h) Channels and Pipes

RETURNING TO THE CHALLENGE

Are we going to solve the proposed challenge?

SUMMING UP

Make a survey indicating all devices used in the supply system seen so far

Water Consumption

6

https://www.flickr.com/photos/agenciasenado/14532859200

Remember the wisdom of water, it never argues with an obstacle, it just bypasses it.

Augusto Cury

GOAL:

Classify and determine the different types of consumption, how this consumption can be affected, evaluate the various factors that affect consumption, determine the design flow rates, classify the different types of losses.

A CHALLENGE FOR YOU

Make a survey with your group about consumption in your neighborhood, what factors affect that consumption, find out the types of losses that occur in your neighborhood and propose a solution to the situation

TALKING ABOUT THE THEME

WATER CONSUMPTION

Studies, according to the UN, recommend that 110 liters per habitat/day of water is enough to meet a person's basic daily consumption needs.

Brazilians consume an average of 154 liters of water per day, according to the National Sanitation Information System of the Ministry of Cities, released in 2018.

Determining a population's water consumption is important for the operation, expansion and improvements to be performed on the system

To do so, we must determine the average consumption per inhabitant, the estimate of the number of current and project inhabitants, as well as variations in demand, additional consumption for fire reserves, industrial areas and public cleaning.

It is also of paramount importance for the sizing of pipes, reservoirs and equipment relevant to them.

Consumption is classified as domestic, commercial, industrial and public. This classification is important to identify homogeneous zones and establish tariff and differentiated charging policies.

DOMESTIC WATER CONSUMPTION

The factors that affect consumption are the climatic conditions, the habits and standard of living of the population, the characteristics of the city and housing, the measurement of water and pressure in the network, the sewage network and the price of water.

WATER FOR INDUSTRIAL USE

In the case of industries we can discriminate the use of water according to the following categories of use: human, domestic, water incorporated into the product, water used in the production process, water lost or for non-routine uses

Water consumption can be determined by:

• **Micromeasuring** – water meter reading

https://bit.ly/2RTqYrW

• Macro measurement – reading of meters installed at the outlet of reservoirs or in measurement districts.

• Absence of Measurements – average consumption or similar areas.

FACTORS AFFECTING WATER CONSUMPTION

Climate

Hot and dry regions have higher water consumption compared to cold and temperate regions

The hotter, the greater the consumption.

Also influencing: humidity and rainfall

Habits and standard of living of the population

The higher the economic and social power of the population, the greater the consumption of water, resulting from washing machines, dishes, washing machines, etc.

Nature of the city

Cities with industrial characteristics have higher consumption than, for example, worker villages, satellite cities and housing estates.

Water supply characteristics

They vary according to the quality of the water distributed; pressures in the distribution network; water rate; distribution mode (measured service); service administration.

Variations in consumption

ANNUALS	It tends to grow over time (population increase or improvement in hygiene habits).
MONTHLY	Increase in summer and decrease in winter
DAILY	Increase in summer and decrease in winter
HOURS	Average increase between 10 and 12 hours (depending on population.

When it comes to demands on a water supply installation, we are talking about the:

- Quality, amount, pressure and continuity
- Current and future demand (project scope)
- Consumption in the system itself (cleaning of ETAs)
- System losses

Water Consumption: Daily Variation

Coefficient of the day of greatest consumption (K1)

1,2 < K1< 2,0

Determination of the dimensioning flow of parts of a public water supply system, including: collection, adduction, elevation, reservoir and treatment plant works.

Recommendation ABNT : K1 = 1,2

Water Consumption: Time Variation

Time of highest consumption coefficient (K2)

1,5 < K2 < 3,0

Value adopted for project purposes the value 1,5.

This coefficient is used when it is intended to dimension the distribution ducts themselves that leave the reservoirs, as it allows to know the conditions of greatest demand in these pipes.

Recommendation ABNT : K2 = 1,5

Look at the table below:

Production system: Upstream of the reservoir	Sized to meet the average flow of the day with the highest consumption of the year (K_1)
Distribution system	Dimensioned for higher demand flow which is the time of greatest consumption of the day of greatest consumption (K_1 K_2)
Reservoir	Dimensioned for higher demand flow which is the time of greatest consumption of the day of greatest consumption.
ETA - Water Treatment Plant	Consumes about 1 to 5% of the treated volume for washing filters and decanters

DIMENSIONING FLOWS

Flow from the catchment, lifting station and pipeline to the ETA (including)

$$Q_a = \left(\frac{K_1 P q}{86.400} + Q_{esp} \right) \times C_{ETA}$$

Flow from the reservoir to the network

$$Q_c = \frac{K_1 K_2 P q}{86.400} + Q_{esp}$$

Flow from WTP to reservoir

$$Q_b = \frac{K_1 P q}{86.400} + Q_{esp}$$

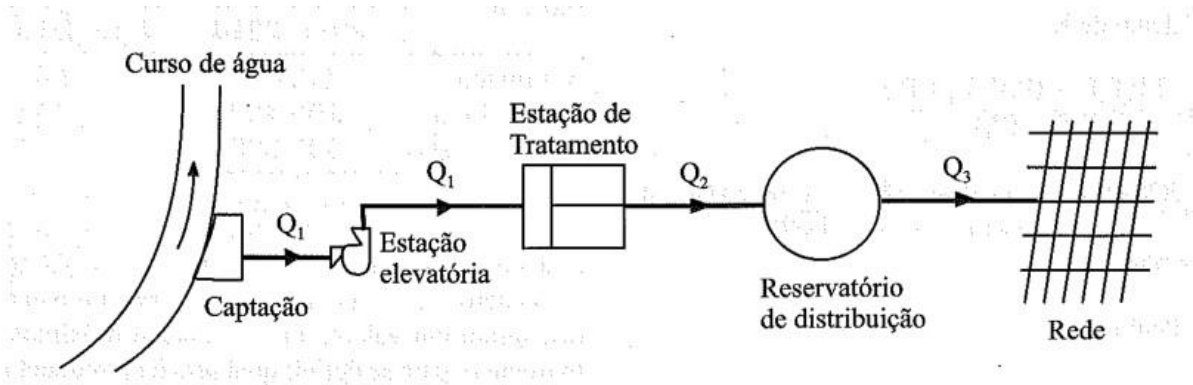
Water Losses

PHYSICAL OR REAL LOSSES	NON-PHYSICAL AND APPARENT LOSSES
Leakage in distribution pipes and building connections	Illegal connections
Overflow of reservoirs	Irregular by-pass in the “cat””
Discharge operations in the distribution networks and cleaning of reservoirs	Micromeasuring problems (inoperative or under-measured water meters, fraud, reading errors, problems with calibrating water meters, among others).

EXERCISES

01. Calculate the design flow rates of a water supply system, to serve a population of 100 000 inhabitants with an industrial flow rate of 25 L/s, with a per capita water consumption of 200 L/hab.day and a consumption in ETA of 3%.

02. Calculate the design flow rates of a water supply system, to serve a population of 278 000 inhabitants with an industrial flow rate of 37 l/s, with a per capita water consumption of 200 L/hab.day and a consumption in the ETA of 5%.



RETURNING TO THE CHALLENGE

Based on what was presented to you, solve the problem.

SUMMING UP

Show the relevance of the topic addressed to your community

Projection Populational 7

https://immigrationreform.com/2016/06/30/why-true-immigration-reform-has-nothing-to-do-with-tearing-families-apart/

With the increase of the world population, the hunger and thirst crisis will spread without borders.

Erasmo Shallkytton

GOAL:

Determine the project population according to its horizon, know the different methods of obtaining the future population.

A CHALLENGE FOR YOU

Do a study and determine your city's project population for a 25-year project horizon

TALKING ABOUT THE THEME

POPULATION PROJECTION POPULATION STUDY

Water supply works and sanitary sewage systems in cities must be designed to serve a specific population, generally larger than the current one, corresponding to demographic growth in a certain number of years.

This period of time is called the project period or project plan, or even the project horizon.

This period has varied between 20 and 30 years, being common to adopt the period of 20 years.

However, if the works foreseen in the project are built to meet the project's horizon, in the early years there will be great idleness which means burdening the current population.

So that this does not happen, the works that can be subdivided must be carried out in stages.

Project scope: 20 years or more

In order to determine the population study, it is necessary to collect population data from the latest censuses, census sectors in the project area, real estate cadastre, field research, existing plans and projects, municipal master plans, socioeconomic situation of the municipality and elaboration of projections of the population

Several methods are applicable for the demographic study, highlighting the following:

- Demographic component method
- Mathematical methods
- Graphical extrapolation method

DEMOGRAPHIC COMPONENTS METHOD

It requires knowledge of information and statistical data. Application to the last known population of the community and data from analogous communities can be used. Adopted population projection must be used for each IBGE survey.

- Socioeconomic trends of the metropolization process
- Global demographic trends
- Mortality trends
- Fertility trend
- Migration trend and population enumeration

$Pt = P_0 + (N - M) + (I - E)$

Where:

Pt = population on date (t)
P_0 = population at start date (t_0)
N = birth in the period ($t - t_0$)
M = deaths in the period ($t - t_0$)
I = immigrants in periods ($t - t_0$)
E = emigrants in the period ($t - t_0$)

MATHEMATICAL METHODS

- Arithmetic method
- Geometric method
- Logistic curve method

Arithmetic method

Considers linear population growth. This method admits that the population varies linearly with time and can be used for the population forecast for a small period, from 1 to 5 years. For forecasting for a very long period, the discrepancy with historical reality is accentuated, since growth is an unlimited assumption.

Where:

$$\frac{dP}{dt} = K_a \Rightarrow P = P_2 + K_a(t - t_2)$$

$$K_a = \frac{P_2 - P_1}{t_2 - t_1}$$

t represents the projection year and P the population

EXERCISE 01. With the census data below, it is requested to project the (fixed) population of the city of Boa Esperança, for the year 2020.

1960.....155 984 hab
1970.....198 405 hab
1980.....262 048 hab
1990.....341 070 hab

Geometric Method

This method considers the same percentage of population increase for equal periods of time. Mathematically, it can be presented as follows:

Considers exponential population growth

Where:

$$\frac{dP}{dt} = K_g P \quad \Rightarrow \quad P = P_2 e^{K_g(t-t_2)} \qquad K_g = \frac{\ln(P_2) - \ln(P_0)}{t_2 - t_0}$$

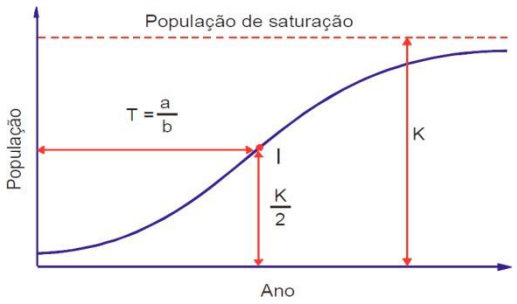
t represents the projection year and P the population.

EXERCISE 02. With the census data below, it is requested to project the (fixed) population of the city of Boa Esperança, for the year 2020.

1960.....155 984 hab
1970.....198 405 hab
1980.....262 048 hab
1990.....341 070 hab

Logistic Curve Method

In this case, it is assumed that the population growth follows a mathematical relationship of the logistic curve type, in which the population grows asymptotically as a function of time to a limit value of saturation (K). The logistical curve has three distinct sections: the first corresponds to accelerated growth, the second to delayed growth and the last to growth tending towards stabilization. Between the first two sections there is an inflection point.



$$P = \frac{K}{1 + e^{(a-bt)}}$$

Where:

b – parameter corresponding to the population growth rate
a – parameter such that for T = a/b there is an inflection (change in the direction of curvature) of the curve
K – P limit (population saturation)
t – time interval between the projection year and t_0

The parameters are determined from known points on the curve $P_0(t_0)$, $P_1(t_1)$ and $P_2(t_2)$ equally spaced in time, that is, $t_0 = 0$, $t_1 = d$, $t_2 = 2d$.

The points P_0, P_1 and P_2 must be such that:

- $P_1^2 > P_0 P_2$
- $P_0 < P_1 < P_2$

$$K = \frac{2.P_o P_1 P_2 - P_1^2(P_o + P_2)}{P_o P_2 - P_1^2}$$

$$a = \frac{1}{0{,}4343}.\log\frac{K - P_o}{P_o}$$

$$b = -\frac{1}{0{,}4343d}.\log\frac{P_o(K - P_1)}{P_1(K - P_o)}$$

EXERCISE 03. With the census data below, it is requested to project the (fixed) population of the city of Boa Esperança, for the year 2020.

1960.....155 984 hab
1970.....198 405 hab
1980.....262 048 hab
1990.....341 070 hab

RETURNING TO THE CHALLENGE

Solve the proposed challenge.

SUMMING UP

Survey what you learned in the chapter.

Adductor 8

https://www.flickr.com/photos/mcdonaldc/16246799812

We must be wise and persistent as the water that descends the mountain and in the narrowest and most tortuous paths will increase its speed and when it is facing an obstacle it will always look for an alternative path, but when it does not find an alternative it faces the obstacle head-on and cautiously gains volume and strength to overcome it and follow your journey.

Eastern Wisdom

GOAL:

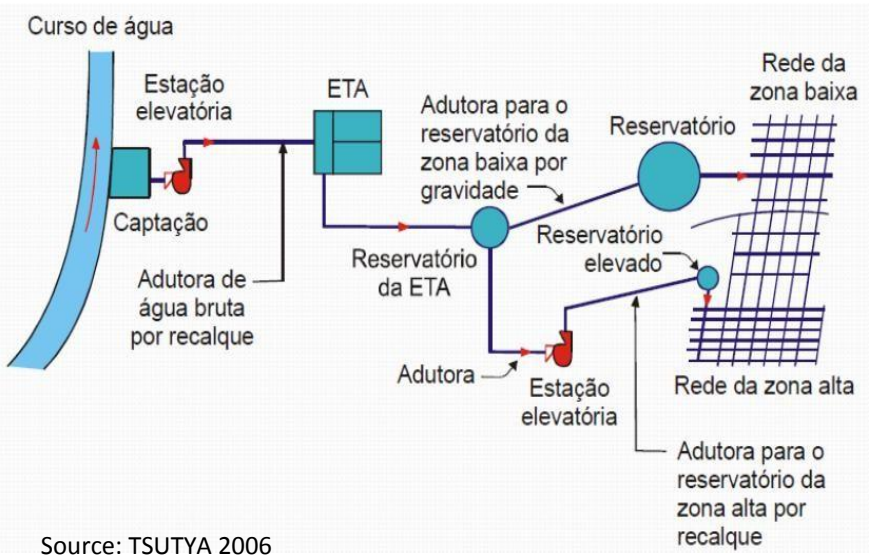
Identify and classify a pipeline, understand the layout of a pipeline, dimension a pipeline.

A CHALLENGE FOR YOU

Identify the various materials that can constitute an Adductor.

ADUCTORS

These are pipelines for water supply systems that lead the water to the collection, treatment, pumping station, reservoir and distribution network units. They interconnect collection, ETA and reservoirs (do not distribute water to consumers)



Source: TSUTYA 2006

The pipeline is classified according to the nature of the transported water, according to the energy that moves that water and according to the flow of the liquid.

According to their nature we can distinguish them in raw water supply and treated water supply.

As for the flow mode through free, forced, and mixed conduits.

As for the energy that moves it, we can distinguish them in adductor by gravity, adductor by repression and mixed adductor.

GRAVITY ADUCTOR

FREE CONDUCTS

The main characteristic of the flow of water in a free conduit is the fact that it presents a free surface, on which the atmospheric pressure acts.

Examples of free open section ducts: Rivers, Canals, Gutters and Drains.

Paraíba do Sul River, municipality of Jacareí, São Paulo
https://pt.wikipedia.org/wiki/Rio_Para%C3%ADba_do_Sul

water channel Santos São Paulo Brazil
https://pixabay.com/pt/canal-%C3%A1gua-santos-s%C3%A3o-paulo-brasil-254498/

The tubes operate as free ducts when they work partially filled, as is the case with the storm galleries and manholes.

FORCED CONDUCTS

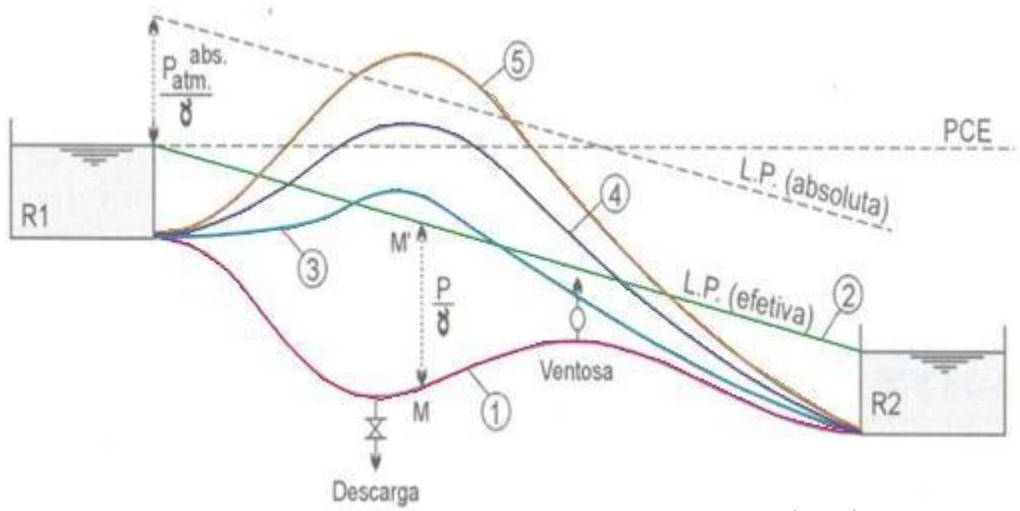
Pipes or conduits under pressure are called pipes where the liquid flows under a pressure different from the atmospheric pressure. The sections of these ducts are always closed and the liquid seeps filling them completely; they are in general circular in section, however, in special cases, such as in the galleries of hydroelectric plants or in large aqueducts, other forms are used.

PCH Buriti
http://www.atiaiaenergia.com.br/imprensa/imagens.php

https://pxhere.com/es/photo/925035

TRUCK OF THE ADUCTOR

Due to the topography of the land, the pipeline may be totally below, coincident or above, in some points, the piezometric line.



Source: Heller (2010)

LINE 1: When the pipeline is seated below the effective piezometric line the pressure load in the pipeline is greater than the atmospheric pressure.

It is recommended for pipeline installations for safety reasons. In this case, at any point in the duct the pressure will be positive and the flow rate will be equal to the design.

In every profile of the penstock: $p/\gamma > P_{atm}$

Special cares:

At the points high: install suction cups in order to remove the accumulated air from gases dissolved in the water and the process of filling the line, which reduces the flow performance.

At low points: installation of discharge valves to promote piping cleanliness.

LINE 2: The tubing coincides with the Effective Piezometric Line, this tubing works as a free conduit where $P=P_{atm}$.

LINE 3: The piping cuts the effective piezometric line, but is below the effective load plane. The section located above this line has pressures lower than the atmospheric pressure, $P < P_{atm}$.

It is difficult to avoid air pockets and water contamination by suction. The accumulation of air forms bubbles and reduces flow, making the flow irregular.

Suction cups do not work, because at these points the pressure is less than atmospheric

LINE 4: The pipe cuts the effective piezometric line and the effective load plane.

It is a siphon that works in poor conditions, requiring priming when entering the pipe.

The water does not reach the stretch above the water level of the R1 reservoir by gravity, drainage will only be possible after filling the pipe.

LINE 5: The tubing cuts the Absolute Piezometric Line.

It is a siphon operating in the worst possible conditions, gravity flow is impossible.

Flow is only possible if a pump is installed to propel the liquid to the highest point in the pipeline.

EXERCISE 01. As a group, solve the proposed situations:

Analyze the five traces, highlight the best situation and propose a solution for each inappropriate situation that you found by presenting your analysis to your colleagues and teacher.

PUTTING SUPPLIES

They transport water, through a lifting station, from one location to another with a higher elevation using a motor pump set

This system consists of penstocks and its adduction can be done by simple settlement where the adduction is made between a lift and a reservoir or by double settlement, where the adduction is made between two lifts and a reservoir.

GRAVITY ADUCTORS

They are pipelines that transport water from a higher level to a lower elevation level using hydraulic energy. Can be done through free or forced conduit.

It is the safest and most economical way to transport water.

In a free conduit, the lineage corresponds to the water level. These ducts can be opened or closed. Where the flow occurs by slope presenting a free surface under the effect of atmospheric pressure. Not working with your section full

In a penstock the piezometric line is above the water line. The water is under pressure above atmospheric pressure. Your session is usually circular as it is the form that resists internal water pressures.

In free and forced conduits, called mixed conduits, we find sections consisting of free conduits, which can be an aqueduct, connecting to forced conduits that function as inverted siphons, located below the piezometric line.

PUTTING AND GRAVITY PIPERS (MIXED)

They are pipelines composed of sections that work by gravity and others by repression. Its adduction can be done by means of a lift and an intermediate reservoir that interconnects by gravity to the distribution reservoir.

A gravity pipeline can operate for 24 hours, whereas the discharge pipeline must operate outside peak hours due to the exacerbated consumption of energy and can operate between 16 and 20 hours to enable equipment maintenance as well.

ADHESIVE SIZING

A GRAVITY ADUCTOR

To dimension a pipeline by gravity, we must enter a known parameter which is the flow rate (Q), we set the speed (V) or the head loss (J) and determine the diameter (D).

Generally, a minimum speed of 0,5 m/s and a maximum speed of between 2,5 and 5 m/s for free ducts and between 4 and 6 m/s for forced ducts are adopted in these pipelines,

We must pay attention to small speeds as they favor the formation of deposits of sedimentable materials and, for high speeds as they increase pressure losses

PUTTING UP

In order to dimension a Pipeline by Settlement, we enter the values known as the flow (Q), the length of the pipeline (L), the unevenness to be overcome and the material of the pipeline and then we determine the diameter (D).

The smaller the diameter, the greater the power of the repression equipment.

Economic speed in downstream pipelines varies between 1,0 to 1,5 m/s

Booster
Fonte: Auto

Equations used in dimensioning to determine the distributed and localized head loss:

Free conduits
- Equação de Chézy
- Equação de Manning

Chézy's equation

$$V=C\,(Rh\,.\,I)^{0,5}$$

Manning equation

$$C= Rh^{1/6} / n$$

Where:
V= average flow speed (m/s)
Rh= hydraulic spoke (m)
I= slope in the power line (m/m)
C= Chézy coefficient
n= is a parameter that depends on the roughness of the wall

Values of the Manning n coefficient

Conduit material	Manning's n
Ceramic	0,013
Concrete	0,013
PVC	0,010
Cast iron with coating	0,012
Uncoated cast iron	0,013
Asbestos cement	0,011
Welded steel	0,011
Polyester, polyethylene	0,011

Pipes

Universal Formula

$$\Delta h = f(L v^2 / D 2g)$$

Where:
Δh= cargo loss (m)
f= coefficient of friction
L= pipe length (m)
V= average speed (m/s)
D= pipe diameter (m)
g= gravity acceleration (m/s²)
Q= flow rate (m³/s)

Hazen-Williams formula

$$J = 10,65\ Q^{1,85}\ C^{-1,85}\ D^{-4,87}$$
$$Q = 0,279\ C\ D^{2,63}\ J^{0,54}$$
$$V = 0,355\ C\ D^{0,63}\ J^{0,54}$$

Where:
J= unit head loss (m/m)
Q= flow rate (m³/s)
D= diameter (m)
C= roughness coefficient

K values cited by Victor Streeter

MATERIALS	K VALUE (mm)
Cement-coated cast iron	0,125
Uncoated cast iron	0,25
PVC tubes	0,10
Concrete Pipes	0,30
Coated steel tubes	0,125
Copper tubes, brass etc.	0,02

Values of the friction coefficient C of the Hazen-Williams equation

TUBE MATERIAL	NEW	USED 10 years	USED 20 years
Corrugated steel (corrugated sheet)	60	-	-
Threaded galvanized steel	125	100	-
New riveted steel	110	90	80
Ordinary welded steel (coated with bitumen)	125	110	90
Welded steel with epoxy coating	140	130	115
Lead	130	120	120
Asbestos cement	140	130	120
Copper	130	135	130
Concrete, good finish	130	-	-
Concrete common finish	130	120	110
Cast Iron, epoxy coating	140	130	120
Cast iron, coated with cement	130	120	105
Glazed ceramic stoneware (shackle)	110	110	110
Brass	130	130	130
Wood in staves	120	120	110
Bricks, well-executed flue	100	95	90
Glass	140	-	-
Plastic or PVC	140	135	135

Localized head loss equation

$$\Delta h_L = K\ (V^2/2g)$$

Where:
Δh_L= localized head loss (m)
K= dimensionless coefficient
V= average speed (m/s)
g= gravity acceleration (m/s²)

Valores de K para o cálculo das perdas de carga localizadas

Peça	K	Peça	K
Ampliação gradual	0,30*	Junção	0,40
Bocais	2,75	Medidor Venturi	2,50**
Comporta aberta	1,00	Redução gradual	0,15*
Controlador de vazão	2,50	Saída de canalização	1,00
Cotovelo de 90°	0,90	Tê, passagem direta	0,60
Cotovelo de 45°	0,40	Tê, saída de lado	1,30
Crivo	0,75	Tê saída bilateral	1,80
Curva de 90°	0,40	Válvula de ângulo aberta	5,00
Curva de 45°	0,20	Válvula de gaveta aberta	0,20
Curva de 22,5°	0,10	Válvula borboleta aberta	0,30
Entrada normal em canalização	0,50	Válvula-de-pé	1,75
Entrada de borda	1,00	Válvula de retenção	2,50
Existência de pequena derivação	0,03	Válvula de globo aberta	10,00
		Velocidade	1,00

* Com base na velocidade maior (seção menor)
**Relativa à velocidade na canalização

Source: AZEVEDO NETTO

Cargo loss

The head loss varies according to the nature of the fluid, the material of the pipe and connections and the diameter of the pipe, the length of the pipes and the number of connections and accessories and the head loss with distribution along the path.

The higher the flow, the greater the internal diameter must be in order to decrease the speed and reduce the pressure drop

The greater the length and the number of connections, the greater the head loss

The distribution flow in progress (q) is found in the water supply networks and in the irrigation systems, as we find water derivations from the main trunk. In these cases the flow is said to be uniformly distributed throughout the duct.

TRUCK OF THE ADUCTOR

Its layout varies depending on the SAA project and the topography, the type of soil, the existence of rocks and floodplains, the interference and crossing of highways, railways, rivers, power lines, etc., and the easement or expropriation strips.

SUPPLY MATERIALS

Regarding the material, it cannot be harmful to the water quality, it must not show any change in roughness over time (incrustation), it must have a chemical, mechanical resistance and adequate water pressure in addition to being economical. They can be in the form of metallic and non-metallic materials.

Metallic materials

- Steel
- Ductile cast iron
- Stainless steel

Non-metallic materials

- High density polyethylene and polypropylene
- Fiberglass reinforced polyester
- PVC

OPERATION OF ADUCTORS

Pipelines can operate in normal condition, emergency condition in case of operational failure and in catastrophic condition when an operational accident occurs or in the event of disruptions.

CROSSING IN WATER COURSES

AERIAL CROSSING

Need grant, Hydrological study, they should not interfere with the water body and take advantage of existing bridges.

BURNED CROSSING

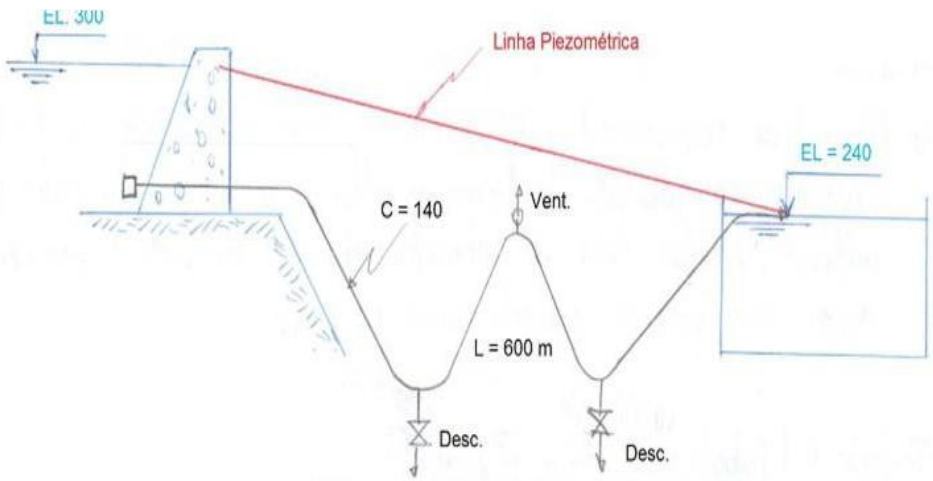
They need a grant, They must not interfere in the water body, they must use tubes of greater resistance and the tubes must be enveloped with concrete

EXERCISES

01. Through a Gravity-Treated Water Pipeline, 900 m in length, which connects two reservoirs located on the 795 and 770m elevation levels, it is desired to transport a flow rate of 23,83 L/s (already considering daily flows and hourly). It is requested to calculate the diameter of the pipeline, as well as the maximum flow and its speed. The pipeline must be made of threaded galvanized steel (used +/- 10 years) and C = 100. Disregard the loss of localized loads.

02. Based on the drawing below determine:

a) Determine the diameter that the pipeline represented must have to transport the flow of 20 L/s, knowing that it will be built in PVC.
   Disregard localized losses.
b) Determine the effective flow and speed;



RETURNING TO THE CHALLENGE

Based on reading the chapter and after reading material provided by the teacher, solve the challenge.

Station Lift 9

https://www.flickr.com/photos/agenciabrasilia/38964980851/in/album-72157690813310295

"The river passes by a tree, greets it, feeds it, gives it water ...
and go ahead, dancing. It does not stick to the tree.
The tree drops its flowers on the river in deep gratitude, and the river moves on. The wind comes, dances around the tree and moves on.
And the tree lends its perfume to the wind ... If humanity grew, matured, that would be the way to love.“

Osho

GOAL

Identify the necessary structures to overcome topographical differences.

A CHALLENGE FOR YOU

Find out if there are pumping stations in your neighborhood and determine their purpose.

TALKING ABOUT THE THEME

LIFT STATION

They are necessary structures to overcome geometric differences, transport water over great distances and integrate supply systems between different municipalities. Being a key component of a supply system.

Lifting Stations (EE) are defined according to the types of pumps and motors attached to them, determining the main aspects of operation and maintenance.

Equipment that allows to overcome the topographic difficulties of the land, being able to connect them to other stations and the water distribution networks

They are also called pumping wells or pumping stations.

EE is of fundamental importance both to capture raw water and to lead it after its treatment to the distribution network.

We can say that EE is the place where water is repressed or pumped. The pump house is the place where the pump, the motor, the registers, the tubes and the accessories are housed.

The box where water is stored is called a reservoir and has the function of guaranteeing the water pressure in the pipes as well as regulating the flow rates.

It is sized according to the location and type of the pump.

These components are essential to the functioning of the systems, they are used in the collection, supply, treatment and distribution of water. They are classified into:

Raw water pumping stations: designed to conduct untreated water.

Treated water elevators: designed to conduct treated water

Both the raw water and the treated water stations have the function of bringing water from the lowest to the highest zones.

In water supply systems, it is common to find booster-type elevators, which are designed to increase pressure in distribution networks. These equipments are mainly used in networks that require an increase in pressure or flow.

The rules for its operation consist of a set of rules or guidelines that indicate when a pump or set of pumps must be turned on or off for a specified time. They are indispensable in places where it is not possible to have a supply system made entirely by gravity.

Raw water lifts: designed to carry untreated water.

Treated water pumping stations: designed to drive treated water.

Both the raw water and the treated water stations have the function of bringing water from the lowest to the highest zones.

Booster-type elevators are common in water supply systems, and are intended to increase pressure in distribution networks. These equipments are mainly used in networks that require an increase in pressure or flow.

Its operation is standardized and guided by rules that indicate when a pump or set of pumps must be turned on or off and the operating time for each case. They are indispensable in places where it is not possible to have a supply system made entirely by gravity.

COMPONENTS OF A LIFTING STATION

The relevance of the components depends on their characteristics, the number of pumps installed, the type of drive and the space required for their installation as well as the pipes and accessories.

The purpose of the pumps is to repress water, but for this reason aggravating factors arise, such as the increase in expenses with electricity, with the operation and maintenance of the equipment. But one must take into account the importance of a distribution of water in quantity and adequate intermittence, thus contributing to avoid the lack of water.

There are several types and models of pump. Since the selection of the type as well as the model will depend on the flow, height and characteristics of the liquid to be pumped and also on the financial expenditure of the same.

.

Attention should always be paid to the power and efficiency of the pump. The power is defined in order to overcome the level difference between the suction point and the maximum discharge point, adding pressure losses. Its performance varies according to the flow, head and type of pump, its relationship being defined between the energy offered by the motor and the energy absorbed by the pump.

Pump manufacturers provide catalogs with the data and characteristics of the pumps, in order to make it possible to choose the type of pump you want.

CONSTITUTING PARTS OF A LIFTING STATION

Electromechanical equipment	Pipes	Construction industry
– Engines – Pumps	– Suction – Barrel – Repression	– Suction well – Pump house

LIFTING STATIONS DESIGN

The number of pumps indicated for a lift station will depend on the reach of that lift, see:

small lift: 2 pumps (1 + 1 reserve)
lifting average:3 pumps (2 + 1 reserve)
big lift: multiple bombs

It can be located at:

- near or in the middle of the source (raw water abstraction)
- near or near ETA's (treated water)
- near or near the distribution reservoirs
- for reinforcement in the adduction or distribution network (*booster*)

This choice will depend:

- ground conditions,
- how to acquire it,
- of the area required for its installation,
- the availability of electricity,
- topography of the area,
- ease of access,
- the stability of the terrain
- the shortest path of the discharge pipe,

TYPES OF PUMPING

- **Direct pumping to the network:** The water leaves the reservoir, goes to the pumping station or booster and goes to the network.

- **Pumping into the network via pressure reducing valve:** The water leaves the reservoir, goes to the lifting station or booster, passes to a pressure reducing valve and goes to the network.

- **Pumping with relief valve for pressure control:** The water leaves the reservoir, goes to the pumping station or booster and goes to the network and returns through a pressure relief valve.

- **Pump with hydropneumatic tank:** The water leaves the reservoir, goes to the pumping station or booster, goes to a hydropneumatic tank and goes to the network.

- **Pumping with spare reservoir:** The water leaves the reservoir, goes to the pumping station or booster and goes to the network, from the network goes to a spare reservoir and returns during the peak period to the network.

- **Network Powered by two pumps:** The water leaves the reservoir, goes to the pumping station or booster and goes to the network, goes through a pressure relief valve and goes to another reservoir from where it goes to another pumping station returning to the network.

Esquema de uma estação elevatória de água.

Fonte: http://www.ufrrj.br/institutos/it/de/acidentes/agua4.htm

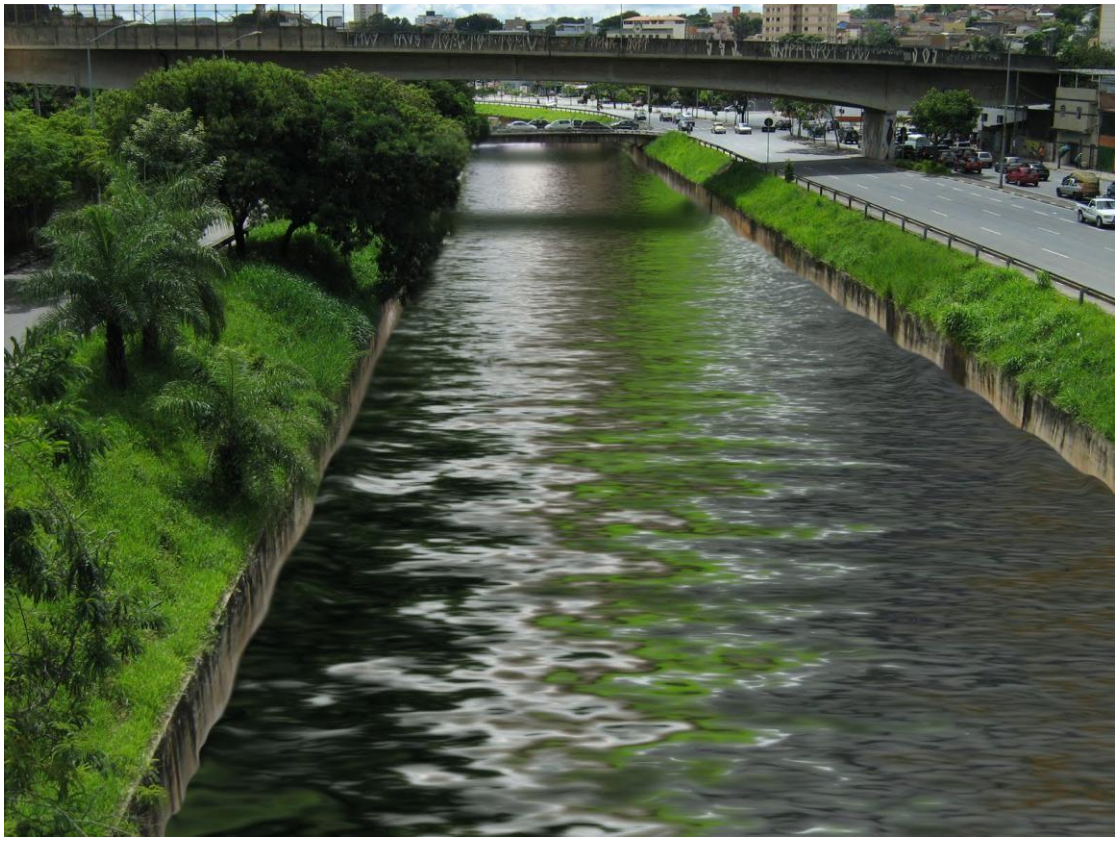
Project flows are determined based on the basic design of the supply system, the stages for implementing the works and the operation regime. Its useful life varies according to:

Durability of approximately 50 years: Pipes and Buildings 25
years: Pumping equipment
Greater or lesser difficulty in magnification
Future population
Economic criteria for installation and operation
Design period for lifting stations: between 20 and 30 years.

RETURNING TO THE CHALLENGE

Based on reading the chapter and after reading material provided by the teacher, solve the challenge.

Drainage Urban 10



http://arq-rafa.blogspot.com/2010/04/

"El agua era el elemento originario de la realidad, el principio de todas las cosas, o bien em el sentido de que todas las cosas estaban constituidas o formadas por agua."

Tales of Miletus

GOAL

Understand what the urban drainage system is and how it works

A CHALLENGE FOR YOU

What comes to your mind when you are asked about the urban drainage system? You may have thought that the urban drainage system is one in which rainwater that falls on the streets, sidewalks and roofs flows into the gutters, which lead to a wolf's mouth and, from that point on, the water flows through galleries to the nearest channel or river. If you thought this is not wrong, this type of urban drainage system is common, which is why it is called the classic urban drainage system. But is this system unique or even the best solution for the situation? Find out what the urban drainage system looks like in your city

TALKING ABOUT THE THEME

URBAN DRAINAGE

These systems are designed to prevent flooding. When they are not considered since the beginning of the formation of urban planning, there is a high probability that this system, when designed, will present a high cost and deficiency. It is extremely important for the community that the urban area is planned in an integrated manner and compatible with regional, state or federal plans.

Whenever there is a plan for urban expansion, an urban drainage plan must be concomitantly defined, in which the lowest possible flooding areas will be delimited in order to verify whether the occupation of these areas in the said expansion is viable.

Canalization of Ribeirão Caladinho in Unileste, Coronel Fabriciano MG.

https://bit.ly/2Gzwzlq

Drainage works on Avenida Vasco da Gama, Salvador.

Source: Portal da Copa/ME

Classic Urban Drainage System

A classic urban drainage system has the priority of removing water from the entire city as quickly as possible, thus avoiding a series of diseases resulting from lack of sanitation and standing water from floods. This idea emerged in the 19th century, and was considered to be functional because it greatly reduced the number of waterborne diseases. Thus, classic urban drainage systems have been adopted almost everywhere in the West with few variations. (SOUZA; CRUZ; TUCCI, 2012)

The big problem with this system arose with the unbridled growth of cities in the 20th century XX. Where areas that previously received water infiltration through their pastures and forests have become waterproof.

As a result, more water ran down the streets and consequently into the drainage system that had to be redone to accommodate this increase in water. And the greater the growth, the more works on the drainage system needed to be redone, becoming increasingly expensive and economically unsustainable. In addition to the environmental impacts that this rapid evacuation of water can cause to water bodies. (URBONAS; STAHRE, 1993).

What makes it essential to study urban drainage techniques that minimize environmental impact and are efficient in terms of runoff control.

Taking into account that the high levels of waterproofing are due to the uncontrolled growth of the urban population and the disordered occupation of the soil that cause frequent floods arising from intense rains aggregated to densely occupied cities and to inefficient or even non-existent urban drainage systems.

Flood Port of Cariacica Author: Felipe de Lima Neves
Source:https://www.panoramio.com/photo/54426877

Objectives and types of hydraulic structures

With the development of a city, the surrounding vegetation is partially suppressed.

We also started to need to organize this city by creating streets, defining lots for buildings and, consequently, making waterproof areas that were free of coverings, in this way we constantly change the characteristics of the land where it was implanted.

The rainwater that falls on this modified location, starts to flow differently, generally with more speed and greater volume, since it cannot penetrate the soil as much as in free ground, it becomes necessary to drain part of this water, to that does not cause disturbances such as floods, floods and does not cause material and human damage.

CLASSIFICATION OF DRAINAGE SYSTEMS

Drainage systems are classified according to their dimensions, in microdrain systems, also called initial drainage systems, and macrodrainage systems.

MICRODRENING

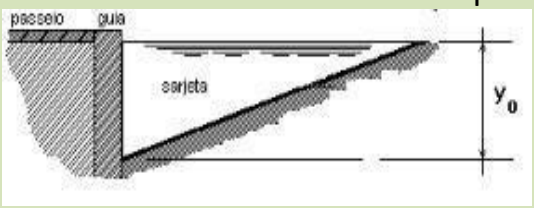
The microdrain system provides reasonable conditions for vehicles and pedestrians to circulate in an urban area, when frequent rains occur, considering the possible damage that they may cause to properties and the risks of human losses due to stronger storms.

In Brazil, the microdrain infrastructure is the responsibility of the municipal governments. As the City Hall is responsible for basic urban infrastructure services related to microdrainage and related services such as earthworks, guides, gutters, rainwater galleries, pavements and slope containment works, to minimize risk to urban occupation.

It includes the collection and removal of surface or groundwater through small and medium galleries, and all the components of the project are part of the system so that this occurs.

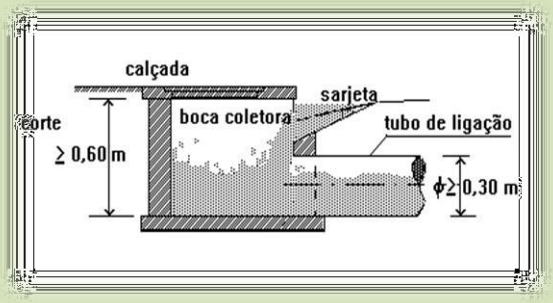
The microdrain network is formed by gutter, guide, wolf mouths or collecting mouths and galleries.

Gutter: longitudinal channel, generally triangular, located between the guide and the raceway, intended to collect and conduct runoff waters to collection points.



Guide: also known as curb, it is the longitudinal strip of separation of the sidewalk with the road bed, generally consisting of mortarized granite pieces.

Wolf mouths or **Collecting mouths:** they are hydraulic structures for capturing surface water carried by gutters and gutters; they are usually located under the sidewalk or under the gutter.



Connecting ducts - also known as connecting pipes, are used to transport the water collected in the collection mouths to the rain galleries.

Visit Well - These are visitable chambers located in previously determined points, intended to allow the inspection and cleaning of underground ducts.

Galleries - are conduits for the transport of the water captured in the collection mouths to the launch points; technically called galleries with a view to being built with a minimum diameter of 400mm.

The vegetation also plays an important role in the management of rainwater, as its leaves retain parts of the rainwater and the beds where the soil is exposed allow absorption of this water.

MACRODRENAGE

It includes, in addition to microdrainage, large galleries with diameters greater than 1,5m and receiving bodies such as channels and channeled rivers.

The macro-drainage infrastructure is the responsibility of the state governments, insofar as these relevances are fundamental for the planning of hydrographic basins.

To control rainwater there is a network of macrodrainage formed by existing watercourses on the site such as rivers and canals

A well-designed surface and groundwater drainage system will provide benefits to the population, such as the development of the road system; the rapid flow of surface water, facilitating traffic during rainfall; the reduction of expenses with maintenance of public roads; the enhancement of existing properties in the benefited area; the elimination of the presence of stagnant waters and mudflats; the lowering of the water table; the recovery of flooded or flooded areas; safety and comfort for the inhabitants or passersby through the project area.

EXERCISE

1. Define Basic Sanitation.
2. Classify drainage systems.
3. Why is it said that the guide is a *longitudinal strip*?
4. Compare gutters and gutters.
5. Why collector mouths are called hydraulic structures?
6. To compare:

a) galleries with connecting ducts.
b) manholes with dead boxes.

7. The larger the drainage basin, the longer the concentration time?
8. Define intense, frequent and torrential rain in terms of recurrence time.
9. Compare in operational and results terms, the instruments *rain gauge* and *rain gauge.*
10. What is the basic objective of urban storm drainage systems?
11. Explain how drainage systems provide the following benefits:

a) road system development;
b) reduction of expenses with maintenance of public roads;
c) valuation of existing properties in the benefited area;
d) rapid flow of surface water, facilitating traffic during rainfall;
e) elimination of the presence of stagnant waters and mudflats;
f) lowering of the water table;
g) recovery of flooded or flooded areas;
h) safety and comfort for the inhabitants or passersby through the project area.

RETURNING TO THE CHALLENGE

Based on reading the chapter and after reading material provided by the teacher, solve the challenge.

Waste Solids

11

https://upload.wikimedia.org/wikipedia/commons/9/9d/LixaoCaminhao20080220MarcelloCasalJrAgenciaBrasil.jpg

"Only when the last tree is felled, the last fish is killed and the last river is polluted will man realize that he cannot eat money."

Indian Proverb

GOAL

Characterize solid waste, determine its importance and the ideal location for its final destination

A CHALLENGE FOR YOU

After reading the text, find out if there is a landfill in your city highlighting the importance of this activity for sanitation.

TALKING ABOUT THE THEME

SOLID WASTE

For the purposes of Law 11445 of 2007, urban cleaning and solid waste management are considered to be the set of activities, infrastructures and operational facilities for the collection, transportation, transhipment, treatment and final destination of domestic waste and the waste originating from the sweeping and cleaning of public places and roads.

According to the Brazilian Association of Technical Standards, NBR 10,004 ABNT (2004):

The garbage are characterized as residues that present themselves in solid and semi-solid states resulting from domestic, industrial, hospital, commercial, agricultural, services and sweeping activities. Sludge from water treatment systems and liquids that are not discharged into the public sewer or bodies of water.

Monteiro classifies solid waste as waste that comes from human activities, considered useless, undesirable or disposable.

Urban solid waste is extremely heterogeneous and, according to Campos, Borges and Ferreira, different ways of treating its different parcels should be considered.

The residues were characterized according to their origin in:

Household: all types of waste that normally originate in homes. They are usually kitchen scraps, toilets, sweeping products, paper, wrappers and others;

Commercial: all solid waste originating from buildings intended for general trade, such as supermarkets, shops, bars, restaurants, etc..;

Special: waste eventually produced: dead animals, clandestine discharges, accident waste, large materials abandoned on public roads, among others.

Health Units: waste from hospitals, pharmacies, drugstores, medical and dental clinics and the like;

Rubble: waste resulting from construction, demolition, and civil construction reforms;

Industrial: solid and semi-solid waste resulting from industrial processes;

Public: waste produced on public roads, squares, gardens, pruning plants, sweeping waste, etc..;

Some authors such as Alvim, Cunha, Santos (2002), Damásio (2007), Borges and SMURBE (2010) argue that the main activity of cleaning public places is sweeping roads, which consists of removing accumulated solid waste, due to natural causes and disposal by the population.

This activity contributes to public health, avoiding the accumulation of waste and the proliferation of vectors, impacting the sanitary quality of the environment.

The handling of garbage from human activities according to Waldman, is not only an issue related to modern societies and much less restricted to contemporary societies, it is much older, cavemen deposited their residues in crevices in the rocks. In the old world there are archaeological sites generated by waste from the peoples of the past, the result of the deposition of shells, animal skeletons and remains of meals made by Tupi-Guarani Indians.

The management of solid waste and urban cleaning in Brazil have their legal frameworks defined in the National Basic Sanitation Policy, Law no. 11,445, of 2007, in which the solid waste plan must integrate the municipal Sanitation plans (PNSB) and the National Solid Waste Policy (PNRS), Law no. 12,305, 2010, regulated through Decree no. 7,404, 2010.

According to Fürstenau, Fofonka (2012) and Chenna (1999), the activities attributed to Brazilian municipalities related to urban cleaning are the collection and transportation of household, hospital, public, selective waste, sweeping, weeding, curbing , clearings, washing of monuments, public places and toilets, cleaning after events of mouths of wolf, removal of debris and pruning of trees, besides the cleaning of beaches, parks and gardens.

Monteiro says that garbage only started to be collected in households instead of simply being thrown on the streets or on land, when it was discovered the relationship between the appearance of rats, flies, cockroaches and the dumping of garbage on the streets, which occurred in mid-19th century, until then the streets were deposits not only of small debris, but also of food and animal and human excrement.

The urban cleaning service officially started in Brazil on November 25, 1880, in the city of São Sebastião do Rio de Janeiro, then capital of the Empire. According to Pechman and Ramos on this day, Decree nº. 3024, which dealt with the approval of a cleaning and irrigation contract for the city. With the support of the Fluminense University, an entity of the German government and the initiative of the residents of a neighborhood in Niterói, RJ, in 1985, the first experience of selective collection in Brazil emerged, according to Rocha, the city hall gave up land where the community performed the service of using the materials and the profits obtained were used in the community itself. Curitiba was the first Brazilian capital, in 1989, to implement a selective garbage collection program.

The management of solid waste in Brazil presents different forms of solution, with a discouraging situation prevailing, the solution will depend on technological development, resources and legislators, who must find plausible solutions to the issue, this inadequate management and disposition cause profound socio-environmental impacts , such as soil degradation, the compromise of water bodies and springs, the intensification of floods, the contribution to air pollution and the proliferation of vectors of sanitary importance in urban centers, in addition to collection in unsanitary conditions on the streets and in the final disposal areas, according to Monteiro and Besen.

Lixo. Domínio Público

https://pixnio.com/pt/diversos/lixo/plastico-giro-do-pacifico-poluicao-lixo-patch

According to the WHO and the EPA, with the increase in the generation of solid waste, significant changes occurred in its composition and characteristics, increasing its dangerousness.

Due to the reduction in the useful life of the products, their excessive and superfluous consumption, the growth and the increase in the life expectancy of the population associated with the intense urbanization and the new technologies significantly increased the volume of waste.

Jacobi and Besen claim that the adoption of sustainable production and consumption patterns together with proper waste management can reduce impacts on the environment and health.

The richer countries that generate greater amounts of solid waste have a greater capacity to mitigate the problem through factors that include economic resources, environmental involvement of the population and technological development.

https://www.flickr.com/photos/agenciasenado/35450939546

Developing countries, on the other hand, have deficits in the financial and administrative capacity of infrastructure and essential services such as water, sanitation, collection and proper disposal of waste and housing, and in ensuring safety and environmental quality control for the population.

According to Klunder and Adedipe when we refer to the reduction of production in generating sources, to reuse, selective collection with the inclusion of recyclable material collectors and recycling, and also energy recovery, we are talking about the integrated and sustainable management of solid waste.

Although federal regulations establish the need to treat certain types of waste from health services, prior to their final disposal, many municipalities still have sanitary landfills, controlled landfills and dumps without prior treatment, which represents a health risk.

The improper destination given to solid waste can cause serious damage to the environment, such as air pollution, water pollution and soil pollution, according to Monteiro, it is also important to keep the streets clean for safety reasons preventing damage to vehicles, promoting traffic safety and preventing clogging of the urban drainage system.

According to D'Almeida in general, the municipality is responsible for the management of urban solid waste, defining the conditions and rules for carrying it out. This task is not easy due to a series of factors such as the lack of a public cleaning policy, untrained professionals, financial limitations, lack of environmental inspection and interruption of administrative policies.

The average generation of solid urban waste in the country, according to SNIS projections (2015), varies from 0.9 to 1.15 kg per inhab./day, with an average indicator for the country of 1 kg per inhab./day . Of the total mass collected estimated at 62.5 million tons, it was found that 60.9% are disposed of in landfills, 11.5% in controlled landfills, 10.1% in dumps and 2.3% sent to waste disposal units. sorting and composting, leaving a portion of 15.4% without information. In this hypothesis, it can be said that 66.8% of the total mass collected in Brazil is properly disposed, with the remainder distributed by destinations in controlled dumps and landfills.

According to CEMPRE, the organic matter generated in homes comes, in general, from food waste, when disposed of in landfills, when it decomposes, emits greenhouse gases and contributes to global warming and climate change.

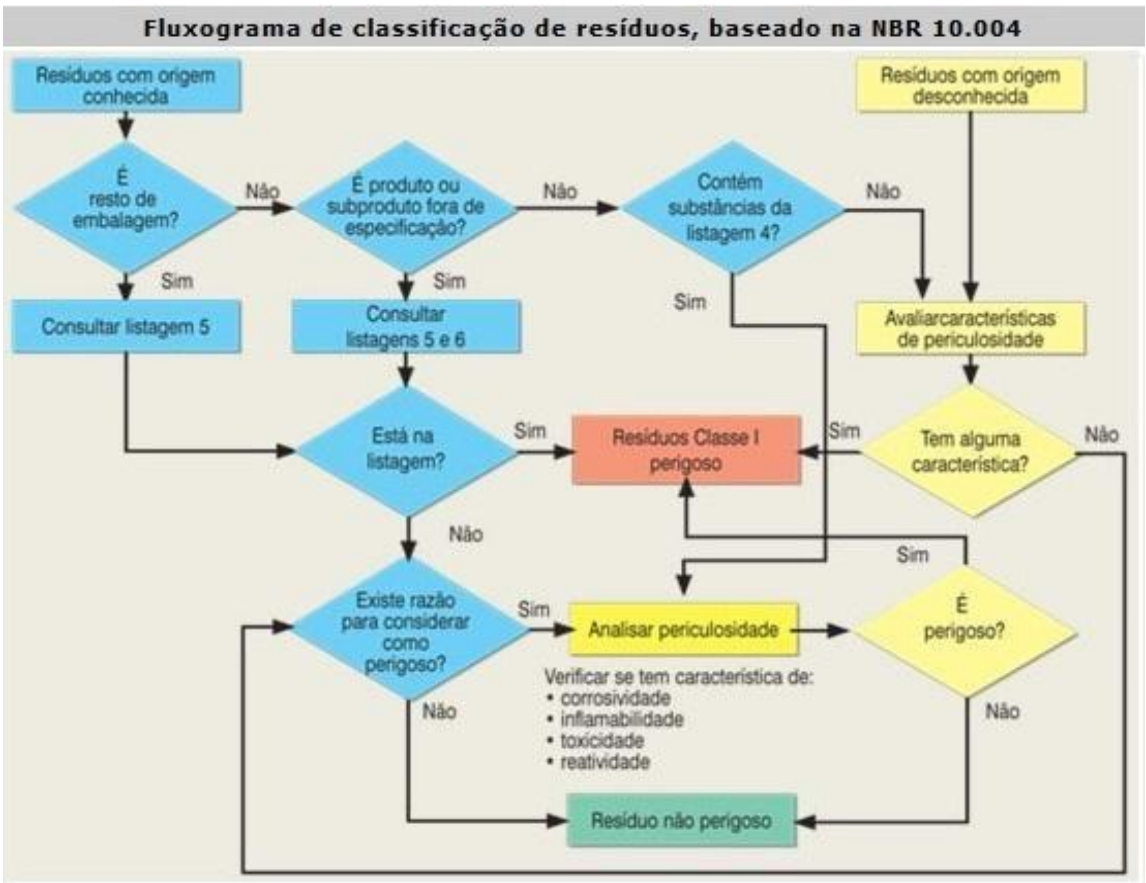
According to the model established by NBR 10.004 (ABNT, 2004) waste is classified into two distinct classes:

Class I - Dangerous: those that, due to their physical, chemical or infectious contagious properties, may pose health risks and / or risks to the environment when improperly managed. To be classified as class I waste, it must be contained in annexes A or B of NBR 10004 or have one or more of the following characteristics: flammability, corrosivity, reactivity, toxicity and pathogenicity.

Class II – No Dangarous: subdivided into: (A) Inert: residues that can alter the potability of water; and (B) Not inert: residues that do not have water-soluble constituents, thus not altering the potability of the water.

Figure 12 shows a flowchart with the classification of waste.

Figure 12 - Waste Classification



Source: https://autonambiental.files.wordpress.com/2012/11/grafico12.jpg

In early 2011, the Interministerial Steering Committee was created for the implementation of reverse logistics systems. The purpose is to ensure that solid waste is reused, recycled or collected by the responsible industry. To this end, sectoral agreements will be signed with the various production chains. Thus, manufacturers, distributors, traders and consumers should share responsibility for waste.

Construction waste is also a major environmental problem, especially due to inadequate disposal in streams, vacant lots and roadsides. Constituting more than 50% of the mass of urban waste. (SINDUSCON, 2005).

The garbage disposed of improperly in open-air dumps, for example, creates unavoidable health and environmental problems, as these places attract animals that are vectors of various diseases, especially for the populations that live from the collection. Furthermore, they are responsible for air pollution when waste, soil and surface and groundwater are burned.

According to CONAMA 307-2002, municipalities are responsible for preparing integrated management plans. These projects must characterize the waste and indicate procedures for sorting, packaging, transportation and disposal.

Photo: Leopoldo Silva / Senado Agency
https://www.flickr.com/photos/agenciasenado/35359813261

Although in most developing countries disposal is still available in an open pit, this is the worst way to dispose of waste, generating negative impacts on the environment and public health. As technical solutions and modern treatment technologies are adopted, smaller these impacts. The final distribution of solid urban waste in landfills has increased over the past few years in the country according to information released by IBGE in 2010.

Controlled landfill also does not represent an adequate solution, as in this type of landfill not all the necessary techniques are applied to ensure the effective protection of the environment and public health, where planning is not carried out in order to avoid negative impacts (SILVA , 2007; ABRELPE, 2009).

Although, in these landfills, sanitary problems are minimized in relation to the dumps, as they adopt the technique of covering the waste with soil daily, environmental problems still persist, due to the compromise of ground and surface water, as they do not adopt measures with the purpose to waterproof the landfill base, and it does not treat the liquid percolated by the decomposition of waste, causing environmental pollution due to the lack of biogas treatment.

The sanitary landfill is the most suitable modality of final disposal of solid urban waste, as it is an engineering work that has environmental, topographic and geotechnical monitoring systems, prevents the pollution of the environment by waterproofing the soil. , the collection and treatment of leachate, the collection, burning or use of biogas, (BIDONE and POVINELLI, 1999; TENÓRIO and ESPINOSA, 2004; BOSCOV, 2008).

Finding suitable locations for the disposal of solid waste is a progressive problem in Brazilian municipalities, since these areas must meet social, economic and environmental criteria (SAMIZAVA et al., 2008). One of the fundamental factors in choosing areas for the implementation of a landfill is the limits of a municipality, although it is possible to form a consortium between municipalities to solve this problem (FUNASA / ASSEMAE, 2016).

Aguazinha Landfill. Photo: Passarinho / Pref.Olinda Published by: Secom, em: 03/08/11 às 18:42
https://www.olinda.pe.gov.br/aterro_aguazinha_foto-passarinho-1/

The choice of the ideal location for the implementation of a landfill is not easy according to Monteiro et al. (2001), due to the large urbanization of cities and the unrestrained occupation of the soil, restricting the availability of suitable areas close to the places where solid waste is generated and with adequate dimensions.

The distances indicated as adequate according to Gomes et al. (2001) are between 2 and 15 km from the generating center. About these distances, the authors call attention to two factors, the farther from the city the landfill is, the more expensive the transport is, and the closer it is, the lower the acceptance of the urban population. Rocha et al. (2004) recommends adopting a minimum distance of 2000m, in order to analyze the influence of the urban area.

Goiânisa Landfill Author: Ev. Alexandry Silva Https://www.panoramio.com/photo/56136749

After compacting the layers in cells, a landfill must reach a height varying from three to six meters (HADDAD, 1999). Another important factor for the installation of landfills is hydrography, making it necessary to assess the influence of the landfill on the quality of surface and groundwater, to avoid possible contamination.

RETURNING TO THE CHALLENGE

Based on reading the chapter and after reading material provided by the teacher, solve the challenge.

Exhaustion Sanitary 12

https://i0.wp.com/www.tratamentodeagua.com.br/wp-content/uploads/2016/09/58.jpeg

"Water determines disease. Water determines health. Proper, adequate water restores health. Water can be used as medicine."

Dr. Lair Ribeiro

"May your food be your medicine."

Hipócrates, the father of medicine

GOAL	A CHALLENGE FOR YOU
Understand the importance of sewage for public health	After reading the text Research and together with your group and present the various existing sewage treatment technologies and systems. With the help of the teacher choose one of them and present a complete study including its dimensioning.

TALKING ABOUT THE THEME

ExhaustionSanitary

According to Law 11445 of 2007, sanitary sewage consists of the activities, infrastructures and operational facilities for the collection, transportation, treatment and final disposal of sanitary sewage, from building connections to their final release into the environment.

Sewage is the only safe way to avoid diseases transmitted by human excreta.

Its implantation is as important as the water supply.

Experience shows that in some communities where the water supply was implemented and the sewage was not collected, the sanitary conditions in the environment worsened, aggravating the problems with waste running in the open.

According to NBR 9 648

Sanitary sewage

They consist of liquids from domestic and industrial sewage, water and infiltration and the contribution of rainwater.

Domestic Sewer

They are liquids resulting from the use of water for personal hygiene and human physiological needs.

Industrial Sewer

They are liquids resulting from industrial processes.

Water and infiltration

Water from the subsoil that penetrates the pipes.

According to SNIS 2016, 49% of the population does not have sewage collection, and of these only 44% are treated, this statistic is at least worrisome as it increases the number of diseases arising from lack of sanitation as well as increasing the rates of infant mortality.

The Biochemical Oxygen Demand (BOD) is the most used parameter to define the types of sewage in sanitary or industrial. The higher the BOD, the greater the load of organic pollution.

In large cities it is where we find the largest volumes of collected sewage and these are dumped, in many cases, without treatment, into rivers and seas that serve as receiving bodies. The effect produced by these attitudes is the pollution of the waters that surround the urban areas, which makes it difficult and more expensive to collect and treat the water destined to supply the population..

With the construction of the sanitary sewage system in a community, the following objectives are sought: to collect individual or collective sewage; move them away quickly and safely using pits or collecting network systems; treat them and dispose of these treated sewers properly.

As benefits, there are:

- Conservation of natural resources such as rivers, lakes, ponds, streams, etc..;
- Elimination of unpleasant aesthetic and visual aspects (aggressive odors);
- Improvement of local health conditions for life;
- Elimination of sources of pollution and contamination;
- Improvement of the productive potential of human beings;
- Reduction of diseases caused by water contaminated by waste;
- Decrease in resources used to treat diseases.

Sewers contain approximately 99,9% water and only 0,1% solids. It is due to this fraction of solids that water pollution problems occur, bringing the need to treat sewage.

The characteristics of the sewage generated by a community is a function of the use to which the water was subjected.

These uses, and the way they are exercised, vary with the climate, social and economic situation, in addition to the habits of the population.

Due to the lack of financial resources, technological support and sometimes scientific, there is a deficit in the sewage treatment rate, especially when we refer to small and medium-sized municipalities.

In Brazil, the collection of sanitary sewage takes place through pipes in the Absolute Separator regime.

The release of sewage into water bodies without any treatment causes great damage to the community, however it continues to happen in much of Brazil.

CLASSIFICATION OF RIVERS

CONAMA 357:

Resolution No. 357 of 17 March 2005 from the National Environment Council. Provides for the classification of water bodies and environmental guidelines for their classification, as well as establishing the conditions and standards for effluent discharge.

Classes and Conditions for Effluent Release

Resolution 357 was partially amended by Resolution 410 of 2009 and 430 of 2011, and establishes criteria for the classification of surface water bodies and determines the environmental guidelines for their classification, as well as the conditions and standards for effluent discharge.

Its classification obeys the quality, capacity and other characteristics of the watercourse. The ETEs must direct the treated effluents to an appropriate body of water, respecting the requirements of each class.

We will highlight the classes of freshwater courses, which have a direct impact on urban and industrial activities which, according to CONAMA, are grouped into the following levels or categories:

CLASS	DESTINY
Special Class	For human consumption, with disinfection; Preserve the natural balance of aquatic communities; and Preserve aquatic environments in full protection conservation units.
Class I	Supply for human consumption, after simplified treatment; Protection of aquatic communities; Recreation of primary contact, such as swimming, water skiing and diving, according to CONAMA Resolution No. 274, of 2000; Irrigation of vegetables that are eaten raw and of fruits that grow close to the soil and that are eaten raw without removing the skin; and Protection of aquatic communities in Indigenous Lands.
Class II	Supply for human consumption, after conventional treatment; Protection of aquatic communities; Primary contact recreation, such as swimming, water skiing and diving; Irrigation of vegetables, fruit plants and parks, gardens, sports and leisure fields, with which the public may come into direct contact; Aquaculture and fishing.
Class III	Supply for human consumption, after conventional or advanced treatment; Irrigation of tree, cereal and forage crops; Amateur fishing; Secondary contact recreation; Animal resentment.
Class IV	Navigation; Landscape harmony.

IMPORTANCE OF CLASSIFICATION

This classification is of great importance, as the treatment of effluents will vary according to the parameters of the water body; it is through this classification that they are monitored and controlled, in case an infringer causes him any damage he must repair the damage caused by being obliged to modify the activities of the ETE and may even cease them. The lower the class in which the water body is, the stricter the inspection and the penalty for non-compliance with the laws.

Most contamination occurs due to inadequate treatment of sewage treatment plants. Inadequate disposal in addition to harming the environment will incur heavy fines imposed by the inspection bodies for not complying with the legislation in force.

Therefore, for the elaboration of a Water Treatment Station Project, one must take into account the parameters of the watercourse where the effluents are to be discharged in order to determine the parameters of the ETE to be implanted.

The choice of the treatment system varies depending on the conditions established for the receiving bodies and on the various variables of the sewage to be treated, such as flow, pH, temperature, BOD, etc.

The composition of the sewage is quite variable, as, while sanitary sewage causes organic and bacteriological pollution, industrial waste generally causes chemical pollution and organic and inorganic impurities resulting from the various activities depending on the type of industry.

The bodies of water recover from pollution by the action of Nature itself, as long as the effluent discharged does not exceed about 2,5% of its flow. When bodies of water receive high loads of effluents in relation to their flow, they are unable to recover by self-purification, then artificial purification is used..

TREATMENT LEVELS

The sewage treatment process can adopt different technologies, but in general it follows a flow that comprises the following steps:

Preliminary Treatment: Coarse solids such as garbage and sand are removed from the sewer.

Physical Processes are used, such as: grating, screening and sedimentation.

Primary Treatment: It reduces part of the organic matter present in the sewers by removing sedimentable suspended solids and floating solids.

In this stage the sewage still contains solids in suspension, not coarse, which are heavier than the liquid part. These solids settle, going to the bottom of the decanters, forming the raw primary sludge. This sludge is removed from the bottom of the decanter, using mechanized scrapers, pipes or pumps.

Anaerobic Processes are used: Occurs through fermentation, in the absence of oxygen.

Secondary treatment: Removes organic matter and suspended solids.

Biological Processes are used, using biochemical reactions, through microorganisms - aerobic, facultative, protozoa and fungi bacteria.

In the aerobic process, the microorganisms present in the sewers feed on the organic matter also present there, converting it into carbon dioxide, water and cellular material. This biological decomposition of organic material requires the presence of oxygen and other appropriate environmental conditions such as temperature, pH, contact time

Tertiary Treatment: Removes specific pollutants (micro nutrients and pathogens), in addition to other pollutants not retained in primary and secondary treatments. This treatment is used when it is desired to obtain a superior quality treatment for sewers. In this treatment, compounds such as nitrogen and phosphorus are removed, in addition to the complete removal of organic matter.

Ultraviolet radiation, chemical and other processes are used.

The technologies used in the treatment of sewage is the improvement of natural purification. Existing systems can be classified, basically into:

Aerobic process

Anaerobic process

Septic tank system – anaerobic filter

Sludge blanket anaerobic reactor (UASB)

Ralf – anaerobic fluidized bed reactor

Stabilization ponds (or oxidation ponds) and their variants

Activated sludge and its variants

The treatment of domestic effluents is a fundamental step in the recovery and preservation of our water resources.

RETURNING TO THE CHALLENGE

Research and together with your group and present the different technologies and systems of sewage treatment. With the help of the teacher choose one of them and present a complete study including its dimensioning.

BIBLIOGRAPHIC REFERENCES

ABNT - Associação Brasileira de Normas Técnicas. ABNT NBR 12213. **Projeto de captação de água de superfície para abastecimento público.**

_____._____. ABNT NBR 10004 - 2004. **Resíduos Sólidos – classificação.** 71 páginas

ABRELPE. **Panorama dos resíduos sólidos no Brasil – 2008**. São Paulo: ABRELPE, 2009. Disponível em: http://www.abrelpe.org.br/Panorama/ panorama 2009.pdf. Acesso em 14 out. 2017.

ADEDIPE N. O. et al. Waste management, processing, and detoxification. In: CHOPRA, K. et al. (Ed.) Millennium Ecosystems Assessment. Ecosystems and Human Well-Being: Policy Responses: findings of the Responses Working Group. Washington, DC: Island Press, 2005. v.3, p.313-34.

ALVIM, C. E., Cunha, M. E. G., Santos, A. L. T. (2002). **Sistematização do serviço de varrição pública.** Revista de Limpeza Urbana, 58, 12-19.

ANA – Agência Nacional das Águas. Disponível em: http://www3.ana.gov.br/. Acesso em: 3 fev. 2019.

AZEVEDO NETTO, J. M. **Manual de Hidráulica.** 8. ed. Editora Edgard Blücher, 1998. 669p.

_____. **Cronologia do abastecimento de água até 1970**. Revista DAE, São Paulo, v. 44, n. 37, p. 106-111, 1984.

_____. **Manual de Hidráulica.** 2. ed. Editora Edgard Blücher, 1954. 297p

BESEN, G. R. et al. Resíduos sólidos: vulnerabilidades e perspectivas. In: SALDIVA P. et al. **Meio ambiente e saúde**: o desafio das metrópoles. São Paulo: Ex Libris, 2010.

BEZERRA, R. Saneamento básico ainda é precário em todo mundo. **Revista Eco.21.** Rio de Janeiro: Edição 136, març. 2008.

BORGES, M. E. 1985. Tecnologias apropriadas – **Limpeza Urbana, apresentado no Seminário Limpeza Urbana:** um direito da Comunidade, Associação Brasileira de Engenharia Sanitária - FINEP - Prefeitura de Nova Friburgo (RJ).

BOSCOV, M. E. G. **Geotecnia Ambiental.** 1. ed. São Paulo Editora Oficina de Textos, 2008.

BRASIL.. **Constituição Federal** .1988. Texto promulgado em 05 de outubro de 1988. Constituição da República Federativa do Brasil. Brasília, DF: Senado Federal, 1988.

_____. **Decreto Nº 3.024, DE 25 DE NOVEMBRO DE 1880.** Approva o contrato de 10 de Outubro de 1876, para a limpeza e irrigação desta cidade, celebrado com Aleixo Gary.

_____. Decreto nº 7.404, de 23 de dezembro de 2010. **Regulamenta a Lei nº 12.305**, de 2 de agosto de 2010, que institui a Política Nacional de Resíduos Sólidos, cria o Comitê Interministerial da Política Nacional de Resíduos Sólidos e o Comitê Orientador para a Implantação dos Sistemas de Logística Reversa, e dá outras providências. Disponível em: http://www.planalto.gov.br/ccivil_03/_ato2007-2010/2010/decreto/d7404.htm. Acesso em 18 ago 2017.

_____. Emenda Constitucional nº 42, de 19 de dezembro de 2003. **Altera o Sistema Tributário Nacional e dá outras providências.** Presidência da República Casa Civil Subchefia para Assuntos Jurídicos. Disponível em: http://www.planalto.gov.br/ccivil_03/Constituicao/Emendas/Emc/emc42.htm. Acesso em: 3 fev 2019.

_____. **Emenda Constitucional N° 51, de 2011.** Dá nova redação ao parágrafo único do artigo 8º da Constituição Estadual, incluindo a acessibilidade no rol das garantias fundamentais do Estado do Rio de Janeiro.

_____. IBGE – Instituto Brasileiro de Geografia e Estatística. **Diretoria de Pesquisas, Coordenação de População e Indicadores Sociais, Estimativas da população residente com data de referência 1o de julho de 2017**. Disponível em: https://cidades.ibge.gov.br/brasil/rj/volta-redonda/panorama. Acesso em 26 fev.2018.

_____. IBGE. **Saneamento básico no Brasil: avanços e desafios**. In: ATLAS nacional do Brasil Milton Santos. Rio de Janeiro: IBGE, 2010. p. 192-198.

_____. IBGE. 2010. **Pesquisa nacional de saneamento básico 2008**. Rio de Janeiro, 2010. 218 p. Acompanha 1 CD-ROM. Disponível em: http://www.ibge.gov.br/home/estatistica/populacao/condicaode vida/ pnsb2008/PNSB_2008.pdf . Acesso em: 21 jun. 2017.

_____. Lei nº 11.445, de 5 de janeiro de 2007. **Estabelece as diretrizes nacionais para o saneamento básico** Disponível em: https://www.planalto.gov.br/ccivil_03 /_ato2007-2010/2007/lei/l11445.htm acesso em 26 nov. 2016

_____. **Lei Federal nº 8.080 de 19 de setembro de 1990.** Dispõe sobre o funcionamento dos serviços de saúde no país. Disponível em http://www.planalto.gov.br/ccivil_03/leis/l8080.htm. Acesso em 14 abr 2018.

_____. **Portaria nº 2.914, de 12 de dezembro de 2011**. Dispõe sobre os procedimentos de controle e de vigilância da qualidade da água para consumo humano e seu padrão de potabilidade. Ministério da Saúde Gabinete do Ministro.

_____. **Resolução nº 430, DE 13 de maio de 2011.** Dispõe sobre as condições e padrões de lançamento de efluentes, complementa e altera a Resolução no 357, de 17 de março de 2005, do Conselho Nacional do Meio Ambiente-CONAMA

_____. **Resolução CONAMA nº 410 de 04/05/2009.** Prorroga o prazo para complementação das condições e padrões de lançamento de efluentes, previsto no art. 44 da Resolução nº 357, de 17 de março de 2005, e no art. 3º da Resolução nº 397, de 3 de abril de 2008.

_____**. Resolução CONAMA 357, de 17 de março de 2005** Publicada no DOU nº 053, de 18/03/2005, págs. 58-63 • Alterada pela Resolução 410/2009 e pela 430/2011 Dispõe sobre a classificação dos corpos de água e diretrizes ambientais para o seu enquadramento, bem como estabelece as condições e padrões de lançamento de efluentes, e dá outras providências.

_____. **Resolução CONAMA nº 307, de 5 de julho de 2002** Publicada no DOU no 136, de 17 de julho de 2002, Seção 1, páginas 95-96 Correlações: · Alterada pela Resolução no 348/04 (alterado o inciso IV do art. 3o) Estabelece diretrizes, critérios e procedimentos para a gestão dos resíduos da construção civil.

_____. **Resolução CONAMA nº 274, de 29 de novembro de 2000** Publicada no DOU no 18, de 25 de janeiro de 2001, Seção 1, páginas 70-71 Correlações: · Revoga os artigos 26 a 34 da Resolução no 20/86 (revogada pela Resolução no 357/05) Define os critérios de balneabilidade em águas brasileiras.

_____. Secretaria de Recursos Hídricos do Ministério do Meio Ambiente. Disponível em: http://www.ipef.br/legislacao/diretrizmataatlantica.pdf. Acesso em: 3 fev. 2019.

BUFF, S. R.; **Saneamento Básico: como tudo começou**. 2009. Organização Elo Ambiental. www.eloambiental.org.br; disponível em: https://pt.slideshare.net/eloambiental/a-história-do-saneamento-bsico. Acesso em: 01 out. 2017.

CEMPRE – **Compromisso Empresarial para a Reciclágem**. Pesquisa Ciclosoft 2010. Disponível em: http://www. cempre.org.br/ciclosoft_2010.php. Acesso em: 3 abr. 2018.

CONSELHO DE REGULAÇÃO E FISCALIZAÇÃO AGÊNCIA REGULADORA - ITU, 2016; **Recursos Hídricos e o Sistema de Água do Município de Itu Um Ensaio em Preto e Branco,** p.123. Disponível em: http://pt.calameo.com/read/004484262426ad436c836; Acesso em 03 out. 2017.

CREDER, H. **Instalações Hidráulicas e Sanitárias.** 5. ed. Livros Técnicos e Científicos Editora S.A. ABDR - Associação Brasileira de Direitos Repográficos. Editora Afiliada. 1991. 465p

CHENNA, S. I. M. **Modelo Tecnológico Para Sistemas de Coleta e Outros Serviços de Limpeza Urbana**, Curso Modelo de Gestão Integrada dos Resíduos Sólidos Urbanos, Brasília, 1999.

DAMÁSIO, H. O. 2007. **Planejamento operacional, Curso de formação de Limpeza Urbana, manuscrito não publicado**, UNICOM - Universidade Corporativa da COMLURB/ Prefeitura do Rio de Janeiro – RJ

EPA-Environment Protection Agency. Climate Change and Waste. Reducing Waste Can Make a Difference. 2010 Disponível em: http://www.epa.gov/epawaste/nonhaz/municipal/pubs/ghg/climfold.pdf. Acesso em: 7 set. 2017.

FERNANDES, C. **Microdrenagem –** Um Estudo Inicial. DEC/CCT/UFPB, Campina Grande, 2002, 196p.

FUNASA/ASSEMAE – Fundação Nacional de Saúde/ Associação Nacional dos Serviços Municipais de Saneamento. **Criação e Organização de Serviços Municipais ou Intermunicipais de Saneamento Básico.** Convênio 816987/2015. Brasília, 2017.

FÜRSTENAU, B. B. R. J.; FOFONKA, L. **Limpeza urbana e manejo de resíduos sólidos:** as impressões ao observar espaços urbanos em duas cidades brasileiras e seis capitais europeias. Revista EA - Educação Ambiental em ação. ISSN 1678-0701, n. 39, Ano X. Março-Maio/2012. Disponível em: http://www.revistaea.org/ artigo.php?idartigo=1213. Acesso em 12 jul. 2017.

Gleick, P. H., 1996: **Recursos de água**. Na Enciclopédia do clima e tempo, ed. PorSuperlogo H. Schneider, Oxford University Press, Nova Iorque, vol. 2, pag. 817-823

GOMES, L. P. et al. Critérios de seleção de áreas para disposição final de resíduos sólidos. In: ANDREOLI, C. (Org.), **Resíduos sólidos do saneamento**: processamento, reciclagem e disposição final. São Carlos: RIMA, 2001.

HADDAD, J. F. **Projetos de aterros sanitários de resíduos sólidos urbanos e especiais.** Indicadores operacionais. Análise de projeto para gestão integrada de resíduos sólidos urbanos. Associação Brasileira de Engenharia Sanitária e Ambiental (ABES). Rio de Janeiro, 1999.

HELLER, L. **Abastecimento de água para consumo.** 2 ed. vol.1, 428p. Belo Horizonte. Editora UFMG. 2010.

INSTITUTO TRATA BRASIL. Ranking do Saneamento Instituto Trata Brasil 2018. Disponível em: http://www.tratabrasil.org.br/images/estudos/itb/ranking-2018/realatorio-completo.pdf

_____**. Saneamento Básico enquanto Direito Fundamental e Direito Humano**. 2015 Disponível em: http://www.tratabrasil.org.br.saneamento-basico-enquanto-direito-fundamental-e-direito-humano. Acesso em: 25 jul. 2017.

JACOBI, P. R.; BESEN, G. R. **Gestão de resíduos sólidos em São Paulo**: desafios da sustentabilidade. [s.l.],Estudos Avançados, v.25, p. 135-158, 2011.

JUSBRASIL, 2015. Disponível em: http://www.tratabrasil.org.br/saneamento-basico-enquanto-direito-fundamental-e-direito-humano. Acesso em 12 Abr. 2017.

KOBIYAMA, M. et al. **Recursos hídricos e saneamento** – 1.ed. Curitiba: Ed. Organic Trading, 2008. 160p. Inclui bibliografia ISBN - 978-85-87755-04-9

MAYS, L. W. **Water distribution systems handbook –** McGraw Hill. Ed. USA, 2000.

MONTEIRO J. H. P. et al. **Manual de Gerenciamento Integrado de resíduos sólidos**. Rio de Janeiro: IBAM, 2001.

NASCIMENTO, N. O.; HELLER, L. Ciência, tecnologia e inovação na interface entre as áreas de recursos hídricos e saneamento. **Revista Engenharia Sanitária e Ambiental**, v. 10, n. 1, p.36-48, Jan./Mar. 2005.

OMS, UNICEF. Progress on Sanitation And Drinking - Water, 2015 – Organização Mundial da Saúde **Relatório sobre o Desenvolvimento dos Recursos Hídricos** – ONU-Água. Disponível em: http://unesdoc.unesco.org/images/00244040por.pdf. Acesso em: 1 nov. 2016

_____. **Relatório mundial da saúde 2013:** pesquisa para a cobertura universal de saúde, p 67, Disponível em: http://apps.who.int/iris/bitstream/10665/85761/26/97892 48564598 por.pdf, acesso em 26 nov. 2016.

ROCHA, C. H. B. et al. Geoprocessamento aplicado à seleção de locais para a implantação de aterros sanitários: o caso de Mangaratiba – RJ. In: SILVA, J. X.; ZAIDAN, R.T (Org.), **Geoprocessamento e análise ambiental**. Rio de Janeiro: Bertrand Brasil, 2004. p. 259-299.

ROCHA, V. J. **Trabalho dos Catadores (as), Cooperativismo e as Políticas Públicas (Sociais):** Experiências da Coleta Seletiva Solidária no Município de João Pessoa. Revista Eletrônica de Ciências Sociais, n.16, p.164-175, 2011.

SAMIZAVA, T. M. et al. **SIG aplicado à escolha de áreas potenciais para instalação de aterros sanitários no município de Presidente Prudente** – SP. Revista Brasileira de Cartografia, v. 60, n. 1, p. 43-55, 2008.

SECRETARIA MUNICIPAL DE POLÍTICAS URBANAS – SMURBE (2010), Edital SMURBE-157/2010, Arquivo **Divisão de Projetos de Limpeza de Vias** (DV LPV), Superintendência de Limpeza Urbana da Prefeitura de Belo Horizonte - MG.

SILVA, R.C. ***Energias Renováveis****. Boletim do Observatório Ambiental Alberto Ribeiro.* Lamego, Campos dos Goytacazes, RJ: Essentia Editora, 2007. v.1, n.1, p35-41.

SINDUSCON. **Gestão ambiental de resíduos da construção civil.** A experiência do SindusCon-SP. São Paulo: Sinduscon, 2005.

SNIS – Sistema Nacional de informações sobre saneamento. 2018. Ministério das Cidades. Secretaria Nacional de Saneamento Ambiental. **Diagnóstico dos Serviços de Água e esgoto 2018.**

_____**.** 2015. Ministério das Cidades. Secretaria Nacional de Saneamento Ambiental. **Diagnóstico dos Serviços de Água e esgoto 2015.**

_____. 2016. Ministério das Cidades. Secretaria Nacional de Saneamento Ambiental. **Diagnóstico dos Serviços de Água e esgoto 2015.**

_____. Ministério das Cidades. Secretaria Nacional de Saneamento Ambiental – SNSA. **SNIS**-Sistema Nacional de Informações sobre Saneamento: **Diagnóstico dos Serviços de Água e Esgotos – 2015**. Brasília: SNSA/MCIDADES, 2017. 212 f.

SOUZA, C. S.; CRUZ, M. A. S.; TUCCI, C. E. M. Desenvolvimento Urbano de Baixo Impacto: Planejamento e TecnologiasVerdes para a Sustentabilidade das Águas Urbanas**. RBRH -Revista Brasileira de Recursos Hídricos**, p. 9-18, Abr/Jun, 2012.

TENÓRIO, J. A. S.; ESPINOSA, D. C. R. Controle Ambiental de Resíduos. In: PHILIPPI Jr, A.; ROMÉRO, M. de A.; BRUNA, G. C. **Curso de Gestão Ambiental,** Barueri, SP: Manole, 2004. (Coleção ambiental; 1).

TSUTIYA, M. T. **Abastecimento de água.** 4ª Edição – São Paulo – Departamento de Engenharia Hidráulica e Sanitária da Escola Politécnica da Universidade de São Paulo, 2006. 643p.

URBONAS, B.; STAHRE, P. **Stormwater: Best management practices and detention for water quality, drainage, and CSO management.** Englewood Cliffs, New Jersey: Prentice Hall. 1993. 450 p.

Von Sperling, Marcos. Introdução à Qualidade das Águas e ao Tratamento de Esgotos. 2 a Edição. Belo Horizonte, MG: Departamento de Engenharia Sanitária e Ambiental da UFMG, 1996.

WALDMAN, M. **Lixo. Cenários e Desafios.** São Paulo: Cortez, 2010.