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Macao International Environmental
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2019年澳門國際環保合作發展論壇及展覽



構建生態文明 推進綠色發展
Promoting Ecological Civilization
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2019年3月28日至3月30日 澳門

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28 March- 30 March 2019 Macao

WASTEWATER RECLAMATION AS A NEW SOURCE OF WATER (WWR)

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March 29, 2019



THE DRY EPISODES VERIFIED WORLDWIDE EVALUATE THE IMPORTANCE OF SWEET WATER RESOURCE AND DEMONSTRATE ITS SCARCITY

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**THERE IS A GLOBAL RECOGNITION OF THE
IMPORTANCE OF THE REUSE OF TREATED
WASTEWATER AS A WAY TO REDUCE
PRIMARY WATER CONSUMPTION**



RIO CONFERENCE, 1992

Agenda 21 - Point 18.2: All States are called upon to implement activities to improve integrated water resources management, including "**new and alternative sources of water supply, such as desalination of seawater and re-use and recycling of the WW**"

(Agenda 21 - Global Action Program for Sustainable Development in the XXI Century)



OCDE (2009)

Corroborates the arguments for **reuse of wastewater**: it reduces the demand for fresh water; diversifies water sources; reduces the volume of wastewater discharged into the environment.



**TO BE CONSIDER THAT THE WASTEWATER SHOULD
BE REUTILIZED, THE WWTP MUST PASS TO BE SEEN
AS “WATER FACTORIES” FOR SECONDARY USES
(Al-jayyousi, 2003, Kalavrouziottis, 2007, Levy,
2007).**



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EMPRESAS

“No aproveitamos a água dos esgotos e descartamos o resto no rio?” Quer o caso de João Levy. Em 1983, o empresário, filho de industrial como projectista de uma empresa de engenharia variada, lançou-se ao negócio dos esgotos. Termina a empresa Ecoserviços e, desde a Sidel, que inicia a produção de esgotos de tratamento de águas residuais (ETAR). Objectivo: a saúde do sistema ecológico. Decidido por razões, aproveitamos a

água dos esgotos para regar campos de golf e jardins e para lavar estradas.

As estações municipais e empresas privadas internacionais de água por esta actividade, que de água usa a terra... a água é ambientalista. “Temos vindo no movimento. Desapareceram-se recursos que são vitais para a saúde do sistema ecológico”, conta João Levy.

Quando a água vai de ETAR em 50% da água, embora não seja potável. Assim, a água de desajustar num rio, o tratamento é

reintegrado e a água é utilizada na rega.

“Nos próximos cinco anos as empresas vão crescer se para dominar o negócio dos esgotos”, prevê João Levy.

Hoje, a empresa utiliza e explora cerca de 40 ETAR e presta serviços de consultoria e projectos. Só a primeira actividade, respondendo a cerca de 100 milhões de esgotos, ou seja, 200 mil litros.

■ Campos de golf, ecologia. A empresa Costa Verde, controlada por investidores locais, que apostou na construção de um complexo turístico no concelho de Grândola. Este empreendimento, entre o Carapal e Melides, a 3 quilómetros da praia, compreende vários campos de golf, um hotel e mais. Mas quando o alvará do regime sobre essas intenções, ficou prejudicado. E que o Alentejo não é propriamente a Escócia, em matéria de água.

A situação só deu luz verde a este complexo quando os empresários contactaram a Ecoserviços e apresentaram uma solução: aproveitar a água dos esgotos do complexo para regar os campos de golf e os jardins. “Este sistema de água que viabiliza o projecto. Com condições, não tem água para regar o golf”, afirma Joaquim Brás, técnico responsável pelo departamento ambiental.

Esgotos: um negócio da China

Um campo de golf consome, por dia, a mesma água que 15 mil pessoas. Por isso, alguns campos começam a utilizar esgotos reciclados. O resultado é bom... e barato

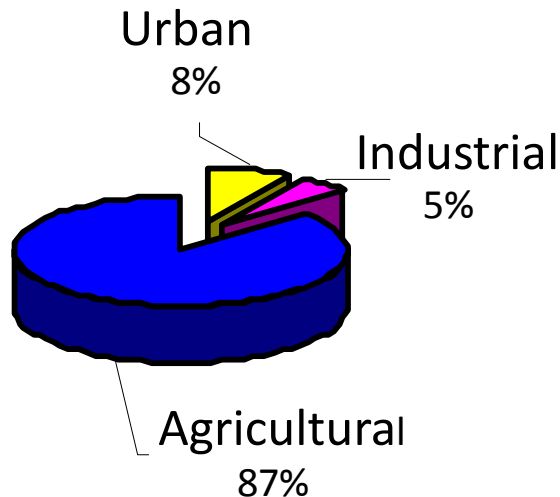
JOÃO ROSÁRIO ASSUNÇÃO

“No futuro as empresas vão crescer pelo negócio dos esgotos”, diz João Levy, da Ecoserviços

THE EXPERIENCE OF ECOSERVICES IN THE
REUTILIZATION
OF TREATED WASTEWATER BEGAN IN
PORTUGAL IN 1994 WITH THE
IRRIGATION OF A GOLF COURSE WITH
2000 m3/d

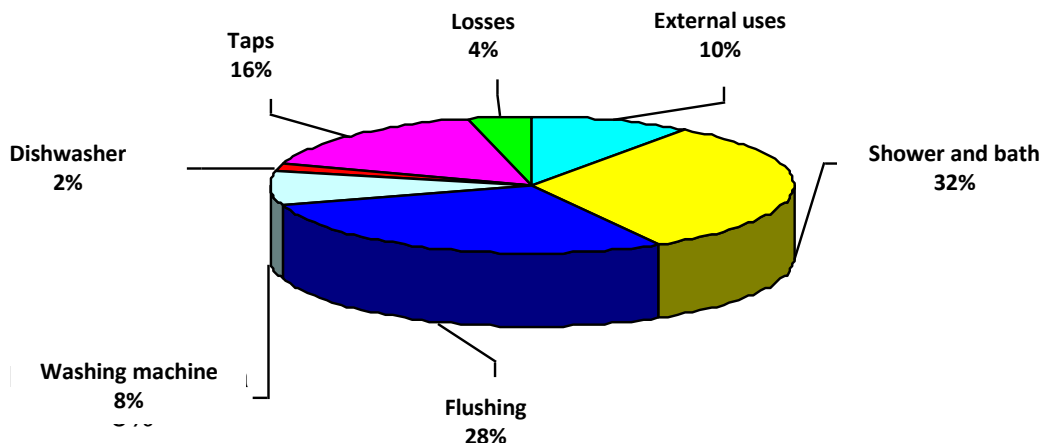


THE WATER USES





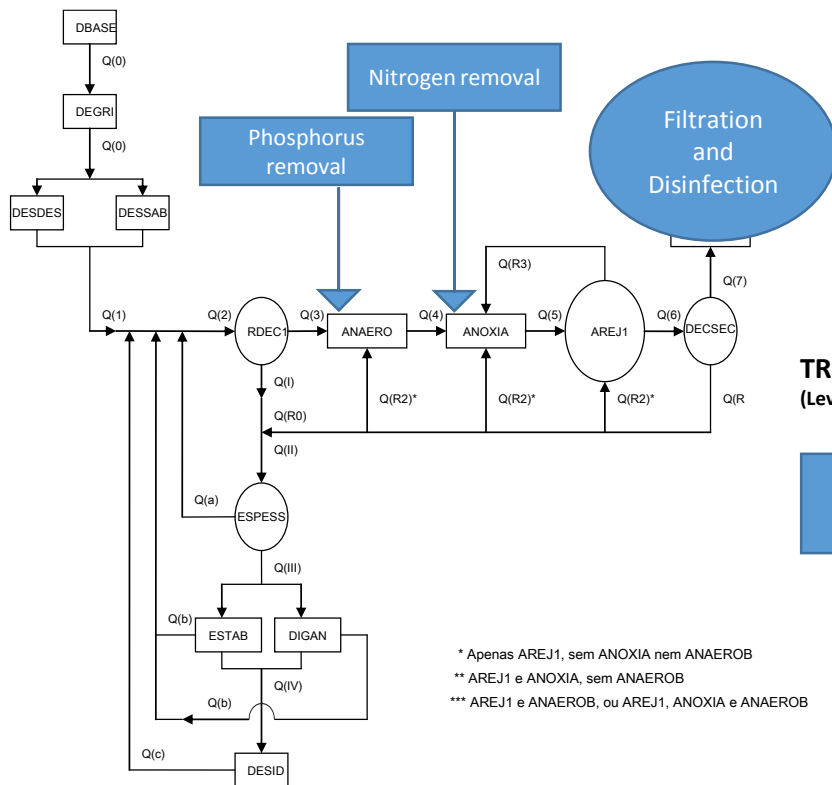
Distribution of household uses (exclusively home use)



38% of water consumption do not require potable water



THE REUSE OF WASTEWATER IMPLIES THAT AFTER THE SECONDARY TREATMENT WE NEED A TERTIARY TREATMENT



TREATMENT SCHEME

(Levy, J. e Silva, J.2006)

Tertiary processes

* Apenas AREJ1, sem ANOXIA nem ANAEROB

** AREJ1 e ANOXIA, sem ANAEROB

*** AREJ1 e ANAEROB, ou AREJ1, ANOXIA e ANAEROB



TREATMENT SCHEMES FOR THE REUSE OF TREATED WASTEWATER DEPENDING ON THEIR USES



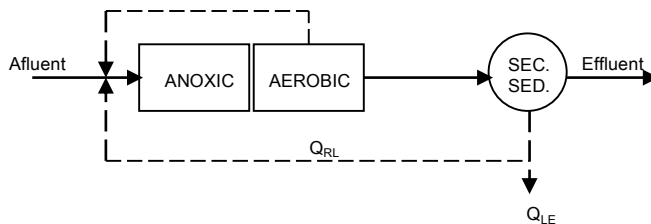
TERTIARY TREATMENT

- **NITROGEN AND PHOSPHORUS REMOVAL**
- **SUSPEND SOLIDS REDUCTION (FILTERING)**
- **DISINFECTION (UV, GAS CHLORINE, HYPOCHLORITE)**
- **SUSPENDED SOLIDS REDUCTION AND DISINFECTION
(MEMBRANE BIOLOGIC REACTOR, MBR)**

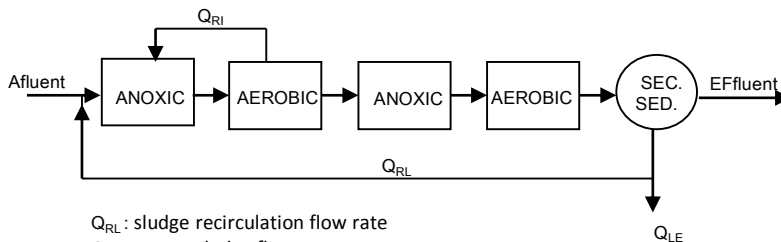


NITROGEN AND PHOSPHORUS REMOVAL

FOR RECHARGE OF AQUIFER,
FOR WATER, FOR DISCHARGE IN LAKES



Modified Ludzack-Ettinger configuration



Q_{RL} : sludge recirculation flow rate

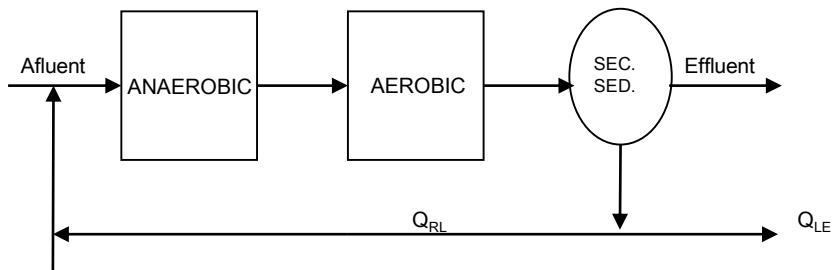
Q_{LE} : excess sludge flow

Q_{RI} : internal recirculation flow rate

Bardenpho® configuration

Established settings for the biological removal of nitrogen

(adapted from WEF & ASCE, 1998)

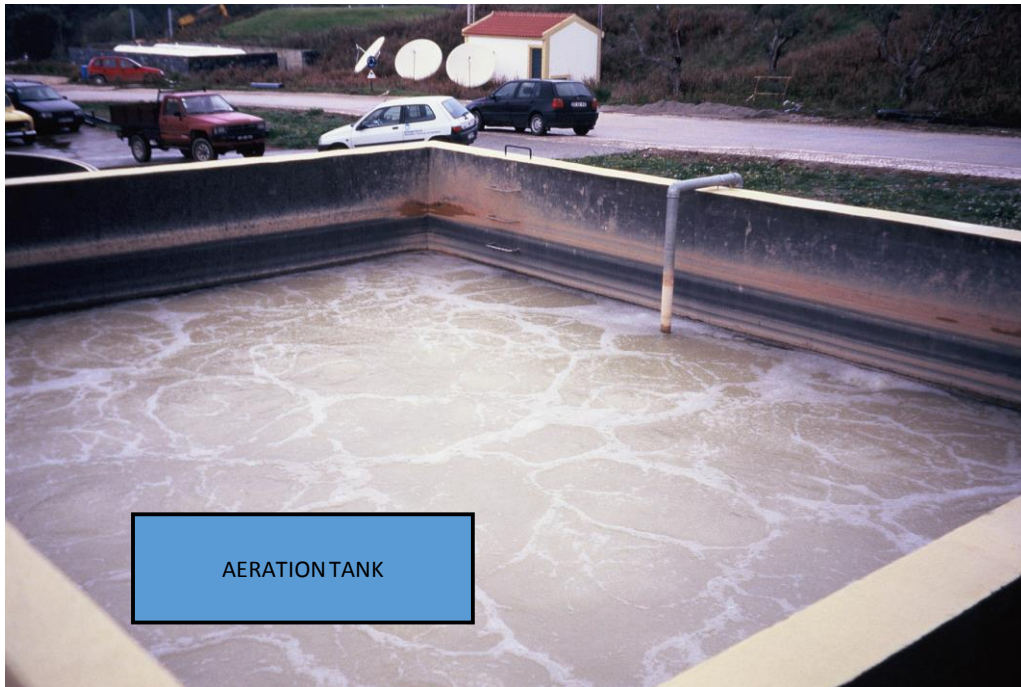


Q_{RL} : sludge recirculation flow rate

Q_{LE} : excess sludge flow

Phosphorus removal by biological means, Process A/O®

(adapted from ASCE, 2003)



AERATION TANK

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DENITRIFICATION



REDUCTION OF SUSPENDED SOLIDS After secondary effluent

FOR WATER, FLUSHING SUPPLY, STREETS WASHING

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PRESSURE
SAND FILTERS



GRAVITICSAND FILTERS



Mechanical filter



DISINFECTION

IN GENERAL IS ALWAYS NECESSARY FOR PUBLIC HEALTH
REASONS

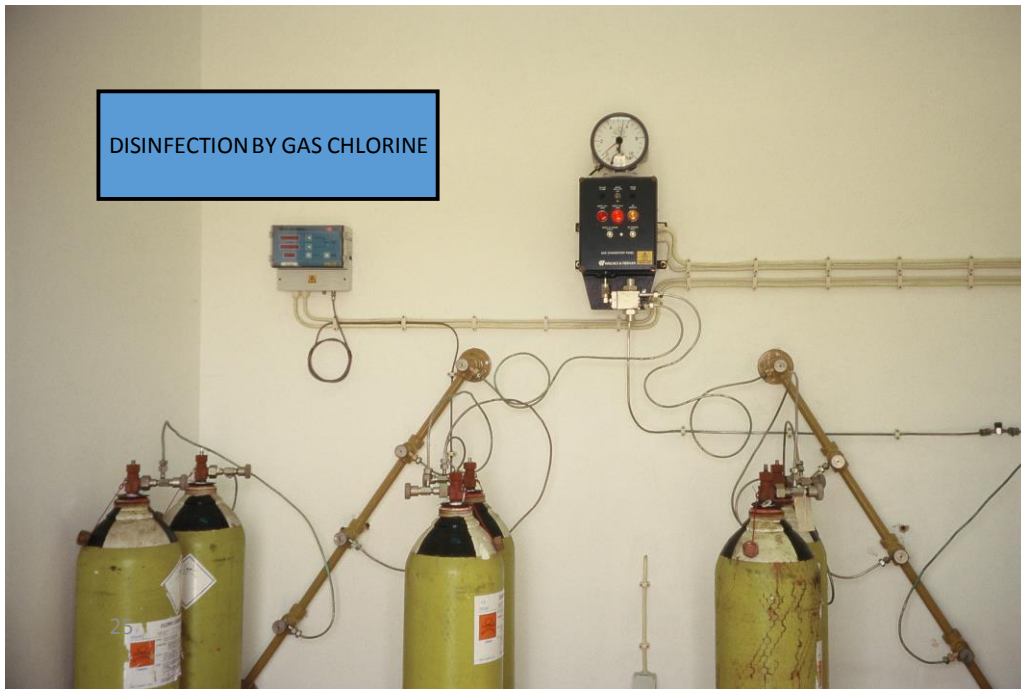


DISINFECTION BY HYPOCHLORITE





DISINFECTION BY GAS CHLORINE



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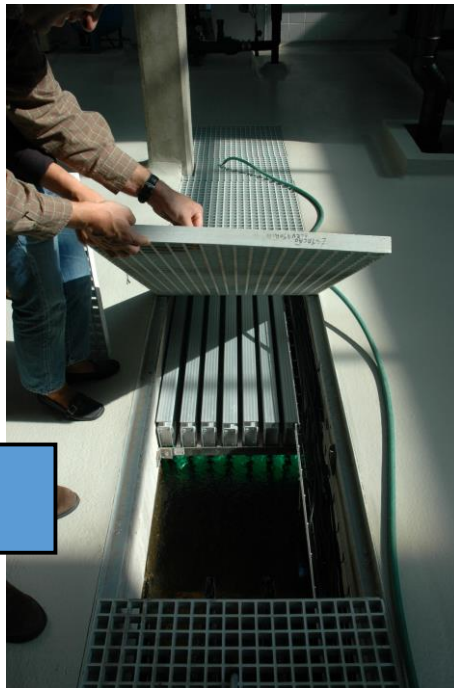
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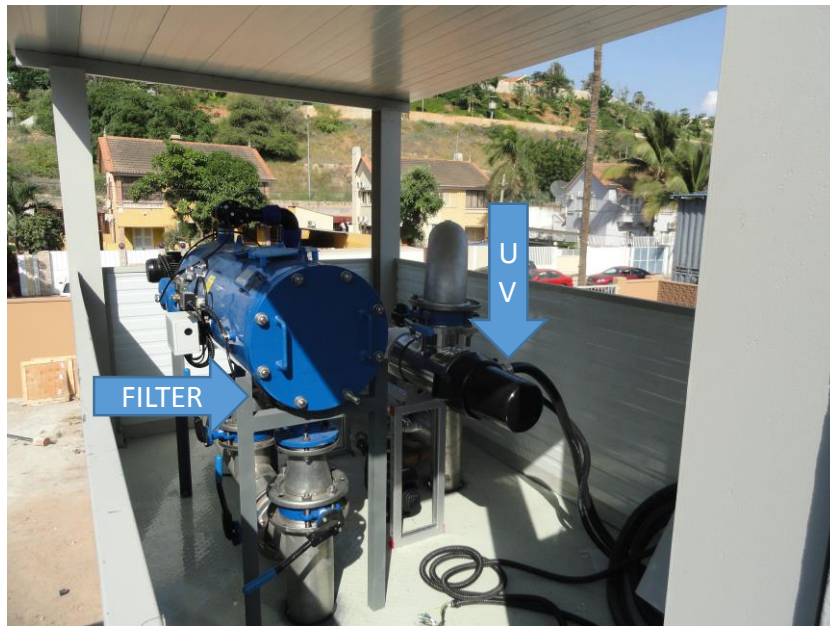
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DISINFECTION BY UV



Tubular UV



**Mechanical and tubular UV filtration
(Luanda)**

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MICRO AND ULTRAFILTRATION



MBR – Flat membranes



31

Reverse Osmosis



THE REUSE IN THE WORLD



Wastewater reuse

- Shindler, 2005: Sensitizing populations to the benefits of reuse, exemplifies with the Big Bear Area Regional Wastewater Agency;
- Day and al, 2005: Arizona increases desalination of brackish water with membrane treatment;
- Shenk et al, 2005: Georgetown, Texas, implements one of the largest wastewater reuse systems;
- Mikeska et al, 2005: Dallas sees reuse as a way to achieve its water supply targets for the next 50 years.



(Water Environmental Research, vol 78, No. 10
2006)



Wastewater reuse

- Arab Emirates (2014): Irrigation of green spaces 287 Mm³/year and 130 Mm³/year in air conditioning;
- Spain (2016): Agriculture 350 Mm³/year and 60 Mm³/year in recharges and landscape;
- East Bay Municipal District, California (2016): the reuse saves primary water corresponding to the annual consumption of 83,000 families





THE FUTURE: FOR WASTEWATER REUSE

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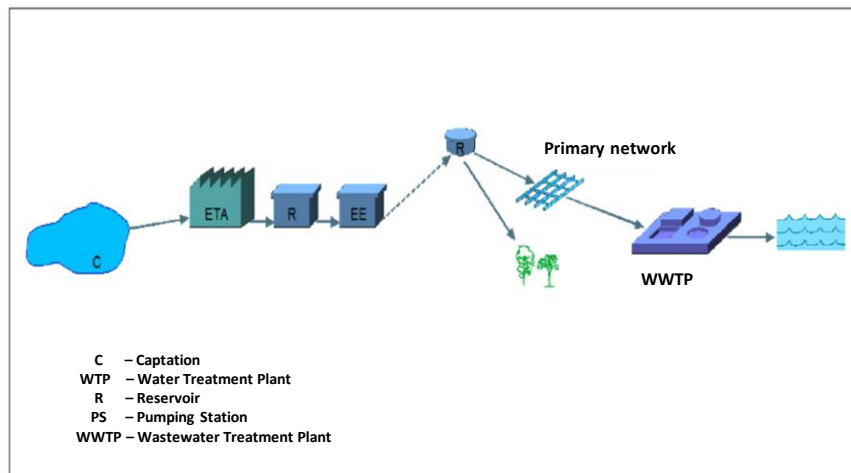


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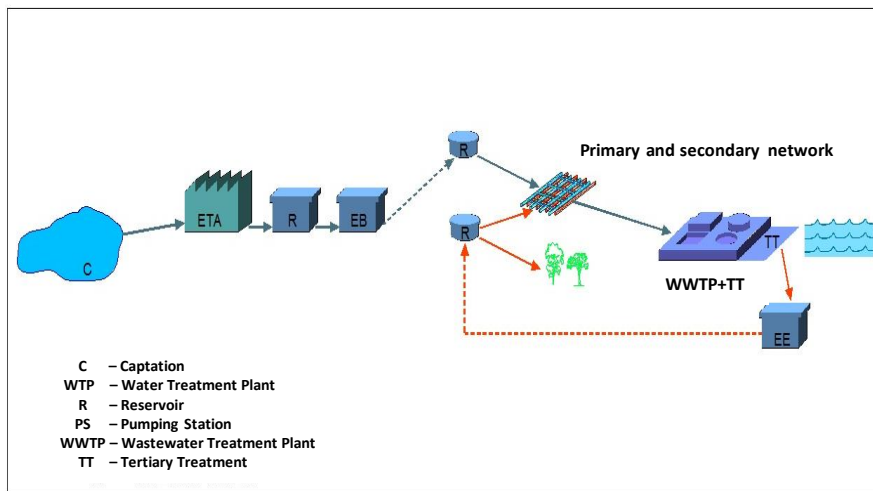
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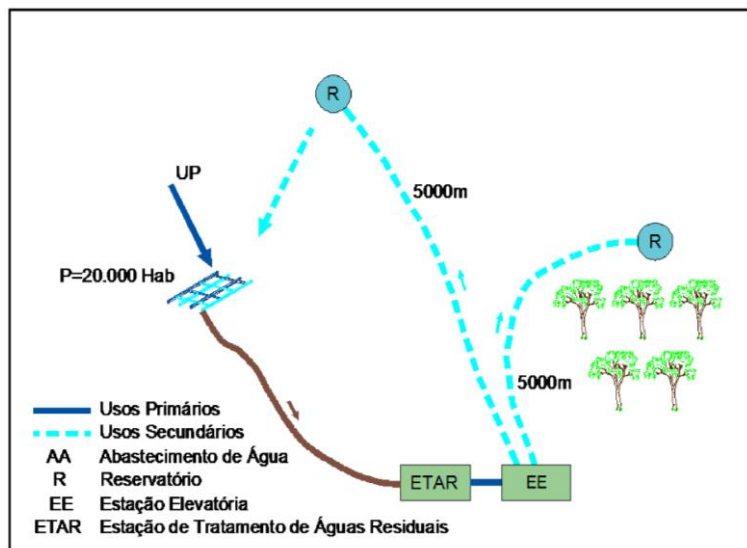
DUAL systems as a contribution to SUSTAINABILITY



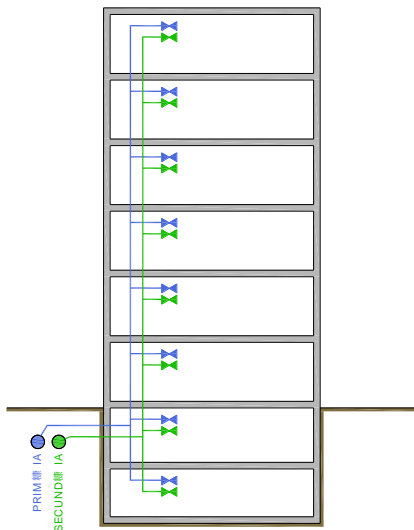
Conventional water supply system



Dual water supply system



Dual System



A NETWORK FOR DRINKING WATER AND ANOTHER FOR FLUSHINGS

DUAL NETWORK IN BUILDINGS

)



EXAMPLE OF HOTEL WITH TWO WATER NETWORKS



Conclusions:

- The re-use of waste water is not only an economic issue but is mainly a way of guaranteeing the use of water
- Agriculture and green space could be the first use of treated wastewater



Conclusions:

- Reuse may reduce by more than 1/3 the volumes of fresh water collected for domestic purposes (dual systems)
- In order to achieve such percentage in buildings, two water networks should be installed