Risk assessment and management

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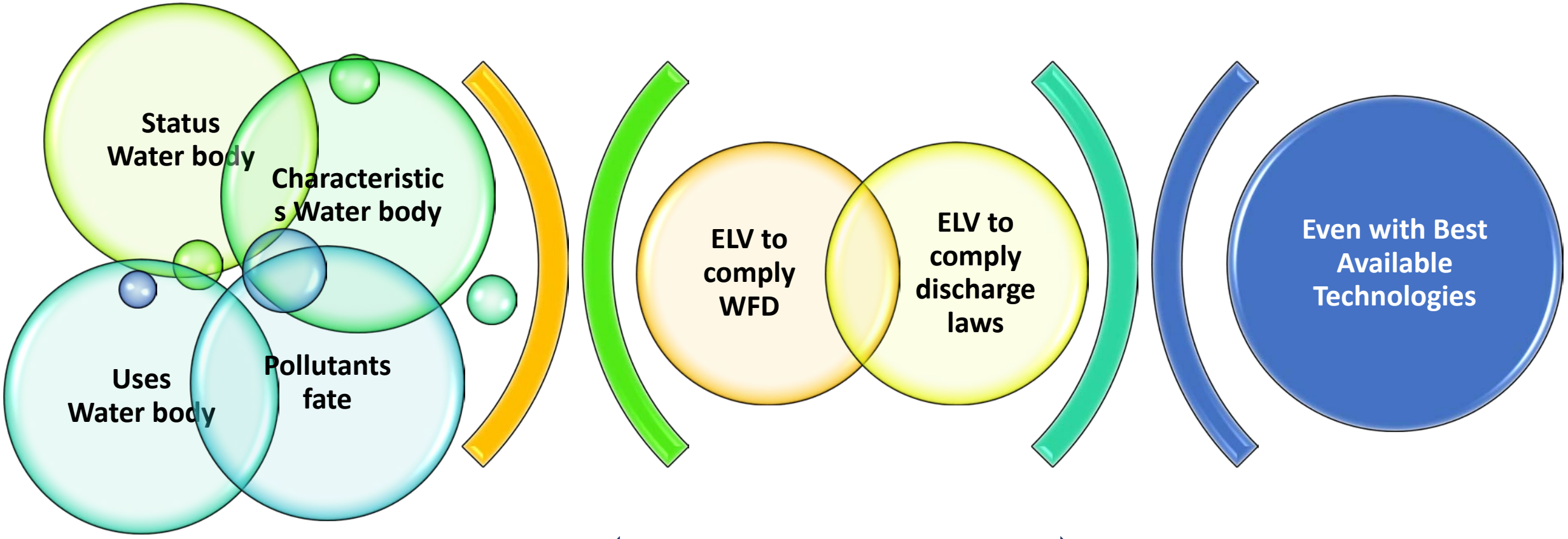
REPÚBLICA PORTUGUESA

ENVIRONMENT AND CLIMATE ACTION

ELV assessment



WFD

DISCHARGE LAWS

Based on natural behavior

Based on treatment level or equipment performance

Portuguese approach

New Plants

- Is N and/or P removal need?
- Is E. coli removal need?
- Is other pollutants removal need?

Existent Plants

- There is a need of the revision of the ELV defined on the permit?

What is taken into account…

ELV from existent permit (in case of reassessment)

Self-monitoting data (in case of reassessment)

Receiving water body status & critical parameters (see RBMP)

Uses of water body (protected areas)

Conceptual tier approach

Hazards

Exposure & pathway assessment

Vulnerability of water resources

Global Vulnerability

Damage

Risk

Control/ Minimization measures

Risk management

- Definition of appropriate ELV
- Measures for self-monitoring programs
- Measures for compliance assessment

$$Risk = Hazard \times Vulnerability_{Receptor} \times Damage$$

Factor classification based on Loads

Description	Factor value
WWTP < 2000 p.e. & Water body in Good Status & No uses & Not sensitive area and/or vulnerable to nitrates & no eutrophication risk	1
2000 p.e. ≤ WWTP < 5000 p.e. & Water body in Good Status & No uses & Not sensitive area and/or vulnerable to nitrates & no eutrophication risk	3
5000 p.e. ≤ WWTP < 10000 p.e. & Water body in Good Status & No uses & Not sensitive area and/or vulnerable to nitrates & no eutrophication risk	5
WWTP ≥ 10000 p.e. & Water body in Good Status & No uses & Not sensitive area and/or vulnerable to nitrates & no eutrophication risk	7
WWTP ≥ 10000 p.e. & Water body in Status Less than Good and/or with uses and/or sensitive area and/or vulnerable to nitrates and/or no eutrophication risk	9

Perform risk assessment for factor higher than 1

Definition of Hazard level (Hz): N & P

Treatment	WW (mg/L)	Hz
No nutrient removal	N > 15 and P > 3	9
With partial removal of N or P*	N ≤ 15 or P ≤ 3	7
With partial removal of N or P*	N ≤ 15 or P ≤ 3	5
With partial removal of N and P	N ≤ 15 and P ≤ 3	3
With advanced removal of N and P	N ≤ 5 and P ≤ 0,5	1

*In vulnerable areas to nitrate pollution or when water body status is less than "Good" due to parameter N, consider Hazard for:

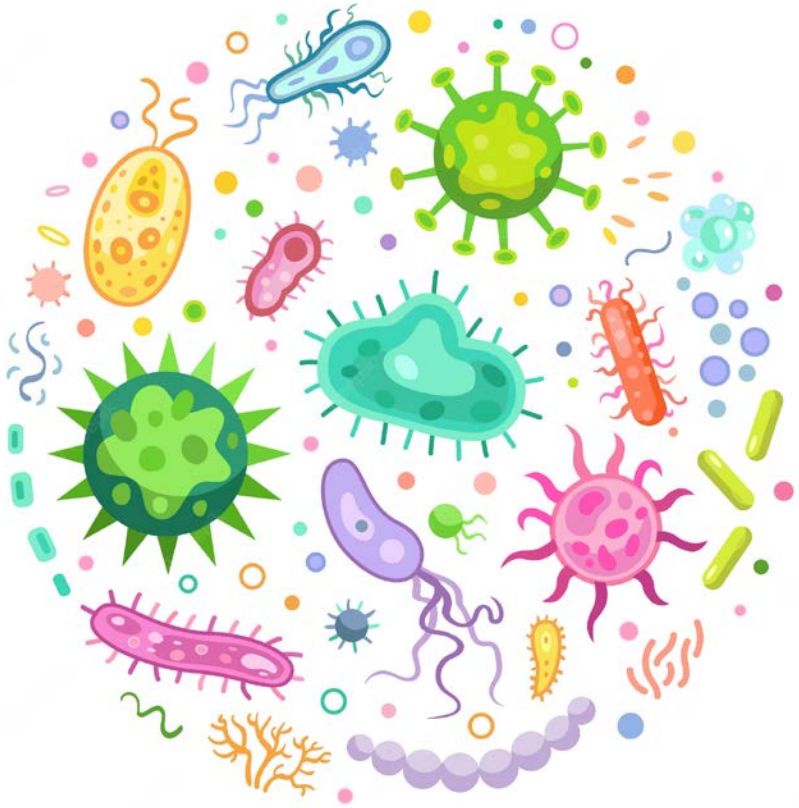
- Hz(N) = 7 and Hz(P)=5

In sensitive areas to eutrophication or when water body status is less than "Good" for parameter P, consider Hazard for:

- Hz(N) = 5 and Hz(P)=7

Definition of Hazard level (Hz): *Escherichia coli*

E. coli (ucf/100 mL)	Hz
$\geq 10^4$	9
$10^3 < E. coli < 10^4$	7
$10^2 < E. coli \leq 10^3$	5
$10^1 < E. coli \leq 10^2$	3
$\leq 10^1$	1



Sensitive areas classified under criterion c (e.g.., protection of shellfish production sites)

Other pollutants

Chemicals: CoC, DBP, etc.

Chemicals: CoC, DBP, etc.	Hz
>EQS or >30·LoQ*	9
>10·LoQ	7
>LoQ	5
>LoD	3
<LoD	1

- For substances without EQS

LoQ – Limit of Quantification
LoD – Limit of Detection

- This table is currently used for:
  - Risk assessment for environment for water reuse purposes
    - Priority & Priority Substances
    - Specific pollutants
    - DBP (in case of disinfection by chlorination)

- **This is a very restrictive table, so for direct discharge a more robust one based on the Removal reduction percentage should be proposed**

Possible new table for UWW discharges

Quality grade	Hz	Indicators	Minimum percentage of removal
1	1	Substances that can pollute water even at low concentrations	80 %
2	3		50 %
3	5		30%
4	7		20%
5	9		No removal rate

Vulnerability of receptor (water resources)

Infiltration rate			No infiltration to groundwater	Low infiltration to groundwater	Medium infiltration to groundwater	High infiltration to groundwater
			I	II	III	IV
Sensitivity to Groundwater	Shallow aquifer or no clay protection	I	2	4	6	6
	Deep aquifer with clay protection	II	2	4	4	6
	Deep aquifer with significant clay protection	III	2	2	4	4
	No aquifer with hydrological continuity to the area	IV	2	2	4	4
Sensitivity to Surface Water			6	6	4	2
			IV	III	II	I
			High surface runoff	Medium Surface runoff	Low surface runoff	No surface runoff
			Surface runoff			

Matrix: Adopted from ISO 16075-1:2020

$$V_{WR} = Vp_{GW} \times fp_{GW} + Vp_{SW} \times fp_{SW}$$

$$f_{p_{GW}} = \frac{V_{p_{GW}}}{V_{p_{GW}} \mp V_{p_{SW}}}$$

$$f_{p_{SW}} = \frac{V_{p_{SW}}}{V_{p_{GW}} \mp V_{p_{SW}}}$$

V_{pGW} – Partial vulnerability to groundwaters

V_{pSW} – Partial vulnerability to surface waters

Values for V_{WR}	V_{WR} Prioritized
5,2	9
5,0	7
4,0	5
3,3	3

Damage (Severity vs Pressure significance)

Severity of damage	Observations according water resources evidence	Value
Severe	Water body with status less than good	5
Major	Water body in good status, with defined use and classification (vulnerable to nitrate pollution or sensitive area) or eutrophication risk	4
Moderate	Water body in good status, with defined use or classification (vulnerable to nitrate pollution or sensitive area)	3
Minor	Water body in good status, without defined use or classification (vulnerable to nitrate pollution or sensitive area)	2

Damage (D)			Low	Medium	High	Very High
			Pressure Mass Load (PML %)			
			2	3	4	5
Minor	Severity of damage	2	2	4	4	5
Moderate		3	4	4	6	7
Major		4	4	6	8	9
Severe		5	5	7	9	9

Pressure significance	Pressure Mass Load (PML %)*	WWTP dimension (Load p.e)**	Value
Low	PML < 10	p.e. < 2000	2
Medium	10 ≤ PML < 20	2000 ≤ p.e. < 1000	3
High	20 ≤ PML < 50	10000 ≤ p.e. < 50000	4
Very high	PML ≥ 50	p.e. ≥ 50000	5

$$\text{* Pressure Mass Load (PML \%)} = \frac{\text{Discharge load of WWTP in assessment (p.e.)}}{\text{Total mass load discharded in water body (p.e.)}} \times 100$$

** Used when is not possible to define the PML

Risk assessment

- **Risk for Water Resources (R_{WR})**

$$R_{WR} = \frac{Hz \times V_{Hz} \times (D/9)}{9}$$

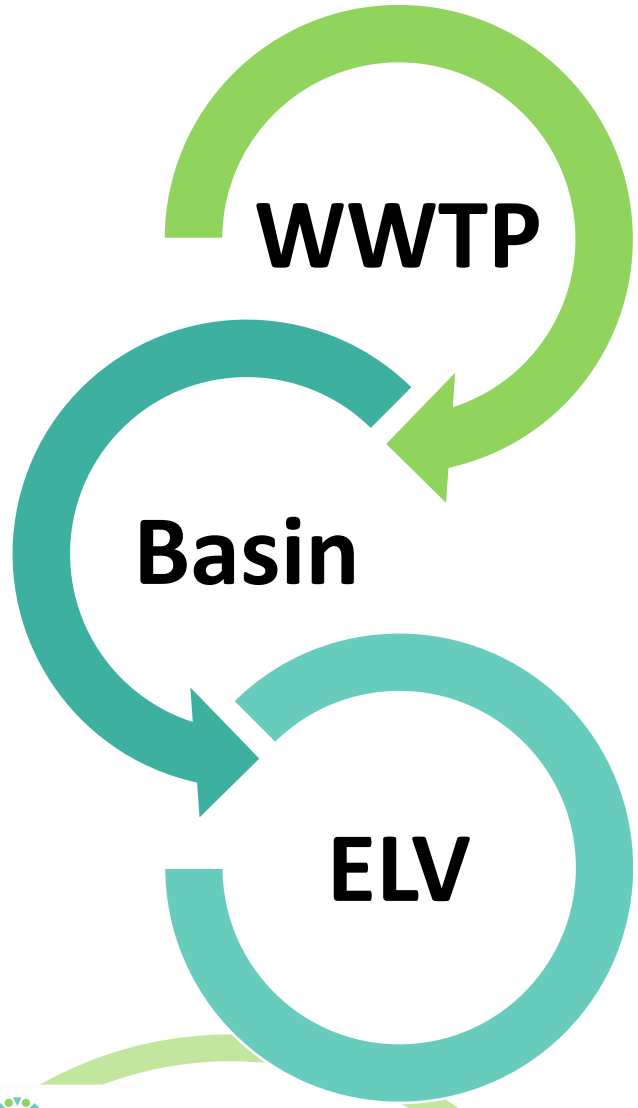
Hz – Hazard for N, P, E. coli or other pollutants

V_{WR} – Vulnerability to water resources

D - Damage

Significance	Result	ELV
High	4,5<R≤9	ELV must be lower than Hz considered
Moderate	1<R≤4,5	Could be applied an • ELV lower than Hz considered (reassessment) • ELV = Hz with additional restrictions (e.g. seasonal criteria) • ELV = Hz with additional monitoring (e.g. water body) in areas with high hydrodynamics
Low	R≤1	ELV can be equal to Hz without the need of additional restrictions

How do we use



New Plant: Before design
Existent plant: Before any retrofitting work

Look at agglomeration load

Load assessment
Water body status
Uses
Classification

Look at River Basin management Plan

Use of described methodology to define best ELV and additional measures (more restricted monitoring, water resources monitoring or different ELV according seasonality

Data source

Wastewater discharge permits (project, monitoring, inspection…

RBMP: Water bodies monitoring under WFD

PGRH 3º ciclo

E-PRTR

PRTR: Data from 5f activities (UWWTP)

Academia: Research projects, e.g. (PT):

REWATER sustainable and safe water management in agriculture

LIFE IMPETUS

"Improving current barriers for controlling pharmaceutical compounds in urban wastewater treatment plants"

Linking Academia with environmental authority

Other existent monitoring data

SNIRH Sistema Nacional de Información de Recursos Hídricos

apa

Example

Agglomeration A: Capacity Load: 51 000 p.e.

WWTP capacity: 55 000 p.e.

WWTP: SEC+ (secondary + UV disinfection)

Receiving water body:

- Classified as sensitive (criterion c) due to shellfish production
- Status (WFD): Good

WWTP (annual load): 7828,8 kg BOD_5/year

Total mass load in the water body: 245242,5 kg BOD_5/year

Substance X or "Group of six substances of UWWTD list"

	Restricted table (Substance X)	**Proposal Min % Reduction ("Group of six substances of UWWTD list")**
ELV proposal	ELV ≤ 30·LoQ	50%
Common data	Surface/Groundwater vulnerability: $V_{SW} = 6$, $V_{GW} = 2$ Pressure mass load: PML = 3,2% (Low)	
Hz	9	3
V_{WR}	7	7
D	4	4
R	3,1 (Moderate)	1,0 (Low)

Substance X – ELV (restricted table):

- **Can be applied an ELV lower than Hz (30·LoQ) considered or imposed additional restrictions, depending WR hydrodynamic**
- **Reassessment result that for R≤1 (low), the ELV should be above LoD, but could be lower than LoQ**

"Group of six substances" – ELV according a possible proposal in terms of minimum percentage removal of 50%

- **Risk = 1,0 (Low)**

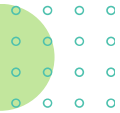
- **Main constraints are the receiving water bodies characteristics and overall discharged load**

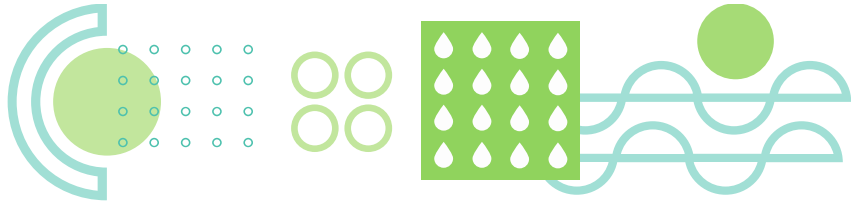
UWWTD Recast vs Risk Assessment (RA) proposal

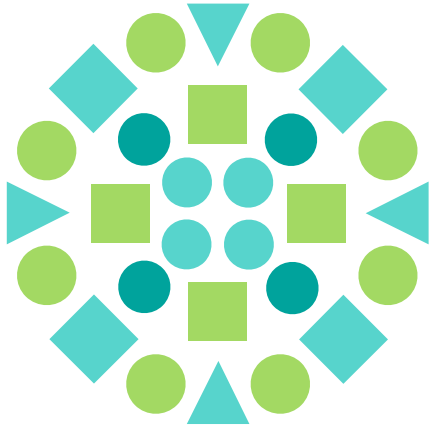
UWWTD	RA
✓ Compliance & achievement of environmental goals	✓ Compliance & achievement of environmental goals
✓ Linking between several directives	✓ Linking between several directives (despite the ones mention on the recast also includes IED and nitrates directive and allow synergies for the use of information collected under the several legal obligations)
✓ ELV definition (use of flat criteria with easy compliance assessment checking)	✓ ELV definition (simple approach to use, with easy inputs and simple outputs, allowing to keep the simple compliance assessment checking process)
✓ Approach that allows to include a cost-benefit assessment ("blind" approach supported on load criteria)	✓ Approach that allows to include a cost-benefit assessment (allows an ongoing cost-benefit assessment, e.g., in permit review, according multiple criteria, such as load and water resources characteristics)
✓ Optimization of efforts and resources use (carbon neutrality)	✓ Optimization of efforts and resources use (carbon neutrality, but minimizes the use of energy and chemicals when more stringent treatment does not lead to a true environmental benefit

Final remarks

- Multicriteria-analyses tool for the assessment of risks caused by urban wastewater discharges to the environment and human health
- Tool with the use of known inputs and easy outputs: Easily assessed its application and that also allow to maintain the simplicity of current compliance assessment under the UWWTD
- Proposal of ELV are used as input data. Other input data result from from RBMP and other monitoring requirements under EU directives
- Is taken into account the susceptibility of the water body to pollution, with assessment of several factors and its relationships (quality and status of water bodies, its current and/or foreseen uses and its hydrogeological, geomorphological and hydrodynamic characteristics)
- The use of PML allows to observe multiple effects from multiple pollution sources (allows to link the overall effect from multiple discharges (e.g., IED installations and UWWP) and subsequently, follow-up results from the implementation of Program of Measures
- This approach can be applied to any range of population (including ≥ 100 000 p.e.) and adjustments could be taken into account the values from UWWTD recast
- The Position Paper proposed by Portugal intends to show the possibility of using this kind of approaches to promote the achievement of the main goal: The Good Water Status







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THANK YOU

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