Rural Roadwater Rescue

Roadwater re-use & treatment options

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MOTIVATION With climate change, extreme periods of both too much water and a shortage of water are getting more frequent. In both situations, roads and especially highways can help in conserving and transporting water, however, the water of roads is highly polluted. The goal of the RRR-project is to achieve that highways are contributing to solving local water problems in both directions. Cleaning the water is obligatory to make it available for local use. Therefore, possible, integrated, cross-sectoral solutions for the use of runoff roadwater depending on water quality and legal boundaries are presented here.

1 HOW IT IS

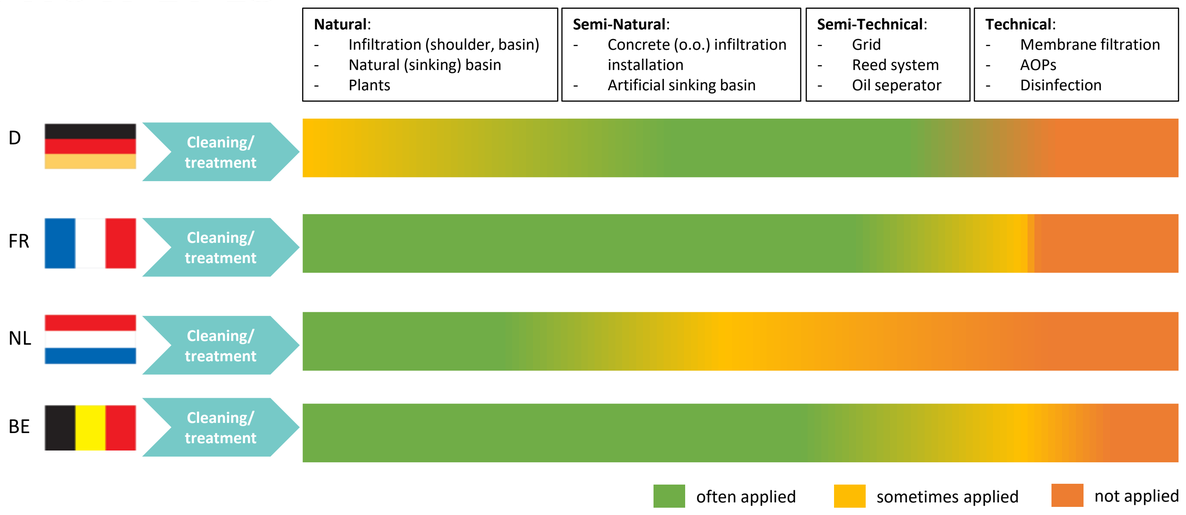

Figure 1: Current degree of roadwater cleaning strategies in NWE partner countries.

- GERMANY: mainly semi-natural and semi-technical solutions
- FRANCE: natural and semi-natural solutions
- NETHERLANDS: only natural solutions
- BELGIUM: natural and semi-natural solutions

There are **no unique EU-wide regulations or recommendations** how to deal with polluted water coming from roads!

3 HOW TO GET THERE

Roadwater is usually contaminated with particles, dissolved hydrocarbons, heavy metals and other materials, that are spread from tyre wear, accidents and wastes. Moreover, as it is in contact with wastes on the roads and on the shoulders next to roads, it will normally be contaminated microbiologically. The cleaning and treatment solutions are ranked according to different categories. With these categories it can be seen, that natural and semi-natural treatments are easier to use than technical treatment steps. Tiles are more green for natural and more red for technical treatments.

Natural treatment	Installation costs	Maintanance costs	Personnel requirements	Robustness	Material requirements	Applicability	Water throughput	Space needed
Natural infiltration (shoulder, basin)	5	5	4	5	5	5	3	5
Natural (sinking) basin	5	4	5	5	5	5	4	3
Plants	5	4	5	4	5	5	4	4

Semi-Natural / Semi-Technical treatment	Installation costs	Maintanance costs	Personnel requirements	Robustness	Material requirements	Applicability	Water throughput	Space needed
Artificial sinking basin	4	4	5	5	3	5	5	3
Infiltration installation	4	4	4	5	4	5	4	4
Grids	4	3	3	4	3	5	5	5
Reed systems	4	3	4	4	4	5	4	4
Oil Separators	4	4	3	4	3	5	5	4

Technical treatment	Installation costs	Maintanance costs	Personnel requirements	Robustness	Material requirements	Applicability	Water throughput	Space needed
Rapid sand filters	3	3	3	3	3	3	3	2
Slow sand filters	3	3	3	3	3	3	3	2
Aeration basin	3	3	3	3	3	3	3	2
Lime	2	3	3	3	3	3	3	2
Chlorine-Dosage	2	3	2	3	3	2	3	3
Aquatextiles	3	2	2	2	3	3	3	3
Flocculation	2	2	2	2	2	2	3	3
Adsorption: Activated Carbon	2	2	2	2	2	2	3	3
STOPPOL® plant	2	2	2	2	2	2	2	2
Disinfection: UV	2	2	2	2	1	2	2	3
Nanobubbles	2	1	2	2	2	2	3	2
Membrane filtration: UF	2	2	1	1	1	1	2	3
Ozonation	2	1	1	1	1	1	3	3
H_2O_2-Dosage	2	1	1	1	1	1	2	3
Membrane filtration: NF	1	1	1	1	1	1	1	3
Membrane filtration: RO	1	1	1	1	1	1	1	3

Installation costs	very cheap	5	4	3	2	1	very expensive	*Costs that must be considered for the installation of the treatment method itself*
Maintenance costs	very cheap	5	4	3	2	1	very expensive	*Costs that must be considered for the maintainance of the treatment method (including personell costs)*
Personnel requirements	very low demand	5	4	3	2	1	very high demand	*Includes personnel costs and requirements of specialists/engineers/..*
Robustness	very robust	5	4	3	2	1	very vulnerable	*Gives indication of the durability of a treatment method*
Material requirements	conventional, easy available	5	4	3	2	1	very special, rare	*Gives indication on how expensive or rare materials are, that are required for construction*
Applicability	easily installable	5	4	3	2	1	complicated	*Gives indication on how easy an installation and operation can be realized*
Water throughput	high and/or flexible	5	4	3	2	1	low and/or fixed	*Amount of water that can be treated in a certain time and adjustability to varying water amounts*
Space needed	very little	5	4	3	2	1	very high	*Space that is needed to construct the treatment plant or the store untreated and treated water*

Figure 4: Ranking of installation categories for the treatment solutions with definitions of water treatment method ranking categories.

2 WHERE TO GO

Roads and especially federal highways in NWE are always very close to industrial, municipal or private facilities, which could make use of the roadwater, often automatically collected by existing gullies. The uses mentioned below are potential uses among many other opportunities not considered here. Several categories could be identified to be useful when evaluating if roadwater could have advantages over the water usually utilised for a certain purpose. The uses require different water qualities which have defined microbiological (and other chemical) limit values.

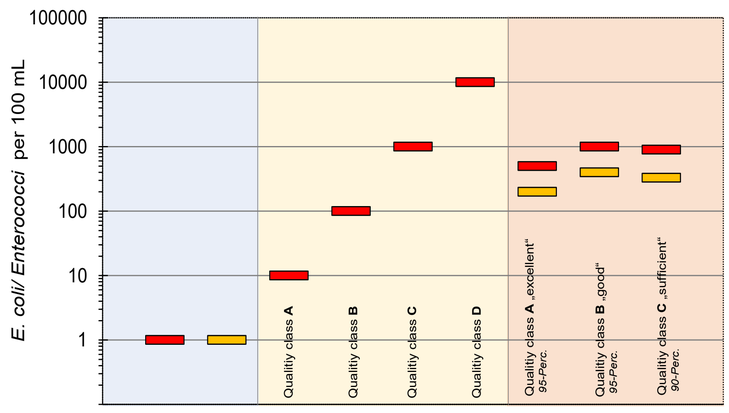

Figure 2: Limit values for fecal indicator bacteria *E. coli* and Enterococci within the three EU directives for drinking water (water for human consumption), reuse water (irrigation water) and bathing water.

Roadwater re-use options	Water quality
Industrial water utilization (e.g. industrial cooling, greenhouse warming)	5
Firefighting	5
Road cooling → prolonging road lifetime	5
Particle extraction to make e.g. new tires	5
Air washing along highways	5
Groundwater infiltration	4
Forestry	4
Re-weat of moors	4
Recharge dried out rivers	4
Concrete production	4

Roadwater re-use options	Water quality
Industrial plant cleaning	4
Toilet flushing (private, highway petrol stations,...)	4
Cementries	4
WWTP network cleaning	4
Gardening (private gardens, green streets)	3
Carwash	3
Paper recycling	3
Road cleaning	3
Industrial tool cleaning	3
Sports facilities (golf gardens,..)	3
Agriculture: eaten crops, vegetables, fruits	2

Water quality	
low quality	
5	*Wastewater (untreated greywater)*
4	*Surface Water (such as rivers and lakes)* ***EU regulation 2000/60/EC (2000)***
3	*Bathing water (Quality B: not for consumption but contact to human body)* ***EU regulation 2006/7/EG (2006)***
2	*Irrigation Water (Quality A: not for consumption but contact to human consumables)* ***EU regulation 2020/741 (2020)***
1	*Drinking Water (intended for human consumption)* ***EU regulation 2020/2184 (2020)***
high quality	

Figure 3: Roadwater reuse opportunities and their ranking for required water qualities. Water quality categories that indicate how low a water quality could be for a certain reuse and thus, how low the effort would be to make use of it. The categories 1, 2 and 3 are derived from the EU directives.

CONCLUSION The suggested treatments can help authorities to find solutions when they struggle with too high amounts of water after heavy rains, too low amounts for agricultural, cultural, municipal or industrial use in dry periods or water users looking for cheaper, more sustainable or generally available water resources for a specific application. Decision makers hopefully will be motivated to take these and similar solutions into account when planning future infrastructures with more circulatory water systems.

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Poster for the final conference of Rural Roadwater Rescue
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