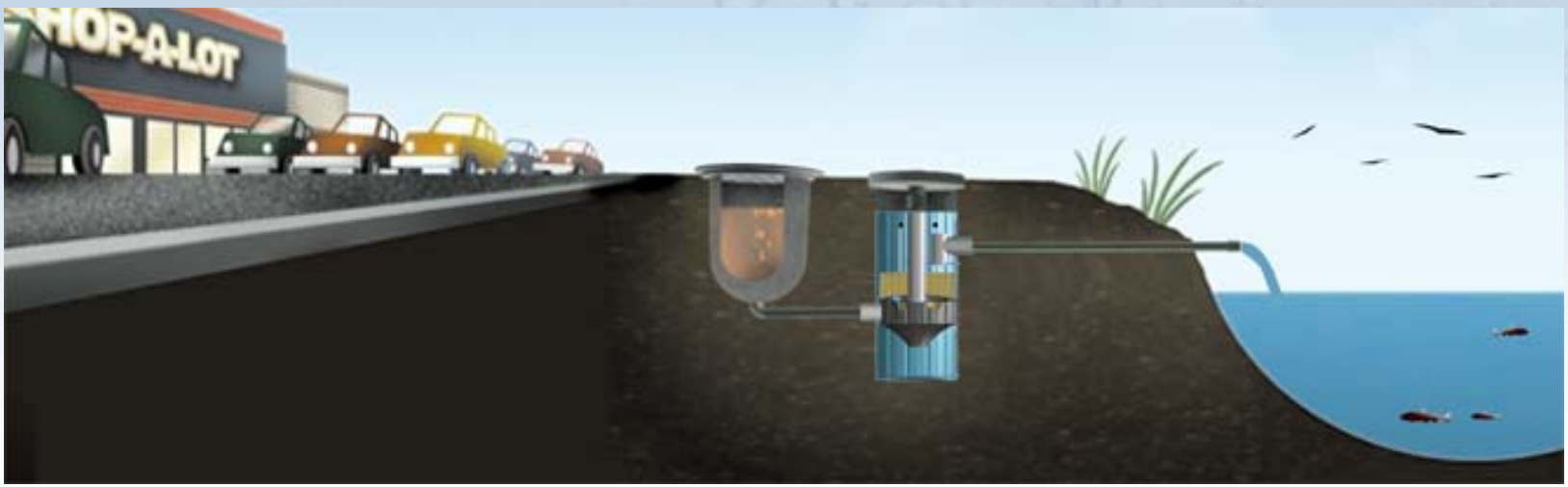
Infiltration of Contaminated Stormwater Runoff through Artificial Barriers



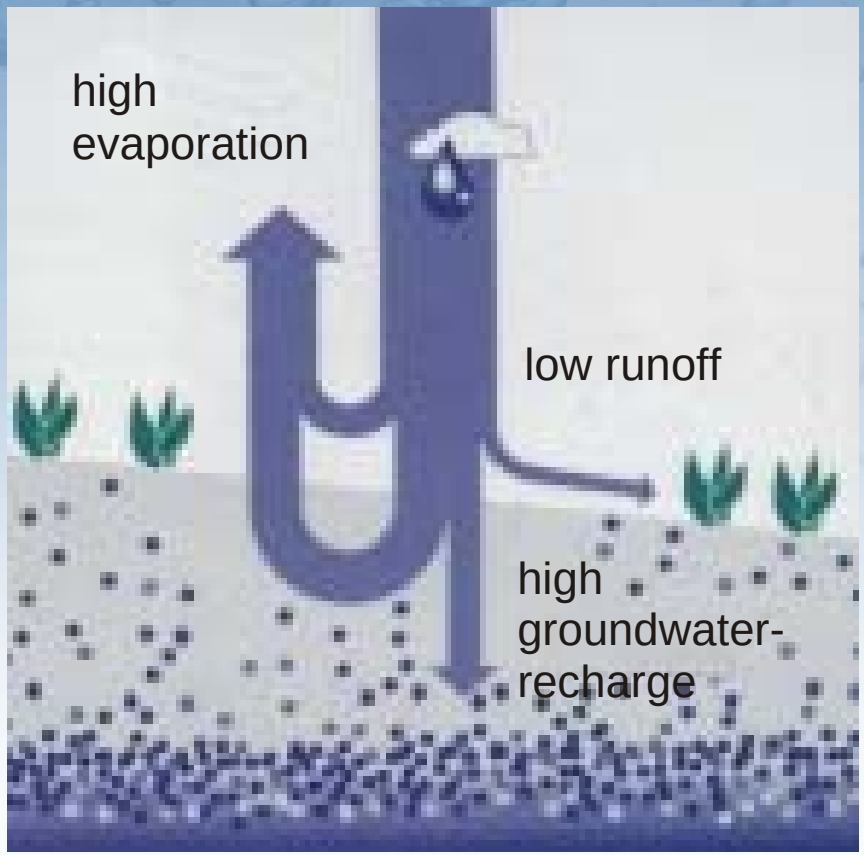
Carsten Dierkes, Münster

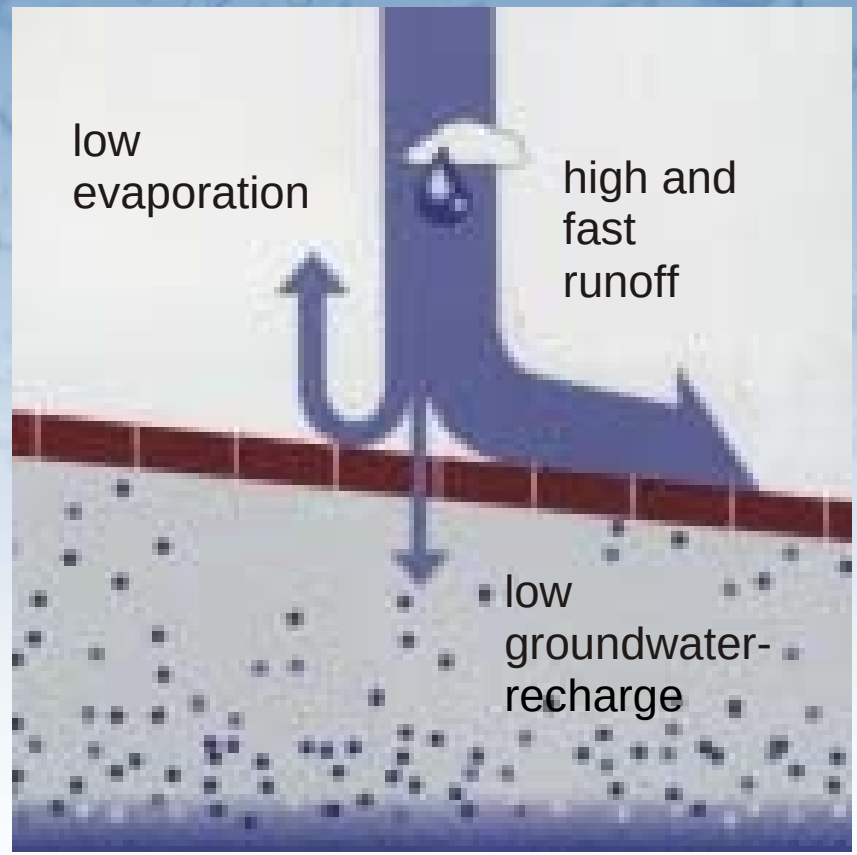
HydroCon

Content

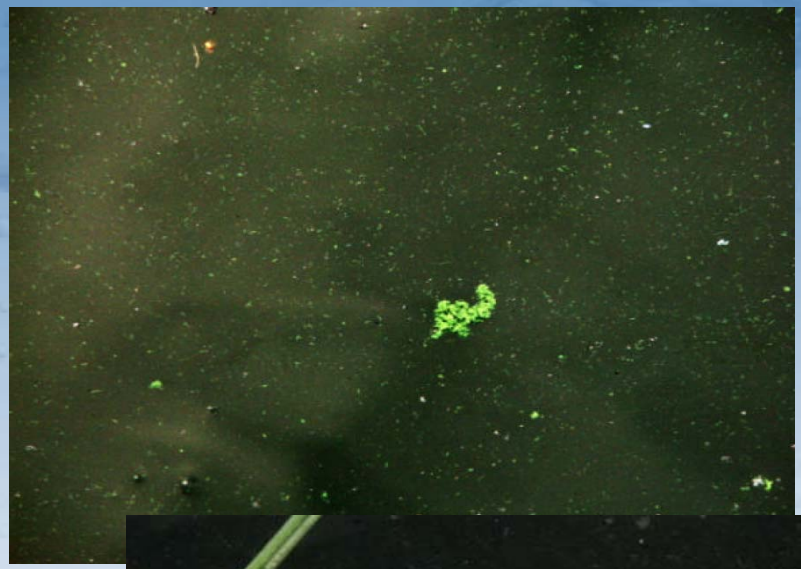
- **Introduction**
- **Pollutants in Stormwater Runoff**
- **Aims for Infiltration**
- **Artificial Barrier Materials**
- **Research Projects and Results**
- **Conclusions**

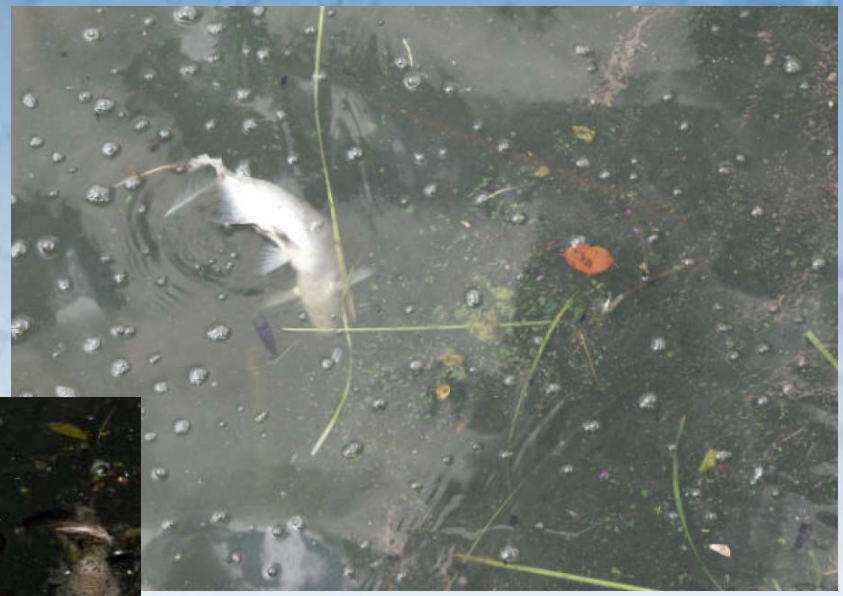
Urban Water Cycle





Endangering Water Resources





Photographs:
Surholt und Keckevoet (2001)

Flooding

Green Roofs

Infiltration Swales

Problems of Stormwater Treatment

- High levels of TSS, filter capabilities are reduced
- Strong rain events, high flow-rates, short contact times with filter material
- Dissolved substances, mechanical filters can not solve the problem
- Space consuming systems
- Maintenance must be cost effective
- Control possibilities

Pollutants in Runoff

inorganic substances

heavy metals
aluminium
arsen
cadmium
chromium
copper
iron
lead
mercury
nickel
zink

salt

organic substances

nutrients
nitrate, phosphate

pesticides

phenols

PAH
benzo(a)pyrene
anthracene
benzo(g,h,i)perylene

hydrocarbons

bacteria, viruses

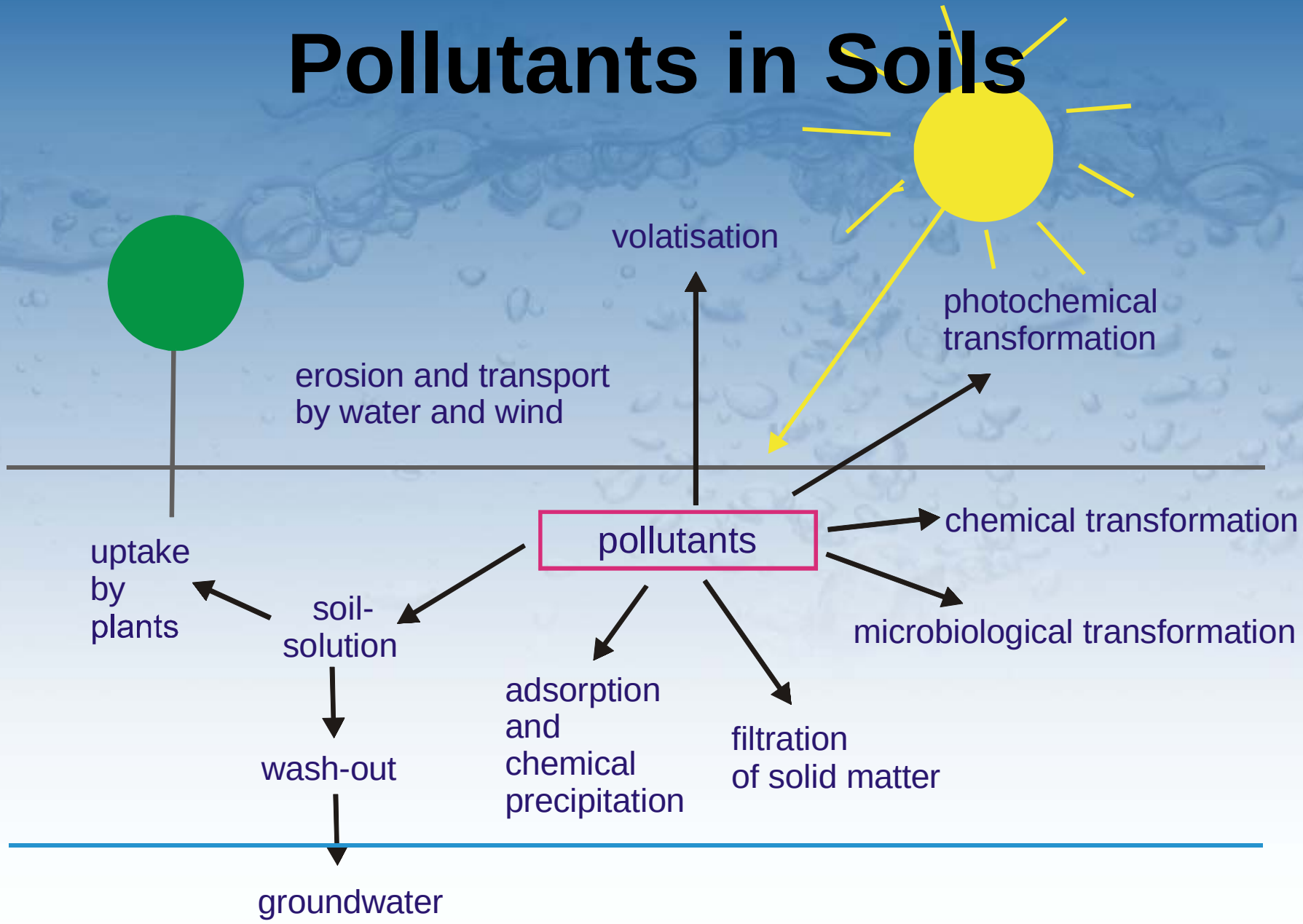
Aims

Stoff	Einheit	Dach allgemein		Kupferdach		Zinkdach		Parkplatz, Anliegerstraße		Hauptstraße		Gewässer LAWA [1]	TrinkWV[2]	BBod SchV	HydroCon System
		von	bis	von	bis	von	bis	von	bis	von	bis	Grenzwert	Grenzwert	Prüfwert	Zielwert
Summenparameter															
elektr. Lf.	(uS/cm)	25	270	25	270	25	270	50	2400	110	2400	-	2500	-	< 1500
pH-Wert	(-)	4,7	6,8	4,7	6,8	4,7	6,8	6,4	7,9	6,4	7,9	-	6,5 - 9,5	-	7,0 - 9,5
Nährstoffe															
P ges	(mg/l)	0,06	0,50	0,06	0,50	0,06	0,50	0,09	0,30	0,23	0,34	-	-	-	-
NH_4	(mg/l)	0,1	6,2	0,1	6,2	0,1	6,2	0,0	0,9	0,5	2,3	-	0,5	-	-
NO_3	(mg/l)	0,1	4,7	0,1	4,7	0,1	4,7	0,0	16,0	0,0	16,0	-	50,0	-	-
Schwermetalle															
Cd	(mg/l)	0,2	2,5	0,2	1,0	0,5	2,0	0,2	1,7	0,3	13,0	1,0	5,0	5,0	< 1,0
Zn	(mg/l)	24	4.880	24	877	1.731	43.674	15	1.420	120	2.000	500	-	500	< 500
Cu	(mg/l)	6	3.416	2.200	8.500	11	950	21	140	97	104	20	2000	50	< 50
Pb	(mg/l)	2	493	2	493	4	302	98	170	11	525	50	10	25	< 25
Ni	(mg/l)	2	7	2	7	2	7	4	70	4	70	50	20	50	< 50
Cr	(mg/l)	2	6	2	6	2	6	6	50	6	50	50	50	50	< 50
Org. Summenparameter															
PAK (EPA)	(ug/l)	0,4	0,6	0,4	0,6	0,4	0,6	0,2	17,1	0,2	17,1	-	0,1 (6 Verb.)	0,2	< 0,2
MKW	(mg/l)	0,1	3,1	0,1	3,1	0,1	3,1	0,1	6,5	0,1	6,5	-	-	0,2	< 0,2

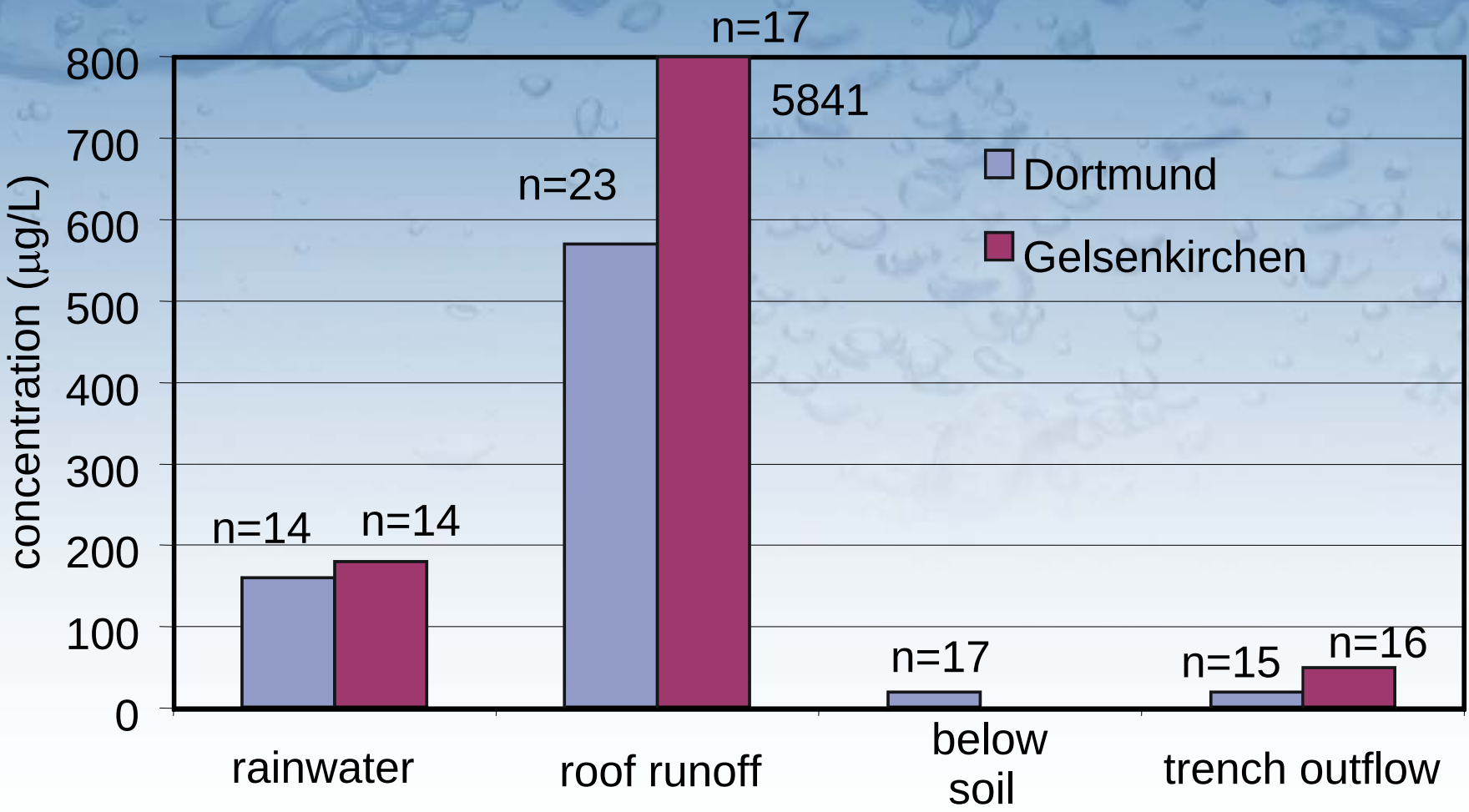
kritischer Parameter, Reinigung notwendig
in der Regel keiner Reinigung notwendig, Einzelfallentscheidung
in der Regel unkritischer Parameter
noch keine Aussage möglich

[1] Zielvorgaben der Länderarbeitsgemeinschaft Wasser für das Schutzgut Oberflächengewässer, Nutzungsart Trinkwasser [LAW98]
[2] Grenzwerte der Trinkwasserverordnung [TVO01]
[3] Prüfwerte des Wirkungspfades Boden-Grundwasser nach §8 Abs. 1 Satz 2 des BBodSchG [BBG99]

Pollutants in Soils



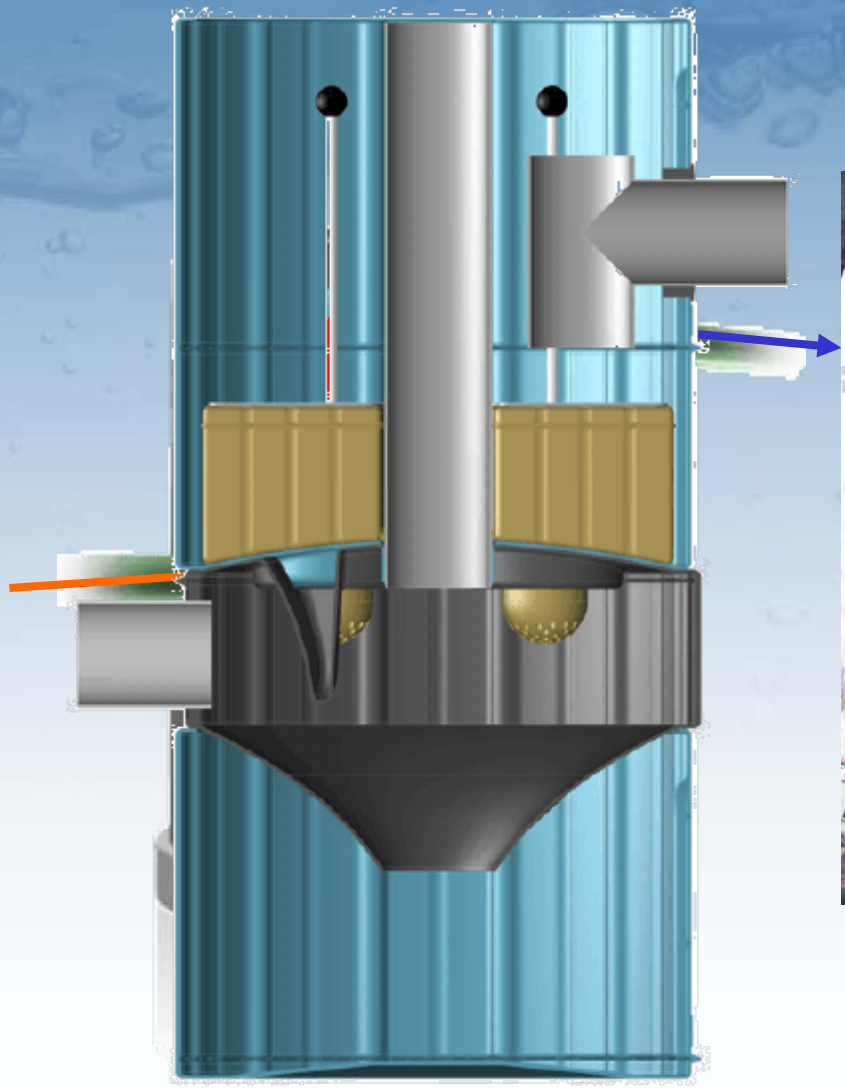
Zinc in a swale



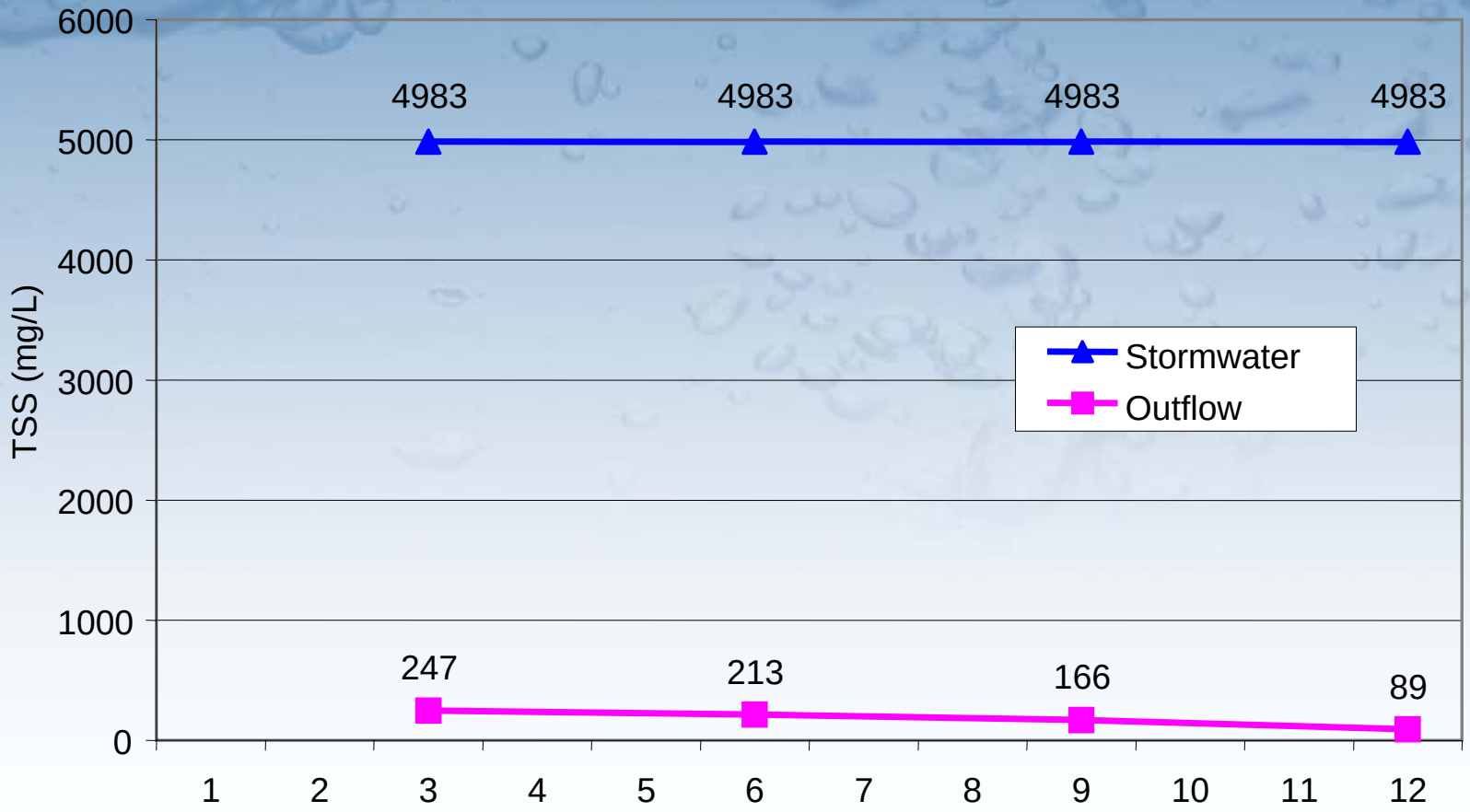
Test Rigs

Test Facilities

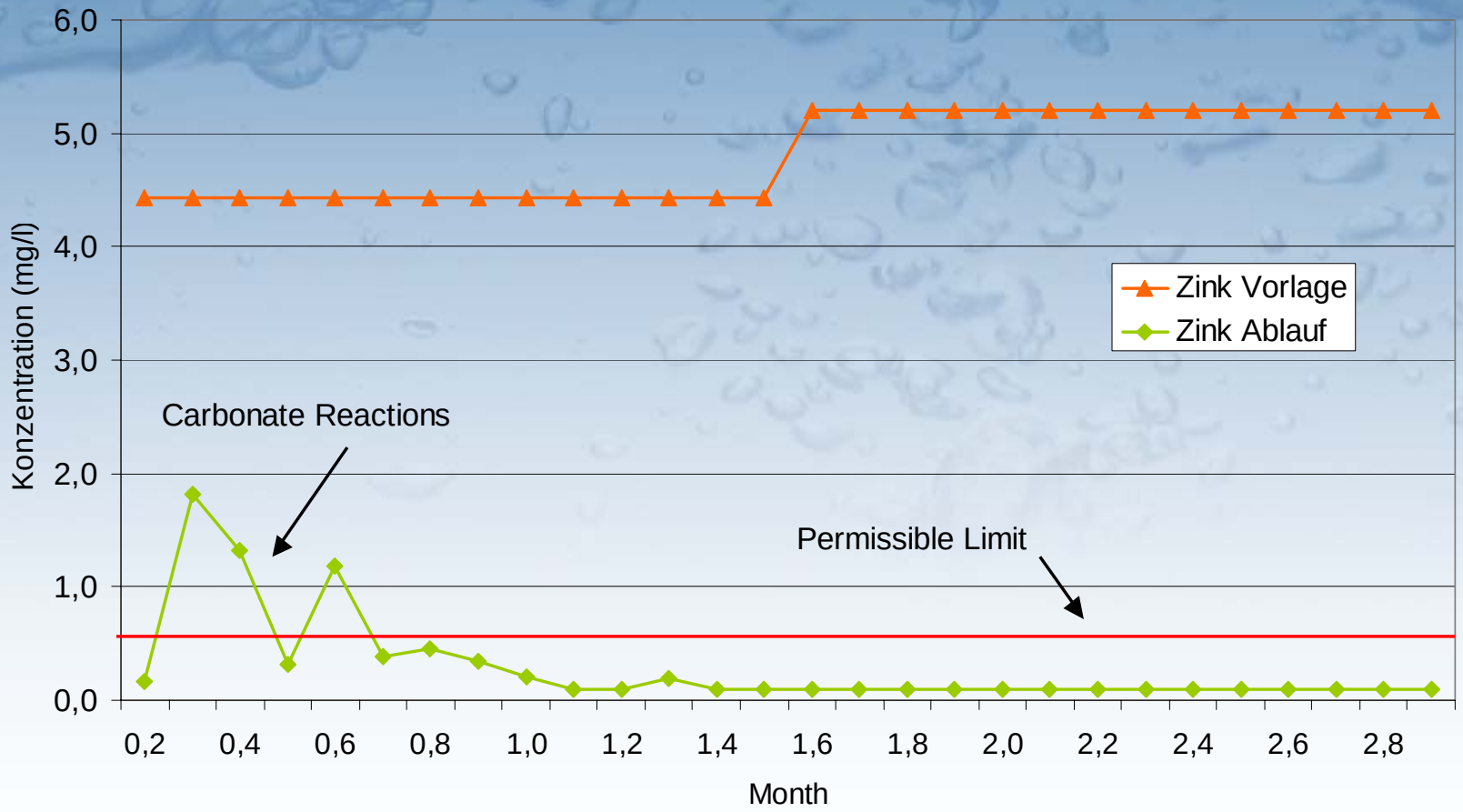
Pollutant Removal



Retention of TSS



Retention of Zinc

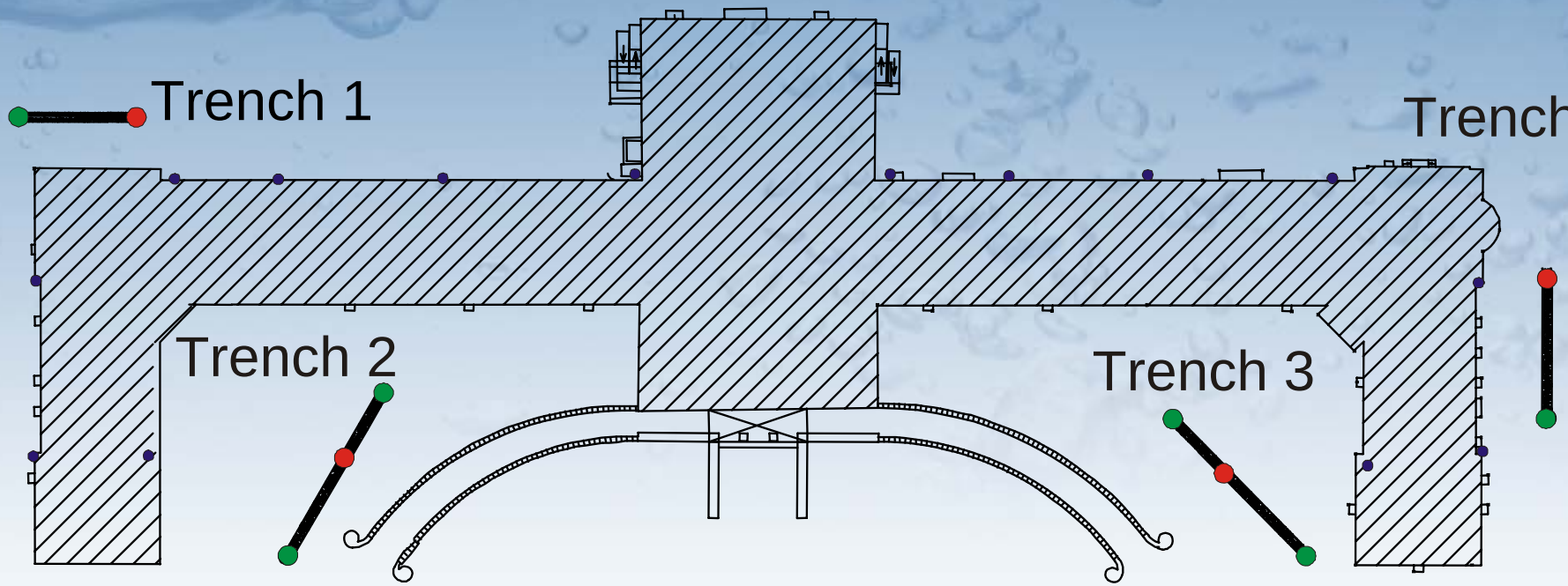


Development of Filters

- Roof Runoff
- Metal Roofs
- Traffic Areas, low traffic density
- Traffic Areas, high traffic density
- Separate System
- Green Roofs
- Industrial Areas

Zeolite Barrier Materials

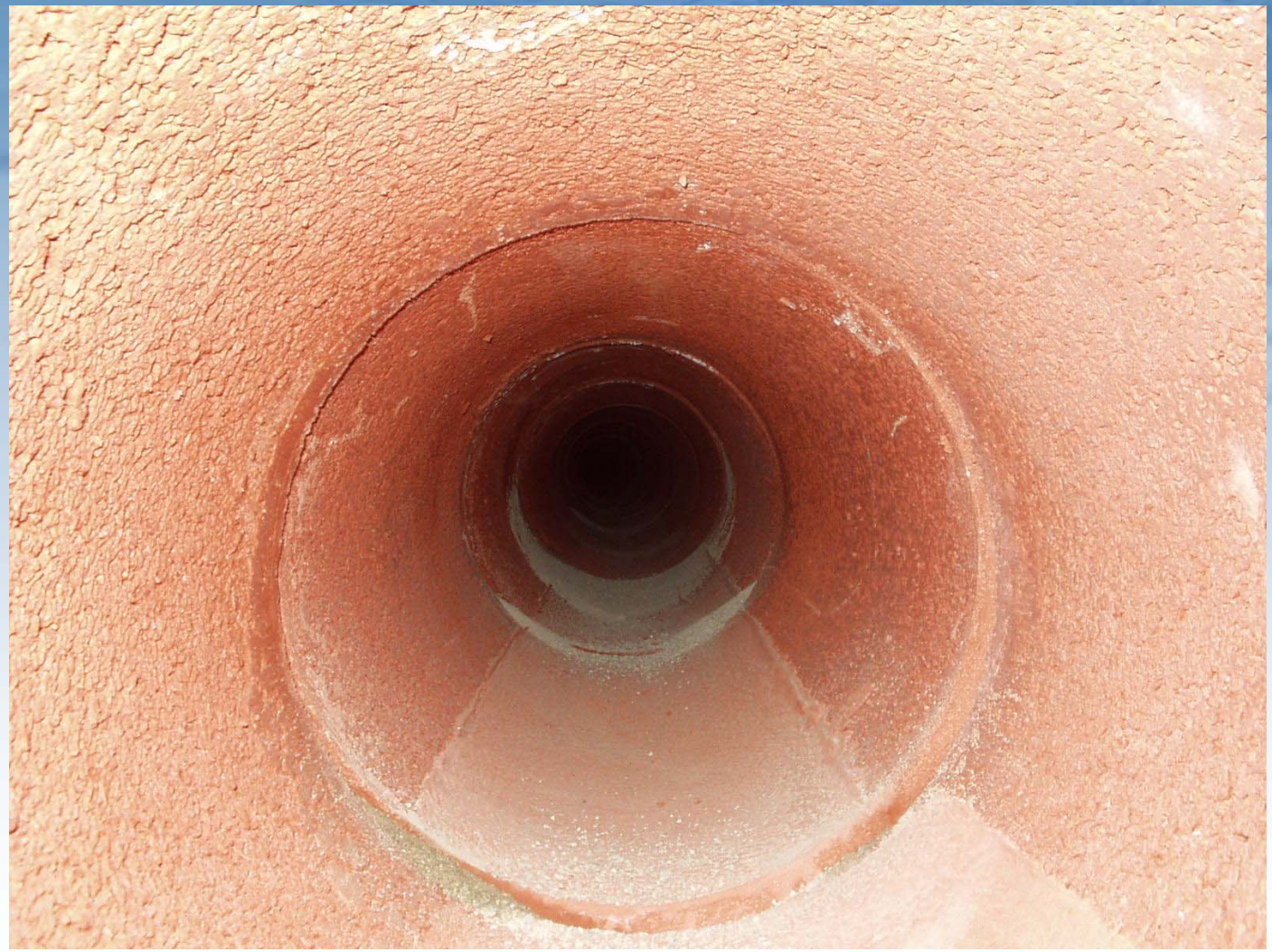
Copper Roof Project in Munich



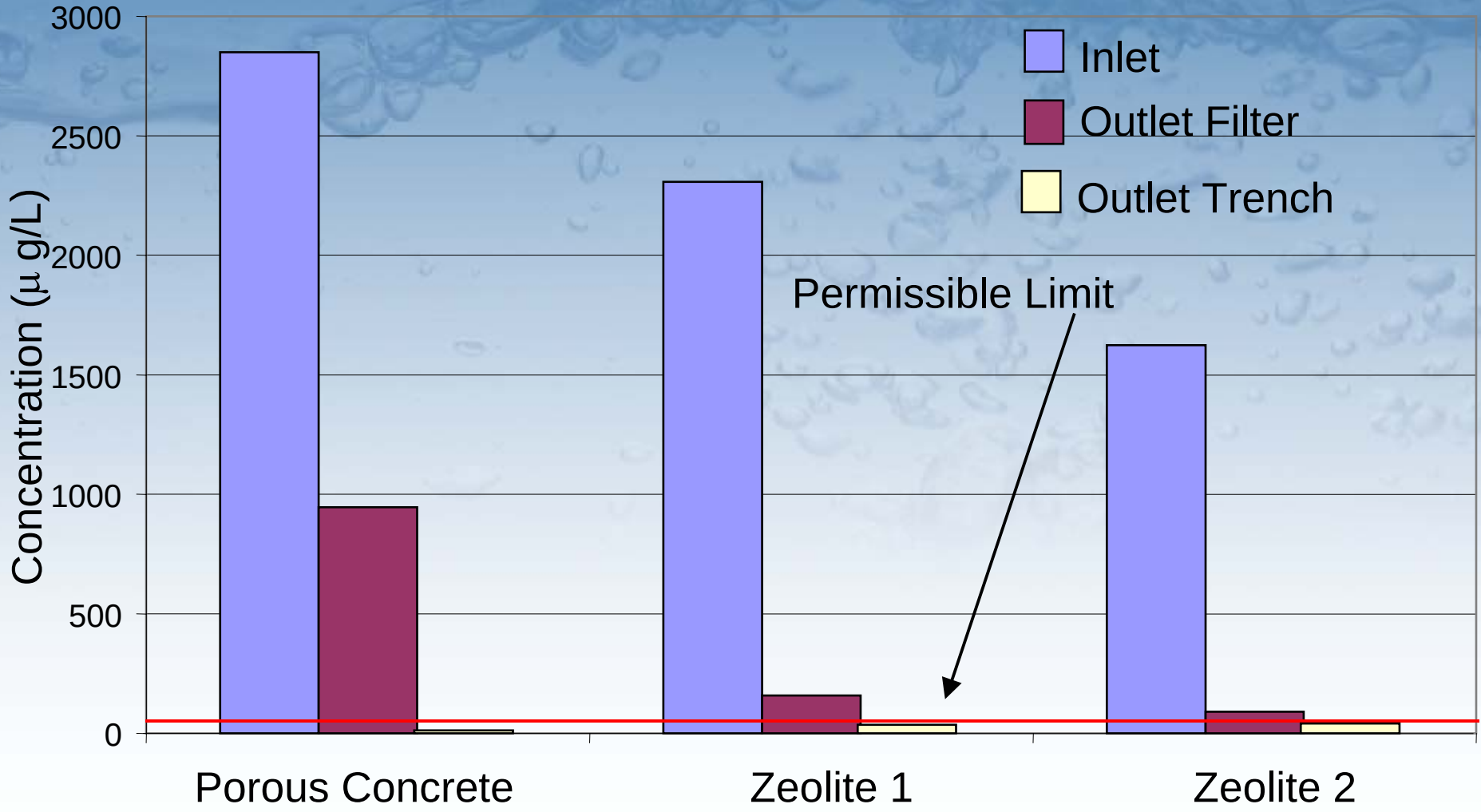
- Pollution Control Pit
- Sampling Pit

Pollution Control Pit

Drainage Pipe



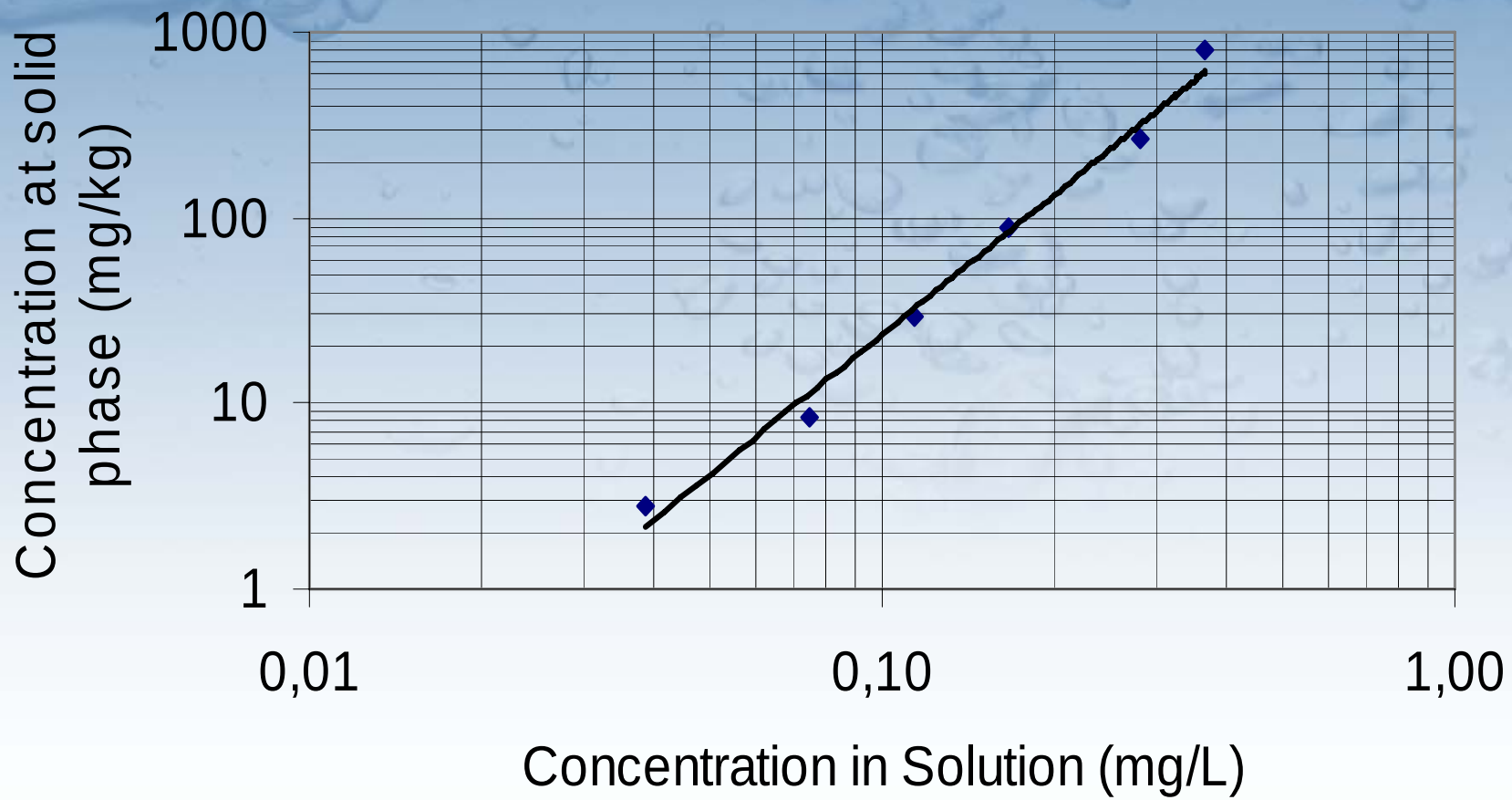
Copper Roofs



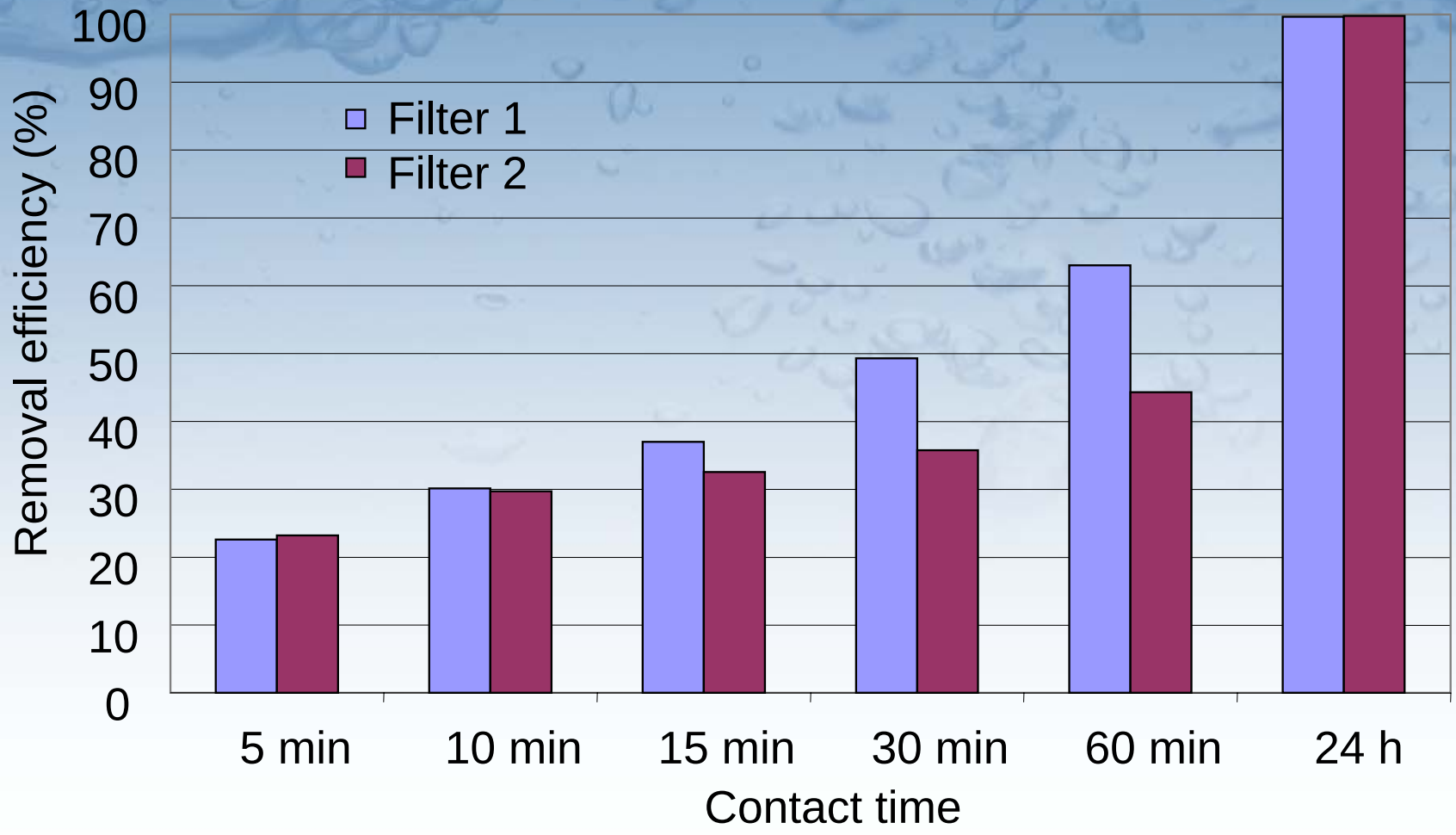
Athanasiadis et al. 2006

Removal of Phosphorous

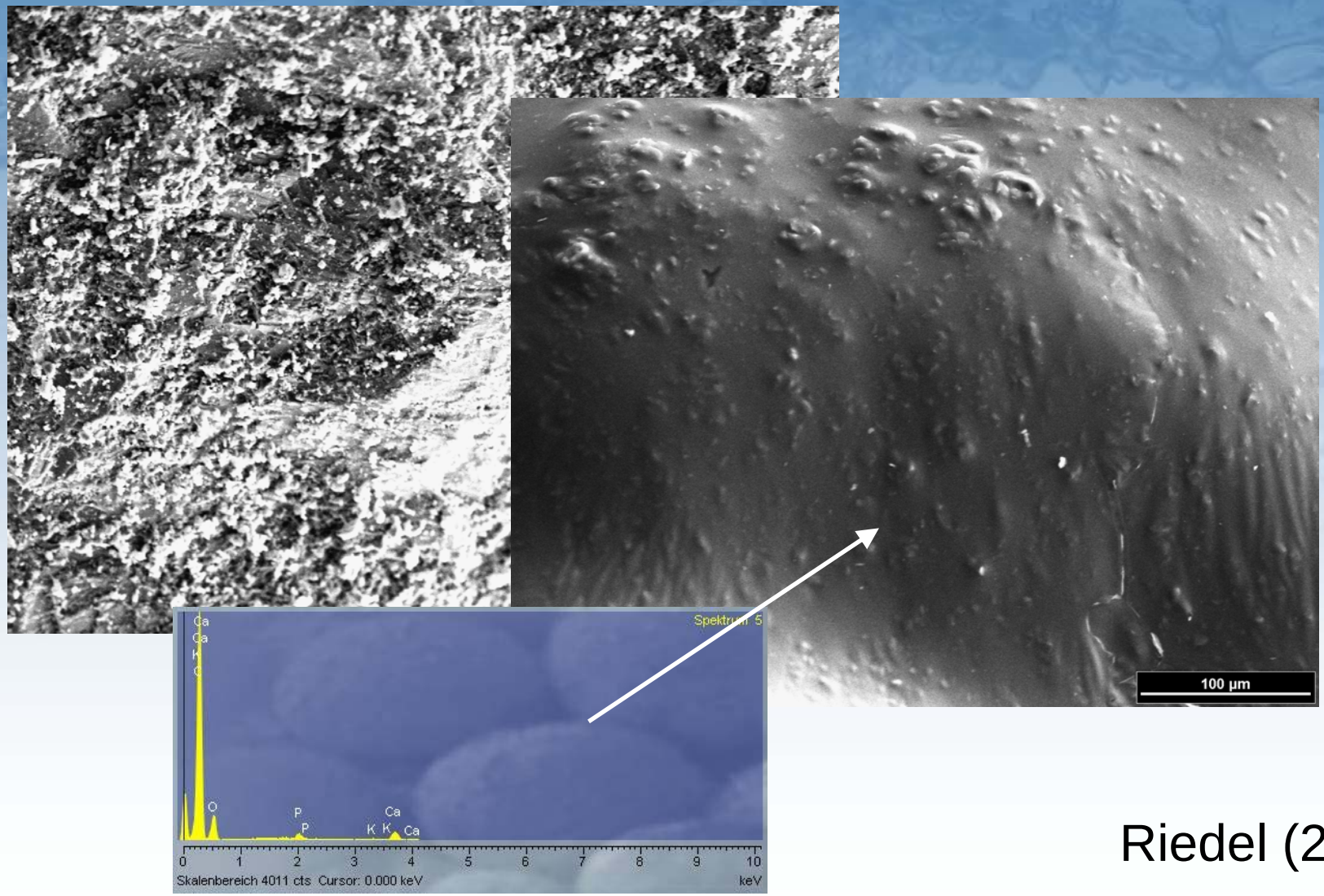
Isotherm for Phosphorous



Kinetics of Sorption



Phosphorous-Removal



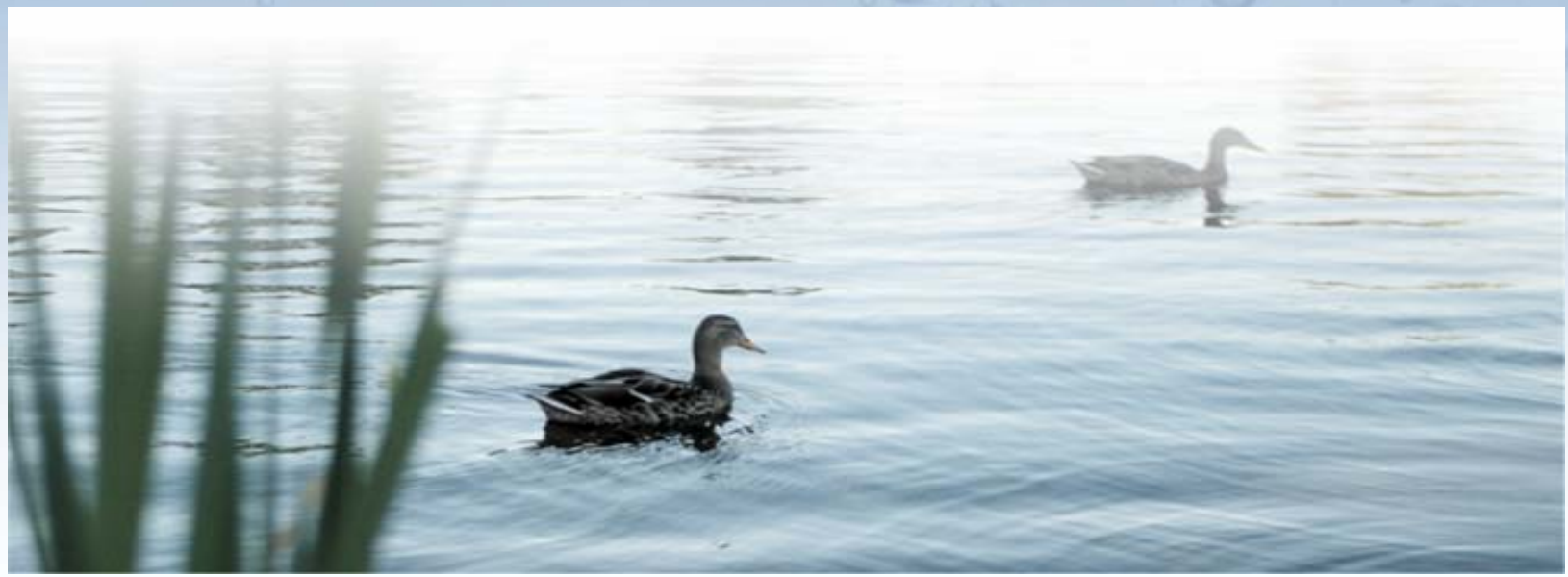
Riedel (2006)

Pollution Control Pit

Conclusions

- Stormwater treatment before infiltration is a complex challenge
- Treatment trains are necessary to retain all relevant pollutants
- Efficiencies more than 90 % are possible
- Contact times, inner surfaces of filter materials must be taken into account
- Long term studies are necessary
- Maintenance and control problems must be solved

Thank you for your Attention



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