Table S1. Chemical composition of quartz pebbles used in our study.

Chemical constituents	**Amount (%)**
SiO_2	97.5
Al_2O_3	1.3
Mn_3O_4	0.01
Fe_2O_3	0.19
TiO_2	0.03
MgO	0.17
K_2O	0.7
P_2O_5	0.03
Na_2O	0.01
Cr_2O_3	0.01

Table S2. PFAS analytes and corresponding isotopically labelled standards

PFAS analyte	**Abbreviation**	**Internal standard**
Perfluoro-3-methoxypropanoic acid	PFMPA	Perfluoropentanoic acid $^{13}C_5$
Perfluoropentanoic acid	PFPeA	Perfluoropentanoic acid $^{13}C_5$
Perfluoropentanoic acid $^{13}C_5$	M5PFPeA	
Perfluorobutane sulfonic acid	PFBS	Perfluorobutane sulfonic acid $^{13}C_3$
Perfluorobutane sulfonic acid$^{13}C_3$	M3PFBS	
Perfluoro-4-methoxybutanoic acid	PFMBA	Perfluorobutane sulfonic acid $^{13}C_3$
Perfluoro (2-ethoxyethane) sulfonic acid	PFEESA	Perfluorobutane sulfonic acid $^{13}C_3$
4:2 fluorotelomer sulfonate	4:2 FTS	4:2 fluorotelomer sulfonate $^{13}C_2$
4:2 fluorotelomer sulfonate $^{13}C_2$	M2-4:2FTS	
Perfluorohexanoic acid	PFHxS	Perfluorohexanoic acid $^{13}C_5$
Perfluorohexanoic acid $^{13}C_5$	M5PFHxA	
Perfluoropentane sulfonic acid	PFPeS	Perfluorohexanoic acid $^{13}C_5$
Perfluoroheptanoic acid	PFHpS	Perfluoroheptanoic acid $^{13}C_4$
Perfluoroheptanoic acid $^{13}C_4$	M4PFHpA	
Perfluorohexane sulfonic acid	PFHxS	Perfluorohexane sulfonic acid $^{13}C_3$
Perfluorohexane sulfonic acid $^{13}C_3$	M3PFHxS	
Sodium dodecafluoro-3H-4, 8-dioxanonanoate	NaDONA	Perfluorohexane sulfonic acid $^{13}C_3$
6:2 fluorotelomer sulfonate	6:2 FTS	6:2 fluorotelomer sulfonate $^{13}C_2$
6:2 fluorotelomer sulfonate $^{13}C_2$	M2-6:2FTS	
Perflurooctanoic acid	PFOA	Perflurooctanoic acid $^{13}C_8$
Perflurooctanoic acid $^{13}C_8$	M8PFOA	
Perflurooheptane sulfonic acid	PFHpS	Perflurooctanoic acid $^{13}C_8$
Perfluorononanoic acid	PFNA	Perfluorononanoic acid $^{13}C_9$
Perfluorononanoic acid $^{13}C_9$	M9PFNA	
Perfluorooctane sulfonic acid	PFOS	Perfluorooctane sulfonic acid $^{13}C_8$
Perfluorooctane sulfonic acid $^{13}C_8$	M8PFOS	
9-chlorohexadecafluoro-3-oxanonane-1-sulfonate	9Cl-PF3ONS	8:2 fluorotelomer sulfonate $^{13}C_2$
8:2 fluorotelomer sulfonate	8:2 FTS	8:2 fluorotelomer sulfonate $^{13}C_2$
8:2 fluorotelomer sulfonate $^{13}C_2$	M2-8:2FTS	
Perfluorodecanoic acid	PFDA	Perfluorodecanoic acid $^{13}C_6$
Perfluorodecanoic acid $^{13}C_6$	M6PFDA	

S1. Statistical Analysis

Statistical analysis was conducted using IBM SPSS 28.0. The normality of all datasets was assessed using the Shapiro-Wilks test. Subsequently, the datasets were compared using both one-way ANOVA and Kruskal-Wallis one-way ANOVA. The outcomes of the statistical analysis are presented in Tables S3 – S5.

Table S3. Non-parametric statistical comparison between adsorption of different PFAS functional groups onto gravels after exposure (up to 7 days) using Kruskal-Wallis (K-W) and Mann-Whitney U ranks.

Carbon chain length	**Condition (functional group)**	**Rank**	***p*-value**
C4	PFMPA	18.08	0.955
	PFBS	18.17	
	PFEESA	19.25	
C5	PFPeA	9.83	0.002*
	PFMBA	21.50	
	PFPeS	24.17	
C6	PFHxA	6.67	< 0.001*
	PFHxS	18.33	
C7	PFHpA	5.75	< 0.001*
	NaDONA	11.75	
	PFHpS	20.00	
C8	PFOA	8.92	< 0.001*
	6:2 FTS	14.80	
	PFOS	34.42	
	9 Cl-PF3ONS	34.42	
C10	8:2 FTS	10.92	0.291
	PFDA	814.08	

**A statistically significant difference (p-value < 0.05) was observed between the conditions under study*

Table S4. Statistical comparison of the amount of PFAS (%) adsorbed to pebbles after exposure for 1, 3 and 7 days, using one-way ANOVA with 95 % confidence level (*p*-value < 0.05).

PFAS	***p*-value**
PFMPA	0.007*
PFPeA	0.004*
PFBS	0.000*
PFEESA	0.001*
4:2 FTS	0.002*
PFHxA	0.003*
PFPeS	0.017*
PFHpA	0.002*
NADONA	0.015*
PFHxS	0.009*
6:2 FTS	0.047*
PFOA	0.085
PFHpS	0.026*
PFNA	0.169
PFOS	0.094
8:2 FTS	0.009*

PFDA	0.015*

*The Shapiro-Wilk test indicated that the dataset (n = 4) followed a normal distribution. *A statistically significant difference (p-value < 0.05) was observed between the conditions under study.*

Table S5. Nonparametric statistical comparison of amount of PFAS (%) adsorbed to pebbles after exposure for 1, 3 and 7 days, using Kruskal-Wallis one-way ANOVA with 95 % confidence level (*p*-value < 0.05).

PFAS	***p*-value**
PFMBA	0.024*
9 Cl-PF3ONS	0.058

The Shapiro-Wilk test indicated that the dataset (n=4) did not follow a normal distribution. A statistically significant difference (p-value < 0.05) was observed between the conditions under study.

Table S6. Partition Coefficient for PFAS adsorption to quartz aggregates after exposure for 1, 3 and 7 days.

PFAS	**Day 1 (K (L/g))**	**Day 1 (Kd(L/Kg))**	**Day 3 (K(L/g))**	**Day 3 (Kd(L/Kg)))**	**Day 7 (K(L/g))**	**Day 7 (Kd (L/Kg))**
PFMPA	0.02	16.94	0.02	23.19	0.02	17.45
PFPeA	0.02	15.93	0.02	20.20	0.01	13.96
PFBS	0.02	18.50	0.03	25.41	0.02	16.97
PFMBA	0.02	15.91	0.03	26.83	0.02	15.84
PFEESA	0.02	18.56	0.03	25.90	0.02	17.46
4:2 FTS	0.02	22.86	0.02	24.57	0.02	16.69
PFHxA	0.02	16.92	0.02	20.35	0.01	13.27
PFPeS	0.02	22.01	0.03	26.29	0.02	18.40
PFHpA	0.02	21.75	0.03	29.59	0.02	19.86
NADONA	0.03	26.70	0.03	31.42	0.02	22.22
PFHxS	0.02	23.51	0.03	32.69	0.02	22.30
6:2 FTS	0.05	49.53	0.04	36.21	0.03	31.31
PFOA	0.03	30.01	0.04	37.09	0.03	28.09
PFHpS	0.04	40.84	0.05	47.60	0.03	33.06
PFNA	0.05	52.49	0.06	58.65	0.05	52.37
PFOS	0.09	88.93	0.10	96.08	0.10	98.74
9 Cl-PF3ONS	0.17	165.79	0.17	168.40	0.19	192.64
8:2 FTS	0.14	138.25	0.15	146.78	0.16	157.60
PFDA	0.15	152.16	0.16	156.40	0.17	173.87

Table S7. Non-parametric statistical comparison for PFAS adsorption onto aggregates after shaking and without shaking for 24 h using Kruskal-Wallis (K-W) and Mann-Whitney U ranks.

Carbon chain Length	**PFAS**	**Rank**	***p*-value**
C4	PFMPA	9.50	0.310
	PFBS	13.25	
	PFEESA	14.75	
C5	PFPeA	7.75	0.008
	PFMBA	11.25	
	PFPeS	18.50	
C6	PFHxA	4.00	< 0.001
	PFHxS	11.50	
C7	PFHpA	5.75	0
	NaDONA	11.75	
	PFHpS	20.00	
C8	PFOA	6.50	0
	6:2 FTS	8.83	
	PFOS	19.88	
	9 Cl-PF3ONS	25.13	
C10	8:2 FTS	8.25	0.878
	PFDA	8.75	

**A statistically significant difference (p-value < 0.05) was observed between the condition under study.*

Table S8. Statistical comparison of the amount of PFAS (%) adsorbed to pebbles after exposure with shaking and without shaking for 24 h, using one-way ANOVA with 95 % confidence level (*p*-value < 0.05).

PFAS	***p*-value**
PFMPA	0.655
PFPeA	0.628
PFBS	0.494
PFMBA	0.199
PFEESA	0.261
4:2 FTS	0.248
PFHxA	0.321
PFPeS	0.944
PFHpA	0.497
NADONA	0.738
PFHxS	0.483
6:2 FTS	0.104
PFOA	0.318
PFHpS	0.317
PFNA	0.465
PFOS	0.303
9 Cl-PF3ONS	0.008*
8:2 FTS	0.023*
PFDA	0.004*

*The Shapiro-Wilk test indicated that the dataset (n=4) followed a normal distribution. *A statistically significant difference (p-value<0.05) was observed between the conditions under study.*

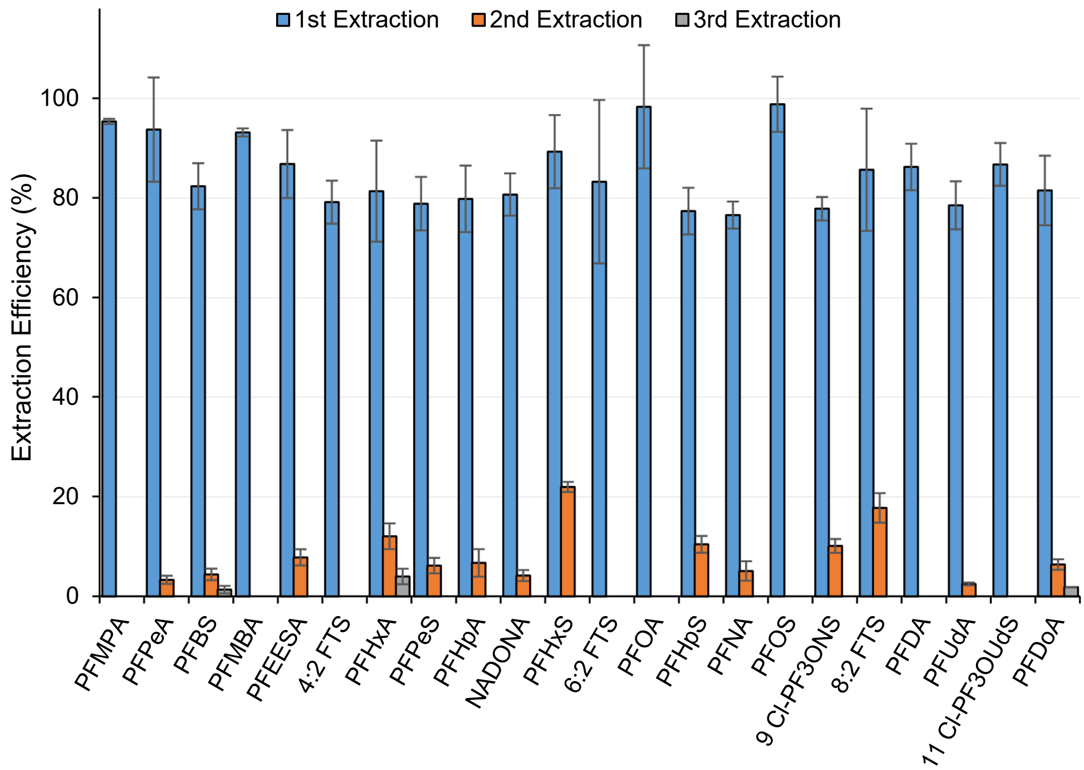

Fig. S1. PFAS recoveries after first (blue bars), second (orange bars) and third (grey bars) filter extraction steps using ultrasonic agitation for 20 min (for each extraction step). The error bars correspond to the standard deviation from four replicates experiments (n = 4).

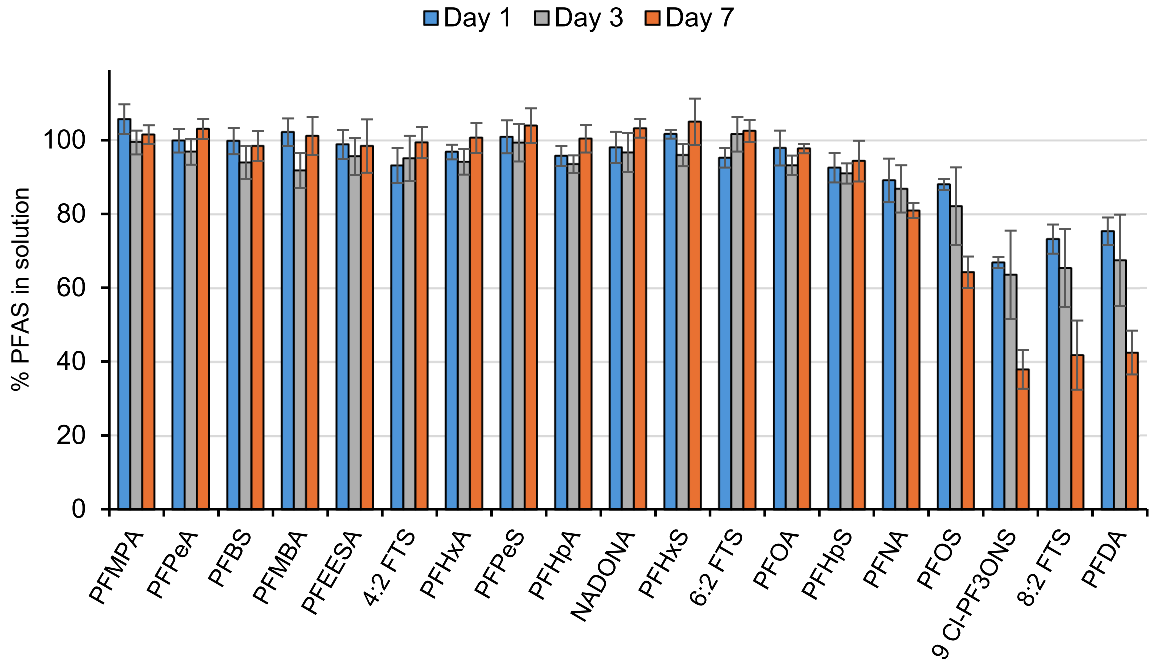

Fig. S2. Amount of PFAS (%) in solutions after exposure for 1 (blue bars), 3 (grey bars) and 7 days (orange bars) in contaminated water. The error bars represent the standard deviation from four replicate experiment (n = 4).

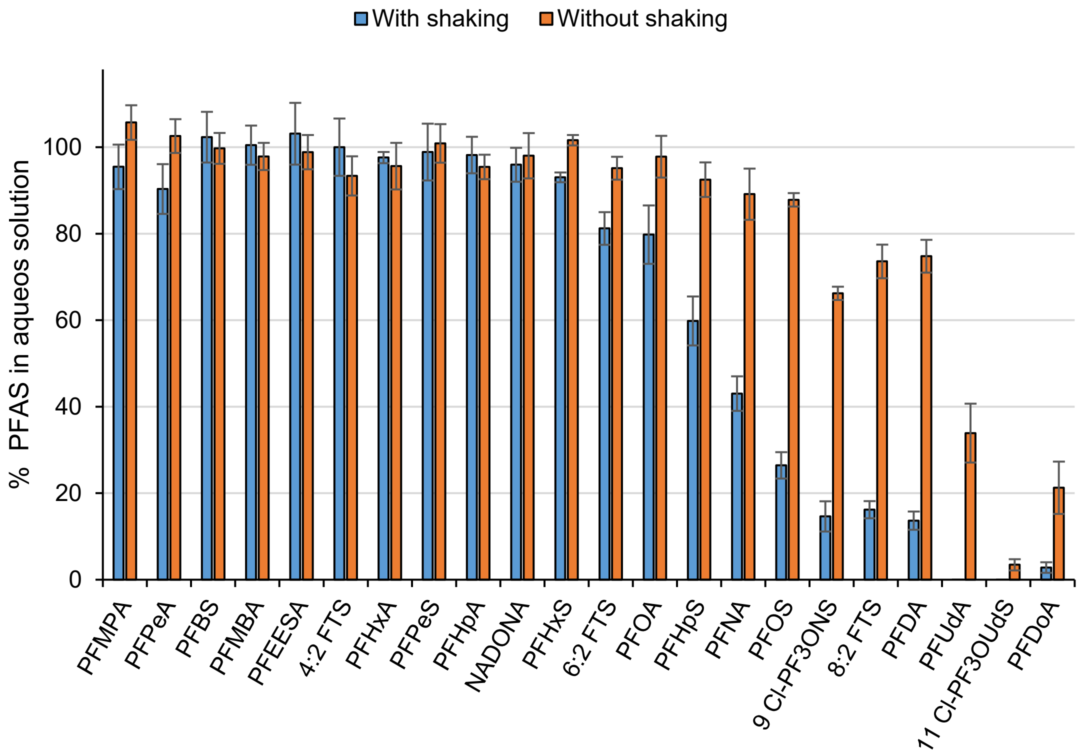

Fig. S3. Amount of PFAS (%) in the aqueous solutions after shaking (blue bars), and without shaking (orange bars) for 24 h. The error bars correspond to the standard deviation from four replicate experiments (n = 4).