Electronic Supplementary Material (ESI) for Environmental Science: Water Research & Technology.

Table S1. Nutrient concentrations in raw and treated water

Types	Concentrations (μg L^{-1})		Removal rates (%)			References
	Raw	Treated	Minimum	Maximum	Average	
BDOC	144–2,000	93–540	32	90	54	Block et al., 1992; Vasyukova et al., 2013; Zhang et al., 2016; So et al., 2017; Son et al., 2019
AOC_{P17}	28–143	20–110	-15	79	45	Lou et al., 2009; 2012; Ohkouchi et al., 2011; Choi et al., 2019
AOC_{NOX}	4–12	10–25	-289	16	-130	Lou et al., 2009; 2012; Ohkouchi et al., 2011; Choi et al., 2019
AOC_{eawag}	56–395	17–121	13	81	49	Hammes et al., 2006; Vital et al., 2010; Park et al., 2016; 2020
AOC_{A3}	84–200	5–15	92	94	93	Hijnen et al., 2018

Table S2. Comparison of AOC P17 and AOC NOX removals through treatment train.

Removal (%)	Lou et al., 2009	Lou et al., 2012 (DWTP C)	Lou et al., 2012 (DWTP G)	Ohkouchi et al., 2011 (Winter)	Ohkouchi et al., 2011 (Summer)	Choi et al., 2019	average
AOC P17							
Preoxidation	n.a.	31%	16%	n.a.	n.a.	-50%	-1%
Sedimentation	37%	36%	48%	61%	50%	27%	43%
Sand filtration	13%	23%	7%	-60%	-14%	40%	2%
Ozonation	10%	-9%	n.a.	5%	-100%	-12%	-21%
BAC	60%	20%	n.a.	-37%	56%	52%	30%
Finished	-8%	-12%	-10%	5%	-151%	-5%	-30%
AOC NOX							
Preoxidation	n.a.	-211%	-183%	n.a.	n.a.	-95%	-163%
Sedimentation	19%	36%	20%	-103%	-23%	2%	-8%
Sand filtration	16%	7%	-3%	-77%	-69%	17%	-18%
Ozonation	-280%	-26%	n.a.	-32%	-147%	-290%	-155%
BAC	81%	26%	n.a.	51%	63%	78%	60%
Finished	-72%	-73%	10%	-215%	-72%	-19%	-73%

Table S3. Previous studies on biodegradable organic matter characterization and fractionations.

Parameters	References
AOC $_{\text{NOX, P17}}$	Hem and Efraimsen, 2001; Chien *et al.*, 2008; Labanowski and Feuillade, 2009; Ohkouchi *et al.*, 2011; Lou *et al.*, 2012; Elhadidy *et al.*, 2016; van der Kooij *et al.*, 2015; Tang *et al.*, 2018;
AOC $_{\text{A3}}$	Sack *et al.*, 2011; 2014; Hijnen *et al.*, 2018; Schurer *et al.*, 2019
AOC $_{\text{eawag}}$	Hammes *et al.*, 2006; Ross *et al.*, 2013; Elhadidy *et al.*, 2016; Park *et al.*, 2016; Kim *et al.*, 2017
BDOC	Volk *et al.*, 1997; Labanowski and Feuillade, 2009; So *et al.*, 2017; Son *et al.*, 2019; Sambo *et al.*, 2020

Table S4. Literature on engineered and environmental factors for nutrient control.

Processes	**Factors**	**References**
Source water	Source type	van der Kooij *et al.*, 1982; Miettinen *et al.*, 1999; Lehtola *et al.*, 2002; Volk and LeChevallier, 2002; van der Wielen and van der Kooij, 2010; van der Wielen and van der Kooij, 2013; Nescerecka *et al.*, 2018
	Seasonal variation	Hu *et al.*, 1999; Escobar and Randall, 2001; Escobar *et al.*, 2002; Ohkouchi *et al.*, 2011; Lohwacharin *et al.*, 2014; Pharand *et al.*, 2015; Elhadidy *et al.*, 2016; So *et al.*, 2017; Choi *et al.*, 2019
	Protection program	LeChevallier *et al.*, 1996; Volk and LeChevallier, 2002
	Algal bloom	*Okuda *et al.*, 2009; *Ramseier *et al.*, 2011; *Sun *et al.*, 2016; Choi *et al.*, 2019
Managed aquifer recharge	Preoxidation	*Kim *et al.*, 2017; *Kim *et al.*, 2019; *Noh *et al.*, 2020a
	Storage time	*Kim *et al.*, 2019
Preoxidation	Chlorine	Lou *et al.*, 2012; Lu *et al.*, 2014; Park *et al.*, 2016; Choi *et al.*, 2019
	Ozone	Hammes *et al.*, 2006; *Chen *et al.*, 2007; Chien *et al.*, 2007; Chien *et al.*, 2008; Vital *et al.*, 2010; Yang *et al.*, 2011; Lou *et al.*, 2012; Zhang *et al.*, 2016; Liao *et al.*, 2018
	Permanganate	*Chen *et al.*, 2007; *Ramseier *et al.*, 2011

Coagulation, sedimentation	Coagulant type, dose	Lehtola *et al.*, 2002; Volk and LeChevallier, 2002; *Bazri and Mohseni, 2016; *Pramanik *et al.*, 2017; *Yang *et al.*, 2020
	Seasonal variation	Ohkouchi *et al.*, 2011; So *et al.*, 2017; Choi *et al.*, 2019
Membrane filtration	Microfiltration, ultrafiltration	*Yu *et al.*, 2011; *Schurer *et al.*, 2019; Park *et al.*, 2020
	Nanofiltration, reverse osmosis	Escobar and Randall, 2001; *Escobar *et al.*, 2002; *Liikanen *et al.*, 2003; Hong *et al.*, 2005; *Park *et al.*, 2005; *Meylan *et al.*, 2007;
	Gravity-driven membrane	*Derlon *et al.*, 2014; *Chomiak *et al.*, 2015
	Polymer materials	Liikanen *et al.*, 2003
Rapid sand filtration, Biologically activated carbon filtration	Seasonal variation	Ohkouchi *et al.*, 2011; Yang et al., 2011; Pharand *et al.*, 2015; So *et al.*, 2017
	EBCT	*Wert *et al.*, 2008; Pharand *et al.*, 2015; *Ross *et al.*, 2019
	Biomass maturation	*Velten *et al.*, 2011; *Ross *et al.*, 2019
	Media type, layer	Chien *et al.*, 2007; Chien *et al.*, 2008; *Wert *et al.*, 2008;; Yang *et al.*, 2011; *Liu *et al.*, 2019
	Backwashing	Bassett *et al.*, 2018
	Oxidant addition	*de Vera *et al.*, 2019; *Noh *et al.*, 2020b
	Nutrient supplement	Bassett *et al.*, 2018; *Xing *et al.*, 2018; *Ross *et al.*, 2019; *Noh *et al.*, 2020b

Disinfection	Chlorine	Zhang and DiGiano, 2002; Chien *et al.*, 2007; Ohkouchi *et al.*, 2011; Park *et al.*, 2016; Zhang *et al.*, 2016; So *et al.*, 2017; Nescerecka *et al.*, 2018; *Li *et al.*, 2018; *Huang *et al.*, 2020; Park *et al.*, 2020
	Chloramine	Zhang and DiGiano, 2002; Lu *et al.*, 2014; *Li *et al.*, 2018; *Chen *et al.*, 2020
	Chlorine dioxide	*Chen *et al.*, 2020
	UV	*Shaw *et al.*, 2000; Lehtola *et al.*, 2003; *Choi and Choi, 2010; *Metz *et al.*, 2011; *Huang *et al.*, 2020
	Seasonal variation	Liu *et al.*, 2002; *Choi and Choi, 2010; Ohkouchi *et al.*, 2011; So *et al.*, 2017; Nescerecka *et al.*, 2018
Main distribution and building plumbing system	Seasonal variation	Liu *et al.*, 2002; Polanska *et al.*, 2005a; Ohkouchi *et al.*, 2011; Prest *et al.*, 2016b; Zhang *et al.*, 2016; So *et al.*, 2017; Li *et al.*, 2018; Nescerecka *et al.*, 2018; Pick *et al.*, 2019
	Building stagnation	Lautenschlager *et al.*, 2010; Chen *et al.*, 2013; Inkinen *et al.*, 2014
	Residual disinfectant	Ohkouchi *et al.*, 2013; Lu *et al.*, 2014
	Water age	Zhang and DiGiano, 2002; Polanska *et al.*, 2005a; van der Kooij *et al.*, 2015; Prest *et al.*, 2016b; Li *et al.*, 2018; Pick *et al.*, 2019; Park *et al.*, 2020
Pipe materials	Material type	*Bucheli-Witschel *et al.*, 2012; Inkinen *et al.*, 2014; *Wen *et al.*, 2015; *Connell *et al.*, 2016;

*Proctor *et al.*, 2016; *Mao *et al.*, 2018; *Park *et al.*, 2019

*lab- or pilot-scale studies only

Table S5. References for AOC removal data from the full-scale water treatment systems.

Processes	AOC (μg L^{-1})			Removal (%)			References
	Min.	Max.	Avg.	Min.	Max.	Avg.	
Prechlorination	97	100	99	-59	-6	-38	Lou *et al.*, 2012; Park *et al.*, 2016; Choi *et al.*, 2019 (n=3)
Preozonation	129	520	249	-166	19	-74	Hammes *et al.*, 2006; Chien *et al.*, 2008; Vital *et al.*, 2010 (DWTP A and B); Yang *et al.*, 2011; Lou *et al.*, 2012; Zhang *et al.*, 2016; Liao *et al.*, 2018 (n=8)
Coagulation, sedimentation	18	149	84	12	67	36	Lehtola *et al.*, 2002; Chien *et al.*, 2008; Lou *et al.*, 2009; Lou *et al.*, 2012; Ohkouchi *et al.*, 2011 (Summer and Winter); Vasyukova *et al.*, 2013; Lu *et al.*, 2014; Park *et al.*, 2016; Zhang *et al.*, 2016; Liao *et al.*, 2018; Choi *et al.*, 2019; Park *et al.*, 2020; Yang *et al.*, 2020 (n=14)
Rapid sand filtration	28	135	64	-27	87	38	Hammes *et al.*, 2006; Chien *et al.*, 2008; Lou *et al.*, 2009; Vital *et al.*, 2010 (DWTP A and B); Ohkouchi *et al.*, 2011 (Summer and Winter); Vasyukova *et al.*, 2013; Lu *et al.*, 2014; Pharand *et al.*, 2015 (Summer and Winter); Elhadidy *et al.*, 2016 (two sampling periods, using $AOC_{P17,NOX}$ and AOC_{Eawag} methods simultaneously); Zhang *et al.*, 2016; Liao *et al.*, 2018; Choi *et al.*, 2019; Park *et al.*, 2020 (n=19)

(Intermediate) Ozonation	45	416	153	-362	2	-101	Lehtola *et al.*, 2002; Chien *et al.*, 2008; Lou *et al.*, 2009; Vital *et al.*, 2010 (DWTP B); Ohkouchi *et al.*, 2011 (two ozonation steps, Summer and Winter); Yang *et al.*, 2011; Vasyukova *et al.*, 2013; Lu *et al.*, 2014; Zhang *et al.*, 2016; Park *et al.*, 2016; Elhadidy *et al.*, 2016 (2 sampling periods, using $AOC_{P17, NOX}$ and AOC_{Eawag} methods simultaneously); Liao *et al.*, 2018; Choi *et al.*, 2019; Park *et al.*, 2020; Yang *et al.*, 2020 (n=22)
BAC filtration	2	154	53	-16	83	52	Lehtola *et al.*, 2002; Chien *et al.*, 2008; Lou *et al.*, 2009; Vital *et al.*, 2010 (DWTP B); Ohkouchi *et al.*, 2011 (Summer and Winter); Yang *et al.*, 2011; Vasyukova *et al.*, 2013; Lu *et al.*, 2014; Park *et al.*, 2016; Zhang *et al.*, 2016; Liao *et al.*, 2018; Choi *et al.*, 2019; Park *et al.*, 2020; Yang *et al.*, 2020 (n=15)
Disinfection	16	135	64	-107	-11	-41	Lehtola *et al.*, 2002; Chien *et al.*, 2008; Lou *et al.*, 2009; Vital *et al.*, 2010; Ohkouchi *et al.*, 2011 (Summer and Winter); Yang *et al.*, 2011; Lu *et al.*, 2014; Zhang *et al.*, 2016; Choi *et al.*, 2019; Park *et al.*, 2020 (n=11)

Table S6. Comparison of assimilable organic carbon (AOC) migration potentials from the polymeric materials in contact with drinking water.

Materials		Common usage	Sum of AOC migration (μg cm^{-2})	S/V ratio (cm^{-1})	References
Acrylonitrile butadiene styrene (ABS)		Pipe, fitting, water tank, housing	0.43–0.92	1.0	Park *et al.*, 2019
Ethylene propylene diene monomer (EPDM)	2% plasticized	Shower hose, fitting, sealing, membranes	0.19	2.0	Bucheli-Witschel *et al.*, 2012
			0.68	1.0	Wen *et al.*, 2015
			0.48	1.0	Mao *et al.*, 2016
	20% plasticized		0.00	2.0	Bucheli-Witschel *et al.*, 2012
			0.00	1.0	Wen *et al.*, 2015
	n.a.		0.15–0.20	1.0	Park *et al.*, 2019
Polybutylene (PB)		Pipe, fitting, tubing	0.14	2.0	Bucheli-Witschel *et al.*, 2012
			0.36	1.0	Mao *et al.*, 2016
Polyethylene (PE)		Pipe, fitting, tubing, water tank	0.26–0.42	1.0	Park *et al.*, 2019
Cross-linked	PEXa (peroxide cross-	Pipe,	0.19	1.0	Wen *et al.*, 2015

	linked)		0.12	1.9–2.4	Connell *et al.*, 2016
polyethylene (PEX)	PEXb (silane cross-linked)	shower hose, tubing	0.27	2.0	Bucheli-Witschel *et al.*, 2012
			0.05–0.18	1.9–2.4	Connell *et al.*, 2016
			0.41	1.0	Mao *et al.*, 2016
	PEXc (electron beam cross-linked)		0.06	1.9–2.4	Connell *et al.*, 2016
			0.54	1.0	Wen *et al.*, 2015
			0.47	1.0	Mao *et al.*, 2016
			0.52	1.0	Proctor *et al.*, 2016
Polyvinyl chloride (PVC)	plasticized	Shower hose, tubing	0.95	0.08	van der Kooij *et al.*, 1982
			50.97	2.0	Bucheli-Witschel *et al.*, 2012
			34.56	1.0	Wen *et al.*, 2015
			3.81–4.81	1.0	Proctor *et al.*, 2016
	unplasticized	Pipe, housing	0.23	0.08	van der Kooij *et al.*, 1982
			0.03	1.9–2.4	Connell *et al.*, 2016
			0.10–0.34	1.0	Park *et al.*, 2019
Silicone		Shower hose, tubing, membranes	0.42	0.07	van der Kooij *et al.*, 1982
			0.15	2.0	Bucheli-Witschel *et al.*, 2012
			0.47	1.0	Proctor *et al.*, 2016

	0.46–1.22	1.0	Park *et al.*, 2019

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References

Reference lists can be found in the manuscript.