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Water Quality and Heavy Metals as a Marker for Water Treatment Plant Efficiency

Wameedh A.K. AL-Yasari, Ayad M.J. Almamoori and Zainab Imran AL-Rifaie

Department of Biology, College of Science, University of Babylon, Iraq.

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ABSTRACT

This study was designed to figure out the efficiency of Alkefl water treatment station in Babylon Governorate, three sites were chosen to evaluate the monthly variations of water quality parameters, dissolved and particulate lead,Copper and Manganese. The results showed according to the statistical analysis that a third site which represents the potable water is a good water quality than a first site (river water) and Second site (Sedimentation tank) for water treatment station, most of water quality parameters like total hardness, Total dissolved solids, Total suspended solids, Alkalinity and Electrical conductivity are low in site 3 than other sites which means that water treatment efficient. While heavy metals showed fluctuation between sites and through months with increasing of dissolved lead, dissolved copper, and particulate Copper especially in December, January, February, March, September respectively and that's reflect that water treatment station is inefficient in some months regarding dissolved and particulate heavy metals.

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INTRODUCTION

The water quality is a term used to express the suitability of water to sustain various or processes (Chapman, D., 1996). The water quality may be described in terms of the concentration and state the organic and inorganic materials present in the water together with the certain physical characteristics of the water (Mapfumo, E., 2002). Safe drinking water is a basic need for good health and it is also basic right of humans. Fresh water is already a limiting resource in many parts of the world, in the next century it will become more limiting due to increased population, urbanization and climate change (Jackson, R.B., 2001).

The aquatic ecosystem receive different types of the contaminants, due to the anthropogenic influences from both point and non point sources (Loska, K., D. Wiechuła, 2003). Among them , the heavy metals contamination in aquatic ecosystem has received considerable attention due to their toxicity , durability and their special depositional properties (Liang, L.N., 2004). Heavy metals are inorganic elements essential for plant growth in trace quantities .They are toxic and poisonous in relatively higher concentrations (Kar, D., 2008). There are two factors contribute to the harmful effects of heavy metals as environmental pollutants, they are cannot be destroyed by biological degradation and they are easily assimilation and can be bio-accumulated in the aquatic organisms (Egborge, A.B.M., 1994). Human beings can be exposed to heavy metals through direct and indirect sources like food , drinking water , exposure to industrial activities and traffic (Ghaedi, M., 2005).

MATERIAL AND METHODS

The study was included three sites on Alkefl water treatment station ,the first site is located in Alhilla river before treatment station , second sites is from Sedimentation tank inside water treatment station, and third site from potable water after treatment station.

Water samples water collected over 12 months from September 2012 till August 2013 with measured some of the water quality parametes such as (pH, Temperature,E.C., Salinity, ,T.D.S.) by multi 350i Germany, and (T.S.S.Alkalinity, total hardness, Calcium, Magnesium) according to methods described by (APHA, 2005), Triplicate samples were collected monthly from each site and transported on ice to the laboratory for analysis. Samples were filtered immediately upon arrival to the laboratory (~1 hr). One litre of each sample was filtrated through 0.45 µm polycarbonate filter. The filtrate was used to determine dissolved heavy metals concentration, whereas the filters were used to determine the concentration of particulate heavy metals by Flame Atomic absorption

Corresponding Author: Wameedh A.K. AL-Yasari, Department of Biology, College of Science, University of Babylon, Iraq.
E-mail: Wameedadil83@gmail.com,

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spectrophotometer Shimadzu 7000A (Japan), Dissolved heavy metal concentration was calculated according to the equation (UNESCO, 1992) which was clarified by (Al-taei, M.M.S., 1999) while particulate heavy metals according to (Sturgeon, R.E., 1982).

Statistical Analysis:

SPSS 17.0 programs used for least significance differences (LSD ≤ 0.05), Analysis of variance test (ANOVA) between sites and different Studies parameters.

Results:

Monthly variation in water quality parameters has been recorded during this study for site 1 , site 2 and Site 3, air temperature have values ranged between (12.33-39 C˚) while Values between (11.33 - 29.1C˚) for Water temperature as showed in table (1,2,3). pH has stable values along study period and ranged between (7.3-8.3). Electrical conductivity Values ranged between highest value (1388 µs/cm) in site 1during autumn 2012 and with lowest value (703 µs/cm) in site 3 during Winter 2013, Alkalinity have limited range (71.6-122 mg/l) in site 3&site 1 exclusively during winter and summer respectively.

Table (1): Monthly Variations of water quality parameters concentrations in site 1 (Mean±S.D).

Months / Parameters	Sept. 2012	Oct.	Nov.	Dec.	Jan. 2013	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.
Air temp. (C˚)	35 ± 0.01	30 ± 0.01	26 ± 0.01	21 ± 0.3	18 ± 0.01	18.5 ± 0.1	19 ± 0.01	26 ± 0.01	29 ± 0.01	35 ± 0.01	40.2 ± 0.3	43 ± 0.01
Water temp. (C˚)	21 ± 0.01	19.1 ± 0.3	18 ± 0.01	16 ± 0.01	12 ± 0.01	12.3 ± 0.3	12 ± 0.05	17.5 ± 0.01	23.6 ± 0.5	27 ± 0.01	32 ± 0.01	32.6 ± 0.3
E.C (µ.S/cm)	1279 ± 42.7	1499 ± 33.4	1388 ± 12.1	1188 ± 12.7	1111 ± 26.5	1332 ± 46.7	1160 ± 8.66	878 ± 22.5	967 ± 13.8	938 ± 55.4	1156 ± 22.5	1310 ± 12.1
pH	7.7 ± 0.01	8.3 ± 0.01	7.9 ± 0.1	7.8 ± 0.05	8.1 ± 0.1	8.2 ± 0.2	8.1 ± 0.2	7.7 ± 0.1	8 ± 0.2	7.8 ± 0.05	7.7 ± 0.05	8.2 ± 0.2
Alkalinity mg/L	122 ± 4.5	112 ± 17.7	90.3 ± 1.8	309.3 ± 48.7	80.6 ± 2.3	91.4 ± 4.2	90.1 ± 3.2	115.5 ± 9.3	104.2 ± 5.7	113.8 ± 14.3	96.1 ± 6.1	103.9 ± 4.6
Total Hardness mg/L	710 ± 45.6	856 ± 25.9	865 ± 29.4	764 ± 31.7	790 ± 39.8	837 ± 42.1	772 ± 11.5	795 ± 15	775 ± 29.4	807 ± 14.4	809 ± 15	746 ± 8.7
Calcium mg/L	176 ± 8.8	172 ± 4.3	173 ± 6.4	138 ± 3.6	143 ± 1.6	170 ± 45.6	159 ± 13.9	158 ± 7.5	153 ± 7.2	131 ± 1.9	168 ± 5.1	164 ± 6.4
Magnesium mg/L	71.9 ± 5.7	103.2 ± 3.7	105 ± 11.1	101 ± 5.5	104 ± 8.7	100 ± 11.9	90.8 ± 11.1	97.1 ± 0.9	92.3 ± 2.3	116 ± 5.4	94.5 ± 6.9	81.3 ± 1.8
TDS mg/L	867 ± 39.8	1005 ± 22.5	930 ± 8.1	796 ± 8.6	744 ± 17.8	892 ± 31.8	777 ± 5.7	588 ± 15	647 ± 9.2	628 ± 36.9	775 ± 15.5	877 ± 8.1
TSS mg/L	0.2 ± 0.01	0.2 ± 0.02	0.1 ± 0.01	0.1 ± 0.01	0.07 ± 0.001	0.06 ± 0.01	0.08 ± 0.005	0.07 ± 0.007	0.07 ± 0.006	0.09 ± 0.01	0.1 ± 0.02	0.1 ± 0.01

p≤0.05

Table (2): Monthly Variations of water quality parameters concentrations in site 2 (Mean±S.D).

Months / Parameters	Sept. 2012	Oct.	Nov.	Dec.	Jan. 2013	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.
Air temp. (C˚)	35 ± 0.3	30 ± 0.01	27 ± 0.01	22 ± 0.3	18 ± 0.01	18.9 ± 0.3	19 ± 0.01	26 ± 0.3	29 ± 0.01	35 ± 0.2	41.6 ± 0.6	43.8 ± 0.3
Water temp. (C˚)	21 ± 0.3	20 ± 0.01	19.6 ± 0.6	16 ± 0.01	11 ± 0.01	12.8 ± 0.3	12 ± 0.01	17.5 ± 0.01	24 ± 0.01	27 ± 0.6	32.3 ± 0.3	33.6 ± 0.6
E.C (µ.S/cm)	969 ± 81.02	1293 ± 13.27	1085 ± 67.5	988.3 ± 8.08	889 ± 30.02	1187 ± 85.4	971 ± 10.4	851 ± 36.4	828 ± 35.2	878 ± 49.6	1039 ± 68.1	1103 ± 38.1
pH	7.8 ± 0.01	7.7 ± 0.01	7.8 ± 0.01	7.5 ± 0.05	7.8 ± 0.1	8.03 ± 0.1	7.7 ± 0.01	7.8 ± 0.1	7.8 ± 0.1	7.9 ± 0.1	7.5 ± 0.1	7.8 ± 0.05
Alkalinity mg/L	111.1 ± 1.42	77.9 ± 2.9	83 ± 1.96	77.6 ± 0.9	75.8 ± 3.002	82.2 ± 0.06	81.3 ± 5.3	117.6 ± 3.8	88.7 ± 3.9	100.7 ± 3.1	100.3 ± 14.8	93.9 ± 2.02
Total Hardness mg/L	636 ± 6.9	641 ± 27.1	731 ± 14.4	714 ± 8.1	707 ± 8.7	703 ± 32.3	719 ± 13.8	651 ± 20.2	707 ± 79.1	680 ± 19.1	767 ± 10.4	614 ± 5.2
Calcium mg/L	157 ± 10.1	143 ± 2.3	168 ± 4.3	119 ± 2.1	124 ± 5.2	142 ± 2.7	117 ± 7.9	125 ± 6.8	146 ± 7.9	118 ± 9.5	140 ± 7.9	136 ± 5.1
Magnesium mg/L	58.9 ± 4.4	68.5 ± 8.1	75.4 ± 0.9	101.1 ± 3.2	96.2 ± 5.3	84.6 ± 9.5	103 ± 1.4	82.3 ± 0.7	82.6 ± 24	93.2 ± 10.4	100.7 ± 7.3	66.1 ± 1.8
TDS mg/L	649 ± 54.8	867 ± 8.6	727 ± 45	662 ± 5.2	595 ± 20.2	795 ± 57.7	651 ± 6.9	570 ± 24.2	555 ± 23.6	588 ± 33.4	696 ± 45.6	739 ± 25.4
TSS mg/L	0.09 ± 0.001	0.1 ± 0.01	0.1 ± 0.01	0.09 ± 0.001	0.05 ± 0.001	0.05 ± 0.01	0.06 ± 0.006	0.07 ± 0.001	0.07 ± 0.008	0.08 ± 0.001	0.06 ± 0.01	0.1 ± 0.01

p≤0.05

Total dissolved solids tend to be highest (898 mg/l) in winter2013 and lowest in Summer 2013 especially in site 3 while total suspended solids have highest value(0.2 mg/l) in Site 1 during summer 2012 and lowest value (0.04 mg/l) in site 3 during winter 2013.

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Total hardness concentration in accordance with Calcium & magnesium concentrations range (529-865 mgCaCo3/l) with Calcium Concentration (96-176mgCaCo3/l) and Magnesium Concentration (42.8-116 mgCaCo3/l). All previously mentioned values and significance differences were clarified in Table 1 ,2,3.

Table (3): Monthly Variations of water quality parameters concentrations in site3 (Mean±S.D).

Parameters \ Months	Sept. 2012	Oct.	Nov.	Dec.	Jan. 2013	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.
Air temp. (C°)	35.8 ± 0.3	31 ± 0.01	27 ± 0.01	22.8 ± 0.3	19 ± 0.3	18.7 ± 0.4	19 ± 0.2	27 ± 0.5	29 ± 0.3	37 ± 0.3	43 ± 0.6	44.7 ± 0.6
Water temp. (C°)	22 ± 0.01	21 ± 0.01	20.3 ± 0.3	16.5 ± 0.05	11.8 ± 0.3	13 ± 0.01	12 ± 0.01	18.3 ± 0.3	24.7 ± 0.5	29 ± 0.6	33 ± 0.01	35.6 ± 0.6
E.C (µ.S/cm)	650 ± 26.6	729 ± 14.4	664 ± 18.4	849 ± 13.27	730 ± 24.2	638 ± 15.5	703 ± 8.7	695 ± 8.08	682 ± 47.9	628 ± 13.27	713 ± 49.6	792 ± 46.2
pH	7.6 ± 0.04	7.3 ± 0.1	7.5 ± 0.05	7.5 ± 0.1	7.7 ± 0.1	7.7 ± 0.01	7.8 ± 0.1	7.8 ± 0.05	7.9 ± 0.1	7.6 ± 0.01	7.7 ± 0.01	7.7 ± 0.01
Alkalinity mg/L	84.6 ± 2.02	82.1 ± 3.9	76.6 ± 1.7	60.8 ± 2.8	65.9 ± 0.9	70.9 ± 1.9	71.6 ± 0.8	81.9 ± 4.4	99.9 ± 5.7	82.3 ± 1.6	91.5 ± 3.2	81.5 ± 3.4
Total Hardness mg/L	592 ± 8.6	530 ± 17.8	529 ± 4.04	534 ± 10.9	608 ± 6.9	597 ± 10.3	582 ± 5.7	536 ± 13.2	553 ± 14.4	532 ± 12.1	592 ± 8.1	542 ± 8.1
Calcium mg/L	147 ± 8.1	118 ± 8.9	141 ± 2.7	96 ± 3.3	114 ± 9.1	121 ± 2.4	111 ± 4.6	110 ± 3.6	117 ± 4.1	126 ± 8.4	131 ± 8.4	123 ± 4.1
Magnesium mg/L	54.3 ± 7.02	56.7 ± 9.7	42.8 ± 2.7	71.1 ± 4.6	78.3 ± 3.8	71.5 ± 3.9	73.6 ± 4.2	63 ± 5.4	63 ± 4.4	52 ± 2.1	64 ± 7.1	56 ± 4.5
TDS mg/L	435 ± 17.8	488 ± 9.8	445 ± 12.1	569 ± 9.2	488 ± 16.1	427 ± 10.9	470 ± 5.7	466 ± 5.1	457 ± 32.3	421 ± 8.6	478 ± 33.4	531 ± 31.2
TSS mg/L	0.06 ± 0.003	0.07 ± 0.001	0.06 ± 0.005	0.05 ± 0.001	0.04 ± 0.01	0.03 ± 0.008	0.04 ± 0.001	0.05 ± 0.006	0.06 ± 0.005	0.05 ± 0.01	0.04 ± 0.01	0.1 ± 0.01

$p \leq 0.05$

Dissolved heavy metals showed monthly variation among study sites. Most of concentrations of measured metals were fluctuated during study period, dissolved lead concentration ranged (2.351-19.489 mg/l) in site 2& site 3 during Autumn 2012 and winter2013 respectively , while dissolved copper concentration has a highest value (42.958 mg/l) in site 2 during Autumn 2012 and lowest value (14.174 mg/l) in site 3 during Autumn 2012. Values between (9.004-22.047 mg/l) were recorded for Mn in site 3 & site2 during winter & Autumn respectively. All measured dissolved metals followed this trend (Cu>Mn>pb) Figures (1,2,3).

For particulate heavy metals and according to data which have been recorded in Figures 4,5,6, pb had the highest value (91.851mg/g) during Winter 2013 in site 1 while the lowest value (19.489 mg/g) for pb during Autumn 2012 in site 3 of study area. Statistical Analysis showed highly significance differences between metals and sites. Particulate Cu has a range between (45.461-88.017 mg/g) during Autumn & winter 2013 in site 2&Site 3 respectively, , a highest value (79.956 mg/g) of Mn have issued during Autumn in site 1 while a lowest value (30.317 mg/g) recorded in site 3 during August 2013.

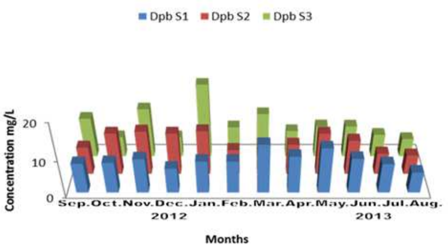

Fig. 1: Monthly Variations of dissolved lead in study sites.

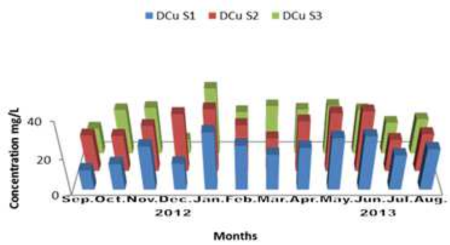

Fig. 2: Monthly Variations of dissolved Copper in study sites.

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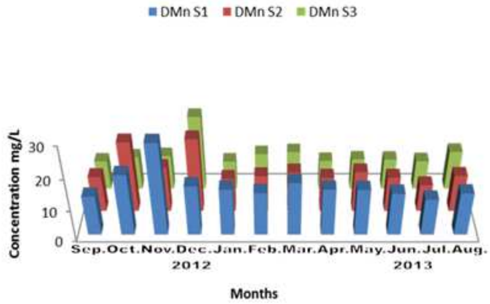

Fig. 3: Monthly Variations of dissolved Manganese in study sites.

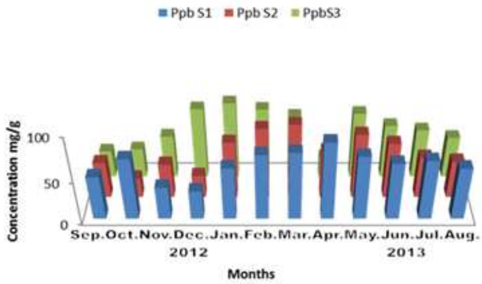

Fig. 4: Monthly Variations of particulate lead in study sites.

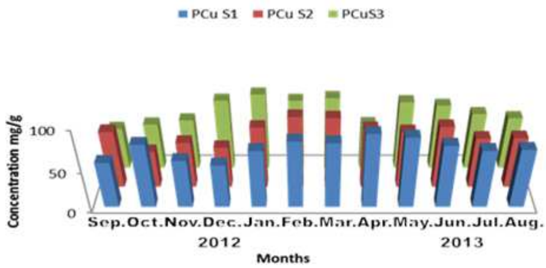

Fig. 5: Monthly Variations of particulate Copper in study sites.

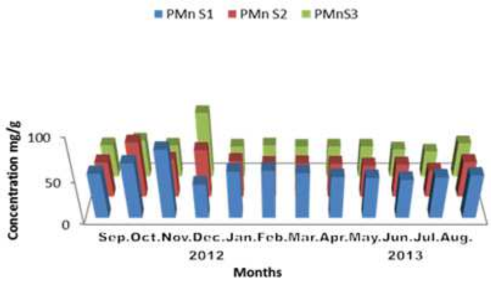

Fig. 6: Monthly Variations of particulate Manganese in study sites.

Discussion:

In addition to inefficiency of water treatment plant, the input due to runoff of allochthones organic matter seems to result in a decrease or increase some of water quality parameters (Salvadó, V., 2006)

Heavy metals concentration in stream are influence by the entrance of materials to the stream such as sediments, hydrothermal activity, Organic and inorganic materials playing important role in increased particulate form of the heavy metals, and the fluctuations in metals pointed to that various types of aquatic organisms have different strategies to heavy metal uptake and exposure (Terry, P.A., W. Stone, 2002).

Copper was found the highest among the studied metals during this study, the main reason for that is the that a major part of the copper can be found in complexes that are biologically not available. Natural organic matter are high complexing agents that may have valuable effect on bioavailable copper concentration (Karmer, K.J.M., 2004) and Copper have high adsorption forces at the soil particles

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surfaces, which are influenced by pH values increasing.

High concentration of particulate form in contrast with soluble form was noticed, because of the population density over the study sites and each metal has its specific sources, pathways and storage methods (Thévenot, D.R., 2007).

The low values recorded in this study during study period, it may be due to high adsorption ability, organic complex formation, and its easily absorption from sediments particles, also The relatively high intensity of the rain event lead to elevated suspended solids which effect on water quality and heavy metals concentrations (Rule, K.L., 2006).

Conclusion:

It was concluded that treatment of heavy metal contaminated water is less efficient that for water quality parameters, and some parameters is treated well and other is not treated which make water classified as not possible for drinking.

REFERENCES

Chapman, D., D.E. Chapman, Ed., 1996. “Water Quality Assessments. A Guide to the Use of Biota, Sediments and Water in Environmental Monitoring,” 2nd Edition, Chapman & Hall, London.

Mapfumo, E., W. Willms and D. Chanasyk, 2002. “Water Quality of Surface Runoff from Grazed Fescue Grassland Watershed in Alberta,” Water Quality Research Journal of Canada, 37(3): 543-562.

Jackson, R.B., 2001. Water in Changing World. Issues in Ecology, 9,Washington, DC: Ecological Society of America, 1-16.

Loska, K., D. Wiechuła, 2003. Application of principal component analysis for the estimation of source of heavy metal contamination in surface sediments from the Rybnik Reservoir, Chemosphere, 51: 723–733, Elsevier Ltd.

Liang, L.N., J.T. Hu, D.Y. Chen, Q.F. Zhou, B. He, G.B. Jiang, 2004. Primary Investigation of Heavy Metal Contamination Status in Molluscs Collected from Chinese Coastal Sites, Bull. Environ. Contam. Toxicol., 72: 937–944,Springer-Verlag New York.

Kar, D., P. Sur, S.K. Mandal, T. Saha, R.K. Kole, 2008. Assessment of Heavy Metal Pollution in Surface Water, International Journal of Environmental Science and Technology, 5(1): 119-124

Egborge, A.B.M., 1994. Water Pollution in Nigeria. Vol.1. Biodiversity and Chemistry of Warri River, Ben Miller Books, Warri.

Ghaedi, M., M.R. Fathi, F. Marahel, F. Ahmadi, 2005. Simultaneous preconcentration and determination of copper, nickel, cobalt and lead ions content by fame atomic absorption spectrometry. Fresen. Environ. Bull., 14: 1158-1165.

APHA, 2005. (American public health association) Standard methods for examination of water and wastewater. 21the Ed. Washington, D.C., U.S.A.

United Nations Educational, Scientific and Cultural Organization, UNESCO, 1992. In: Al-Taee, M.M.S. (1999). Trace elements in water, sediments, fish & plants of shatt Al-Hilla river. Ph.D. thesis, Babylon univ. (in Arabic).

Al-taei, M.M.S., 1999. Trace elements in water, sediments, fish & plants of shatt AlHilla river. Ph.D. thesis, Babylon univ. (in Arabic).

Sturgeon, R.E., J.A. Desaulincrs, S.S. Berman, D.S. Russell, 1982. Determination of trace metals in estuarine sediment by graphite fernace atomic absorption spectrophotometry. Anal. Chem. Acta., 134: 288-291.

Salvadó, V., D. Quintana, M. Hidalgo, 2006. Monitoring of Nutrients, Pesticides, and Metals in Waters, Sediments, and Fish of a Wetland, Arch. Environ. Contam. Toxicol, 51: 377–386.

Terry, P.A., W. Stone, 2002. Biosorption of cadmium and copper contaminated water by Scenedesmus abundans, Chemosphere, 47: 249–255.

Karmer, K.J.M., R.G. JAK, B.V. Hattum, R.N. Hooftman, J.G. Zwolsman, 2004. Copper toxicity in relation to surface water dissolved matter: Biological effects to Daphnia Magna, Environmental Toxicology and Chemistry, 23(12): 2971–2980.

Thévenot, D.R., R. Moilleron, L. Listels, M.C. Gromaire, V. Rocher, P. Cambier, P. Bonté, J.L. Colin, Pontevès, C.d.& M. Meybeck, 2007. Critical budget of metal sources and pathways in the Seine River basin (1994–2003) for Cd, Cr, Cu, Hg, Ni, Pb and Zn, Science of the Total Environment, 375: 180–203.

Rule, K.L., S.D.W. Comber, D. Ross, D. Thornton, C.K. Markopoulos, R. Rautiu, 2006. Diffuse sources of heavy metals entering an urban wastewater catchment, Chemosphere, 63: 64–72.