TECHNICAL NOTE

TO: Ms. Marielle Morin and Mr. Real Vaudry
Public Works and Government Services Canada

FROM: Mr. Jean-Simon Roy, WSP Canada Inc.

DATE : 25/05/2016

OBJECT : **Sediment Characterization of the Rivière-au-Renard Fishing Harbour prior to Wharf Repair Work**
Ref/No.: 161-02986-00

1. MANDATE AND OBJECTIVES

Small craft harbours (SCH) - Fisheries and Oceans Canada (DFO) is soon expecting to conduct excavation work on the sea bed as part of the repair of the Rivière-au-Renard fishing harbour wharf. The DFO thus mandated Public Works and Government Services Canada (PWGSC) to coordinate this project's environmental assessment. In this context, PWGSC in turn mandated WSP Canada Inc. (WSP) to conduct the sampling campaign and to draw up the physico-chemical portrait of the sediment sampled with regard to various management criteria to be taken into consideration at this spot. The document briefly presents the methodology used as well as the analysis results obtained (inorganic, organic and grain-size analyses). An assessment of the sediment quality is then presented, with regard to the criteria for assessing sediment quality in Québec (Environment Canada and Ministère du Développement durable, de l'Environnement et des Parcs du Québec[1] [MDDEP], 2007). Given the obvious land-based management, the analysis results were also compared to the criteria of the Soil Protection and Contaminated Sites Rehabilitation Policy (Policy) in force in Québec (MDDELCC, 2014).

2. METHODOLOGY

2.1 Sampling

The sampling plan established by PWGSC included six stations located near the wharf to be repaired, in the area where the sediment dredging and reworking is planned. Sampling was carried out on April 13, 2016, by a WSP professional, in partnership with a team of professional divers from *Repère du Plongeur inc.*, acting as WSP's subcontractor. Sediment was sampled using a percussion corer (manual).

[1] Now the ministère du Développement durable, de l'Environnement et de la Lutte contre les changements climatiques (MDDELCC).

There was refusal of the instrument during the coring at three of the six stations, namely RR1, RR5 and RR6, where the shallow depth of sediment allowed for sampling over depths of 90, 60 and 20 cm, respectively. At the other three stations, the cores sampled were all 120 cm long. Then, three separate depth strata in the sampled cores were sub-sampled, namely 0 to 20 cm, 20 to 50 cm, and 50 cm to the maximum depth reached. The samples were then kept cold as per Environment Canada recommendations (2002a and b) until their delivery to the MDDELCC-accredited analysis laboratory (Agat Laboratories). The grain size analyses were conducted by Laboratoire Gradisca.

2.2 Sediment Quality Assessment Criteria

Five criteria are used to establish the level of contamination of marine sediment in Québec, namely the rare effect level (REL), the threshold effect level (TEL), the occasional effect level (OEL), the probable effect level (PEL) and the frequent effect level (FEL) (Environment Canada and MDDEP, 2007):

- → the lowest range of concentrations, within which adverse biological effects are rarely observed (Class 1);
- → the range of possible effects, between the TEL and the PEL, within which adverse biological effects are sometimes observed (Class 2);
- → the range of probable effects, within which adverse biological effects are frequently observed (Class 3).

When a measured concentration is above the OEL threshold, but below the FEL threshold, dumping sediment into open water can only be considered a viable option if toxicity tests demonstrate that the sediment is harmless for the receiving environment and that dumping will not cause damage to the receiving environment. Beyond the FEL threshold, all open-water dumping of sediment is prohibited with no additional analyses required.

In the event of land-based sediment management, the Soil Protection and Contaminated Sites Rehabilitation Policy's (MDDELCC, 2014) criteria were also used. Three contamination thresholds (thresholds A, B and C) are established to classify soils in four groups, from clean (< A; use without restriction) to the most contaminated (> C, soils requiring optimal decontamination).

3. RESULTS

3.1 Sediment Quality

Table 1 presents the results of the chemical analyses conducted on the samples collected from the harbour according to the different previously-mentioned criteria.

Table 1 Sediment quality for the samples collected in the Riviere-au-Renard fishing harbour on April 13th 2016.

Parameter	Units	DL[a]	Criterion[b]					Policy[c]			RR1			RR2				RR3			RR4			RR5			RR6
			REL	TEL	OEL	PEL	FEL	A*	B	C	1	2	3	1	2	Dup 2	3	1	2	3	1	2	3	1	2	3	1
											0-20 cm	20-50 cm	50-120 cm	0-20 cm	20-50 cm	20-50 cm	50-120 cm	0-20 cm	20-50 cm	50-120 cm	0-20 cm	20-50 cm	50-120 cm	0-20 cm	20-50 cm	50-120 cm	0-20 cm
Inorganic substances																											
Arsenic	mg/kg	0,7	4,3	7,2	19	42	150	15	30	50	3,8	9,0	6,3	3,8	2,8	4,1	3,3	7,8	8,3	9,0	8,2	8,8	11,1	11,0	7,8	9,0	10,8
Cadmium	mg/kg	0,3	0,32	0,67	2,1	4,2	7,2	1,30	5	20	0,51	0,67	0,69	0,54	0,44	0,68	0,64	1,11	0,78	0,72	0,62	0,80	0,97	0,92	0,76	0,76	1,19
Chromium	mg/kg	1	30	52	96	160	290	75	250	800	38	35	36	29	28	31	28	41	36	38	33	42	39	40	36	35	39
Copper	mg/kg	1	11	19	42	110	230	50	100	500	34	172	49	23	23	52*	24	85*	60*	79*	53*	79*	66*	101	60*	77*	118
Mercury	mg/kg	0,04	0,051	0,130	0,29	0,70	1,4	0,2	2	10	0,07	0,07	0,08	0,10	0,15	0,08	0,09	0,11	0,07	0,07	0,13	0,07	0,11	0,13	0,06	0,07	0,12
Tin	mg/kg	5	-	-	-	-	-	5	50	300	<5	<5	<5	9*	<5	<5	<5	7*	<5	7*	5	<5	5	5	7*	<5	8*
Nickel	mg/kg	2	-	-	-	-	-	55	100	500	46	36	40	32	31	34	31	43	38	36	34	43	38	39	37	37	40
Lead	mg/kg	5	18	30	54	110	180	40	500	1 000	21	33	21	16	14	21	18	30	24	34	21	23	41*	30	29	33	41*
Zinc	mg/kg	5	70	120	180	270	430	130	500	1500	87	327*	149*	92	76	97	103	193*	165*	286*	163*	211*	200*	359*	186*	227*	357*
Organic compounds																											
Total organic carbon (titration)	%	0,3	-	-	-	-	-	-	-	-	2,9	2,4	-	-	-	-	-	3,9	3,7	-	-	-	-	-	-	-	-
Total sulfur	mg/kg	200	-	-	-	-	-	400	1000	2000	-	-	-	*17 800*	-	-	-	-	-	-	-	-	-	-	-	-	-
Polychlorinated biphenyl congeners (PCBs)																											
Cl-3 IUPAC # 17 + 18	mg/kg	0,01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0,010	<0,010	-	-	-	-	<0,010
Cl-3 IUPAC # 28 + 31	mg/kg	0,01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0,010	<0,010	-	-	-	-	<0,010
Cl-3 IUPAC # 33	mg/kg	0,01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0,010	<0,010	-	-	-	-	<0,010
Cl-4 IUPAC # 52	mg/kg	0,01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0,010	<0,010	-	-	-	-	<0,010
Cl-4 IUPAC # 49	mg/kg	0,01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0,010	<0,010	-	-	-	-	<0,010
Cl-4 IUPAC # 44	mg/kg	0,01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0,010	<0,010	-	-	-	-	<0,010
Cl-4 IUPAC # 74	mg/kg	0,01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0,010	<0,010	-	-	-	-	<0,010
Cl-4 IUPAC # 70	mg/kg	0,01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0,010	<0,010	-	-	-	-	<0,010
Cl-5 IUPAC # 95	mg/kg	0,01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0,010	<0,010	-	-	-	-	<0,010
Cl-5 IUPAC # 101	mg/kg	0,01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0,010	<0,010	-	-	-	-	0,012
Cl-5 IUPAC # 99	mg/kg	0,01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0,010	<0,010	-	-	-	-	<0,010
Cl-5 IUPAC # 87	mg/kg	0,01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0,010	<0,010	-	-	-	-	<0,010
Cl-5 IUPAC # 110	mg/kg	0,01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0,010	<0,010	-	-	-	-	0,011
Cl-5 IUPAC # 82	mg/kg	0,01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0,010	<0,010	-	-	-	-	<0,010
Cl-6 IUPAC # 151	mg/kg	0,01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0,010	<0,010	-	-	-	-	<0,010
Cl-6 IUPAC # 149	mg/kg	0,01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0,010	<0,010	-	-	-	-	<0,010
Cl-5 IUPAC # 118	mg/kg	0,01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0,010	<0,010	-	-	-	-	<0,010
Cl-6 IUPAC # 153	mg/kg	0,01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0,010	<0,010	-	-	-	-	<0,010
Cl-6 IUPAC # 132	mg/kg	0,01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0,010	<0,010	-	-	-	-	<0,010
Cl-5 IUPAC # 105	mg/kg	0,01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0,010	<0,010	-	-	-	-	<0,010
Cl-6 IUPAC # 158 + 138	mg/kg	0,01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0,010	<0,010	-	-	-	-	0,010
Cl-7 IUPAC # 187	mg/kg	0,01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0,010	<0,010	-	-	-	-	<0,010
Cl-7 IUPAC # 183	mg/kg	0,01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0,010	<0,010	-	-	-	-	<0,010
Cl-6 IUPAC # 128	mg/kg	0,01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0,010	<0,010	-	-	-	-	<0,010
Cl-7 IUPAC # 177	mg/kg	0,01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0,010	<0,010	-	-	-	-	<0,010
Cl-7 IUPAC # 171	mg/kg	0,01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0,010	<0,010	-	-	-	-	<0,010
Cl-6 IUPAC # 156	mg/kg	0,01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0,010	<0,010	-	-	-	-	<0,010
Cl-7 IUPAC # 180	mg/kg	0,01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0,010	<0,010	-	-	-	-	<0,010
Cl-7 IUPAC # 191	mg/kg	0,01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0,010	<0,010	-	-	-	-	<0,010
Cl-6 IUPAC # 169	mg/kg	0,01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0,010	<0,010	-	-	-	-	<0,010
Cl-7 IUPAC # 170	mg/kg	0,01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0,010	<0,010	-	-	-	-	<0,010
Cl-8 IUPAC # 199	mg/kg	0,01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0,010	<0,010	-	-	-	-	<0,010
Cl-9 IUPAC # 208	mg/kg	0,01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0,010	<0,010	-	-	-	-	<0,010
Cl-8 IUPAC # 195	mg/kg	0,01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0,010	<0,010	-	-	-	-	<0,010
Cl-8 IUPAC # 194	mg/kg	0,01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0,010	<0,010	-	-	-	-	<0,010
Cl-8 IUPAC # 205	mg/kg	0,01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0,010	<0,010	-	-	-	-	<0,010
Cl-9 IUPAC # 206	mg/kg	0,01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0,010	<0,010	-	-	-	-	<0,010
Cl-10 IUPAC # 209	mg/kg	0,01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0,010	<0,010	-	-	-	-	<0,010
PCBs Sum (41 compounds)	mg/kg	0,01	0,012	0,022	0,059	0,19	0,49	-	-	-	-	-	-	-	-	-	-	-	-	-	<0,010	<0,010	-	-	-	-	0,033

Table 1 Sediment quality for the samples collected in the Riviere-au-Renard fishing harbour on the April 13th 2016.

Parameter	Units	DL[a]	Criterion [b]					Policy [c]			RR1			RR2				RR3			RR4			RR5			RR6
			REL	TEL	OEL	PEL	FEL	A*	B	C	1	2	3	1	2	Dup 2	3	1	2	3	1	2	3	1	2	3	1
											0-20 cm	20-50 cm	50-120 cm	0-20 cm	20-50 cm	20-50 cm	50-120 cm	0-20 cm	20-50 cm	50-120 cm	0-20 cm	20-50 cm	50-120 cm	0-20 cm	20-50 cm	50-120 cm	0-20 cm
Polycyclic Aromatic Hydrocarbons (PAHs)																											
Naphtalene	mg/kg	0,01	0,017	0,035	0,12	0,39	1,2	0,1	5	50	0,01	0,04	0,04	0,06	0,06	0,05	0,06	0,07	0,08	0,11*	0,06	0,09	0,07	0,10	0,10	0,10	0,12*
1-Methylnaphtalene	mg/kg	0,01	-	-	-	-	-	0,1	1	10	0,01	0,03	0,03	0,04	0,03	0,04	0,03	0,04	0,04	0,08	0,03	0,03	0,03	0,07	0,01	0,04	0,05
2-Methylnaphtalene	mg/kg	0,01	0,016	0,02	0,063	0,20	0,38	0,1	1	10	0,02	0,06	0,06	0,12*	0,12*	0,12*	0,11*	0,08	0,09	0,15*	0,07	0,07	0,06	0,12*	0,03	0,08	0,11*
1-3-Dimethylnaphtalene	mg/kg	0,01	-	-	-	-	-	0,1	1	10	0,02	0,08	0,06	0,11*	0,09	0,10	0,08	0,06	0,06	0,08	0,05	0,04	0,05	0,15*	0,02	0,06	0,08
Acenaphtylene	mg/kg	0,003	0,0033	0,0059	0,0310	0,130	0,340	0,1	10	100	<0,003	0,022	0,017	0,015	0,018	0,026	0,052	0,066	0,144*	0,039	0,041	0,036	0,077	0,153*	0,021	0,058	0,098
Acenaphtene	mg/kg	0,003	0,0037	0,0067	0,0210	0,089	0,940	0,1	10	100	0,007	0,021	0,030	0,043	0,026	0,027	0,024	0,070	0,067	0,098	0,056	0,076	0,062	0,201*	0,032	0,090	0,103*
2-3-5 Trimethylnaphtalene	mg/kg	0,01	-	-	-	-	-	0,1	1	10	0,01	0,03	0,02	0,05	0,05	0,04	0,05	0,02	0,02	0,02	0,02	0,02	0,02	0,03	0,01	0,03	0,03
Fluorene	mg/kg	0,01	0,0100	0,0210	0,0610	0,140	1,200	0,1	10	100	0,02	0,06	0,06	0,07	0,07	0,08	0,08	0,13*	0,16*	0,14*	0,09	0,10	0,10	0,26*	0,05	0,14*	0,16*
Phenanthrene	mg/kg	0,01	0,0230	0,0870	0,2500	0,540	2,100	0,1	5	50	0,02	0,08	0,08	0,13*	0,15*	0,14*	0,3*	0,29*	0,4*	0,39*	0,18*	0,19*	0,21*	1,05*	0,10	0,32*	0,32*
Anthracene	mg/kg	0,01	0,0160	0,0470	0,1100	0,240	1,100	0,1	10	100	0,01	0,08	0,06	0,07	0,07	0,10	0,12*	0,25*	0,54*	0,24*	0,19*	0,15*	0,25*	1,25*	0,09	0,24*	0,33*
Fluoranthene	mg/kg	0,01	0,027	0,110	0,500	1,500	4,200	0,1	10	100	0,05	0,54*	0,23*	0,36*	0,27*	0,24*	0,57*	0,55*	0,68*	0,6*	0,38*	0,44*	0,4*	1,83*	0,19*	0,6*	1,73*
Pyrene	mg/kg	0,01	0,041	0,150	0,420	1,400	3,800	0,1	10	100	0,04	0,46*	0,35*	0,26*	0,24*	0,21*	0,43*	0,84*	1,4*	0,51*	0,57*	0,32*	0,77*	2,56*	0,23*	0,59*	1,52*
Benzo (c) phenanthrene	mg/kg	0,01	-	-	-	-	-	0,1	1	10	<0,01	0,02	0,02	0,01	0,02	0,01	0,03	0,06	0,15*	0,03	0,03	0,02	0,05	0,16*	0,01	0,08	0,18*
Benzo (a) anthracene	mg/kg	0,01	0,0270	0,0750	0,2800	0,690	1,900	0,1	1	10	0,01	0,13*	0,10	0,08	0,11*	0,11*	0,2*	0,4*	1,31	0,27*	0,23*	0,17*	0,41*	1,19	0,12*	0,62*	1,19
Chrysene	mg/kg	0,01	0,0370	0,1100	0,3000	0,850	2,200	0,1	1	10	0,01	0,09	0,08	0,06	0,10	0,10	0,19*	0,36*	1,65	0,26*	0,17*	0,18*	0,4*	1,02	0,12*	0,47*	0,83*
Benzo (b,j,k) fluoranthene	mg/kg	0,01	-	-	-	-	-	0,1	1	10	0,01	0,18*	0,13*	0,12*	0,2*	0,18*	0,34*	0,66*	2,47	0,44*	0,37*	0,3*	0,7*	1,95	0,21*	0,92*	1,79
7-12-Dimethylbenzo (a) anthracene	mg/kg	0,01	-	-	-	-	-	0,1	1	10	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	0,01	<0,01	<0,01	<0,01
Benzo(e) pyrene	mg/kg	0,01	-	-	-	-	-	-	-	-	0,01	0,07	0,06	0,05	0,08	0,08	0,13	0,25	0,85	0,18	0,15	0,12	0,29	0,73	0,08	0,33	0,64
Benzo(a) pyrene	mg/kg	0,01	0,0340	0,0890	0,2300	0,760	1,700	0,1	1	10	0,01	0,07	0,06	0,05	0,09	0,08	0,17*	0,3*	1,06	0,21*	0,16*	0,13*	0,34*	0,93*	0,09	0,42*	0,84*
3-Methylcholanthrene	mg/kg	0,01	-	-	-	-	-	0,1	1	10	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Indeno (1,2,3-cd) pyrene	mg/kg	0,01	-	-	-	-	-	0,1	1	10	<0,01	0,03	0,02	0,02	0,04	0,03	0,09	0,13*	0,43*	0,11*	0,08	0,06	0,17*	0,51*	0,04	0,18*	0,36*
Dibenzo (a,h) anthracene	mg/kg	0,003	0,0033	0,0062	0,0430	0,140	0,200	0,1	1	10	0,003	0,016	0,011	0,011	0,020	0,016	0,036	0,058	0,223*	0,050	0,034	0,031	0,072	0,13*	0,020	0,080	0,157*
Benzo(g,h,i) perylene	mg/kg	0,01	-	-	-	-	-	0,1	1	10	0,01	0,05	0,03	0,03	0,06	0,04	0,11*	0,17*	0,52*	0,14*	0,1*	0,08	0,2*	0,55*	0,06	0,21*	0,42*
Dibenzo (a,l) pyrene	mg/kg	0,01	-	-	-	-	-	0,1	1	10	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	0,01	0,02	0,05	0,01	0,01	0,01	0,02	0,05	<0,01	0,02	0,04
Dibenzo (a,i) pyrene	mg/kg	0,01	-	-	-	-	-	0,1	1	10	<0,01	0,01	0,01	0,01	0,01	0,01	0,03	0,04	0,10	0,04	0,02	0,02	0,05	0,15*	0,01	0,04	0,10
Dibenzo (a,h) pyrene	mg/kg	0,01	-	-	-	-	-	0,1	1	10	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	0,01	0,02	0,01	<0,01	<0,01	0,01	0,03	<0,01	0,01	0,02
HAP (somme bas & haut poids)	mg/kg	0,01	-	-	-	-	-	-	-	-	0,23	2,16	1,55	1,76	1,92	1,82	3,23	4,91	12,5	4,20	3,08	2,67	4,80	15,2	1,63	5,72	11,2
Petroleum hydrocarbons (C_{10}-C_{50})	mg/kg	100	-	-	-	-	-	300	700	3500	101	1660	626*	980	1940	852	1180	2190	1580	556*	1440	590*	771	2110	478*	462*	570*

(a) Detection limit

(b) ENVIRONNEMENT CANADA ET MINISTÈRE DU DÉVELOPPEMENT DURABLE, DE L'ENVIRONNEMENT ET DES PARCS DU QUÉBEC (MDDEP), 2007, Criteria for the Assessment of Sediment Quality in Quebec and Application Frameworks: Prevention, Dredging and Remediation, 39p.

Sediment Quality Criteria Env. Canada & MDDEP 2007 (marine water) :

REL	Rare effect level
TEL	Threshold effect level
OEL	Occasional effect level
PEL	Probable effect level
FEL	Frequent effect level

(c) Soil Protection and Contaminated Sites Rehabilitation Policy. (online), April 25th, 2016

http://www.mddelcc.gouv.qc.ca/sol/terrains/politique/annexe_2_tableau_1.htm

The following parameters were analyzed according to the sampling plan established per the project's needs (Table 2):

- → Metals (As, Cd, Cr, Cu, Hg, Ni, Pb, Zn)
- → Petroleum hydrocarbons C_{10}-C_{50}
- → PAHs
- → Total organic carbon (TOCs)
- → Polychlorinated biphenyls (PCBs);
- → Total sulphur

3.1.1 Inorganic Compounds

The highest exceedances are at the OEL and/or the PEL and involve copper and zinc levels. For copper, while exceedances of at least one criterion were observed for all samples and that exceedances of the OEL (42 mg/kg) were recorded for 13 samples, the highest exceedances, for the PEL (110 mg/kg), were recorded for samples RR1-2 (172 mg/kg) and RR6-1 (118 mg/kg). The analyses of zinc levels show an exceedance of the REL for all samples, whereas an exceedance of the OEL was recorded for nine samples. For this same parameter, the largest exceedance (PEL: 270 mg/kg) was recorded for sample RR5-1 (359 mg/kg).

As for the comparison of the results with the Policy, 14 samples show an exceedance of criterion A for at least one parameter, and three samples for criterion B. The parameters for which the largest number of exceedances were recorded are zinc and copper.

3.1.2 Organic Compounds

The total organic carbon (TOC) content of the samples varies from 2.4 % to 3.9 % (Table 4). For its part, the analysis of sulphur concentrations (17,800 mg/kg) identified a relatively large exceedance of the Policy's criterion C (2,000 mg/kg).

Regarding the analysis of PCB levels, reference criteria are available exclusively for the summation of these for a same sample. The values obtained are mostly under the detection limit (DL) for individual analyses. For the summations, the TEL was exceeded in only one of the three samples, RR6-1.

As for PAHs, all samples analyzed show exceedances of the criteria established by the MDDELCC and the MDDEP for different parameters. The highest PAH concentrations are observed for seven samples from stations RR3, RR4, RR5 and RR6, for which exceedances of the PEL criterion were recorded. Sample RR5-1 shows the highest exceedance, as the anthracene concentration recorded (1.25 mg/kg) largely exceeds the FEL criterion (1.10 mg/kg). As for the comparison with the Policy, the highest exceedances, that is greater than criterion B (B-C range), were recorded nine times in the samples from cores RR3, RR5 and RR6.

3.1.3 Grain Size

The grain size results show that the majority of sediment sampled in the Rivière-au-Renard fishing harbour mainly comprise clay-silt and sand (<0.063 – 2 mm), except for station RR5, where coarser sediment is found, namely 44.35 % sand and 50.73 % gravel (Table 2, grain size classes according to the Wentworth classification).

Table 2 Grain-Size Summary of Surface Sediment Sampled in the Rivière-au-Renard Fishing Harbour, Gaspésie, April 13, 2016.

PARAMETERS		SIZE (mm)	RR1 (%)	RR2 (%)	RR4 (%)	RR5 (%)
Grain-size class	Clay-Silt	<0.063	77.24	39.38	41.98	4.92
	Sand	0.063 - 2	22.53	60.18	56.23	44.35
	Gravel	2 - 32	0.09	0.44	1.80	50.73

4. CONCLUSION

Following the assessment of the chemical analysis results obtained for the sediment samples taken from the Rivière-au-Renard fishing harbour, the OEL criterion was exceeded for 16 of the 17 samples analysed. Exceedances were seen for eight samples for the PEL and one sample for the FEL. It is therefore possible to confirm that the study site's sediment cannot be dumped in open water as the biological effects associated with their level of contamination are too high.

In a land management perspective, this soil must be managed in such a way as it does not constitute a new source of contamination for the environment. It must thus comply with the criteria established in the Policy and be treated as per the requirements associated with the highest level of contamination noted in the analyses, that is the B-C range. Additional physico-chemical analyses (hydraulic conductivity and acid base accounting) will provide additional information so as to establish the management method for the dredged sediment.

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