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GUIDELINES FOR THE PROTECTION AND MANAGEMENT OF AQUATIC SEDIMENT QUALITY IN ONTARIO

AUGUST 1993

Ontario

Ministry of Environment and Energy

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GUIDELINES
FOR THE PROTECTION AND MANAGEMENT
OF AQUATIC SEDIMENT QUALITY IN ONTARIO

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AUGUST 1993

SECTION 2

SEDIMENT QUALITY GUIDELINES

The essence of the guideline levels and their significance are provided below. The guidelines as set out define three levels of ecotoxic effects and are based on the chronic, long term effects of contaminants on benthic organisms. These levels are:

1. A No Effect Level at which no toxic effects have been observed on aquatic organisms. This is the level at which no biomagnification through the food chain is expected. Other water quality and use guidelines will also be met at this level.

2. A Lowest Effect Level indicating a level of sediment contamination that can be tolerated by the majority of benthic organisms.

3. A Severe Effect Level indicating the level at which pronounced disturbance of the sediment-dwelling community can be expected. This is the sediment concentration of a compound that would be detrimental to the majority of benthic species.

Guideline Levels and Their Significance

Guideline Level	Sediment Quality	Potential Impact
	Grossly Polluted	Will significantly affect use of sediment by benthic organisms.
Severe Effect Level		
	Marginally - Significantly Polluted	Will affect sediment use by some benthic organisms.
Lowest Effect Level		
	Clean - Marginally Polluted	Potential to affect some sensitive water uses.
No Effect Level		
	Clean	No impact on water quality water uses or benthic organisms anticipated.

Details on these levels, and the protocols used in developing the guidelines are provided in section 4 of this document.

The No Effect and Lowest Effect guidelines compare closely with the lowest or no effect levels determined through a review of sediment toxicity bioassays by National Oceanic and Atmospheric Administration (NOAA) (Long and Morgan, 1990)

As is discussed in Section 4.4, it is not currently possible to calculate a No Effect value for all parameters. Where this is the case for the metals, an interim value based on the lower of the background or Lowest Effect Levels will be used as a lower practical limit for management decisions. For the organics, the background values in Table 5 define the lower practical limit for management decisions.

Table 1: Provincial Sediment Quality Guidelines for Metals and Nutrients.
(values* in ug/g (ppm) dry weight unless otherwise noted)

METALS	No Effect Level	Lowest Effect Level	Severe Effect Level
Arsenic	-	6	33
Cadmium	-	0.6	10
Chromium	-	26	110
Copper	-	16	110
Iron (%)	-	2	4
Lead	-	31	250
Manganese	-	460	1100
Mercury	-	0.2	2
Nickel	-	16	75
Zinc	-	120	820
NUTRIENTS			
TOC (%)	-	1	10
TKN	-	550	4800
TP	-	600	2000

* - values less than 10 have been rounded to 1 significant digit. Values greater than 10 have been rounded to two significant digits except for round numbers which remain unchanged (e.g., 400).

"-" - denotes insufficient data/no suitable method.

TOC - Total Organic Carbon TKN - Total Kjeldahl Nitrogen TP - Total Phosphorus

(June 1992)

Table 2a: Provincial Sediment Quality Guidelines for PCBs and Organochlorine Pesticides.
(values[a] in $\mu g/g$ (ppm) dry weight unless otherwise noted)

Compound	No Effect Level	Lowest Effect Level	Severe Effect Level ($\mu g/g$ organic carbon)*
Aldrin	-	0.002	8
BHC	-	0.003	12
α-BHC	-	0.006	10
β-BHC	-	0.005	21
γ-BHC	0.0002	(0.003)[b]	(1)[c]
Chlordane	0.005	0.007	6
DDT(total)	-	0.007	12
op+pp-DDT	-	0.008	71
pp-DDD	-	0.008	6
pp-DDE	-	0.005	19
Dieldrin	0.0006	0.002	91
Endrin	0.0005	0.003	130
HCB	0.01	0.02	24
Heptachlor	0.0003	-	-
H epoxide	-	0.005[b]	5[c]
Mirex	-	0.007	130
PCB(total)	0.01	0.07	530
PCB 1254[d]	-	(0.06)[b]	(34)[c]
PCB 1248[d]	-	(0.03)[b]	(150)[c]
PCB 1016[d]	-	(0.007)[b]	(53)[c]
PCB 1260[d]	-	(0.005)[b]	(24)[c]

Lowest Effect Levels and Severe Effect Levels are based on the 5th and 95th percentiles respectively of the Screening Level Concentration (SLC) (see Section 4.2.4) except where noted otherwise.

( ) Denotes tentative guidelines

[a] - Values less than 10 have been rounded to 1 significant digit. Values greater than 10 have been rounded to 2 significant digits except for round numbers which remain unchanged.

[b] - 10% SLC.

[c] - 90% SLC.

[d] - Analyses for PCB Arochlors are not mandatory unless specifically requested by MOE.

- Insufficient data to calculate guideline.

* Numbers in this column are to be converted to bulk sediment values by multiplying by the actual TOC concentration of the sediments (to a maximum of 10%), e.g. analysis of a sediment sample gave a PCB value of 30 ppm and a TOC of 5%. The value for PCB in the Severe Effects column is first converted to a bulk sediment value for a sediment with 5% TOC by multiplying 530 x 0.05 = 26.5 ppm as the Severe Effect Level guidelines for that sediment. The measured value of 30 ppm is then compared with this bulk sediment value and is found to exceed the guideline.

(March 1993)

Table 2b: Provincial Sediment Quality Guidelines for Polycyclic Aromatic Hydrocarbons.
(values in μg/g (ppm) dry weight unless otherwise noted)

Compound	No Effect Level	Lowest Effect Level	Severe Effect Level (μg/g organic carbon)*
Anthracene	-	0.220	370
Benz[a]anthracene	-	0.320	1,480
Benzo[k]fluoranthene	-	0.240	1,340
Benzo[a]pyrene	-	0.370	1,440
Benzo[g,h,i]perylene	-	0.170	320
Chrysene	-	0.340	460
Dibenzo[a,h]anthracene	-	0.060	130
Fluoranthene	-	0.750	1,020
Fluorene	-	0.190	160
Indeno[1,2,3-cd]pyrene	-	0.200	320
Phenanthrene	-	0.560	950
Pyrene	-	0.490	850
PAH (total)	-	4	10,000

(Guidelines could not be calculated for Acenaphthene, Acenaphthylene, Benzo[b]fluorene and Naphthalene due to insufficient data. These will be calculated when sufficient data is available.)

Lowest Effect Levels and Severe Effect Levels are based on the 5th and 95th percentiles respectively of the Screening Level Concentration (SLC) (see Section 4.2.4) except where noted otherwise.

- Insufficient data to calculate guideline.

* Numbers in this column are to be converted to bulk sediment values by multiplying by the actual TOC concentration of the sediments (to a maximum of 10%), e.g. analysis of a sediment sample gave a B[a]P value of 30 ppm and a TOC of 5%. The value for B[a]P in the Severe Effects column is first converted to a bulk sediment value for a sediment with 5% TOC by multiplying 1443 x 0.05 = 72 ppm as the Severe Effect Level guideline for that sediment. The measured value of 30 ppm is then compared with this bulk sediment value and is found to not exceed the guideline

PAH (total) is the sum of 16 PAH compounds: Acenaphthene, Acenaphthylene, Anthracene, Benzo[k]fluoranthene, Benzo[b]fluorene, Benzo[a]anthracene, Benzo[a]pyrene, Benzo[g,h,i]perylene, Chrysene, Dibenzo[a,h]anthracene, Fluoranthene, Fluorene, Indeno[1,2,3-cd]pyrene, Naphthalene, Phenanthrene and Pyrene.

(March 1993)

Table 3: Additional Parameters.

Parameters carried over from the Open Water Disposal Guidelines.

Oil and Grease	0.15%
Cyanide	0.1 ppm
Ammonia	100 ppm
Cobalt	50 ppm
Silver	0.5 ppm

Routine testing for these parameters would not be required but may be requested on a case-specific basis.

(June 1992)

SECTION 3

APPLICATION OF THE SEDIMENT QUALITY GUIDELINES

The Provincial Sediment Quality Guidelines (PSQGs) shown in Tables 1 and 2 supersede the Open-Water Disposal Guidelines and will provide the basis for all sediment (or potential lakefill materials to be placed in water) evaluations in Ontario. The guidelines pertain mainly to activities within the aquatic environment and adherence to them is not to be construed as exemption from the requirements of other guidelines, policies, or regulations of this Ministry or other agencies (e.g., the placement of contaminated sediment at an upland site or facility will be subject to the requirements of the Ministry's Waste Management Regulations). The PSQGs will be used in making decisions on a number of sediment-related issues ranging from prevention of sediment contamination to remedial action for contaminated sediment. Issues to be addressed include, but are not limited to, the following:

- Determination of fill quality for lakefilling associated with shoreline development programs.
- Evaluation of sediment quality.
- Determination of appropriate action with regard to sediment clean-up in areas with historic sediment contamination such as IJC Areas of Concern as well as other areas of potential impact.
- Determination of the suitability of dredged material for open-water disposal.
- Establishing the chemical suitability of substrate material for the restoration of benthic habitat.
- Determination of the appropriate degree of sediment clean-up as a result of chemical spills or unauthorized discharge.

3.1 THE EVALUATION PROCESS

Initial evaluation of bottom sediment or fill material is conducted by comparing the chemical concentrations of the material to the appropriate parameter values listed in Tables 1 and 2a, and where required Tables 4 and 5, based on the conditions described in section 3.1.1. Chemical analysis for compounds listed in Table 2b will be performed where specifically requested by MOE or where there is reason to suspect contamination by PAH compounds. Provincial Sediment Quality Guidelines could not be calculated for the parameters in Table 3. Since these parameters can be of concern in protecting aquatic biological resources, the Open Water Disposal Guidelines will continue to be used though chemical analysis for these parameters will be performed only where specifically requested by MOE. The Open Water Disposal Guidelines are equivalent to the Lowest Effect Level in terms of management decisions.

3.1.1 General Conditions Governing Evaluation

(a) Material will be tested by bulk sediment analyses and results reported on a dry weight basis (MOE Analytical Methods (MOE 1983) or MOE approved equivalent analytical procedures to be used).

(b) For the purposes of sediment or fill quality evaluation, actual analytical results reported by the performing laboratory must be provided. However, in comparing the results with the parameter values in the guidelines the results will be rounded as follows: if the reported value is less than ten, it will be rounded to one significant digit. Values greater than 10 will be rounded to two significant digits. Round

numbers remain unchanged.

e.g.	Reported Value		Rounded Value
	< 10	1.78	2
		0.0364	0.04
		0.0052	0.005
	> 10	10.827	11
		128.4	130

(c) If all parameter values for a given material are at or below the No Effect Level Guidelines, that material passes the guideline and it is anticipated that the material will have no adverse chemical effects on aquatic life or water quality.

(d) If a single parameter value for a given material, based on a sampling program, exceeds the No Effect Level Guideline but is below the Lowest Effect Level Guideline, the material fails the No Effect Level Guidelines and would be considered as having a negligible potential to impair the aquatic environment.

(e) If a single parameter value for a given material, based on a sampling program, is at or above the Lowest Effect Level Guidelines, that material fails the guideline and it is anticipated that such material may have an adverse effect on some benthic biological resources. If all values are below the Lowest Effect Level Guidelines, no significant effects on benthic biological resources are anticipated.

(f) If any single parameter value for a given material, as determined by a sampling program, is at or above the Severe Effect Level Guideline, that material is considered highly contaminated and will likely have a significant effect on benthic biological resources.

(g) The Ministry recognizes that in an area as geologically diverse as Ontario, local natural sediment levels of the metals may vary considerably and in certain areas, such as wetlands, the organic matter content and nutrient levels may be naturally high.

METALS: In areas where local background levels are above the Lowest Effect Level, the local background level will form the practical lower limit for management decisions. In some waterbodies surficial

Table 4: Background Levels for the Metals

Metal	Background ($\mu g/g$)
Arsenic	4.2
Cadmium	1.1
Chromium	31
Copper	25
Iron (%)	3.12
Lead	23
Manganese	400
Mercury	0.10
Nickel	31
Zinc	65

Values are based on analyses of Great Lakes pre-colonial sediment horizon.

(June 1992)

Table 5: Background Sediment Concentrations* of Organic Compounds.

Compound	Background ($\mu g/g$ dry wt.)
Aldrin	0.001
α-BHC	0.001
β-BHC	0.001
γ-BHC	0.001
Chlordane	0.001
DDT (total)	0.01
op+pp DDT	0.005
pp-DDD	0.002
pp-DDE	0.003
Dieldrin	0.001
Endrin	0.001
HCB	0.001
Heptachlor	0.001
Heptachlor epoxide	0.001
Mirex	0.001
PCB (total)	0.02

* Values are based on the highest of the Lake Huron or Lake Superior mean surficial sediment concentrations.

(June 1992)