

Biosolids Recycling Criteria for B.C. Land Reclamation

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Surface mining, mineral exploration, and deposition of spoils and tailings from mining operations have created over 30 000 hectares of disturbed land in B.C. Of this 23 000 hectares remain to be reclaimed. Conditions vary considerably from site to site. However, difficulties in supporting vegetation is usually the result of several distinct factors.

Lack of nutrients - Mine soils have low N, P, K, and/or micro-nutrient levels.

Physical properties - Stony or sandy materials have poor water-holding capacity and low cation exchange capacity (CEC). Clay soils have poor infiltration, permeability, and drainage.

Organic matter - Little if any, organic matter is present.

Topography - Many sites are characterized by steep slopes that are subject to excessive erosion.

Biosolids and municipal solid waste (msw) composts can be used for reclaiming land where mining and other activities have removed the topsoil. Both provide needed organic matter and slow-release nutrients that help establish vegetative cover.

For the past ten years in B.C., biosolids has been permitted for use on agricultural land and for sales and distribution under the Waste Management Act. Environment B.C., along with a wide range of stakeholders, is developing new *Biosolids Recycling Criteria for B.C.* The new criteria will contain requirements for biosolids quality when used for reclamation. Provincial regulations exist which allow MSW compost to be used on land without a permit.

Developing Biosolids Recycling Criteria for B.C. Land Reclamation

Subject:

- B.C. biosolids recycling criteria for land reclamation

Objective:

- Determine if agronomic rates should be used for mine reclamation or should biosolids application rates be more flexible to reflect a range of site conditions?
- If it is determined that while applying biosolids, agronomic rates can be exceeded, should temporary pollution of surface and ground water be allowed during the process of restoring the site?

Scope:

Loading rate criteria will affect:

- Jurisdictions, such as the GVRID and the CRD with limited agricultural land to apply biosolids to:
- Organizations with land to reclaim such as Similco Mining near Princeton and Brenda Mines near Peachland.
- The Ministry of Energy, Mines and Petroleum Resources which is responsible for establishing the criteria and evaluating the success of mine reclamation projects.
- The Groundwater Section of the Ministry of Environment, Lands, and Parks (MOELP).

Responsibility:

- Municipal Waste Reduction Branch, Liquid Waste Unit

Background:

- The MOELP document "Guidelines for the disposal of Domestic Sludge under the Waste Management Act" details yearly nitrogen application rates for a range of crops. Application rates associated with mine reclamation have yet to be described in the provincial guideline.

Description of the Subject:

- Open pit mines, mineral exploration, sand and gravel sites and deposition of spoils and tailings from mining operations have created large areas of disturbed land within B.C. These projects are increasingly required to reclaim sites that have been degraded during the mining process.
- The surface temperatures of barren sites can be high during the summer months and available soil moisture is usually low which can inhibit successful revegetation. This combined with the steep slopes often associated with mine sites results in severe wind and water erosion.
- Sites to reclaim are usually made up of coarse textured materials with poor water holding capacity and low cation exchange capacity (CEC). The same material is usually low in both NPK and micro-nutrients with little if any, organic matter present. Attempts to establish a persistent hardy vegetation depend, to a large extent, on soil fertility and soil moisture status.
- When properly managed, biosolids utilization can accelerate the reclamation process and improve the end result.

Subject Characterization:

- A major design criteria for appropriate rates of biosolids may be future provincial regulation of the amount of nitrates entering groundwater. The provincial drinking water standard is presently 10 mg/L NO₃⁻.
- High amounts of nitrates in groundwater can be harmful to cattle and to infants less than six months old. Ordinarily biosolids should be applied at rates that do not exceed the nitrogen requirement of the type of vegetation on the application site.,
- In many cases the agronomic rate of the vegetation to be established can be used to reduce occurrences of groundwater contamination.
- However, the restrictions of the agronomic rate may or may not be necessary to protect ground water quality. Mine sites may have groundwater levels close to the surface, but many are exceptionally well drained and subject to severe drought conditions in summer.

- As well, aquifers in the vicinity of mine sites may already be substantially degraded through metal contamination or the leaching of ammonium nitrate from spent explosives.
- If biosolids are applied at above agronomic rates, the appropriate application rates are highly site specific.
- Dry climatic conditions linked with increased moisture retention from increased organic matter content may reduce leachate generation.
- A range of properties vary considerably from site to site (e.g. soil, pH, slope, depth to ground water). Soil conditions may range from fine textured materials to areas where the substrate consists primarily of sand.
- The present reclamation code for mines in B.C. states "that the land surface shall be reclaimed to an acceptable use that considers previous and potential use.... The level of land productivity to be achieved on reclaimed areas shall not be less than existed prior to mining.... Land shall be revegetated to a self sustaining state using appropriate plant species.... On all lands to be revegetated, the growth medium shall satisfy land use, productivity, and water quality objectives... Vegetation shall be monitored for metal uptake. Where harmful metal levels are found, reclamation procedures shall ensure that levels are safe for plant and animal life.

Experience in other jurisdictions:

- According to the EPA the amount of biosolids that have been applied to reclamation sites around the U.S. is highly variable, ranging from 7 to 450 dry tonnes per hectare. A typical application is 112 tonnes per hectare. Because of this variability the EPA suggests that a permit is needed to address the potential for temporary pollution of both surface and ground water. The EPA also suggests that to protect surface and ground water, permit writers should strongly consider using the seasonal N loading limitations recommended for agriculture especially where ground water is less than one metre from the soil.
- New Jersey presently bases application limits to land reclamation sites on the nutrient requirements of the proposed vegetation. However, the agronomic rate for reclamation may be based on an annual or periodic addition of nutrients.

- Revegetation requirements in Pennsylvania require "a diverse, effective and permanent vegetation cover of the same seasonal variety as vegetative cover native to the site and capable of self-generation and plant succession at least equal in extent of cover to the natural vegetation of the area. Introduced species may be used when desirable and necessary to achieve the approved post-closure land use. Vegetative cover shall be considered of the same seasonal variety when it consists of a mixture of species that is of equal or superior utility to native vegetation during each season of the year... Revegetation shall provide a quick germinating, fast-growing vegetative cover capable of stabilizing the soil surface from erosion... **Mulch shall be applied to regraded areas where necessary to control erosion, promote germination of seeds and increase moisture retention of the soil.**"
- In Michigan a groundwater discharge permit can be required to ensure that reclamation activities do not degrade the quality of usable aquifers. Experience with the use of biosolids for land reclamation is limited and in Michigan it is suggested that departures from use of the annual agronomic rate should be thoroughly discussed with Waste management division staff prior to the development of a formal proposal.

Assessment of Control Options, Methods and Technologies:

Options:

- a) Base N leaching on seasonal or periodic agronomic rates in order to ensure minimum loss of nitrates to groundwater.
- b) Base N loading on site specific criteria, e.g. depth to groundwater, existing groundwater quality.
- c) Combination of a) and b) where N is applied at rates necessary to achieve the most productive cover possible for a particular environment.

Financial Impact Assessment:

- The agronomic rate associated with an initial vegetative cover (option a) may be far below that required for later stages of plant succession. In some regions application rates limited to annual N requirements may result in mine reclamation becoming a non-

viable option. Higher costs are linked to transportation and the expense of applying biosolids to a disrupted site.

- Option b) opens the door for a wide range of application rates based on site specific criteria. While possibly making mine reclamation more economically interesting to biosolids generators, it will make the process of permitting and review more complex.

Recommendations:

At this time, Option c) is recommended.

- Option c) allows the highest amount of N needed for beneficial use, while recognizing the importance of local conditions such as depth to and quality of ground water. This option will require that the MOELP provides guidance as to what appropriate application rates should be.
- This option will prevent mine areas from becoming burials sites for municipal biosolids.
- Option c) will require close co-ordination with new provincial groundwater criteria presently being drafted by the Groundwater Section of the MOELP.
- The use of biosolids for mine reclamation in general may involve discussions with the Ministry of Energy, Mines and Petroleum Resources about expanding existing codes to include the use of organic matter to reduce erosion, supply nutrients, and retain moisture.

CPR Task Group Membership

- Ministry of Environment, Lands, and Parks
 - Municipal Waste Reduction Branch (Victoria)
 - Technical Services Section -Environmental Protection (Penticton)
 - Groundwater Section (Victoria)
- Ministry of Health
 - South Okanagan Health Unit (Kelowna)
- GVRD
 - Biosolids Utilization Committee member
- City of Kelowna

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- Ministry of Energy, Mines, and Petroleum Resources
 - Mineral Policy Branch, Land Use Policy
- Ministry of Transportation and Highways
 - Highway Engineering Branch (Victoria)
- Industry
 - Terrasol
- Greenpeace (Victoria)

Table 1: Proposed changes to B.C. Biosolids Recycling Criteria

Maximum recommended trace element concentrations in soil other than reclamation sites after biosolids application

(mg/kg) *dried weight basis*)

Arsenic	14	Lead	60
Cadmium	1.6	Selenium	1.6
Cobalt	20		
Chromium	120	Soil analyses should be undertaken from	
Copper	100	from top 30 cm. before each subsequent	
Mercury	0.5	biosolids application.	
Molybdenum	4		
Nickel	32		
Zinc	220		

Table 2: Proposed Trace Element Loading Rate Calculation for B.C. Biosolids Recycling Criteria

1983 B.C. Agric. Low Grade	Typical B.C. Biosolids analyses		Application Rate Limit		Allowable biosolids application rate* Annual Site Limit	Cumulative
	mg/kg	kg/dry tonne	kg/ha/yr	kg/ha/site		
As	75	5.2	.005	2	15	400
Cd	25	3.0	.003	.5	4	166
Co	150	5.4	.005	5	30	1000
Cu	-	867	.867	75	-	86.5
Pb	1000	159	.159	14	100	88.01
Hg	10	5.6	.005	.85	1	170
Mn	20	6.8	.006	.9	4	150
Ni	200	30	.03	21.3	36	710
Se	14	5.4	.005	5	2.8	1000
Zn	2500	705	.705	140	370	560
						524

Steps

- Obtain biosolids trace metal analyses from wastewater treatment plant historical data base
- Compute kilograms of element per dry tonne of biosolids
- Compute allowable annual biosolids application rate (dry tonnes per hectare) Divide annual element loading rate limit (kg. trace element per hectare) by kilograms trace element per dry tonne.
- Compare calculated biosolids loading rates for nitrogen and trace elements. Use the lowest computed application rate.
- Keep records of the amount of biosolids applied (dry tonnes per hectare).