Improved drainage (subsurface drainage)

Excess water is undesirable in agriculture for a number of reasons. The excess may be due to poor drainage, the presence of a groundwater table not far below the surface, or seepage or runoff from nearby watercourses. Water-saturated soil is an unfavourable environment for vegetation (*e.g*. asphyxiation of roots). Biological activity is reduced in such soil; organic matter decomposes slowly, nitrogen mineralization is disrupted. Nutrients go into solution and may be leached away. Excess water is also a constraint from the standpoint of productivity: saturated soils are slow to warm up in spring, their structure quickly becomes degraded, and they do not stand up well under the weight of farm machinery (compaction is a hazard) (Brady 1974). Consequently, the object of a drainage system is to remove excess water from the soil. This results in a longer growing season, more vigorous plant growth and better tillage conditions (Plant Production Council of Quebec (CPVQ) 1984, Gosselin 1986).

The effectiveness of a subsurface drainage system depends on the soil's moisture balance, including such factors as drainage class, permeability of the soil profile, source of the excess water (underground or surface) and relief. The model proposed here (Table 1) purports to show that subsurface drainage is advantageous in the case of agricultural land with natural drainage that is imperfect, poor or very poor. The effectiveness of subsurface drainage is determined in part by the permeability of the soil profile. With this model, a poorly drained soil with slow permeability moves up one class, and a soil with moderate to rapid permeability moves up two classes (Lavoie and Nolin 1997).

Table 1. Estimated improvement in drainage after installation of a subsurface drainage system

Natural drainage	Permeability of profile*	Improved drainage
Imperfect	Slow Moderate to rapid	Moderate Good
Poor	Slow Moderate to rapid	Imperfect Moderate
Very poor and surface layer organic carbon content <17 %	Slow Moderate to rapid	Poor Imperfect
Very poor and surface layer organic carbon content ≥17 %	Slow to rapid	Poor

*See Table 2 for definition of classes

Table 2. Definition of permeability classes

Class	Hydraulic conductivity (cm/hr)	Percentage of area
Slow	<0.5	24.7
Moderate	0.5 - 15.0	43.9
Rapid	≥15.0	31.4

Day and McMenamin 1983

Estimated drainage after installation of subsurface drainage pipes was used to assess compaction and wind erosion vulnerability and to estimate water stress and vulnerability to losses to groundwater.

Table 3 shows estimated improvement following installation of subsurface drainage pipes. As will be seen, soils with poor (86.7%) and very poor (4.5%) natural drainage have been redistributed into the drainage classes identified as imperfect (25.5%), moderately good (64.3%) and good (8.1%). This improvement is clearly apparent when maps for all counties are compared. In the case of the less permeable clay soils of Chambly and Verchères Counties, the drainage rating moves up one class (from poor to imperfect) (e.g. Providence series). In the case of the loamy and sandy soils of Richelieu and Saint-Hyacinthe, the drainage rating is upgraded from poor to moderately good (e.g. Achigan series).

Table 3. Distribution of areas (%) by drainage class for natural and improved drainage

Drainage class	Percentage area before improvement of drainage (natural drainage)	Percentage area after improvement of drainage (improved drainage)
Rapid	0.1	0.1
Good	2.8	8.1
Moderately good	0.1	64.3
Imperfect	5.8	25.5
Poor	86.7	1.1
Very poor	4.5	0.9