3. Planning a shelterbelt

To ensure the desired protection is obtained, the shelterbelt has to be adequately located. The next step is then selecting and arranging species with this objective in mind.

3.1 Location

The best location for a shelterbelt is a compromise between the ideal location in terms of protection objectives and the location that takes into account the inherent limitations of the site such as available area, presence of electrical poles and ditches or loss of crop land.

To maximize reduction of odour emissions, it is recommended that a high-rising, dense plant screen be installed as close as possible to the odour source, since odour reduction potential varies depending on the W/H ratio where W = distance between the hedge and the odour source, and H = height of the hedge (Figure 12). In the case of impervious barriers, the odour reduction potential increases from 26% at a W/H ratio of 8, to 92% at a W/H ratio of 0.6 (Liu and al., 1996). Studies conducted by Choinière (2004) confirm these findings: odour dispersion is greater when hedges are installed at a distance of 15 m from the source, rather that 30 or 60 m.

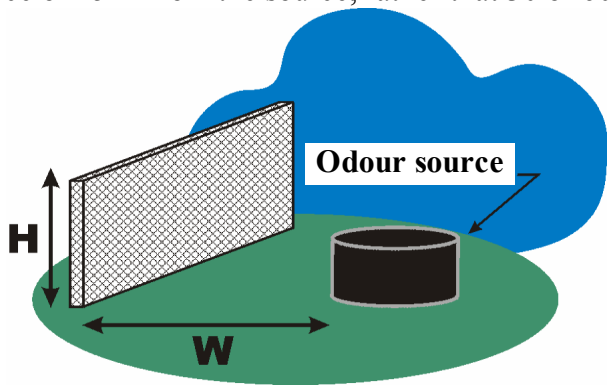

Figure 8 – Shelterbelt installed for odour mitigation purposes (design: Roch Lavoie)

Complaints from neighbours tend to be less frequent when installations responsible for causing the odours are not visible.

Snow accumulation resulting from the shelterbelt must also be taken into consideration. There should be a minimal distance of 30 metres between the first windward row and the installations requiring protection. It is in this zone that most of the snow trapped by the shelterbelt will be deposited.

Another factor to be considered is the reduction of heating costs. This reduction varies in relation with wind speed reduction. As is evidenced in Figure 4, maximum reductions are obtained in the zone ranging from 2 to 4 H for a moderately dense to dense shelterbelt. Because prevailing winds are usually from the west, south-west

and north-east along the St. Lawrence Valley, shelterbelts should, ideally, be oriented perpendicularly to these directions. The hedge should however not be installed too close to the buildings to avoid producing shade during the winter.

In the case of a 15-meter high hedge, and considering odours, snow and heating costs, a distance of 30 metres should be allowed for between the outermost row of the hedge and the area requiring protection in order to prevent the wind from flowing around the extremities of the hedge and hitting the building (Figure 9). The hedge should extend 30 to 60 metres more than the length of the area requiring protection to prevent winds from running around the edges and hitting this area. This design also ensures added protection from winds blowing from other directions. Snow accumulations and turbulence prevailing at the extremities of the hedge are therefore further removed form the area requiring protection.

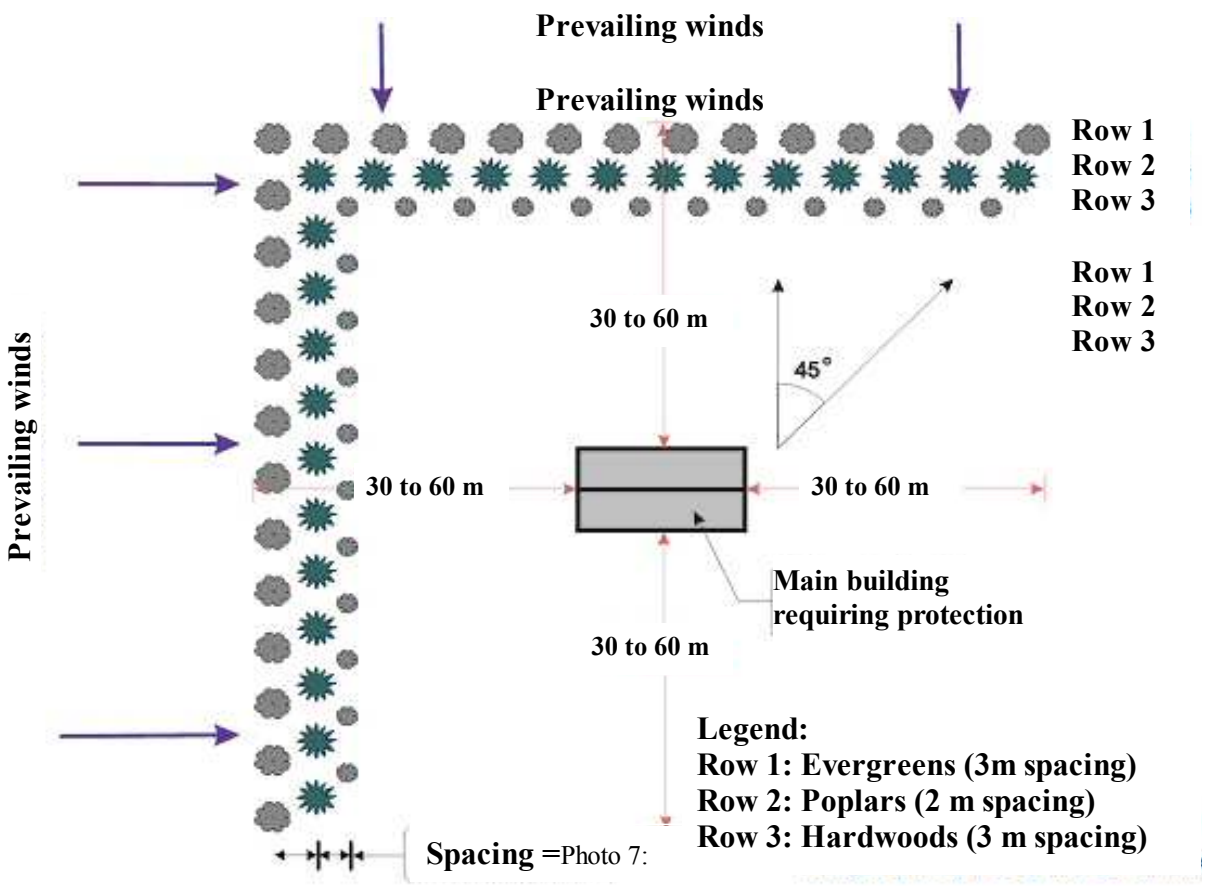

Figure 9 – Example of hedges installed for the purpose of protecting a building

In the case of buildings with natural ventilation systems, the hedge should be installed perpendicularly to prevailing winds (usually on the westward side) at a distance of 8 H from the building, which allows air streams to flow back down (Figure 1).

3.2 Legal considerations regarding shelterbelts in Quebec

In collaboration with Mr. Yvon Pesant, Geographer and Design Advisor
MAPAQ, Direction régionale Richelieu-Saint-Hyacinthe

The establishment, existence and development possibilities of shelterbelts in rural areas may be governed by municipal standards and by-laws or by sections of the law contained in the Municipal Code and/or the Civil Code.

Currently, in the case of disputes regarding shared hedges that define the boundaries between two properties, agrarian inspectors largely refer – perhaps too much so –to Section 237 of the new Quebec Municipal Code (formerly Section 195 of the

previous Code) to enforce the 5-metre (15 feet)[1] standard. It is important to note that Section 195 refers to Section 531 of the Civil Code of Lower Canada. The latter section addresses complaints in the case of cultivated lands adjacent to wildlands and stipulates that maples, swamp maples and fruit trees are excluded from the regulation; whereas Section 237 already indicates that all ornamental trees are to be excluded from the regulation. In the case of hedges or rows of trees, reference should rather be made to Sections 527 through 530 of the Civil Code of Lower Canada. These articles indicate, substantially, that existing municipal by-laws have to be respected or, in the absence of municipal by-laws, common practices are to be followed. These sections reflect the notion by which the plaintiff must demonstrate the existence of a nuisance caused by one or several trees or by the entire hedge.

In our day and age when environmental protection, overall quality of life, soil preservation and water protection, in particular, are of the utmost importance, we must recognize the value of shelterbelts as key management tools in agriculture and land-use planning. It is imperative that we take advantage of the momentum gained through the revision of county regional frameworks and overall municipal development plans, as well as of the consolidation projects underway regarding municipal by-laws and the Civil Code of Quebec in order to avoid potential legal complications arising from the interpretation of statutory enactments.

Trees are an important part of the rural landscape. Let's work together to make sure they are considered by all as an asset rather than as a nuisance.

3.3 Nature and selection of trees and shrubs

Selecting and arranging trees and shrubs is perhaps the most critical step in establishing a shelterbelt. To make the right decisions, the first thing to determine is the kind of protection required and the time of the year when this protection will be the most crucial. This information, along with any identifiable limitation, will determine the structure and location of the protective plantation.

A complete guide was designed to assist designers in Eastern Canada in making the right choices and is based on studies conducted over the past 25 years, not only in Quebec, but also in Ontario and in the Maritimes. This guide is available on the CD-Rom and on the website produced within this project.

[1] Forces owners to cut down trees that are located within 15 feet of the boundary with the plaintiff's lot.

3.4 Plants ordering

The order of the plants is a crucial stage which should not be neglected. The autumn is the best moment for the reservation of the trees and shrubs that will be planted in the following spring. It's safe to verify the quality of the stock from the nursery you have ordered the plants.

3.5 Regional planning for shelterbelts

The implementation of a network of shelterbelts will have an incidence on regional climate, including air temperature (Guyot, 1989). Shelterbelts tend to have an effect on temperature, raison highs and lowering lows. The spacing between the hedges will determine the extent of variation compared to an open area (Figure 10).

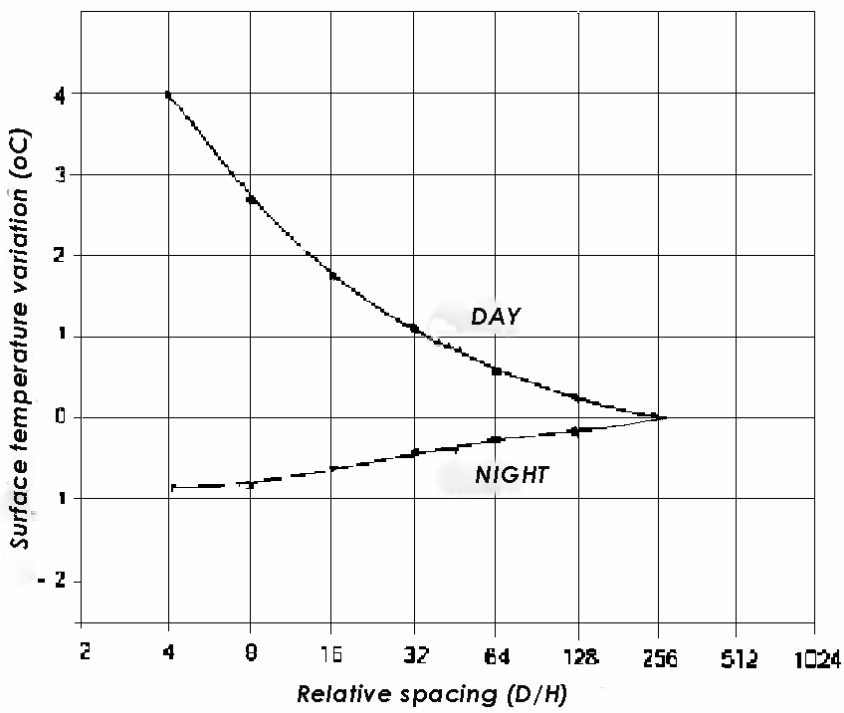

Figure 10 – Impact of hedge spacing on surface temperature variation between the centre of a parcel of land in an area surrounded by shelterbelts and the centre of an open area (simulation on a model) (adapted from Chiapale, as used in Guyot, 1989)

Wind speed reductions in a network of shelterbelts are not cumulative with each hedge. The first windward shelterbelt will increase turbulence of air flows, which will reduce the effectiveness of the following shelterbelt (fig. 15). However, if the network is sufficiently large, it will create an uneven regional profile that will have a protective effect that is added to that of each barrier (Guyot, 1989). It is unclear at what length this regional effect becomes noticeable. According to Heisler and

DeWalle (1988), the effect becomes noticeable at distances superior to 50 H from the first shelterbelt.

The ideal distance to be allowed between shelterbelts depends on numerous factors such as crop resistance, wind force, cost of the land and protection objectives. In terms of wind speed reduction only, the results obtained by Nägeli (1953), as used in Guyot (1989) indicate there are no benefits in installing shelterbelts too close together (Figure 11). The effectiveness of a network of shelterbelts exhibiting a porosity level around 50% was increased by 14% when the spacing between shelterbelts was reduced from 20 to 15 H, and by another 7% when the distance was further reduced from 15 to 10H.

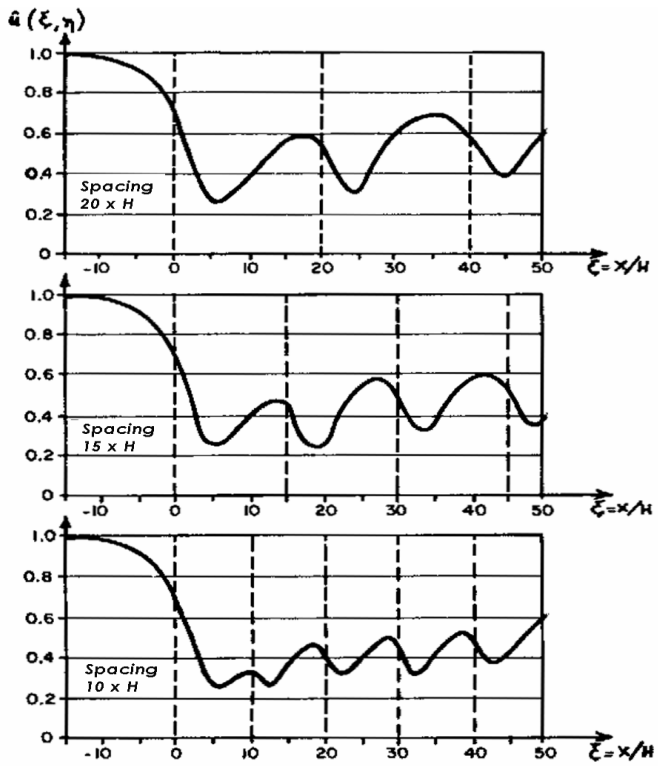

Figure 11 – Impact of a series of identical windbreaks (common reed screens measuring 2.2 metres in height with a porosity level of 50%) on relative wind speed with respect to spacing (adapted from Nägeli, 1965, as used in Guyot, 1989)

For most types of cultures in Quebec, the ideal spacing between two shelterbelts is 20 H, where H is the height of the tallest trees at maturity. For trees measuring between 15 and 20 metres, this ideal spacing would be 300 to 400 metres. However, in order to gain the desired protection more rapidly, facilitate renewal of the network and still respect land boundaries, the shelterbelts should be spaced at 175 to 250 metres.