

Shelterbelts for Livestock Farms in Alberta Planning, Planting and Maintenance



Published by

Alberta Agriculture and Rural Development
Environmental Stewardship Division
#306, 7000-113 Street
Edmonton, Alberta T6H 5T6

©2014. All rights reserved by her Majesty the Queen in Right of Alberta

Acknowledgement

Agriculture and Agri-Food Canada
Alberta Agriculture and Rural Development
Intensive Livestock Working Group
The Carbon Farmer
University of Alberta

Photo Credits:

Agriculture and Agri-Food Canada

Disclaimer

All information (including descriptions of or references to products, persons, websites, services or publications) is provided entirely "as is," and the authors make no representations, warranties or conditions, either expressed or implied, in connection with the use of or reliance upon this information. This information is provided to the recipient entirely at the risk of the recipient, and because the recipient assumes full responsibility, the authors shall not be liable for any claims, damages or losses of any kind based on any theory of liability arising from the use of or reliance upon this information (including omissions, inaccuracies, typographical errors and infringement of third-party rights).



Did you know that shelterbelts (trees and shrubs) planted around your livestock farm provide lots of benefits, including financial benefits? The publication series, *Shelterbelts for Livestock Farms in Alberta*, provides practical information about livestock farm shelterbelts.

This planning, planting and maintenance publication outlines how to design a shelterbelt to serve multiple purposes on a livestock farm and how to plant and care for shelterbelts.

Create a shelterbelt plan long before you start ordering or planting tree and shrub seedlings or cuttings.

1. Shelterbelt Planning

Creating a plan before you plant one or more shelterbelts on your livestock farm is extremely important. It enables you determine what purpose each shelterbelt will serve, where to plant it, what types of trees and shrubs would be most suitable, how many rows are needed, and so on. Ultimately, creating a plan will increase the chances of your shelterbelt performing effectively, being economical, and providing multiple benefits.

Click on the following link, *[Shelterbelts for Livestock Farms in Alberta - Shelterbelt Planning Workbook \(Agdex 400/092-3\)](#)*, to access a shelterbelt planning guide. A paper copy of the workbook can also be obtained by contacting [ARD Publications](#) (see contact information on back page). Finally, it is highly recommended that you consult an agroforestry specialist through the [Ag-Info Centre](#) (see contact information on back page) to assist you with creating your plan.

Be sure to read this entire publication before filling out the workbook.



1.1 Mapping the Farm Site and Surroundings

Map your livestock farm and surroundings with respect to:

- Roads: public roads (including rights-of-way) and on-farm roads.
- Livestock barns: mechanically-ventilated barns and naturally-ventilated barns.
- Feedlot pens and feed alleys.
- Outdoor manure storage units.
- Catch basins.
- Farm office.
- Silage pit.
- Feed mill.
- Future development (e.g., expansion, downsize, etc.) on the farm.
- Utility lines above and below ground level (e.g., power, cable, telephone, water, sewer, natural gas, propane, etc.).
- Pipelines and valves including rights-of-way and easements.
- Vehicle parking areas.
- Sidewalks and pathways.
- Flood plains.
- Wooded lots (e.g., shelterbelts, etc.).
- Water sources (e.g., dugouts, wells, streams, lakes, sloughs, etc.).
- Neighbouring property on land zoned by municipality for: agricultural purposes (e.g., farmstead, acreage residences, etc.); non-agricultural purposes (e.g., country residential, rural commercial businesses, etc.); high use recreational or commercial purposes; or large-scale country residential, rural hamlet, village, town or city.
- Other unique features either on or off the farm.
- Prevailing seasonal wind directions.

Click on the following links to view seasonal prevailing wind maps for Alberta
[WINTER](#) [SPRING](#) [SUMMER](#) [FALL](#)



On your map, indicate where various facilities and other features both on and off your farm are situated or will be in the future. You can use aerial photographs or click on the link, [Alberta Soil Information Viewer](#), to assist with this mapping process. Creating a map will help you determine the most appropriate location for each shelterbelt so you can achieve the most benefits and experience the least problems.

1.2 Purpose of the Shelterbelt

After careful consideration, document what benefits you expect your shelterbelt(s) will provide. For example, your shelterbelt may be used to: (1) manage odour and dust emissions from your livestock farm; (2) visually screen the farm; and (3) protect livestock from extreme weather. Documenting the expected benefits will help you figure out details such as the best location for each shelterbelt.

Do not use shelterbelts as vegetative buffer strips to filter runoff water from feedlots, barns or manure storage units. Exposing trees or shrubs to excessive nutrients in runoff water can lead to significant damage or the eventual death of the trees and shrubs.

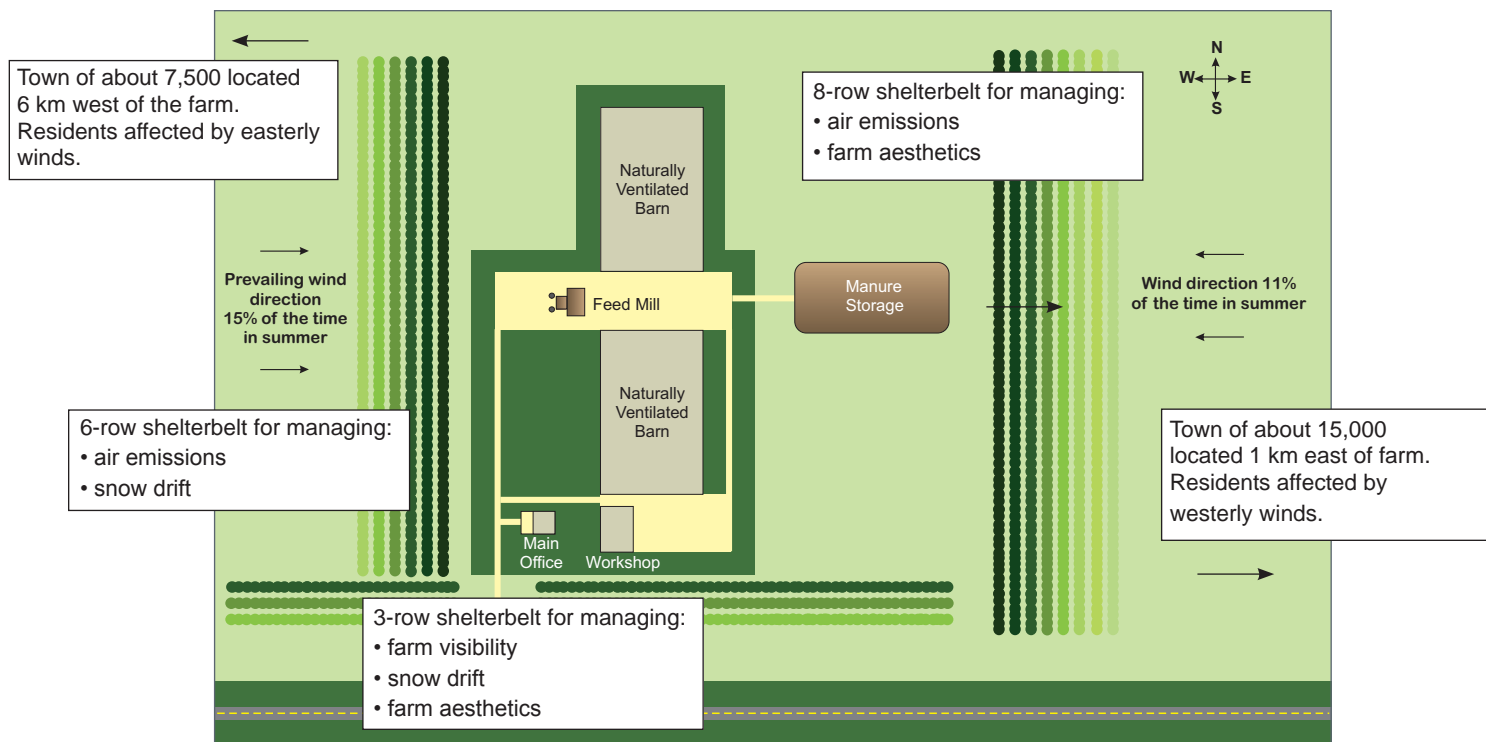


Figure 1. Shelterbelts on livestock farms can provide several different benefits.



1.3 Shelterbelt Orientation and Shape

Mark the proposed location and approximate length of each shelterbelt on your map. If one of the purposes of your shelterbelt is to manage odour and other air emissions such as dust, then the shelterbelt should be located between your livestock farm and the neighbouring property you are trying to shield. For example, if the prevailing wind from late spring to early fall is from the southwest (SW) and a neighbouring property is located northeast (NE) of your farm, then it would be best to plant the shelterbelt NE of the barns, feedlot pens or manure storage units on your farm.

Locating the shelterbelt between your livestock farm and neighbouring properties will allow the shelterbelt to:

- Filter odour and other air emissions produced by your farm.
- Drive concentrated emissions high into the air where they are diluted.
- Reduce air speed so that emissions such as dust particles can settle out of the air well before reaching neighbouring properties.

In some situations you may decide to plant another shelterbelt at a different location on your farm to achieve a different benefit. For example, your first shelterbelt could be planted to help manage odour and other air emissions while your second shelterbelt could be planted to provide privacy by screening your farm from view from a public road.

A shelterbelt's shape does not necessarily have to be straight (I-shaped) or at right angles (L-shaped). For aesthetic reasons, it could be curved or wedge-shaped. Regardless of its shape, the shelterbelt must be properly designed to serve its intended purpose.

2. Shelterbelt Site Assessment

2.1 Soil Characteristics

Knowledge of soil properties such as, [soil texture](#) (click on link), [salinity](#) (click on link), [organic matter](#) (click on link), moisture content (related to drainage) and alkalinity, is important to determine what types of trees and shrubs would be best suited to the proposed location for your shelterbelt. Some tree and shrub species cannot survive or perform well under certain soil conditions.

Information about soil characteristics in your area can also be obtained by contacting a soil specialist through the [Ag-Info Centre](#).

Consult your county agricultural office about your intentions to plant a shelterbelt, what federal, provincial or municipal regulations exist, what permits are required and what safety issues exist regarding planting close to roads, along neighbouring property lines, close to buried utility lines, etc. If you plant a shelterbelt in violation of any regulations, you may have to remove it at your own expense.



2.2 Permits

As part of the planning process, it is important to investigate what federal, provincial or municipal rules, regulations, permits, etc., govern the planting of trees or shrubs in your area, e.g., setback distances from municipal roads. Also contact Alberta One-Call online at, [Click Before You Dig](#), or toll free at 1-800-242-3447 about your intentions to plant a shelterbelt. You may find that your proposed location is unsuitable for your shelterbelt because of underground utility or high-pressure gas lines and you will have to adjust your plan.

2.3 Limitations

Document any concerns you may have about each prospective shelterbelt. Documenting your concerns will help you compare the risks of each shelterbelt to its benefits. Then you can decide whether or not to proceed with designing and planting the shelterbelt. For some examples of limitations click on the link, [Shelterbelts for Livestock Farms in Alberta - Overview \(Agdex 400/092-1\)](#), or contact [ARD publications](#) for a paper copy.

3. Shelterbelt Design

3.1 Number of Rows

Shelterbelts for managing livestock odour and other air emissions are recommended to have a minimum of three, four, five or six rows of trees and shrubs depending on the municipal zoning for the area (see Table 1). For example, for a neighbouring residence on land zoned for agricultural purposes, a shelterbelt with a minimum of three rows should suffice to manage odour and other air emissions. In developing your shelterbelt plan, keep in mind that each additional row in your proposed shelterbelt could take land away from cropping or some other purpose.

Table 1. Recommended minimum number of shelterbelt rows for different municipal land use zones in Alberta

Category	Municipal Land Use Zone	Minimum Number of Rows
1	Agricultural purposes (e.g., farmstead, acreage residences, etc.)	3
2	Non-agricultural purposes (e.g., country residential, rural commercial businesses, etc.)	4
3	High-use recreational or commercial purposes	5
4	Large-scale country residential, rural hamlet, village, town or city	6

3.2 Length of Rows

Extend your shelterbelt by at least 15 m (50 ft) at each end to ensure that the entire (combined) span of your barns or feedlot pens and manure storage unit is adequately screened from the wind or from view. For example, if the length from the farthest end of your livestock barn to the farthest end of your manure storage unit is 170 m (560 ft), add an additional 15 m (50 ft) to each end to give you a shelterbelt length of 200 m (660 ft).



Table 2. Area of land needed for a 5-row shelterbelt versus an 8-row shelterbelt

Row Length (m)	Area Needed for 5-Row Shelterbelt		Area Needed for 8-Row Shelterbelt	
	(m ²)	(acres)	(m ²)	(acres)
100	2,100	~0.5	3,600	~1
200	4,200	~1	7,200	~2.5
300	10,500	~2.5	18,000	~4.5

3.3 Spacing between Shelterbelts and Other Facilities

A spacing of at least 30 m (100 ft) is recommended between shelterbelts and livestock barns, on-farm roads (to help prevent snow from drifting onto the roads), overhead lines (e.g., power lines, telephone lines, etc.), or buried utility lines such as water lines (to prevent damage that can be caused by tree or shrub roots). A greater setback of at least 50 m (165 ft) is recommended between shelterbelts and manure storage units or catch basins. Dugouts should also be spaced at least 50 m (165 ft) from shelterbelts to prevent fallen leaves from trees or shrubs from contaminating the water.

According to Alberta’s Ministry of Transportation, shelterbelts should be spaced at least 60 m (200 ft) from the centre-line of provincial highways, or 30 m (100 ft) from the boundary of highway rights-of-way, based on the greater of the two distances. For municipal roads, consult your municipal office about setback distances for trees and shrubs from roads and rights-of-way.

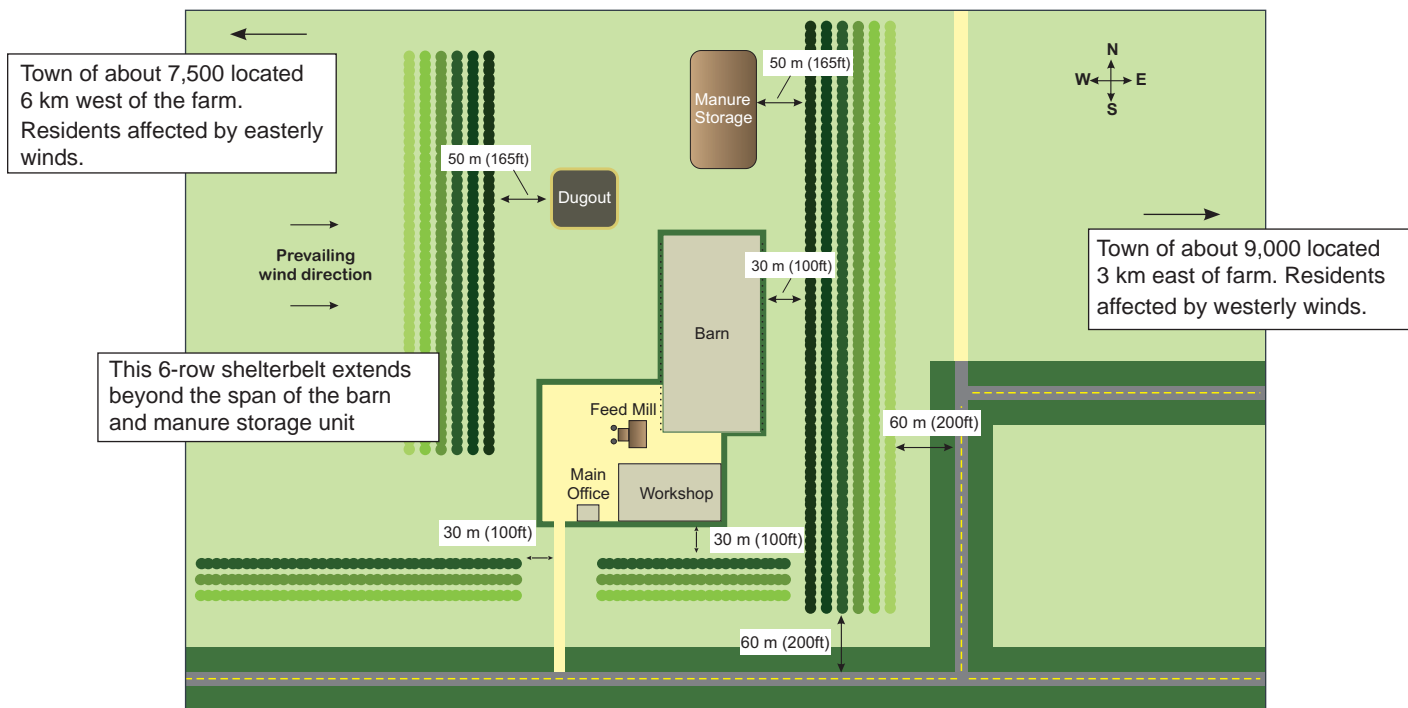


Figure 2. On-farm and off-farm setback distances from livestock farm shelterbelts.



3.4 Selection of Trees and Shrubs

Use the Shelterbelt Site Assessment information you gather (see Section 2 above) to help you determine what types of trees and shrubs would be best suited to your local conditions. Click on the following link to view, [*Shelterbelt Varieties for Alberta*](#), or contact [ARD Publications](#) for a paper copy. Alternatively, for additional information click on the link, [*Trees and Shrubs for Agroforestry on the Prairies*](#).

You can also consult your county agricultural office for advice about trees and shrubs for your shelterbelt.

3.5 Row Spacing

Spacing between rows depends on the types of trees and shrubs in each row. The Agroforestry Development Centre recommends a minimum spacing of:

- 5 m (16 ft) between adjacent rows of shrubs
- 5 m (16 ft) between a row of shrubs adjacent to a row of deciduous trees
- 5 m (16 ft) between adjacent rows of deciduous trees
- 6 m (20 ft) between a row of deciduous trees adjacent to a row of coniferous trees
- 5 m (16 ft) between adjacent rows of coniferous trees

For more information, click on the link [*Shelterbelts - Design Guidelines for Farmyard, Field, Roadside, Livestock, Wildlife and Riparian Buffer Plantings on the Prairies*](#).

3.6 Spacing between Individual Trees and Shrubs

For information about the recommended spacing between trees or shrubs in each row, click on the link, [*Shelterbelts - Design Guidelines for Farmyard, Field, Roadside, Livestock, Wildlife and Riparian Buffer Plantings on the Prairies*](#), or consult an agroforestry specialist through the [Ag-Info Centre](#).

If you also decide to plant a shelterbelt on the side of your barn or feedlot that faces the prevailing winds, then consider increasing the spacing between the trees and shrubs to minimize obstruction to wind flow on that side. This is especially important if you depend on summer winds to cool your barn or feedlot. Under these circumstances it may also be best to plant the minimum number of rows of trees and shrubs corresponding to the municipal zoning in your area.

Caution!

Excessively wide spacing between trees or shrubs can lead to problems with snowdrifts on nearby roads.



3.7 Number of Trees and Shrubs of Each Species

You can calculate how many of each tree species and shrub species you will need for your shelterbelt based on the planned length, number of rows, and types of trees and shrubs. A mixture of tree species or tree and shrub species can be planted in the first row (row nearest the farm facilities), second row and so on. Similarly, a mixture of shrub species can be planted in the last row farthest from the facilities. Planting a mixture of species of trees and/or shrubs within rows can help fill up the spaces (height and density) within the shelterbelt. This can also be helpful for controlling weeds.

Planting mixtures of shrub and/or tree species within your shelterbelt rows helps manage odour and other air emissions effectively, as well as control weeds.

To calculate the number of tree and shrub seedlings or cuttings required for a livestock farm shelterbelt, consider the example of a 300 m (990-ft) long, 5-row shelterbelt shown in Table 3 below. For this example, you would require: 87 Colorado Spruce trees; 87 White Spruce trees; 121 Acute Leaf Willow trees; 121 Green Ash trees; 2,280 Caragana shrubs; and 301 Choke Cherry shrubs; totaling 2,997 tree and shrub seedlings.

Table 3. Number of tree and shrub seedlings required for a 300-m, 5-row shelterbelt (example)

Row #	Tree or Shrub Type	Spacing between Plants	Number of Seedlings or Cuttings
1	Colorado Spruce (coniferous trees)	3.5 m	$(300 \text{ m} \div 3.5 \text{ m}) + 1 \text{ tree} = 87$
2	White Spruce (coniferous trees)	3.5 m	$(300 \text{ m} \div 3.5 \text{ m}) + 1 \text{ tree} = 87$
3	Acute Leaf Willow (deciduous trees)	2.5 m	$(300 \text{ m} \div 2.5 \text{ m}) + 1 \text{ tree} = 121$
	Caragana (7 shrubs between every 2 Acute Leaf Willow trees)	0.3 m	$(300 \text{ m} \div 2.5 \text{ m}) \times 7 = 840$
4	Green Ash (deciduous trees)	2.5 m	$(300 \text{ m} \div 2.5 \text{ m}) + 1 \text{ tree} = 121$
	Caragana (7 shrubs between every 2 Green Ash trees)	0.3 m	$(300 \text{ m} \div 2.5 \text{ m}) \times 7 = 840$
5	Choke Cherry (shrubs)	1.0 m	$(300 \text{ m} \div 1 \text{ m}) + 1 \text{ shrub} = 301$
	Caragana (2 shrubs between every 2 Choke Cherry shrubs)	0.3 m	$(300 \text{ m} \div 1 \text{ m}) \times 2 = 600$

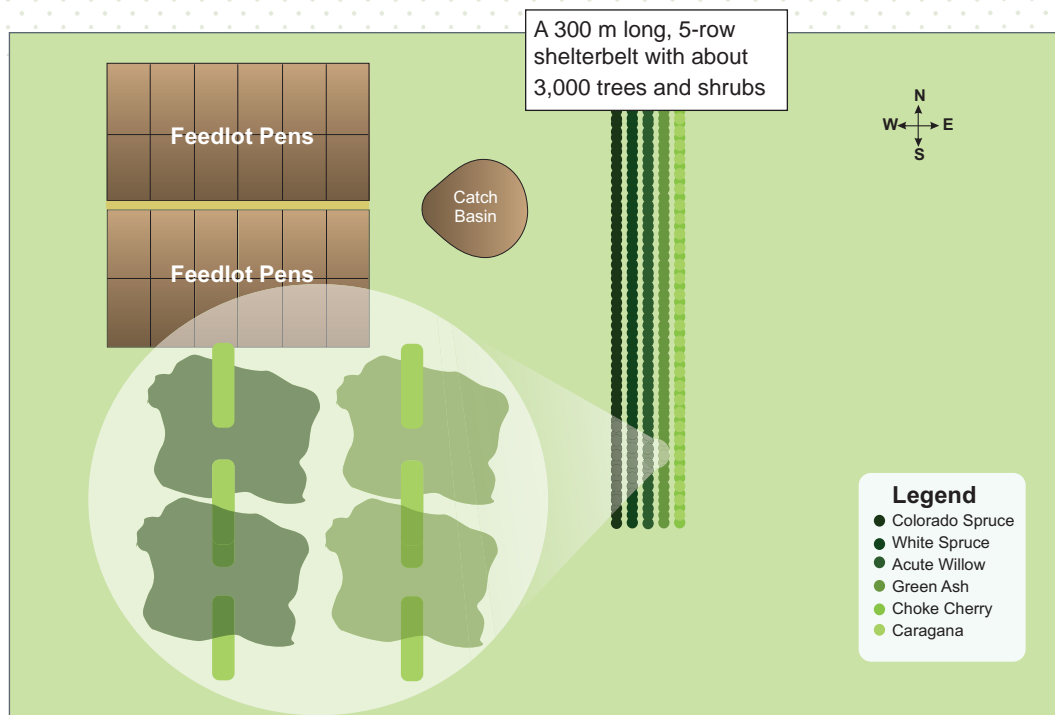


Figure 3. *Caragana* shrubs growing between *Acute Leaf Willow* trees, *Green Ash* trees and *Choke Cherry* shrubs in rows 3, 4 and 5.

3.8 Obtaining Trees and Shrubs

Options for obtaining tree and shrub seedlings and cuttings include:

- Consult your local county agricultural office.
- Contact large commercial tree nurseries.
- Contact local *small tree nurseries* (click the link).
- Grow your own trees or shrubs from cuttings.

If you obtain seedlings or cuttings from a tree nursery, inquire what the warranty is for replacing dead or dying plants.

3.9 Mulching

Apply mulch around your seedlings to help control weeds, conserve soil moisture, and provide other benefits to your shelterbelts. You can use organic mulch (e.g., woodchips, bark or compost) or plastic mulch.



If organic mulch is used, apply the mulch to a depth of 10 cm to 15 cm (4 in to 6 in) and a radius of 0.5 m to 1 m (1.5 ft to 3 ft) around each seedling. You can calculate the volume of organic material you need to apply to your shelterbelt by multiplying the number of trees and shrubs by the depth of the mulch bed and the surface area of the mulch bed.

Based on the example in Section 3.7 indicating how many trees and shrubs would be required for a 300-m (990-ft) long, 5-row shelterbelt, we can calculate how much organic mulch would be needed for this shelterbelt as follows:

Table 4. Amount of organic mulch required for a 300 m, 5-row shelterbelt (example)

What Needs to be Calculated?	Answer
Total number of trees and shrubs	2,997
Depth of mulch bed	15 cm (0.15 m)
Radius of mulch bed around each tree or shrub	1 m
Surface area of mulch bed: $n \times \text{radius} \times \text{radius} = 3 \times 1 \times 1$ around each tree or shrub	3 m ²
Total amount of woodchip mulch required: $2,997 \times 0.15 \times 3$	1,350 m ³

Similarly, if plastic mulch is used, you can calculate how many rolls you require depending on the number of rows and length of your shelterbelt. For the above example, and assuming a roll of plastic mulch is 450 m (1,480 ft) long, you would need:

$$300 \text{ m} \times 5 \text{ rows} \div 450 \text{ m} = 4 \text{ rolls of plastic mulch, totaling } 1,800 \text{ m}$$

For more information about shelterbelt mulch, click the following links: [Weed Control for Alberta Shelterbelts](#), [Controlling Weeds in Your Agroforestry Planting](#), [Plastic Mulch Retailers in the Prairies](#).

3.10 Watering

If you decide to water your shelterbelt using a drip irrigation system, your irrigation system design will depend on the length of the shelterbelt, spacing between rows, and spacing between the trees and between the shrubs. These features will also help determine the appropriate size of the water pump and water storage tank. Keep in mind you may have to bury the water lines to prevent coyotes, rodents and other pests from making holes in the lines in their attempt to access water.

Consult an irrigation specialist through the [Ag-Info Centre](#) to assist you with designing a drip or other irrigation system.



4. Planting a Shelterbelt

Once you have created a detailed plan for your shelterbelt, then you can start on the steps involved in planting the shelterbelt. For additional information about planting shelterbelt seedlings and cuttings click the link, [*Spring Planting and Care of Seedlings*](#).

4.1 Preparing the Site before Planting

You need to prepare the ground at least one year prior to planting any trees or shrubs in your shelterbelt. Be sure to contact Alberta One-Call online ([*Click Before You Dig*](#)) or toll free at 1-800-242-3447 about your intentions to plant a shelterbelt at the proposed location. Cultivate the soil where you intend to locate your shelterbelt and apply recommended herbicides, if you desire. If you are using herbicides and the site is in forage or grass, then apply glyphosate herbicide two weeks prior to cultivating the soil. For information on herbicides and other weed management practices, see Section 5.2 below.

These pre-planting practices will help your shelterbelt survive and continue to thrive by reducing the competition from weeds for nutrients, soil moisture and light.

4.2 Caring for Seedlings or Cuttings

Since tree and shrub seedlings are highly perishable:

- Do not leave the seedlings in direct sunlight, and keep them cool at all times prior to planting.
- During planting, keep your supply of seedlings moist and cool by wrapping moist burlap or peat moss around their roots.
- If at all possible, plant your seedlings on the day of delivery or the next day.
- If the seedlings cannot be planted the next day after delivery, then store them in a cool, dark space for no more than five days.
- If the seedlings cannot be planted within five days, then plant them temporarily in shallow boxes for long-term storage and water them regularly so they do not dry out.

Keep in mind, different tree and shrub species may have different care requirements.

4.3 Planting Depth

Plant your seedlings to the same depth as at the tree nursery. The colour difference on the seedling stem can be used as a marker to indicate how deep to plant the seedlings. Remember that shallow planting can cause the seedling roots to dry out, and deeper planting can prevent oxygen from getting to the roots.

4.4 Planting Techniques

The best time to plant tree and shrub seedlings is in spring. It is critical to ensure that the seedlings are planted properly. Seedlings may be planted by hand or mechanically depending on your selection of trees



and shrubs, size of your shelterbelt, soil type and available labour. Consult your local municipality to determine if you can rent planting equipment. Prior to planting, consider staking each row based on the spacing requirements written in your plan.

4.5 Mulching

Mulch your tree and shrub seedlings soon after planting to help conserve soil moisture and control weeds. If plastic mulch is used, pull the seedlings immediately through slits you make in the sheet to prevent suffocation. Consult your local municipality to determine if you can rent mulching equipment.



*Figure 4. A seedling pulled through a slit cut in plastic mulch while planting a shelterbelt.
Photo courtesy of Donald George, Agriculture and Agri-Food Canada, Red Deer, AB.*

If organic mulch is used, apply the mulch to a radius of 0.5 m to 1 m (1.5 ft to 3 ft) around each seedling, and a depth (bed thickness) of 10 cm to 15 cm (4 in to 6 in). Be sure to keep the mulch 8 cm to 10 cm (3 in and 4 in) away from seedling stems to prevent rodents from damaging the seedlings. Do not over-apply mulch. Excess mulch will attract rodents to the mulch bed which will put the seedlings at risk.



4.6 Watering

Water the seedlings immediately after planting to prevent their root systems from drying out. You can use a water hose or a drip irrigation system. If you use a hose, soak the soil around each seedling heavily. Remember, shallow watering encourages shallow root development which inhibits plant growth.

4.7 Fertilization

Shelterbelt trees and shrubs do not need fertilizer. Their extensive and deep rooting systems enable them to reach the nutrients they require for growth and development.

5. Shelterbelt Maintenance

Once a shelterbelt has been planted, it must be maintained regularly to guarantee its successful growth, development and ability to serve its intended purpose. Inspect your shelterbelt weekly for:

- Soil moisture.
- Weeds.
- Pests and diseases.
- Broken, low lying and dead branches.
- Dying and dead trees and shrubs.

5.1 Soil Moisture

Watering your shelterbelt, especially in its first two years, is critical for the survival and growth of the trees and shrubs. The amount and frequency of water application will depend on the soil moisture content, types of trees and shrubs, and weather conditions. If you are in an area that typically receives considerable amounts of rainfall at particular times in summer, then you do not need to water during those periods. In regions where rain and snow are limited or when periods of hot, dry weather occur, supplemental watering may be required.

Regardless of where you are, make sure you water heavily just before freeze-up in fall. Some of the water will freeze in the soil around the tree and shrub roots and will remain in the soil until the following spring when it will thaw, supplying moisture early in the season to the tree and shrub roots.

5.2 Weeds

If weeds are not controlled they can limit the growth rate or survival of your shelterbelt, especially in the first three years after planting. Weeds compete with trees and shrubs for soil nutrients, light and moisture.



You can control weeds in your shelterbelt by mowing, cultivating or herbicide application. For instructions on weed management over the lifetime of your shelterbelt and a listing of recommended herbicides, click the following links: [Weed Control for Alberta Shelterbelts](#), [Controlling Weeds in Your Agroforestry Planting](#), or consult an agroforestry specialist through the [Ag-Info Centre](#).

5.3 Pests and Diseases

Shelterbelt pests and pathogens include parasites, insects, rodents (e.g., mice), other small mammals (e.g., rabbits), birds, ungulates (e.g., deer), fungi (e.g., black knot disease in Choke Cherry shrubs), etc. Pests attack trees and shrubs by feeding on their leaves, bark, twigs, branches, trunks (stems) or roots. This can lead to significant damage to the shelterbelt, including killing trees and shrubs, increasing susceptibility of the trees and shrubs to diseases, limiting performance of the shelterbelt, and so on.

You may want to consider putting up a fence to protect your shelterbelts from damage (grazing, browsing, trampling, soil compaction, etc.) by livestock or wild animals, especially young shelterbelts.

For more information, click the link, [Shelterbelt Varieties for Alberta](#), or contact [ARD Publications](#) for a paper copy.

5.4 Broken, Low Lying and Dead Branches

Over the lifetime of your shelterbelt you may have to prune your trees and shrubs to remove broken, low lying and dead branches for safety reasons. If it is essential for specific trees or shrubs in your shelterbelt to be pruned, then prune the affected trees and shrubs in late winter or early spring.

5.5 Dying and Dead Trees and Shrubs

It is crucial to replace dead trees and shrubs in your shelterbelt in the following spring. Although this is especially important in the first three years of growth, older trees and shrubs also need to be replaced after they die. Replacing dead trees and shrubs will help guarantee that you derive the most benefit from your shelterbelt.

In some situations, when a shelterbelt is approaching the end of its useful life, it may have to be replaced. You can achieve this by starting up a new shelterbelt on land adjacent to the old, dying shelterbelt.



Publications in this Series

Shelterbelts for Livestock Farms in Alberta: Overview (Agdex 400/092-1)

Shelterbelts for Livestock Farms in Alberta: Planning, Planting and Maintenance (Agdex 400/092-2)

Shelterbelts for Livestock Farms in Alberta: Shelterbelt Planning Workbook (Agdex 400/092-3)

Information Sources

AAFC. 2010. *Shelterbelts - Design Guidelines for Farmyard, Field, Roadside, Livestock, Wildlife and Riparian Buffer Plantings on the Prairies*. Indian Head, SK: Agroforestry Development Centre, Agriculture and Agri-Food Canada (AAFC).

AAFC. 2012. *Controlling Weeds in Your Agroforestry Planting*. Indian Head, SK: Agroforestry Development Centre, Agriculture and Agri-Food Canada (AAFC).

Alberta One-Call. 2013. *Click Before You Dig*. Calgary, AB: Alberta One-Call Corporation.

GOA. 2007. *Weed Control for Alberta Shelterbelts*. Agri-Facts, Agdex 277/645-1. Edmonton, AB: Alberta Agriculture and Rural Development (ARD), Government of Alberta (GOA).

GOA. 2012. Roadside development application - general instructions. Factsheet. Edmonton, AB: Alberta Transportation, Government of Alberta (GOA).

ISUE. 2005. Farmstead windbreaks: Establishment, care and maintenance. PM 1717. Ames, IA: Iowa State University Extension (ISUE).

NDSUE. 1995. Common insect pests of trees and shrubs in North Dakota. E-296. Fargo, ND: North Dakota State University Extension (NDSUE) Service.

UNLE. 2006. *Windbreak Establishment*. EC1764. Lincoln, NE: University of Nebraska-Lincoln Extension (UNLE).

USDA. 2007a. Windbreak plant species for odour management around poultry production facilities. Maryland Plant Materials Technical Note No. 1, pp 2-3. Beltsville, MD: National Plant Materials Center, Natural Resources Conservation Service (NRCS), United States Department of Agriculture (USDA).



USDA. 2007b. Using windbreaks to manage odour from livestock facilities. Fact Sheet, Windbreaks and Odour Management, pp 6, 8. Champaign, IL: Natural Resources Conservation Service (NRCS), United States Department of Agriculture (USDA).

USDA. 2010. *Windbreak/Shelterbelt/Living Snow Fence Establishment*. CP5A/CP16A/17A, Conservation Practice Job Sheet, ver 2/07. Washington, DC: Natural Resources Conservation Service (NRCS), United States Department of Agriculture (USDA).

USDA. 2011a. Tree and shrub planting, care and management. Technical Notes, TN Plant Materials No. 43. Boise, ID: Natural Resources Conservation Service (NRCS), United States Department of Agriculture (USDA).

USDA. 2011b. Windbreaks: A “fresh” tool to mitigate odours from livestock production facilities. Agroforestry Notes, AF Note-41, pp 2-4. Lincoln, NE: National Agroforestry Centre, United States Department of Agriculture (USDA).

USUCE. 2012. Windbreak benefits and design. Utah Forest Facts, NR/FF/005. Logan, UT: Rural/Conservation Forestry, Utah State University Cooperative Extension (USUCE).

Contact Information

ARD Publications
Alberta Agriculture and Rural Development
7000 - 113 Street, Edmonton, AB T6H 5T6
Tel (toll free): 1-800-292-5697

Ag-Info Centre
Alberta Agriculture and Rural Development
Tel (toll free): 310-FARM (3276) | Email: duke@gov.ab.ca

Website: www.agriculture.alberta.ca

