Shelterbelts for Livestock Farms in Alberta

Shelterbelt Planning Workbook

Alberta Government

Agdex 400/092-3

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Instructions for Completing this Workbook

This workbook has been developed to assist livestock farmers with planning shelterbelts that can be used to manage odour and other air emissions from the farm.

The easiest way to complete the workbook is to first read the following publications (click on the links below):

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)

In addition, consulting an agroforestry specialist can be very helpful. The specialist can provide input on your plan and review your completed plan. You can contact an agroforestry specialist through the Ag-Info Centre.

Section 1 of the workbook helps you identify information you need to document about your livestock farm, surroundings, local weather, etc. Such information not only helps in making decisions about your shelterbelt design, but also serves as a form of record keeping if questions about your shelterbelt arise in the future.

Refer to (click on link) *Agdex 400/092-2* to assist you in completing this section.

Section 1. Livestock Farm Site Assessment

1.1 Use the blank grid paper in the appendix (last section of the workbook) to create a map of your livestock farm and its surroundings. You can use the sample map provided as a guide.

On your map, show facilities, utilities and other features that are on and off the farm, and label each one. You do not have to draw to scale. You can use aerial photographs or click the link, *Alberta Soil Information Viewer*, to assist you with mapping your farm and its surroundings.

Check off (☑) any of the following items that apply to your farm, and sketch and label them on your map:

- ☐ Public roads (paved or gravel), including rights-of-way
- ☐ On-farm roadways
- ☐ Mechanically ventilated livestock barn(s)
- ☐ Naturally ventilated livestock barn(s)
- ☐ Feedlot pens and feed alleys
- ☐ Outdoor manure storage unit(s)
- ☐ Catch basin(s)
- ☐ Other farm facilities (specify, e.g., main office, silage pit, feed mill, etc.)

  _____

  _____

  _____

- ☐ Future development on the farm (e.g., expansion, downsize, etc.)
- ☐ Power lines (above and below ground)
- ☐ Cable lines (above and below ground)
- ☐ Telephone lines
- ☐ Water and sewer lines
- ☐ Natural gas and propane lines
- ☐ Pipelines and valves, including rights-of-way and easements

- ☐ Parking areas
- ☐ Sidewalks and pathways
- ☐ Flood plains
- ☐ Wooded areas or shelterbelts
- ☐ Water sources (specify, e.g., dugouts, wells, streams, lakes, sloughs, etc.)

_____

_____

_____

- ☐ Neighbouring property on land zoned for agricultural purposes (e.g., farmstead, acreage residences, etc.)
- ☐ Neighbouring property on land zoned for non-agricultural purposes (e.g., country residential, rural commercial businesses, etc.)
- ☐ Neighbouring property on land zoned for high-use recreational or commercial purposes
- ☐ Neighbouring property on land zoned for large-scale country residential, rural hamlet, village, town orcity
- ☐ Other (specify)

_____

_____

1.2 On your map, indicate the direction of the prevailing wind (where wind comes from) in your area. Use the seasonal prevailing wind maps in the appendix to assist you.

Example: The seasonal prevailing wind directions for a livestock farm located close to Brooks in the County of Newell are:

Summer (__W__) Fall (__SW__) Winter (__W__) Spring (__SSW__)

North = N; North-Northeast = NNE; Northeast = NE; East-Northeast = ENE; East = E; East-Southeast = ESE; Southeast = SE; South-Southeast = SSE; South = S; South-Southwest = SSW; Southwest = SW; West-Southwest = WSW; West = W; West-Northwest = WNW; Northwest = NW; North-Northwest = NNW

Section 1. Livestock Farm Site Assessment

Enter your seasonal prevailing wind information:

Summer (_____) Fall (_____) Winter (_____) Spring (_____)

1.3 On your map, indicate the location, orientation and shape of each proposed shelterbelt and label them. Consider the following minimum setback distances when mapping your proposed shelterbelt(s). Some of these setbacks are legal requirements; if you plant a shelterbelt in violation of any regulations, you may have to remove it at your own expense. Check off any setbacks that apply to your proposed shelterbelt(s); if any setback condition is not met, then do not check the box.

- ☐ Spacing from livestock barn is 30 m (100 ft) or more
- ☐ Spacing from manure storage unit is 50 m (165 ft) or more
- ☐ Spacing from catch basin is 50 m (165 ft) or more
- ☐ Spacing from dugout is 50 m (165 ft) or more
- ☐ Spacing from on-farm road(s) is 30 m (100 ft) or more
- ☐ Spacing from provincial highway(s) is 60 m (200 ft) or more (legal requirement)
- ☐ Spacing from municipal roads meets bylaw specifications (specify)

_____

_____

_____

- ☐ Spacing from overhead or buried lines is 30 m (100 ft) or more
- ☐ Other (specify)

_____

_____

If any specified setback distance will not be met, then it is recommended that you adjust the design to achieve the minimum setback by:

(a) increasing the setback distance
(b) having fewer rows (not less than the minimum recommended - see *Agdex 400/092-2*)
(c) shortening the length of the shelterbelt
(d) relocating the shelterbelt entirely

1.4 If you own a hog farm with mechanically ventilated barns and an outdoor liquid manure storage unit, and the farm meets **ALL THE CONDITIONS** outlined below (i.e., all boxes checked), then consider planting another shelterbelt on the upwind side of the barn to help manage odour and other air emissions (see *Agdex 400/092-2*).

- ☐ Manure storage unit in path of prevailing wind
- ☐ Manure storage unit sited between barn and proposed downwind shelterbelt
- ☐ Manure storage unit more than 20 m (70 ft) from barn
- ☐ Upwind shelterbelt can be spaced 30 m (100 ft) or more from barn

1.5 Check off the number of proposed shelterbelts that apply to your livestock farm and number them on your map (see the example below):

- ☐ Shelterbelt #1
- ☐ Shelterbelt #2
- ☐ Shelterbelt #3
- ☐ Shelterbelt #4
- ☐ Shelterbelt #5
- ☐ Additional shelterbelts (specify)

_____

_____

Example: The sample map on grid paper in the appendix shows three proposed shelterbelts on a livestock farm. This information is checked off as follows:

- ☑ *Shelterbelt #1*
- ☑ *Shelterbelt #2*
- ☑ *Shelterbelt #3*
- ☐ *Additional shelterbelts (specify)*

_____

Section 2 helps you identify the characteristics of each location where you propose to plant a shelterbelt. You need to have this information before you proceed to design any shelterbelt because the conditions at the proposed site may not be good for growth or survival of the shelterbelt. This could mean that you have to consider a different location or select trees and shrubs that are better suited to the soil conditions. Consult a soil specialist through the Ag-Info Centre to advise you on how to obtain soil information. You may need a soil test to get site-specific information.

Refer to *Shelterbelts for Livestock Farms in Alberta - Planning, Planting and Maintenance (Agdex 400/092-2)* to aid you in completing this section.

Section 2. Shelterbelt Site Assessment

Shelterbelt #_____
(For each additional shelterbelt, copy and paste or print a blank copy of this section.)

2.1 Use the soil maps in the appendix to assist you in determining soil characteristics (*texture*, *salinity* and *organic matter*) where you propose to site the shelterbelt. If the information you seek is not on any of the soil maps provided, then consider consulting a soil specialist through the Ag-Info Centre.

- ☐ Texture (specify, e.g., SLC = sandy clay loam)

  _____

- ☐ Salinity - low (< 10)
- ☐ Salinity - moderate (10 - 30)
- ☐ Salinity - high (> 30)
- ☐ Organic Matter - low (< 10)
- ☐ Organic Matter - moderate (10 - 30)
- ☐ Organic Matter - high (> 30)
- ☐ Moisture - low (very dry soil)
- ☐ Moisture - moderate (moderately dry, well-drained soil)
- ☐ Moisture - high (very wet, poorly drained soil)
- ☐ Alkalinity (specify as low, medium or high)

  _____

2.2 Are there other characteristics (e.g., limitations, concerns, etc.) to consider about the intended site for the proposed shelterbelt(s) such as, too close to a water source, obstacle to movement of farm equipment, minimum setback distance from county road, interference with overhead power lines, and so on?

- ○ Yes (specify)

  Example: Setback distance from dugout located to the west is a concern.

  _____

  _____

  _____

- ○ No

Section 3 focuses on the design of each shelterbelt while taking into consideration the information documented in Sections 1 and 2. The information documented will also serve as a record for future purposes.

Refer to *Agdex 400/092-2* to aid you in completing this section.

Section 3. Shelterbelt Design

Shelterbelt #_____
(For each additional shelterbelt, copy and paste or print a blank copy of this section.)

3.1 Number of Rows

This will depend on the orientation of neighbouring properties to your barn(s)/feedlot pens and manure storage unit, as well as municipal zoning around your property. A minimum of three, four, five or six rows of trees and shrubs is recommended for managing odour and air emissions from your farm depending on the municipal zoning for neighbouring residences or other properties frequented by the public in the area around the farm (see Table 1 in *Agdex 400/092-2*).

Example: Shelterbelt #2-W

Number of Rows = *5*

Reason: *The land west of the farm is zoned for high-use recreational or commercial purposes and there are a number of businesses in that area. Furthermore, as mentioned in Agdex 400/092-2, it is important to minimize obstruction of airflow to the air inlet walls of naturally ventilated barns in summer. Therefore, based on these conditions, a 5-row shelterbelt will be planted on the west side of the barns.*

Enter your design information:

Number of Rows =

Reason:

3.2 Shelterbelt Length

To determine the length of the shelterbelt, measure the distance it has to cover from the farthest end of the barn or feedlot pens to the farthest end of the manure storage unit. To achieve maximum effectiveness, extend the shelterbelt by an additional 15 m (50 ft) at each end.

Example: Shelterbelt #2-W

The length from the far end of the barns to the far end of the manure storage unit is about 270 m. Therefore, for maximum effectiveness, the approximate length of the shelterbelt should be:

Shelterbelt Length: 15 m + 270 m + 15 m = 300 m

Enter your design information:

Shelterbelt Length: 15 m (50 ft) + _____ + 15 m (50 ft) = _____

3.3 Setback Distances

Specify the distance between the shelterbelt and the following facilities or utilities on or off the farm. This information is valuable for record keeping and for future planning and development.

Livestock barn _____

Manure storage unit _____

Catch basin _____

Dugout _____

On-farm roads _____

Provincial highways _____

Municipal roads _____

Nearest overhead or buried line _____

Other (specify) _____ _____

3.4 Tree and Shrub Selection

Select your trees and shrubs based on your site assessment information from Section 2 and the number of rows for your shelterbelt from Section 3.1. Refer to *Agdex 400/092-2* to assist you with making your selection. Begin with the row of trees closest to your barn or manure storage unit. In some rows, you can have two different species of trees, shrubs, or both (one tree species and one shrub species), with one as the main species and the second as the other species.

Example: Shelterbelt #2-W

Row #	*Main Tree/Shrub Species*		*Other Tree/Shrub Species*
1	*Colorado Spruce*	*and*	*None*
2	*White Spruce*	*and*	*None*
3	*Acute Leaf Willow*	*and*	*Caragana*
4	*Green Ash*	*and*	*Caragana*
5	*Choke Cherry*	*and*	*Caragana*

Enter your design information:

Row #	Main Tree/Shrub Species		Other Tree/Shrub Species
		and	
		and	
		and	
		and	
		and	
		and	
		and	
		and	
		and	
		and	

3.5 Row Spacing

Specify the spacing between rows based on the types of trees and shrubs in each row. Refer to *Agdex 400/092-2* to assist you with determining row spacing requirements. Begin with the row closest to your barn, feedlot pen or manure storage unit.

Example: Shelterbelt #2-W

Row #	*1*	*to*	*Row #*	*2*	=	*7 m*
Row #	*2*	*to*	*Row #*	*3*	=	*6 m*
Row #	*3*	*to*	*Row #*	*4*	=	*5 m*
Row #	*4*	*to*	*Row #*	*5*	=	*6 m**
Row #	*5*	*to*	*Row #*	*6*		
Row #	*6*	*to*	*Row #*	*7*		
Row #	*7*	*to*	*Row #*	*8*		
Row #	*8*	*to*	*Row #*	*9*		
Row #	*9*	*to*	*Row #*	*10*		

** In this example a spacing greater than the minimum is used between rows #4 and #5.*

Enter your design information:

Row #	1	to	Row #	2	=	
Row #	2	to	Row #	3	=	
Row #	3	to	Row #	4	=	
Row #	4	to	Row #	5	=	
Row #	5	to	Row #	6	=	
Row #	6	to	Row #	7	=	
Row #	7	to	Row #	8	=	
Row #	8	to	Row #	9	=	
Row #	9	to	Row #	10	=	

3.6 Tree or Shrub Spacing

Specify the spacing between trees or shrubs in each row. Click on *Shelterbelts - Design Guidelines for Farmyard, Field, Roadside, Livestock, Wildlife and Riparian Buffer Plantings on the Prairies* to assist you with making your decision. Begin with the row closest to your barn, feedlot pen or manure storage unit.

Example: Shelterbelt #2-W

Row #	*Main Species*	*Spacing*	*Other Species*	*Spacing*
1	*Colorado Spruce*	*3.5 m*	*None*	
2	*White Spruce*	*3.5 m*	*None*	
3	*Acute Leaf Willow*	*2.5 m*	*Caragana*	*0.3 m*
4	*Green Ash*	*2.5 m*	*Caragana*	*0.3 m*
5	*Choke Cherry*	*1.0 m*	*Caragana*	*0.3 m*

Enter your design information:

Row #	Main Species	Spacing	Other Species	Spacing

3.7 Total Number of Trees and Shrubs

Calculate how many tree and shrub seedlings or cuttings of each plant species you will need for your shelterbelt. Use the example below as a guide.

Example: Shelterbelt #2-W

Row #: *1*

A. Number of Trees or Shrubs of the Main Species (Colorado Spruce trees)

$$\text{\# of seedlings/cuttings} = \frac{300\text{ m}}{\text{row length}} \div \frac{3.5\text{ m}}{\text{main species spacing}} + 1 = 87$$

B. Number of Trees or Shrubs of the Other Species in between Every Two Trees or Shrubs of the Main Species (None)

Row #: *3*

A. Number of Trees or Shrubs of the Main Species (Acute Leaf Willow trees)

$$\text{\# of seedlings/cuttings} = \frac{300\text{ m}}{\text{row length}} \div \frac{2.5\text{ m}}{\text{main species spacing}} + 1 = 121$$

B. Number of Trees or Shrubs of the Other Species between Every Two Trees or Shrubs of the Main Species (Caragana shrubs between Acute Leaf Willow trees)

$$\text{\# of in-between species} = \frac{2.5\text{ m}}{\text{main species spacing}} \div \frac{0.3\text{ m}}{\text{other species spacing}} - 1 \approx 7$$

C. Number of Trees or Shrubs of the Other Species (Caragana shrubs)

$$\text{\# of seedlings/cuttings} = \frac{300\text{ m}}{\text{row length}} \div \frac{2.5\text{ m}}{\text{main species spacing}} \times \frac{7}{\text{\# of other species in between main species}} = 840$$

Use an erasable pencil to enter your design information, working on one shelterbelt row at a time. For each row, enter the number of seedlings or cuttings of each species in the table provided in Section 4 of this workbook.

Enter your design information:

Row #: ☐

A. Number of Trees or Shrubs of the Main Species

$$\text{\# of seedlings/cuttings} = \frac{\text{row length}}{\text{main species spacing}} + 1 = \_\_\_\_$$

B. Number of Trees or Shrubs of the Other Species in between Every Two Trees or Shrubs of the Main Species

$$\text{\# of in-between species} = \frac{\text{main species spacing}}{\text{other species spacing}} - 1 = \_\_\_\_$$

C. Number of Trees or Shrubs of the Other Species

$$\text{\# of seedlings/cuttings} = \frac{\text{row length}}{\text{main species spacing}} \times \text{\# of other species in between main species} = \_\_\_\_$$

3.8 Mulch

Calculate how much (A) plastic mulch or (B) organic mulch you will require.

A. Plastic Mulch

$$\text{\# of rolls of plastic mulch} = \text{SBL} \times \text{\# of rows} \div \text{length of 1 roll}$$

SBL = Shelterbelt Length

Example: Shelterbelt #2-W

# of rolls of plastic mulch = 300 m (SBL) x 5 (# of rows) ÷ 450 m (length of 1 roll) ≈ 4

Enter your design information:

# of rolls of plastic mulch = _____ (SBL) x _____ (# of rows) ÷ _____ (length of 1 roll) ≈ _____

B. Organic Mulch

Organic mulch volume = # of trees or shrubs x SA per plant x bed depth

SA = Surface area of mulch bed around each tree or shrub = π x radius x radius
π = 3

Example: Shelterbelt #2-W

If the radius of the organic mulch bed around each plant is 1 m, then:

Organic mulch volume = 2,997 (# of trees or shrubs) x 3 m^2 (SA per plant) x 0.15 m (bed depth) ≈ 1,350 m^3

Enter your design information:

Organic mulch volume = _____ (# of trees or shrubs) x _____ (SA per plant) x _____ (bed depth) ≈ _____

Section 4 summarizes each shelterbelt's design specifications in a table based on information obtained from Section 3 of this workbook. You can then use the summarized information to figure out where and how each shelterbelt will be located, how much space will be required, what items you need to order/purchase and how much of each item.

Example:

Shelterbelt #:	*2*				
Orientation:	*W*	*Length:*	*300 m*	*# of Rows:*	*5*
Row Spacing:	*Row # to Row #*	*Spacing Between Rows*			
	1 to 2:	*7 m*			
	2 to 3:	*6 m*			
	3 to 4:	*5 m*			
	4 to 5:	*6 m*			
Trees/Shrubs:	*Row #*	*Main Species (total)*	*Other Species (#[1]; total)*		
	1	*Colorado Spruce (87)*	*None (0)*		
	2	*White Spruce (87)*	*None (0)*		
	3	*Acute Leaf Willow (121)*	*Caragana (7; 840)*		
	4	*Green Ash (121)*	*Caragana (7; 840)*		
	5	*Choke Cherry (301)*	*Caragana (2; 600)*		
			**Total Caragana = 2,280*		
	Total Number of Trees and Shrubs:		*2,997*		
Mulch:	*4 rolls of plastic mulch*				

[1] *# refers to the number of trees or shrubs of the other species between every two trees or shrubs of the main species in each row. In the example above, there will be seven Caragana shrubs between every two Acute Leaf Willow trees in row #3.*

Section 4. Shelterbelt Specifications

For each shelterbelt, print a copy of this page and fill in the details.

Shelterbelt #:					
Orientation:		Length:		# of Rows:	

Row Spacing:	Row # to Row #	Spacing Between Rows

Trees/Shrubs:	Row #	Main Species (total)	Other Species (#[1], total)
		Total Number of Trees and Shrubs:	

Mulch:	

[1] # refers to the number of trees or shrubs of the other species between every two trees or shrubs of the main species in each row.

Section 5 provides a budgeting sheet to help you estimate how much the tree and shrub seedlings and cuttings, and plastic mulch, for each shelterbelt will cost.

Section 5. Trees, Shrubs and Plastic Mulch Cost Summary Sheet

Caution: This summary sheet only covers the costs of trees, shrubs and plastic mulch. It does not include costs for other aspects of the shelterbelt like soil testing, land preparation, herbicide application, planting, etc.

Example:

Trees and Shrubs					
Species	*# Required*	*# of Seedlings/Cuttings per Bundle*	*Total # of Bundles*	*Cost/Bundle**	*Cost/Species*
Colorado Spruce	*87*	*10*	*9*	*$23.00*	*$207.00*
White Spruce	*87*	*10*	*9*	*$23.00*	*$207.00*
Acute Leaf Willow	*121*	*10*	*13*	*$23.00*	*$299.00*
Green Ash	*121*	*10*	*13*	*$23.00*	*$299.00*
Choke Cherry	*301*	*10*	*31*	*$23.00*	*$713.00*
Caragana	*2,280*	*10*	*228*	*$17.50*	*$3,990.00*
				Sub-Total Cost:	*$5,715.00*
				GST:	*$285.75*
				Total Cost:	*$6,000.75*
Plastic Mulch					
# of Rolls	*Cost per Roll*				*Amount*
4	*$200.00*			*Sub-Total Cost:*	*$800.00*
				GST:	*$40.00*
				Total Cost:	*$840.00*

** Prices taken from Alberta Shelterbelt Program website.*

Section 5. Trees, Shrubs and Plastic Mulch Cost Summary Sheet

For each shelterbelt, print a copy of this page and fill in the details.

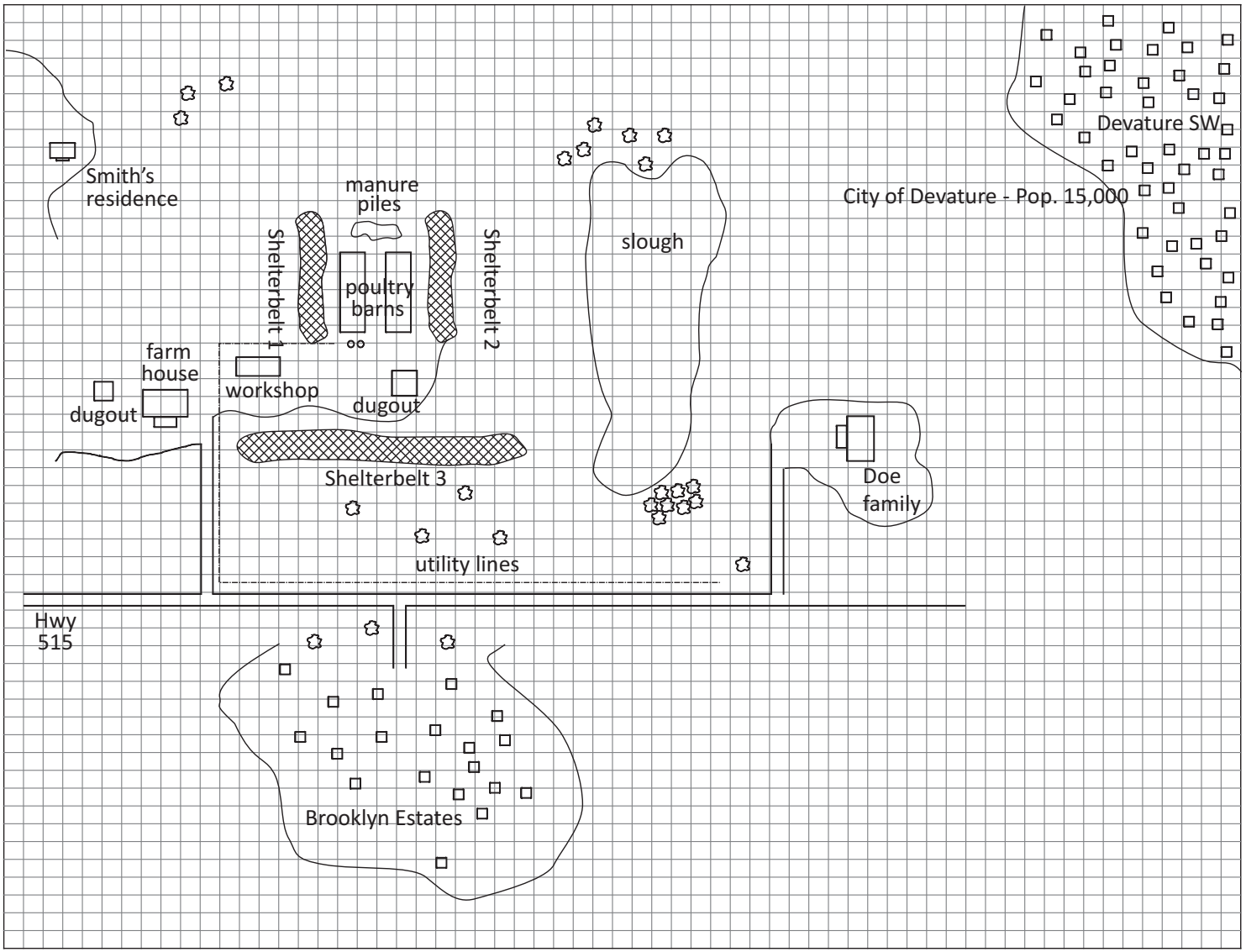
Shelterbelt #_____

Trees and Shrubs					
Species	# Required	# of Seedlings or Cuttings per Bundle	Total # of Bundles	Cost per Bundle	Cost per Species
				Sub-Total Cost:	
				GST:	
				Total Cost:	
Plastic Mulch					
# of Rolls	Cost per Roll				Amount
				Sub-Total Cost:	
				GST:	
				Total Cost:	

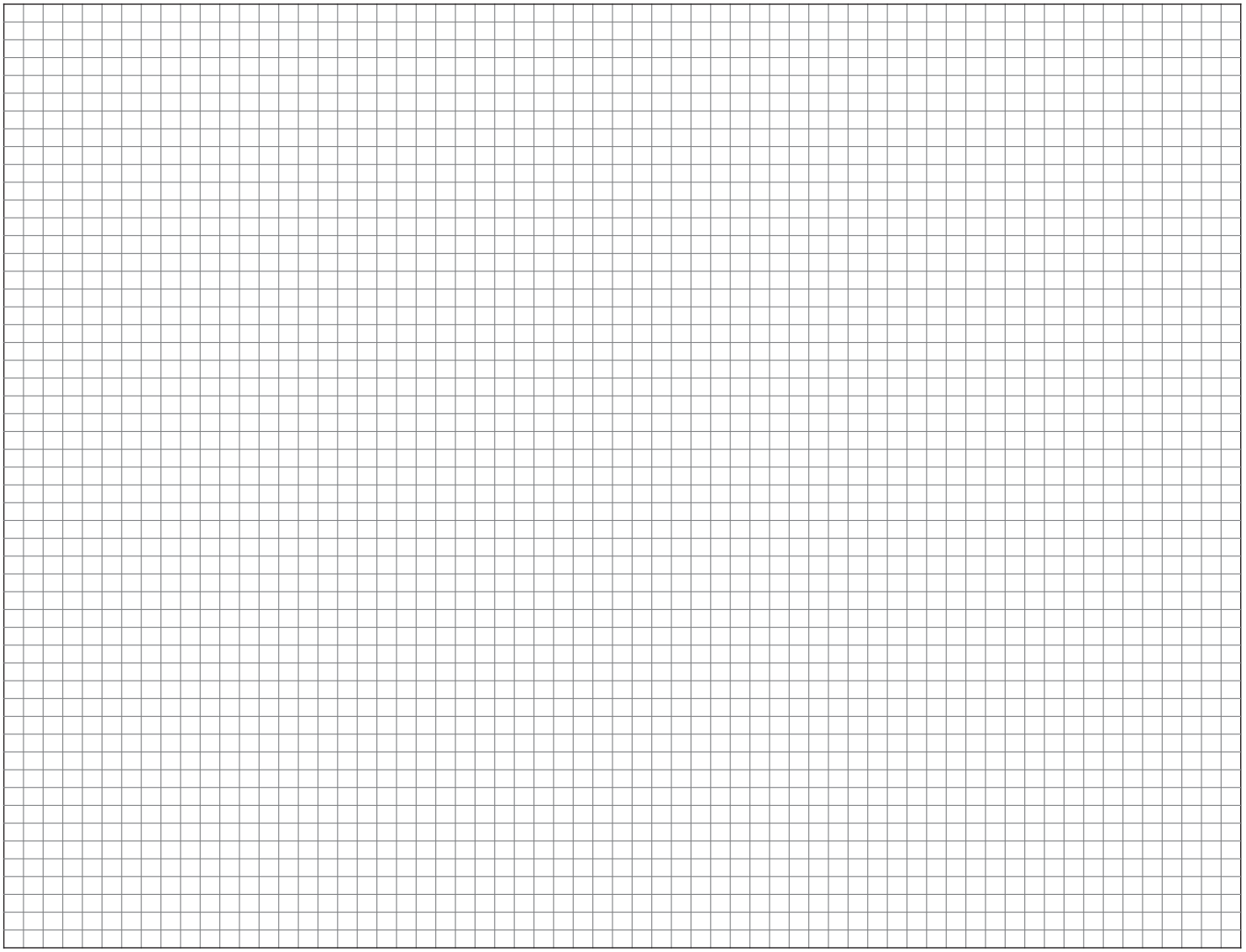
APPENDIX

Map of Livestock Farm and Surroundings

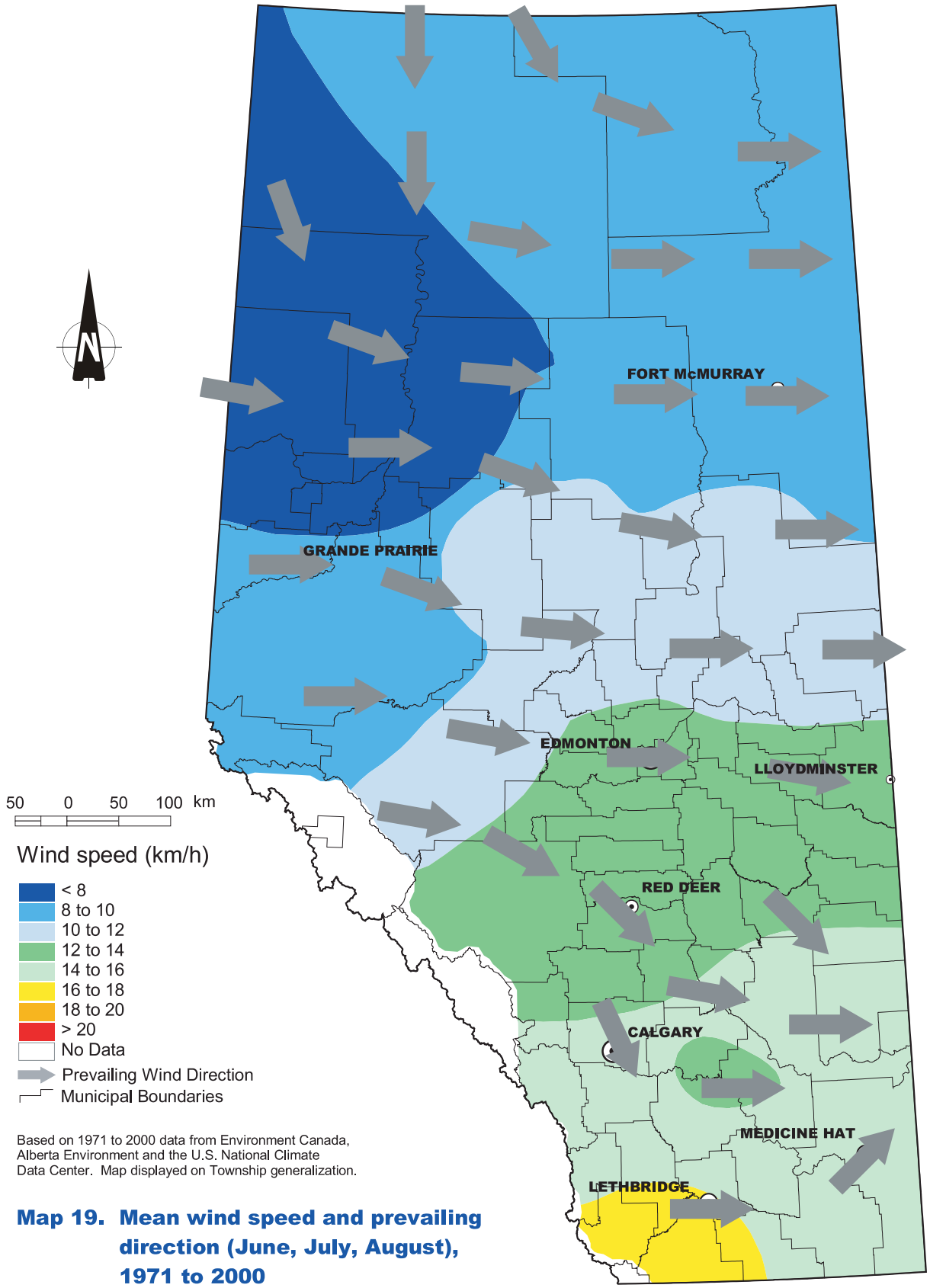
Sample: Map of The Newby's Farm and Surrounding Area



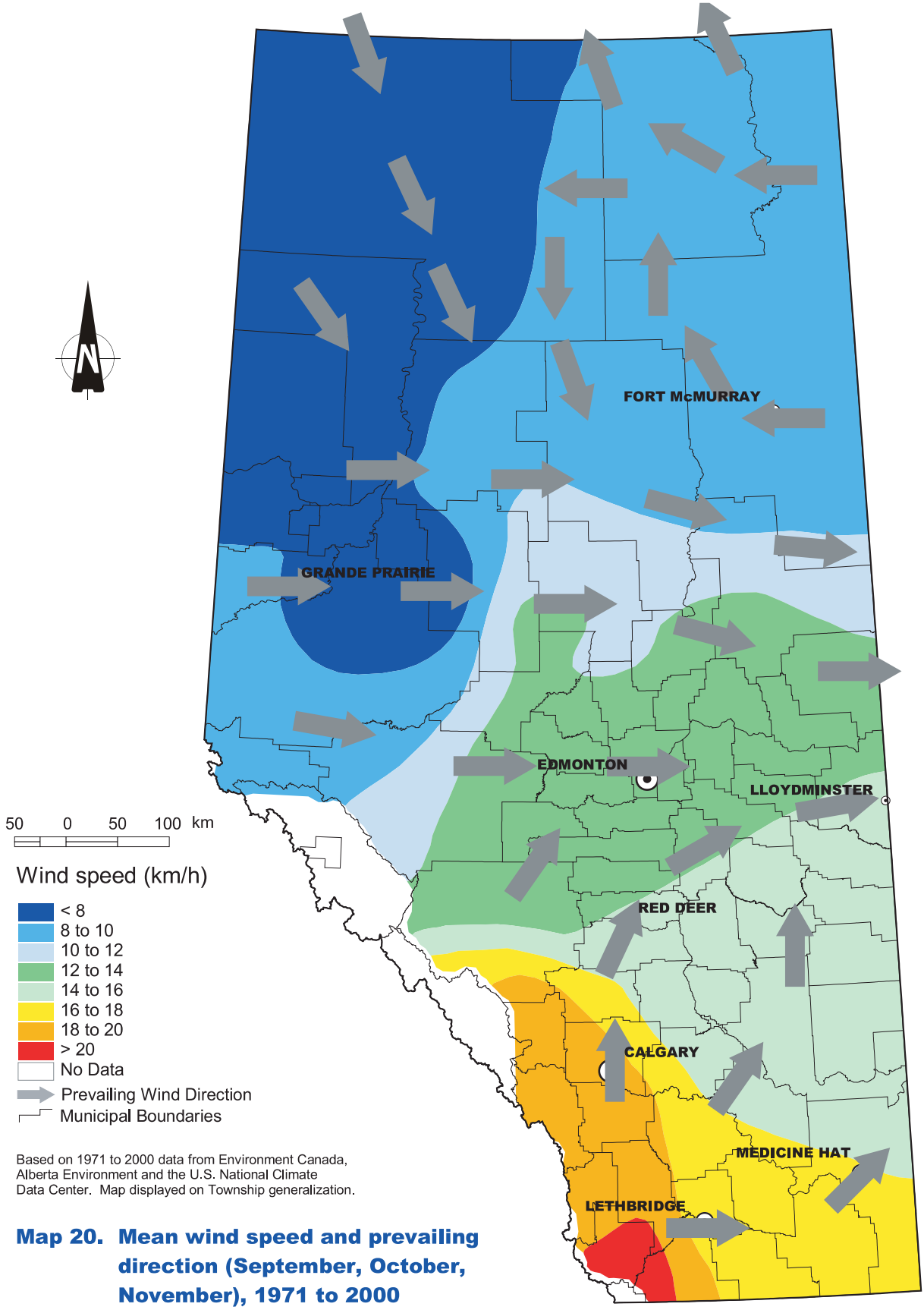
(If you need more grid paper then print a blank copy of this page)



Prevailing Wind Direction in Summer in Alberta

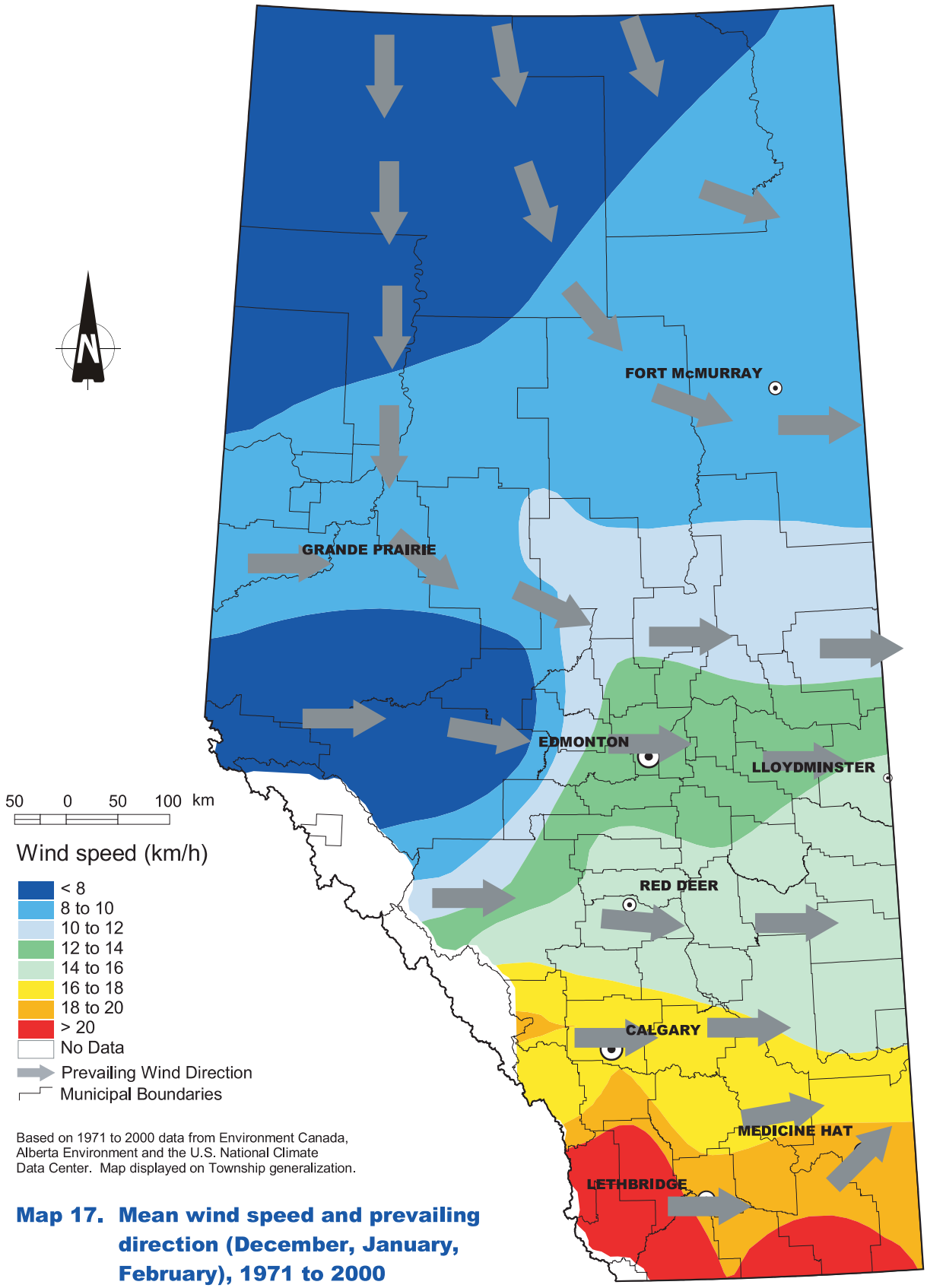


Map 19. Mean wind speed and prevailing direction (June, July, August), 1971 to 2000



Based on 1971 to 2000 data from Environment Canada, Alberta Environment and the U.S. National Climate Data Center. Map displayed on Township generalization.

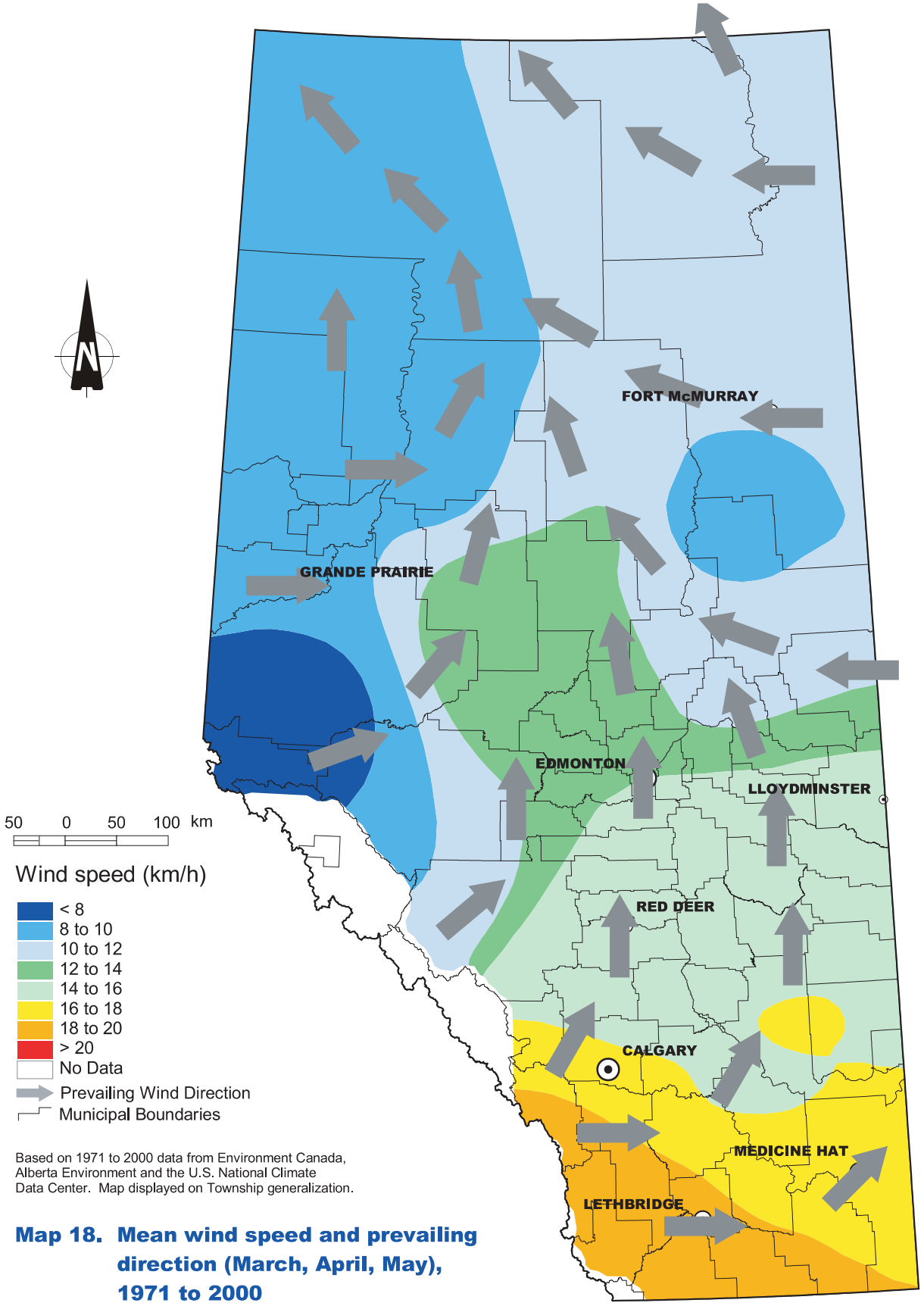
Map 20. Mean wind speed and prevailing direction (September, October, November), 1971 to 2000



Based on 1971 to 2000 data from Environment Canada, Alberta Environment and the U.S. National Climate Data Center. Map displayed on Township generalization.

Map 17. Mean wind speed and prevailing direction (December, January, February), 1971 to 2000

Prevailing Wind Direction in Spring in Alberta

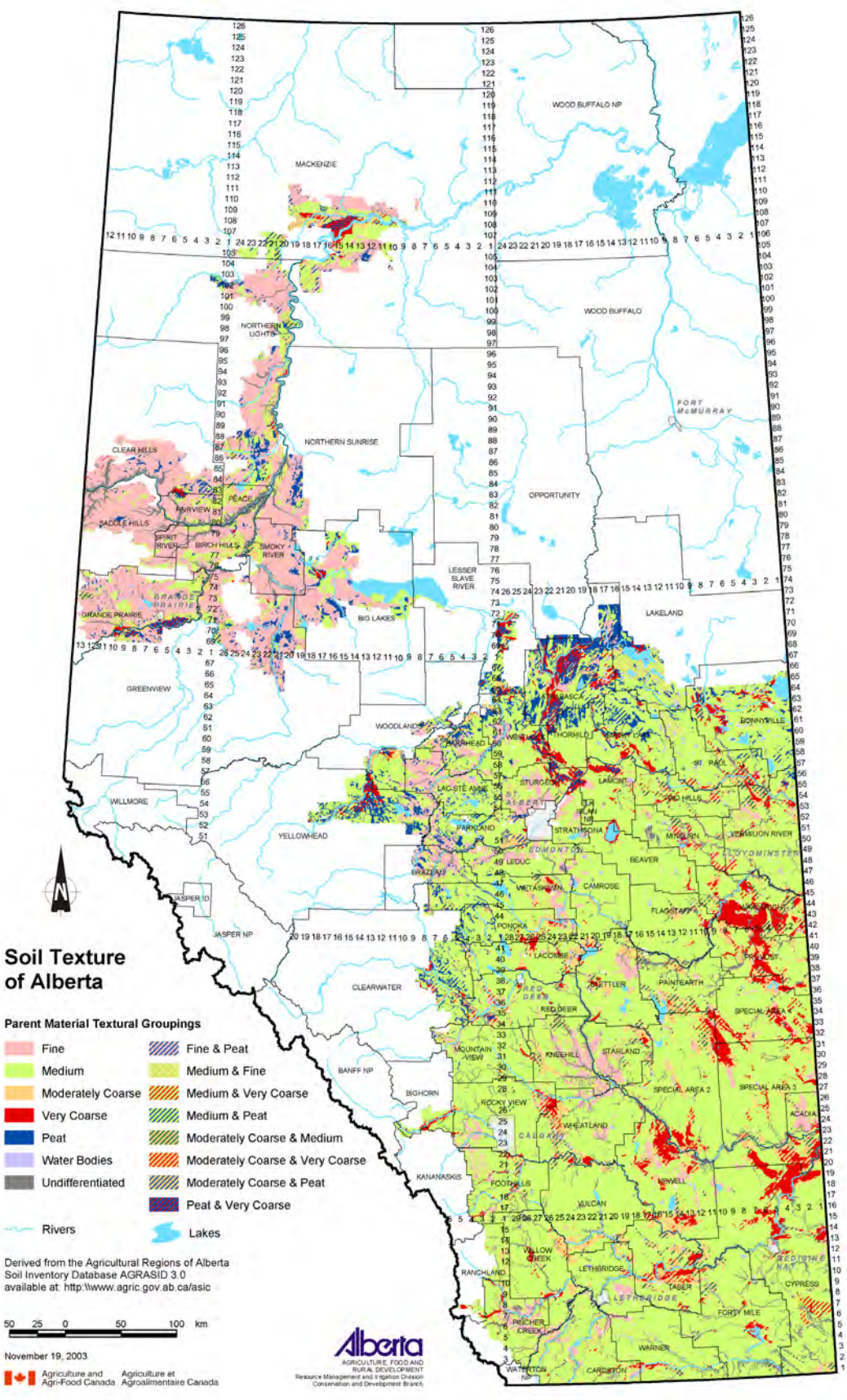


Based on 1971 to 2000 data from Environment Canada, Alberta Environment and the U.S. National Climate Data Center. Map displayed on Township generalization.

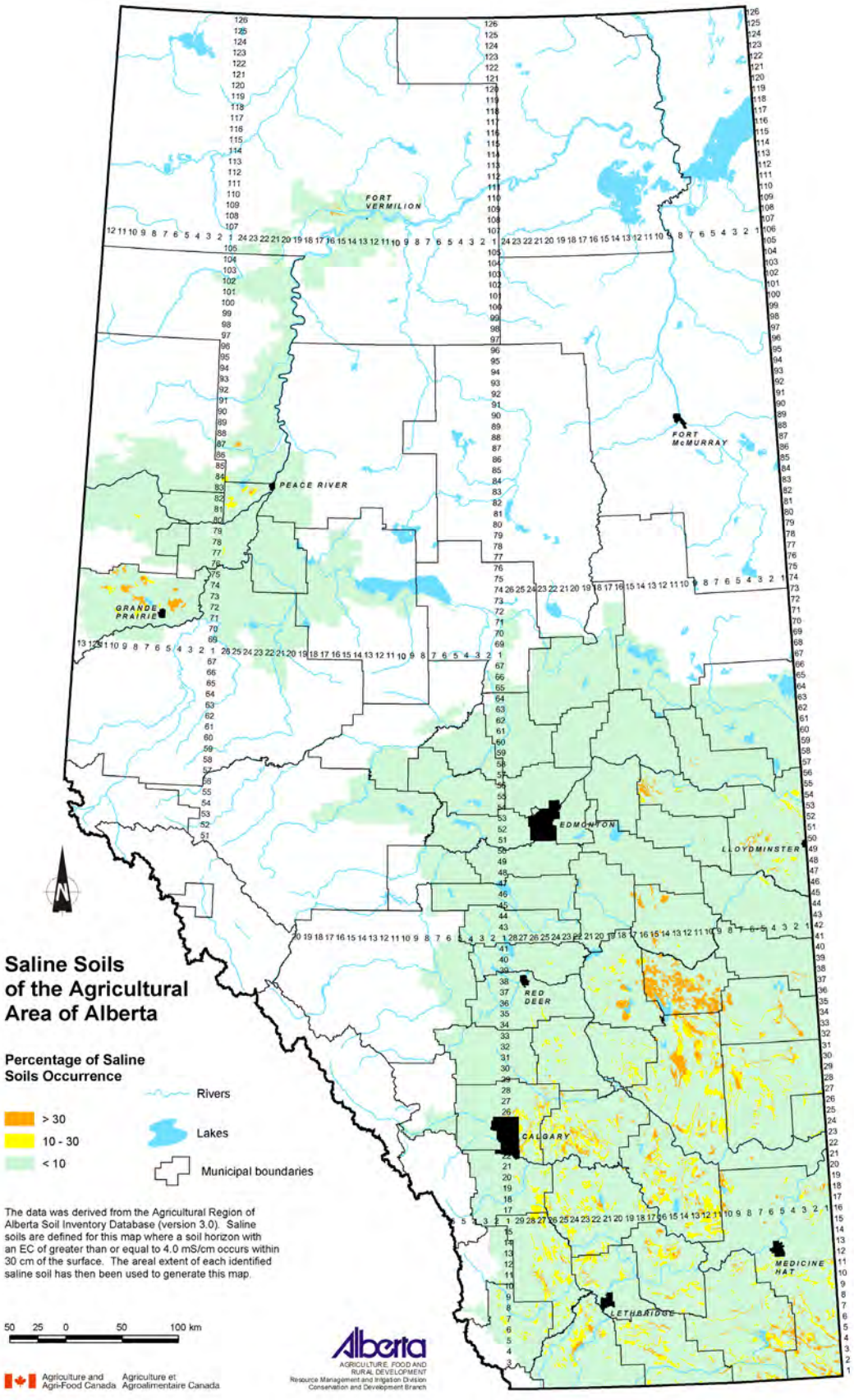
Map 18. Mean wind speed and prevailing direction (March, April, May), 1971 to 2000

Soil Texture of Agricultural Areas in Alberta

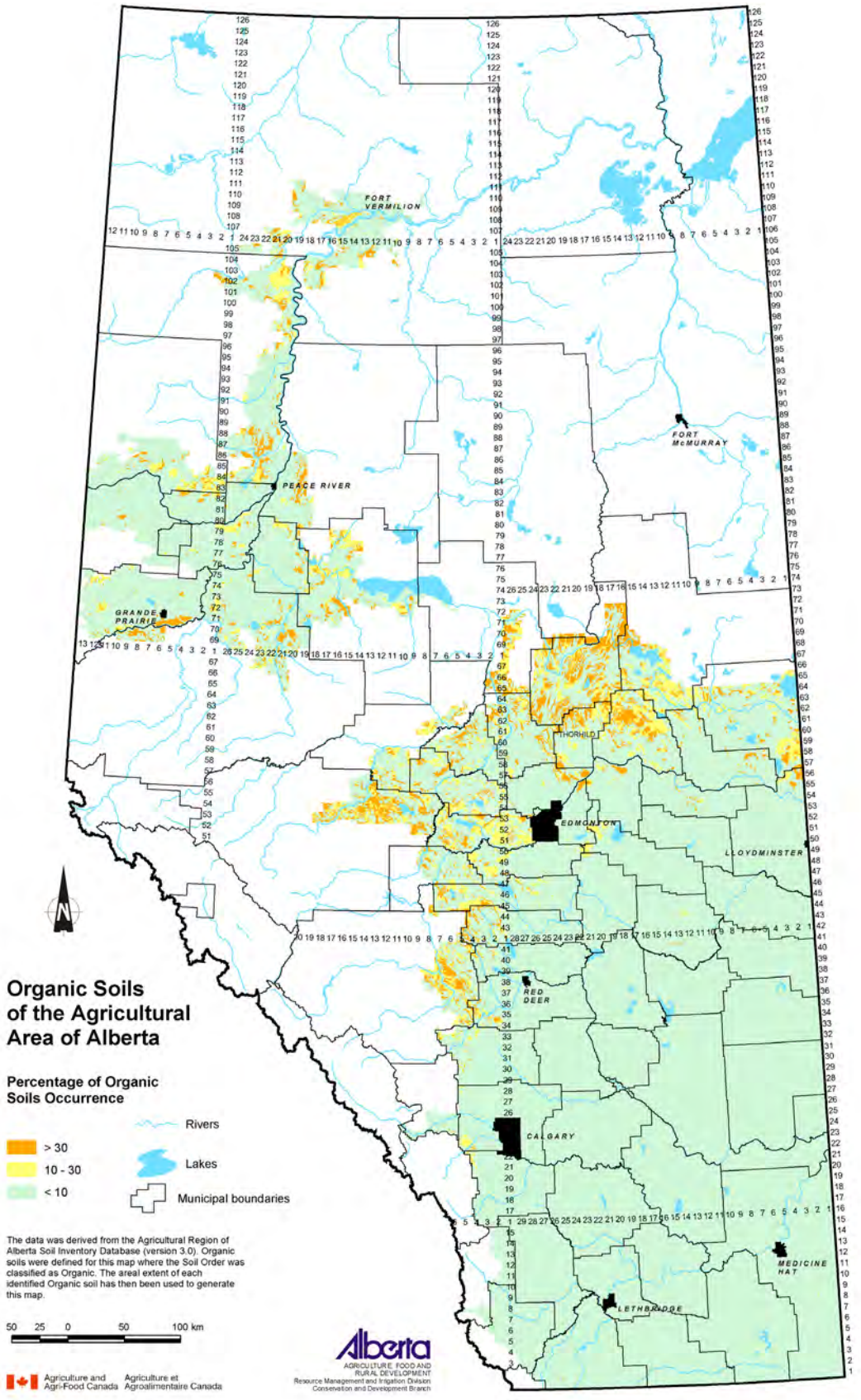
(Click the link to view *soil textural class groupings*, e.g., L = loam)



Saline Soils in Agricultural Areas in Alberta



Organic Soils in Agricultural Areas in Alberta



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