

PROGRESS REPORT 2011

Climatic Suitability and Feasibility Assessment of Growing Wine Grapes In the Lillooet-Lytton Area, British Columbia



Pinot blanc in full bloom at Pietila Vineyard July 2, 2011

**Prepared by
John Vielvoye P.Ag.
And**



**For
Investment Agriculture Foundation of
British Columbia**

March 2012

PROGRESS REPORT 2011

TABLE OF CONTENTS

ACKNOWLEDGEMENTS	1
PROJECT TIMING	2
OBJECTIVES	2
COMMUNICATIONS	4
PROJECT OUTPUTS DURING 2011.....	5
PROJECT OUTPUTS INCLUDE THE FOLLOWING:	5
PROGRESS TOWARDS ACHIEVING PROJECT OBJECTIVES AND BENEFITS.....	6
OBJECTIVES	6
BENEFITS	10
TABLES	12
TABLE 1 COMMUNICATIONS 2011	12
TABLE 2 LOCATION OF ENVIRONMENT CANADA WEATHER STATIONS AT LYTTON AND LILLOOET	13
TABLE 3 LYTTON FROST FREE PERIODS AND EXTREME MINIMUM TEMPERATURES	13
TABLE 4 LILLOOET FROST FREE PERIODS AND EXTREME MINIMUM TEMPERATURES	14
TABLE 5 LYTTON AND LILLOOET GROWING DEGREE DAYS (GDD) APRIL – OCTOBER (BASE 10° C).....	15
TABLE 6 PRECIPITATION (MM) AND HOURS OF BRIGHT SUNSHINE (APRIL-OCTOBER) - LYTTON	16
TABLE 7 PRECIPITATION (MM) - LILLOOET	17
TABLE 8 LOCATION OF SELECTED ENVIRONMENT CANADA (EC) WEATHER STATIONS USED FOR COMPARING MINIMUM WINTER TEMPERATURES AT STATIONS AT LILLOOET AND LYTTON IN TABLE 9.....	17
TABLE 9 MINIMUM TEMPERATURES (°C) DECEMBER 2010, FEBRUARY, MARCH, NOVEMBER AND DECEMBER 2011 AT SELECTED ENVIRONMENT CANADA WEATHER STATIONS.....	18
TABLE 10 APPROXIMATE DATES OF PHENOLOGY EVENTS IN TEST VINEYARDS 2011.....	18
TABLE 11 FRUIT QUALITY ANALYSIS PROVIDED BY PIETILA VINEYARD. 2011	18
TABLE 12 FRUIT QUALITY OF HARVESTED GRAPE SAMPLES FROM ROSHARD AND WONDERLAND VINEYARDS CONDUCTED AT THE PACIFIC AGRI-FOOD RESEARCH CENTRE (PARC), SUMMERLAND BC – OCT. 24, 2011	19
TABLE 13 HARVEST DATES OF GRAPE VARIETIES IN TEST PLANTINGS.....	20
TABLE 14 BRIX OF GRAPE VARIETIES IN TEST PLANTINGS	21
TABLE 15 TOTAL ACID OF GRAPE VARIETIES IN TEST PLANTINGS	23
TABLE 16 pH OF GRAPE VARIETIES IN TEST PLANTINGS	24
TABLE 17 NUMBER OF DAYS FROM BUDBREAK TO HARVEST AT ROSHARD VINEYARD	26
TABLE 18 ESTIMATED PERCENT VINE MATURITY IN PARTICIPATING VINEYARDS OCTOBER 7, 2011	27
TABLE 19 FROST FREE PERIOD (DAYS), GROWING DEGREE DAYS (GDD) AND EXTREME MINIMUM WINTER TEMPERATURE AT TEST VINEYARDS.....	28
TABLE 20 TYPE OF WEATHER STATION, DATA LOGGERS AND ELEVATION AT DATA COLLECTION SITES	29
TABLE 21 EXTREME MINIMUM WINTER TEMPERATURES (°C) AT IBUTTON; HOBO PRO 2 AND WEATHER STATION LOCATIONS	30
TABLE 22 TOTAL GROWING DEGREE DAYS (GDD) ¹ AND LENGTH OF FROST FREE SEASON AT IBUTTON; HOBO PRO 2 AND WEATHER STATION LOCATIONS	34
GRAPHS.....	38
MAP OF PROJECT STUDY AREA	39
PROJECT STUDY AREA IN THE LILLOOET-LYTTON AREA	40
SOLAR RADIATION MAPS	41

ACKNOWLEDGEMENTS

This project was made possible by funding in part and support provided by B.C. Ministry of Agriculture, B.C. Ministry of Jobs, Tourism and Innovation, the former B.C. Ministry of Community and Rural Development, the former B.C. Ministry of Economic Development, the former B.C. Ministry of Sustainable Resource Management, District of Lillooet, Village of Lytton, the Forum for Research and Extension in Natural Resources (FORREX), Fraser Basin Council, Investment Agriculture Foundation of British Columbia, property owners and vineyard managers E. and B. Pietila, T. Jones and A. Brown, the former Ruddock Goldpan Ranch, G. and B. DiCasteri, D. Robson and C. Roshard, the Pacific Agri-Food Research Centre (PARC), Summerland, B.C., and British Columbia Grapegrowers' Association. The help and participation of property owners throughout the study area for the use of their property for the collection of climate data is gratefully acknowledged.

The project and this publication was funded in part by the Investment Agriculture Foundation of BC (IAF) through Agriculture and Agri-Food Canada's Advancing Canadian Agriculture and Agri-Food (ACAAF) program.

Agriculture and Agri-Food Canada (AAFC) is pleased to participate in the delivery of this publication and is committed to working with our industry partners and the Investment Agriculture Foundation of BC to increase public awareness of the importance to the agriculture and agri-food industry in Canada. Opinions expressed in this publication are those of the British Columbia Grapegrowers' Association and not necessarily AAFC's.

This innovative project would not have been possible without the cooperation of Investment Agriculture Foundation of BC (IAF), the various landowners and vineyard managers and interested individuals who have contributed much time and expertise. The B.C. grape and wine industry needs this type of undertaking to explore the risks associated with the potential development of new grape growing regions. The British Columbia Grapegrowers' Association expresses appreciation to all the people who supported this project and to those who assisted in the preparation of this publication.

Copies of this publication and other progress reports are available as free downloads from web sites identified in Table 1 of this report or at a nominal fee from:

British Columbia Grapegrowers' Association, Administration Service, 451 Atwood Road, Grand Forks, BC, V0H 1H9. Tel. 877-762-4652; Fax 250-442-4076

Trade Names

Trade (brand) names used in this publication are references only and other products with a similar function may be suitable. No endorsement of any kind is implied.

Corrections to Progress Report 2010

This Progress Report contains corrected data in Table 5 "Lytton and Lillooet Calculated Growing Degree Days (April 1 – October 31)" for Lytton in the Year 2000, 2001, 2002, 2005, 2007, 2008, and in Table 21 "Total Growing Degree Days (GDD) and Length of Frost Free Period at iButton; Hobo Pro 2 and Weather Stations" for the Length of Frost Free Period in 2010 at iButtons #17, 19, 20, 21, 22, 27, 29, 30, 51, 52, 58, 59, 87.

PROJECT CONCEPTS/GOALS

To provide production and climatic information for better assessment of the feasibility and suitability of commercial grape production in the Lytton-Lillooet area.

KEY ACTIVITIES IN PERIOD APRIL 2011 TO MARCH 2012

Increased frequency of irrigation at Wonderland Farm resulted in improved vine vigour. Soil and water test results from Pietila Vineyard have very high calcium carbonate content in the water (877 mg/l) and a soil pH of 8.6 which appears to have contributed to inadequate vine vigour and growth of the own rooted vines. Vines grafted to lime tolerant rootstocks planted at this site in 2010 are growing well. The test vineyard at Roshard was found to contain high populations of root damaging nematodes which are likely major contributors to the low vine vigour. This report contains corrected and updated data and new information.

PROJECT DESCRIPTION

Project Timing

Original Planned Start Date:	March 1 st , 2007	Original Planned Completion Date:	December 31 st , 2009
Project Extension		New completion Date	April 2012

Investment Agriculture Foundation of B.C. (IAF) approved the use of funds that remained at the end of December 2009 for a project extension to April 2012. The extension provided an opportunity to assess vineyard recovery following the damaging temperatures of December 2008, and permitted the ongoing collection of viticulture and year round climate data. Continued support by other project partners also made the project extension possible.

Objectives

- 1) To test the suitability and performance of wine grape varieties in the Lytton-Lillooet region.**

Mechanism: Measure, compile and compare information relating to grape phenology and vineyard management, production, and fruit quality from a wine grape planting established in 2005 and two others established in 2007.

Grape phenology consists of events that recur such as the date when grapes begin to grow (budbreak), bloom, veraison (start of ripening), reach ripeness, harvest date, and vine maturity. Available phenology data for 2011 is provided in Tables 10, 11, 12, 17 and 18.

Three criteria are used to indicate grape quality at harvest. Degrees Brix is a measure of the percent total soluble solids (sugar, minerals, proteins, amino acids, hormones and other solids) in 100 grams of grape juice. Approximately 90 to 95% of the total soluble solids in ripe grapes are fermentable sugars. Total acid is expressed as grams/litre of tartaric acid, the principle acid in grape juice. The pH indicates the acidity of the juice and increases as the grapes ripen.

Fruit quality data for 2011 is provided in Tables 11 and 12. Samples of grapes collected and frozen at harvest are provided to participants at PARC, Summerland, B.C. for official quality determination. Analysis of these grapes and comments regarding desirable fruit quality values is provided in Table 12. Harvest dates and fruit quality analysis data for 2001 to 2011 is provided in Tables 13, 14, 15, and 16. Table 17 lists the number of days required from budbreak to harvest based on limited crops and anticipated arrival of the first fall frost.

Vine maturity (hardening) at the end of the growing season provides an indication that shoot growth has ceased, the development of periderm (bark) has taken place and the vine has reduced water content in the tissue. It is a measure of the vine preparedness for colder temperatures. Data concerning vine maturity by October 7, 2011 is provided in Table 17.

2) To develop a detailed climatic profile of the area.

Mechanism: Collect and compile climatic data to help determine the suitability of an area for commercial grape production including the frost free period, growing degree-days (heat units), extreme minimum temperatures, and rainfall. This data is collected via weather stations and supplemental temperature data loggers.

The length of the frost-free period for 2011 is presented in Table 22 and Graph 1 and represents the number of days between the last frost (0° C) in the spring and the first frost (0° C) in the autumn. This is the time available for vines to begin growth, bloom, mature fruit and to mature the vine at the end of the growing season. A minimum of 140 frost free days is generally required for very early maturing grape wine grape varieties and 180 days or more for very late maturing varieties.

The total amount of heat accumulated during each month, generally from April 1 to October 31, is expressed as growing degree days in Table 22 and Graph 2 (a few growing degree days (GDD) accumulated in March may be included). Growing degree days are indicative of the ripening potential of an area for a range of grape varieties. Growing degree days refers to the sum of the accumulated mean monthly temperatures above 10° C multiplied by the number of days per month. For example, if the mean monthly temperature for the month of June is 17° C, then the number of growing degree days for June is $(17-10) \times 30 = 210$. If the growing degree days calculate to a negative number it is made equal to zero. A minimum of 900 growing degree days are generally required for very early maturing varieties while 1400 to 1600 or more are usually required for late maturing varieties.

Minimum winter temperatures for 2011 are presented in Table 21 and Graph 3. Temperatures above -20°C are preferred. Temperatures of -23°C to -25°C may severely injure or kill some European wine grape varieties. Grape variety susceptibility to low temperatures may vary when the same variety is grown in different areas. This variation may be influenced by differences in vine age, nutrition, water content of the vine, micro climates, site or physiological status of the vines. Temperatures colder than -25°C usually kill European grape varieties. Hybrid varieties such as Foch or Chancellor may survive temperatures to -28°C. New hardy hybrid wine grapes, not part of this project but added to the test vineyards in 2010, are reportedly hardy to between -30°C to -35°C.

The amount of rain at specific times of the year may impact vine growth and vine development at bloom, fruit maturation, harvest date and disease or pest control strategies. Rainfall information is also important to determine if an irrigation system is needed.

Climate data for 2007 to 2011 from Environment Canada (EC) weather stations at Lytton and Lillooet forms part of the climatic data collected and is provided in Tables 2 to 9. Climate data for 2007 to 2011 at project test vineyards is provided in Table 19.

Climatic data for 2007 to 2011 collected from project climate stations and data loggers is contained in Tables 21 and 22. A map showing the extent of the project study area and locations of climate stations and data loggers is attached to this report. This map can be viewed on a computer via Google Earth by following the instructions provided in this Progress Report or on most web sites listed in Table 1.

Solar radiation is a function of day length and the sun's angle to the earth and has a major effect on soil and air temperatures which affect vine phenology, and vine water requirements. A Geographical Information System (GIS) project has produced calculated solar radiation maps in support of this project. The maps are available as portable document format (pdf) files for viewing and download free of charge at <http://www.solarradiationmapping.ca/>. In addition to the Calculated Solar Radiation, each map sheet identifies the location and elevation of iButtons and provides supplemental climate data for 2007 to 2010 that includes Extreme Minimum Temperatures, Growing Degree Days, Frost Free Period and the dates of the last spring frost and the first fall frost. The maps are suitable for any agricultural crop or project that requires knowledge of the amount of calculated solar radiation or climate data in the area.

COMMUNICATIONS

Communication and outreach to create awareness about this project and the project's progress occurred with the participation of the British Columbia Grapegrowers' Association, interest by wineries; participation by government officials representing different levels of government; by impromptu visits to Roshard Vineyard by interested local individuals and by people from outside the Lillooet-Lytton area.

Direct contact is maintained with the landowners, who are also the test vineyard managers, by the project technician Norm Vernon when he collects data from the data loggers and by project participant Myles Bruns when he collects data from the weather stations. Participants Doug Robson and Christ'l Roshard maintain contact with other participating vineyard managers. John Vielvoye P.Ag., vineyard consultant, discusses project events and progress with project team members, provides pro bono consulting services, records vineyard observations and produces progress reports.

Published articles and five web sites that relate to this project are listed in Table 1. Reference to this project is frequently made to visitors at Fort Berens Estate Vineyard and Winery in Lillooet.



Vines at Wonderland Farm 2011

PROJECT OUTPUTS DURING 2011

Project outputs include the following:

- Project progress reports are posted on the District of Lillooet; Village of Lytton; British Columbia Grapegrowers' Association; Fraser Basin Council and British Columbia Ministry of Agriculture websites and are listed in Table 1. Awareness of the project is also provided through local media and word of mouth.
- Climate data from five project weather stations and from 99 data loggers at 59 properties was collected at regular intervals. Final data for 2011 was collected in January 2012.
- All climate data collected from the project network is provided to project participants at the Pacific Agri-Food Research Centre (PARC) – Summerland, B.C. where it is analysed, stored and climatic data summaries are prepared. Minimum winter temperatures, growing degree days and frost free periods obtained from data analysis by PARC is provided in Tables 21 and 22. Graphs of the extreme minimum temperatures recorded, the total annual growing degree days (April 1 – Oct. 31) and the frost free period in 2011 are provided in this report.
- On-line accessibility to weather data from the Davis Vantage Pro 2 stations at Diamond S and Halfway Ranch was made available to growers, industry and the public via the Farmwest website at: <http://www.farmwest.com/index.cfm?method=climate.showclimate>.
- Minimum winter temperatures from Environment Canada weather stations at Lillooet and Lytton for the months of December 2010 and the coldest months in 2011 are provided in Table 9 for comparison to minimum temperatures for these months at Environment Canada weather stations in other selected locations.
- Project outputs include on-going assessment and recording of the effects of winter temperatures, growing degree days and frost free period, vine performance and condition, and consultations with vineyard owners regarding all aspects of vineyard management.
- Brix (sugar) analysis for several varieties at Pietila Vineyard is provided in Table 11. Fruit quantity for fruit at harvest at Wonderland Farm and Roshard Vineyard is provided in Table 12.



Vine stunted by nematodes at Roshard Vineyard

PROGRESS TOWARDS ACHIEVING PROJECT OBJECTIVES AND BENEFITS

Objectives

1) To test the suitability and performance of wine grape varieties in the Lytton-Lillooet region.

- Vineyards were visited before pruning, during the growing season and in early October to record phenological events, presence of diseases or insects, vine and vineyard conditions and to provide consultations to vineyard managers.
- Vineyard owners/managers prune & tie vines, irrigate, apply the required spray programs; fertilize including spray application of nutrients; provide weed control and assist in collection of phenological data.
- All participating vineyards use a mixture of spur and cane pruning; use drip irrigation and have a permanent cover crop consisting of native grasses and weeds. Tensiometers were installed at all sites in the spring to assist with irrigation scheduling and are removed prior to fall frosts.
- Viticulture observations record phenology events and dates (Table 10). The dates for bud break in the spring was normal but consisted of a mixture of primary and secondary buds, indicative of some winter damage to primary buds. Vine maturity by Oct. 7, 2011 is provided in (Table 18). Fruit quality was monitored in September and October at a facility provided by Roshard Vineyard. Percent Brix for several varieties at Pietila vineyard was provided by the owner and is provided in Table 11. Fruit quality at harvest at Wonderland Farm and Roshard vineyard is provided in Table 12. The Foch variety produced 680 kg fruit. Yield data for other varieties is not available due to limited crops produced at all sites.
- Observations of grape varieties at Roshard Vineyard include the Foch variety established in a separate adjacent planting in 1972. Foch is a valuable variety to use for the comparison of European varieties maturity dates and hardiness. Harvest dates, Brix, total acid and pH values for varieties in test vineyards for 2007 to 2011, including the Foch variety, are provided in Tables 13, 14, 15 and 16.
- Low vine vigour at Wonderland farm in past years was improved significantly in 2011 through the installation of equalizing emitters and the application of a 24 hour irrigation every 2 weeks during the growing season. Tensiometers were used to schedule the irrigation and the gauges were kept at 40 to 50 centibars. Irrigation in previous years was scheduled once per month for 24 hours.
- Irrigation water high in calcium carbonate (877mg/l) and high soil pH (8.6) have been identified as major contributors to low vine vigour of own rooted test vines at the Pietila vineyard. Twenty five vines each of Cabernet Franc and of Pinot Gris grafted to more lime tolerant rootstocks planted in 2009 are growing well.
- High quantities of root damaging root lesion, dagger and pin nematodes were identified in 2011 as major contributors to low vine vigour at the Roshard vineyard. Affected vines lack new and fine root development and lack secondary roots in the surface 60 cm.

- The frost free period at Lytton was 3 days shorter than the average of 195 days (Table 3) while at Lillooet the frost free period was 11 days shorter than the average of 186 days (Table 4). A cool April, May, June and July contributed to delayed bloom, delayed fruit maturity and decreased accumulations of growing degree days. Rain during bloom reduced the fruit set. Fruit was thinned to 1 cluster per shoot in early August to encourage earlier ripening. A warm August and September combined with fruit thinning made it possible to ripen some fruit. There were no accumulations of growing degree days in October. Growing degree days at Lytton were 133 fewer than the average of 1415 and were 111 fewer in Lillooet compared to the average of 1424 (Table 5). Canes produced in all vineyards were generally well matured by Oct. 7, with a few exceptions at both the Roshard Vineyard and Wonderland Farm (Table 18).
- The effects of powdery mildew in 2010 at Roshard Vineyard resulted in die back of some canes and some bud mortality in 2011 in all varieties. Sulphur sprays to control powdery mildew in all vineyards during 2011 was generally successful. Erineum mite is present in several varieties at Roshard and Wonderland vineyards. Other insects common to vineyards in other areas or crown gall disease have not been observed in test vineyards.
- Wildlife such as wasps, birds, deer and bears are a problem. Pietila and Roshard Vineyard have deer fencing. Roshard Vineyard also installed electric fencing to protect the grape crop from bears. Early varieties such as Foch and Riesling Muscat are susceptible to wasp damage. None of the test vineyards are protected from birds.



Pinot gris grafted to more lime tolerant root stock at Pietila vineyard



White residue from high calcium carbonate at the base of a Riesling vine at Pietila vineyard

2) To develop a climate profile of the area.

- Climatic information from Environment Canada climate stations located near the Village of Lytton and in the District of Lillooet is a component of ongoing climate data collection (Tables 2 to 9) and provides climatic data for comparison to data from data collection sites in the current project climate network.
- Climatic data from data collection sites in the project climate network show variations in frost free periods, growing degree days and extreme minimum temperatures from data at Environment Canada weather stations at Lillooet and Lytton.
- Project weather stations and data loggers are located on private property and reserve lands and range in location from approximately 15 km south of Lytton north from Lytton along both sides of the Fraser River and past Lillooet to the vicinity of Big Bar Creek. Several data loggers are also located in the Botanie valley and along the Thompson River. The project climate network extends over a distance of 200 km. Data loggers are located at elevations ranging from 155m to 575m.
- The project climate network consists of 3 Weatherhawk and 2 Davis Vantage Pro 2 weather stations; 87 temperature data loggers (iButtons) and 12 Hobo Pro temperature data loggers.
- Data from the 3 Weatherhawk and 2 Davis Vantage Pro 2 weather stations was collected every two months; data from the 87 iButtons was collected every 4 months and annually from the Hobo Pro 2 data loggers. The final data collection was January 2012. All data is sent to PARC at Summerland, BC. The Davis Vantage Pro 2 station at Diamond S malfunctioned during part of September and October in 2011 and was repaired by project partner Mr. Myles Bruns.
- Tables 21 and 22 provide climatic data collected from project climate data collection sites for 2007 to 2011. The data for 2011 indicates:
 - The range of Growing Degree Days (GDD) was from 859 to 1424 GDD.
 - The range in the frost free season was from 154 days (May 12 to Oct. 13) to 192 days (April 22 to Oct. 31).
 - The extreme minimum temperatures recorded during the coldest month, February, ranged from -11.04 °C to -21.25° C.
 - Extreme minimum temperatures that ranged from -11 °C to -15.0 °C were recorded at 9 sites (approximately 9%)
 - Extreme minimum temperatures that ranged from -15.1 °C to -17.0° C were recorded at 67 sites (approximately 64%).
 - Extreme minimum temperatures that ranged from -17.1°C to -18.0° C were recorded at 12 sites (approximately 11 %)
 - Extreme minimum temperatures that ranged from -18.1 °C to 20.0 °C were recorded at 10 sites (approximately 10%)
 - Extreme minimum temperatures that ranged from -20.0 °C to 21.5 °C were recorded at 6 sites (approximately 6%)

Accumulated climate data from the project climate network for 2007 to 2011 identifies climatic differences between the Environment Canada weather station sites (Tables 4, 5) and data collection sites of the current project climate network (Tables 21, 22). Data in Tables 21 and 22 illustrate the differences among current project climate data collection sites for the frost free periods, growing degree days and extreme minimum winter temperatures as follows:

1. Frost free periods ranged from 142 days at iButton 70 in 2007 to 221 days at iButton 40 in 2010. The number of data collection sites with at least one occurrence of a minimum frost free period:
 - a. less than 150 days: 2
 - b. between 151-160 days: 21
 - c. between 161-170 days: 64
 - d. between 171-180 days: 5
 - e. more than 180 days: 0

Average frost free periods for data collection sites in the years 2007-2011.:

- a. Frost free period averaging less than 160 frost free days: 1
 - b. Frost free periods averaging 160 to 165 days: 7
 - c. Frost free periods averaging 166 to 170 days: 8
 - d. Frost free periods averaging 171 to 175 days: 16
 - e. Frost free periods averaging 176 to 180 days: 51
 - f. Frost free periods averaging 181 to 185 days: 6
 - g. Frost free periods averaging 186 to 205 days: 3
2. Growing degree days ranged from 859 at iButton 44 in 2011 to 1729 at iButton 75 in 2009 (not including 2007 data due to the late installation of the climate network in 2007). The number of data collection sites with at least one occurrence of minimum accumulated growing degree days:
 - a. less than 1000: 2
 - b. from 1001 to 1100: 5
 - c. from 1101 to 1200: 30
 - d. from 1201 to 1300: 44
 - e. from 1301 to 1400: 10
 - f. from 1401 to 1500: 1

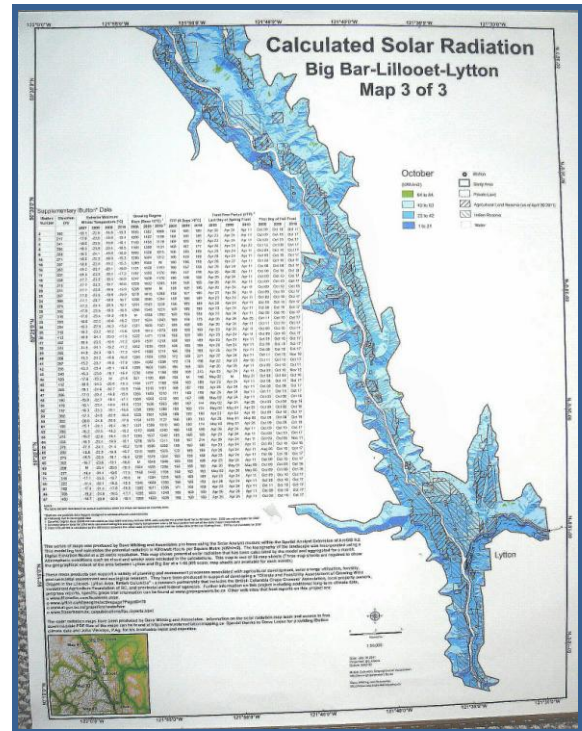
Average Growing Degree Days for data collection sites in the years 2008 to 2011.

- a. Growing Degree Days averaging less than 1000: 1
 - b. Growing Degree Days averaging 1001 to 1100: 3
 - c. Growing Degree Days averaging 1101 to 1200: 8
 - d. Growing Degree Days averaging 1201 to 1300: 22
 - e. Growing Degree Days averaging 1301 to 1400: 49
 - f. Growing Degree Days averaging 1401 to 1500: 8
 - g. Growing Degree Days averaging 1500: 1

3. Extreme minimum temperatures ranged from -10.2°C at iButton 50 in January 2010 to -31.4°C at iButton 76 in December 2008. The number of data collection sites:
 - a. which did not record temperatures colder than -23°C: 13
 - b. at which the coldest temperature recorded was between -23°C and -25°C: 52
 - c. at which the coldest temperature recorded was between -25.1°C and -27°C: 11
 - d. at which the coldest temperature recorded was between -27°C and -31.4°C: 15
 - e. at which the coldest temperature recorded was colder than -31.4°C: 0

Benefits

- This project provides detailed viticulture and climate data that are useful for the entire study area. The data will help to determine if any wine grape varieties planted in the test plantings or other varieties not currently part of the testing program could be grown in the study area.
- This project is providing technology transfer in grape production skills to the participants who in turn share their knowledge with interested people.
- Project viticulture and climate data is being studied by individuals interested in the feasibility of growing wine grapes in the study area. Data from the current project was taken into consideration in the establishment of the Fort Berens Estate Vineyard and Winery at Lillooet. A three acre test vineyard with wine grapes grafted to rootstocks that advance fruit maturity and a collection of own rooted fresh market grape varieties was established at Texas Creek Ranch. A new vineyard was established near Lytton in 2011.



TABLES

Table 1 Communications 2011

Project progress reports are available on the following websites:

- District of Lillooet: <http://www.lillooetbc.com/business.aspx>
- Village of Lytton: <http://www.lytton.ca/siteengine/activepage.asp?PageID=78>
- British Columbia Grapegrowers' Association: <http://www.grapegrowers.bc.ca>
- Fraser Basin Council: http://www.fraserbasin.bc.ca/publications/fbc_reports.html
- British Columbia Ministry of Agriculture:
<http://www.al.gov.bc.ca/grape/factsheets.htm>

Articles and solar radiation map web site related to this project:

- The Bridge River Lillooet News. October 12, 2011 Fort Berens harvests first grapes.
- The Bridge River Lillooet News. Nov. 12, 2011 Leading edge technology maps solar radiation in Lillooet area.
- Nov. 22, 2011 Premier's reps visit Lillooet for firsthand look.
- Spring 2011 –BC Wine Trails. Fort Berens winery breaks new ground in Lillooet
- Spring 2011 Canadian Grapes to Wine. Fort Berens Estate Winery breaks new ground in Lillooet
- Calculated Solar Radiation Maps for the Lillooet-Lytton area
<http://www.solarradiationmapping.ca/>



*Budbreak on Limberger vine May 9 at
Wonderland Farm*



Limberger grapes at Roshard vineyard Oct. 8

Table 2 Location of Environment Canada Weather Stations at Lytton and Lillooet

Active Stations

Lytton station Latitude 50° 13'28.0 N Longitude 121° 34'55.00'W Elevation 225m
 Lillooet Station Latitude 50° 41'01.380N Longitude 121° 56'02.820'W Elevation 235m

Deactivated Stations referred in Table 4, 5 and 7

Lillooet Seton BCHPA Latitude 50°40'24.000"N Longitude 121°55'27.000"W Elevation 198.1m
 Lillooet Russell St. Latitude 50°42'00.000"N Longitude 121°56'00.000"W Elevation 243.8m

Table 3 Lytton Frost Free Periods and Extreme Minimum Temperatures

Year	Date Last Spring Frost & Temp. (°C)	Date First Fall Frost & Temp. (°C)	Frost Free Periods (days)	Extreme Minimum Temperatures (°C)
1941-70	April 24	Oct. 24	183	Jan. (-31.7) (year n/a)
1951-80	April 20	Oct. 24	187	Jan. (-31.7) (year n/a)
1961-90	Not available	n/a	n/a	Dec. 31, 1984 (-27.1) Nov. 27, 1985 (-27.7)
1971-2000	Not available	n/a	n/a	Nov. 27, 1985 (-27.1) Dec. 31, 1984 (-27.1)
1995	April 20 (-1.3)	Oct. 28 (-0.3)	191	Dec 8 (-18.6)
1996	April 4 (-0.4)	Oct 20 (-1.4)	199	Jan 30 (-22.8)
1997	April 11 (-2.0)	Oct 20 (-0.6)	192	Jan 26 (-22.0)
1998	April 15 (-1.5)	Nov 10 (-0.6)	209	Jan 12 (-22.9)
1999	May 10 (-0.2)	Oct 27 (-1.1)	170	Jan 24 (-11.0)
2000	April 14 (-0.4)	Nov 6 (-0.8)	206	Jan 20(-14.3)
2001	April 15 (-0.8)	Oct 28 (-1.1)	196	Feb 7 (-10.0)
2002	April 25 (-0.8)	Oct 24 (-2.3)	182	Jan 28 (-17.1)
2003	April 6 (-0.6)	Oct 31 (-4.1)	208	Mar 8 (-12.7)
2004	April 2 (-2.0)	Oct 27 (-1.3)	208	Jan 5 (-20.4)
2005	April 9 (-0.2)	Nov.14 (-1.1)	219	Jan 15 (-22.3)
2006	May 3 (-0.2)	Oct. 30 (-3.8)	180	Nov. 29 (-20.0)
2007	April 11 (-0.8)	Nov. 2 (-0.4)	205	Jan 12 (-16.0)
2008	April 26 (-0.5)	Oct. 11 (-1.8)	168	Dec. 20 (-23.5)
2009	April 24 (-2.0)	Oct. 10 (- 1.7)	169	Dec. 14 (-18.8)
2010	April 11 (-2.2)	Nov. 11 (-0.5)	214	Nov. 24 (- 15.7)
2011	April 23 (-0.6)	Nov. 1 (-1.2)	192	Feb. 25 (-15.5)
Average 1995-2011	April 17 (-1.0)	Oct. 29 (-1.4)	195	Extreme minimum temperature, 1995 to 2011 = -23.5°C, Dec. 20, 2008

Table 4 Lillooet Frost Free Periods and Extreme Minimum Temperatures

Year	Date Last Spring Frost & Temp. (°C)	Date First Fall Frost & Temp. (°C)	Frost Free Periods in Days	Extreme Minimum Temperatures(°C)
1968 (Russell St.)*	April 22 (-1.1)	Nov. 1 (-2.8)	193	Dec. 30 (-31.1°C)
1969(Russell St.)*	April 3 (-1.1)	Oct. 4 (-1.1)	184	Jan. 29 (-31.1°C)
1995 (BCHPA)*	April 20 (-1.0)	Oct. 18 (-2.0)	181	Dec. 9 (-24.5)
1996 (BCHPA)*	April 3 (-2.0)	Oct. 26 (-1.0)	206	Dec. 27 (-24.5)
1997 (BCHPA)*	April 11 (-2.0)	Nov. 10 (-1.5)	213	Jan. 26 (-23.5)
1998	April 15 (-1.1)	Oct 24 (-0.2)	192	Jan 12 (-25.1)
1999	May 10 (-0.1)	Oct 23 (-0.3)	166	Jan 20 (-11.2)
2000	April 17 (-0.1)	Oct 6 (-0.8)	172	Jan 20(-15.5)
2001	April 12(-3.3)	Oct 25 (-1.2)	196	Feb 7 (-10.4)
2002	April 25 (-0.4)	Oct 12 (-1.5)	170	Jan 28 (-17.7)
2003	April 18 (-0.1)	Oct 15 (-0.1)	180	Mar 8 (-14.4)
2004	April 3 (-0.5)	Oct 27 (-1.3)	207	Jan 6 (-22.7)
2005	April 14 (-0.6)	Oct. 27 (-0.8)	196	Jan 15 (-25.4)
2006	April 17 (-0.6)	Oct. 30 (-3.7)	196	Nov. 29 (-20.0)
2007	Missing	Oct. 26 (-1.0)	M	Dec 8 (-18.2)
2008	April 26 (-0.1)	Oct. 9 (-1.1)	166	Dec. 20 (-24.6)
2009	April 26 (-0.1)	Oct. 10 (-0.6)	167	Dec. 14 (-20.1)
2010	April 11 (-1.0)	Oct. 17 (-1.8)	189	Nov. 23 (- 16.2)
2011	April 23 (-0.9)	Oct. 15 (-2.5)	175	Feb. 25 (-16.1)
Average 1995-2011	April 17 (-1.0)	Oct. 21 (-1.0)	186	Extreme minimum 1995 to 2011 = -24.6°C Dec. 20, 2008
* See Table 2				



Alice Brown at Wonderland Farm inspects successful layer

Table 5 Lytton and Lillooet Growing Degree Days (GDD) April – October (Base 10° C)

Year	Lytton	Lillooet
1951-80	1,368	1,266
1995	1,401	1,399 (BCHPA)*
1996	1,223	1,203 (BCHPA)*
1997	1,315	1,230 (BCHPA)*
1998	1,665	1,719
1999	1,179	1,229
2000	1,257	1,262
2001	1,346	1,379
2002	1,310	1,406
2003	1,550	1,562
2004	1,618	M
2005	1,448	1460
2006	1,578	M
2007	1,338	M
2008	1,307	1,334
2009	1,644	1,651
2010	1,285	1,354
2011	1,282	1,313
Average GDD 1998 -2011	1,415	1,424

* See Table 2. Average GDD calculated with available data. M = missing data



*Riesling almost at trace of bloom at
Wonderland Farm July 7*

Table 6 Precipitation (mm) and Hours of Bright Sunshine (April-October) - Lytton

	May	June	July	Aug	Sept	Oct	May-Oct. Total	Total Annual Precipitation (mm)	Hours Bright Sunshine Apr.-Oct.
1941-70	15	21	12	19	23	50	140	335	n/a
1951-80	15	18	12	23	25	45	138	327	1584
1961-90	18	18	14	17	26	35	128	324	1529
1971-2000	18	19	14	23	27	36	137	339	1523
1997	18	15	3	11	17	60	124	297	n/a
1998	41	31	10	0.5	2	40	125	401	n/a
1999	14	10	58	27	20	40	169	646	n/a
2000	58	67	336	M	M	48	>509	>673	n/a
2001	17	M	M	2	23	25	>67	>302	n/a
2002	28	16	21	33	18	4	120	278	n/a
2003	6	20	M	13	8	137	>184	> 500	n/a
2004	27	9	27	17	42	33	155	357	n/a
2005	31	46	17	30	33	32	189	435	n/a
2006	25	33	3	10	18	24	113	599	n/a
2007	19	28	16	20	32	30	145	502	n/a
2008	25	35	29	40	31	15	175	374	n/a
2009	M	25	26	5	12	M	>68	>392	n/a
2010	53	30	32	53	51	22	241	> 542	n/a
2011	52	11	15	9	37	8	132	562	n/a
Average 1997 - 2011	28	27	46	19	31	39	189	479	n/a

M= Missing data. n/a = not available or no longer collected.



*Tensiometers installed at 30 and 60 cm at
all test vineyards*

Table 7 Precipitation (mm) - Lillooet								
	May	June	July	Aug	Sept	Oct	May- Oct. Total	Total Annual Precipitation (mm)
1941-1970	21	28	25	26	33	46	179	327
1951-1980	16	30	21	26	26	31	276	276
1995	5	28	32	28	11	40	144	> 276 (BCHPA)*
1996	35	9	9	25	47	43	168	> 252 (BCHPA)*
1997	30	39	9	11	18	35	142	321 (BCHPA)*
1998	15	29	44	4	24	30	146	334
1999	7	13	81	15	14	3	133	297
2000	52	14	37	21	16	52	192	265
2001	6	35	40	8	9	31	129	298
2002	32	9	13	19	M	1	>74	>166
2003	16	24	1	9	22	58	130	319
2004	24	22	32	9	30	M	>117	>173
2005	M	M	18	31	73	M	>122	>122
2006	M	M	M	M	M	M	M	M
2007	M	M	M	18	44	M	>62	>62
2008	32	39	8	22	32	M	>133	>133
2009	7	6	2	8	M	M	>23	>23
2010	68	17	13	21	50	M	> 169	>169
2011	69	10	21	0	10	0	110	> 110
Average 1995-2011	27	22	24	17	29	31	122	> 186
M means missing data. * See Table 2								

Table 8 Location of Selected Environment Canada (EC) Weather Stations Used for Comparing Minimum Winter Temperatures at Stations at Lillooet and Lytton in Table 9				
Name	Latitude	Longitude	Elevation (m)	Elevation (feet)
Kamloops Airport	50°42'08.00 N	120°26'31.00 W	345.3	1133
Kelowna AWOS	49°57'26.00 N	119°22'40.00 W	433.1	1421
Lillooet	50°44'01.38 N	121°56'23.00 W	235.0	771
Lytton	50°13'28.00 N	121°34'55.00 W	225.0	738
Lytton RCS	50°13'28.00 N	121°34'55.00 W	225.0	738
Penticton Airport	49°27'47.00 N	119° 36'08.00 W	334.1	1129
Summerland CS	49°33'49.40 N	119°36'18.20 W	454.2	1490
Osoyoos CS	49°01'42.00 N	119°26'28.00 W	282.9	928

Table 9 Minimum Temperatures (°C) December 2010, February, March, November and December 2011 at Selected Environment Canada Weather Stations

Stations	Dates				
	Dec. 2010	Feb. 2011	March 2011	Nov. 2011	Dec. 2011
Kamloops A	-14.3	-16.0	-14.3	-13.1	-11.9
Kelowna	-16.7	-15.9	-9.4	-15.2	-10.9
Lillooet	-11.6	-16.1	-14.1	-13.0	-9.1
Lytton	-11.3	-15.5	-13.5	-13.4	-8.1
Lytton RCS	-11.5	-15.8	-13.9	M	-8.3
Penticton A	-12.6	-14.9	-7.0	-8.8	-9.8
Summerland CS	-13.4	-15.9	-7.4	-8.3	-8.8
Osoyoos CS	-12.1	-13.2	-4.0	-8.3	-8.9

Table 10 Approximate Dates of Phenology Events in Test Vineyards 2011

Vineyard	Fuzzy Bud to Bud Break	Bloom	Veraison	Harvest (see Table 11 and 12)
Pietila	May 9 to 14	June 7 to 20	Aug. 31 to Sept. 2	Oct. 1 to 8
Roshard	May 9 to 14	June 7 to 20	Aug. 31 to Sept. 2	Oct. 9 to 16
Wonderland	May 9 to 14	June 7 to 20	Aug. 31 to Sept. 2	Oct. 9 to 15

Table 11 Fruit Quality Analysis Provided by Pietila Vineyard. 2011

Variety	Brix %	Harvest Date
Cabernet Franc	15.0	Oct. 8
Chardonnay	20.0	Oct. 8
Cocseji Zamos	19.0	Oct. 8
Foch	16.3	Oct. 8
Johannisberg Riesling	19.1	Oct. 8
Pinot blanc	19.0	Oct. 8
Pinot gris	21.0	Oct. 8
Syrah	18.5	Oct. 8

Table 12 Fruit Quality of Harvested Grape Samples from Roshard and Wonderland Vineyards Conducted at the Pacific Agri-Food Research Centre (PARC), Summerland BC – Oct. 24, 2011

Roshard Vineyard Variety	Berry Weight (gm)	Brix %	pH	Total Acid (mg/l)	Harvest Date
Cabernet Franc	0.91	18.8	3.1	8.1	Oct. 16
Cabernet Sauvignon	0.76	19.1	3.2	7.4	Oct. 16
Chancellor	1.38	15.4	2.9	11.4	Oct. 16
Chardonnay	0.83	22.4	3.3	7.0	Oct. 15
Cocseji Zamos	1.10	19.6	2.9	9.1	Oct. 13
Foch	1.02	22.3	3.5	9.2	Oct. 9
Gewurztraminer	1.06	21.0	3.1	6.8	Oct. 15
Johannisberg Riesling	0.68	18.4	2.9	10.5	Oct. 15
Limberger	1.17	18.8	3.1	5.9	Oct. 16
Merlot	1.20	23.4	3.7	4.9	Oct. 15
Muscat Ottonel	0.98	18.7	3.3	6.2	Oct. 15
Petit Verdot	0.61	17.7	3.1	12.0	Oct. 15
Pinot Blanc	1.01	19.3	3.2	7.0	Oct. 15
Pinot Gris	1.11	17.9	3.3	7.1	Oct. 15
Pinot Noir	0.92	21.4	3.5	6.5	Oct. 16
Riesling Muscat	0.92	18.2	3.5	5.6	Oct. 16
Sauvignon Blanc	0.95	20.0	2.8	13.2	Oct. 15
Syrah	1.03	16.9	3.0	11.7	Oct. 16
Tinta Madeira	1.08	19.6	3.0	8.7	Oct. 16
Viognier	1.10	20.2	3.3	8.0	Oct. 15
Zweigeltrebe	1.12	23.2	3.2	5.8	Oct. 13
Wonderland Farm					
Cabernet Franc	0.85	16.5	3.1	11.6	Oct. 15
Chancellor	1.14	19.2	3.1	10.6	Oct. 15
Chardonnay	1.03	18.9	3.2	10.2	Oct. 15
Cocseji Zamos	1.28	19.5	3.0	8.8	Oct. 15
Johannisberg Riesling	0.96	18.1	2.8	14.2	Oct. 15
Merlot	0.92	21.2	3.1	9.4	Oct. 15
Muscat Ottonel	1.11	19.7	3.1	9.5	Oct. 15
Riesling Muscat	0.94	14.7	3.4	4.9	Oct. 15
Pinot Blanc	1.29	17.9	3.2	8.1	Oct. 15
Pinot Noir	1.04	20.0	3.2	8.8	Oct. 15
Sauvignon Blanc	0.96	20.1	2.9	13.7	Oct. 15
Tinta Madeira	1.02	16.7	3.1	12.2	Oct. 15
The minimum Brix level required for grapes at harvest for BC Wines of Distinction and BC VQA Wines is 17%. Higher levels are required for late harvest wines. Desired fruit quality varies amongst wineries but generally for table wine consists of 22 % Brix or higher, pH 3.2 to 3.5 and Total Acid 6 to 8 mg/l.					

Table 13 Harvest Dates of Grape Varieties in Test Plantings					
Roshard Vineyard		Harvest Date			
Variety	2007	2008	2009	2010	2011
Cabernet Franc	Oct. 6	Oct. 11	Oct. 2	Oct. 17	Oct. 16
Cabernet Sauvignon	Oct. 6	Oct. 11	Oct. 2	Oct. 17	Oct. 16
Chancellor	Oct. 6	Oct.17	Oct. 2	Oct. 17	Oct. 16
Chardonnay	Sept. 22	Oct. 11	no fruit	Oct. 17	Oct. 15
Cocseji Zamatos	Sept. 27	Oct. 11	Oct. 2	Oct. 17	Oct. 13
Foch	Oct.7	Sept. 27	Oct. 2	Oct. 3	Oct. 9
Gewurztraminer	Sept. 22	Oct. 4	no fruit	Oct. 10	Oct. 15
Johannesburg Riesling	Oct. 7	Oct.18	no fruit	Oct. 17	Oct. 15
Limberger	Oct. 6	Oct. 11	Oct. 2	Oct. 17	Oct. 16
Merlot	Oct. 6	Oct. 11	Oct. 2	Oct. 17	Oct. 15
Muscat Ottonel	Sept. 22	Oct. 11	no fruit	Oct. 10	Oct. 15
Petit Verdot	no fruit	no fruit	Oct. 2	Oct. 17	Oct. 15
Pinot Blanc	Sept. 26	Oct. 10	no fruit	Oct. 17	Oct. 15
Pinot Gris	Sept. 22	Oct. 4	no fruit	Oct. 17	Oct. 15
Pinot Noir	Sept. 27	Oct. 11	Oct. 2	Oct. 17	Oct. 16
Riesling Muscat	Sept. 22	Sept. 28	no fruit	Oct. 17	Oct. 16
Sauvignon Blanc	Oct. 6	Oct. 11	no fruit	Oct. 17	Oct. 15
Syrah	Oct. 6	Oct. 11	Oct. 2	Oct. 17	Oct. 16
Tinta Madeira	Oct. 6	Oct. 11	Oct. 2	Oct. 17	Oct. 16
Viognier	no fruit	Oct. 12	no fruit	Oct. 17	Oct. 15
Zweigeltrebe	Oct. 6	Oct. 11	Oct. 2	Oct. 17	Oct. 13
Wonderland Farm					
Cabernet Franc	no fruit	no fruit	no fruit	no fruit	Oct. 15
Chancellor	“	“	Oct. 5	Oct.5	Oct. 15
Chardonnay	“	“	no fruit	Oct. 5	Oct. 15
Cocseji Zamatos	“	“	no fruit	no fruit	Oct. 15
Johannesburg Riesling	“	“	Sept. 30	no fruit	Oct. 15
Limberger	“	“	no fruit	Oct. 5	no fruit
Merlot	“	“	no fruit	no fruit	Oct. 15
Muscat Ottonel	“	“	no fruit	Oct. 5	Oct. 15
Riesling Muscat	“	“	Sept. 11	Oct. 5	Oct. 15
Pinot Blanc	“	“	Sept. 30	no fruit	Oct. 15
Pinot Noir	“	“	Sept. 16	no fruit	Oct. 15
Sauvignon Blanc	“	“	no fruit	no fruit	Oct. 15
Syrah	“	“	Sept. 11	no fruit	no fruit
Tinta Madeira	“	“	no fruit	no fruit	Oct. 15
Continued					

Table 13 Harvest Dates of Grape Varieties in Test Plantings					
Pietila Vineyard		Harvest Date			
Variety	2007	2008	2009	2010	2011
Cabernet franc	no fruit	no fruit	no fruit	no fruit	Oct. 8
Cabernet Sauvignon	“	Sept. 28	Sept. 16	Oct. 5	no fruit
Chardonnay	“	Sept. 28	no fruit	no fruit	no fruit
Cocseji Zamatos	“	Sept. 28	no fruit	no fruit	Oct. 8
Foch	“	no fruit	no fruit	no fruit	Oct. 8
Gewurztraminer	“	Sept. 28	no fruit	no fruit	no fruit
Johannisberg Riesling	“	Sept. 28	Sept. 24	Oct. 5	Oct. 8
Pinot Blanc	“	Sept. 28	Sept. 11	Oct. 5	Oct. 8
Pinot Noir	“	Sept. 28	no fruit	no fruit	no fruit
Pinot Gris	“	no fruit	no fruit	no fruit	Oct. 8
Syrah	“	Sept. 28	no fruit	no fruit	Oct. 8

Table 14 Brix of Grape Varieties in Test Plantings					
Roshard Vineyard		Brix			
Variety	2007	2008	2009	2010	2011
Cabernet Franc	21.9	19.4	18.2	18.3	18.8
Cabernet Sauvignon	22.2	20.0	17.9	19.3	19.1
Chancellor	21.2	19.0	21.1	17.6	15.4
Chardonnay	21.7	25.0	no fruit	18.7	22.4
Cocseji Zamatos	20.6	21.3	25.9	15.2	19.6
Foch	22.3	24.6	26.5	25.5	22.3
Gewurztraminer	21.7	20.1	no fruit	21.4	21.0
Johannesburg Riesling	19.1	16.2	no fruit	17.5	18.4
Limberger	22.8	19.1	24.3	20.1	18.8
Merlot	24.5	23.2	26.0	22.9	23.4
Muscat Ottonel	21.2	21	no fruit	15.5	18.7
Petit Verdot	no fruit	no fruit	20.5	16.4	17.7
Pinot Blanc	18.4	20.6	no fruit	21.1	19.3
Pinot Gris	20.5	18.2	no fruit	20.1	17.9
Pinot Noir	20.3	21.5	16.2	18.5	21.4
Riesling Muscat	21.3	28.1	no fruit	19.4	18.2
Sauvignon Blanc	22.1	24.6	no fruit	20.7	20.0
Syrah	21.7	18.0	24.9	18.0	16.9
Tinta Madeira	21.1	20.8	22.4	18.8	19.6
Viognier	no fruit	19.5	no fruit	15.1	20.2
Zweigeltrebe	19.5	20.8	19.8	18.7	23.2
Continued					

Table 14 Brix of Grape Varieties in Test Plantings					
Wonderland Farm			Brix		
Variety	2007	2008	2009	2010	2011
Cabernet Franc	no fruit	no fruit	no fruit	no fruit	16.5
Chancellor	“	“	23.9	15.5	19.2
Chardonnay	“	“	no fruit	17.0	18.9
Cocseji Zamos	“	“	no fruit	no fruit	19.5
Johannesburg Riesling	“	“	21.2	no fruit	18.1
Limberger	“	“	no fruit	15.5	no fruit
Merlot	“	“	no fruit	no fruit	21.2
Muscat Ottonel	“	“	no fruit	22.0	19.7
Riesling Muscat	“	“	18.6	18.0	14.7
Pinot Blanc	“	“	22.4	no fruit	17.9
Pinot Noir	“	“	23.9	no fruit	20.0
Sauvignon Blanc	“	“	no fruit	no fruit	20.1
Syrah	“	“	16.0	no fruit	no fruit
Tinta Madeira	“	“	no fruit	no fruit	16.7
Pietila Vineyard					
Cabernet Franc	no fruit	18.0	no fruit	no fruit	15.0
Cabernet Sauvignon	“	no fruit	20.0	18.0	no fruit
Chardonnay	“	20.5	no fruit	no fruit	20.0
Cocseji Zamos	“	23.6	no fruit	no fruit	19.0
Foch	“	no fruit	no fruit	no fruit	16.5
Gewurztraminer	“	23.2	no fruit	no fruit	no fruit
Johannisberg Riesling	“	18.0	18.6	17.0	19.1
Pinot Blanc	“	19.8	21.5	19.2	19.0
Pinot Noir	“	22.0	no fruit	no fruit	no fruit
Pinot Gris	“	no fruit	no fruit	no fruit	21.0
Syrah	“	20.0	no fruit	no fruit	18.5



Electric fence with electric charger used to protect the grape crop from bears at Roshard Vineyard

Table 15 Total Acid of Grape Varieties in Test Plantings					
Roshard Vineyard			Total Acid		
Variety	2007	2008	2009	2010	2011
Cabernet Franc	6.8	15.8	10.2	7.0	8.1
Cabernet Sauvignon	5.7	12.0	7.7	7.0	7.4
Chancellor	8.0	15.0	6.5	8.2	11.4
Chardonnay	4.8	9.1	no fruit	7.4	7.0
Cocseji Zamatos	6.5	7.7	3.9	7.3	9.1
Foch	11.7	12.4	8.0	6.9	9.2
Gewurztraminer	4.6	5.3	no fruit	3.7	6.8
Johannesburg Riesling	7.7	9.2	no fruit	8.7	10.5
Limberger	6.0	11.1	4.2	4.9	5.9
Merlot	6.8	9.0	4.1	4.7	4.9
Muscat Ottonel	3.9	6.4	no fruit	5.7	6.2
Petit Verdot	no fruit	no fruit	10.5	10.5	12
Pinot Blanc	5.4	7.3	no fruit	6.4	7.0
Pinot Gris	5.8	7.5	no fruit	4.3	7.1
Pinot Noir	4.7	10.8	10.9	6.0	6.5
Riesling Muscat	3.9	5.3	no fruit	2.4	5.6
Sauvignon Blanc	4.9	9.5	no fruit	7.1	13.2
Syrah	5.9	11.9	5.4	8.3	11.7
Tinta Madeira	6.9	9.6	7.2	8.1	8.7
Viognier	no fruit	7.9	no fruit	8.4	8.0
Zweigeltrebe	5.1	7.7	7.1	4.8	5.8
Wonderland Farm					
Cabernet Franc	no fruit	no fruit	no fruit	no fruit	11.6
Chancellor	“	“	9.0	“	10.6
Chardonnay	“	“	no fruit	“	10.2
Cocseji Zamatos	“	“	no fruit	“	8.8
Johannesburg Riesling	“	“	12.5	“	14.2
Limberger	“	“	no fruit	“	no fruit
Merlot	“	“	no fruit	“	9.4
Muscat Ottonel	“	“	no fruit	“	9.5
Riesling Muscat	“	“	7.3	“	4.9
Pinot Blanc	“	“	7.5	“	8.1
Pinot Noir	“	“	6.8	“	8.8
Sauvignon Blanc	“	“	no fruit	“	13.7
Syrah	“	“	15.8	“	no fruit
Tinta Madeira	“	“	no fruit	“	12.2
Continued					

Table 15 Total Acid of Grape Varieties in Test Plantings					
Pietila Vineyard		Total Acid			
Variety	2007	2008	2009	2010	2011
Cabernet Franc	no fruit	no fruit	no fruit	no fruit	n/a
Cabernet Sauvignon	“	11.7	13.5	“	no fruit
Cocseji Zamos	“	11.2	no fruit	“	n/a
Foch	“	no fruit	no fruit	“	n/a
Gewurztraminer	“	7.1	no fruit	“	no fruit
Johannisberg Riesling	“	16.7	7.3	“	n/a
Pinot Blanc	“	9.6	6.4	“	n/a
Pinot Noir	“	no fruit	no fruit	“	no fruit
Pinot Gris	“	no fruit	no fruit	“	n/a
Syrah	“	9.4	no fruit	“	n/a

n/a = not available

Table 16 pH of Grape Varieties in Test Plantings					
Roshard Vineyard		pH			
Variety	2007	2008	2009	2010	2011
Cabernet Franc	3.2	2.8	3.1	3.3	3.1
Cabernet Sauvignon	3.5	3.0	3.3	3.2	3.2
Chancellor	3.4	2.9	3.5	3.3	2.9
Chardonnay	3.6	3.3	no fruit	3.6	3.3
Cocseji Zamos	3.3	3.1	3.7	3.2	2.9
Foch	3.2	3.4	3.9	3.8	3.5
Gewurztraminer	3.6	3.4	no fruit	3.5	3.1
Johannesburg Riesling	3.1	3.0	no fruit	3.2	2.9
Limberger	3.3	3.0	3.4	3.4	3.1
Merlot	3.3	3.3	3.6	3.4	3.7
Muscat Ottonel	3.6	3.3	no fruit	3.3	3.3
Petit Verdot	no fruit	no fruit	3.3	3.4	3.1
Pinot Blanc	3.4	3.3	no fruit	3.5	3.2
Pinot Gris	3.4	3.2	no fruit	3.6	3.3
Pinot Noir	3.4	3.0	3.2	3.7	3.5
Riesling Muscat	3.7	3.4	no fruit	3.8	3.5
Sauvignon Blanc	3.5	3.1	no fruit	3.3	2.8
Syrah	3.4	3.1	3.4	3.2	3.0
Tinta Madeira	3.4	3.1	3.3	3.3	3.0
Viognier	no fruit	3.1	no fruit	3.2	3.3
Zweigeltrebe	3.2	3.1	3.2	3.5	3.2
Continued					

Table 16 pH of Grape Varieties in Test Plantings					
Wonderland Farm			pH		
Variety	2007	2008	2009	2010	2011
Cabernet Franc	no fruit	no fruit	no fruit	no fruit	3.1
Chancellor	“	“	3.3	“	3.1
Chardonnay	“	“	no fruit	“	3.2
Cocseji Zamos	“	“	no fruit	“	3.0
Johannesburg Riesling	“	“	3.0	“	2.8
Limberger	“	“	no fruit	“	no fruit
Merlot	“	“	no fruit	“	3.1
Muscat Ottonel	“	“	no fruit	“	3.1
Riesling Muscat	“	“	3.1	“	3.4
Pinot Blanc	“	“	3.4	“	3.2
Pinot Noir	“	“	3.1	“	3.2
Sauvignon Blanc	“	“	no fruit	“	2.9
Syrah	“	“	2.7	“	no fruit
Tinta Madeira	“	“	no fruit	“	3.1
Pietila Vineyard					
Cabernet Franc	no fruit	no fruit	no fruit	no fruit	n/a
Cabernet Sauvignon	“	2.9	2.9	“	no fruit
Cocseji Zamos	“	3.1	no fruit	“	n/a
Foch	“	no fruit	no fruit	“	n/a
Gewurztraminer	“	3.4	no fruit	“	no fruit
Johannisberg Riesling	“	3.0	3.1	“	n/a
Pinot Blanc	“	3.1	3.1	“	n/a
Pinot Noir	“	no fruit	no fruit	“	no fruit
Pinot Gris	“	no fruit	no fruit	“	n/a
Syrah	“	3.3	no fruit	“	n/a

n/a=not available



Chardonnay at Pietila Vineyard Oct. 7



Riesling Muscat at Wonderland Farm Oct. 7

Table 17 Number of Days from Budbreak to Harvest at Roshard Vineyard

Variety	2008	2010	2011	average
Cabernet Franc	157	172	155	161
Cabernet Sauvignon	154	160	155	156
Chancellor	157	160	155	157
Chardonnay	155	169	155	160
Cocseji Zamatos	154	167	152	158
Foch	143	163	153	153
Gewurztraminer	150	165	160	158
Johannisberg Riesling	154	166	155	158
Limberger	159	172	160	164
Tinta Madeira	157	167	155	160
Merlot	156	158	154	156
Muscat Ottonel	157	159	154	157
Petite Verdot		169	155	162
Pinot Blanc	156	170	154	160
Pinot Gris	150	169	154	158
Pinot Noir	157	167	155	160
Riesling Muscat	108	162	155	142
Sauvignon Blanc	157	169	154	160
Syrah		158	155	160
Viognier	158	171	159	163
Zweigeltrebe	157	172	158	162

* With the exception of Foch, crops were limited. The number of days from budbreak to harvest would be greater for test varieties if crops were not limited.

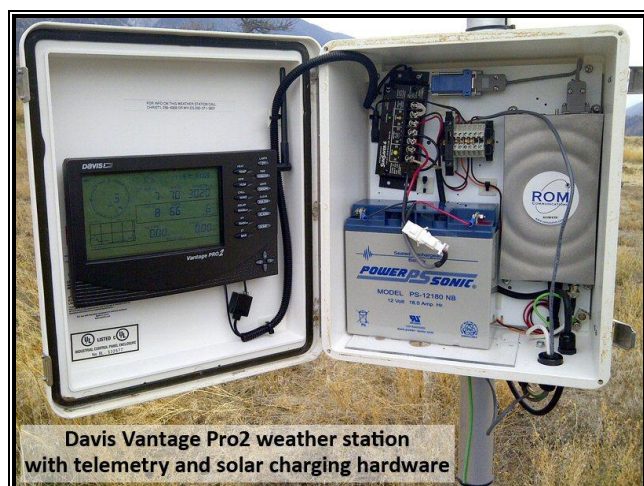


Foch grapes at Roshard Vineyard Oct. 8

Table 18 Estimated Percent Vine Maturity in Participating Vineyards October 7, 2011

Grape Variety	Vineyard		
	Roshard Vineyard	Pietila Vineyard	Wonderland Farms
	%	%	%
Cabernet Franc	90		70
Cabernet Sauvignon	80	90	80
Chancellor	90		90
Chardonnay	80	90	70
Göcseji Zamatos	90		80
Foch	90		
Gewurztraminer	90	90	70
Johannisberg Riesling	80	90	80
Limberger	90		80
Merlot	75	90	70
Muscat Ottonel	50		80
Petit Verdot	70		
Pinot Blanc	70	90	80
Pinot Gris	70		90
Pinot Noir	70	90	90
Riesling Muscat	60		90
Sauvignon Blanc	50		40
Syrah	50		60
Tinta Madeira	60		80
Viognier	70		
Zweigeltrebe	90		

All varieties are not planted at all sites.



Davis Vantage Pro2 weather station with telemetry and solar charging hardware



Instrument panel of Davis Pro 2 weather station at Half Way Ranch and Diamond- S Ranch with solar panel and wind gauge.

Table 19 Frost Free Period (Days), Growing Degree Days (GDD) and Extreme Minimum Winter Temperature at Test Vineyards

IButton Number, Test Vineyard Site And Project Weather Station	Years				
	2007*	2008	2009	2010	2011
Frost Free Period (Days)					
# 9 Wonderland Farm	187	169	169	190	178
# 12 Pietila Vineyard	188	166	169	190	178
# 85 Roshard Vineyard	M	160	167	189	175
# 87 Ruddock Ranch	M	166	169	189	178
Roshard Weather Station	M	160	169	189	154
Ruddock Ranch Weather Station	166	160	162	175	175
Growing Degree Days					
# 9 Wonderland Farm	457	1320	1621	1310	1278
# 12 Pietila Vineyard	463	1306	1612	1272	1231
# 85 Roshard Vineyard	M	1268	1607	1312	1273
# 87 Ruddock Ranch	M	1269	1553	1225	1166
Roshard Weather Station	980	1201	1597	1286	1252
Ruddock Ranch Weather Station	1261	1218	1667	1328	1306
Extreme Minimum Temperature					
# 9 Wonderland Farm	-17.7	-26.5	-22.4	-17.5	-14.2
# 12 Pietila Vineyard	-17.8	-25.7	-21.3	-16.4	-16.3
# 85 Roshard Vineyard	-16.4	-24.0	-19.3	-16.2	-15.1
# 87 Ruddock Ranch	-16.7	-23.9	-20.0	-18.1	-17.0
Roshard Weather Station	-18.3	-24.8	-19.9	-17.1	-15.7
Ruddock Ranch Weather Station	-18.0	-24.5	-20.6	-18.6	-17.9
* Climate network established Aug. to Dec. 2007. Note: Length of Frost Free Period in 2007 reflects the number of days between the last spring frost at the Lytton Environment Canada climate station and the first date of fall frost at current project data collection sites.					

Site characteristics of participating vineyards

Pietila vineyard is located in Lillooet and consists of manmade west facing terraces developed on a hillside with a 30% slope. The vineyard is at an elevation of 340m, approximately 150m above the Fraser River which is located some distance to the west. Soil at the site is gravelly, coarse textured, moderately stony, is rapidly drained and has formed in calcareous deposits.

Wonderland Farm is located approximately 12 km north of Lillooet along Highway 99 on a terrace at 340m in elevation and has a north aspect with a 10% slope. The vineyard is approximately 120m above the Fraser River. Soil at the site is developed on gravelly or coarse textured fluvio-glacial deposits with thin, loamy or sandy eolian cappings. The soil is slightly to very stony and is rapidly drained.

Roshard vineyard is located in Lillooet on a low terrace with 2 to 3% slope. The vineyard is well exposed in all directions and is at an elevation of 210m, approximately 30m above the Fraser River. Soil at the site is mainly silty loam which overlays gravel at depths. The soil is well drained and stone free.

Ruddock Ranch is located approximately 30 km north of Lytton along Highway 12. The former vineyard location sloped to the west and was at an elevation of 400m. The Fraser River is located some distance to the west. Soil at the site consists of well drained, coarse and moderately coarse textured colluvium, very stony and gravelly with a shallow loamy capping.

Table 20 Type of Weather Station, Data Loggers and Elevation at Data Collection Sites

Property Name	Station Elevation (m)	Type of Weather Station
Diamond S Ranch	445	Davis Vantage Pro 2 & iButton # 83
Grossler Farm	304	Weather Hawk & iButton # 84
Halfway Ranch	308	Davis Vantage Pro 2 & iButton # 86
Wonderland Farms	348	iButton # 9
Pietila Vineyard	349	iButton # 12
Roshard Vineyard	210	Weather Hawk & iButton # 85
Ruddock Ranch	400	Weather Hawk & iButton # 87
Hobo Pro 2 Data Loggers are located at the following iButton locations and are referred to in Tables 21 & 22 by the same iButton number. There are no iButtons at sites 88 & 89, only Hobo Pro 2.		
iButton 9	340	9 Hobo Pro 2
iButton 16	265	16 hobo Pro 2
iButton 38	243	38 Hobo Pro 2
iButton 44	520	44 Hobo Pro 2
iButton 49	200	49 Hobo pro 2
iButton 50	190	50 Hobo Pro 2
iButton 74	400	74 hobo Pro 2
iButton 83	445	83 hobo Pro 2
iButton 86	308	86 Hobo Pro 2
iButton 87	400	87 hobo Pro 2
35 km north of Lillooet on West Pavilion Rd	540	88 Hobo Pro 2
19 km south of Lillooet on Texas Creek Rd.	393	89 Hobo Pro 2

Table 21 Extreme Minimum Winter Temperatures (° C) at iButton; Hobo Pro 2 and Weather Station Locations										
iButton Number (No.), Hobo Pro 2 and Elevation (m)		Dec.	Jan.	Dec.	Jan.	Dec.	Jan.	Nov.	Feb.	Nov.
No.	m	2007	2008	2008	2009	2009	2010	2010	2011	2011
1	340	-17.3	-19.4	-24.1	-19.0	-21.0	-13.9	-16.6	-16.6	-14.3
2	190	-18.1	-17.7	-22.8	-18.3	-18.9	-14.5	-15.3	-15.5	-14.4
3	217	-17.6	-18.8	-23.7	-18.3	-19.9	-14.5	-15.4	-15.4	-14.2
4	341	-18.0	-19.4	-23.6	-18.9	-19.9	-14.4	-16.1	-16.6	-15.7
5	336	-18.3	-19.4	-23.9	-19.5	-20.5	-15.7	-16.5	-16.3	-15.6
6	328	-19.5	-21.4	-24.1	-19.9	-19.9	-13.7	-16.9	-16.0	-17.9
7	309	-17.8	-19.9	-26.3	-19.9	-22.4	-15.4	-18.1	-17.2	-14.1
8	424	-21.4	-21.5	-29.0	-22.8	-23.8	-18.4	-20.1	-19.0	-19.0
9	340	-17.7	-20.2	-26.5	-20.0	-22.4	-15.0	-17.5	-17.2	-13.7
9 Hobo Pro 2	340	n/a	n/a	n/a	n/a	-22.7	-15.0	-17.7	-14.2	M
10	315	-18.5	-19.0	-25.5	-20.3	-20.9	-15.2	-17.6	-15.9	-12.8
11	225	-16.4	-18.4	-24.2	-18.2	-20.1	-15.1	-17.1	-15.3	-12.8
12	349	-17.8	-19.6	-25.7	-19.9	-21.3	-14.2	-16.4	-16.3	-13.1
13	300	-20.4	-19.4	-25.3	-20.4	-20.3	-16.1	-16.9	-16.6	-17.1
14	271	-18.2	-18.1	-22.2	-18.7	-18.9	-14.7	-15.3	-15.6	-14.6
15	297	-18.0	-18.2	-22.4	-18.2	-19.2	-14.2	-15.2	-16.0	-13.6
16	263	-19.2	-18.8	-23.8	-19.0	-20.1	-13.9	-16.9	-17.7	-15.5
16 Hobo Pro 2	265	n/a	n/a	n/a	n/a	-20.1	-14.6	-16.7	-14.0	M
17	297	-19.3	-18.8	-23.5	-19.0	-19.4	-14.5	-17.2	-16.1	-14.6
18	339	-17.7	-19.1	-23.2	-18.6	-19.4	-14.6	-16.9	-16.3	-17.1
19	316	-17.7	-18.8	-23.5	-18.7	-19.7	-14.1	-16.6	-16.6	-14.9
20	241	-17.7	-18.0	-22.6	-18.0	-18.6	-13.9	-15.9	-16.0	-14.6
21	267	-17.0	-18.4	-23.6	-18.6	-19.6	-14.2	-15.9	-16.0	-13.9
22	284	-20.1	-20.5	-26.3	-20.7	-20.9	-15.3	-17.2	-17.7	-15.2
23	200	-18.2	-18.9	-24.2	-18.7	-19.6	-14.6	-16.1	-16.1	-14.6
24	369	-17.2	-18.9	-23.7	-18.9	19.9	-13.0	-16.7	-17.3	-14.8
25	375	-17.3	-19.6	-24.4	-19.3	-20.5	-13.7	-16.7	-17.2	-15.0
26	352	-17.8	-18.8	-23.5	-18.5	-19.5	-13.5	-16.5	-16.7	-14.9
27	318	-17.6	-18.7	-23.4	-18.6	-19.9	-13.9	-16.6	-16.8	-14.7
28	375	-22.5	-21.8	-29.1	-22.5	-21.7	-16.0	-22.9	-20.0	-15.7
29	385	-21.9	-21.9	-28.6	-22.1	-21.8	-15.1	M	-18.6	-14.8
30	405	-18.6	-20.9	-27.6	-21.3	-23.2	-15.7	-18.7	-18.7	-15.3

Continued

Table 21 Extreme Minimum Winter Temperatures (° C) at iButton; Hobo Pro 2 and Weather Station Locations										
iButton Number (No.), Hobo Pro 2 and Elevation (m)		Dec.	Jan.	Dec.	Jan.	Dec.	Jan.	Nov.	Feb.	Nov.
No.	m	2007	2008	2008	2009	2009	2010	2010	2011	2011
31	413	-18.8	-21.3	-28.2	-21.6	-23.5	-15.5	-18.7	-18.7	-15.8
32	238	-17.2	-18.6	-24.8	-19.1	-20.6	-14.8	-16.8	-15.6	-13.2
33	255	-16.6	-17.3	-22.2	-17.1	-18.6	-14.2	-15.2	-15.9	-14.4
34	264	-16.3	-17.0	-22.5	-17.4	-18.3	-13.4	-15.0	-15.3	-13.6
35	310	-16.3	-17.6	-23.2	-17.5	-19.2	-13.5	-15.6	-15.9	-13.7
36	415	-16.9	-19.2	-24.1	-18.5	-20.0	-13.5	-17.5	-16.4	-14.2
37	352	-16.5	-18.6	-23.5	-18.3	-19.5	-12.9	-17.2	-16.5	-15.0
38	243	-14.6	-17.4	-24.1	-17.2	-19.2	-10.7	-17.2	-17.3	-14.2
38 Hobo Pro 2	243	n/a	n/a	n/a	n/a	-19.2	-10.9	-17.0	-11.1	M
39	265	-14.8	-17.6	-24.3	-17.8	-19.1	-11.0	-17.3	-17.4	-14.5
40	266	-15.3	-16.9	-24.3	-17.5	-18.8	-11.5	-16.0	-15.1	-13.8
41	287	-15.2	-17.3	-23.7	-17.3	-19.6	-10.7	-17.9	-16.5	-12.7
42	255	-15.3	-16.9	-23.4	-17.3	-19.1	-13.3	-16.0	-15.8	-14.9
43	240	-15.3	-16.9	-23.9	-17.9	-18.7	-11.7	-16.4	-15.7	-14.4
44	520	-17.6	-21.6	-23.3	n/a	-24.2	-14.0	-21.6	-19.9	-14.8
44 Hobo Pro 2	520	n/a	n/a	n/a	n/a	-23.8	-13.8	-22.4	-16.1	M
45	412	-18.0	-20.0	-24.3	-19.6	-20.8	-13.2	-16.3	-16.7	-14.4
46	285	-18.1	-19.3	-24.6	-19.3	-20.7	-14.5	-15.9	-16.9	-14.9
47	256	-17.0	-18.9	-23.4	-18.2	-19.6	-13.6	-15.6	-15.6	-13.7
48	210	-16.9	-18.1	-23.2	-18.0	-19.2	-14.0	-15.0	-14.8	-13.7
49	196	-17.7	-18.6	-23.6	-18.6	-19.1	-13.9	-15.2	-15.2	-14.2
49 Hobo Pro 2	200	n/a	n/a	n/a	n/a	-19.2	-14.0	-15.1	-12.8	M
50	190	-15.9	-17.0	-22.7	-17.5	-18.4	-10.2	-17.1	-16.6	-13.9
50 Hobo Pro 2	190	n/a	n/a	n/a	n/a	-18.6	-10.5	-16.3	-11.0	M
51	175	-16.1	-17.6	-23.4	-16.9	-19.4	-13.2	-16.6	-16.3	-15.4
52	157	-16.3	-17.5	-23.3	-16.9	-19.1	-12.2	-16.6	-16.8	-15.1
53	348	-18.9	-20.0	-25.4	-20.0	-20.7	-16.4	-16.4	-16.4	-15.5
54	353	-18.2	-19.9	-24.7	-19.4	-20.6	-15.0	-16.5	-16.4	-14.5
55	364	-17.6	-19.9	-24.8	-19.2	-21.1	-14.9	-16.8	-16.8	-15.8
56	364	-17.3	-20.0	-25.3	-19.8	-21.5	-14.5	-16.5	-16.6	-15.4
57	416	-17.4	-20.1	-25.1	-19.9	-21.3	-13.3	-16.5	-16.5	-14.3
58	382	-17.3	-20.2	-24.6	-18.9	-20.9	-13.5	-16.6	-16.8	-14.2
59	302	-20.0	-19.5	-24.8	-20.0	-19.6	-15.5	-17.8	-15.7	-16.9
Continued										

Table 21 Extreme Minimum Winter Temperatures (° C) at iButton; Hobo pro 2 and Weather Station Locations										
iButton Number (No.), Hobo Pro 2 and Elevation (m)		Dec.	Jan.	Dec.	Jan.	Dec.	Jan.	Nov.	Feb.	Nov.
No.	m	2007	2008	2008	2009	2009	2010	2010	2011	2011
60	402	-22.5	-22.9	-28.9	-22.4	-23.4	-17.2	-19.2	-19.7	-16.1
61	158	-15.1	-17.4	-24.1	-17.6	-19.4	-14.5	-16.7	-16.1	-15.8
62	250	-16.2	-16.6	-22.5	-17.2	-18.3	-13.4	-15.2	-15.5	-13.9
63	275	-16.2	-17.1	-22.8	-17.2	-18.4	-13.3	-15.7	-15.6	-14.0
64	250	-16.3	-17.6	-23.4	-17.0	-19.8	-10.6	-16.1	-15.6	-13.7
65	274	-17.3	-19.4	-24.1	-18.3	-21.4	-12.8	-18.2	-16.9	-14.2
66	200	-16.6	-16.7	-22.9	-17.3	-18.8	-13.4	-15.8	-15.9	-13.7
67	275	-16.9	-17.7	-22.9	-17.7	-18.7	-13.4	-16.0	-16.2	-13.9
68	302	-16.7	-18.0	-23.6	-18.4	-19.1	-13.9	-16.0	-15.7	-14.4
69	288	M	-19.2	-25.4	-20.6	-19.9	-16.7	-18.3	-15.8	-17.2
70	277	-18.4	-19.1	-24.4	-19.6	-19.4	-17.5	-17.0	-15.6	-15.5
71	318	-17.1	-19.1	-23.6	-18.9	-19.7	-13.8	-16.1	-16.2	-14.3
72	407	-19.8	-21.8	-28.0	-21.1	-23.6	-15.3	-19.5	-19.1	-15.0
73	572	-20.2	-24.6	-29.1	-22.7	-25.6	-16.1	-22.1	-21.3	-15.4
74	400	-21.1	-22.9	-30.1	-23.8	-26.0	-16.9	-19.2	-19.8	-16.1
74 Hobo Pro 2	400	n/a	n/a	n/a	n/a	-26.3	-16.7	-19.9	-17.7	M
75	285	-19.9	-21.8	-29.1	-22.0	-24.9	-16.0	-17.6	-18.4	-15.6
76	490	-20.3	-23.0	-31.4	-24.0	-26.9	-16.9	-19.7	-20.1	-16.9
77	510	-22.6	-23.9	-30.3	-24.3	-27.2	-16.7	-20.7	-20.5	-17.0
78	465	-20.8	-23.0	-31.1	-24.4	-27.1	-16.8	-19.7	-20.9	-16.9
79	428	-21.7	-22.5	-30.4	-24.0	-27.3	-16.7	-19.4	-20.2	-16.6
80	222	-17.4	-17.3	-22.1	-17.8	-18.5	-13.7	-15.5	-15.9	-13.3
81	182	-17.3	-16.8	-21.4	-17.1	-17.8	-13.5	-15.0	-15.2	-13.1
82	300	-17.1	-19.4	-24.7	-20.6	-20.7	-16.3	-18.7	-16.0	-16.1
83	445	-19.4	-21.5	-20.0	M	-24.2	-15.2	-19.2	-18.7	-15.0
83 Hobo Pro 2	445	n/a	n/a	n/a	n/a	-24.5	-15.7	-19.0	-15.8	M
84	304	-18.0	-18.9	-24.9	-19.2	-20.8	-15.2	-18.2	-15.8	-13.0
85	210	-16.4	-18.1	-24.0	-18.8	-19.3	-14.8	-16.2	-15.1	-12.8
86	308	-19.2	-18.9	-24.8	-19.5	-19.6	-14.1	-17.2	-17.0	-15.4
86 Hobo Pro 2	308	n/a	n/a	n/a	n/a	-19.8	-15.1	-17.5	-14.2	M
87	400	-16.7	-18.9	-23.9	-18.2	-20.0	-12.2	-18.1	-17.0	-14.6
87 Hobo Pro 2	400	n/a	n/a	n/a	n/a	-17.8	-12.4	-16.7	-13.5	M

Continued

Table 21 Extreme Minimum Winter Temperatures (° C) at iButton; Hobo Pro 2 and Weather Station Locations

iButton Number (No.), Hobo pro 2 and Elevation (m)		Dec.	Jan.	Dec.	Jan.	Dec.	Jan.	Nov.	Feb.	Nov.
No.	m	2007	2008	2008	2009	2009	2010	2010	2011	2011
88 Hobo Pro 2	540	n/a	n/a	n/a	-20.4	n/a	-15.2	-16.4	-14.7	M
89 Hobo Pro 2	393	n/a	n/a	n/a	-14.8	n/a	-4.4	-14.0	M	M
Project and Environment Canada Weather Stations										
Grossler	304	-19.7	-19.7	-26.0	-19.9	-21.2	-16.6	-18.8	-16.1	-13.4
Ruddock	400	-18.0	-19.6	-24.5	-19.00	-20.6	-14.0	-18.6	-17.9	-15.5
Roshard	210	-18.3	-19.2	-24.8	-19.00	-19.9	-15.7	-17.1	-15.7	-13.5
Diamond S	445	-19.3	-14.4	-27.4	M	-23.6	-14.7	-18.4	M	M
Halfway Ranch	308	-17.9	-18.6	M	-19.5	-19.7	M	-16.4	-17.2	-14.4
Lillooet	235	-17.5	-18.5	-24.6	-19.0	-20.1	-15.0	-16.2	-16.1	-13.0
Lytton	225	-16.0	-16.7	-23.5	-17.3	-18.8	-11.1	-15.7	-15.5	-13.4
n/a means not available. M means missing data										



Reaction ferry on the Fraser River near Big Bar Creek used to access project climate stations on the east side of the river during the summer months. Access to the climate network on the east side of the river during winter months requires a 330 km return detour.

Table 22 Total Growing Degree Days (GDD)¹ and Length of Frost Free Season at iButton; Hobo Pro 2 and Weather Station Locations

iButton Number (No.), Hobo Pro 2 and Elevation (m)		Growing Degree Days ¹ Corrected Data (Base 10°C)					Length of Frost Free Period (Days)				
No.	m	2007*	2008	2009	2010	2011	2007*	2008	2009	2010	2011
1	340	475	1310	1708	1420	1311	188	169	169	189	178
2	190	364	1055	1302	1088	991	188	166	169	189	174
3	217	411	1206	1492	1196	1146	188	169	169	189	175
4	341	414	1148	1458	1179	1114	188	169	169	189	175
5	336	403	1108	1398	1131	1131	188	169	167	177	175
6	328	362	1065	1338	1015	976	188	166	169	189	178
7	309	463	1403	1682	1381	1371	188	171	178	189	178
8	424	425	1244	1550	1261	1205	187	158	158	160	173
9	340	457	1320	1621	1310	1278	187	169	169	190	178
9 Hobo Pro 2	340	n/a	n/a	1610	1312	M	n/a	n/a	169	190	M
10	315	472	1282	1579	1239	1227	187	160	167	188	173
11	225	471	1306	1586	1299	1300	188	166	165	188	174
12	349	463	1306	1612	1271	1231	188	166	169	190	178
13	300	357	1175	1526	1203	1167	188	166	152	160	173
14	271	388	1286	1604	1312	1242	188	166	169	189	178
15	297	404	1289	1580	M	1229	188	166	166	189	178
16	263	M	1131	1450	1153	1075	M	166	167	189	175
16 Hobo Pro 2	265	n/a	n/a	1394	1152	M	n/a	n/a	167	189	M
17	297	383	1197	1493	1176	1144	188	166	167	190	175
18	339	392	1247	1528	1170	1146	188	166	169	189	175
19	316	381	1229	1522	1205	1178	188	166	169	189	175
20	241	416	1295	1654	M	1176	188	166	169	190	175
21	267	376	1278	1615	1288	1218	188	169	167	189	174
22	284	358	1220	1530	1221	1174	188	160	165	164	173
23	200	376	1252	1573	1341	1238	188	166	167	189	174
24	369	385	1296	1596	1264	1229	188	169	169	189	178
25	375	M	1291	1563	1230	1196	M	166	169	189	178
26	352	M	1266	1546	1223	1184	M	169	169	189	175
27	318	392	M	1589	1282	1266	188	169	169	189	175
28	375	206	1141	1423	1135	1068	175	160	159	160	173
29	385	201	1131	1442	1124	1104	175	159	160	160	173
30	405	227	1202	1493	1165	1166	188	166	169	163	173

Continued

Table 22 Total Growing Degree Days (GDD) ¹ and Length of Frost Free Season at iButton; Hobo Pro 2 and Weather Station Locations

iButton Number (No.), Hobo Pro 2 and Elevation (m)		Growing Degree Days ¹ Corrected Data (Base 10°C)					Length of Frost Free Period (Days)				
No.	m	2007*	2008	2009	2010	2011	2007*	2008	2009	2010	2011
31	413	250	1291	1557	1283	1255	188	169	169	160	174
32	238	277	1324	1639	1354	1321	175	166	165	190	174
33	255	291	1247	1534	1243	1277	175	168	169	175	175
34	264	305	1321	1605	1321	1283	188	168	169	189	175
35	310	301	1318	1613	1272	1227	175	169	169	189	178
36	415	269	1222	1471	1218	1222	188	169	169	189	178
37	352	280	1249	1537	1218	1184	188	169	169	189	175
38	243	263	1352	1630	1333	1313	188	166	169	189	175
38 Hobo Pro 2	243	n/a	n/a	1577	1356	M	n/a	n/a	169	189	M
39	265	256	1315	1598	1274	1254	175	166	169	189	175
40	266	271	1280	1569	1259	1219	189	172	169	221	192
41	287	286	1364	1582	1288	1251	188	172	170	190	179
42	255	275	1308	1603	1305	1286	188	166	169	189	176
43	240	M	1236	1495	1198	1186	M	169	169	215	192
44	520	205	921	1190	888	859	188	159	M	148	154
44 Hobo Pro 2	520	n/a	n/a	1179	909	M	n/a	n/a	M	148	M
45	412	240	1184	1477	1180	1103	188	169	169	189	178
46	285	229	1166	1510	1181	1147	188	166	167	189	174
47	256	275	1285	1609	1310	1263	188	171	169	189	178
48	210	190	1220	1549	1261	1223	188	171	167	189	175
49	196	202	1311	1642	1379	1275	188	166	167	189	174
49 Hobo Pro 2	200	n/a	n/a	1593	1436	M	n/a	n/a	167	189	M
50	190	235	1308	1565	1312	1306	188	160	167	188	175
50 Hobo Pro 2	190	n/a	n/a	1499	1292	M	n/a	n/a	167	189	174
51	175	225	1233	1526	1263	1247	187	160	167	144	184
52	157	247	1298	1590	1286	1280	187	160	160	174	175
53	348	203	1089	1439	1066	1179	188	166	165	174	175
54	353	201	1130	1698	1252	1202	188	166	169	189	174
55	364	215	1164	1579	1162	1069	188	166	169	189	174
56	364	210	n/a	1516	1163	1119	188	166	169	190	178
57	416	218	1166	1450	1160	1115	188	169	169	184	177
58	382	161	1225	1561	1259	1196	188	169	189	190	174
59	302	151	1154	1476	1127	1134	188	166	160	163	174

Continued

PROGRESS REPORT 2011

Table 22 Total Growing Degree Days (GDD) ¹ and Length of Frost Free Season at iButton; Hobo Pro 2 and Weather Station Locations											
I Button Number (No.), Hobo Pro 2 and Elevation (m)		Growing Degree Days ¹ Corrected Data (Base 10°C)					Length of Frost Free Period (Days)				
No.	m	2007*	2008	2009	2010	2011	2007*	2008	2009	2010	2011
60	402	132	1128	1423	1073	1061	187	158	160	160	154
61	158	139	1321	1599	1310	1258	188	160	160	174	174
62	250	133	1272	1566	1240	1222	188	166	169	189	175
63	275	128	1250	1537	1240	1222	188	169	169	189	176
64	250	136	1278	1575	1311	1254	188	166	167	214	179
65	274	475	1310	1586	1293	1256	188	169	169	188	175
66	200	136	1315	1609	1323	1248	188	122	169	189	175
67	275	127	1258	1579	1344	1260	188	169	169	189	178
68	302	62	M	1540	1346	1264	188	169	169	189	175
69	288	50	1224	1555	1206	1178	188	166	160	160	173
70	277	51	1160	1449	1105	1101	142	160	165	163	173
71	318	52	M	1594	1253	1193	188	169	169	189	178
72	407	39	1318	1554	1256	1218	175	169	169	189	176
73	572	24	1085	1356	1017	998	187	162	162	163	174
74	400	58	1397	1656	1380	1317	188	171	189	190	178
74 Hobo Pro 2	400	n/a	n/a	1552	1333	M	n/a	n/a	189	190	M
75	285	76	1468	1729	1503	1424	188	171	169	190	176
76	490	62	1361	1570	1314	1263	188	171	164	166	175
77	510	55	1312	1544	1255	1172	188	171	178	166	177
78	465	63	1383	1577	1353	1264	188	171	177	189	177
79	428	67	1393	1646	1359	1283	188	171	169	166	176
80	222	35	1345	1668	1359	1307	188	166	169	189	175
81	182	34	1302	1611	1306	1264	188	171	169	189	178
82	300	66	1240	1578	1266	1205	175	161	160	160	154
83	445	0	1304	1524	1254	1233	M	171	M	190	176
83 Hobo Pro 2	445	n/a	n/a	1444	1250	M	n/a	n/a	M	190	M
84	304	0	1304	1613	1323	1293	M	160	160	160	173
85	210	0	1268	1607	1312	1273	M	160	167	189	175
86	308	0	1292	1621	1248	1182	M	166	169	189	175
86 Hobo Pro 2	308	n/a	n/a	1551	1274	M	n/a	n/a	169	189	M
87	400	0	1269	1553	1225	1166	M	166	169	189	178
87 Hobo Pro 2	400	n/a	n/a	1519	1241	M	n/a	n/a	169	189	M

Continued

Table 22 Total Growing Degree Days (GDD) 1 and Length of Frost Free Season at iButton; Hobo Pro 2 and Weather Station Locations

iButton Number (No.), Hobo Pro 2 and Elevation (m)		Growing Degree Days ¹ Corrected Data (Base 10°C)					Length of Frost Free Period (Days)				
No.	m	2007*	2008	2009	2010	2011	2007*	2008	2009	2010	2011
88 Hobo Pro 2	540	n/a	n/a	1393	1084	M	n/a	n/a	M	189	M
89 Hobo Pro 2	393	n/a	n/a	1342	1106	M	n/a	n/a	M	163	M
Project and Environment Canada Weather Stations											
Grossler	304	1236	1215 **	1573	1351	1327	M	160	160	160	154
Ruddock	400	1261	1218**	1667	1328	1306	M	160	162	175	175
Roshard	210	980	1201**	1597	1286	1252	166	160	169	189	154
Diamond S	445	129	1264**	1503	1255	M	M	171	189	190	M
Halfway Ranch	308	136	1206**	1517	1231	1176	M	166	169	189	175
Lillooet	235	M	1333	1651	1351	1313	M	166	167	189	175
Lytton	225	1335	1301	1644	1285	1282	205	168	169	214	192

* Partial data. IButtons installed in late 2007. ** Missing data. IButton data used. M means missing data. n/a means not available.

¹Includes a few GDD from March.

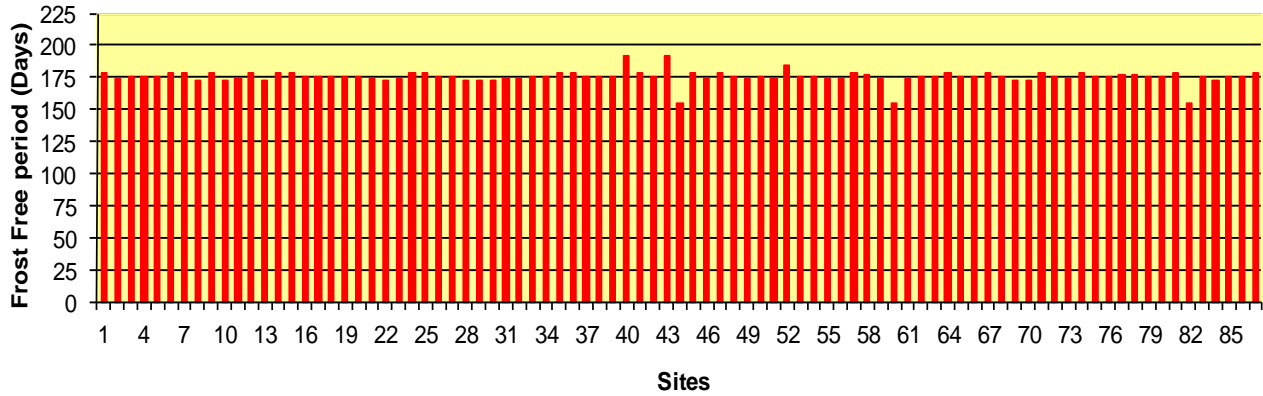
Note: Length of Frost Free Period in 2007 reflects the number of days between the last spring frost at the Lytton Environment Canada climate station and the first date of fall frost at project iButtons.



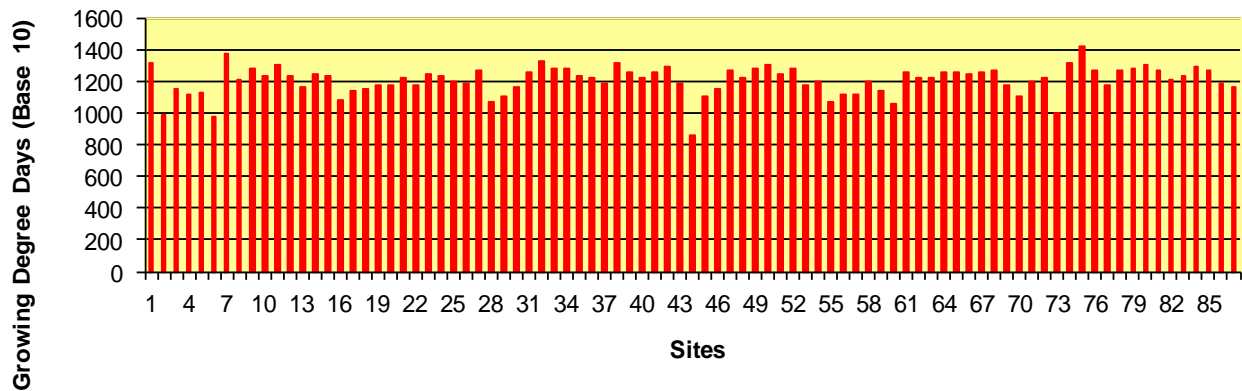
Protection of iButtons from wild life and domestic animals was required at many locations.

GRAPHS

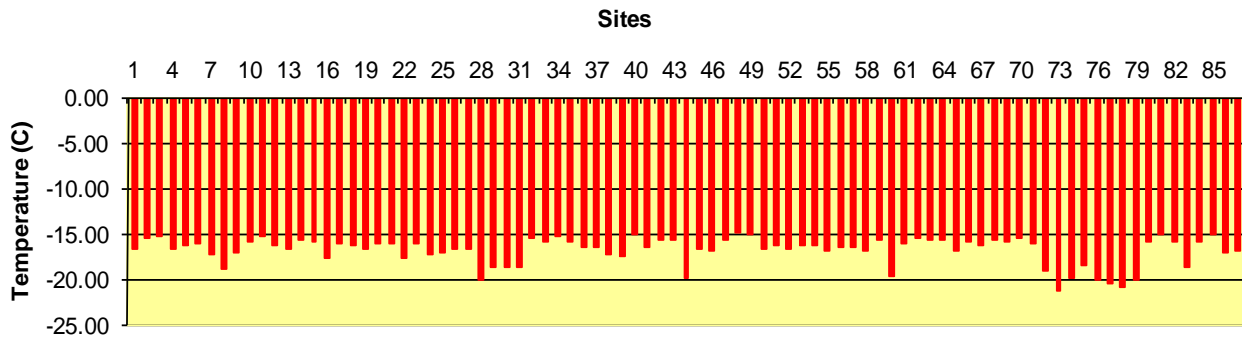
Graph 1. Frost Free Period (Days) at iButton Sites 1-87, 2011



Graph 2. Total Growing Degree Days at iButton Sites 1-87, 2011



Graph 3. Extreme Minimum Winter Temperatures (C) at iButton Sites 1-87, February, 2011

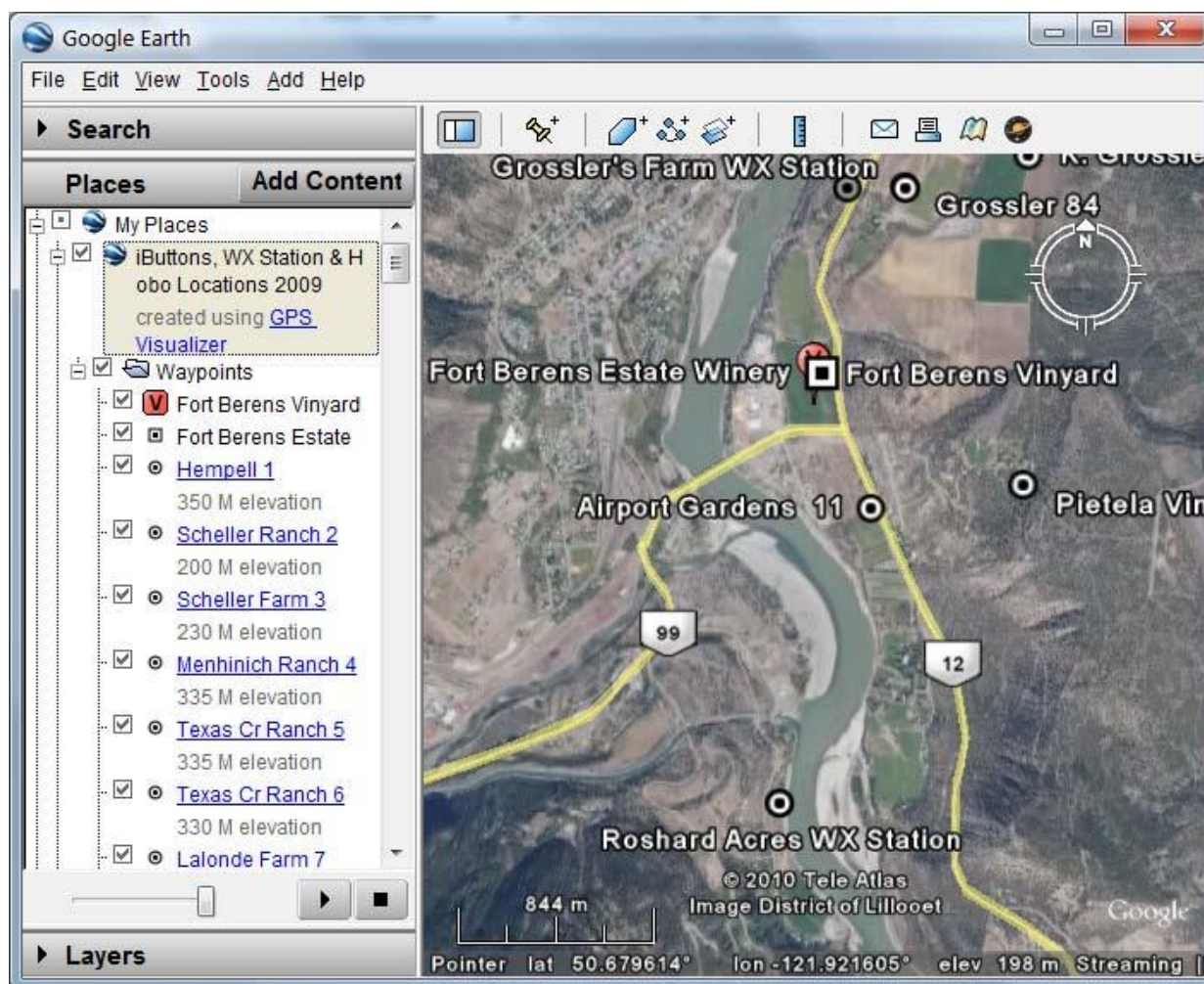


MAP OF PROJECT STUDY AREA

iButton and Weather Station locations – Google Earth Maps

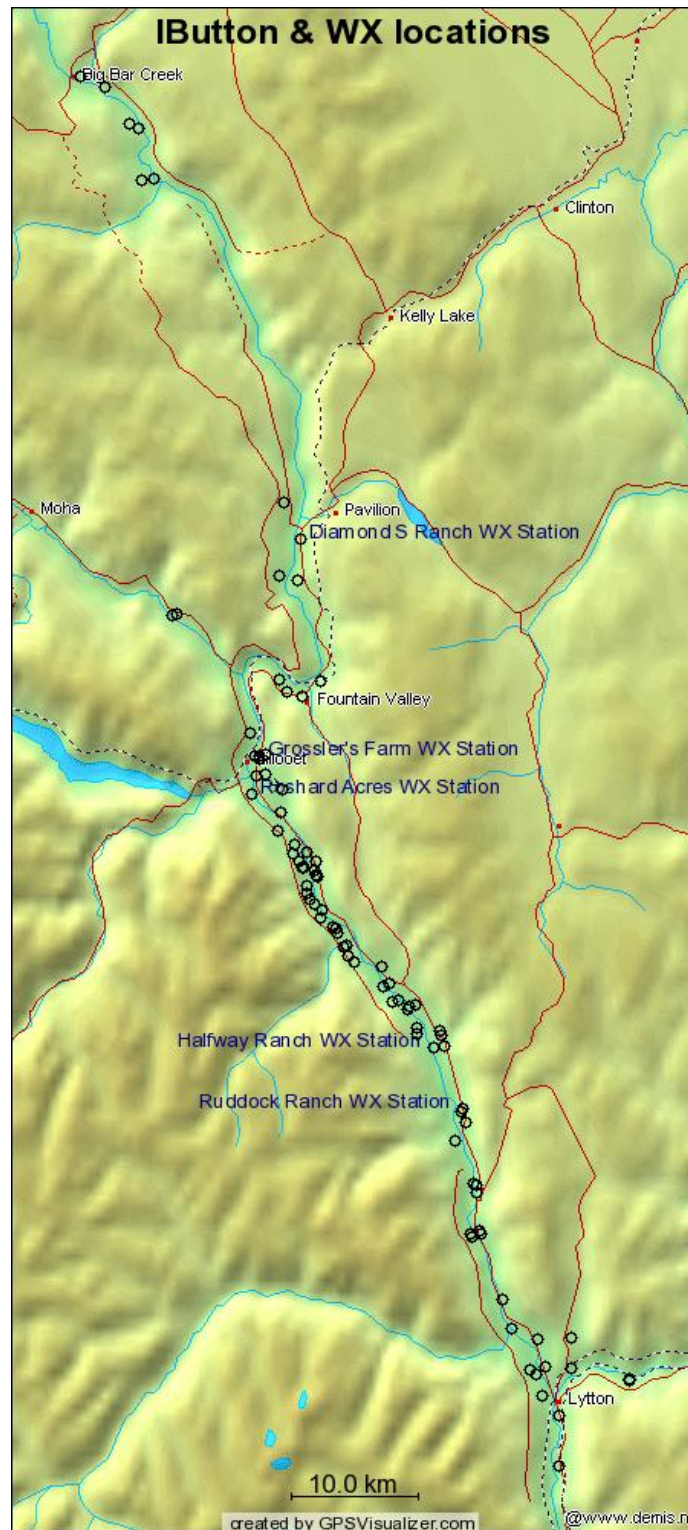
A data set has been created that allows users of Google Earth to interactively view the weather stations, Hobo & iButton temperature data loggers, and test vineyard locations. Using Google Earth you are able to see the locations, find the latitude, longitude and elevation of a point of interest, and better understand the topography and geography of the area. To download and install Google Earth click on this link <http://earth.google.com/download-earth.html> and follow the instructions.

Once you have Google Earth running on your computer, open the file “iButtons.kmz” (which can be downloaded from either the Village of Lytton or District of Lillooet websites) with Google Earth. In “My Places” expand the icon titled ‘iButtons, WX Station & Hobo Locations 2009’, expand the “Waypoints” folder and then click on the iButton number or weather station location of interest.



A portion of the study area on Google Earth showing several locations with a weather station, several iButton locations and the side bar with iButton locations.

PROJECT STUDY AREA IN THE LILLOOET-LYTTON AREA



SOLAR RADIATION MAPS

Maps to support decision making in agriculture, energy and natural resource management.

Lillooet - Lytton Maps

This series of 36 maps has been produced in support of developing a “Climate and Feasibility Assessment of Growing Wine Grapes in the Lillooet-Lytton Area, British Columbia” – a research partnership that includes the British Columbia Grapegrowers' Association, local property owners, Investment Agriculture Foundation of BC, and local, provincial and federal agencies. Further information on this project can be found on web sites of: District of Lillooet <http://www.lillooetbc.com/business.aspx>

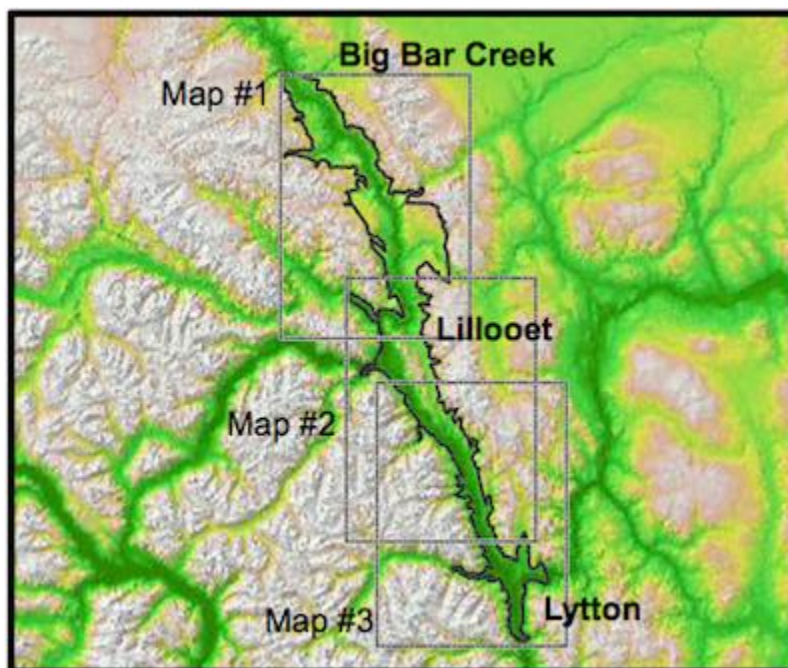
Village of Lytton: <http://www.lytton.ca/siteengine/activepage.asp?PageID=78>

British Columbia Grapegrowers' Association: <http://www.grapegrowers.bc.ca>

Fraser Basin Council: http://www.fraserbasin.bc.ca/publications/fbc_reports.html

British Columbia Ministry of Agriculture:

<http://www.al.gov.bc.ca/grape/factsheets.htm>www.grapegrowers.bc.ca



These maps are in jpeg and pdf format and are designed to be plotted on 34 by 44 inch paper. This will result in a map at 1:50,000 scale. Three map sheets are required to show the extent of the study area. A set of three maps has been prepared for each month. [A large zip file \(33 Mb\) containing all 36 pdf files is available for download.](#) Use the drop-down menu to download these maps.