CLIMATE CHANGE ADAPTATION PROGRAM

BC Peace Agri-Weather Network & Monitoring Enhancement

Funding for this project has been provided by the Governments of Canada and British Columbia through the Canadian Agricultural Partnership, a federal-provincial-territorial initiative. Additional funding has been provided by BC Hydro and Northern Development Initiative Trust. The program is delivered by the Investment Agriculture Foundation of BC.

Northern Development Initiative Trust

BC Hydro Power smart

Delivered by: Investment Agriculture Foundation

Funding provided by: Canadian Agricultural Partnership; British Columbia; Canada

BC PEACE AGRI-WEATHER NETWORK & MONITORING ENHANCEMENT

Final Report – February 2022

Prepared by PEAK HydroMet Solutions

Overview

The BC Peace Agri-Weather Network continues to provide valuable weather information for both agricultural and non-agricultural stakeholders in the BC Peace region. Over the past several years, the network has evolved to a point where its operation has become stable and consistent. This allows for a somewhat predictable forecast of resource allocation and budget. At the same time, there remain some unknowns about how the program will be structured in the future with regards to administration and operation. Currently, the program is administered by the Peace Region Forage Seed Association (PRFSA). The following report provides a brief update of the program and some direction for the upcoming season.

Updates

The following lists some of the main changes and enhancements that were made to the data flow and web components of the program:

Website User Experience: Many aspects of the website were redesigned to improve clarity and ease of use. Some of the changes included clearer labeling, a more intuitive map, improvements to the charts, and the ability to sort tables by various parameters. There were also certain nonfunctioning elements that were fixed.

Data Handling: Previously there were discrepancies in rainfall between the raw station measurements and what the website was reporting. A full revamp of the data ingestion process was completed, including switching to the newest version of the Davis Instruments application programming interface (API), the portal from which the weather data gets retrieved. This solved the data issue and improved the reliability of the retrieval process. The historical data was re-imported so that all records are now consistent.

Gridded Weather Forecast: Instead of the previous regional forecast that did not account for any sort of local variability, a gridded forecast was implemented. This feature provides a forecast that is specific to the location of the weather station, providing improved spatial resolution.

Summaries and Normals: In the Historical and growing degree days (GDD) sections of the website, data summary sections were added. When the user queries a certain station over a defined date range, the summary shows the actual accumulations, the long-term normals, and the percent of normals. This feature provides a simple way to compare a certain period to climatic averages.

Growth Stages: In addition to providing accumulations of GDD, growth stage estimates for canola, wheat, and barley were added. This provides an indication of the phenological stages of these crops based on a user-defined planting date.

How-to-Videos: Short videos that describe some of the main features and functionality of the website were recorded and added as links in the User Guide. Videos include *Introduction to Features and Functions*, *Historical Weather Data, Accessing and Interpreting Forecasts, Fusarium Head Blight Risk,* and *Registering and Weather Alerts.* These videos are also available directly from the BC Climate Change Adaptation Program YouTube channel.

Web Traffic

Since September 2020, Google Analytics has been in place to monitor and provide reporting of web traffic. During the 2021 growing season (May 1 through September 30), 798 users were recorded with a total of 2,618 pageviews (Figure 1). Continued web monitoring will provide a good indication of usership and trends.

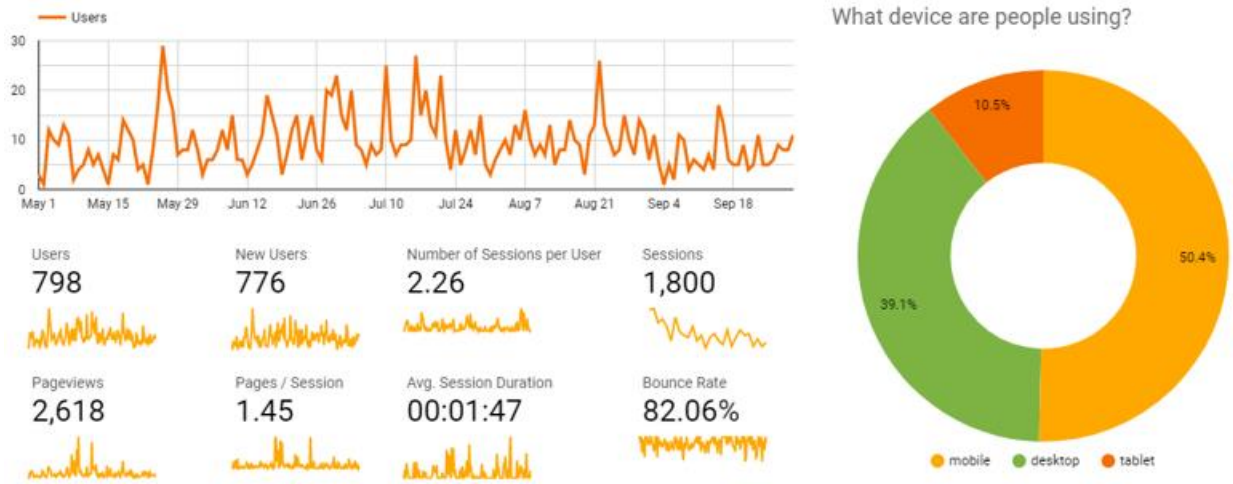

Figure 1:Google analytics web traffic and device use. May 1 through September 30, 2021

Another insight of interest from Google Analytics is that most users are accessing the site using mobile devices. Desktop computers make up only 39% of the users while mobile phones and tablets make up 61%. While the website has a responsive design, meaning that the content adjusts smoothly to various screen sizes, this highlights the importance of optimizing the application for mobile functionality. It may even justify considering offering a mobile app in the future.

Network Servicing, Maintenance, & Operation

Weather stations require regular servicing and maintenance to ensure their proper operation. A scheduled spring maintenance visit should be planned to ensure that each station is in good working condition for the upcoming season. A typical spring maintenance visit should include a site and equipment inspection, cleaning of instruments, and calibration of the rain gauge. Any site parameters or equipment concerns should be corrected.

The main costs associated with network operation are time, travel, and parts. These costs vary substantially, depending on the performance of the stations, how many station visits are needed, and the components that need replacing. In 2020, labour and travel costs were over $6,000. In 2021, they were less than half that amount. Likewise, tools, supplies, and equipment cost over $4,000 in 2020 yet under $1,000 in 2021. Given that the network is aging, a higher rate of equipment failure is expected. This will require more service visits and additional equipment replacements. In addition, certain components should be replaced at regular intervals. For example, the temperature/relative humidity sensors should be replaced every two to three years. The proposed budget reflects this.

The network servicing and oversight has been performed by Keith Uloth, who also works with the region's pest monitoring program. This combined role has allowed certain efficiencies as some of the travelling to field sites can be combined with station visits. This has saved the program in contractor costs and in travel expenses. Funding for the pest monitoring program has been secured until the end of 2022, which is expected to allow this dual-role arrangement to continue for another season. The continuation of the pest monitoring program after 2022 is not guaranteed. If the pest program were to be discontinued, a new network technician would need to be recruited and trained. The costs associated with network maintenance would therefore increase.

Data subscriptions through Davis Instruments are another necessary cost. Having the station communicate through cellular connection is more expensive but is more stable than using residential internet connections. For the entire network, the annual Davis subscription cost is approximately $3,600. This provides both the communications and the platform (Davis WeatherLink) from which the data is retrieved for the website. As new technologies become available, there should be continued investigation into viable alternatives to the Davis WeatherLink system that may be more economical while providing a high level of reliability.

Station Metadata

Whenever changes are made to station location, exposure of sensors, instrumentation, methods of calculation, or when the immediate area has been altered, this can affect the measurements. Having a proper description for every station is critical to identify and explain any abnormalities that may exist in the data. Even station maintenance, calibrations, and repairs must be recorded. Metadata (data about data) should be kept concerning anything that may influence the data that is being collected.

British Columbia is in the process of implementing a Canadian Metadata Standard for Hydrometeorological Monitoring Stations. This national standard recommends best practices that follow the World Meteorological Organization (WMO) protocols to accurately describe the conditions under which an observation or measurement was made. The standard recommends that the metadata for any hydrometeorological station in Canada be published to a central repository. Currently, the BC Peace Agri Weather Network station information is maintained within a Dropbox folder that is accessible to those overseeing the network. As the BC standard becomes formalized, the BC Peace Network should work towards integrating the station metadata.

Data Quality Control

Data quality control (QC) is necessary to identify potential problems with the measurements so that they can be addressed. Over the past season, some basic data QC has been implemented whereby the network operators can view time-series charts and daily summaries to easily identify any anomalies in the measurements. For example, the chart in Figure 2 shows the 24-hour temperature trends for a group of stations. The user can identify an obvious issue with the temperature at Lone Prairie as the plotted values abruptly rise, plateau, then subsequently drop. Such errors can be flagged for further investigation.

These charts and summaries are generated automatically and are accessible by web link. Alerts and notifications can also be configured to send an email/text when data is delayed or if certain conditions are met. The system that is currently in place queries data from Davis WeatherLink independently of Big Bear's system. This platform can continue to be maintained by Peak HydroMet to provide ongoing data quality control and support.

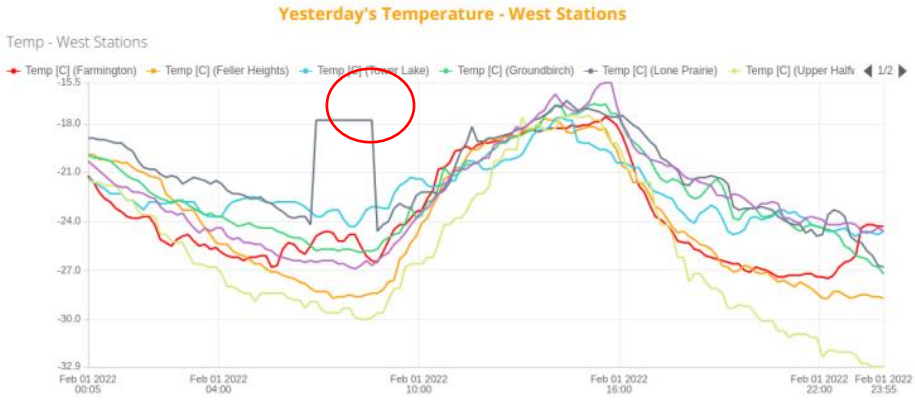

Figure 2: Example time-series temperature plot to identify data anomalies

Web Hosting

The website was built and continues to be hosted by Big Bear Software. In 2020, Big Bear implemented new categories of service that include Hosting, Support and Maintenance, and Sustainment. These categories of service are broken into the following components.

- **Cloud Hosting Administration and Management (HAM)** - Management of the cloud services that are used to host the software. Includes resolving incidents related to its configuration. ~$50/month
- **Application Support and Maintenance (ASM)** - Addresses incidents related to the application, including anything that prevents it from working as designed. Also ensures the application is appropriately patched from a security and interoperability perspective. ~$100/month
- **Application Sustainment** - Application sustainment is an add-on to ASM that provides a bundle of hours at a discounted rate to be used towards enhancing or changing the functionality of the application. The three levels of ASM are Gold ($16,000), Silver ($9,600), and Bronze ($5,400)

When many new features and functionality were being added to the site, PRFSA was subscribed to the Gold plan. With no major development projects anticipated, PRFSA is advised to discontinue the Application Sustainment option and simply allocate a modest budget (~$200/month) for any necessary changes, updates, or special requests that may require developer time.

A fourth category is the website hosting that gets paid directly to Microsoft Azure (~$40/month). While the site was being redeveloped, separate staging (testing) and production instances were being maintained. As of February 2022, the staging site has been removed. Going forward, the expected monthly cost is expected to be $25-$30.

Product Development & Agrometeorological Support

Since early 2020, Andrew Nadler of Peak HydroMet Solutions was contracted to provide support for the network, knowledge transfer, and to implement the upgrades and improvements to the website. The service contract officially ended December 31, 2021.The PRFSA has suggested a continued engagement with Mr. Nadler, which could include monitoring of data (quality control), liaising and working with Big Bear on any web issues or development, and general agrometeorological support.

2022 Budget & Administration

Without network expansion or any major website enhancements, the 2022 program expenditures will be less than in previous years. In 2020, the annual expenditures were $46,000 and in 2021, they were $34,000. The 2022 costs are expected to be around $25,200. While website and Product Development/Agrometeorological support are lower, the expenditures on hardware, servicing, and travel are expected to remain the same or increase. This is attributed to the age of the equipment and overall price increases (labour, fuel, parts). If the pest monitoring program were to be discontinued, wages and travel costs would increase significantly. The Canada-US currency exchange rates may also affect expenses that are paid in US dollars (Davis Instruments equipment, Davis data subscriptions). The proposed 2022 budget is presented in Table 1.

For the production season of 2022, the administration of the weather program will continue to be the responsibility of the PRFSA and will continue to benefit from the linkages to the pest monitoring activities.

Table 1: 2022 proposed budget

Description	Annual
Tools, Supplies, Equipment	$ 4,000
Contractors/Wages	$ 6,000
Travel/Mileage	$ 1,200
Davis Data Subscriptions	$ 4,000
Website	$ 5,000
Product Dev/Agmet Support	$ 5,000
Total Annual Cost	**$ 25,200**

Sustaining the Peace Agri-Weather Network into the Future

A model for sustaining the network beyond 2022 has not yet been confirmed but there is time for regional and provincial partners to determine the most suitable approach. Two options are highlighted below for future consideration.

Maintaining a regional network

While the PRFSA has been administering the Peace agri-weather network for the last several years, this isn't necessarily a sustainable approach going forward. Forming a regional collaboration of interested partners – likely to include not only PRFSA, but also the BC Grain Producers Association (BCGPA), the Peace River Forage Association of BC (PRFA) and the Peace River Regional District (PRRD), is likely the best option for sustaining the network at a regional level. This would involve forming a group (e.g., steering committee) to support the network and make shared decisions, as well as to share the responsibility for sustaining and administering the network. There have been many sources of funding for the network over the years – including industry groups and the PRRD – so there may be potential for developing a five or ten year strategy to support the regional network.

In previous years, network funding has come from contributions from the Governments of BC and Canada, PRFSA, BCGPA, PRRD, PRFA, the BC Branch of the Canadian Seed Growers Association, and BC Hydro.

Integrating with the provincial weather network

Another possible approach to sustaining the network would be to merge the Peace agri-weather stations and tools into the provincial-level weather network (Farmwest) and to eliminate the regionally focused network. Farmwest has the provincial mandate to provide weather information and tools for agriculture.

Integrating into the provincial network would have the benefit of reducing the reliance on local groups and partners. If the data delivery platform were to be shifted from the current BC Agri-Weather Network website to Farmwest, certain existing content and tools would need to be made available on Farmwest so that functionality is not lost. Some of these features include current weather conditions, gridded forecasts (instead of regional), email alerts, crop growth stages, wheat midge emergence, and fusarium head blight risk. Farmwest would need to have the resources and expertise to build and support these regionally relevant features.