CLIMATE CHANGE
ADAPTATION PROGRAM

Delta Farmers Institute Water and Salinity Monitoring Program: 2022 Project Report

Prepared by: Andrew Nadler, Peak HydroMet Solutions

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Introduction

The farmers in Delta rely on being able to access water that is of suitable quality to irrigate their crops. If water supply is inadequate or if the salinity of the water is too high, crops cannot be irrigated, which can result in reduced crop yield or quality. Irrigating with water with very high levels of salinity can result in permanent crop damage. Production losses negatively impact the profitability of farms and can threaten the livelihoods of farmers.

In 2022, the Delta Farmers Institute Water & Salinity Monitoring Program expanded to include several new monitoring sites, new ways for users to access the data, and greater engagement from stakeholders. The program has become an indispensable tool for area producers. The farmers in Delta have expressed a strong desire to continue supporting this program.

Monitoring Network Update:

In the past 12 months, 10 new water monitoring sites were installed, bringing the total count to 16 (Figure 1). New sites were chosen based on recommendations from farmers and valuable input from City of Delta staff. Most of the new sites (eight) were installed within the canal system to provide better visibility of water quality close to where it gets consumed. The other two sites were installed in the Fraser River on the North and South shores of Westham Island. All new installations were performed by Peak HydroMet Solutions (PHS).

The monitoring sites all communicate wirelessly and transmit measurement at regular intervals –every 15 minutes during the growing season. There are three different types of telemetry devices being used. The original four sites use cellular modems that were provided by and are managed by ROM Communications. Five of the sites use Digital Matter 4G cellular modems provided by PHS. The five most recent installations communicate on a low power wide area network (LPWAN). This wireless technology has a long range (~10km) and is well suited to remote monitoring networks as the devices and sensors consume very little power. A new LPWAN gateway and antenna was installed on a structure at Westcoast Greenhouses south of Ladner.

A detailed report of the 2022 network operation and data was compiled and made available to stakeholders. A program update and monitoring data were also presented to the Delta Farmers at their annual grower meeting on December 14, 2022.

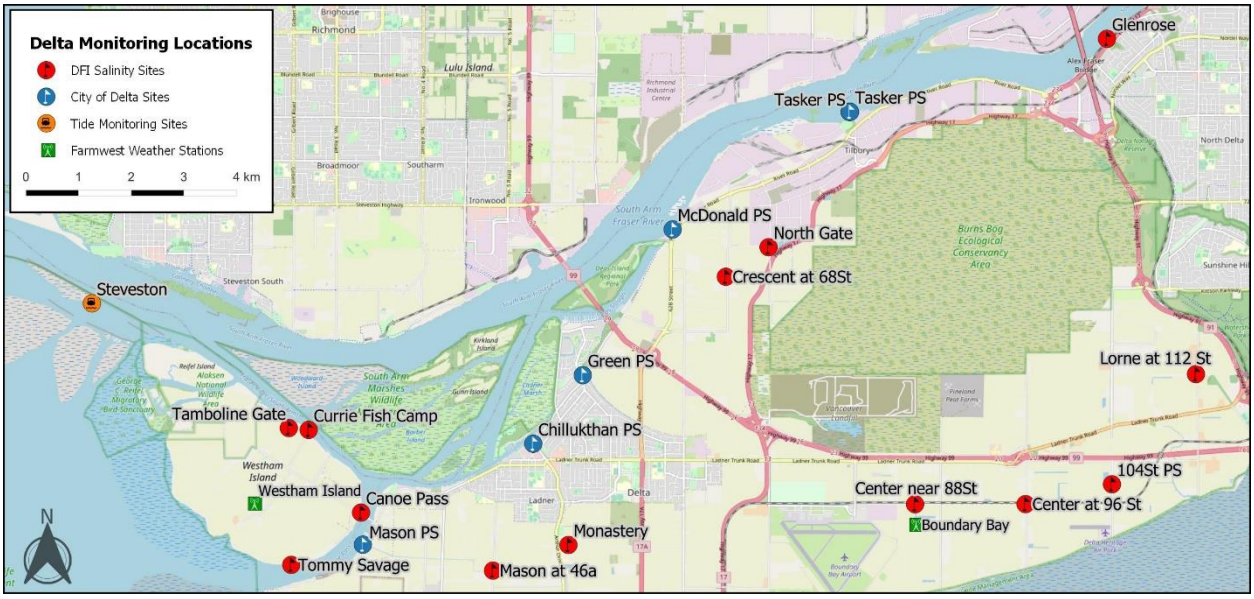

Figure 1: Map of monitoring sites in Delta

2023 Network Operation

The monitoring network requires a minimum amount of maintenance to ensure that the system continues to operate properly. Sites should be inspected at least once, but ideally more, per year to ensure that there are no obvious issues. During inspections, solar panels (if equipped) should be cleaned and all cable connections and mountings should be checked. Salinity sensors should be physically inspected and cleaned at least once per season to ensure that buildup of sediment and algae do not affect their performance. In addition, the area around the sensor should be checked for buildup of debris or sediment and cleared if necessary.

Various issues occasionally cause monitoring stations to malfunction. This could be physical damage, battery depletion, or sensor errors. Such problems should be addressed reasonably quickly, particularly during the peak of the irrigation season (July-August). Fortunately, problems like low battery can be detected and addressed in advance of device failure. Sensor or communications errors can normally be detected immediately after they occur.

Figure 2: New monitoring site installed at Lorne Drain at 112 Street

Data Handling and Management

The sensor information that is collected from the monitoring sites includes conductivity (salinity), water level, and water temperature. The devices themselves send the raw measurements wirelessly to a cloud-based data handler, which provides some initial quality control and then formats the data so that it can be sent on to various applications.

The information gets backed up in a few places for redundancy. First, all measurements are immediately sent to a secure cloud based InfluxDB timeseries database, providing long-term, secure storage. Monitoring information within InfluxDB can either be queried directly or the data can be accessed through an application programming interface (API). Ubidots, the primary platform being used to display the information, provides two years of data retention. This allows any of the dashboards, charts, and tables to go back that far. Manual exports in a comma-separated value (CSV) format are also possible.

Accessing the Information

The near-real-time sensor values can be accessed at http://deltafarmersinstitute.com, which is hosted as a subpage of PHS's website. Ubidots is used as the main platform to build displays and dashboards for general online viewing. Ubidots has the advantage of providing tools for quickly building and sharing information dashboards. This was extremely valuable during the early establishment of the program as there was a need to disseminate the information without spending a great deal of time and money developing custom software. The disadvantages of Ubidots are loading speed and flexibility. The platform allows for some customization, but there are limitations. Furthermore, Ubidots does not have the capability of integrating a native mobile app. Stakeholders have expressed interest in being able to

access the information on a mobile app. For these reasons, different platforms are currently being investigated.

Design Evaluation

In December 2022, a group of students enrolled in Simon Fraser University's School of Interactive Arts and Technology (SIAT) used the DFI Water & Salinity Monitoring Program as a case study to assess the design and usability of the current user-interface. The students' objective was to uncover opportunities for improvement to the interface that would better support the Delta farmers.

The assessment consisted of a pre-questionnaire survey and interviews with participants at their farms. The process revealed several items that could be improved. Some of these include loading speed, making key information more readily visible, and providing access to historical data. Some desired features include custom notifications and alerts and improved mobile access to the information.

The group proceeded to recommend a basic design for a mobile app. The proposed layout and features were based on their evaluation, interviews, and best practices for app design (Figure 3). Some of the recommended components include the ability to bookmark certain key information, tools to filter information, a list of monitoring locations with live data, comparisons between monitoring sites, and real-time notifications. Should DFI decide to pursue a mobile app, these recommendations will be extremely helpful.

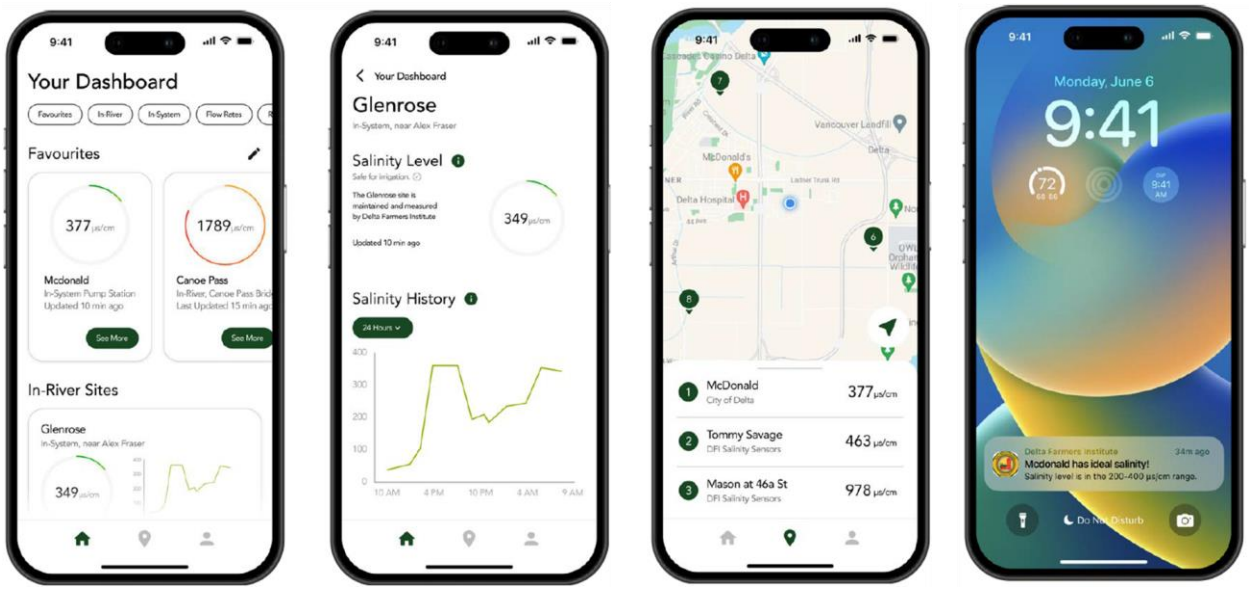

Figure 3: New dashboard designs proposed by the evaluation.

Potential Enhancements

Based on user-feedback, the following is a list of potential enhancements to the program. These initiatives would be contingent upon funding.

Mobile App

Stakeholders have expressed the desire to have a mobile app that would enable easier access to the information. It is estimated that a fully functional mobile app could be built for approximately $15,000. An operational version could likely be released by late spring.

Water Levels

In addition to water quality, several users have requested that the system also report water quantity (level). The existing sensors already measure and report water level. These values would need to be calibrated to benchmarked elevations that could potentially be provided by the City of Delta. Some site surveys and some additional sensors may be needed.

Additional Monitoring Sites

There are some locations that have been identified as potentially benefiting from a monitoring station. These include an improved installation at Tamboline gate – one that is closer to the actual river and Brunswick Point, near one of the existing floodboxes. Other locations are likely to be identified through further consultation. If budgets permit, these sites could be installed and operational prior to the irrigation season.

Irrigation Support

Farmers rely heavily on Delta's canal system. The system is managed closely by the City to ensure that farmers have access to water that is of suitable quality for irrigating crops. While the program focuses on water supply, little has been done to address the demand side. Specifically, ensuring that the water is being used efficiently. Promotion of irrigation scheduling tools has been identified as a logical next step. This would include promoting better understanding of crop water demand, irrigation efficiency, system uniformity, and soil characteristics. Soil moisture sensors are an effective tool to help manage irrigation. In 2022, a demonstration and evaluation of these technologies was completed on two Delta farm sites as a component of the DFI Water & Salinity Monitoring Program. Continued support and promotion would benefit producers.

Weather Stations

Farming is highly influenced by the weather. Currently, there are only two weather stations in the entire Delta region – one near Boundary Bay and one on Westham Island. Additional weather monitoring stations would provide farmers with more site-specific information that would help them manage their crops. These stations would also provide stakeholders like the City of Delta and the Ministry of Agriculture & Food with improved monitoring of extreme events.

Proposed Budget

The following budget provides an approximate cost breakdown of the components listed above.

Component	Description	Estimated Budget	Type
Data management & software costs	Data management, data quality assurance/quality control, sensor communication costs, data transmission, software fees, website, dashboards	$12,000	Ongoing
Monitoring network maintenance & repairs	Site maintenance, upkeep, repairs, replacement parts, and updates (~20 sites x ~$500/site)	$10,000	Ongoing
Salinity data portal enhancements	Based on Usability Study and user-feedback, implement enhancements to the existing user-interface (www.deltafarmersinstitute.com)	$4,000	New
New salinity monitoring sites	4 new salinity monitoring sites to be added to existing network ($2,500 each)	$10,000	New
Weather stations	Improved weather station coverage of the region. Also, to include irrigation management tools like	$10,000	New

	crop evapotranspiration. Station data to be shared with Farmwest (2 stations x $5,000 each)		
Water level information	Calibrating sensor readings to align with known elevations. Adding visualization.	$2,000	New
Irrigation tools demo	Soil moisture sensor demonstration in cranberry crops (4 sites x $1,250/site)	$5,000	Ongoing
DFI water monitoring network mobile app	Salinity and water information be made available through a mobile app. This project consists of building out Version 1 of an app. Anticipated release of June 2023.	$15,000	New
Professional services and network management	Includes project management, planning, design, and implementation of project objectives.	$12,000	New
	Total	**$80,000**	

Conclusion

The 2022 operational year served as a successful proof-of-concept of the Delta Farmers Institute Water & Salinity Monitoring Program. The project successfully demonstrated that an organization can establish and maintain an effective and efficient monitoring system that provides direct benefits to its stakeholders. For 2023, the farmers in Delta have expressed continued support for the program. DFI and PHS looks forward to continued collaboration.