ES 441 – FIRST PROJECT DRAFT
Meteorological Station Proposal for the Galiano Conservancy Association

SUMMARY

This report identifies and assesses the Galiano Conservancy Association (GCA) needs for a weather system, and provides design considerations concerning the weather system(s) that the GCA might acquire. First, we briefly introduce the purpose of the paper and outline the main problem which the project aims to address and solve. Next we provide background on the usefulness and relevance of weather systems for educational, research and restoration activities to demonstrate the value that weather systems would bring to the GCA's Learning Center. Our goals and objectives are divided into the three categories: education, research, and restoration. Finally, in the design portion of the paper, we provide design considerations concerning how many weather system devices the GCA should acquire, where the device(s) should be located, and what attributes the Association should consider when purchasing weather system devices.

INTRODUCTION

The Galiano Conservancy Association (GCA) is a community based non-profit society and registered charity dedicated to preserving and enhancing the human and natural environment (Curran, 2013). The GCA mainly aims to physically restore ecosystems that have been historically degraded but also focuses on reconnecting people with place through education and experiential practice (Curran, 2013; IUCN, 2014). The GCA is a grant and government funded organization accountable to the Land Trust associated with the Provincial Land Acquisition. All activities conducted on a GCA property must uphold to the permanent and legally binding conservation covenant agreements established with the property Title; this is to ensure the native vegetation is rigorously protected.

The GCA has undertaken multiple large and small scale restoration projects across Galiano Island including the Pebble Beach Reserve (District Lot 63) and the Laughlin Lake Wetland Project for example. Through such successful environmental

restoration and social involvement, education programs have stemmed. The Galiano Conservancy Association offers a Learning Center located on District Lot 57 (DL 57) that provides a hands on educational programs with experiential learning opportunities for all ages and disciplines. Programs varying from marine life to Garry Oak Ecosystems to renewable energy, have resulted in a community base that extends through not only the Galiano Island community but throughout the Gulf Islands, Vancouver Island and even to the mainland.

As the Conservancy's legacy expands, detailed weather and atmospheric information would be a useful tool for future restoration projects and educational programs in sight of changing climates. Presently however, the Galiano Conservancy Association property DL 57 does not have a weather station network or system in place that is able to provide the Learning Center with specific and representative climatic data. The lack of accurate and reliable weather information useful for restoration, education and future research limits opportunities and potential growth. Therefore, the purpose of this project proposal is to support the Galiano Conservancy Learning Center in obtaining on-site advanced meteorological stations.

BACKGROUND

In sight of global climate change, increasing planetary temperatures are expected to impact all regions at varying scales climatically and ecologically (Dore, 2005). According to the mid-range 4.5 Representative Concentration Pathway (RCP) model of the 2014 International Panel on Climate Change (IPCC), in the 5th Assessment Report, global temperatures are expected to rise an estimated 2.6ºC by 2050. This increase will influence all related global, regional and local climatic variables respectfully (Dore, 2005). Due to the individuality of specific regions, aspects of the encompassing environment including topography, vegetation, hydrology, and locality, will all heavily influence microclimatic composition and the conditions of a region (Dingman, 2015). Land use changes induced by human practices also majorly influence microclimates as the natural hydrological processes are interrupted and surface albedo is altered (Dingman, 2015). However, the influence of global temperature increases on microclimatic conditions is

highly variant and difficult to predict and understand without increased weather networking and educational awareness (Dore, 2005).

Currently, the Galiano Conservancy Association does not have on-site networking or instrumentation, and therefore relies entirely on the School-Based Weather Network station at the South end of Galiano Island or the station located on Saturna Island for weather information and daily forecasts (Curran, 2013). The Vancouver Island School-Based Weather Network uses simple and affordable weather stations to create a broader networking system that offers temperature, precipitation, relative humidity, wind, and other conditions of specific areas; the recorded data is easily accessible and available to the public. Alternatively, several other methods of regional climatic modeling are available and offer sources of predictable conditions. For example, the University of Victoria provides a Canada-wide 300 arc-seconds resolution scenario produced by the Pacific Climate Impacts Consortium; this system offers basic modeled regional temperature and precipitation predictions. But although useful, these off site station systems and regional resolutions do not offer the GCA Learning Center with the most accurate, local nor reliable meteorological data specific for the restoration and education goals in mind on the DL 57 property.

As restoration is the main goal of the GCA, attaining on-site meteorological stations and local data would support and provide the Conservancy with key knowledge and tools useful for planning and maintaining the ecological restoration on DL 57. The GCA has several restoration projects and plans underway on DL 57 such as the food forest, native foraging forest, and plant nursery (Curran, 2013). These projects will require condition information for seeding, planting and harvesting, which could be recorded in conjunction with the gathered weather data for seasonal predictions and activity scheduling. The temperature and precipitation data could be used to calculate growing degree days of native and non-native vegetation (Mather,1923). Such seasonal predictions and growing degree days could also help support the GCA in their active invasive species management [eg. Scotch Broom (*Cytisus scoparius)* pulling and controlling] (Curran, 2013; Mather,1923). Additionally, achieving long term trends from the recorded daily data would provide the opportunity to track local climatic shifts and forecast seasonal projections useful for future project planning and tracking vegetative

responses (Mather,1923). As all these attributes would positively support successful restoration for the GCA, providing education closely follows as a main goal and requires consideration.

From an educational perspective, attaining meteorological weather station(s) and data would provide the Conservancy with a unique and hands on learning utensil that would engage and enrich the involved program groups as well as the public. By offering climatic visuals, graphical trends, and real time data recordings, the weather station(s) and corresponding system(s) would offer a meteorological experience that is directly connected to the GCA restoration work that is being promoted and achieved. This promotion would increase awareness of not only climate change globally and locally, but expand general knowledge of the impacts and influences land use change via human disturbances has on the atmospheric conditions of an area. By comparing varying altered sites (eg. the Learning Center site) with restored sites (eg. the food forest site) across the property, as well interactively connecting the proposed GCA Learning Center station(s) with the School Based Weather Network discussed, student groups could learn the importance of restored landscapes and the organic benefits that such landscapes reintroduce like temperature regulation, precipitation management, and evapotranspiration control within an ecosystem/microclimate.

GOALS & OBJECTIVES

We determined three goals and four related objectives for our design proposal to directly address the problem at hand and offer possible solutions as such:

Restoration Goal:

To broaden the ecological restoration possibilities across the site by offering detailed and comparable climatic information.

Objective:

To provide two weather stations that offer comparison between the altered Learning Center site and the restored native food forage forest site.

Educational Goal:

To encourage education around climate change and shifting microclimates related to human presence and altered landscapes.

Objectives:

1. To provide access to reliable and easy-to-use climatic data for all ages and learning groups involved with the Learning Center.
2. To provide access to the recorded on-site meteorological data as well as the broader School- Based Weather Network in order to further awareness and understanding of microclimates.

Research Goal:

To provide capacity for understanding long term microclimate shifts occurring in the varying restored and altered landscapes of mid-western Galiano Island.

Objective:

To use the recorded climatic data to predict growing conditions and formulate long term trends for the harvest and health of the food forage forest, as well as management of invasive species.

DESIGN PROPOSAL

The design considerations involved in our project are: what attributes the weather station(s) should have, where the station(s) should go, and how many stations to suggest. Upon deciding on these considerations, we then found some potential meteorological devices that the GCA might want to look into, and created a table which compares three different options for the devices. These options provide insight on the specific power usage and source, instrumentation, accessibility and user friendliness, and data recording method/functions. Ultimately, it is up to the Conservancy to decide which device to acquire, depending on the GCA's main purpose for the stations (i.e., primarily educational, primarily restoration or primarily research).

Depending on the primary use identified by the Galiano Conservancy Association, the weather systems chosen would require different attributes as the devices service varying preciseness and purposes. Given that the problem that we identified was the need for site specific data, it is clear that the systems chosen for the site must be durable

and reliable, so that the data can accumulate over many years with minimal interruptions or investments. We suggest that the system chosen by the GCA should be easy-to-use, allowing the maximum number of visitors and student groups to the Learning Center to have access to local weather data. Ability to tap into a greater network, such as the Vancouver Island School-Based Weather Station Network discusses, is another potentially valuable attribute that we suggest that the GCA consider; such a network would connect the study groups, the restoration work, and the facilities cohesively. If the priority of the Association is education, then a system such as the Davis VantagePro would be best suited; this system is simple but adequately meets the needs suggested by the Association, and used throughout Vancouver Island's School-based Weather Station Network (Table 1). If the priority however is research, and there is adequate funding, the GCA might consider a research-grade device, such as one produced by Campbell Scientific (Table 1). Ultimately, the GCA can decide on whichever system is best suited for their purposes.

In addition to the attributes of the weather system(s), we also considered the number of meteorological stations the GCA might want. Given that the major goal of the Association is restoration, we decided that they should consider acquiring two stations. One station would be located in an area that has a history of disturbance and will in the future be maintained as an intensively used site, such as the area in and around the classroom building; the second station, we suggest putting in a site being restored. With two such locations, the data collected over time would be useful for attaining insight on the specific microclimates of the two sites on Lot DL57, and the microclimatic effects of restoration via comparison.

Finally, we chose two possible locations for the two potential stations. The first, we suggest putting on top of the classroom building. The classroom building is an obvious first choice for a system as the information from the system can easily be used and integrated into the educational workshops that come through the Learning Center. We suggest that the second weather system be put in a soon-to-be restored area, so that the weather systems can be used to assess the microclimate of restored vs. non-restored areas over the long term. Depending on the device that the GCA chooses, the second system will likely need to be close and within line-of-sight (up to 300 meters) to the main

source of power and wifi. For this reason, we suggest that the second weather system device be introduced into the native plant food forest as seen in Figure 1, marked in red.

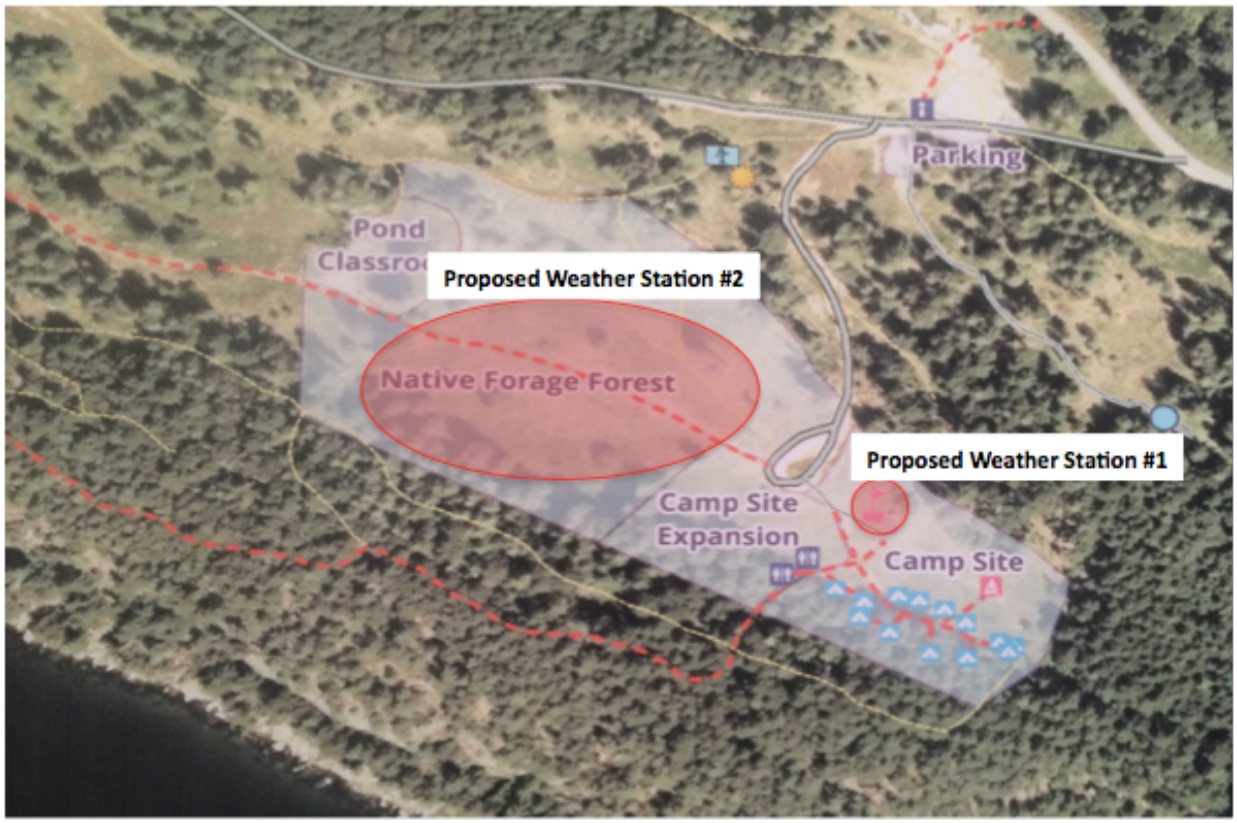

Figure 1. The Galiano Conservancy Association Learning Center DL 57 on Galiano Island, BC and the two proposed weather station locations.

After determining the attributes, amount, and locations of the weather systems for the GCA, we found three potential devices that the GCA may want to consider buying for the Learning Center. We built a table comparing the three devices to demonstrate the differences among the systems to help the GCA determine which weather system would be the best choice for their purposes as seen in Table 1 below.

Table 1. Meteorological Station Comparison Table

Offers:	**Consumer - Grade Station AcuRite Pro**	**Davis Vantage Pro 2**	**Campbell Basic Weather Station**

	Color		
Cost:	$169.99 (full system set)	$1095.75 (full station set)	Quoted
Quality:	Low/Mid	Mid	High
Power Consumption & Source:	Low – Wired or Solar	Low - Solar	Low - Solar
Instrument Setup/Function:	Simple	Simple	Complex
Operability:	Basic	Intermediate	Advanced
Data Collection/ Monitoring:	Wired/ Automatic	Wireless/ Automatic	Manual
Data Storage:	N/A	Immediate Transmission to PC storage	6 M Bytes Data Storage box
Durability:	Low/Mid	Mid	High
Warranty:	30 Days	1 Year	3 Years
Upgradable/ Compatible:	Yes	Yes	Yes
On Site Station-Station Network:	No	Yes	Yes
Greater Network Connection:	No	Yes	Yes
Graphical Displays:	N/A	Automatic	Manual
Research Grade:	No	No	Yes

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REFERENCES

Curran, D. (2013). Collaborative conservation planning resource guide. *Galiano Conservancy Association.*

Dingman, L. (2015). Introduction to Physical Hydrology (3rd Edition). Waveland Press. Chapter 1,3,6.

Dore, M.H.I. (2005). Climate change and changes in global precipitation patterns: What do we know?. *Environmental International*. **31**(8), 1167-1181. Received from http://www.sciencedirect.com/science/article/pii/S0160412005000553

Field, C.B., Barros V.R., Dokken D.J., Mach K.J., Mastrandrea M.D., Bilir T.E., Chatterjee M., Ebi K.L., Estrada Y.O., Genova R.C., Girma B., Kissel E.S., Levy A.N., MacCracken S., Mastrandrea P.R., and White L.L. (2014). IPCC: Summary for policymakers. *Fifth Assessment Report of the Intergovernmental Panel on Climate Change: Impacts, Adaptation, and Vulnerability*. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 1-32.

Keenleyside, K., Dudley, N., Cairns, S., Hall, C., & Stolton, S. (2011). IUCN: Ecological restoration for protected areas. Receiving from https://portals.iucn.org/library/efiles/documents/PAG-018.pdf

Mather, J.R. (1923). The climatic water budget in environmental analysis. *Health and Company.* pp 1-239.