THIS MASTER DOCUMENT - WPS NON-PROFIT GOOGLE DRIVE

Salt Spring Island (SSI), Water Preservation Society (WPS), FreshWater Catalogue (FWC) Project

FWC field "processed" data, compilation & interpretation, and "raw" data management guidelines

- for FWC data analysis working group(s) -

SSIFWC DATA COMPILATIONS & INTERPRETATION GUIDELINES

This document:

Section [A]

FWC data compilation & interpretation - an overview

Section [B]

Basic Freshwater data interpretation guidelines
- Known issues
- Watershed oriented
- Cross-watershed (regional)

SSIFWC DATA PROCESSING GUIDELINES

This document:

Section [E]

FWC Epicollect5 cloud database
Raw V3 data editing for download
- Coordinates
- Selected site renaming
- Check on flow data entries

Examples
SSIFWC Epicollect5 cloud database

Section [D]

Cloud data export (.CSV)
Raw cloud data download for:
- FWC cloud data transfer to Excel
- Processing Cloud data (dates, flow etc)

Examples
worksheet:
SSIFWC V3 data download 20211122 form-1__ssiwpsfwg.csv

Section [D]

Monthly fielddata & weather worksheets (.xls)
Processed field data for:
- Cloud data transfer/format for Excel
- VBA formatting - raw data (date, flow etc)

Examples:
workbook
DLV35ep 30 2021.xlsx

worksheets
Form-1__ssiwpsfwg
Walkers
Recce
Formules to be added

Section [C]

Watershed worksheets (.xls)
Processed field data for:
- Weather data chart merge (air T., pptn)
- Data QC
- Data Analysis (interpretation notes)
- Information share
- VBA formatting - regional trends

Examples:
workbook
MasterSSIFWCData Jan20220127 V3

worksheets
Dec312021, Dec72020, etc
Weather (Air Temperature & Precipitation)
9076CusheonCove, FNCKFernCreek, etc
Conductivity_All

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Summary

This FWC data compilation and interpretation manual runs through procedures necessary to take original "live" *raw* Cloud based FWC data and format this to develop a *processed* FWC field data, suitable for field data QC and for further field data analysis and interpretation. This document outlines the processes for the development of "processed" FWC field data (A] - D]) in reverse order below, and provides information on basic data QC steps (E]) as follows:

A] Introduction - something on the why we are doing this, an overview of the insights that the FWC might bring to island freshwater/watershed analysis - "the value proposition"

B] Using the FWC watershed worksheets to review field data - for field data QC and site(s) selection/focus and/or for review. To be considered where there a sufficiency of field data (ie a regularly visited site, or sampled well) to examine data interpretation options, eg using discrete watershed-oriented worksheets, and/or regional island-wide well/watershed worksheet comparisons)

C] Moving *processed* data into the FWC watershed worksheets, within the Master data Excel workbook

D] Preparing *raw* FWC cloud field data for Excel use in the Master data Excel workbook

E] Common SSIFWC Admin workflow notes - raw FWC cloud data quality control

[A] FreshWater data compilations & interpretations - an overview

Manipulation/chart analysis of the FWC data, along with some basic data QC and management, is key to ensure that our field data collection is adding value. The data should help in improving the understanding and behaviour, of our island's creeks and watersheds, with seasonal rainfall, and of the interplay between surface water and groundwater for "water balance" work (remembering that we have just the one "freshwater lens"). In many cases we are establishing a reference (baseline) freshwater dataset for the many island creeks that have never had one!

Our island FWC data charting (examples in the images below) delivers a lot of insights into our island's freshwater, addressing questions around:

*1] basic charting - data QC and suitability, for instance: *

- are we consistently sampling particular sites?

- is there a clear value to the data collection at a particular site (there is potential for real variability and trend identification, or just a constant and/or noise)?

2] chart data trends analysis, including

- understanding seasonal/longer term flow variability at a watershed's sea outfall, and in determining principle and secondary creek contributions within the watershed, and how these change over time…

- air temperature vs water temperature trends, help characterise freshwater inflows (groundwater and/or lake contributions),

- flow vs precipitation correlations (from comparisons of rainfall precipitation vs creek flow patterns), may give insights into the surface capture and recharge effectiveness/watershed(?) with rain events

- determining seasonal, groundwater components (from year-round flow and chemistry variability trends), gives an indication of key groundwater secondary - primary creek contributions, and their impact(s) (flow, temperature, dissolved oxygen) on aquatic ecosystem health/maintenance

- comparing/determining surface freshwater vs groundwater signatures and correlations (conductivity - flow), providing insights into the quantitative contribution of groundwater systems (groundwater inflow, or base flow), and of groundwater discharge at the coast

If correlations are encouraging, taking an established groundwater-flow contribution relationship/analysis a bit further, with (at selected sites) 24/7 recording of chemistry and flow, to determine the quantitative, through summer groundwater contributions to some of the island's key creeks and lakes...

All of the above FWC data charting and interpretation efforts require some continuous review and judgement of the FWC field programme that is ongoing, with the driver being understanding island-wide, "big picture" (watershed scale +/-) variability. Some of the above are initial investigations and may be "paused" if there is no obvious value, some are a "work in progress" or have already established working models (three years+ data) documented in some of our Facebook group posts, and will/may be used in upcoming SSI water budget and groundwater sustainability modelling initiatives!

The FWC well chemistry data we are now collecting is another story, and... "one swallow does not a summer make". Suffice to say that we are seeing indications that some of the wells sampled may be interacting immediately with the surface freshwater systems and some do not… Given that some of this variability takes place areally over <250m… any (a) model is likely to be a complicated beast (if that is the right word…).

The 40,000’ (or elevator pitch) summary of the above musings(?) - all of the observations and analysis are dependant (of course) on our FWC data collection, and both the consistent recordings and background management of our data. With these as givens the analysis of our charted data allows us to determine where our collected data are of key value, influencing our understanding of:

- Factors controlling aquatic system health (mainly year-round groundwater baseflow

- Variability in watershed (recharge)efficiency

- Surface freshwater -groundwater interactions and the impact of surface water on our groundwater recharge systems, and areal water balance(s)!

Volunteers supporting the data analysis and interpretation play a vital role!

[B] Basic FreshWater data - interpretation guidelines

The SSIFWC project data gathering focuses primarily on "regional" water quantity year-round (baseline) data gathering, in support of developing "groundwater sustainability" and "water budget" modelling work for SSI. The absence of key total flow and groundwater (baseflow) components for SSI modelling work was first highlighted in a 2019 Groundwater Potential study by Golder (ref.).

Water quality oriented work is locally being undertaken to support specific SSI projects (eg the Xwaaqw'um Watersheds Restoration Project). Water quality indicators are also a partial fall-out from island-wide screening related to water quantity field measurement.

B1]. Key FWC field data collection

these include the following**:**

1] Basic field location data

- Field locations and coordinates, and freshwater characteristics (setting, wetland, creek, ephemeral, perennial etc)

2] Water quantity oriented data collection 2018 - present, including:

- Flow (l/s)
- Chemistry (conductivity, pH, water temperature)

3] Water quality parameters:

- Turbidity (xxx and Secchi derived) and coliforms (total coliforms, E. coli and fecal) . These water quality datasets are associated with various water quality pilots and local detail project areas,and in addition to some of the items in [2] above.

A live overview of the SSIFWC data collection sites, highlighting regular watershed locations, is available via the online SSIFWC webmap. Key focus "local detail areas" are highlighted in the relevant SSIFWC website "Watershed Notes" (under development).

B2] Known FWC data collection & interpretation issues

Natural creek and watershed setting(s), and seasonal site flow variability influence field collection parameters, as does site visit frequency. Depending on the season, measurement frequency (and type) and site variability impact data consistency and measurement accuracy (particularly flow). The acquisition of longer term, baseline data (flow, flow vs chemistry) data may partly negage seasonal data collection issues and consistency… Data loggers provide a solution though suitable installation sites and conditions, and installation/maintenance create challenges with the widespread adoption of these tools.

SSI year round creek flow is highly variable, the characterisation of watershed flow vs rainfall (precipitation) patterns, and the relationship of these variables to watershed area recharge (vadose zone, shallow and deep groundwater, surface cover, +) *and discharge* is complex. Methodologies to investigate relationships between flow (typically measured weekly) and rainfall (daily records) are being investigated, though this is an ambitious project.

The impact of flow vs precipitation (pptn) variables on comparisons between watershed "recharge efficiency" (rainfall per area vs discharge-to-sea per area) are likely to be crude approximations. The determination of a percentage groundwater inflow from total in-creek surface flow is limited by the absence of continuous flow and chemistry data collection at most FWC sites, though flow vs chemistry correlations may give, per creek indicative groundwater inflow percentages (Howe and Allen, 2020).

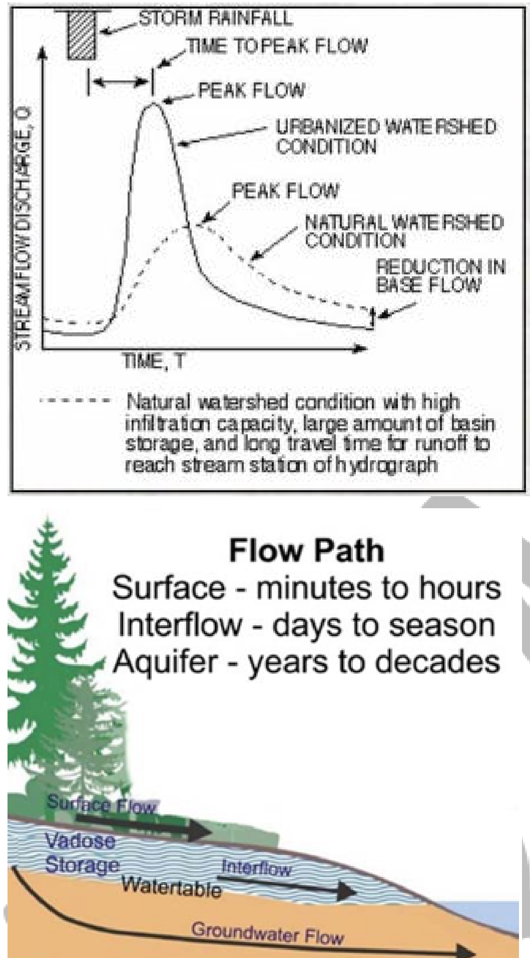

Figure _ Factors controlling surface water (and groundwater inflow) surface flow variability (courtesy of North Shore Stream Keepers and Dumont MVIHES). Lakes and wetlands introduce additional buffering considerations to pptn - surface flow responses.

Research on the interplay between watershed area ground and subsurface geology conditions, and/or surface cover may provide insights into local controls on rainfall-flow relationships (factors controlling lag-times etc)

B3] Watershed-oriented, FWC data interpretation

Field data charting supports basic data QC and interpretation of some aspects of water quantity, and quality (see [A} above). The following charting groups are used in data QC, and in further analysis and interpretation of discrete areas for "watershed notes", and to determine the value of these datasets in further island-wide, comparative "regional" studies of selected parameters.

The intent of the FWC data being collected is that this data is used to inform ongoing studies, for example water allocations, and (ultimately) in ground-truthing developing groundwater recharge and water budget models. The data collected may also be of value in more academic studies (*cf* Howe and Allen, 2020).

<u>FWC Field Site Data Overview Charts - for QC and site data gathering value determination</u>

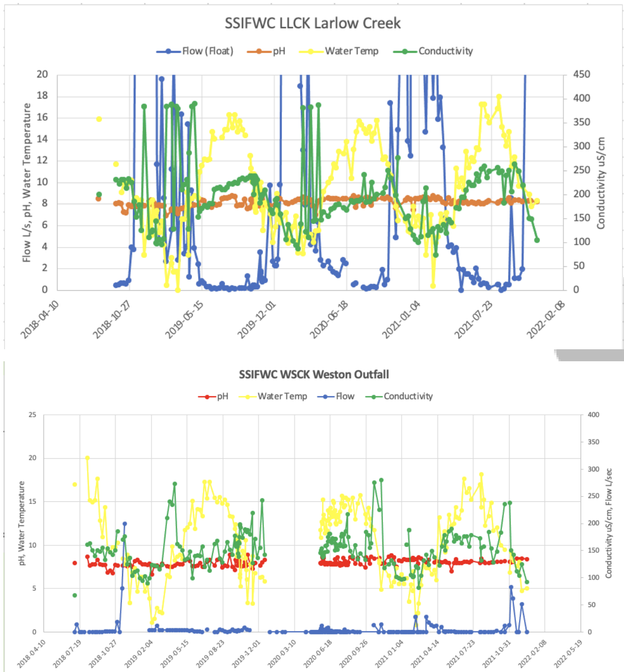

Figure _ Examples of SSI field site data - illustrating typical seasonal creek flow and chemistry variability, and of outlier "spikes" in conductivity (Larlow Creek) attributed to anthropogenic overprints…

For single watershed sites an overview of flow and chemistry data available allows simple quality control (QC) of data measurements (trends, outliers, spikes etc). For watersheds with multiple, start-up data collection sites (aka local detail areas), comparisons of flow/chemistry at discrete sites may allow decisions on what representative, "regional-scale" sampling for a watershed/sub-aquifer region is necessary/ideal, and may highlight local data outliers ("spikes") that may merit further investigation.

FWC Field Site Flow vs Precipitation charts - for watershed creek flow vs rainfall investigations

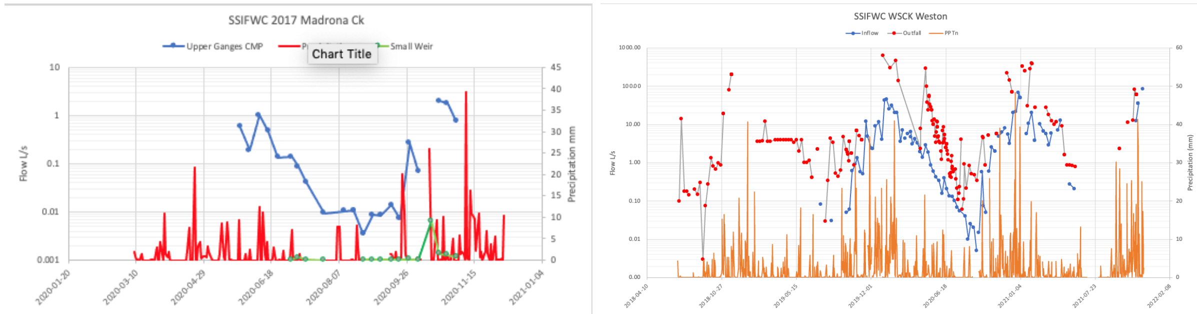

Figure _ Examples of measured per watershed creek flow (weekly) vs precipitation (daily)

Weekly flow sampling (undertaken at most FWC field sites) is inadequate to be able to back-calculate total creek flow within a watershed. This total flow (freshwater loss) is a key part of any watershed/subaquifer water budget calculation, where an “in” from pptn (water volume falling in a watershed vs leaving the island from a (single watershed outfall) is required. The possibility of establishing a correlation between flow and precipitation, and using daily (24 hour) precipitation records as a proxy to flow has been investigated…

To-date seasonal in-watershed/sub-aquifer region variables (eg potential changes in areal precipitation land cover, and/or absorption, and offtake patterns) preclude the use of total flow data volume calculations. This limitation of weekly FWC field data acquisition limits the use of other flow-chemistry relationships (eg yearly baseflow determinations) in water budget analysis, though provides a basis for determining/developing full 24/7 sites to do more robust analysis (eg the FWC field site “Weston Creek Lake inflow”, “Weston Creek outflow”).

FWC Field Site Data Air vs Water Temperature charts - for (seasonal) creek groundwater-inflow (baseflow) presence interpretation

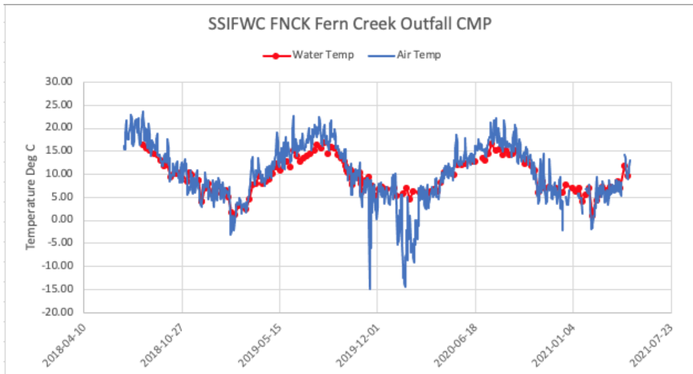

Figure _ Examples of SSI field site data - illustrating air temperature - water temperature inverse correlations.

Year-round flow, and an inverse relationship between water temperature and air temperature, gives a clear indication of in-stream groundwater (base flow) contributions through the year. These inflows vary as a function of ground water table fluctuations varying with the yearly precipitation cycle (and shallow and/or deep groundwater recharge).

The limited inverse relationship between Weston Creek outflow air - water temperature indicates the impact of “Weston Lake blending” (and general lake blending) on discrete lake inflow water creek chemistry signatures.

FWC Field Site Data Conductivity vs Flow charts - for (seasonal) creek groundwater-inflow (baseflow) quantity interpretation

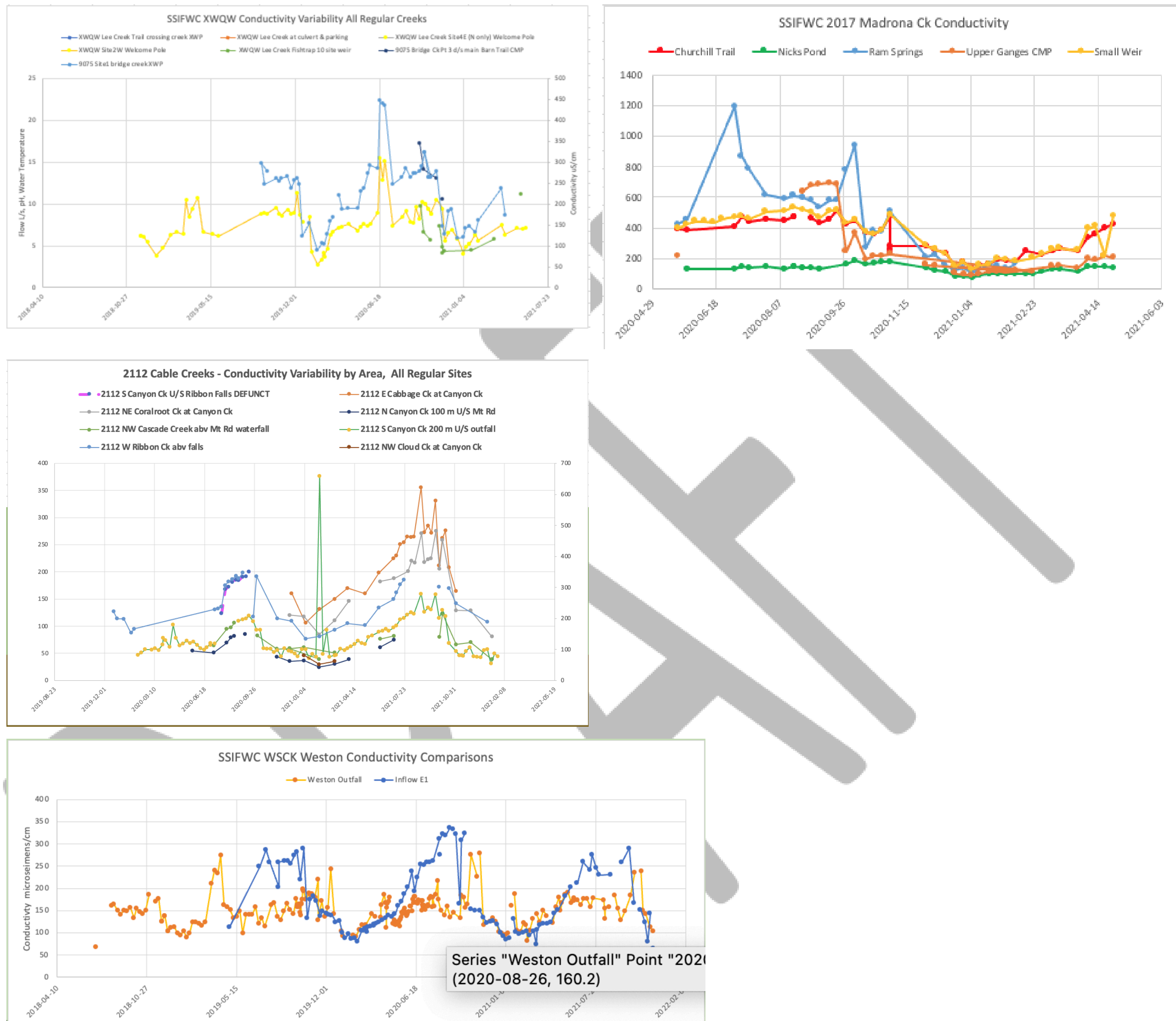

Figure _ Examples of SSI watershed multiple sites data - illustrating in-watershed conductivity variations

Conductivity variations within individual watershed areas give an indication of potential variability in groundwater (baseflow) inflow into creek(s). These may relate to discrete groundwater sources (springs, aquifers and/or other) within a watershed…

<u>FWC Field Site Data Conductivity vs Flow charts - for (seasonal) creek groundwater-inflow (baseflow) quantity interpretation</u>

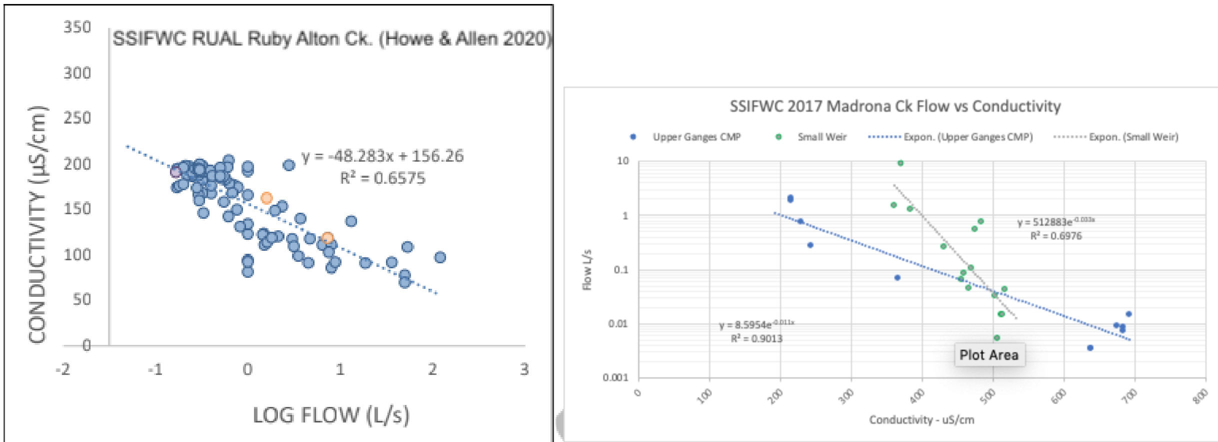

Figure _ (a) left, example of SSI field site data - illustrating RUAL Ruby Alton Ck., flow vs conductivity correlation. (Howe, and Allen, 2020). Figure _ (b) right, example of SSI field site data - illustrating in watershed flow vs conductivity correlations. Robust R^2, apparent in both charts, apparent in a number of island creeks.

In a number of island creeks conductivity vs flow relationships (R2 >0.6) give an indication of how in-stream groundwater (base flow) contributions vary through the year, summer to winter with gradual changes during the spring and fall shoulder seasons. This variation varies during the yearly precipitation cycle and provides a potential mechanism for a per creek, percentage groundwater inflow determination. Groundwater data from key, deep and shallow, watershed area wells may allow this groundwater (base) inflow volume “working model” per creek to be further refined (Cf. Howe and Allen, 2020).

Dissolved Oxygen - along creek length for (seasonal) creek water quality interpretation

Map based chart (SLS-FWC collaboration) not ready yet!

Maximum water temperature in-creek conditions for (seasonal) creek water quality interpretation

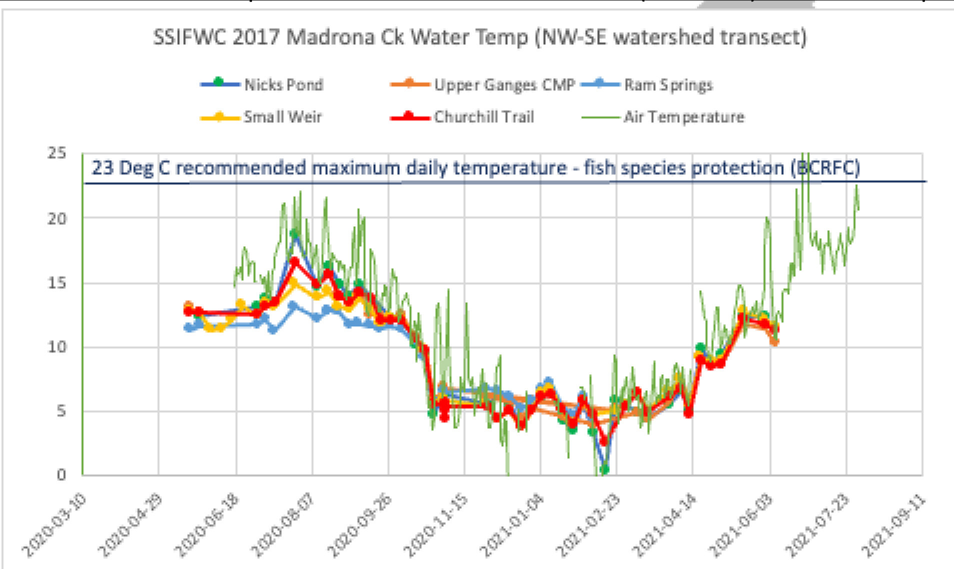

Figure _ , example of SSI field site data - illustrating 2017 (Madrona Creek system., water temperature vs air temperature correlation. In-creek seasonal temperatures below maximum daily air temperature (BCRFC), likely a function of groundwater inflows (Ram Springs, cf figure _ above; other, TBD)

Province (BCRFC) guidelines for sustained fish habitat within riparian areas are as follows:

-

Cross-island watershed(area) “regional” comparisons and data interpretation

Across island-area watershed data comparisons allow insights into the influence of larger (regional) scale parameters on freshwater, including: watershed size - flow relationships, understanding the impact of subsurface (geological) variability on discrete creek, freshwater chemistry signatures, and determining if there are local “exotic” anthropogenic overprints on the field data being collected.

FWC Across-island Watershed Area vs Creek Flow variability

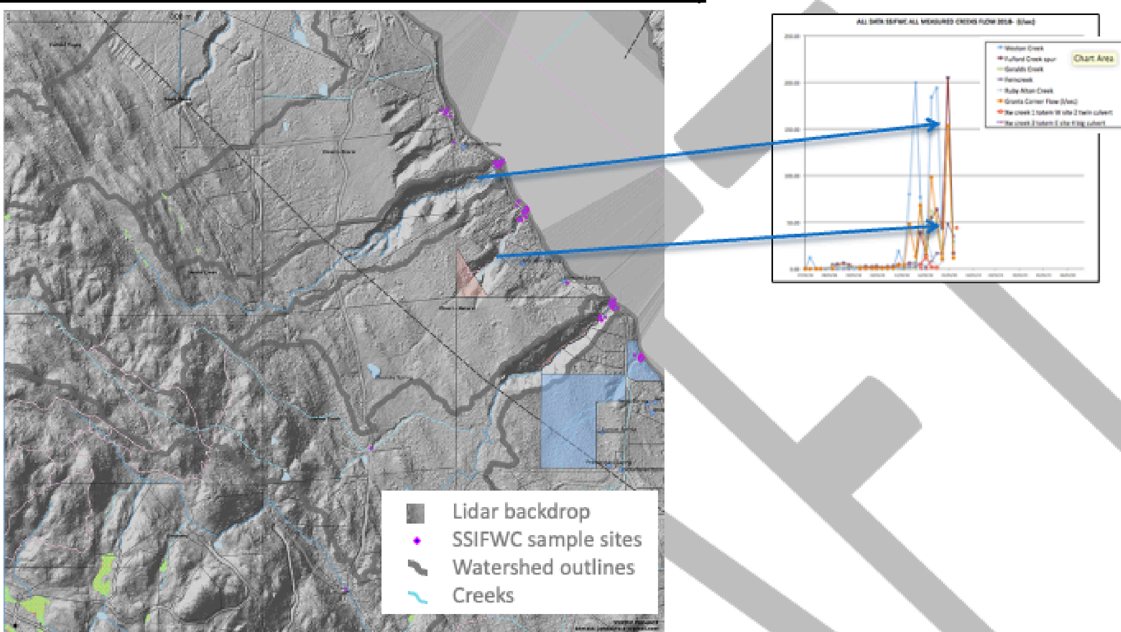

Figure _ South island watersheds (Lidar backdrop), inset watershed(area) dependant flow variability

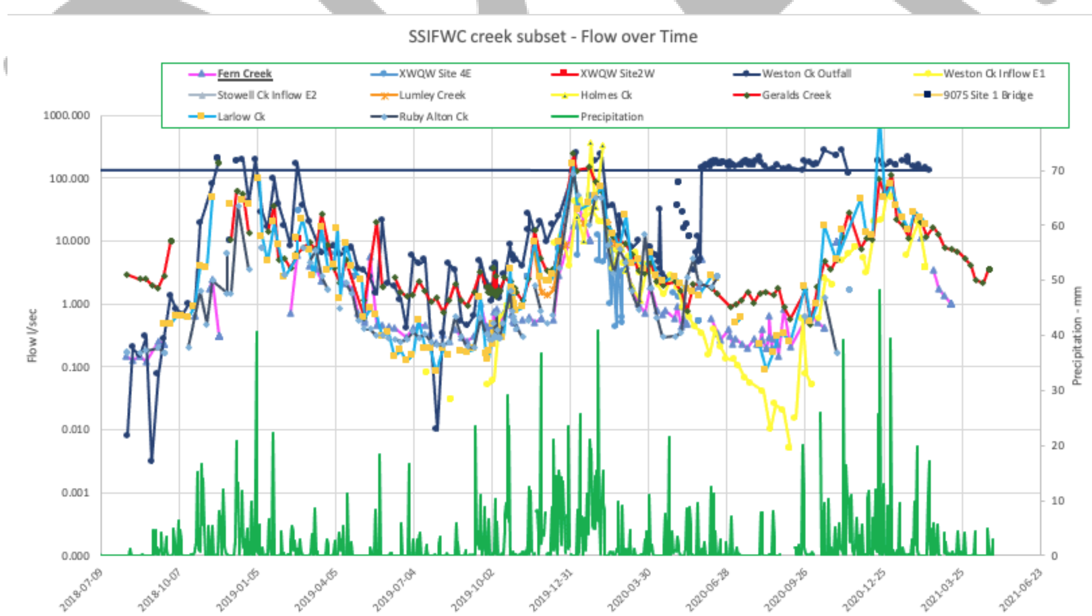

Figure _ Across island creek flow variability, illustrating watershed(area) size (and rainfall) interdependency? - chart needs updating to 2022. Impact of in-watershed groundcover variability TBD

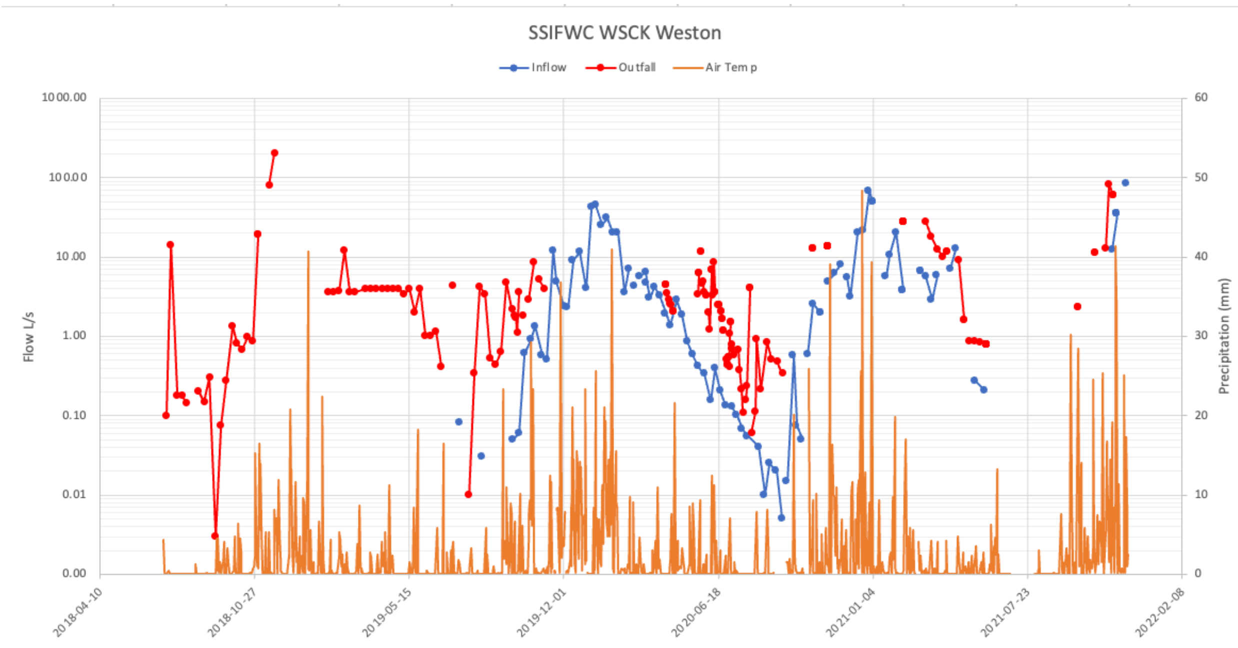

Figure _ Examples of within-watershed creek flow vs precipitation variability, scope for flow-pptn correlations potential per watershed??? TBD - example charts needs updating to 2022 (cf section B2 figure _ potential groundwater baseflow sources)

Working Model(s)

- Watershed catchment size drives winter (and year-round?) creek flow volume variation
- Area & ground cover may impact rainfall vs run-off and groundwater inflow relationship (TBD)

Qu - what potential is there for developing a correlation between (weekly) FWC field flow sampling and (daily) rainfall records to derive a total outflow per creek…. *Cf.* challenges highlighted in section B1] above.

FWC Across Island - Creek Conductivity Variability

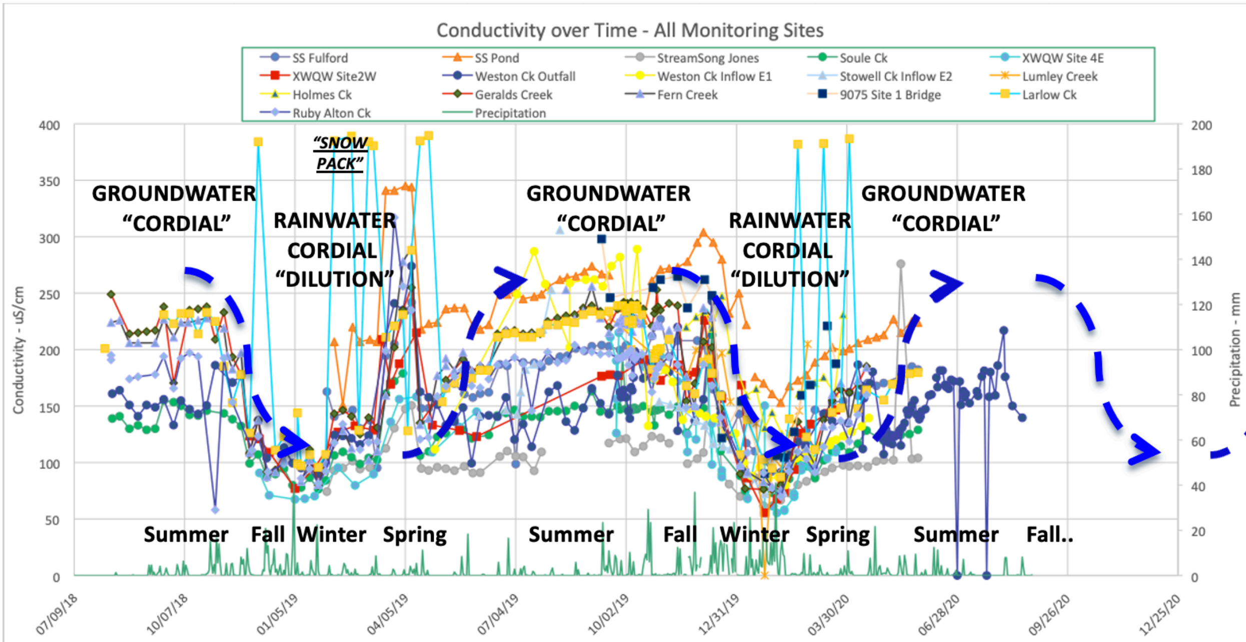

Figure _ Across island watersheds creek conductivity vs flow compilation - highlighting distinct island (watershed) area and seasonal chemistry variability chart needs updating to 2023

Working Model(s)
Distinct island (watershed) creek chemistry variability (discrete "fingerprints") may indicate:
- Areal (per watershed?) variations in groundwater inflow (aquifer) source(s)
- Seasonal groundwater dilution by precipitation potential discrete creek system spikes or outliers

Examples

As per figure x above the majority of the island's creek systems show a systematic seasonal flow-chemistry pattern attributable to fluctuations in groundwater baseflow components as a function of rainfall dilution of the surface systems. However, isolated SSI creek systems in the regional island-wide picture do give "outlier" chemistry values, either as spikes (LRCK, Larlow Creek; GGCK, Swanson Creek) or as consistent outliers (9178, Hudson Point)?

Ganges Creek Watershed: the"GGCK Swanson Ck Hereford Mdw" sites show unusual seasonal conductivities (limited dataset!). These are "oddly" (high) for winter season flow/pptn, more typical from the datasets is that across-island all conductivity signatures "come together" at low (<150-100 microseimens/cm) in winter. We have only one other creek with these higher winter chemistry values, Larlow Creek in the south.

Larlow Creek Watershed: Larlow Creek sporadic spikes may be attributable to some sort to anthropogenic overprint, perhaps road salt (though air T freezing days vs chemistry spikes not plotted yet), or something else…. a grow-op in the creek shed?, or…

9178 (Fernwood) Watershed: Hudson Point Creek….

FWC creeks, groundwater (base flow) vs surface flow correlation - a potential model for island-wide watershed creek *percentage* groundwater inflow (baseflow) vs surface flow determinations?

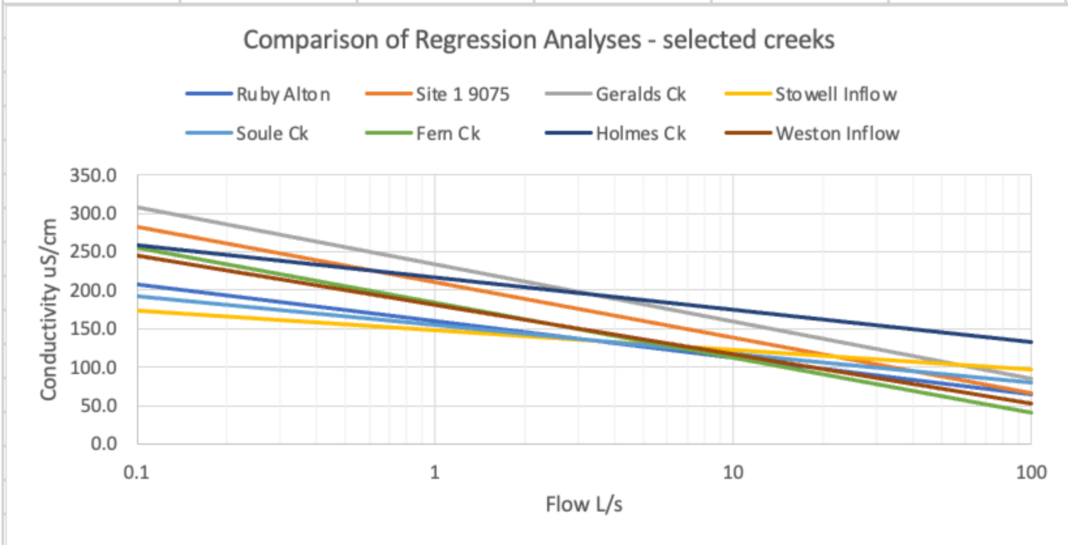

Figure _ Across island regression-lines for key (higher R2) creeks

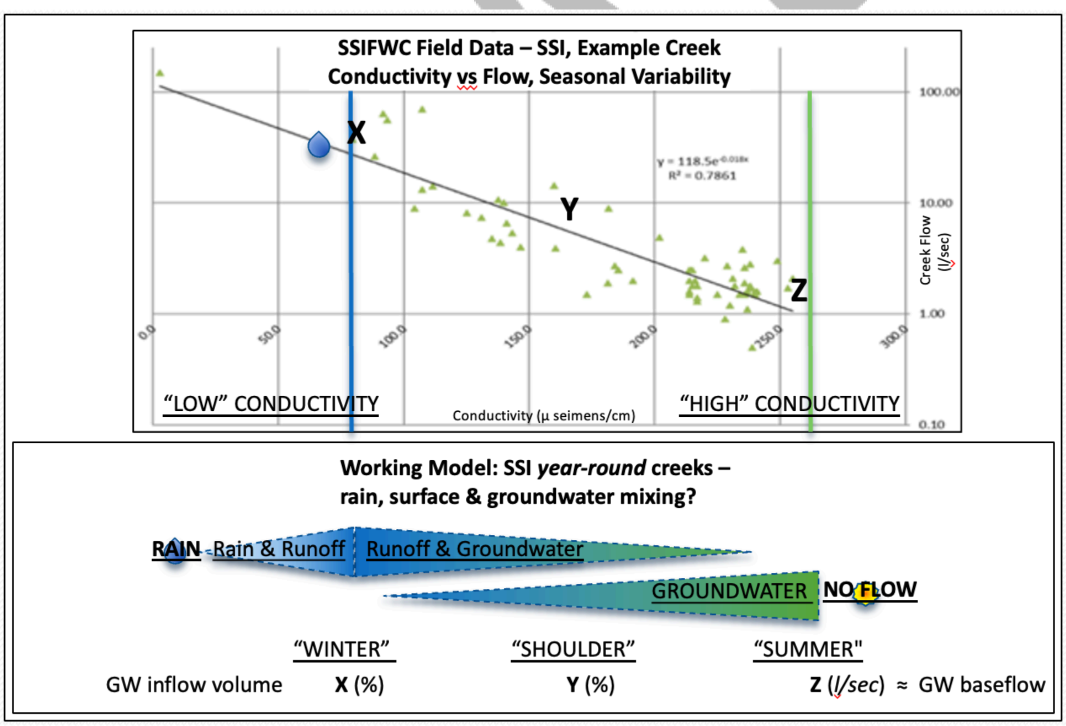

Figure _ Island conductivity vs flow model, based on flow vs conductivity correlations (cf. illustrated Soule Creek, Geralds Creek examples in figure _ (a) and (b), and figure_ above). Seasonal variability in creek chemistry associated with distinctive groundwater(+) "cordial" fingerprints, and seasonal variability in creek chemistry modifier attributed to surface freshwater (precipitation) groundwater chemistry "cordial" dilution.

Working model(s)

A background groundwater signature is typical visible in the island's FWC creek dataset, with creeks with a clear groundwater fingerprint (water temperature, conductivity, through-summer flow), and having distinctive summer groundwater signature "a groundwater cordial" which represents dominant groundwater inflow (or baseflow).

In multiple creeks seasonal increases in precipitation result in this groundwater signature being overwhelmed by seasonal rainwater dilution "rainwater cordial dilution.

Island wells cross-island deep - shallow well conductivity comparisons and data interpretation

FWC wells deep vs shallow, and watershed area conductivity variability

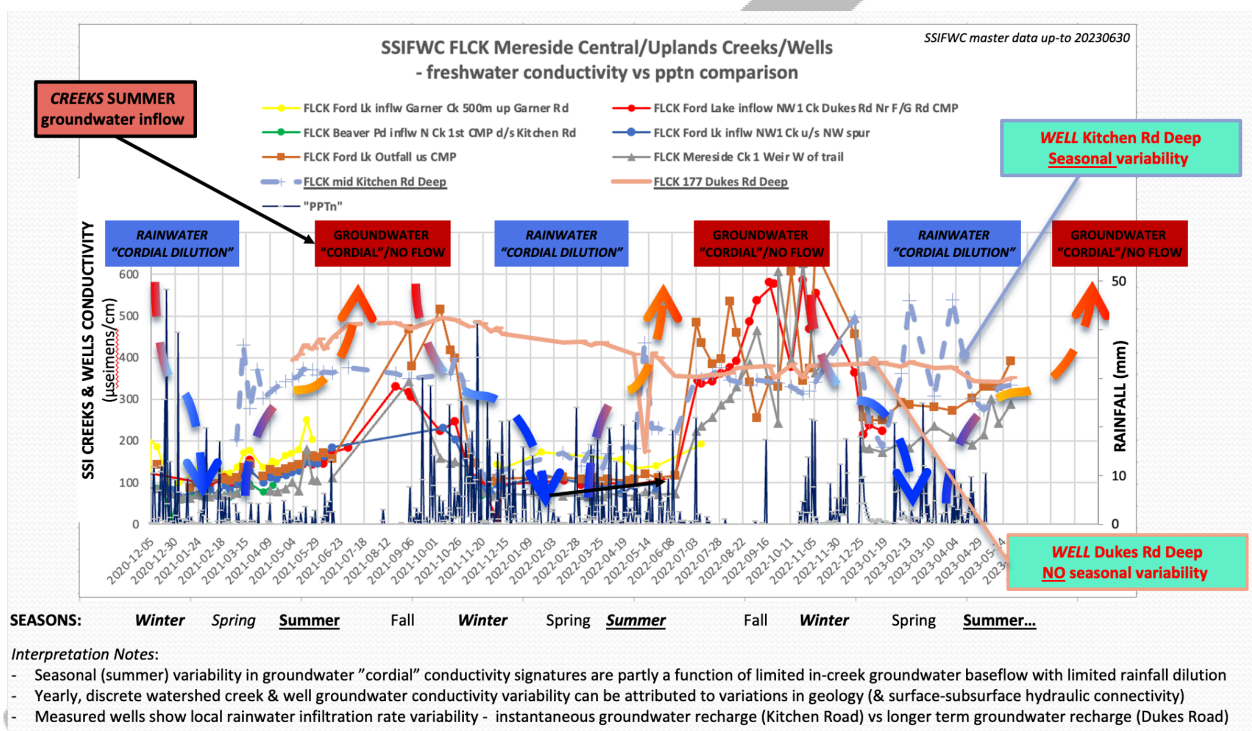

Figure _ Central -island deep/shallow well vs surface water chemistry comparisons and impact of Pptn (or not)

Figure _ Across-island deep/shallow well vs surface water chemistry comparisons -TBD

Working Model(s)

Distinct island (watershed) *creek* chemistry variability (discrete "fingerprints") may be expressed/mimicked (with offsets) by *wells* in the same subaquifer and watershed) regions, this would improve our understanding of:

- the relationship between creek and aquifer groundwater inflow (baseflow)chemistry
- the potential for (per watershed/subaquifer?) groundwater (aquifer) source(s) determinations
- improved understanding of the (instantaneous) impact of seasonal precipitation on groundwater dilution (or not)

[C] Updating Master Watershed(s) Workbook Datasets - guidelines for migrating "date worksheets" to "watershed worksheets" (courtesy of Anne Parkinson; *cf* section G on automating "moving monthly data *automatically* with macros" - currently a *work in progress* courtesy of Daphne W.)

FWC field data QC, monitoring and interpretation needs to be done in Excel (charting and macros used to format data are designed for Excel use only – see [D] below for further details.

1. Open your web browser and navigate to 'the relevant Google Drive data analysis area/volunteer working group folder under [SSIFWC Data sharing - processed]
2. Download and and select the relevant MasterSSIFWCData (Date) V3.xls file. This spreadsheet will have been shared with you by John Millson. The most current date will be indicated in the title.
3. Open MasterSSIFWCData (Date) V3 and download to your desktop. This is to ensure that if any errors occur while working on your downloaded file, you can always re-download the MasterSSIFWCData (Date) V3 which remains intact in Google Drive. Also, working in Google Drive does not have the same function capacity as Excel. To download the open MasterSSIFWCData (Date) V3 spreadsheet, select from the top bar "File/Download/Excel .xlsx"
4. Find the download copy on your desktop (or whichever folder your downloads are stored) and edit the file name to include today's date, your initials and area eg "MasterSSIFWCData (Date) V3 Jan.9.21 AP Fulford Watershed".
5. Open your copy and review the tabs across the bottom of the sheet. Starting on the left, are a series of dates followed by tabs such as 'Walkers', 'Revision', 'HistoricData', scrolling further right the names of creeks will appear and further right still various freshwater indicators such as 'pH'.
6. Your mission (should you choose to accept!) will be to copy and paste from each monthly tab, the data relevant to your creek.
7. Find the creek you want to update and open the tab to view the sheet. In columns I Year and J Date, scroll to the last entry. Remembering the last date entered, you will now scroll back to the left and find that month. Eg. If I am updating 'GDCKGeraldsCk', I see the last entry was 2021-04-25 and so will scroll left to find that month 'April31'.
8. Working with two screens open will make this copy/paste function much easier! rather than constantly scrolling left and right. With your specific creek tab open, go to the data sheet menu and click 'View/New Window'. When the new window pops up, go back to view and click 'Arrange All'. Select your preferred option of having the windows one below the other (Horizontal) or side by side (Vertical).
9. In one of the windows (1), scroll to the left to view monthly data tabs, open the last month of entry (eg.Tab 'April31') and scroll or use the upper right box 'Search Sheet' to find your creek. In the other window (2), scroll to the creek you are updating and check that the dates for that creek ('April31') were properly entered.
10. In Window1, move to the next consecutive month (ie. Tab 'May31') and scroll or use the upper right box 'Search Sheet' to find your creek. Highlight the relevant dates and select 'Copy'. In Window2, highlight the row under the last date entered and select 'Paste Special' (not regular

'Paste'). The data from the date tab should now be added to your creek tab. Please change the colour of the data you just added to make it easier for differentiating the months added.

11. Proceed to cut and paste for each month available so that your creek is fully updated. Continue the process for each creek for which you are responsible.
12. Save and share your updated sheet back to the relevant area/watershed Google Drive folder for a merge with the main "Master FWC processed dataset!

[D] FreshWater field data workflow - raw FWC cloud, & UVIC weather - *field data worksheets* and processed *watersheds worksheets* Master workbook integration (cf workflow - page 1)

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1.0 Introduction

The Freshwater Catalogue is a Citizen Science based effort collecting data on the creeks and watersheds of Salt Spring Island. Field measurement of flow in creeks (using a variety of techniques) and simple chemistry data are collected with an APP developed using Epicollect5. As the project has grown, the APP has been modified and updated to allow additional field measurements, and is referred to Fresh Water Catalogue Version 3 (supersedes Version 2 and Version 1). Epicollect5 does not support any mathematical functions and as a result, calculations required for flow, and for chemistry-flow analyses, take place externally. The primary repository of data is within EpiCollect5. To allow for additional graphical representation and analyses of these data, entries from EpiCollect5 are downloaded, modified and presented in an Excel Workbook, referred to as the Master Workbook. This Workbook was developed using Microsoft Excel 2019 for PC. There are differences in date formats between Macintosh and PC, which are discussed in Section 3.

The Master Workbook records all monitoring data (flow related measurements, simple chemistry and observational data). The Workbook contains 18 individual worksheets, each corresponding to one specific watershed. Each worksheet includes one or more tables, depending on how many monitoring locations are in the watershed. Each worksheet has the same number of columns of data; however, not all columns are utilized in every worksheet. Each monitoring site typically has a minimum of three graphs. These include flow, conductivity, pH and water temperature over time, flow versus conductivity, flow and precipitation over time, and air and water temperature over time. Additional comparison graphs have been created when there is more than one monitoring location with a single watershed. There are additional worksheets as described in Section 3.

The Workbook is typically updated monthly. Based on experience, this is most judicious use of time, as opposed to weekly or quarterly updates. This manual has been prepared to provide guidance to future volunteers. The Workbook is stored on the FWC shared Google space. A solid knowledge of Excel and general computer skills are required.

The primary components included in an update are as follows:

- Retrieving precipitation and temperature data for Salt Spring Island
- Downloading data from Epicollect5 – SSI-watershed groups - Version 3 and modifying data to fit Master Workbook format. The Version 3 Workbook includes data collected with APP Version 2.
- Quality review of data, particularly as related to cross-sectional area measurements, and general entry errors.
- Updating each table within an individual worksheet for each of the monitoring sites. Note that graphs will update automatically until a certain number of entries are reached (although there is a simple mechanism for addressing this issue).

The following sections address each of these components.

1. <u>Updating precipitation and temperature data</u>

Temperature and precipitation data are taken from the School Based Weather Station Network found at http://www.islandweather.ca/

More specifically, data has been taken primarily from the Gulf Islands Secondary School (GISS) Station. On some occasions, GISS has incomplete data and then Fernwood School station is used. This data has been compiled on a monthly basis since January 1, 2018 and is complete until December 7, 2020 - ONGOING, 202206.

The steps are outlined as follows:

1. Open the latest workbook containing the FWC data, located https://sites.google.com/view/freshwater-catalogue/resources/data-access The naming convention is **MasterSSIFWCData Date V3**. Click on the worksheet weather and scroll down to the latest measurements (Figure 1).

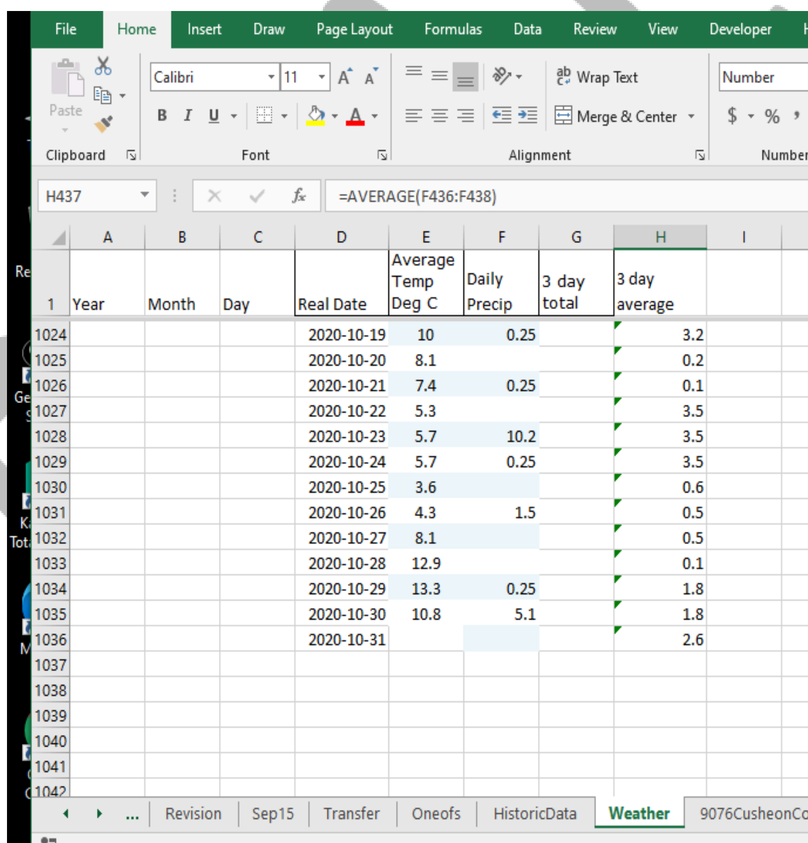


Figure 1 Weather Worksheet (note it has been updated since this screen shot was taken)

2. Open browser, and go to the main page of http://www.islandweather.ca/ . Select Gulf Islands Secondary School (or a SSI school site which is active) from the drop-down menu. (Figure 2)

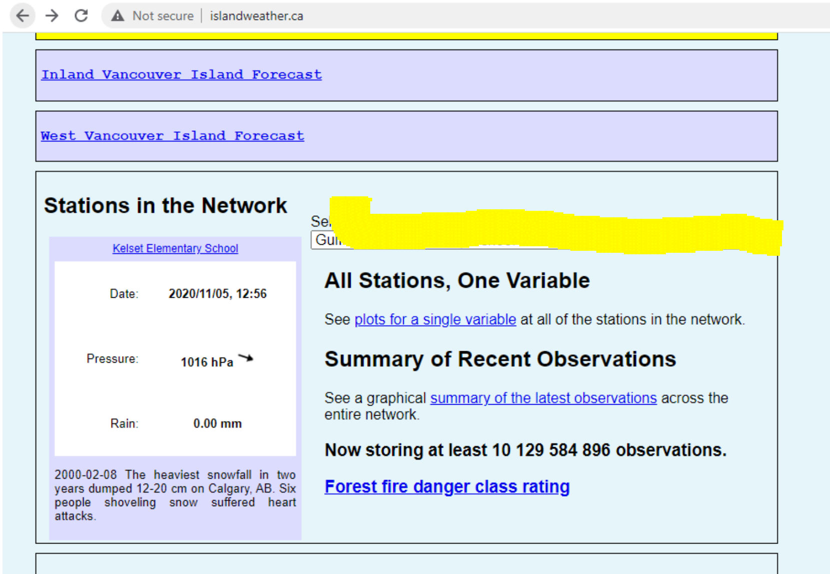


Figure 2 Main Page – Islandweather website – drop-down menu highlighted.

3. The Station page will be displayed. Select More Data. From this menu, *Temperature (average)* and *Total Rain Data* are used in the FWC master workbook. (Figures 3 and 4)

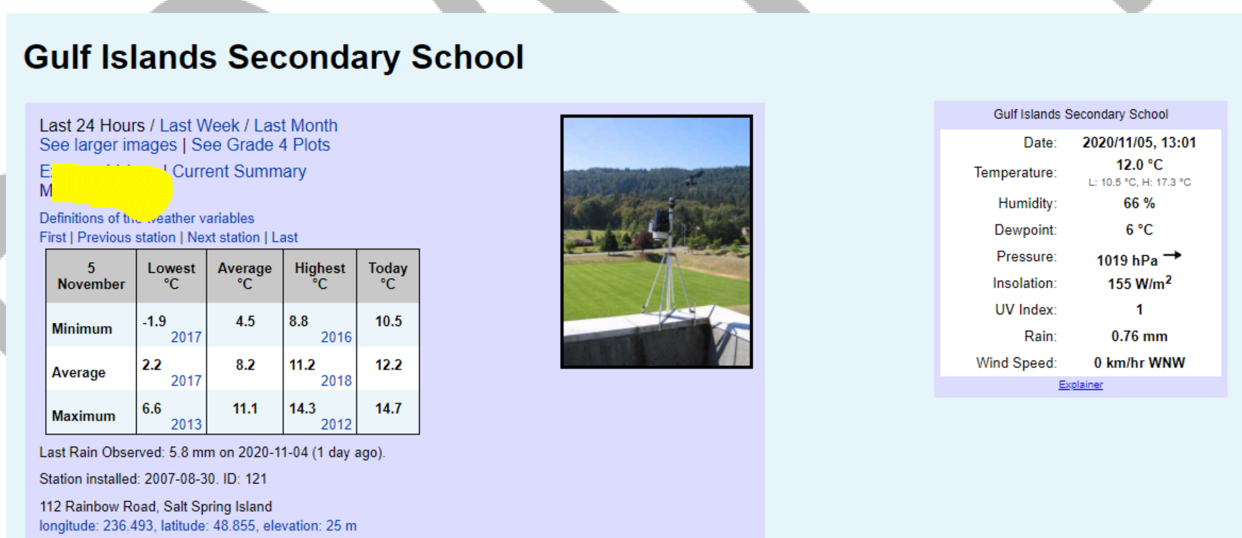


Figure 3 Gulf Island webpage - More Data highlighted

Data Summary Options

Gulf Islands Secondary School

Choose from the list below.

- Data Browser
- Average Data Browser
- Moment in Time Data Browser, select a moment in time, see all stations.
- Monthly Summary Data Browser, Select a month and a station.
  - Monthly Means, Select a station and a month.
  - Annual Means, Select a station.
  - One Year of Monthly Means, Select a station and a year.
- Temperature Records for Today.
- Total Rain by Month
- Count of Days of Rain by Month
- Heating Degree Days
- Growing Degree Days
- Probability Density Functions (PDF) of Daily Temperatures
- Probability Density Functions (PDF) of Total Daily Rain

Figure 4   Data Summary Options – Data of Interest Highlighted

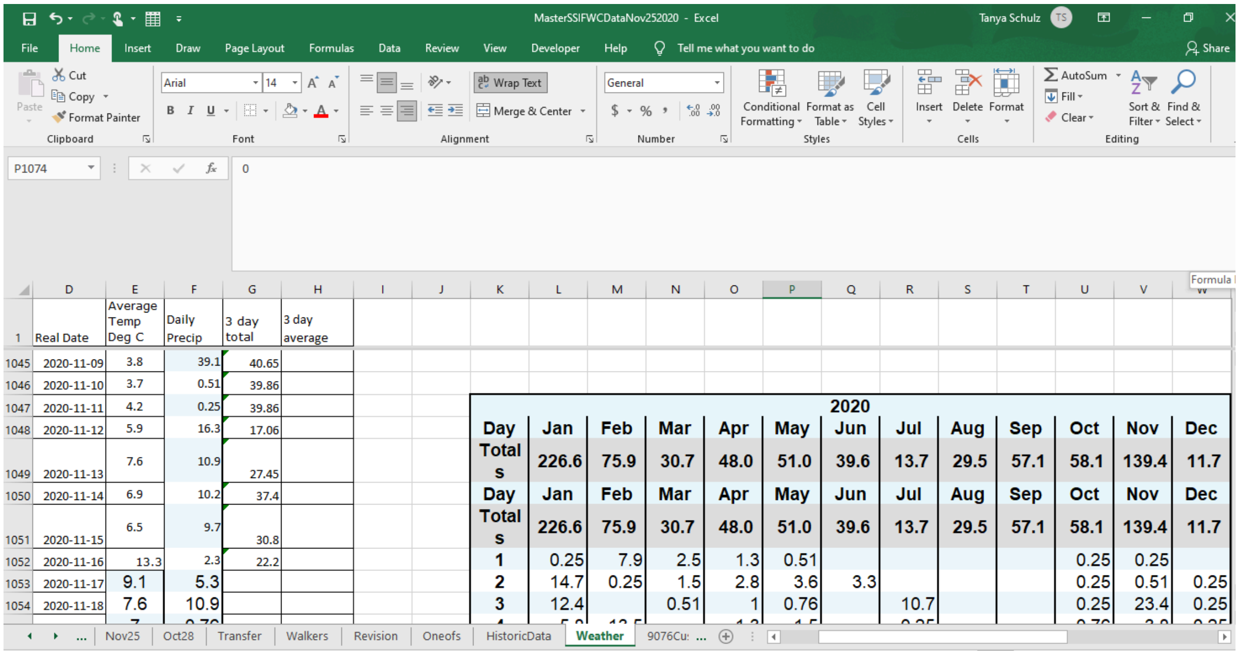
4. The Temperature Data is displayed as a table with Months as column headers and day of the month in rows. Select the entire table, copy [ctrl c] and paste [ctrl v] into the "weather" worksheet. The website does not allow to one to select only one column (month of data), but rather the entire table. (Figures 5 and 6)

Select a year: 2020

Select a different view: Minimum | Average | Maximum | All

2020												
Day	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
1		-5.2		5.2	11.2	12.9	15.1	17.1	16.2	15.1	6.2	
2		-4.0	6.2	5.1	10.1	11.3	15.1	17.0	16.1	15.4	6.9	
3		-1.6	7.3	4.8	8.6	13.1		17.3	17.8	12.0	10.4	
4		1.0	7.2	4.7	9.0	13.4		19.9	19.2	12.3	14.5	
5		1.1	6.6	7.6	12.1	14.1	15.5	18.2	15.0	13.6		
6		-4.3	3.5	6.3	13.0	13.3	15.0	18.0	16.8	13.6		
7		-4.9	2.6	7.3	11.9	13.6	15.4	16.2	20.7	13.7		
8	3.2	-6.9	2.8	8.4	15.8	14.4	14.0	16.2	17.9	14.2		
9	2.3	-5.0	2.5	9.2	17.6	12.1	15.8	17.1	19.7	13.4		
10	-5.2	-5.0	6.4	9.6	18.6	14.6	14.7	17.9	20.0	13.1		
11	0.8	-5.7	7.8	10.3	17.1	14.5	13.7	15.7	15.7	10.2		

Figure 5   Example Temperature Data from Islandweather website



Real Date	Average Temp Deg C	Daily Precip	3 day total	3 day average
2020-11-09	3.8	39.1	40.65	
2020-11-10	3.7	0.51	39.86	
2020-11-11	4.2	0.25	39.86	
2020-11-12	5.9	16.3	17.06	
2020-11-13	7.6	10.9	27.45	
2020-11-14	6.9	10.2	37.4	
2020-11-15	6.5	9.7	30.8	
2020-11-16	13.3	2.3	22.2	
2020-11-17	9.1	5.3		
2020-11-18	7.6	10.9		

						2020						
Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Totals	226.6	75.9	30.7	48.0	51.0	39.6	13.7	29.5	57.1	58.1	139.4	11.7
Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Totals	226.6	75.9	30.7	48.0	51.0	39.6	13.7	29.5	57.1	58.1	139.4	11.7
1	0.25	7.9	2.5	1.3	0.51					0.25	0.25	
2	14.7	0.25	1.5	2.8	3.6	3.3				0.25	0.51	0.25
3	12.4		0.51	1	0.76		10.7			0.25	23.4	0.25

Figure 6 Example of data table copied and pasted into weather worksheet. Table on right from website.

5. The data for the appropriate month is then copied and pasted into the excel primary weather table. [i.e. the table on the left in Figure 6]
6. Total Rain is displayed as monthly totals; however, there is the option of displaying all rows to see daily totals. Data can be downloaded as .csv file, but it is more expedient to copy similar to the temperature data.
7. Once the required data is entered into the primary weather table, the tables copied from the website can be deleted [i.e. the table on the right in Figure 6].

In the worksheet, the column "real date" is entered by copying and pasting the last populated cell in the real date column down the required amount of rows (so that temperature and precipitation are associated with the correct date for graphing).

3. Downloading Epicollect5 data – Version 3

To download field data (Figures 7 to 9):

1. Sign in to Epicollect5 and proceed to My Projects.
2. Click on Freshwater Catalogue Version 3
3. Click on View.
4. A new page is displayed, click on View Data
5. Click on Download in upper right hand corner
6. Select the time frame, depending on the frequency of updates (30 days or custom time frame)
7. Click download

   202207 Note - the Epicollect downloads work with the system generated "uploaded_at" date, this means that if volunteers enter (upload)data after the data collection day (eg data collected in April is uploaded to SSIFWC cloud in May), depending on the data download frequency the downloaded monthly data in the SSIFWC Excel Master dataset may be downloaded/associated with the incorrect month (eg is captured in “May” rather than “April”) note - the data will be captured in the following months download, eg is “in May”). This date stamp issue does not impact the Pacific DataStream dataset which directly accesses from the Epcollect cloud only the “monitor_date”. data for charting.

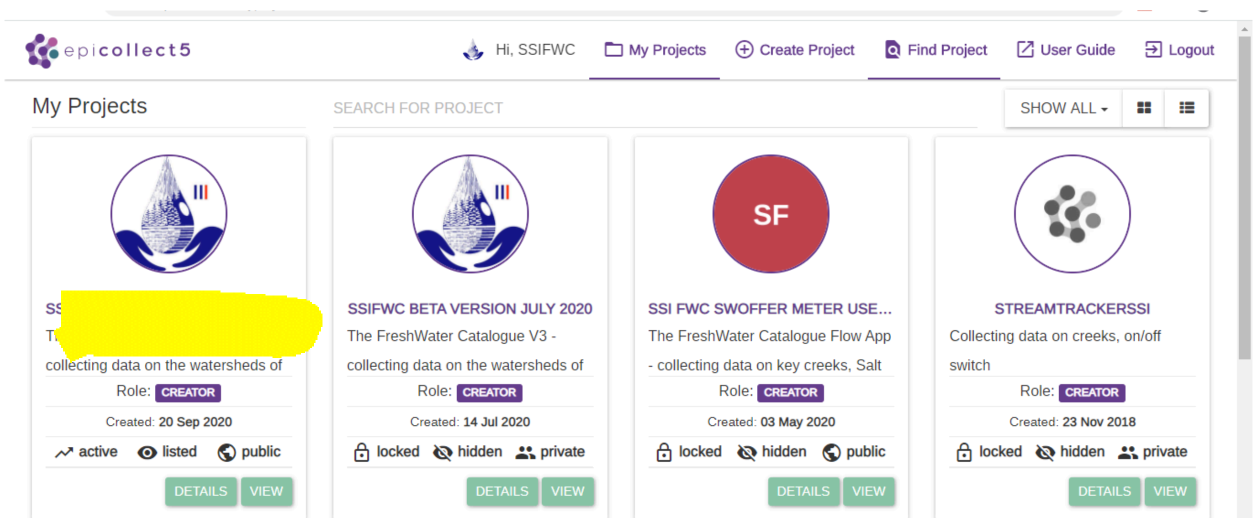


Figure 7 Main Page Epicollect5 – Version 3 highlighted (not all these versions visible to different users

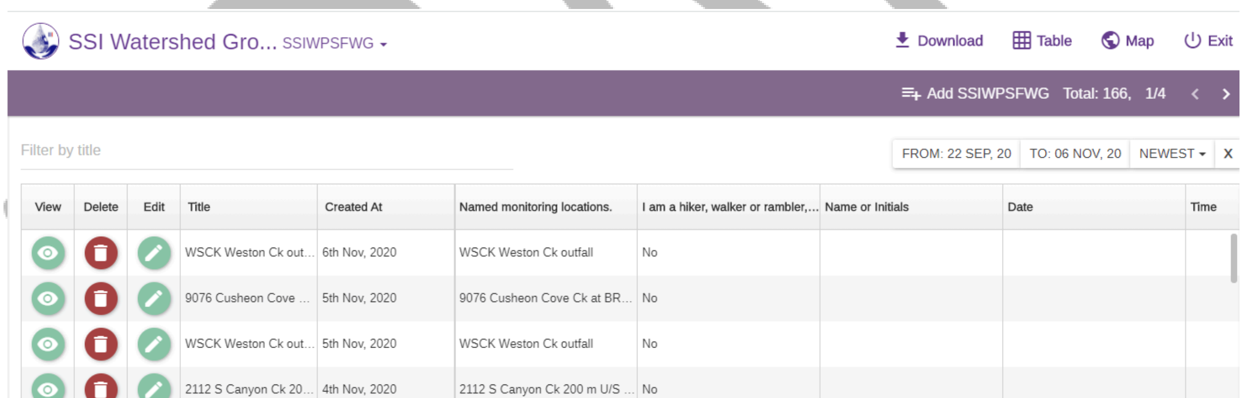


Figure 8 View Epicollect5 data

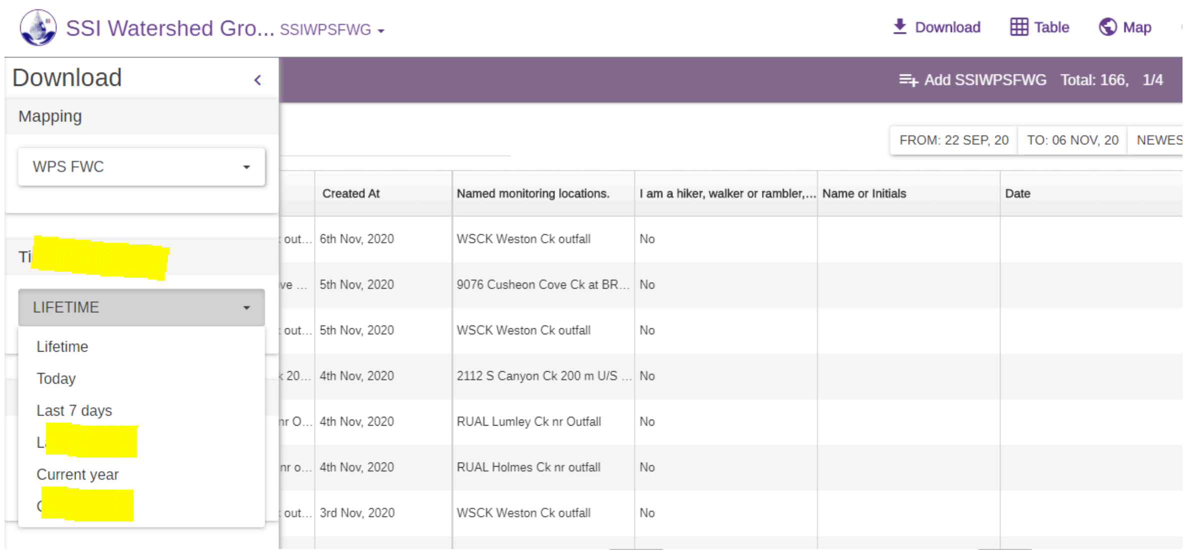


Figure 9 Time Frame for Download

A zip file (with .csv data) will be created. Extract the .csv file and copy it into the last version of the DLV3FWC Workbook. **Save As** Excel workbook with name DLV3todaysdate (i.e. DLV3Dec 8 2020). **Note: These notes were written and tested on a Windows Operating System using Microsoft Excel 2019.**

The .csv file from EpiCollect5 has to be modified to be consistent with the Master Workbook format. This can either be done using specifically coded macros or by manual manipulation. Using macros is the preferred method, but instructions are also provided to carry out the modifications manually.

3.1 Macro Version: Modifying the download data to match the workbook format.

A macro enabled excel workbook has been developed that modifies the .csv file from EpiCollect5. Ensure that the Developer tab is available when Excel is opened. If not, proceed to File/more/options/customize ribbon – and ensure a check mark is beside Developer]

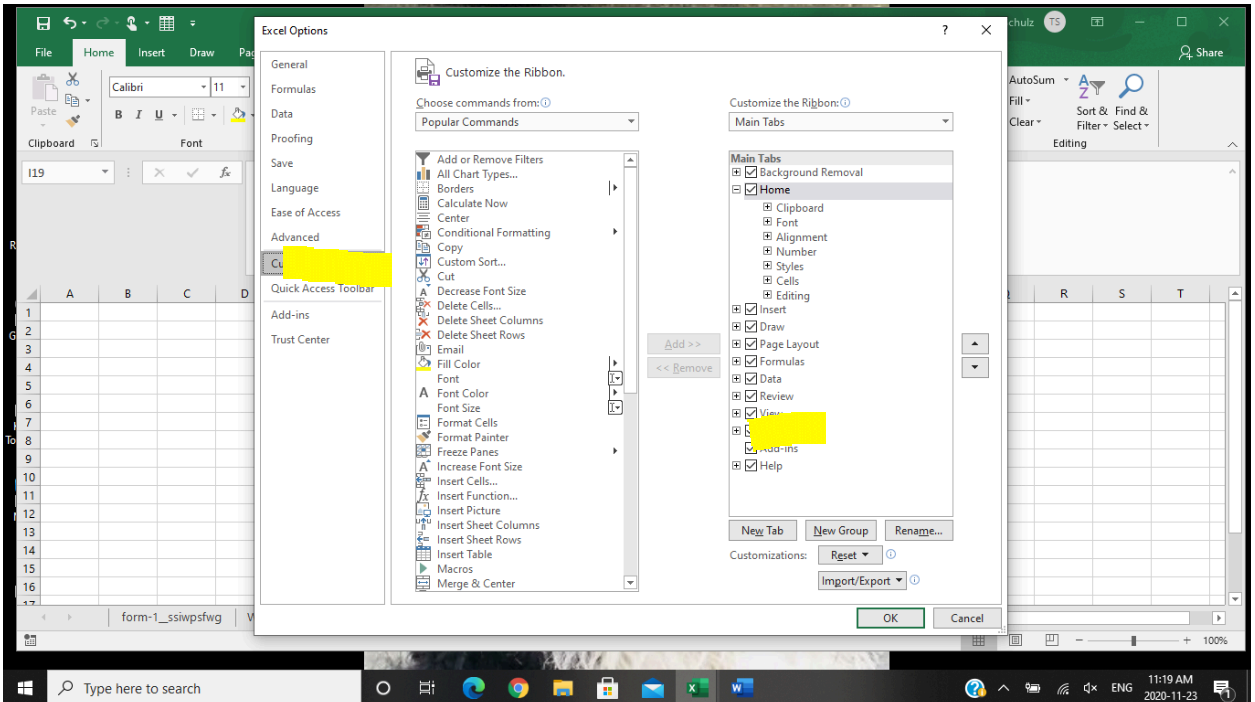


Figure 10 Developer is added as a tab

1. Open workbook DLV3"date".
2. Copy the .csv file (Epicollect5) into the workbook, keeping the same name **form-1__ssiwpsfwg**. [Right-click on the worksheet tab and select Move or Copy, [ensure create a copy is turned on], and select the DLV3date as the destination Workbook.]
3. Save As DLV3date.xlsx
4. Review the Walker column [Column F] to see if there are any **Yes** responses. Cut and copy these rows to the separate worksheet titled Walkers. At present, little is done with this data, but a record may be required for future "new site investigations" review. [To search column, select column by clicking on header, and use the Find function on the Home Tab to find Yes responses.]
5. Review the visit_type Column [Column AF]. For those rows that contain **Recce**, cut and copy those rows to the separate worksheet titled **Recce**. [Highlight column by clicking on header, and use the Find function on the Home Tab to find Recce responses.]
6. NB adding Secchi Disk depth into our V3 App (**202202**) added an extra "47_Secchi_depth_m" (column AV) on the Epicollect5 .csv export file. This "AV" column needs ***removing*** before the Excel 2021 macros version run (until these macros are updated…). Note - this secchi field data attribute .csv export column addition does not appear to have impacted our webmap data displays ((which use more flexible Jason (JSON) data attribute headers rather than fixed and named Excel columns))
7. **202303** and **202305** additional field data attributes added in under "Turbidity" (*Turbidity NTU, NTU_device_type*) and "Water Quality" (Coliform; *total, fecal, E. coli*), with some additional fields ("xxx_*Null_for_now*") also added by the Epicollect5 App software… These various water quality parameters have added additional columns to the Epicollect5 .csv file. Note these columns need to be removed (nine columns) and moved (one column) before running the Excel 2021 macros (process steps summarised in Table _ below; see also 6. above)

202401 additional data fields added to capture stream velocity board. These additional water quality/flow parameters have added additional columns to the Epicollect5 .csv file

Import columns to be removed or **moved** from raw SSIFWC download	Name of data in import column for deletion	Comments
AV	47_Secchi_depth_m	SSIFWC Epcicollect5 data field added to record Maxwell Lake data
DZ	138_Wetted_width_cm_	Field mistakenly added (duplicated) during 2023 SSIFWC cloud database updates to capture turbidity
EA	139_Turbidity_NTU	Field added for 2023 SSIFWC cloud database updates to capture turbidity
EB	140_Null_for_now	Field added by system during 2023 SSIFWC cloud database updates to capture turbidity
EC	142_NTU_device_type	Field added for 2023 SSIFWC cloud database updates to capture turbidity
ED	143_Weeks_since_last	Field added for 2023 SSIFWC cloud database updates to capture turbidity
EI (eye) to EL (with column AV above removed) ie, after column "EK" "chlorine_test_strip"	temperature_air	Field moved by Epicollect5 SSIFWC cloud database updates during 2023Q1/Q2 to capture turbidity and/or coliform data
EJ	150_Coliform_total	
EK	151_Coliform_fecal	
EL	152_Coliform_E_coli	
DI to DW	115_VELH1 to 129_VELH15	added in 202401 update
DY	velocity_bd_lpersec	

Table _. Tabulation of SSIFWC cloud data export Epicollect5 fields (imported cloud files "xxxxxx ") that need to be deleted (nine columns) or moved ((one column) for 2021 macros to work!

OR WE NEED TO UPDATE THE 2021 MACROS!

8. **Note:** Items 4, 5 and 6 are best performed manually as they may or not be present in every download and no macros have been developed to address these. Item 7. is required to ensure 2021 macros work!
9. Review data in monitor_date [Column T] to ensure all entries have a date included. In some instances, for some unknown reason, these are not included. If there is no date, macros will not function as intended.
10. Go to Developer tab.

11. Go to Macros, and run macros in the following order. [These **macros are set-up based on a maximum of 200 entries** in the download .csv file. This is generally sufficient when downloading of the .csv file takes place on a monthly basis. There will be errors if > 200 entries.
    a. Deletecolumns [This deletes columns not required in the Workbook]
    b. Realdate [This converts the text entry of date in EpiCollect5 to the date format recognized by Excel]
    c. Addculvert [This adds a column to the worksheet – for calculation purposes]
    d. Sort [This sorts data in the worksheet by title, and then by date, so monitoring sites are grouped together in subsequent rows, with newest entries last]
    e. Formulas [This adds the formulas that calculate cross-section areas and flow]

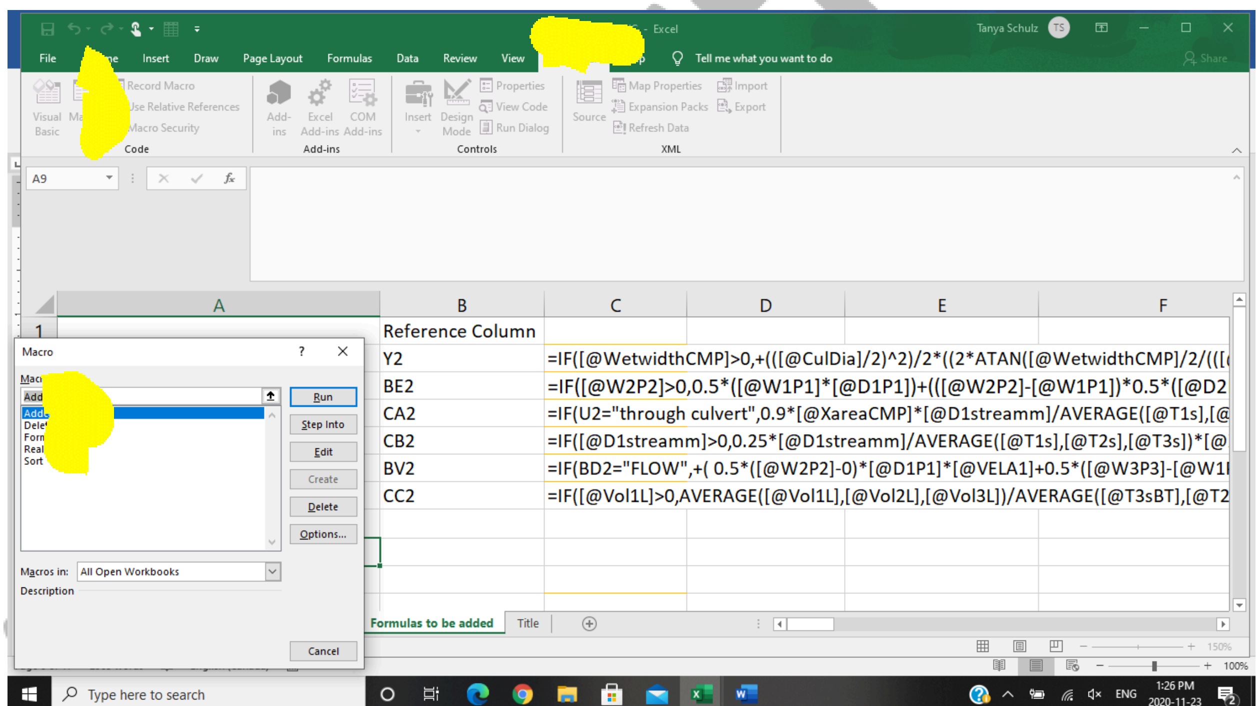


Figure 11 Developer Tab – Run Macros

12. Carry out a review to confirm data entries are correct. Reference https://sites.google.com/view/freshwater-catalogue/field-notes/what-to-record Specific issues to date have included:
    a. Leaving off last data point in width – depth measurements for cross-section area. The last point should be equivalent to wetted width and depth of 0. If necessary, enter manually. Manual entries should be highlighted in red/yellow for the record and FWC Cloud sourced (Epicollect5) Master data updated accordingly.
    b. Occasionally, the width entry is mistakenly entered in the depth column.
    c. Related to the d1streamm (float distance) entry, this number is to be entered as metres. Sometimes it is entered as cm.
    d. In the past, sometimes data for calculation of cross-section area was not included. This will result in errors.

13. At this point, copy the entire table into Master FWC Workbook to a separate empty worksheet and rename the worksheet with the date. **This MUST be done using the copy and paste special (values and number format, so as to not transfer the formulas directly).**
14. Data is now ready to be transferred by **cutting and pasting** individual rows or groups of rows to corresponding site worksheet. By cutting specific rows out, it is easier to track progress.
15. The graphs [excel charts] within the worksheets are scatter charts, where and X and Y range are defined [eg. X value = date, Y value = flow]. For each of these graphs, the X and Y range has been set to the extent of the table. For example, there may be only 28 rows of data, but when setting the range for the graph, (for both x and y), they are set to X2..X128, Y2..Y128. The data points on the graph only reflect cells that have an entry in them. As soon as new data is added in the rows, graphs will update automatically. Additional instructions are provided in Section 4 for modifying/resizing the table to continue updating the graphs.
16. **NOTE: Macintosh versions of Microsoft Excel default to the 1904 date system, based on early versions of the Mac OS and beginning with January 1, 1904. Under Windows, the default 1900 date system begins with January 1, 1900. Unfortunately, this results in a difference in dates when moving files between the two different operating systems [an issue with older Mac OS /Excel only - V16.63 Excel for Mac M1 no errors for these macros]. To circumvent this problem, type in following formula @if(I2>0,@date(I2,H2,G2),"") in column J2. Modify the row number (2 in this case) to reflect the actual row number.**

3.2 Manual Version.

A manual version was created for users who do not like or are uncomfortable with employing macros written by others.

1. Open the .csv file from Epicollect5 and copy into Workbook DLV3FWC Manual [this workbook must be open]. [Right-click on the worksheet tab and select Move or Copy, [ensure create a copy is turned on], and select the destination file DLV3FWC Manual Workbook].

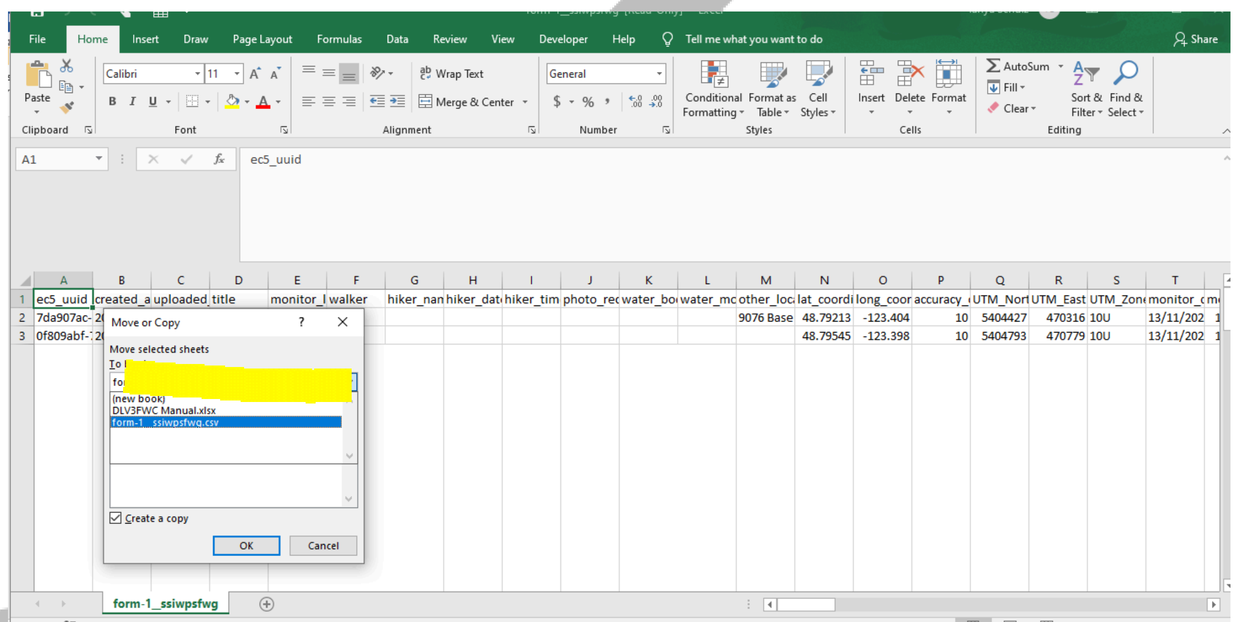


Figure 12 Making a copy of Epicollect worksheet for transfer to Workbook

2. See Steps 3 to 6 above in macro version
3. Not all columns of data in the download file are required in the workbook as the focus of Excel is to facilitate calculations and graphing. In the form-1ssiwpsfwg worksheet, delete the following columns manually.

ec5_uuid	created_at	uploaded_at
monitor_location	hiker_name	hiker_date
hiker_time	photo_record	water_body
water_movement	other_location	UTM_Zone_Coordinates
Safe_to_work	No_people	Water_moving
Flow_type	Visit_type	gen_land_use
other_land_use	water_use	other_water_use
drainage_sources	terrain	water_level
vegetation	canopy_coverage	surficial_geology
water_surface	algae	algae_extent
location	reference	photo_pond
qual_or_quant	rate_of_flow	describe_water_level

photo_us	photo_ds	additional_photo_1
additional_photo_2	short_video	photo_wq1
photo_wq2		

4. Go the Column monitor_time. Type /ic 3 times [This will insert 3 empty columns]
5. Go to Data Tab at top of worksheet.
6. Go to monitor_date first entry. Holding shift key, press end then down. [this will select entire column].
7. Select text to columns function on ribbon.
    a. Select delimited. next
    b. Select other, enter / next
    c. First column set to date YMD
    d. Click on 2nd column – set to date YMD
    e. Click on 3rd column – set to date YMD
    f. Enter Finish
8. Excel may ask "want to replace data", click yes.
9. Enter column names as Day, Month, Year, Real Date in column G1, H1, I1, J1 respectively
10. Click on empty cell J2, type in following formula @if(I2>0,@date(I2,H2,G2),"")
    Note: if the cell contains a number after the formula is entered instead of a date, on the Home tab, select date in the number format drop down menu.
11. **Copy and paste** formula down to as many entries as there are in the preceding column. The number of entries may vary from download to download.
12. Go to Column CA (header float_flow_Lpersec), and insert column to the left [**/ic**]. In the new column, enter **FlowThruCMP** as the heading.
13. From the worksheet named "title", copy the first row to V3date worksheet, overwriting the existing header row. This is done as some of the formulas use the headers as reference.
14. If not already completed, convert to Table format using the function on the Home tab.
15. From the formula worksheet, copy and paste the formulas into the V3Date worksheet. The column references are provided. The formulas that calculate the x-section areas are to be copied first. Once pasted into the V3date worksheet – edit the formula to remove ' from the start of the formula (i.e. converting from text to formula). If the range has been converted to the table format, the formula will populate itself to the extent of the table. If not in table format, you must **copy and paste** the formulas down the individual columns.
16. Click on the Data tab. Use Sort function to have 2 sorting levels, the first by column labelled Title (A-Z), and then by Real Date (oldest to newest). [If the range has not been converted to Table format, you must highlight the entire range to be included in the sort]
17. Carry out a review of the data to confirm data entries are correct. Specific issues are identified in Point 9, in Section 3.1
18. At this point, copy the entire table in the master FWC Workbook to a separate empty worksheet (label worksheet with date). This MUST be done using the **copy and paste special** (values and number format, so as to not transfer the formulas directly.)
19. Data is now ready to be transferred to individual worksheets by cutting and pasting individual rows to the appropriate worksheet.
20. Existing graphs will update automatically.

21. See Note 14 from Macro version.

4. Updating Individual Worksheets

Table 1 shown on the following pages, identifies the existing worksheets in the master workbook as of November 11, 2020. There are 45 individual named tables pertaining to the monitoring program.

Each worksheet has the same number of columns of data; however, not all columns are utilized in every worksheet. These columns can be hidden if desired. Each monitoring site typically has a minimum of three graphs associated with it. These include flow, conductivity, pH and water temperature over time, flow versus conductivity, flow and precipitation over time, and air and water temperature over time. Some additional comparison graphs have been created when there is more than one monitoring location with a single watershed.

Any individual table can be accessed quickly by using the drop-down menu on the left-hand side a worksheet.

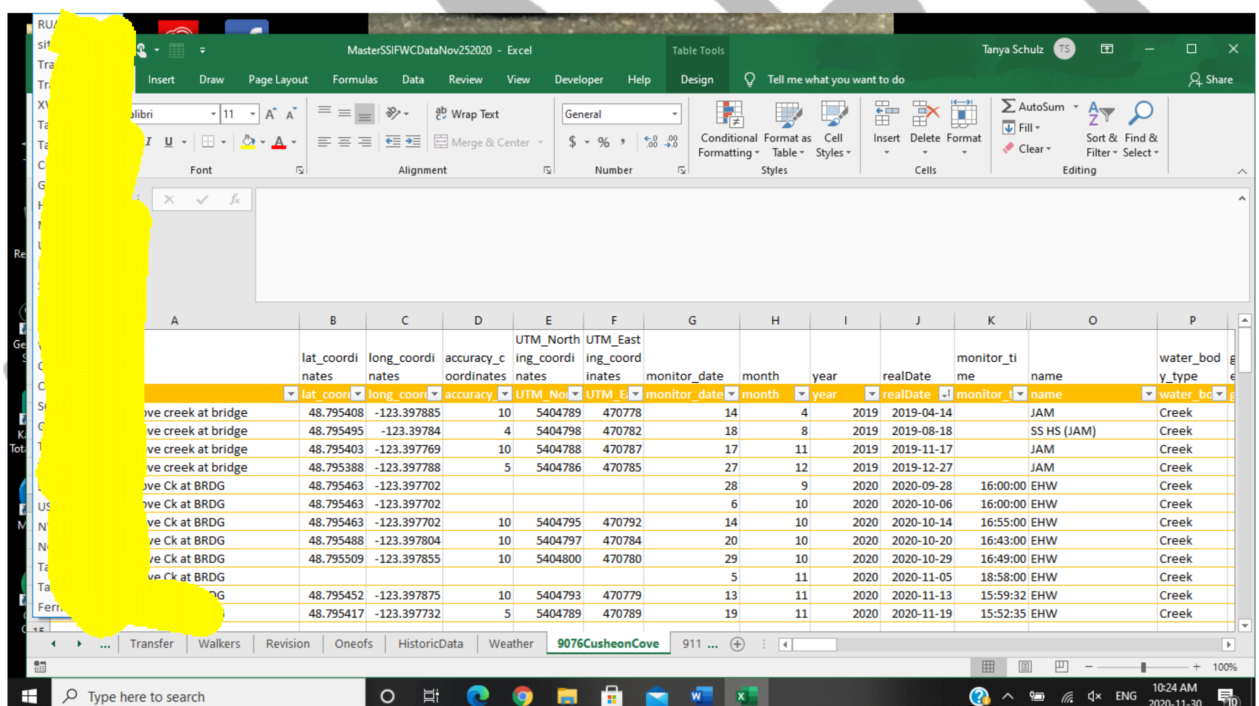


Figure 13 Access to tables using drop down menu

Each worksheet table has been sized to allow approximately 100 additional entries.

To update individual tables, Cut and Paste the corresponding rows of data into the worksheet. Graphs will update automatically until the original number of rows in the Table is reached (as indicated in Table 1).

Table size can be modified. The **preferred method** for inserting new rows is manually by clicking on a row number (within the designated Table) and entering **/ir** the required number of times. [The Table is demarked by different colored grid lines]. This eliminates the problem of overlapping tables and has the **added benefit of modifying the graph ranges automatically**.

Alternatively, the table size can be modified manually as follows:

- Click on any cell in the table
- A design tab will show up on the ribbon.
- Click on Design Tab
- On the left hand side of the ribbon, the Table name will be displayed as well as Resize Table. Additional rows can be added by changing the range in this box. For worksheets that contain multiple tables, ensure they do not overlap.

When this method is used, all ranges in the graphs will require updating to reflect the addition of new rows to allow for continued automatic updates.

4.1 Adding new worksheets

To add a new worksheet:

- Copy an existing worksheet by right click on the worksheet name, and click make a copy and select destination within the Workbook. It is best to use an existing worksheet with only one table.
- Rename the worksheet to the new monitoring site or watershed name (right click on the spreadsheet tab and choose rename option).
- Rename the Table [within the worksheet]. [See steps above related to modifying table size]. It is **best** to use abbreviated names so that the entire table name is visible in the dropdown menu.
- Copy data from the new site into the table, and erase any entries from the previous site if required.
- Update graph titles.

4.2 Adding new tables

To add a new table:

- Copy a header row from another table and place above the data.
- Click on a cell within the table and from the Home tab – use format as Table function. Ensure table has a header is clicked on.
- Click on a cell within table and the table tools (format and design) will be shown. Click on design to rename table and resize table to allow approximately 100 additional entries. Ensure it does not overlap with an existing table.
- To create graphs, copy an existing graph from within the worksheet, and change ranges for x-y data to reflect the new ranges.

Table 1 Worksheets and Tables related to Monitoring (Example - *Last Update 2020*)

Worksheets	Monitoring Location Name	Table Name	Rows Used/No. of Rows in Table
9076 Cusheon Cove	9076 Cusheon Cove Ck at BRDG	CusheonBRDG	4/100
9119GrandmotherTree (S)	Multiple sites, not divided into individual sites as yet	GmaCk (no graphs as yet)	13/100
9178HudsonPtOutfall	9178 Hudson Point Ck Outfall	HudsonPt	16/100
2017MadronaCkTrail	2017 Madrona Ck at Churchill Trail	MadronaTrail	19/100
	2017 Madrona Ck Upper Ganges CMP	UpperGangesCMP	23/100
	2017 Madrona Ck Nicks Pond	NicksPond	16/100
	2017 Madrona Ck Weir	SmallWeir	21/100
	2017 Madrona Ck Ram Spring	RamSpring	19/100
9192CypressCks (S)	9192 E Cypress Ck	ECypressCk	8/100
	9192 W Cypress Ck	WCypressCk	16/100
	9192 Cypress Ck Ganges Outfall	CypressGanges	2/100
2112CableCk	2112 Cable Ck WW Site 2	CableWW2	8/100
Misc. discontinued data sets at Cell A994	2112 Canyon Ck 200 m	SCanyon200	8/100
	2112 Cable Ck Gorge Narrows	GorgeNarrows	6/100
	2112 Cable Ck tributary Gorge Narrows	TribGorgeNarrows	6/100
	2112 W Ribbon Ck 20 m U/S from falls	WRibbonCk	12/100
	2112 Canyon Ck Gorge at base of Ribbon Falls	BaseRibbon	13/100
	2112 S Canyon Ck U/S Ribbon Falls	USRibbon	9/100
	2112 NW Cascade Ck 5m U/S upper waterfall	NWCascade	8/100
	2112 N Canyon Ck 100 U/S Mt. Rd. CMP	NCanyonCk	8/100
FNCKFernCk	FNCK Fern Ck CMP Outfall	FernCk	165/265
GDCKGeraldsCk	GDCK Geralds Ck Outfall	GeraldsCk	123/223
LLCKLarlow	LLCK Larlow Ck aka Grants Corner Ck	LarlowCk	129/229
MNCKManselCk	MNCK Mansell Ck CMP at Robinson Rd.	MansellCK	10/78
RUALWS • Includes other data not put into table yet	RUAL Holmes Ck	HolmesCk	31/141
	RUAL Lumley Ck CMP nr 1171 Isabella Pt. Rd	Lumley1171	17/128
	RUAL Lumley Ck at Sea Outfall	LumleyCkOutfall	17/117
	RUAL Ruby Alton Ck Outfall	RubyAlton	139/239

• Very limited data to date re: additional sites			
STCKStowellCk	SWCK Stowell Ck Outfall	StowellCk	118/218
	SWCK Stowell Lake Inflow Ck E2	Stowell In	36/150
SLCKSouleCk	SLCK Soule Ck aka Fulford Ck Spur	SouleCk	128/228
FLCKStreamSong + house well	FLCK Streamsong Jones Ck	SSJonesCk	89/189
	FLCK Streamsong Pond	SSPond	94/194
	FLCK Streamsong Fulford Ck	SSFulford	90/190
	FLCK Fulford Ck	FulfordMain	4/104
WKBKWalkerBk	WKBK Walker Brook Ck outfall to the sea	WalkerBkOutfall	9/109
+ misc.entries	WLBK Walker Brook Site 2	WalkerBK2	12/112
WSCKWeston +46 Misc Entries	WSCK Weston Ck Inflow E1	WestonInE1	70/170
	WSCK Weston Ck Outfall	WestonOut	194/294
XWQWSites	XWQW Site 2W welcome pole Ck CMP	XWQWSite2W	62/162
Additional data no graphs	XWQW Site 4E Welcome Pol Ck Big CMP N ck	XWQWSite4E	86/186
	XWQW Lee Ck at CMP & parking road	XWQWLeeCk	10/110
	XWQW Lee Ck 50 m above CMP Park Roadside	LeeCk50	12/112
	XWQW Trail Crossing Ck XWP	CkXWP	14/114
	9075 Site 1 BRDG Ck XWP	Site1BridgeXWP	44/144
Conductivity		ConductTime	
FlowTime		FlowTime	
ConductivityFlow		Yet to be named	
pHPrecip		Yet to be named	

Section D - FWC Flow Measurements - Field Methods & Flow Calculations (SSIFWC webmap & Excel Master "processed" datasets

Macro "flow" formulas calculate flow (l/sec), for the various field measurement conditions and recorded in the SSIFWC field App (or via a web browser) V3. *Note: - no flow calculation is possible in the Epicollect5 App, flow values (webmap and Excel) are derived from the formulae below.*

The FWC flow measurement types, and calculation procedures, are outlined below, in order of preference (& seasonal accuracy) *cf.* What is Right?

1. Bucket and Timer

Flow formula used for measurements made during low to moderate flow conditions, where in-creek measurement conditions provide a suitable natural or CMP weir, and are safe, eg "WSCK Weston Ck outfall", "Ferncreek". Flow formula construct as follows (*cf*. full equation below):

- flow result stored in "BandTLpersec" column "CC"
- formula developed with Volume and Time data, columns "CD to "CI", used to derive flow volume (l/s)

2. Flow Meter

Flow formula used for measurements made during higher and lower flow conditions, where in-creek measurement conditions are suitable, and are safe, eg "WSCK Weston Ck outfall", "Geralds Creek". Flow formula construct as follows (*cf*. full equation below):

- flow result stored in "float_flow_lpersec" column "BV"
- formula developed with width-depth data, columns "Z' to "BC", used to derive an area profile "BE"
- velocities (m/sec), columns "BG to BU", used for profile section areas to develop flow result

3. Float Flow Culvert

Flow formula used for flow-through-culvert (CMP) measurement sites, used at suitable sites only, for higher flow/shallow flow conditions.Measurement technique typically utilised where field measurement and calculation methods for 2, 3, or 4 are not suitable and/or safe, eg at site "WSCK Weston Lake Ck inflow E1". Flow formula construct as follows (*cf.* full equation below):

- flow result stored in "flow_meter_lpersec" column "BV"
- formula developed with width-depth data, columns "Z' to "BC", used to derive an area profile "BE"
- float distances, columns "BX to BZ" averaged over distance "D1 stream", column "BW"

4. Float Flow Complex Profile

Flow formula used for measurement sites with high and/or low (shallow) flow conditions, where field measurement and calculation methods for 1, 3, or 4 not suitable/safe, eg "WSCK Weston Ck outfall", "Soule Creek Outfall". Flow formula construct as follows (*cf.* full equation below):

- flow result stored in "float_flow_lpersec" column "CA"
- formula developed with width-depth data, columns "Z' to "BC", used to derive an area profile "BE"
- float distances, columns "BX to BZ", averaged over distance "D1 stream", column "BW".

The full flow equations used in FWC cloud data download flow calculations (Excel, macros; SSIFWC webmap, React) are as follows:

	Reference Column	
X-section Area Culvert	Y2	=IF([@WetwidthCMP]>0,+((([@CulDia]/2)^2)/2*((2*ATAN([@WetwidthCMP]/2/((([@CulDia]/2)-[@MaxWaterDepth])))-SIN((2*ATAN([@WetwidthCMP]/2/((([@CulDia]/2)-[@MaxWaterDepth]))))),"")
X-Section Area Profile	BE2	=IF([@W2P2]>0,0.5*([@W1P1]*[@D1P1])+((([@W2P2]-[@W1P1])*0.5*([@D2P2]+[@D1P1]))+ ((([@W3P3]-[@W2P2])*0.5*([@D3P3]+[@D2P2]))+ ((([@W3P3]-[@W2P2])*0.5*([@D3P3]+[@D2P2]))+((([@W4P4]-[@W3P3])*0.5*([@D4P4]+[@D3P3]))+((([@W5P5]-[@W4P4])*0.5*([@D5P5]+[@D4P4]))+((([@W6P6]-[@W5P5])*0.5*([@D6P6]+[@D5P5]))+((([@W7P7]-[@W6P6])*0.5*([@D7P7]+[@D6P6]))+((([@W8P8]-[@W7P7])*0.5*([@D8P8]+[@D7P7]))+((([@W9P9]-[@W8P8])*0.5*([@D9P9]+[@D8P8]))+((([@W10P10]-[@W9P9])*0.5*([@D10P10]+[@D9P9]))+((([@W11P11]-[@W10P10])*0.5*([@D11P11]+[@D10P10]))+((([@W12P12]-[@W11P11])*0.5*([@D12P12]+[@D11P11]))+((([@W13P13]-[@W12P12])*0.5*([@D13P13]+[@D12P12]))+((([@W14P14]-[@W13P13])*0.5*([@D14P14]+[@D13P13]))+((([@W15P15]-[@W14P14])*0.5*([@D15P15]+[@D14P14])),"")
Float Flow Culvert	CA2	=IF(U2="through culvert",0.9*[@XareaCMP]*[@D1streamm]/AVERAGE([@T1s],[@T2s],[@T3s])/10,"")
Float Flow Complex Profile	CB2	=IF([@D1streamm]>0,0.25*[@D1streamm]/AVERAGE([@T1s],[@T2s],[@T3s])*[@Xareaprofile]/10,"")
Flow Meter	BV2	=IF(BD2="Meter",+(0.5*([@W2P2]-0)*[@D1P1]*[@VELA1]+0.5*([@W3P3]-[@W1P1])*[@D2P2]*[@VELA2]+0.5*([@W4P4]-[@W2P2])*[@D3P3]*[@VELA3]+0.5*([@W5P5]-[@W3P3])*[@D4P4]*[@VELA4]+0.5*([@W6P6]-[@W4P4])*[@D5P5]*[@VELA5]+0.5*([@W7P7]-[@W5P5])*[@D6P6]*[@VELA6]+0.5*([@W8P8]-[@W6P6])*[@D7P7]*[@VELA7]+0.5*([@W9P9]-[@W7P7])*[@D8P8]*[@VELA8]+0.5*([@W10P10]-[@W8P8])*[@D9P9]*[@VELA9]+0.5*([@W11P11]-[@W9P9])*[@D10P10]*[@VELA10]+0.5*([@W12P12]-[@W10P10])*[@D11P11]*[@VELA11]+0.5*([@W13P13]-[@W11P11])*[@D12P12]*[@VELA12]+0.5*([@W14P14]-[@W12P12])*[@D13P13]*[@VELA13]+0.5*([@W15P15]-[@W13P13])*[@D14P14]*[@VELA14])/10,"")
Bucket and Timer	CC2	=IF([@Vol1L]>0,AVERAGE([@Vol1L],[@Vol2L],[@Vol3L])/AVERAGE([@T3sBT],[@T2sBT],[@T1sBT]),"")

Foot note =IF(BD2="FLOW",+(0.5([@W2P2]-0)*[@D1P1]*[@VELA1]+0.5*([@W3P3]-[@W1P1])*[@D2P2]*[@VELA2]+0.5*([@W4P4]-[@W2P2])*[@D3P3]*[@VELA3]+0.5*([@W5P5]-[@W3P3])*[@D4P4]*[@VELA4]+0.5*([@W6P6]-[@W4P4])*[@D5P5]*[@VELA5]+0.5*([@W7P7]-[@W5P5])*[@D6P6]*[@VELA6]+0.5*([@W8P8]-[@W6P6])*[@D7P7]*[@VELA7]+0.5*([@W9P9]-[@W7P7])*[@D8P8]*[@VELA8]+0.5*([@W10P10]-[@W8P8])*[@D9P9]*[@VELA9]+0.5*([@W11P11]-[@W9P9])*[@D10P10]*[@VELA10]+0.5*([@W12P12]-[@W10P10])*[@D11P11]*[@VELA11]+0.5*([@W13P13]-[@W11P11])*[@D12P12]*[@VELA12]+0.5*([@W14P14]-[@W12P12])*[@D13P13]*[@VELA13]+0.5*([@W15P15]-[@W13P13])*[@D14P14]*[@VELA14])/10,"")*

* it appears that the calculation for "flow meter" data uses the incorrect BD2 (float or flow) status this formula should read"Meter" not "Flow" - updated 2022/01/29 for 2021 entries

The flow results from the above formulae calculations (generated by the Excel macros used in the “DLV3”date Epicollect workbook to data transfer/format exports from the Epicollect5 cloud database) are placed in the respective flow calculation column for the formula being used. For ease of flow vs other parameters charting purposes in the Master SSIFWC workbook, flow measurements need to be copied to a single flow data column (usually CC is used).

[E] *Raw* FWC cloud data, basic quality control

Basic data quality (QC) control steps are occasionally required with the raw FWC field data, for both the provision of consistent raw data for studies and for our FWC webmap and Excel processed data manipulation. These FWC data QC steps revolve around:

- correcting basic field data entries, to allow further data processing and mapping (in both our webmap and in Excel)
- rationalising early FWC field site names
- improved clustering of coordinate data associated with a single field site

For further details of these data QC steps see the procedures detailed below, and the relevant SSIFWC website Homeoffice data entry pages. Note - in some cases field and field data entry techniques (coordinate entry, profile definition) need to be revisited by the field volunteer(s) involved - contact the SSIFWC Project Lead if this is required.

<u>Coordinates, entries & refinement</u>
For regular sites with no coordinate data entry, site coordinate data entry is required (along with reminders to the volunteer to collect/add this as necessary for each data entry. No coordinates - no data on the map(s)!

Clustering of coordinate data associated with a single field site (our Epicollect5 App host does not support "geolocking" a single set of coordinates to a repeat location), coordinate refining (usually to a single coordinate set for repeat sampling sites) is required (see established site coordinates below).

<u>Stream Profile Width-Depth Entries</u>
FWC field data creek flow calculations (webmap and Excel) use a set of formulas (Cf Appendix D above) to calculate flow, if…

xxxx

<u>Field site naming, adopting/following conventions</u>
xxxx

<u>Established regular site coordinates</u>
xxxx

[F] Basic location codes used in FWC field site naming conventions

Established regular field sites have a defined field location name, accessible from the scrollable list within our Epicollect5 SSIFWC field data collection App (V3), and via the SSIFWC accessible via the Epicollect5 SSIFWC project web browser.

Established field sites are listed in reverse alphabetical order, with numbered watersheds (see below) at the end. If using "Other" for a new site, or for a new well, please provide 4 letter code for the watershed, water feature, name or local feature, or an address for a well.

Location name abbreviations used

Bridge - BRDG

Creek - Ck

Culvert (Corrugated Metal Pipe) - CMP

Drive - Dr

Downstream - D/S

Lake - Lk

Point - Pt

Road - Rd

Downstream - D/S

Upstream - U/S

Watershed Codes used are as follows (under development)

Fulford Creek - FLCK

Soule Creek - SLCK

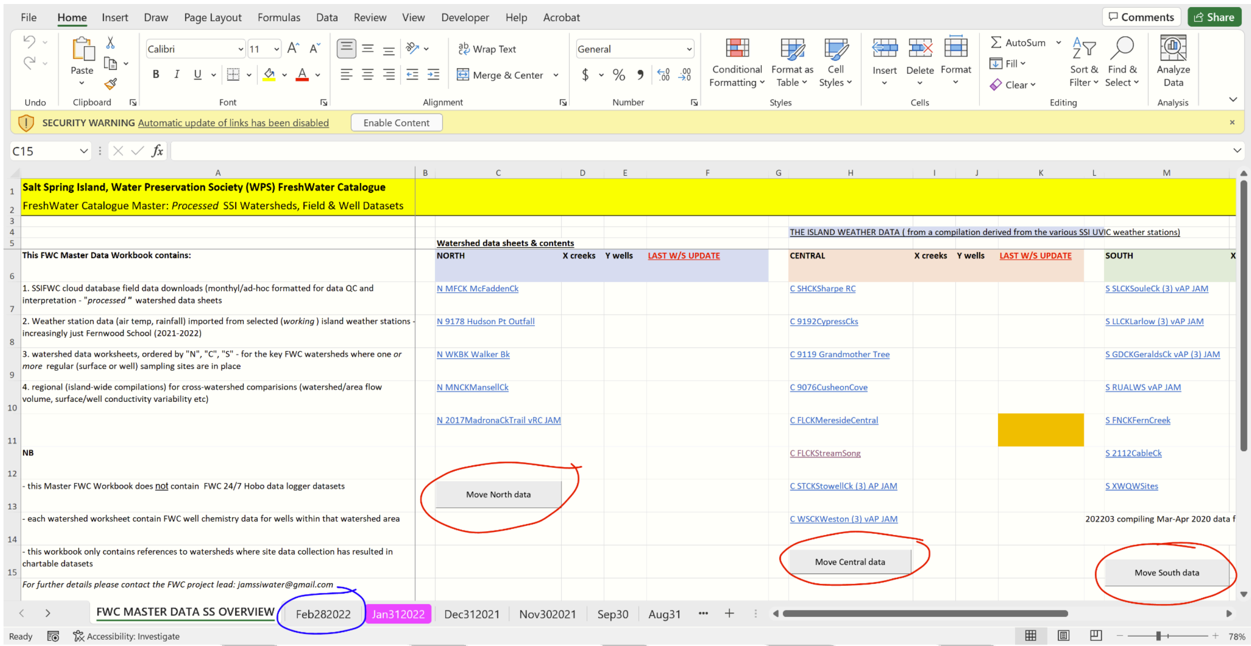
Weston Creek - WSCK

2112 - 2112 (no watershed name is available for a large number of "direct - storm" island watersheds)

[G] Macros for moving monthly FWC data into the FWC Master Dataset (courtesy of Daphne W.)

Moving monthly data with the macro

1. On the master spreadsheet, you should see three buttons (circled in red below). The monthly data sheet you want to use as your data source (circled in blue below) should be directly to the right of the master spreadsheet tab.



2. Press a button to begin moving data. Do not use your mouse, touchpad, or keyboard during this time.
3. When data moving is complete (motion on your screen will stop and your cursor will stop changing shapes), switch to the monthly data tab.
4. You should see yellow highlighting on rows which have successfully been copied.
5. Repeat for the other two regions.

How it works

1. Pressing a button calls one of the following Subs:

```
Sub NorthButton()
    dataMover "north"
End Sub

Sub CentralButton()
    dataMover "central"
End Sub

Sub SouthButton()
    dataMover "south"
End Sub
```

2. The Sub calls another Sub, called dataMover.

3. dataMover creates a dictionary:

```
    Set dictToUse = CreateObject("Scripting.Dictionary")
```

   Dictionaries store data in “key-value pairs.” When you look up a word in the dictionary, you get its definition. When you look an EpiCollect site up in this script’s table, you want to find the table where its data is stored.

4. Depending on which button is called, the dictionary will be populated with key-value pairs corresponding to north, central, or south sites:

```
    If (StrComp(region, "north", vbTextCompare) = 0) Then
    'dictToUse.Add key (cell value), value (table name)
        dictToUse.Add "MFCK mid North End Rd. Deep well", "HudsonPt8586"
        dictToUse.Add "MFCK McFadden Ck NE of North End Rd", "HudsonPt85"
        dictToUse.Add "MKCK McFadden Ck at RW", "HudsonPt85"
        dictToUse.Add "MNCK culvert at Robinson Rd", "MansellCMP"
        dictToUse.Add "MNCK above wetlands", "MNCKWetlands"
        dictToUse.Add "9178 Hudson Pt Ck Outfall", "HudsonPt"
```

5. The second worksheet in the workbook (the newest monthly sheet) is set as the source of our new data:

```
    Set NewDataSheet = Worksheets(2)
```

6. Now we loop through every cell in the first column of our monthly worksheet

```
    For Each currentCell In NewDataSheet.UsedRange.Columns("A").Cells
```

   This corresponds to the site or creek name of each new entry:

1	title
2	0 Other MXCK another ck on S trail
3	0 Other MXCK ck spur S trail N close to Mx Rd
4	0 Other MXCK Rippon Ck bdg ds wetland nr E trail
5	0 Other MXCK Rippon Ck wetland nr E trail
6	0 Other MXCK Rippon? Ck alng trail
7	0 Other MXCK roadside Ck wetland at fence

7. For each cell, we check if this site name is in our dictionary:

```
        If dictToUse.Exists(currentCell.Value2) Then
```

8. If so, we loop through every table in our worksheet:

```
            For Each sh In ThisWorkbook.Worksheets
                For Each tbl In sh.ListObjects
```

9. Until we find the table corresponding to the site:

```
                    If tbl.Name = dictToUse(currentCell.Value2) Then
```

10. We copy the site’s row of data from our monthly data sheet:

```
                        NewDataSheet.Rows(currentCell.Row).Copy
```

11. And find the next available row in its site’s table:

```
                        lastRow = tbl.Range.End(xlDown).Row + 1
```

12. We find the date column in the table (which can be called either realDate or Real Date:

```
On Error Resume Next
  Set dateColumn = tbl.ListColumns("realDate").Index

'If Error WS Does not exist
If Err.Number <> 0 Then
  Set dateColumn = tbl.ListColumns("Real Date").Index
End If

On Error GoTo -1
```

13. We paste the data into the table:

```
sh.Cells(lastRow, iter).PasteSpecial Paste:=xlPasteValuesAndNumberFormats
```

14. And we use the date column from Step 12, above, to make sure our date is in the right format:

```
sh.Cells(lastRow, dateColumn).NumberFormat = "yyyy-mm-dd"
```

15. Lastly we change the colour of our row in the monthly datasheet to indicate the data has been copied:

```
currentCell.EntireRow.Interior.Color = RGB(255, 255, 0)
```

Future steps

- It would be helpful if the macro checked for duplicate data before pasting into the creek's data table
- It would also be helpful if the macro automatically added dates in the LAST W/S UPDATE column on the master sheet after running
- As more tables are added for sites that don't yet have tables, the macro will need to be updated

[H] Macros for SSIFWC watershed data visualisation - FWC Master Dataset (courtesy of Cole T.)

During the course of 2023-2024 a variety of SSIFWC data manipulation macros were developed by Cole Thompson (GISS > University of Waterloo). These macros were to streamline the compilation of more onerous data compilation displays for scientific analysis.

This data analysis and visualisation sub-project was done to support further insights into various island freshwater flow and chemistry variability , including how individual creek systems are impacted by groundwater vs surface water inflows, watershed (area, pptn. levels) etc., (see notes in section B2 above). A secondary objective of this data/visualization/analysis sub-project was to streamline basic data integration (import) workflows necessary for updating and using the FWC Master Data.

In support of SSIFWC field data analysis the following data visualisation macros were considered for development/testing:

- flow vs watershed area - to assess the impact of watershed shape, size (and ground cover) on creek flow and chemistry variability
- automated flow vs conductivity charting - to determine the impact of surface vs groundwater (inflow)
- regional" wells (conductivity and/or pptn) comparison - to investigate the variability in groundwater types and recharge (hydraulic connectivity)
- regional" wells (conductivity and/or pptn) vs creek chemistry comparisons - to investigate the variability in surface (inflow) vs well groundwater recharge timing (hydraulic connectivity)
- data import from a SSIFWC Epicollect5 cloud database export (see section [G] above) to improve project data manipulation workflows

The following macros were developed/tested:

[I] Preparing a bulk freshwater field data (e.g. acquired independently) for upload to the SSI FreshWater Catalogue (SSIFWC) cloud database.

Guidelines for bulk uploads (associated with historical data compilations, independent field observations etc), to the SSIFWC cloud database (required for mapping and charting/analysis).

SSIFWC meta data description and mapping

A summary of the *key* Epicollect5 SSIFWC cloud database data attributes. These are required for: successful SSIFWC cloud uploads (ie imports into the online FreshWater Catalogue database), for basic data QC and for analysis (at a local, watershed, and for island-wide correlation/comparisons), cf Table x for details.

Note:- when entering new data into the FreshWater Catalogue database the data attributes used (presented) in the SSIFWC Epicollect5 database are pre-defined based on the field measurement type selected (eg walker/rambler, creek monitoring, flow and or water chemistry etc)

Field Name	Field Contents	Metadata
Named monitoring locations	Field site name	Regular field site names containing four digit watershed code and attibutes identifuying the field site. For regular sites this data is entered via a scrollable list, accessed in the App or via a browser (updated periodically for new sites)
LAT/LONG	Latitude, Longitude	Decimal coordinates format, longitude -ve Coordinates cannot be entered manually via the App.
MONITOR DATE (month/day/year)	Date when at field site	Not the created or uploaded date used by Epicollect5 for their software management
MONITOR TIME (24 hour)	Time when at field site	
NAME	Initials of observer(s)	Used to
WATER BODY TYPE (ie.stream/creek, lake etc)		
CULVERT DIAMETER (cm)? WETTED WIDTH?		
WETWIDTH CMP V (cm)		
METHOD OF MEASURE – "Through Culvert", " Flow Meter or Flotation Complex Profile" etc *cf* cloud database upload template flow types and descriptions on Taking Flow Meaurements webpage:		
culvert_diameter		
-		
MAX DEPTH WATER (cm)		
W1P1, D1P1, W2P2 ETC. widths and associated		

Field Name	Field Contents	Metadata
depths required unless a very simple "V" creek profile assumed so basically W1P1, D1P1 *cf* descriptions on Creek Profiles webpage		
		Assuming this is general "wetted width" (needed) not culvert (see above) – Pierre to confirm
		Calculated in cloud and by Excel macros (not needed for data entry)
		Calculated in cloud and by Excel macros (not needed for data entry)
D1 STREAMM		
Calculated in cloud and by Excel macros (not needed for data entry)		
T1s, T2s etc		
Calculated in cloud and by Excel macros (not needed for data entry)		
TEMPERATURE WATER (oC.)		
pH OAKTON		
CONDUCTIVITY (µS/m)		
OAKTON ID		