

Teacher Farm Experience Program

GPS Livestock Tracking Practical
(student version)



AGRICULTURE
AUSTRALIA'S
GREATEST
EXPERIENCE



Rabobank



Name: _____

Meet Farmer Brad (Wooldridge Family Farm)

The Wooldridge Family, Brad and Tracy and daughters, Sophie and Emily, live at Arthur River, half way between Perth and Albany.

They run a mixed cropping and livestock farm. Crops cover about half the area and include Barley, Oats, Canola and Lupins. The remainder is pasture and on this run up to 2000 composite and Suffolk ewes, supplying store prime lambs for a feed lotter.

Over the past 20 years the farm has been assisting researchers with areas to run projects. This includes fitting his sheep with GPS tracking collars to be better understand how they utilise paddock resources. The data you will using for the practical is from one of these sheep!



Analysing GPS tracking data computer practical

Important links (you will need to copy these links in order to complete the computer practical)

Activity 2.1: Paddock (Wooldridge)

[https://services4.arcgis.com/panNT1e4COILr8V9/arcgis/rest/services/Paddock_\(Wooldridge\)/FeatureServer](https://services4.arcgis.com/panNT1e4COILr8V9/arcgis/rest/services/Paddock_(Wooldridge)/FeatureServer)

Activity 2.3: Animal165 (Wooldridge)- Raw data

[https://services4.arcgis.com/panNT1e4COILr8V9/arcgis/rest/services/Animal165_\(Wooldridge\)_Raw_data/FeatureServer](https://services4.arcgis.com/panNT1e4COILr8V9/arcgis/rest/services/Animal165_(Wooldridge)_Raw_data/FeatureServer)

Activity 3.1 onwards: Animal165 (Wooldridge)

[https://services4.arcgis.com/panNT1e4COILr8V9/arcgis/rest/services/Animal165_\(Wooldridge\)/FeatureServer](https://services4.arcgis.com/panNT1e4COILr8V9/arcgis/rest/services/Animal165_(Wooldridge)/FeatureServer)



GPS LIVESTOCK TRACKING DATA ANALYSIS PART 1

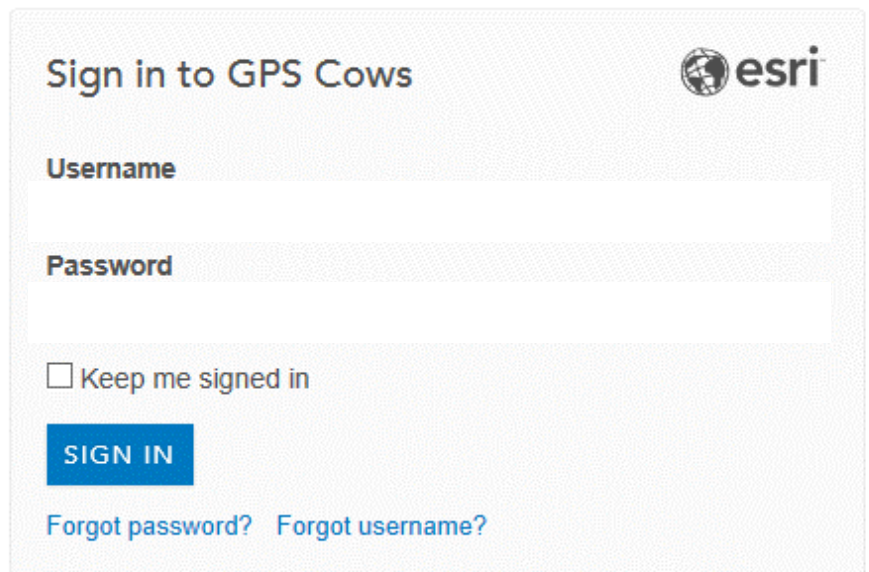
Part One:

1 Getting started in ArcGIS online

1. Open up ArcGIS online

1.1 Turn on your computers and in google/safari/firefox search www.gpscows.maps.arcgis.com/

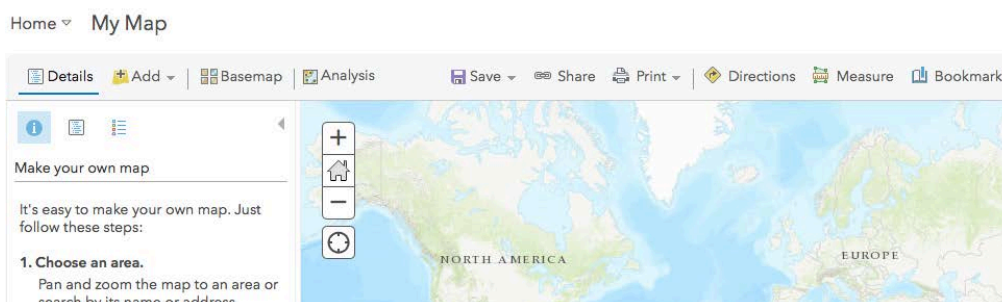
- Sign in with your login details:



- Select the map tab

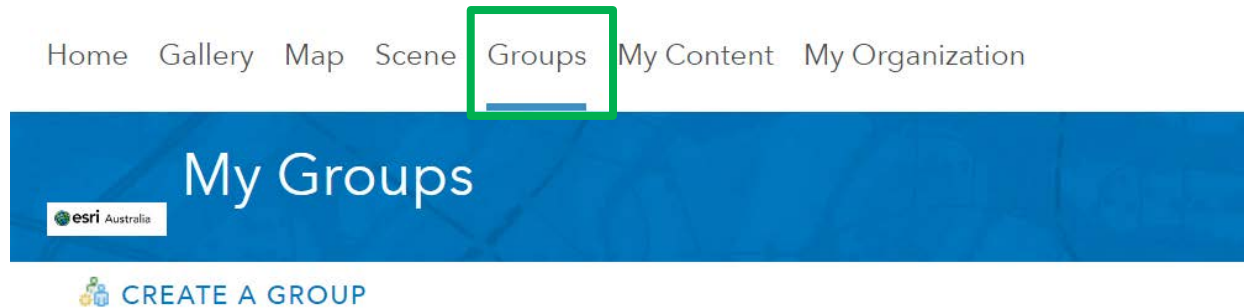


You will come to a screen that looks like this:



1.2 Check you are added to your class or school group

- Select the “Groups” tab



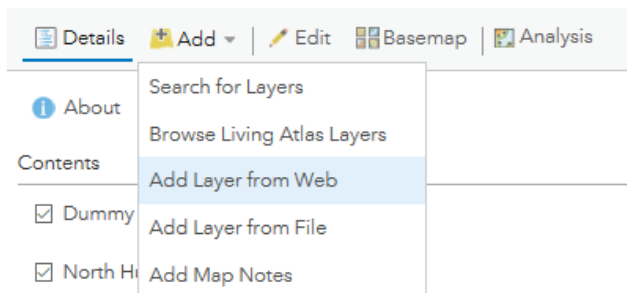
1.2.1 If you have not been added to your class or school group, get your teacher to share the URL link of the group with you

Part Two:

- 2** Importing layers into ArcGIS online
 - 2.1 Importing paddock boundary files
 - 2.2 Importing GPS data
 - 2.3 Visualising raw and bad data

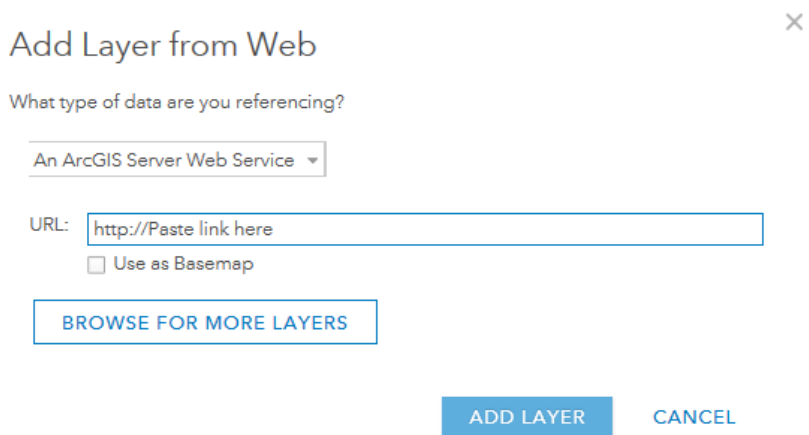
2.1 Importing paddock boundary files

- Select the “Add” tab > Add layer from web



- Enter the Paddock file “Paddock (Wooldridge)” link next to URL:

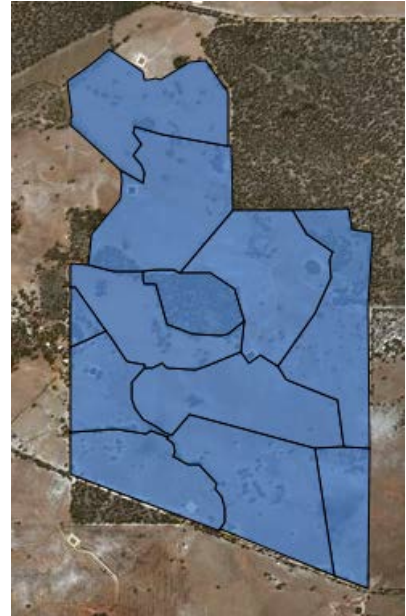
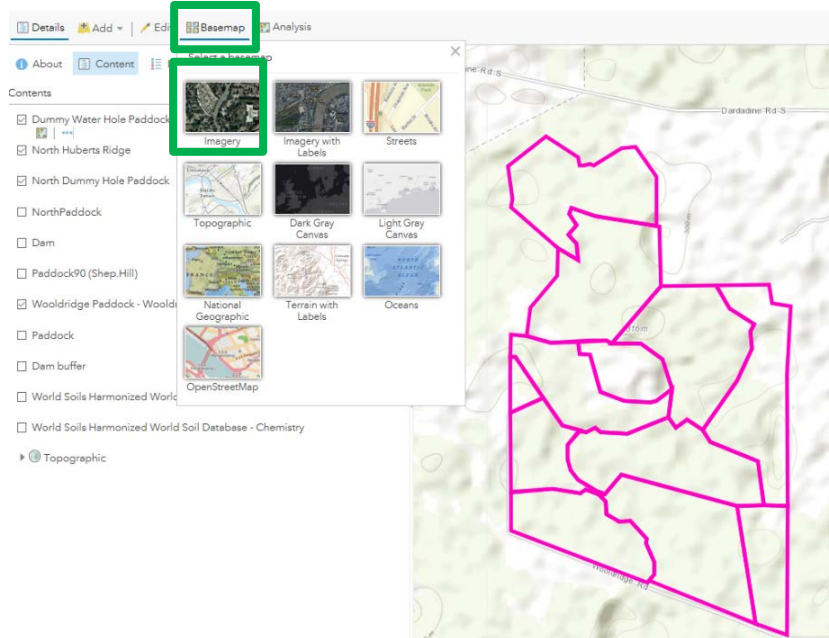
[https://services4.arcgis.com/panNT1e4COILr8V9/arcgis/rest/services/Paddock_\(Wooldridge\)/FeatureServer](https://services4.arcgis.com/panNT1e4COILr8V9/arcgis/rest/services/Paddock_(Wooldridge)/FeatureServer)



- Click Add Layer

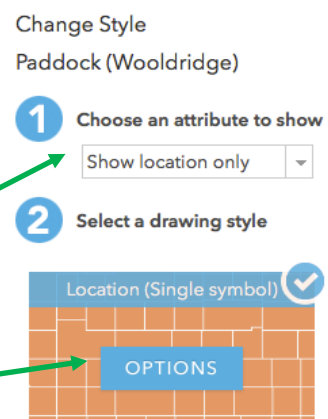
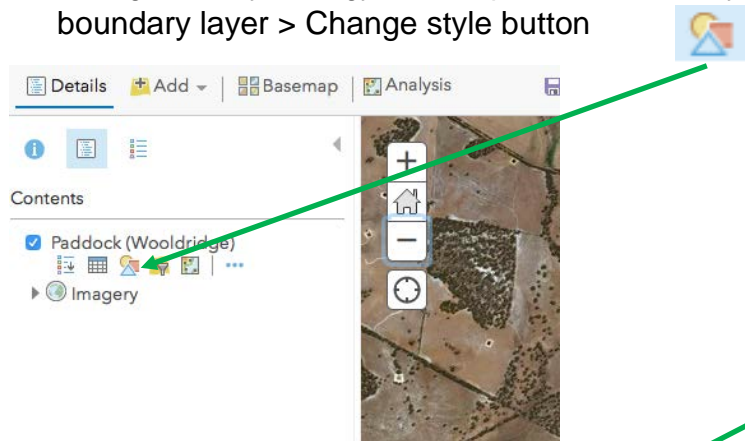
2.1.1 Changing the base map to imagery

- Select the “Basemap” tab and choose “Imagery”



2.1.2 Editing layers

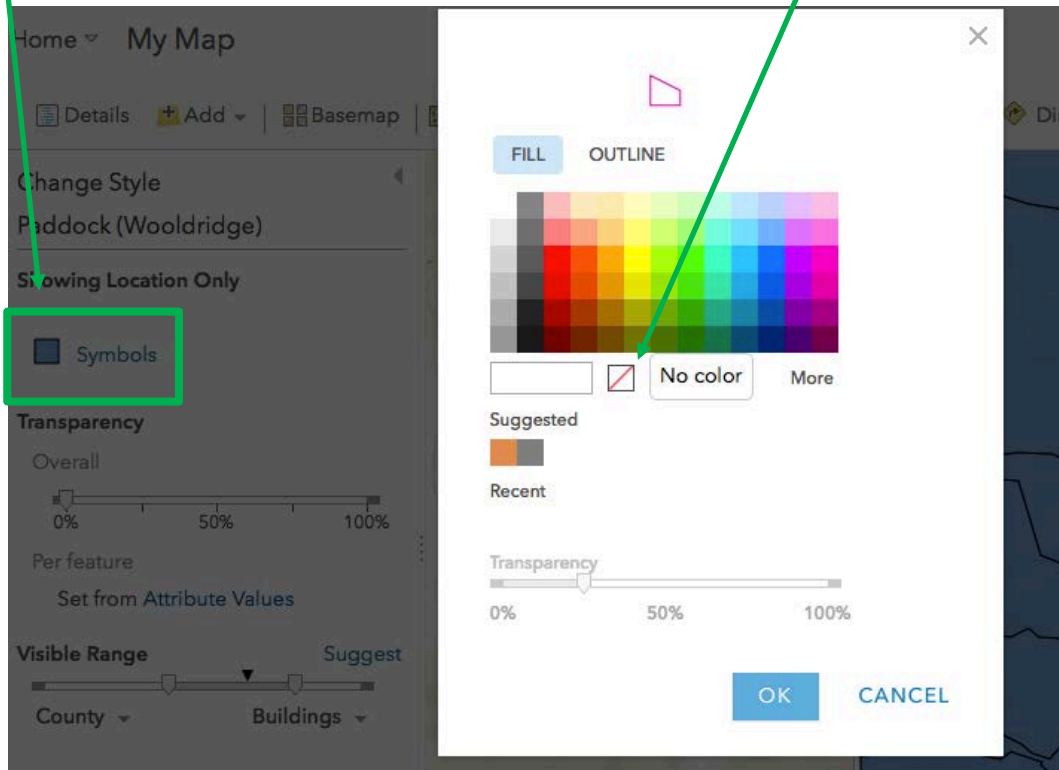
- Change the symbology of the paddock boundary layer, by selecting your paddock boundary layer > Change style button



- Under “Choose an attribute to show”, select “Show location only”
- Under “Select drawing style”, select “Options”

DONE CANCEL

- Select Next, then select “Symbols”
- Once you are on this page choose “Fill” and select “No colour”



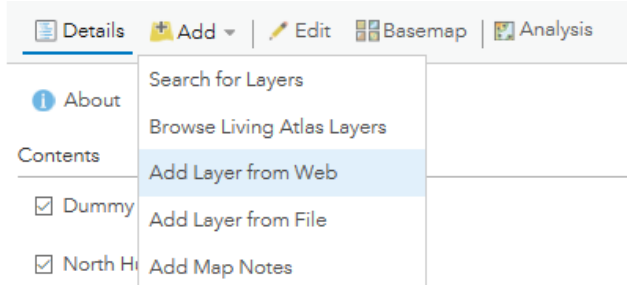
- Choose “Outline” and select a colour of your choice. You can also adjust the width of “Outline” line
- Select “OK”, then click “Done” at the bottom of the page

Your paddock should now look something like this:



2.2 Importing GPS data

- Select the “Add” tab > Add layer from web

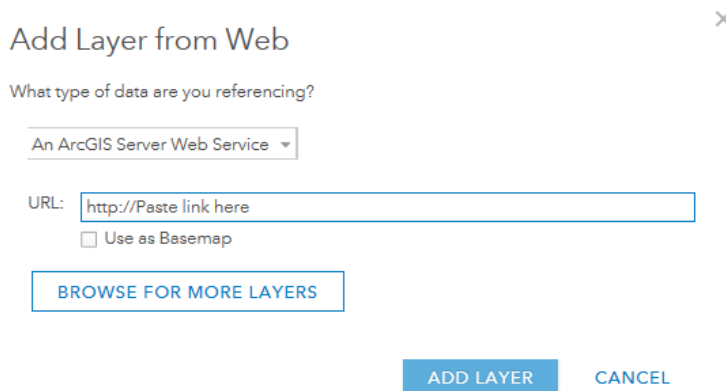


2.3 Visualising raw and bad data

- Here you will add some raw GPS data, that is, GPS that is yet to be cleaned and removed of erroneous or bad data points.

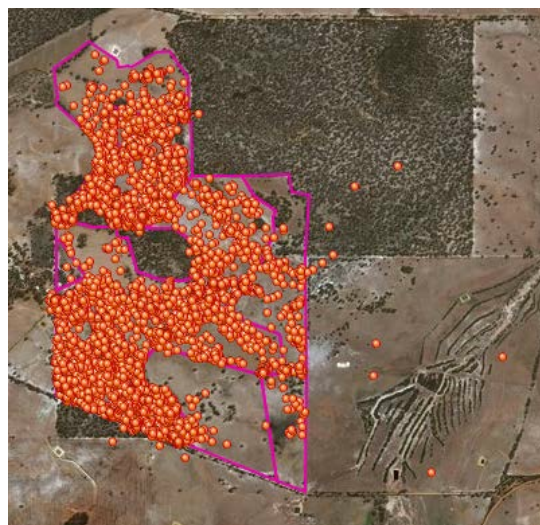
GPS data “Animal165 (Wooldridge)- Raw data” link:

[https://services4.arcgis.com/panNT1e4COILr8V9/arcgis/rest/services/Animal165_\(Wooldridge\)_Raw_data/FeatureServer](https://services4.arcgis.com/panNT1e4COILr8V9/arcgis/rest/services/Animal165_(Wooldridge)_Raw_data/FeatureServer)



- Select “Add Layer”
- Update style, selecting any colour dot and symbol you like (follow the change the symbology steps above- same as you did for the paddock boundary file)
- Select “Done”

Your map should look something like this:

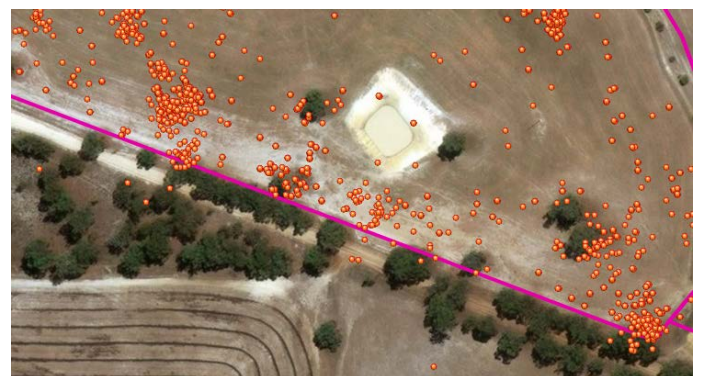


QUESTION 1 – Look at your map. Can you identify any GPS points that might be considered as “bad data”? Write below where these GPS points are located.

Below are some screenshots of erroneous data for Animal165. **QUESTION 2:** Can you identify the reason why we are seeing erroneous data in each screenshot? Write your answer next to each screenshot.







QUESTION 3: What are some of the causes of erroneous data?

- ---
- ---
- ---

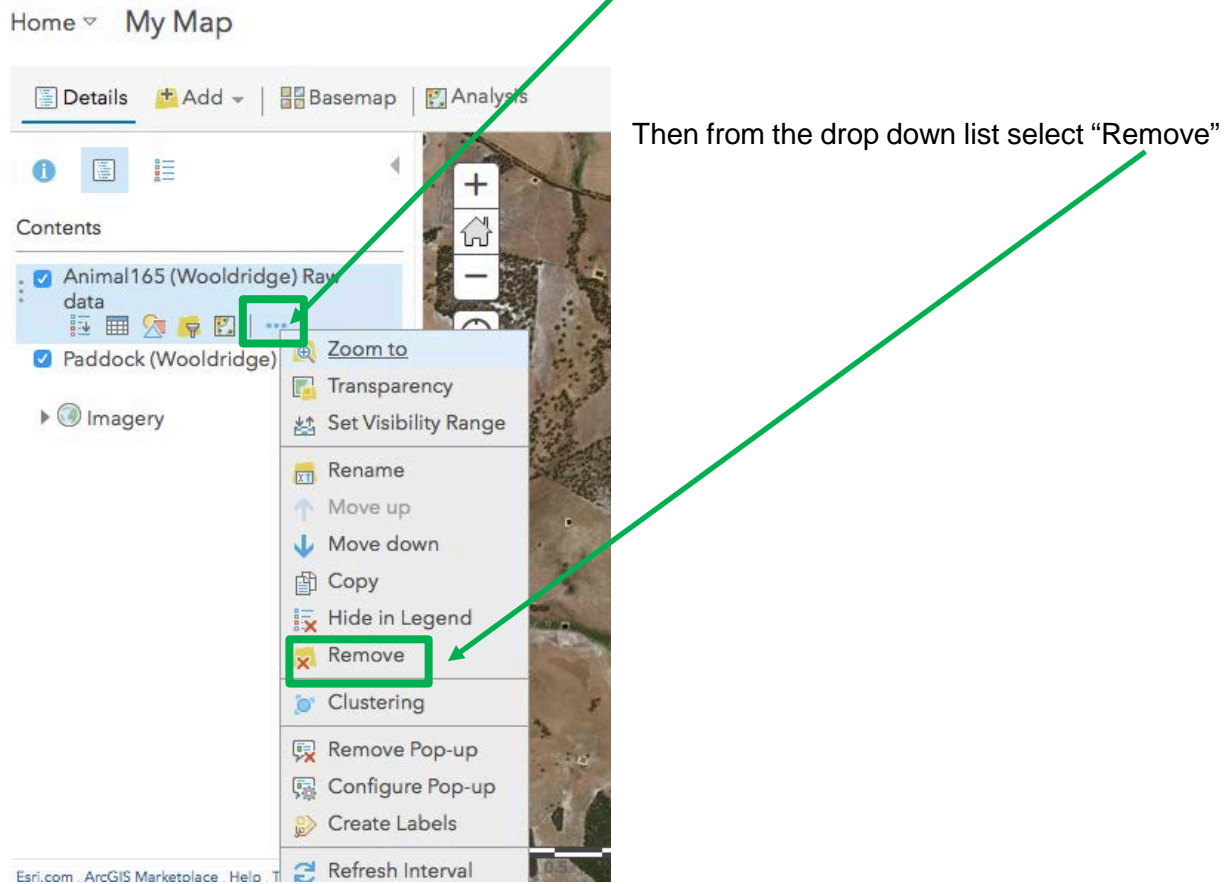


Class discussion time

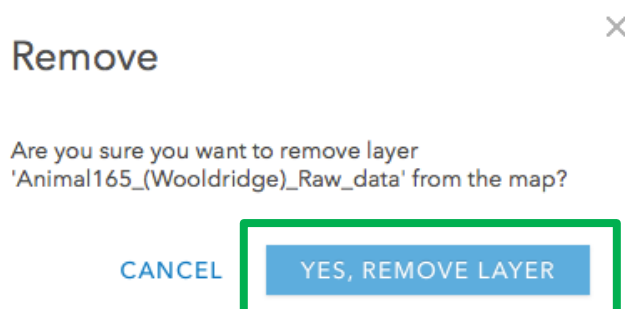
GPS livestock tracking practical

Before we move on to the next part of the practical, we need to remove the 'Raw Data' layer with the erroneous data

- To **remove a layer** from your map, select the '...'



- Then select "Yes, Remove Layer"



Part Three:

- | | |
|----------|-----------------------------------|
| 3 | Analysis activities |
| 3.1 | Paddock utilisation |
| 3.2 | Water visitation |
| 3.3 | Analysing Data in Microsoft Excel |
| 3.4 | Weather analysis |

3.1 Paddock utilisation

Livestock are known as selective graziers, where they actively search and graze their environment or paddock for available pasture in order to meet their demands. The areas they select to graze is dependant upon a number of variables including the distance to available water, shelter, climate, pasture biomass (how much pasture is available) and quality (e.g., protein, fibre content etc.). These areas can become heavily utilised (determined by a large number of GPS points at those locations) and can have negative environmental consequences. Additionally, areas avoided (no GPS points) can indicate areas of insufficient biomass or quality, difference in soil type or perhaps it is too far away from water. This activity will investigate paddock utilisation by using GPS data to determine clustering in ArcGIS online.

3.1.1 Import data by selecting the “Add” tab > Add layer from web

GPS data “Animal165 (Wooldridge)” link:

[https://services4.arcgis.com/panNT1e4COILr8V9/arcgis/rest/services/Animal165_\(Wooldridge\)/FeatureServer](https://services4.arcgis.com/panNT1e4COILr8V9/arcgis/rest/services/Animal165_(Wooldridge)/FeatureServer)

✕

Add Layer from Web

What type of data are you referencing?

An ArcGIS Server Web Service ▾

URL:

Use as Basemap

[BROWSE FOR MORE LAYERS](#)

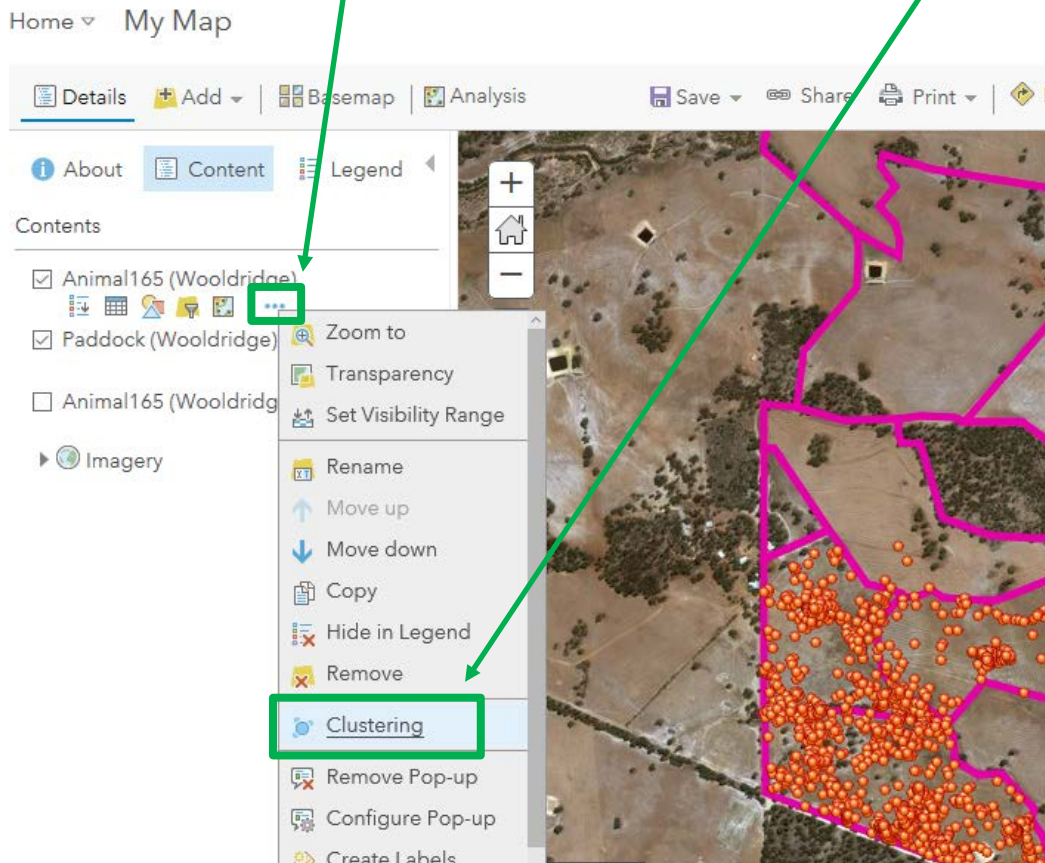
ADD LAYER
CANCEL

- Select “Add Layer”

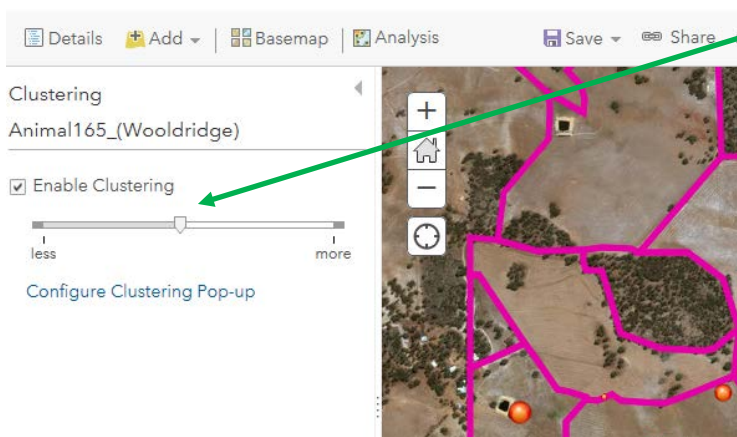
3.1.2 Cluster Analysis

Cluster analysis is used to visualise the areas animals are heavily utilising, where the larger the cluster dot, the greater the amount of time animals are spending in that location. Areas with no cluster dots have not been utilised by the animal

- Select the three dots ‘...’ next to the GPS data file and choose “Clustering” from the drop down menu



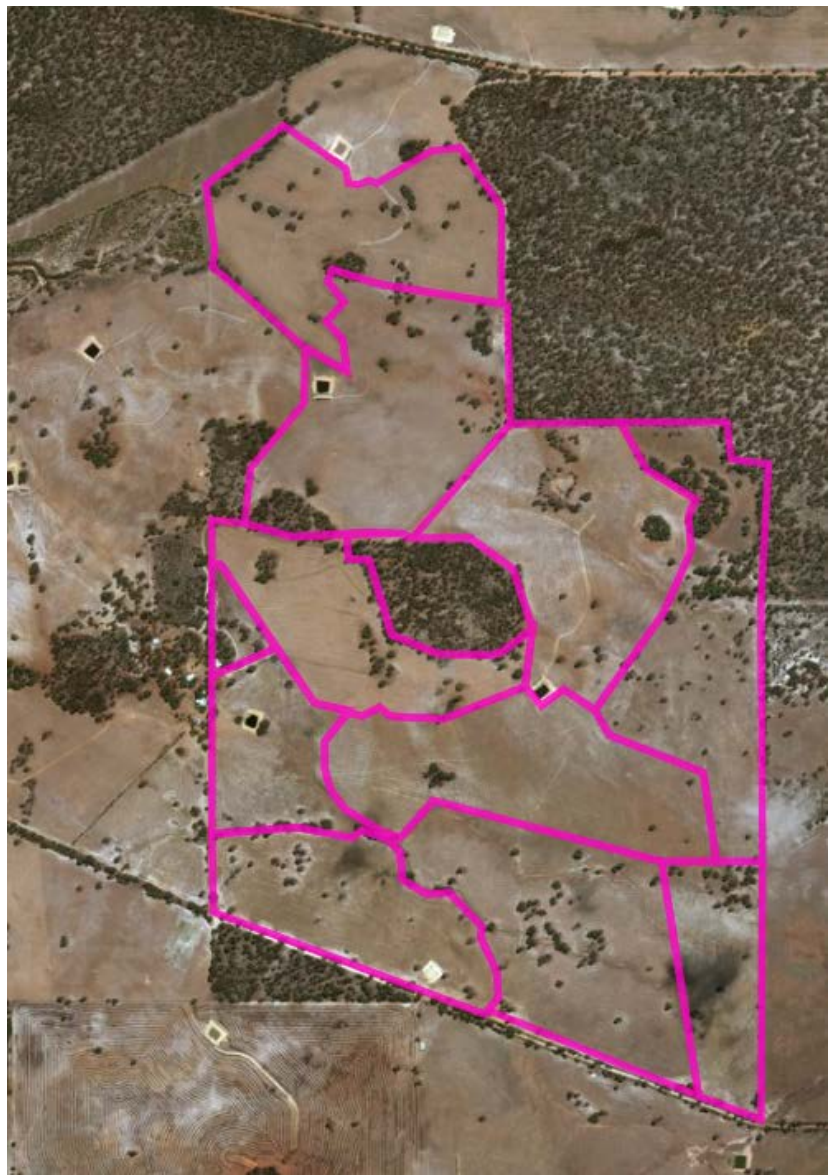
- Next you need to change the scale, by moving the scale to “less” or “more”



<p>Data interpretation</p>	<p>The larger the dot in the clustering analysis, the more time an animal was spending there. Here we will investigate what was driving the areas of high paddock utilisation and if any areas were not utilised (underutilised)</p>
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Ensure you are zoomed out to see the entire farm. Identify, by drawing on the map any:

- paddock/s that were utilised *~~~~~* Shade/colour these paddocks in
- water sources, dams or troughs ○ Draw a circle around these



QUESTION 4: Do any areas of high utilisation correspond to where water sources are located?



QUESTION 5: Farmer Brad fed these sheep some supplementary feed. Can you identify where these sheep may have been fed? (Hint: you may need to increase your clustering scale bar to “more”)

QUESTION 6: List the factors that could be driving animals to be spending a large proportion of time in certain areas:

- ---
- ---
- ---
- ---
- ---
- ---
- ---
- ---



Class discussion time

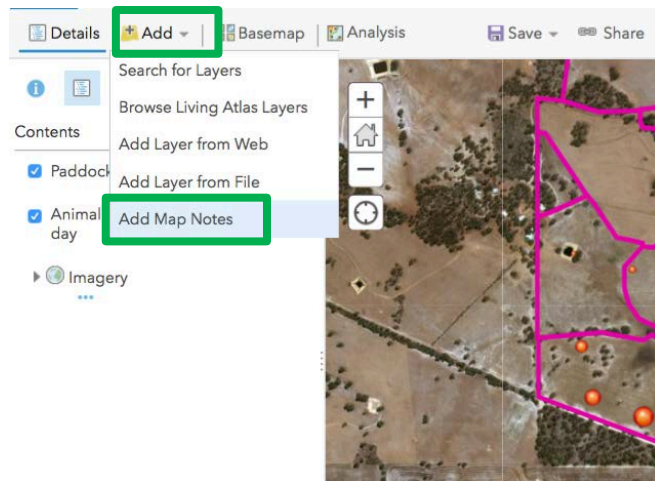
GPS LIVESTOCK TRACKING DATA ANALYSIS PART 2

3.2 Water visitation

Buffers are used around points or features of interest, enabling us to determine the percentage of time (or GPS points) that fall within that area (the buffer). A buffer can be created for any point or feature class. The example used here is water to investigate the percentage of time animals visited water and if there were any days where animals did not visit water.

3.2.1 Create a water point or feature of interest

- Create your own 'Water Point' by selecting the Add tab > Add map notes



- Name your note 'Water Point' and leave the Template as 'Map Notes' > Create

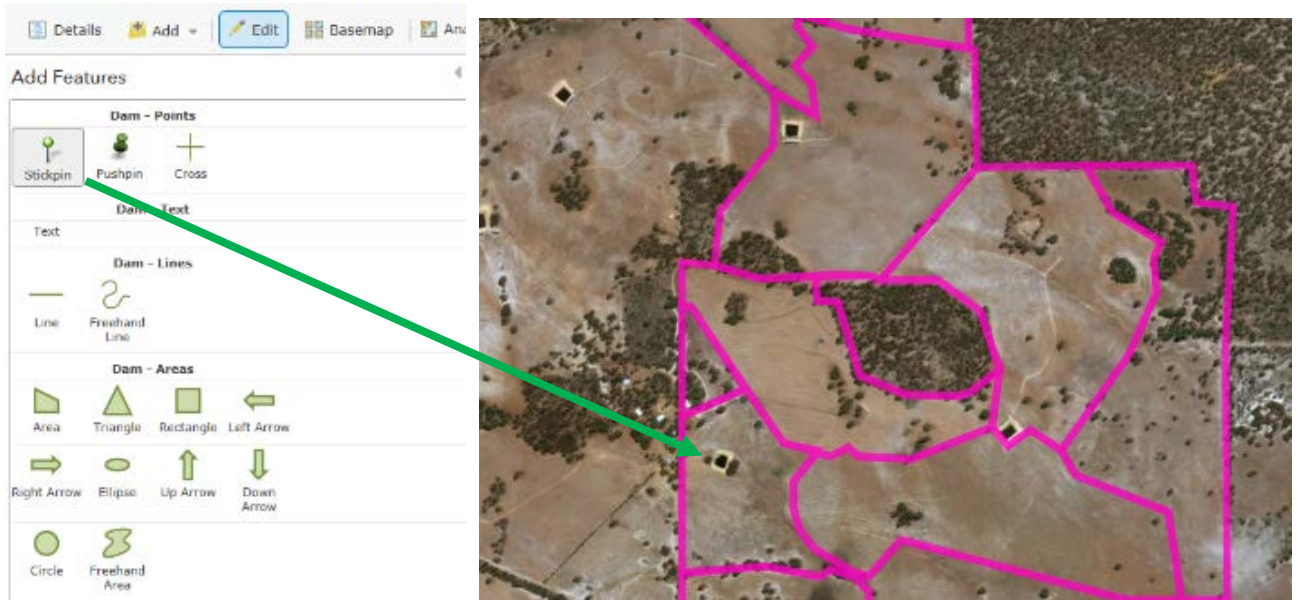
Add Map Notes

Name:

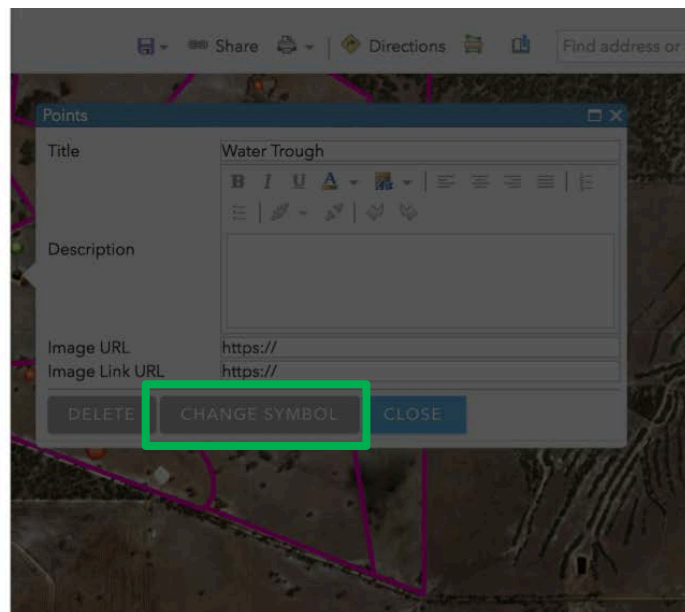
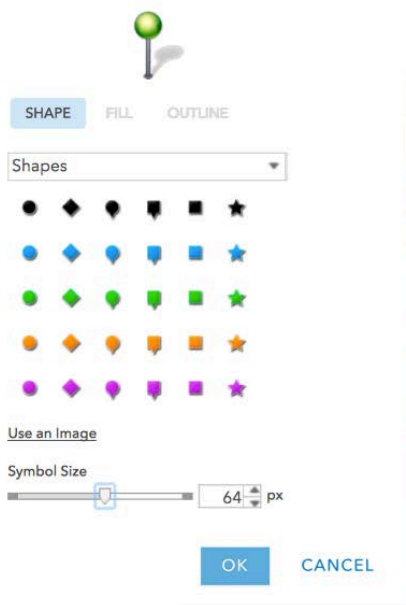
Template:

Use Map Notes to create basic shapes in a wide variety of applications.

- Select one of the “Points” options (stickpin, pushpin, cross) and drag a pin onto the location of the water trough (indicated by arrow on map).
Note: you only need to select the indicated water point (don’t select any others). **TIP: Zoom in for more accurate placement of the pin**



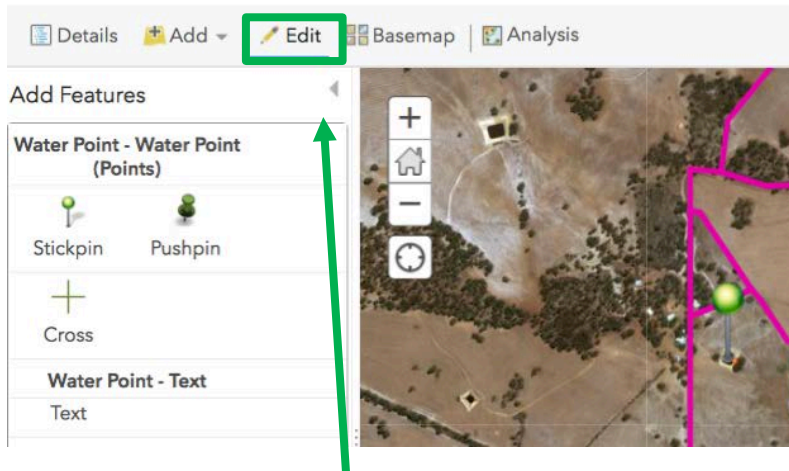
- You can choose to give your point a ‘Title’ and choose to increase the size, shape and colour of the symbol by choosing “Change Symbol”
- Select “Close”



Help

Made a mistake of the water point's true location?

- Select your point (e.g., stick pin), then the edit tab and drag it to its new location

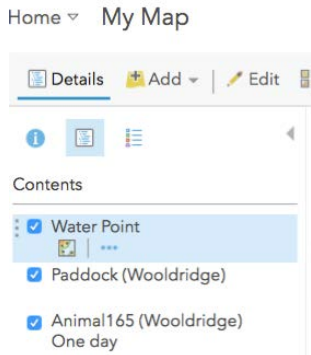


- When finished, select the arrow to return to your map

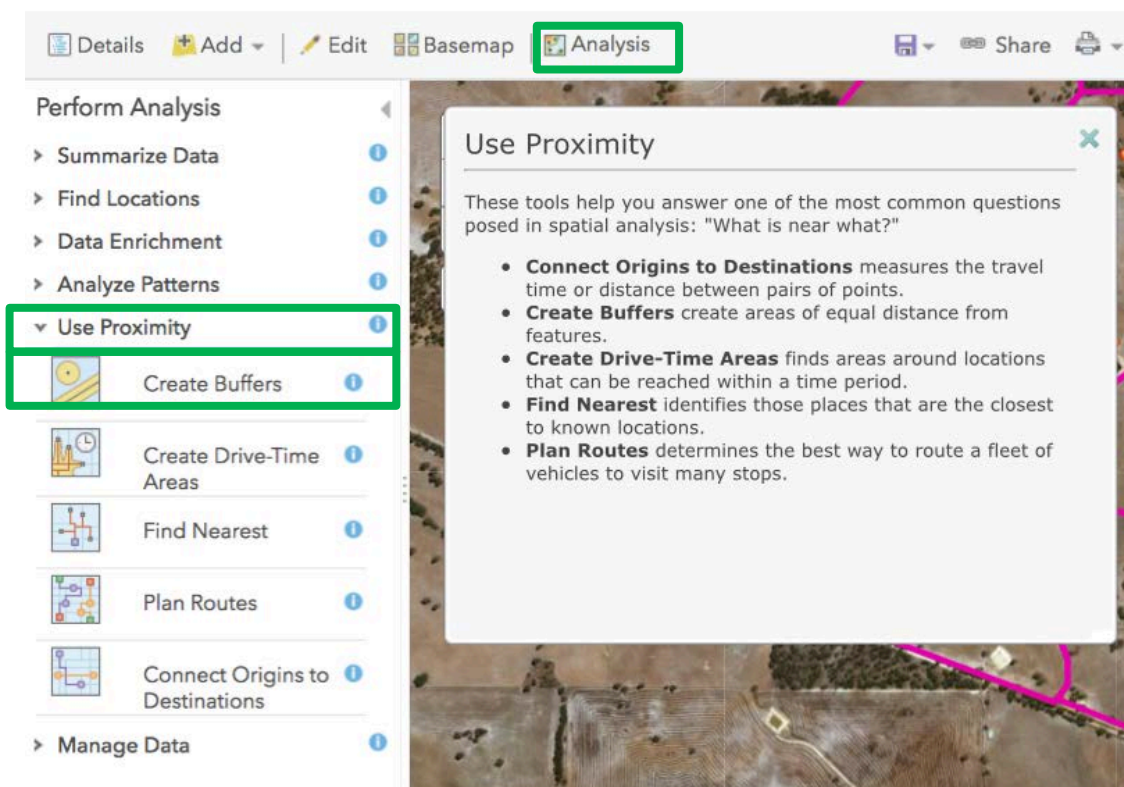
3.2.2 Creating buffers (Analysis > Use proximity > Create buffers)

To determine if animals are utilising a point of interest we need to create a buffer around a water point (or feature of interest)

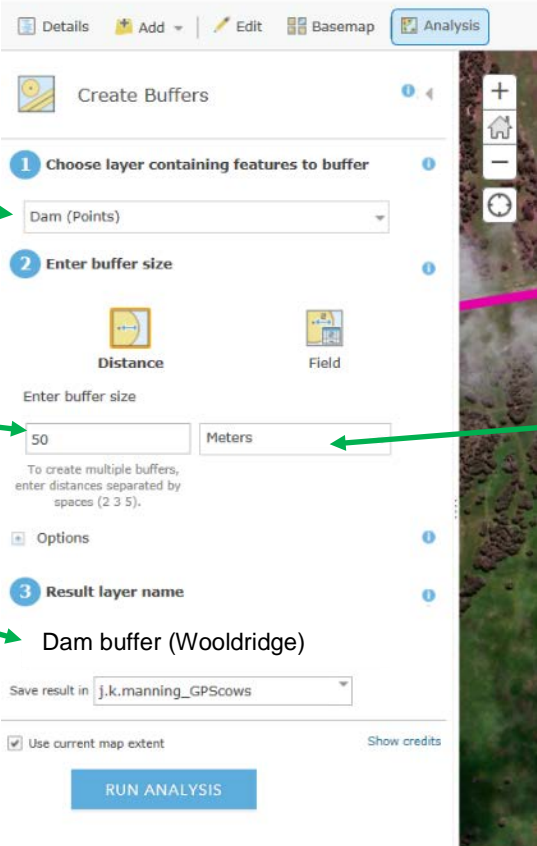
- Select your water point file



- Select Analysis and under the drop down box for “Use proximity” choose “Create buffer”



- Under the “Create Buffers” menu follow the instructions below



File of interest e.g., dam →

Specify the distance
50 m is a good start with water usage analysis →

Start with 50 m, but you could experiment with a different distance value next time →

Name your file →

The name of my file is:

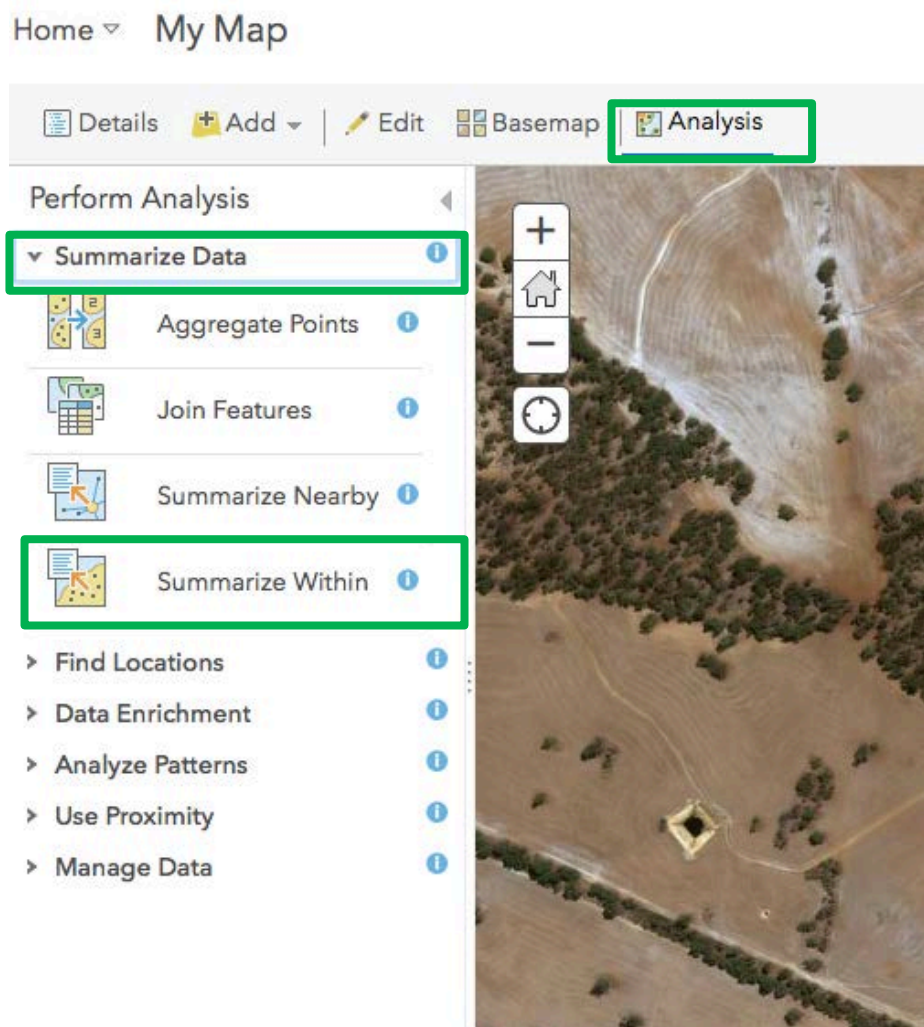
- Select “Run Analysis” – this might take a few moments. Your created buffer should look like this:



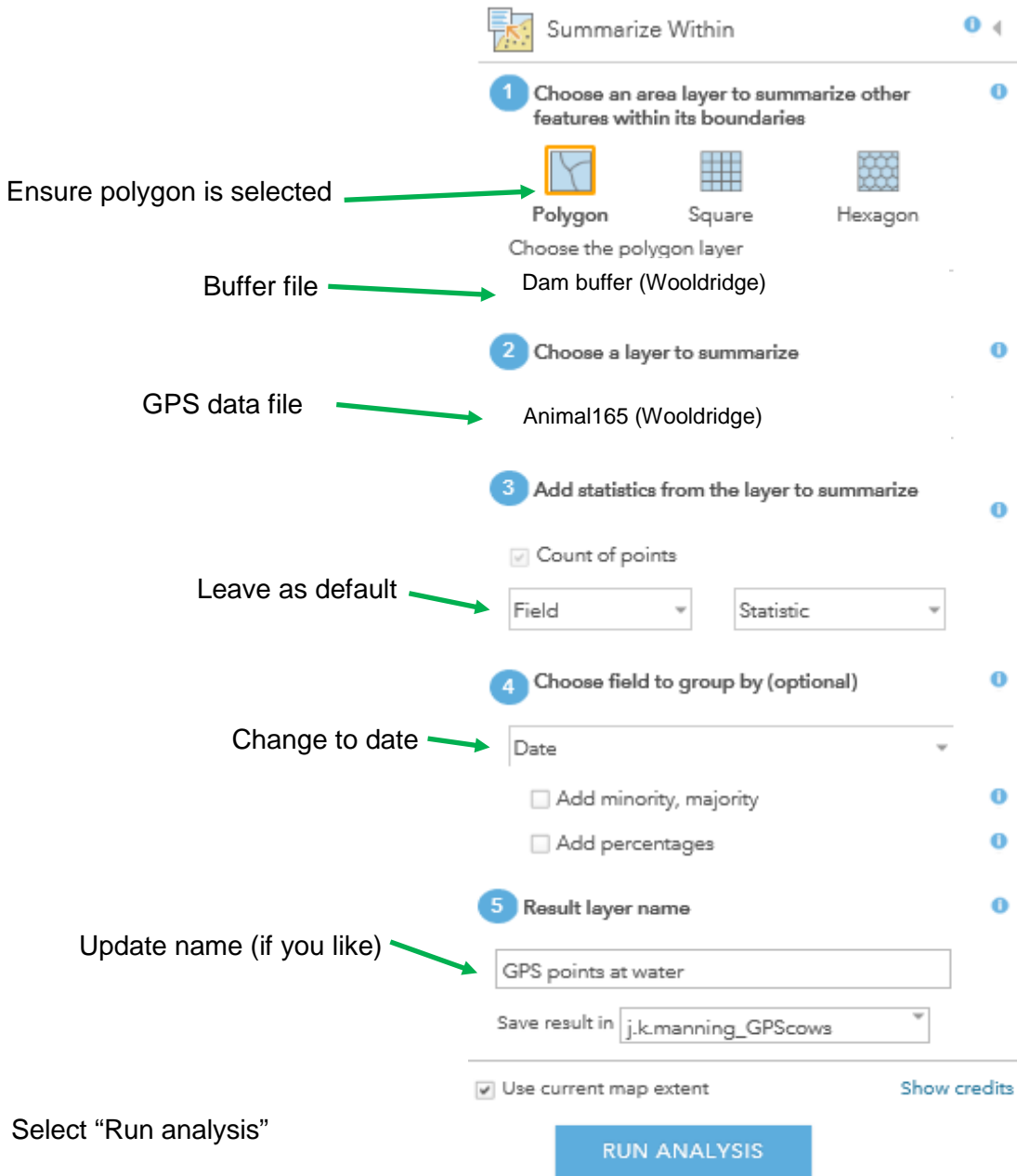
3.2.3 Calculating the number of points within an area/layer (Analysis > Summarise data > Summarise within)

Determining the number of GPS points within a layer will enable us to see how frequently animals were visiting that layer of interest. For this example, we are interested in the % of GPS points within 50 m of water.

- You will be using “Animal165 (Wooldridge)”, which was imported previously. Check to see that the file is still in your contents section, otherwise you will have to re-import it
- Select ‘Animal165 (Wooldridge)’ data layer > Select the “Analysis” tab > Choose “Summarise data” from the dropdown menu > Select “Summarise within”



- Under the “Summarize Within” menu follow the instructions below



The screenshot shows the 'Summarize Within' tool interface with the following steps and annotations:

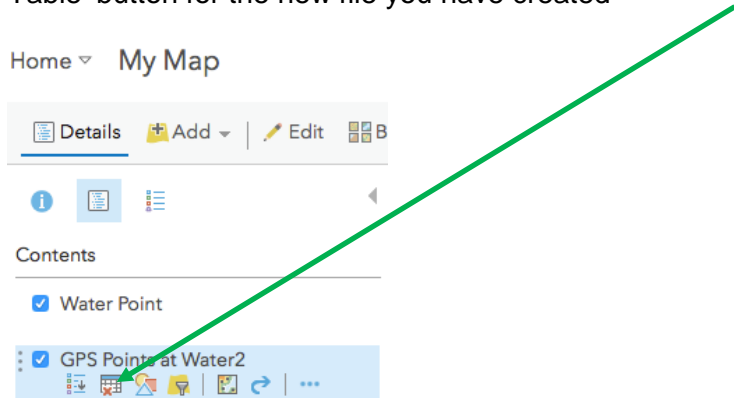
- 1 Choose an area layer to summarize other features within its boundaries**
 - Ensure polygon is selected (arrow points to Polygon icon)
 - Choose the polygon layer: Dam buffer (Wooldridge) (arrow points to this text)
- 2 Choose a layer to summarize**
 - GPS data file (arrow points to Animal165 (Wooldridge))
- 3 Add statistics from the layer to summarize**
 - Count of points (checked)
 - Field (dropdown menu) (arrow points to this dropdown, labeled 'Leave as default')
 - Statistic (dropdown menu)
- 4 Choose field to group by (optional)**
 - Date (dropdown menu) (arrow points to this dropdown, labeled 'Change to date')
 - Add minority, majority (checkbox)
 - Add percentages (checkbox)
- 5 Result layer name**
 - Update name (if you like) (arrow points to the text 'GPS points at water' in the input field)
 - Save result in: j.k.manning_GPScows (dropdown menu)

At the bottom, there is a checked box for 'Use current map extent' and a 'Show credits' link. A blue 'RUN ANALYSIS' button is located at the bottom center.

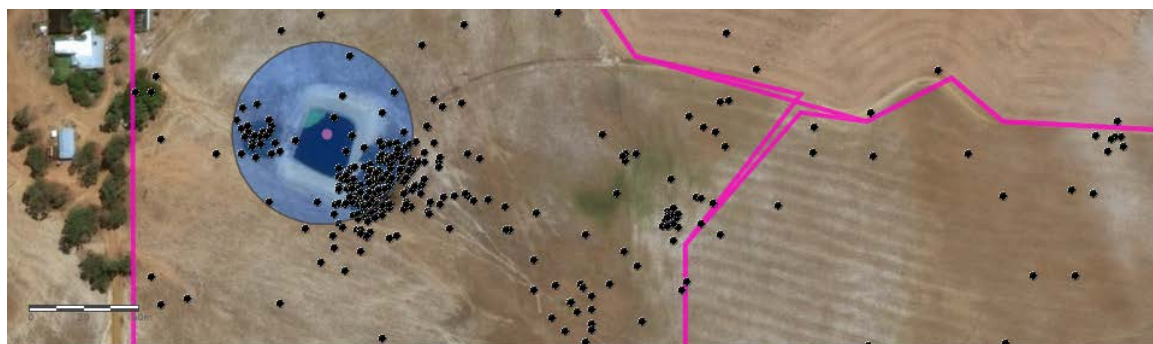
Select “Run analysis”

The name of my file is:

- To calculate the number of GPS points within the Water Point buffer click on the 'Show Table' button for the new file you have created



- Note the number of points within the buffer (See "Count of points" in the table, an example is below). Write this number in the purple box below. Please note this number may vary depending on the exact location of your 'Pin' as the buffer will be in a slightly different location



Wooldridge Ewe165 1week within Water buffer (Features: 1, Selected: 0)

Count of Points	Title	Visible	Description	Image URL	Image Link URL	DATE	Type ID	Buffer distance Meters
174	Wooldridge_Dam	1					0	50.0000

- To determine the number of GPS points in the Animal165 (Wooldridge) file click on the "Show Table" button.

Wooldridge Ewe165 1week (Features: 1889, Selected: 0)				
Index	timestamp	Longitude	Latitude	EHPE
4,549	17/02/2018 6:03	116.95	-33.26	2,720
4,447	16/02/2018 20:56	116.95	-33.27	3,088
4,550	17/02/2018 6:08	116.95	-33.26	6,528
4,551	17/02/2018 6:13	116.95	-33.26	5,328

Write this number in the orange box below

- To calculate the % of GPS points within a given area:

$$\left[\begin{array}{l} \text{The number of GPS points} \\ \text{within 50 m of water} \\ = \underline{\hspace{2cm}} \\ \\ \div \\ \\ \text{The total number of GPS} \\ \text{points in the paddock} \\ = \underline{\hspace{2cm}} \end{array} \right] \times 100 = \underline{\hspace{2cm}}$$

of data was located
within 50 m of water



Class discussion time

Discussion point Why is knowing water utilisation important?

Water is the main constituent of an animal's body (it makes up 50 to 80 percent of their liveweight!). It is also important in the digestion of pasture (food). But it is the large quantity that animals consume on a daily basis that makes it important in knowing if they are visiting water. On average beef cattle consume 45 litres of water per day, but depending on conditions, this can increase to 60 litres of water. That is the equivalent of 36 1.25L bottles of softdrink!



QUESTION 7: List the factors that may affect water usage by livestock:

- _____

- _____

- _____

- _____

- _____




Class discussion time

GPS LIVESTOCK TRACKING DATA ANALYSIS PART 3

3.2.4 Water analysis by day

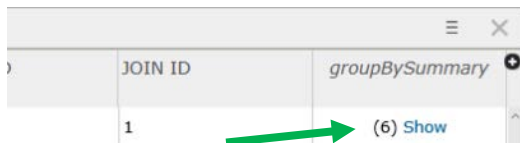
Scenario	We know that climate can influence how frequent animals visit water. There was a high maximum temperature recorded for one day during this period and our farmer is interested to know if this animal visited water on that particular day and during the week.
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The number of GPS points within 50 m of water per day

- Open up the new file you created in the previous step, by selecting your file and the “Show Table” button 

This is the file name you wrote in the purple box above. Copy this file name so that you can remember it later on:

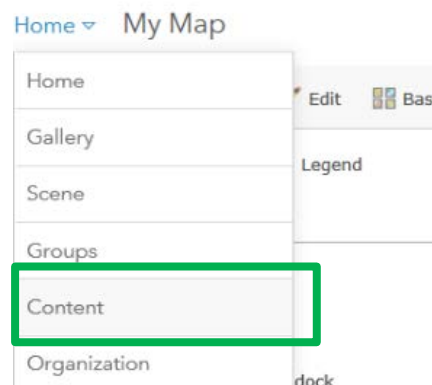
- Scroll to the far right to “groupBySummary” and click on “**Show**” to get the breakdown of GPS points at water per day



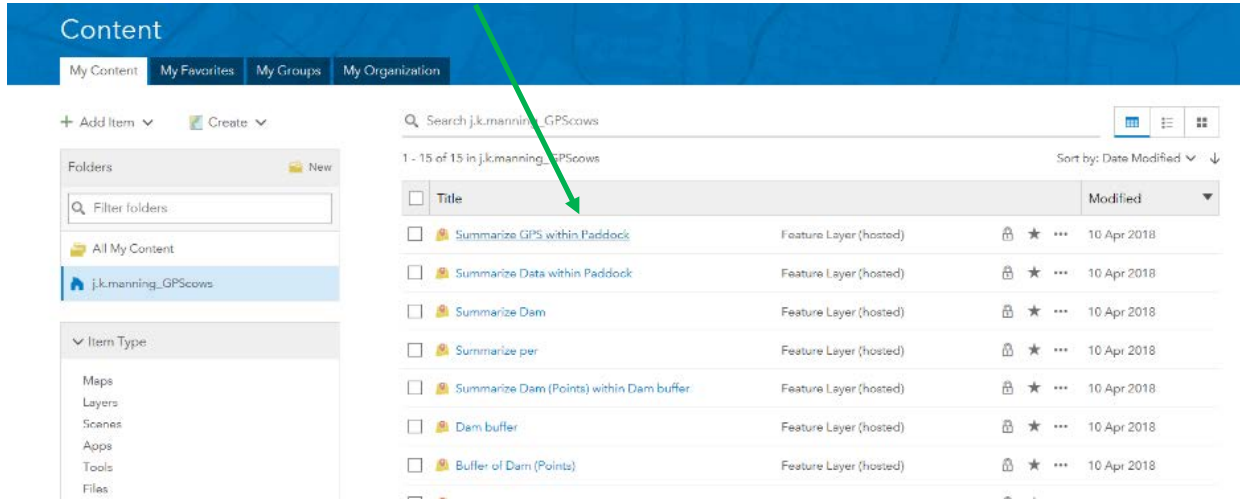
GroupBySummary (Features: 6, Selected: 0)				
OBJECTID	Join ID	Date	Count of Points	
1	1	15/02/2018	10	
2	1	16/02/2018	12	
3	1	17/02/2018	50	

These will be the new values that we will use next (after downloading the data)

- Download this file by **exporting the data**. To do this select the Home tab (top left) > Content



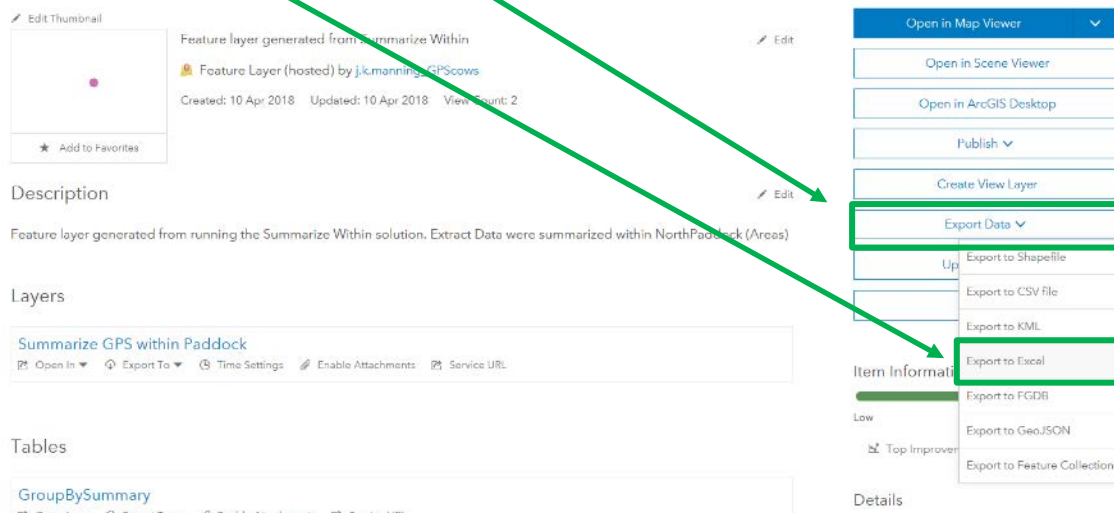
- Select the file of interest by clicking on the file link (remember yours will have a different name, depending on what you named your file. The name of your file is in the purple box)



The screenshot shows the 'Content' page with a list of files. The 'Title' column header is highlighted with a green arrow. The list contains several files, all of which are 'Feature Layer (hosted)' and were created on '10 Apr 2018'. The files listed are:

Title	Type	Created
Summarize GPS within Paddock	Feature Layer (hosted)	10 Apr 2018
Summarize Data within Paddock	Feature Layer (hosted)	10 Apr 2018
Summarize Dam	Feature Layer (hosted)	10 Apr 2018
Summarize per	Feature Layer (hosted)	10 Apr 2018
Summarize Dam (Points) within Dam buffer	Feature Layer (hosted)	10 Apr 2018
Dam buffer	Feature Layer (hosted)	10 Apr 2018
Buffer of Dam (Points)	Feature Layer (hosted)	10 Apr 2018

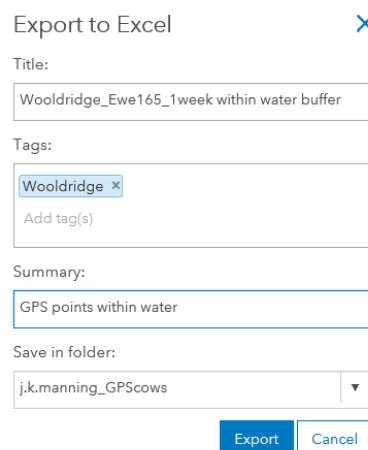
- Click on "Export data"
- Then select "Export to Excel"



The screenshot shows the details page for a feature layer. The 'Export Data' dropdown menu is open, and 'Export to Excel' is selected. The file details are as follows:

- Title:** Feature layer generated from Summarize Within
- Type:** Feature Layer (hosted) by j.k.manning_GPScows
- Created:** 10 Apr 2018
- Updated:** 10 Apr 2018
- View Count:** 2
- Description:** Feature layer generated from running the Summarize Within solution. Extract Data were summarized within NorthPaddock (Areas)
- Layers:** Summarize GPS within Paddock
- Tables:** GroupBySummary

- Add a title, tags and summary and click "Export"

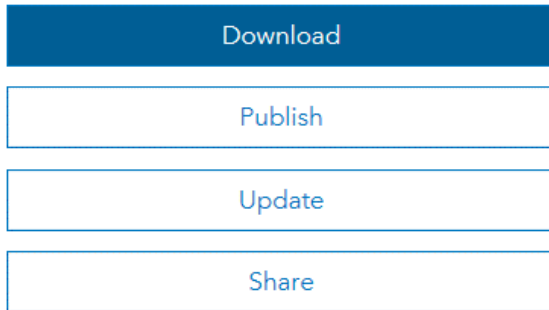


The 'Export to Excel' dialog box is shown with the following fields:

- Title:** Wooldridge_Ewe165_1week within water buffer
- Tags:** Wooldridge
- Summary:** GPS points within water
- Save in folder:** j.k.manning_GPScows

Buttons: Export, Cancel

- Select “Download”

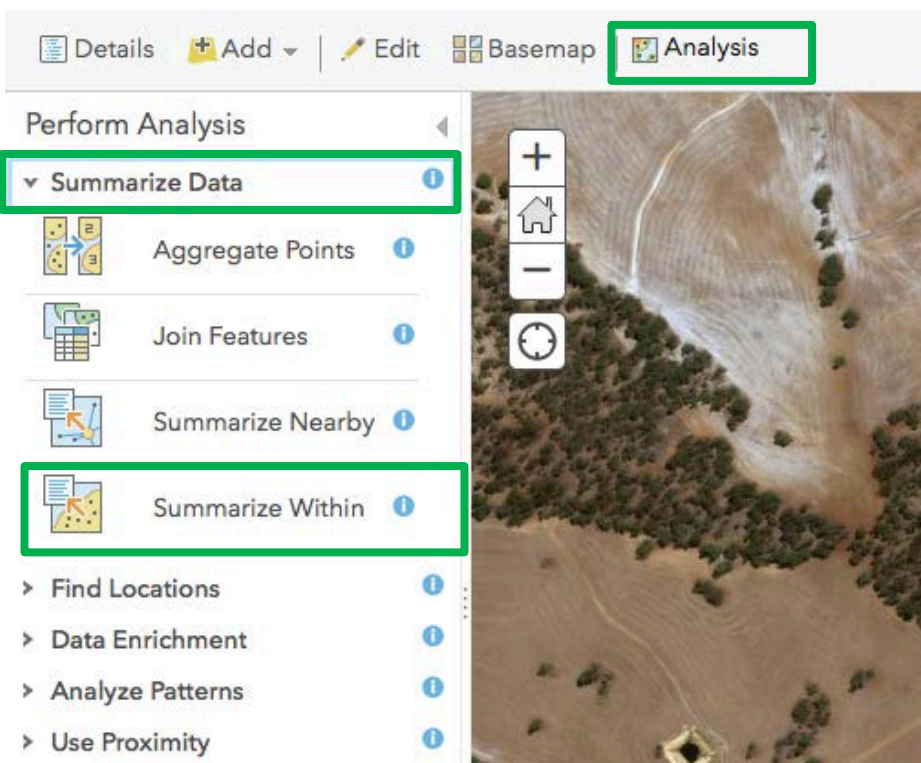


- Open up this excel file and leave it for now

The total number of GPS points in the paddock per day

3.2.5 You will also need to know the number of GPS points per day that was recorded (not the total like we calculated previously). To do this, select ‘Animal165 (Wooldridge)’ data layer > Select the “Analysis” tab > Choose “Summarise data” from the dropdown menu > Select “Summarise within”

Home ▾ My Map



- Ensure you change the **polygon layer to Paddock** (or the boundary of your GPS data).

Summarize Within

1 Choose an area layer to summarize other features within its boundaries

Polygon
 Square
 Hexagon

Choose the polygon layer

Paddock (Wooldridge)

2 Choose a layer to summarize

Animal165 (Wooldridge)

3 Add statistics from the layer to summarize

Count of points

Field Statistic

4 Choose field to group by (optional)

Date

Add minority, majority

Add percentages

5 Result layer name

GPS points in paddock

Save result in

Use current map extent [Show credits](#)

RUN ANALYSIS

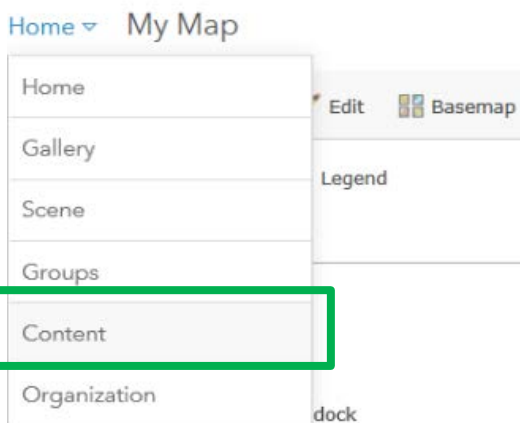
Select "Run analysis"

The name of my file is:

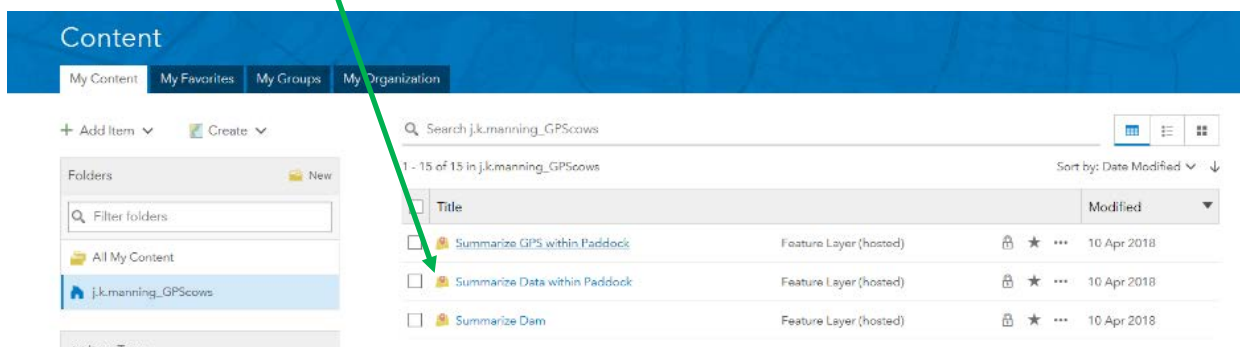
- Under the new file created Select Show table > scroll over to “groupBySummary”

JOIN ID	groupBySummary
1	(5) Show
2	(3) Show
3	(7) Show
4	(0)

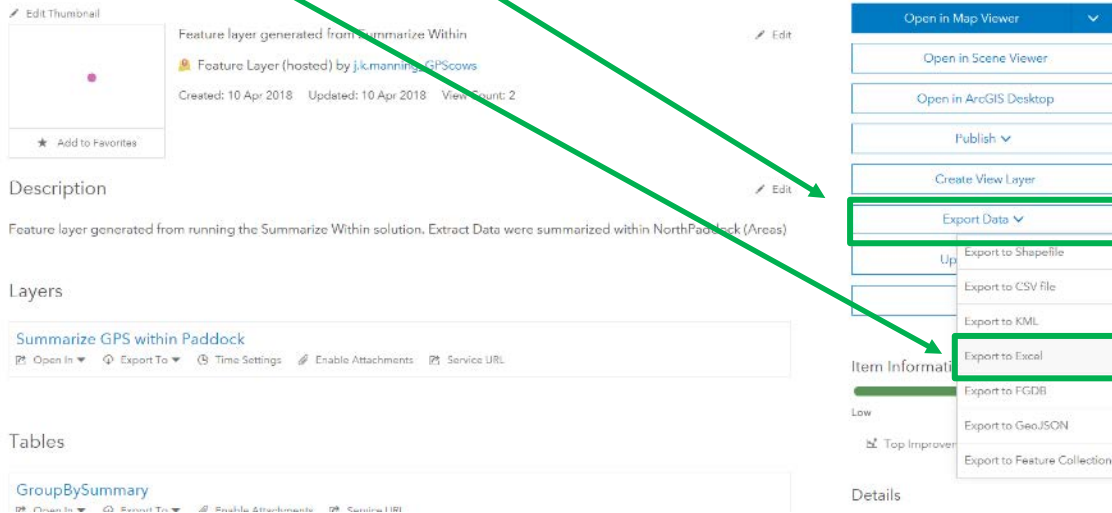
- Because this animal had access to multiple paddocks during the week, each of the paddocks has a separate row
- Download this file by **exporting the data**. To do this select the Home tab (top left) > Content



- Select the file of interest by clicking on the file link (remember yours will have a different name, depending on what you named your file. The name of your file is in the blue box)



- Click on “Export data”
- Then select “Export to Excel”



- Add a title, tags and summary and click “Export”

Export to Excel ✕

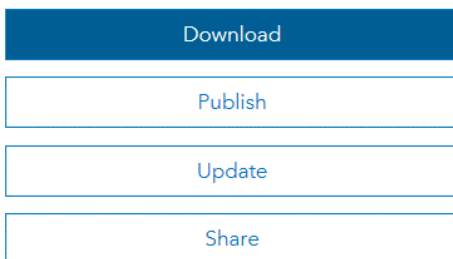
Title:

Tags:
 ✕
 Add tag(s)

Summary:

Save in folder:

- Select “Download”



- Open up this excel file. You should have two excel files opened now: **the total number of GPS points in the paddock per day** and **the number of GPS points within 50 m of water per day**

GPS LIVESTOCK TRACKING DATA ANALYSIS PART 4

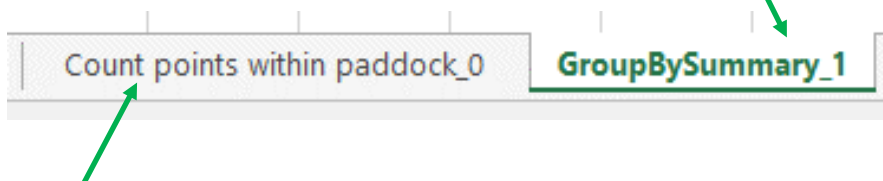
3.3 Analysing Data in Microsoft Excel

- Open the file needed for **the total number of GPS points in the paddock per day**

This is the file name you wrote in the blue box above.



The data tab we are interested is the “GroupBySummary” tab



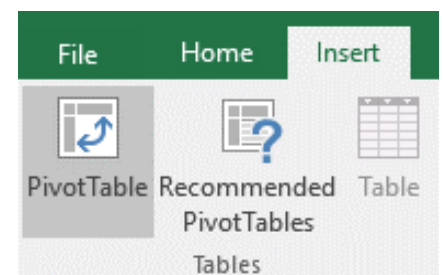
(This tab may be different, depending on what you named the file)

- You will notice that on some dates this animal visited multiple paddocks, so there are multiple rows of data for some dates

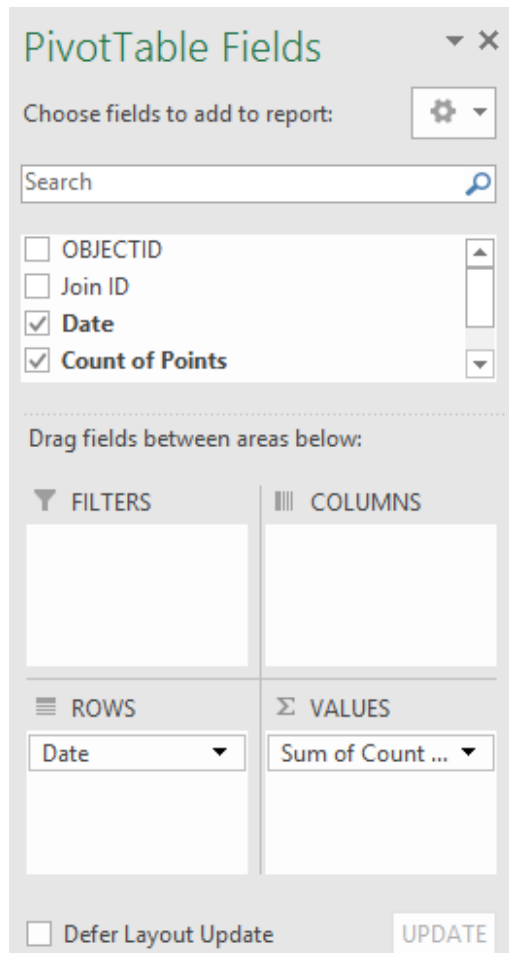
	A	B	C	D	E
1	OBJECTID	Join ID	Date	Count of Points	
2	1	1	15/02/2018	10	
3	2	1	16/02/2018	4	
4	3	1	20/02/2018	2	
5	4	1	21/02/2018	1	
6	5	1	22/02/2018	2	
7	6	2	15/02/2018	4	
8	7	2	20/02/2018	2	
9	8	2	21/02/2018	1	
10	9	3	15/02/2018	26	
11	10	3	16/02/2018	46	

3.3.1 As we are interested in the total number of GPS points per day (regardless of which paddock they were in) we need to create a **pivot table**. Select all data in the “Group by Summary” tab of your spreadsheet highlighting all of the data

- Next click on the “Insert tab”, select “Pivot table” and press “OK”



- Under rows = Date; Values = Sum of “Count of points”



- Copy the pivot table data and paste ‘as values’ into **the number of GPS points within 50 m of water per day** spreadsheet

Note: animals did not visit water on all days (no data for 19/2/2018)

GroupBySummary (Features: 6, Selected: 0)		
OBJECTID	Join ID	Date
1	1	15/02/2018
2	1	16/02/2018
3	1	17/02/2018
4	1	18/02/2018
5	1	20/02/2018

3.3.2 Organise your data like the following, and ensure you match the dates up

(As there may not be data for each day in the number of GPS points within 50 m of water per day spreadsheet. If this is the case, you may need to add a blank cell to match the dates)

- Delete column A (OBJECTID) and column B (Join ID)
- Rename your columns to match the names below

Column A	Column B	Column C	Column D
Date	GPS points at water	Total GPS points	% of GPS points at water
15/02/2018	10	173	$=(B2/C2)*100$
16/02/2018	12	266	$=(B3/C3)*100$
.....			

- Use the “% of GPS points within a given area” formula (outlined above in column D), on a daily basis to see how water usage changed over time and to detect which days animals did and did not visit water
- Type the formula in cell D2 and press enter
- Copy the formula into the remaining cells, by dragging it down from the right-hand-side corner of the cell D2

You should get similar values to those in the table below. Remember the value may not be exactly the same as each person’s buffer from their water point will be different

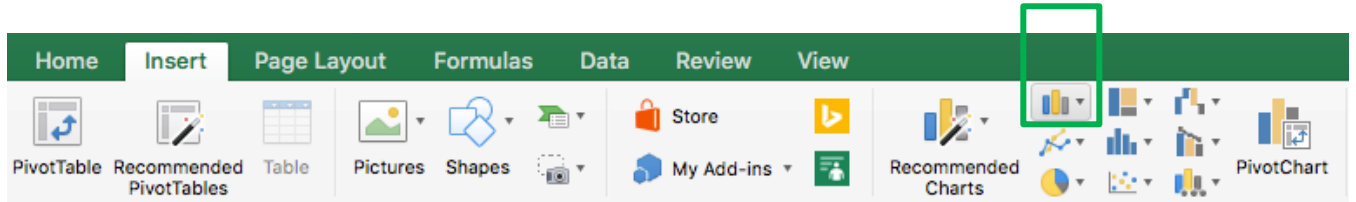
Date	GPS points at water	Total GPS points	% of GPS points at water
15/02/2018	10	174	5.7
16/02/2018	12	269	4.5
17/02/2018	50	236	21.2
18/02/2018	64	220	29.1
19/02/2018		119	0.0
20/02/2018	1	139	0.7
21/02/2018	37	137	27.0
22/02/2018		33	0.0

Note

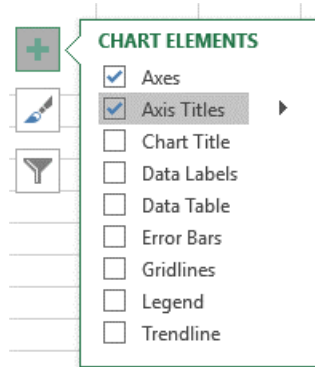
Note: we had no GPS points at water on the 19 and 22 but have a total GPS count value. This means that zero points went to water on those dates

3.3.3 Next we will **create a column graph** plotting the % of GPS points at water over time, by selecting the data (including the column label) in Column A and D

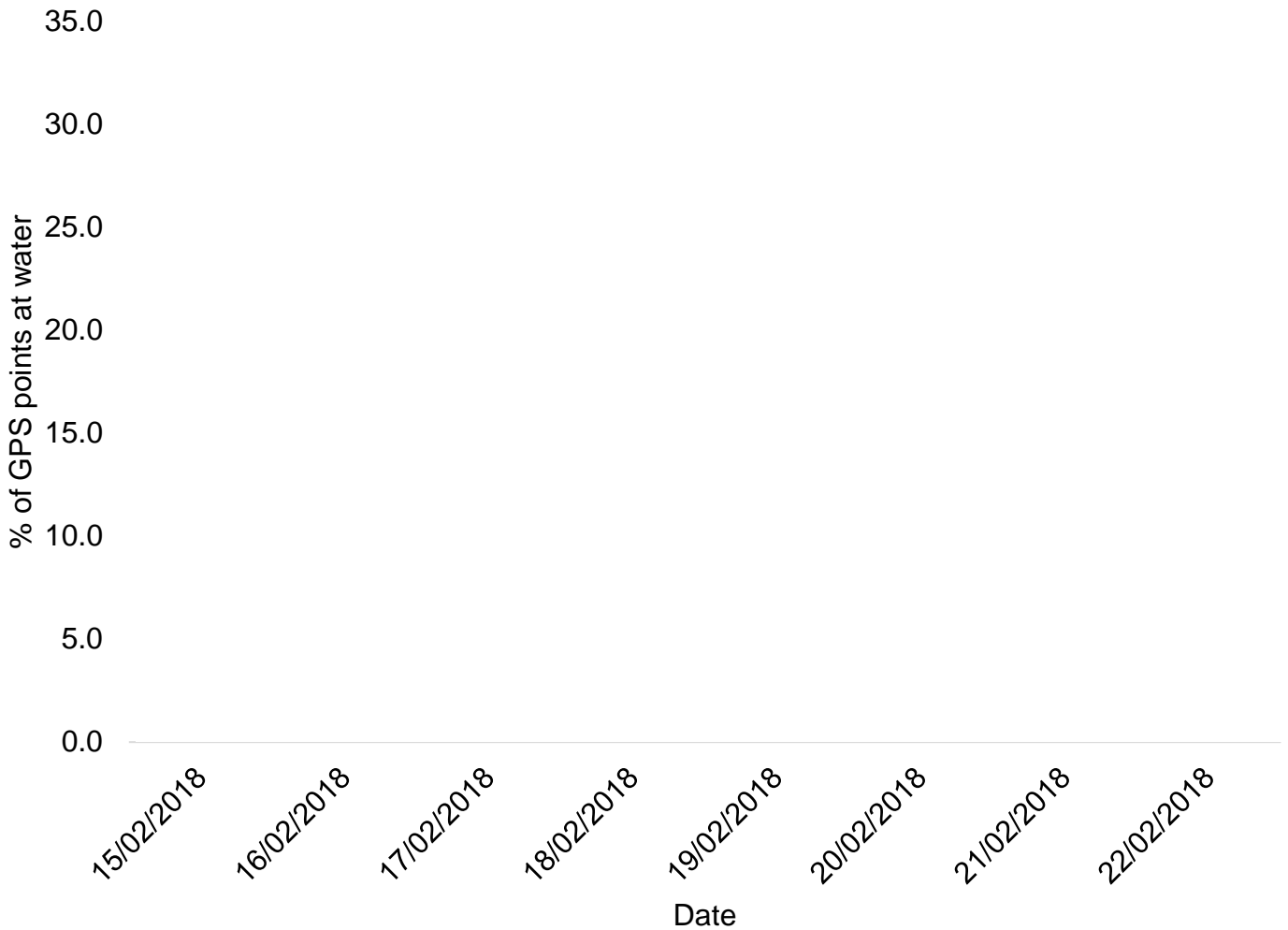
- Now select “Insert” and click on the Column Graph icon



- Add axis titles by clicking on your graph > + symbol > tick 'axis titles' > update titles



- Graph your results below



QUESTION 8: Were there any days that animals did NOT visit water? If so, when:

QUESTION 9: When was the highest utilisation of water?



Class discussion time

GPS LIVESTOCK TRACKING DATA ANALYSIS PART 5

3.4 Weather analysis

3.4.1 Add weather data to your graph

- Open up the weather data excel spreadsheet
- Select the 'minimum temperature', 'maximum temperature' and 'rainfall' headings > copy > paste into column E in your **the number of GPS points within 50 m of water per day** excel spreadsheet

	A	B	C	D	E	F
1	Daily Weather Observations for Wagin, Western Australia for February 2018					
2	Prepared at 16:03 UTC on Monday 16 April 2018 IDCJDW6126.201802					
3	Copyright 2003 Commonwealth Bureau of Meteorology					
4	Observations were drawn from Wagin {station 010647}					
5						
6		Date	Minimum tempe	Maximum tem	Rainfall (mm)	Evaporat
7		1/02/2018	15	27.8	0	
8		2/02/2018	18.3	30	0	
9		3/02/2018	18.9	35.1	0	

Your spreadsheet should now look like this:

Column A	Column B	Column C	Column D	Column E	Column F	Column G
Date	GPS points at water	Total GPS points	% of GPS points at water	Minimum temperature (°C)	Maximum temperature (°C)	Rainfall (mm)
15/02/2018	10	173	=(B2/C2)*100			
16/02/2018	12	266	=(B3/C3)*100			
.....						

- Select and copy the weather data for the dates where your animal was tracked. For this example it is 15/2/2018 to 22/2/2018

	A	B	C	D	E	F	G	H	I
1	Daily Weather Observations for Wagin, Western Australia for February 2018								
2	Prepared at 16:03 UTC on Monday 16 April 2018 IDCJDW6126.201802								
3	Copyright 2003 Commonwealth Bureau of Meteorology								
4	Observations were drawn from Wagin {station 010647}								
5									
6		Date	Minimum tempe	Maximum tem	Rainfall (mm)	Evaporati	Sunshine	Direction	Speed of i Tin
7		1/02/2018	15	27.8	0				
8		2/02/2018	18.3	30	0				
9		3/02/2018	18.9	35.1	0				
10		4/02/2018	19	33.8	0				
11		5/02/2018	16.5	37	0				
12		6/02/2018	18.2	32	0				
13		7/02/2018	15.5	24.2	0				
14		8/02/2018	12.9	28.7	0				
15		9/02/2018	15.7	31	0				
16		10/02/2018	12.9	28.6	0				
17		11/02/2018	12.5	30.5	0				
18		12/02/2018	12.8	31	0				
19		13/02/2018	13.5	28.5	0				
20		14/02/2018	15.5	31	0				
21		15/02/2018	14	34.9	0				
22		16/02/2018	16.3	39.8	0				
23		17/02/2018	19.5	34.5	0.4				
24		18/02/2018	18		0				
25		19/02/2018	18	29.1	0				
26		20/02/2018	14.5	24.6	0				
27		21/02/2018	12	28	0				
28		22/02/2018	17.2	32.8	0				
29		23/02/2018	18.5	22.3	0				
30		24/02/2018	11	26.9	0				
31		25/02/2018	14	24.5	0				
32		26/02/2018	18	25.9	14				
33		27/02/2018	9.9	23.8	0				
34		28/02/2018	9.9	25.8	0				

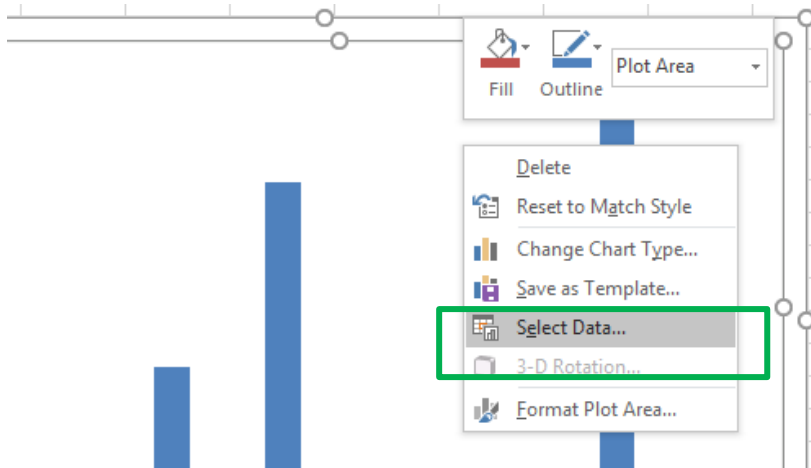
- Paste this data into Columns E-G in your spreadsheet

Your spreadsheet should now look like this:

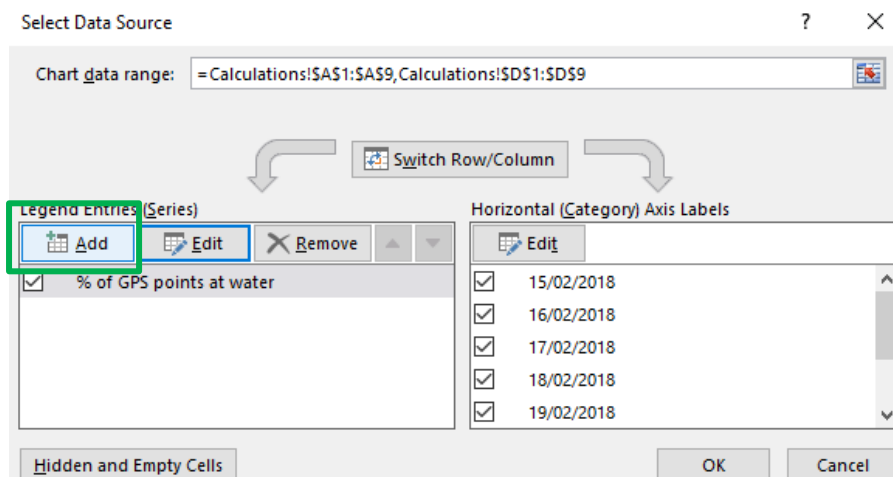
Column A	Column B	Column C	Column D	Column E	Column F	Column G
Date	GPS points at water	Total GPS points	% of GPS points at water	Minimum temperature (°C)	Maximum temperature (°C)	Rainfall (mm)
15/02/2018	10	173	$=(B2/C2)*100$	14	34.9	0
16/02/2018	12	266	$=(B3/C3)*100$	16.3	39.8	0
.....						

3.4.2. Next we will add the weather data to your column graph, plotting the % of GPS points at water over time

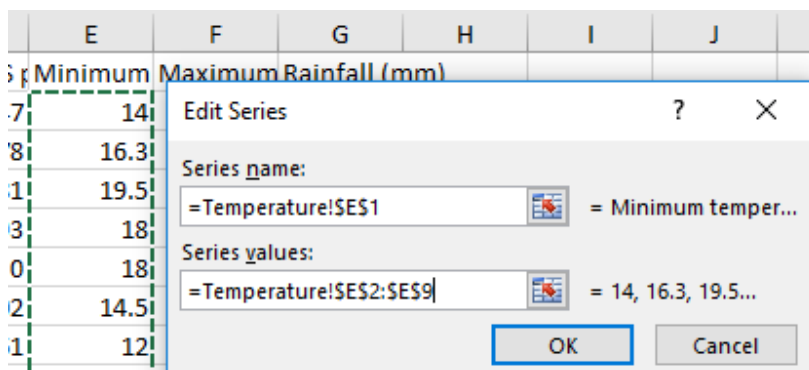
- Click on your graph > right click > select data



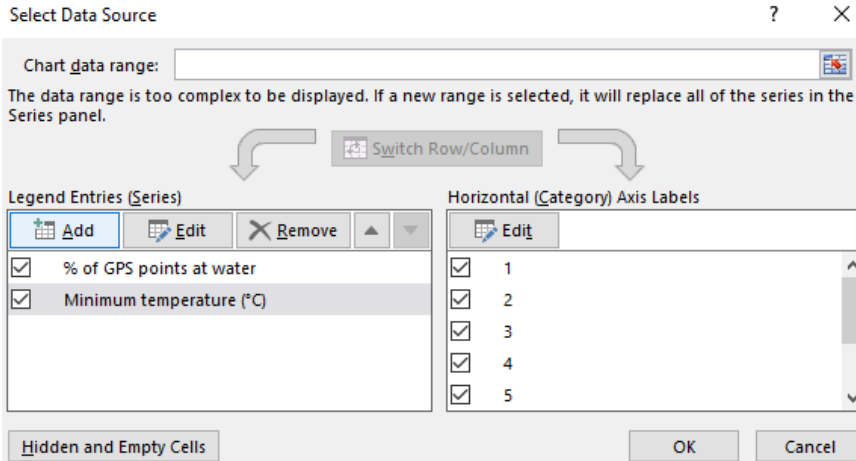
- To add the weather data, select the “Add” button



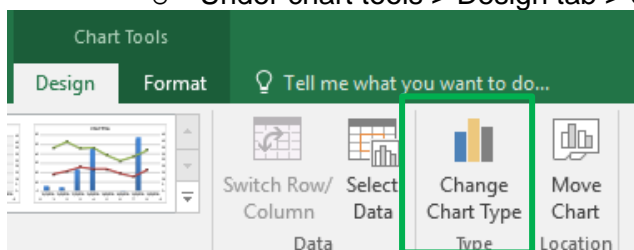
- Series name = Title (Cell E1); Series value = Minimum temperature data points (Cells E2:E9); Select OK



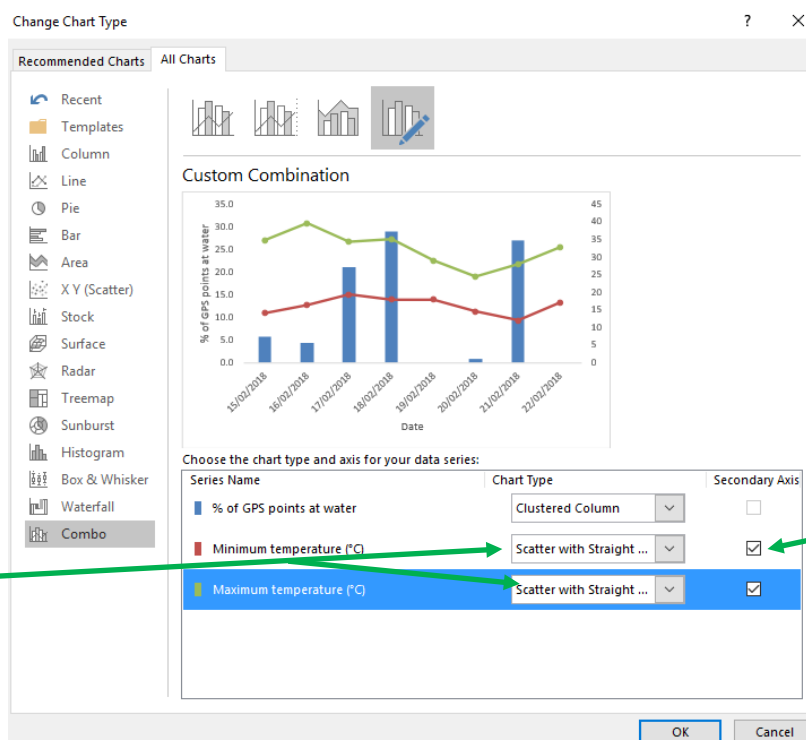
- Repeat for 'maximum temperature' and 'rainfall' by selecting the add button and choosing your data. When all three data sets of your climate data ('minimum temperature', 'maximum temperature' and 'rainfall') have been added, select OK



- For temperature, we want these as a secondary axis
 - Click on your graph
 - Under chart tools > Design tab > Select change chart type



- Update to the following:



Change the chart type to "scatter with straight lines"

Tick the secondary axis boxes

QUESTION 10: Did these days of high water utilisation relate to a high maximum temperature event?

QUESTION 11: What was the maximum temperature during this period and on what day did it occur?

QUESTION 12: How many days had rainfall?

QUESTION 13: List the reasons why tracking technology is important for livestock production, monitoring and welfare:

- ---

- ---

- ---

- ---

- ---



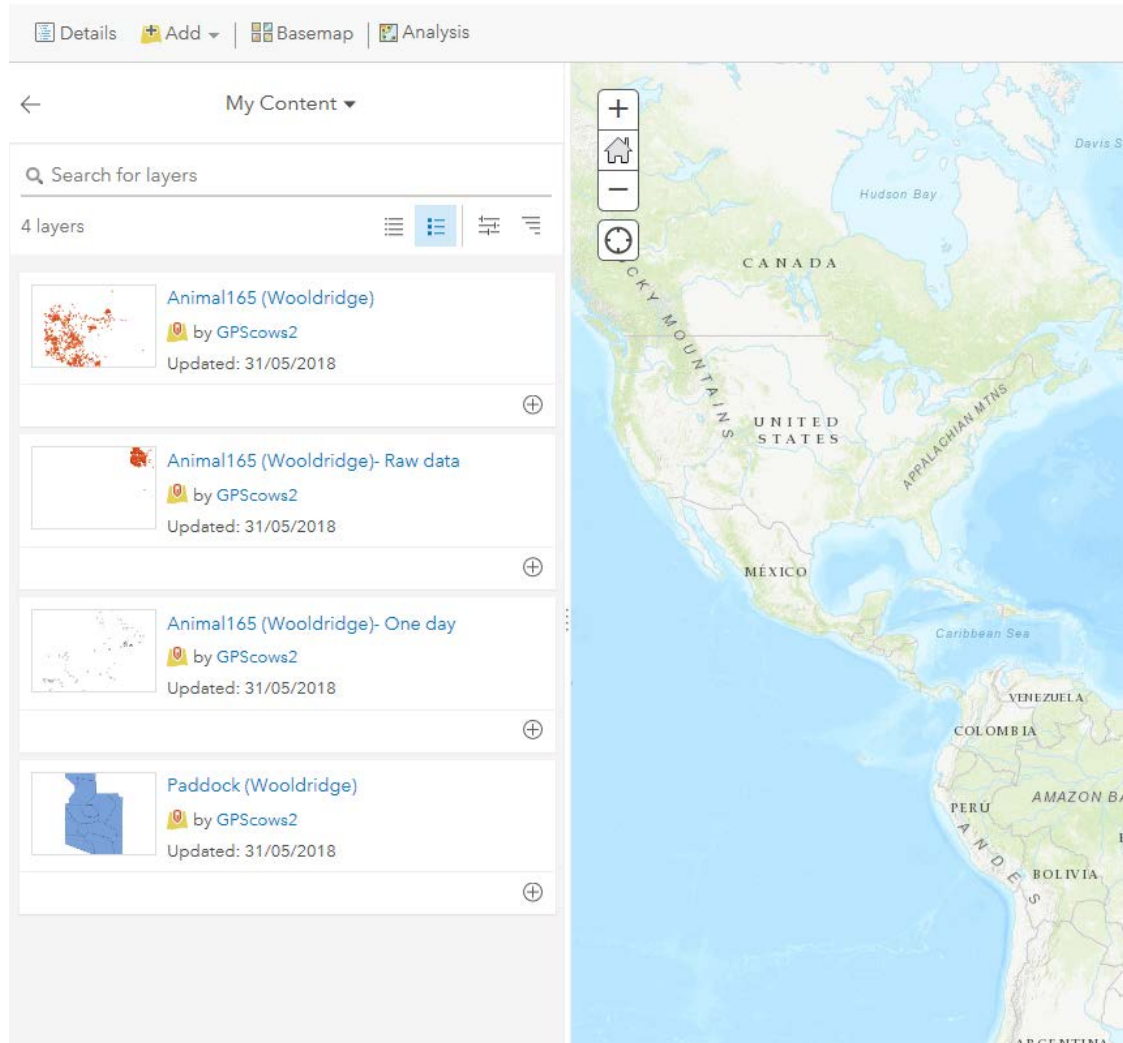
Class discussion time

Troubleshooting

Help! I cannot import my data using the link

Select the Add tab > Search for layers and all available layers will appear

Select the “+” sign to add which layer you are after. To return to your map select the ← sign



Help! I am having issues creating a buffer around the dam

Import the following link, and continue on with the steps

[https://services4.arcgis.com/panNT1e4COILr8V9/arcgis/rest/services/Buffer%20of%20Wooldridge_Dam%20\(Points\)/FeatureServer](https://services4.arcgis.com/panNT1e4COILr8V9/arcgis/rest/services/Buffer%20of%20Wooldridge_Dam%20(Points)/FeatureServer)

Further resources

Interested in learning more about agri-tech at school? Visit www.gpscows.com



Teacher Farm Experience Program



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