GPS collection app

Introduction

We work with approximately 200 farmers annually to collect soil samples and interpret the chemical analysis of those soil samples. Around half of the farmers collect their own soil samples, and collect the geolocations of those samples at the same time. A single composite soil sample is collected in a farmers paddock, and usually consists of 30 subsamples to provide a representative sample. The geolocation of each of the 30 subsamples within a paddock is recorded using a purpose built iOS app containing only the data for each farmer. Each set of 30 geocoordinates is called a transect, and these transects are presented to farmers as part of a larger report on their soil testing results (Figure 1). The transects provide a record of where the sample was collected so that future samples can be collected along a similar transect.

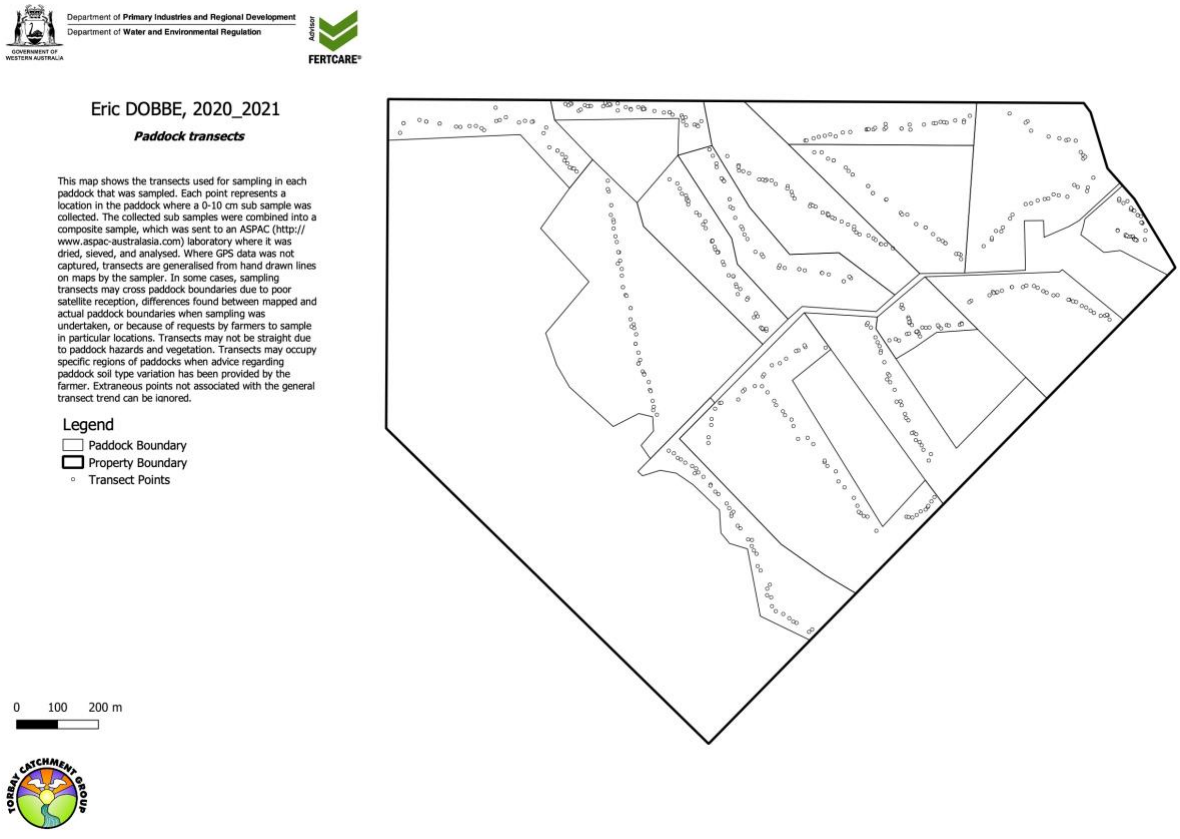


Figure 1. Map showing paddock transects within a farm

To collect geocoordinates we have developed a solution in FileMaker Pro which is deployed in FileMaker Go on iOS devices. There is no equivalent solution for Android since FileMaker Go is not available on the Android platform. We wish to develop and deploy an equivalent tool for Android users in our soil sampling program.

Current System

The current solution developed in FileMaker Pro is based around a relational database model containing 3 tables – Farmer, Paddocks, and Geolocations (Figure 2). A Farmer has

one or more paddocks, and each paddock has one or more geocoordinates. The solution assumes there is one soil sample for each paddock comprised of 30 subsamples. Most farmers to date have enrolled one farm property in the program, but recently farmers have enrolled more than one farm property. Rather than restructure the existing tool with the addition of a farm property table to accommodate multiple farm properties, the paddocks for each farm property are simply filtered using a popup showing farm property ID's.

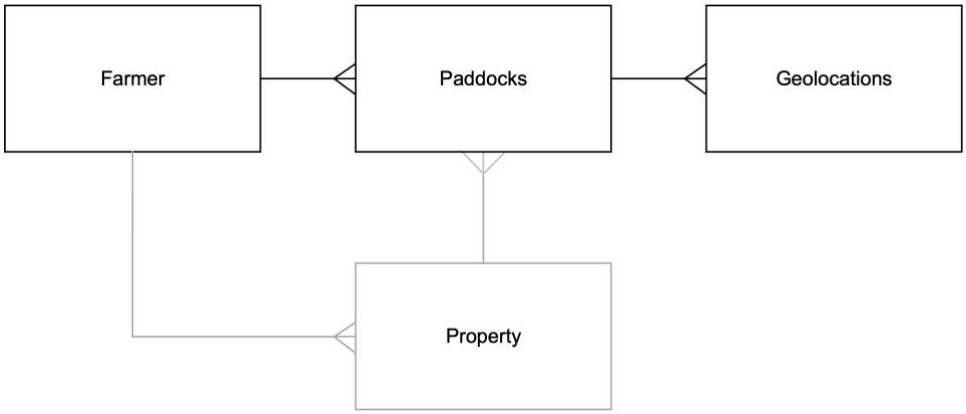


Figure 2. Entity relationship diagram

The solution is populated with data prior to deployment with data that is unique to each Farmer. This is achieved using the scripting capabilities of FileMaker Pro, looping through the farmers in our database who require access to the geolocational app, exporting two excel files, one with farmer information (Figure 3), and another with paddock information (Figure 4). This information is then imported into an empty FileMaker Pro file, and saved with the growers name ready to AirDrop to the farmers iOS device.

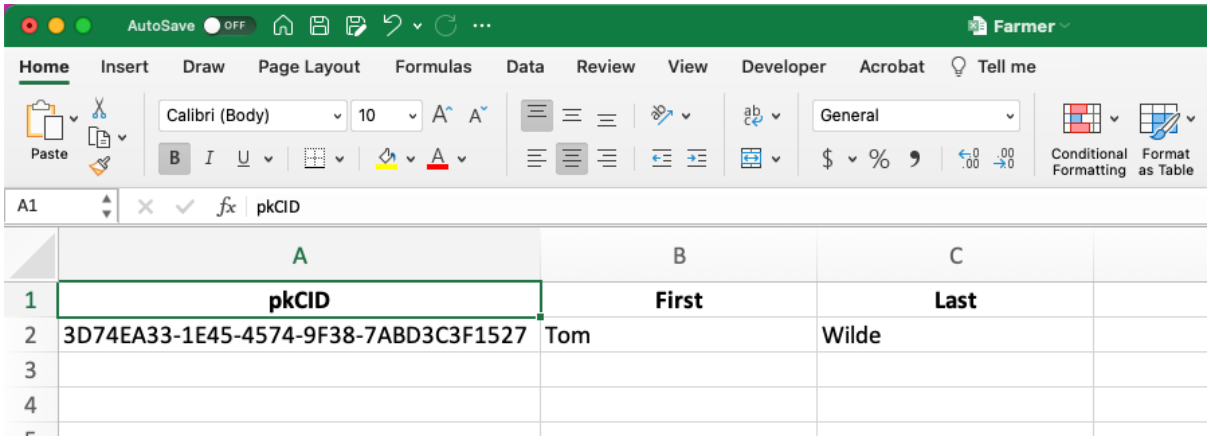
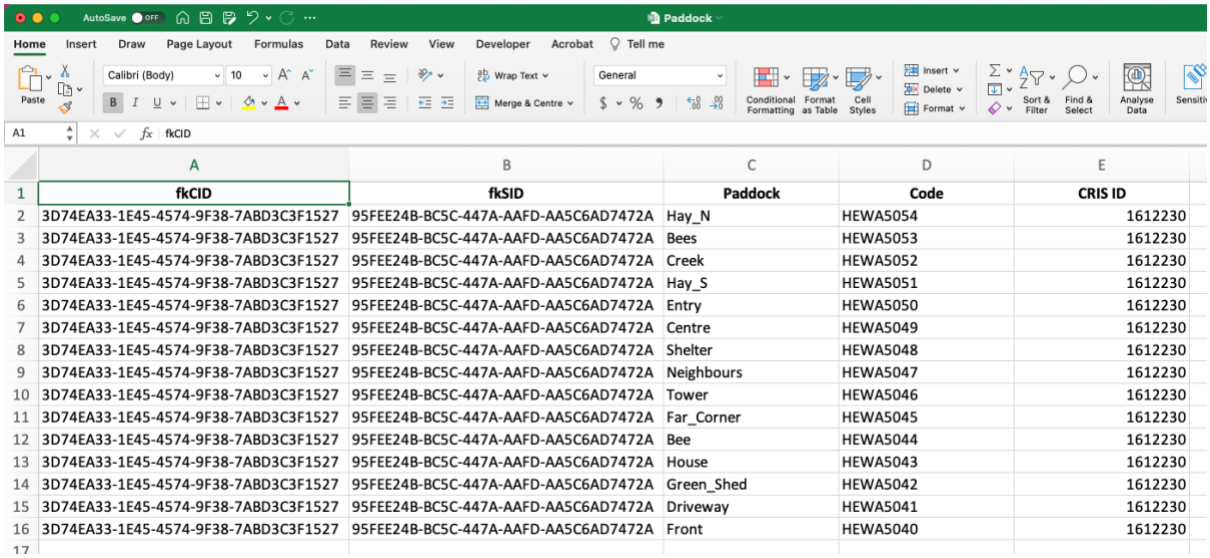


Figure 3. Excel file containing farmer information for import into the empty FileMaker file

The FileMaker Pro/Go solution makes use of the imported data in the solution for its operation when collecting geocoordinates.



	A	B	C	D	E
1	fkCID	fkSID	Paddock	Code	CRIS ID
2	3D74EA33-1E45-4574-9F38-7ABD3C3F1527	95FEE24B-BC5C-447A-AAFD-AA5C6AD7472A	Hay_N	HEWA5054	1612230
3	3D74EA33-1E45-4574-9F38-7ABD3C3F1527	95FEE24B-BC5C-447A-AAFD-AA5C6AD7472A	Bees	HEWA5053	1612230
4	3D74EA33-1E45-4574-9F38-7ABD3C3F1527	95FEE24B-BC5C-447A-AAFD-AA5C6AD7472A	Creek	HEWA5052	1612230
5	3D74EA33-1E45-4574-9F38-7ABD3C3F1527	95FEE24B-BC5C-447A-AAFD-AA5C6AD7472A	Hay_S	HEWA5051	1612230
6	3D74EA33-1E45-4574-9F38-7ABD3C3F1527	95FEE24B-BC5C-447A-AAFD-AA5C6AD7472A	Entry	HEWA5050	1612230
7	3D74EA33-1E45-4574-9F38-7ABD3C3F1527	95FEE24B-BC5C-447A-AAFD-AA5C6AD7472A	Centre	HEWA5049	1612230
8	3D74EA33-1E45-4574-9F38-7ABD3C3F1527	95FEE24B-BC5C-447A-AAFD-AA5C6AD7472A	Shelter	HEWA5048	1612230
9	3D74EA33-1E45-4574-9F38-7ABD3C3F1527	95FEE24B-BC5C-447A-AAFD-AA5C6AD7472A	Neighbours	HEWA5047	1612230
10	3D74EA33-1E45-4574-9F38-7ABD3C3F1527	95FEE24B-BC5C-447A-AAFD-AA5C6AD7472A	Tower	HEWA5046	1612230
11	3D74EA33-1E45-4574-9F38-7ABD3C3F1527	95FEE24B-BC5C-447A-AAFD-AA5C6AD7472A	Far_Corner	HEWA5045	1612230
12	3D74EA33-1E45-4574-9F38-7ABD3C3F1527	95FEE24B-BC5C-447A-AAFD-AA5C6AD7472A	Bee	HEWA5044	1612230
13	3D74EA33-1E45-4574-9F38-7ABD3C3F1527	95FEE24B-BC5C-447A-AAFD-AA5C6AD7472A	House	HEWA5043	1612230
14	3D74EA33-1E45-4574-9F38-7ABD3C3F1527	95FEE24B-BC5C-447A-AAFD-AA5C6AD7472A	Green_Shed	HEWA5042	1612230
15	3D74EA33-1E45-4574-9F38-7ABD3C3F1527	95FEE24B-BC5C-447A-AAFD-AA5C6AD7472A	Driveway	HEWA5041	1612230
16	3D74EA33-1E45-4574-9F38-7ABD3C3F1527	95FEE24B-BC5C-447A-AAFD-AA5C6AD7472A	Front	HEWA5040	1612230

Figure 4. Excel file containing paddock and property information for import into the empty FileMaker file

The solution makes use of the GPS capabilities of iOS devices containing a SIM slot, and does not need to be connected to the internet to enable the capture of geocoordinates. It does not access any mapping facilities or libraries to present the data spatially. Offline capture and storage of geocoordinates is preferred to reduce battery consumption on the mobile device.

User interface

The user interface for the current solution is simple, tabular in nature, and uses a minimum of icons and popup menus to capture relevant data (Figure 5). A GPS icon is clicked to capture a geolocation (Figure 5). A tool icon is clicked to choose a sampling tool prior to collection of the sample and capture of geolocations (Figure 6). Clicking the send mail button composes an email using the device mail client and attaches an excel spreadsheet of the captured data (Figure 7), the contents of which are shown in Figure 8.

The current interface uses a popup menu to show the paddocks for the farmer (Figure 9). Choosing a paddock shows the unique sample code assigned to that paddock (Figure 10).

The current user interface provides feedback to the end user of the number of subsamples collected within a paddock, and uses conditional formatting to indicate when the number of required subsamples has been achieved (Figure 11, Figure 12, Figure 13).

For farmers who have more than one farm property to sample, a coloured icon appears allowing the user to select a different property (Figure 14). This is achieved via a popover and popup menu showing farm property ID's (Figure 15). This icon does not appear when a farmer has a single property to sample.

Figure 5. Interface of current solution

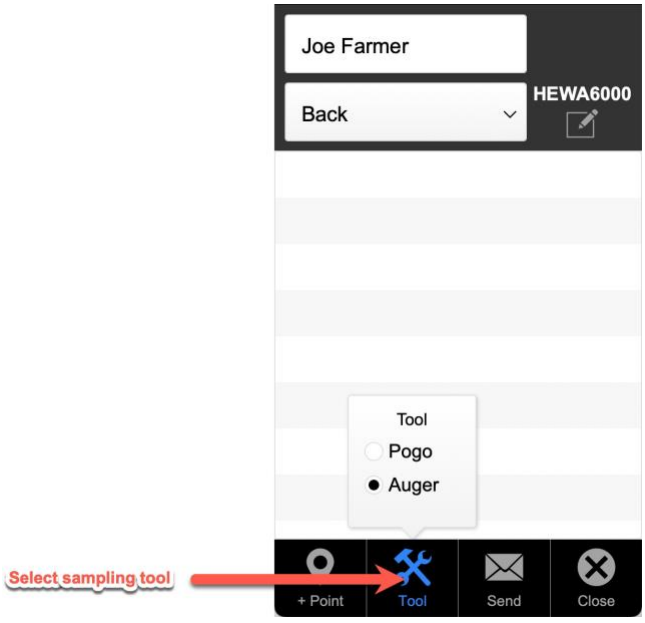


Figure 6. Popover showing radio buttons for selection of sampling tool

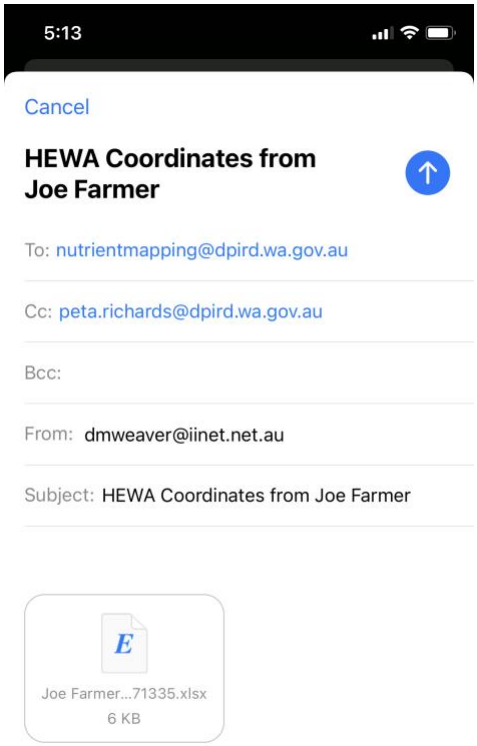
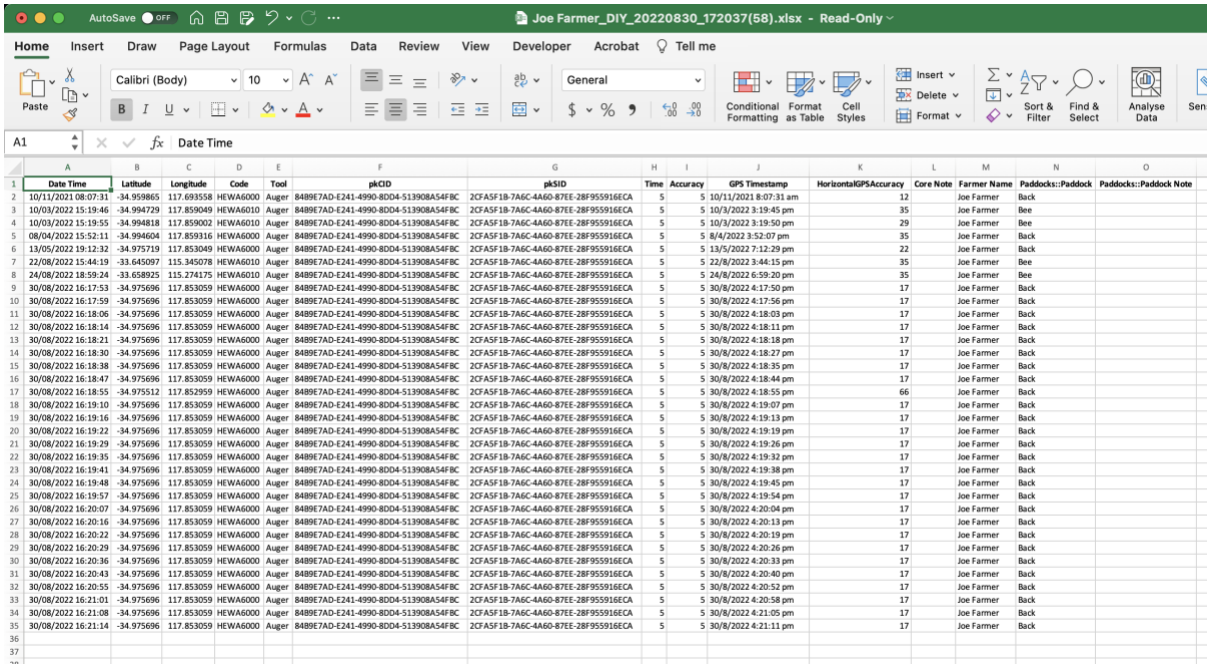


Figure 7. Composed email using the device mail client with excel spreadsheet of the captured data attached



Date Time	Latitude	Longitude	Code	Tool	pkCID	pkSID	Time	Accuracy	GPS Timestamp	HorizontalGPSAccuracy	Core Note	Farmer Name	Paddocks::Paddock	Paddocks::Paddock Note
10/11/2021 08:07:31	-34.959865	117.693558	HEWA6000	Auger	8489E7AD-E241-4990-8DD4-513908A54FBC	2CFA5F1B-7A6C-4A60-87EE-28F955916ECA	5	5	10/11/2021 8:07:31 am	12		Joe Farmer	Back	
10/03/2022 15:19:46	-34.994729	117.859049	HEWA6010	Auger	8489E7AD-E241-4990-8DD4-513908A54FBC	2CFA5F1B-7A6C-4A60-87EE-28F955916ECA	5	5	10/3/2022 3:19:45 pm	35		Joe Farmer	Bee	
10/03/2022 15:19:55	-34.994818	117.859002	HEWA6010	Auger	8489E7AD-E241-4990-8DD4-513908A54FBC	2CFA5F1B-7A6C-4A60-87EE-28F955916ECA	5	5	10/3/2022 3:19:50 pm	29		Joe Farmer	Bee	
08/04/2022 15:52:11	-34.994604	117.859316	HEWA6000	Auger	8489E7AD-E241-4990-8DD4-513908A54FBC	2CFA5F1B-7A6C-4A60-87EE-28F955916ECA	5	5	8/4/2022 3:52:07 pm	35		Joe Farmer	Back	
13/05/2022 19:12:32	-34.975719	117.853049	HEWA6000	Auger	8489E7AD-E241-4990-8DD4-513908A54FBC	2CFA5F1B-7A6C-4A60-87EE-28F955916ECA	5	5	13/5/2022 7:12:29 pm	22		Joe Farmer	Back	
22/08/2022 15:44:19	-33.645097	115.345078	HEWA6010	Auger	8489E7AD-E241-4990-8DD4-513908A54FBC	2CFA5F1B-7A6C-4A60-87EE-28F955916ECA	5	5	22/8/2022 3:44:15 pm	35		Joe Farmer	Bee	
24/08/2022 18:59:24	-33.658925	115.274175	HEWA6010	Auger	8489E7AD-E241-4990-8DD4-513908A54FBC	2CFA5F1B-7A6C-4A60-87EE-28F955916ECA	5	5	24/8/2022 6:59:20 pm	35		Joe Farmer	Bee	
30/08/2022 16:17:53	-34.975696	117.853059	HEWA6000	Auger	8489E7AD-E241-4990-8DD4-513908A54FBC	2CFA5F1B-7A6C-4A60-87EE-28F955916ECA	5	5	30/8/2022 4:17:50 pm	17		Joe Farmer	Back	
30/08/2022 16:17:59	-34.975696	117.853059	HEWA6000	Auger	8489E7AD-E241-4990-8DD4-513908A54FBC	2CFA5F1B-7A6C-4A60-87EE-28F955916ECA	5	5	30/8/2022 4:17:56 pm	17		Joe Farmer	Back	
30/08/2022 16:18:06	-34.975696	117.853059	HEWA6000	Auger	8489E7AD-E241-4990-8DD4-513908A54FBC	2CFA5F1B-7A6C-4A60-87EE-28F955916ECA	5	5	30/8/2022 4:18:03 pm	17		Joe Farmer	Back	
30/08/2022 16:18:14	-34.975696	117.853059	HEWA6000	Auger	8489E7AD-E241-4990-8DD4-513908A54FBC	2CFA5F1B-7A6C-4A60-87EE-28F955916ECA	5	5	30/8/2022 4:18:11 pm	17		Joe Farmer	Back	
30/08/2022 16:18:21	-34.975696	117.853059	HEWA6000	Auger	8489E7AD-E241-4990-8DD4-513908A54FBC	2CFA5F1B-7A6C-4A60-87EE-28F955916ECA	5	5	30/8/2022 4:18:18 pm	17		Joe Farmer	Back	
30/08/2022 16:18:30	-34.975696	117.853059	HEWA6000	Auger	8489E7AD-E241-4990-8DD4-513908A54FBC	2CFA5F1B-7A6C-4A60-87EE-28F955916ECA	5	5	30/8/2022 4:18:27 pm	17		Joe Farmer	Back	
30/08/2022 16:18:38	-34.975696	117.853059	HEWA6000	Auger	8489E7AD-E241-4990-8DD4-513908A54FBC	2CFA5F1B-7A6C-4A60-87EE-28F955916ECA	5	5	30/8/2022 4:18:35 pm	17		Joe Farmer	Back	
30/08/2022 16:18:47	-34.975696	117.853059	HEWA6000	Auger	8489E7AD-E241-4990-8DD4-513908A54FBC	2CFA5F1B-7A6C-4A60-87EE-28F955916ECA	5	5	30/8/2022 4:18:44 pm	17		Joe Farmer	Back	
30/08/2022 16:18:55	-34.975512	117.852959	HEWA6000	Auger	8489E7AD-E241-4990-8DD4-513908A54FBC	2CFA5F1B-7A6C-4A60-87EE-28F955916ECA	5	5	30/8/2022 4:18:55 pm	66		Joe Farmer	Back	
30/08/2022 16:19:10	-34.975696	117.853059	HEWA6000	Auger	8489E7AD-E241-4990-8DD4-513908A54FBC	2CFA5F1B-7A6C-4A60-87EE-28F955916ECA	5	5	30/8/2022 4:19:07 pm	17		Joe Farmer	Back	
30/08/2022 16:19:16	-34.975696	117.853059	HEWA6000	Auger	8489E7AD-E241-4990-8DD4-513908A54FBC	2CFA5F1B-7A6C-4A60-87EE-28F955916ECA	5	5	30/8/2022 4:19:13 pm	17		Joe Farmer	Back	
30/08/2022 16:19:22	-34.975696	117.853059	HEWA6000	Auger	8489E7AD-E241-4990-8DD4-513908A54FBC	2CFA5F1B-7A6C-4A60-87EE-28F955916ECA	5	5	30/8/2022 4:19:19 pm	17		Joe Farmer	Back	
30/08/2022 16:19:29	-34.975696	117.853059	HEWA6000	Auger	8489E7AD-E241-4990-8DD4-513908A54FBC	2CFA5F1B-7A6C-4A60-87EE-28F955916ECA	5	5	30/8/2022 4:19:26 pm	17		Joe Farmer	Back	
30/08/2022 16:19:35	-34.975696	117.853059	HEWA6000	Auger	8489E7AD-E241-4990-8DD4-513908A54FBC	2CFA5F1B-7A6C-4A60-87EE-28F955916ECA	5	5	30/8/2022 4:19:32 pm	17		Joe Farmer	Back	
30/08/2022 16:19:41	-34.975696	117.853059	HEWA6000	Auger	8489E7AD-E241-4990-8DD4-513908A54FBC	2CFA5F1B-7A6C-4A60-87EE-28F955916ECA	5	5	30/8/2022 4:19:38 pm	17		Joe Farmer	Back	
30/08/2022 16:19:48	-34.975696	117.853059	HEWA6000	Auger	8489E7AD-E241-4990-8DD4-513908A54FBC	2CFA5F1B-7A6C-4A60-87EE-28F955916ECA	5	5	30/8/2022 4:19:45 pm	17		Joe Farmer	Back	
30/08/2022 16:19:57	-34.975696	117.853059	HEWA6000	Auger	8489E7AD-E241-4990-8DD4-513908A54FBC	2CFA5F1B-7A6C-4A60-87EE-28F955916ECA	5	5	30/8/2022 4:19:54 pm	17		Joe Farmer	Back	
30/08/2022 16:20:07	-34.975696	117.853059	HEWA6000	Auger	8489E7AD-E241-4990-8DD4-513908A54FBC	2CFA5F1B-7A6C-4A60-87EE-28F955916ECA	5	5	30/8/2022 4:20:04 pm	17		Joe Farmer	Back	
30/08/2022 16:20:16	-34.975696	117.853059	HEWA6000	Auger	8489E7AD-E241-4990-8DD4-513908A54FBC	2CFA5F1B-7A6C-4A60-87EE-28F955916ECA	5	5	30/8/2022 4:20:13 pm	17		Joe Farmer	Back	
30/08/2022 16:20:22	-34.975696	117.853059	HEWA6000	Auger	8489E7AD-E241-4990-8DD4-513908A54FBC	2CFA5F1B-7A6C-4A60-87EE-28F955916ECA	5	5	30/8/2022 4:20:19 pm	17		Joe Farmer	Back	
30/08/2022 16:20:29	-34.975696	117.853059	HEWA6000	Auger	8489E7AD-E241-4990-8DD4-513908A54FBC	2CFA5F1B-7A6C-4A60-87EE-28F955916ECA	5	5	30/8/2022 4:20:26 pm	17		Joe Farmer	Back	
30/08/2022 16:20:36	-34.975696	117.853059	HEWA6000	Auger	8489E7AD-E241-4990-8DD4-513908A54FBC	2CFA5F1B-7A6C-4A60-87EE-28F955916ECA	5	5	30/8/2022 4:20:33 pm	17		Joe Farmer	Back	
30/08/2022 16:20:43	-34.975696	117.853059	HEWA6000	Auger	8489E7AD-E241-4990-8DD4-513908A54FBC	2CFA5F1B-7A6C-4A60-87EE-28F955916ECA	5	5	30/8/2022 4:20:40 pm	17		Joe Farmer	Back	
30/08/2022 16:20:55	-34.975696	117.853059	HEWA6000	Auger	8489E7AD-E241-4990-8DD4-513908A54FBC	2CFA5F1B-7A6C-4A60-87EE-28F955916ECA	5	5	30/8/2022 4:20:52 pm	17		Joe Farmer	Back	
30/08/2022 16:21:01	-34.975696	117.853059	HEWA6000	Auger	8489E7AD-E241-4990-8DD4-513908A54FBC	2CFA5F1B-7A6C-4A60-87EE-28F955916ECA	5	5	30/8/2022 4:20:58 pm	17		Joe Farmer	Back	
30/08/2022 16:21:08	-34.975696	117.853059	HEWA6000	Auger	8489E7AD-E241-4990-8DD4-513908A54FBC	2CFA5F1B-7A6C-4A60-87EE-28F955916ECA	5	5	30/8/2022 4:21:05 pm	17		Joe Farmer	Back	
30/08/2022 16:21:14	-34.975696	117.853059	HEWA6000	Auger	8489E7AD-E241-4990-8DD4-513908A54FBC	2CFA5F1B-7A6C-4A60-87EE-28F955916ECA	5	5	30/8/2022 4:21:11 pm	17		Joe Farmer	Back	

Figure 8. Contents of excel file attached to composed email

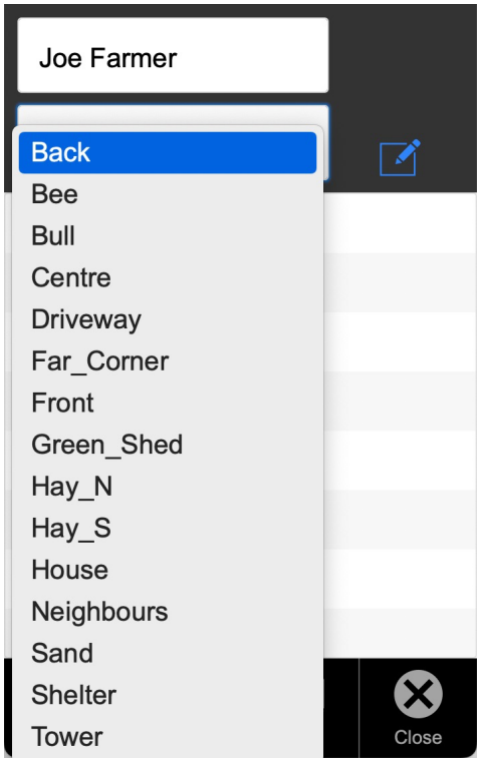


Figure 9. Interface showing popup menu for paddock selection

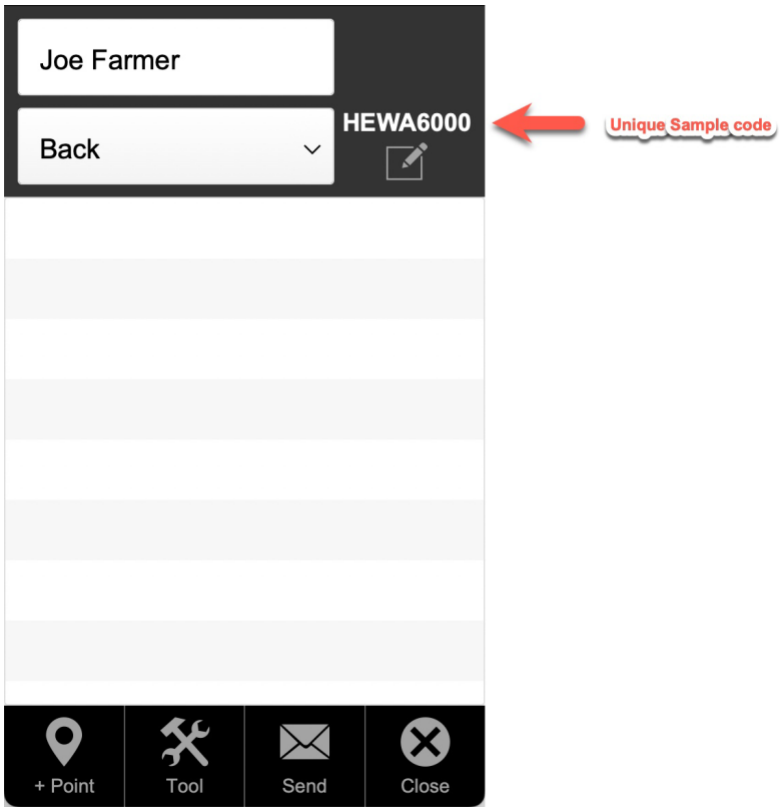


Figure 10. Interface showing selected paddock and associated unique sample code

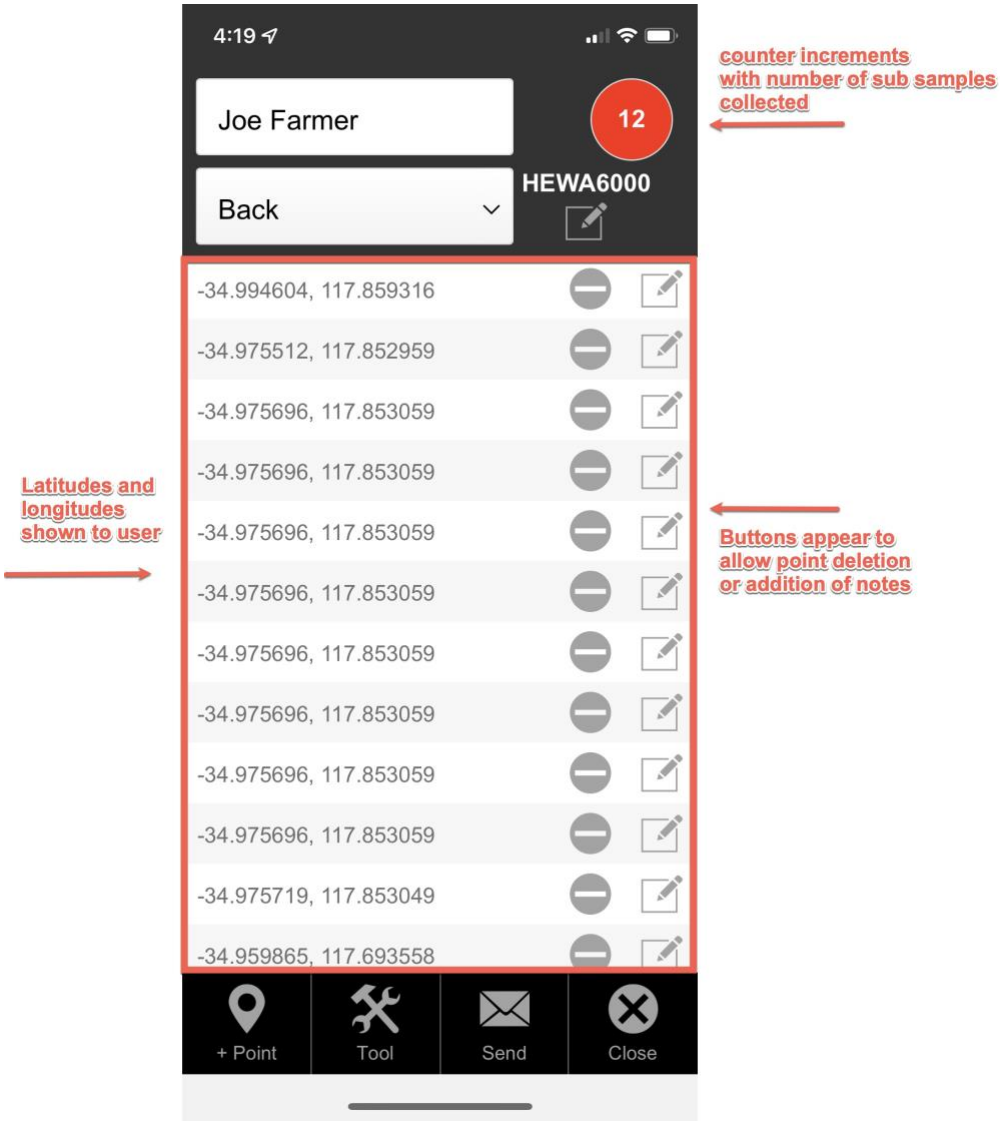


Figure 11. Interface showing collected geolocations for the selected paddock, and a conditionally formatted counter (red<26) with the number of geolocations collected for the selected paddock

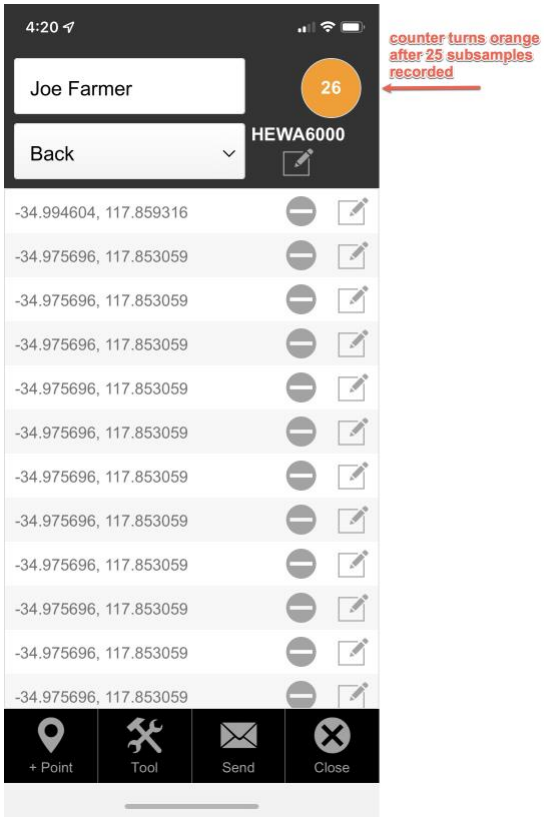


Figure 12. Interface showing collected geolocations for the selected paddock, and a conditionally formatted counter (orange 26-29) with the number of geolocations collected for the selected paddock

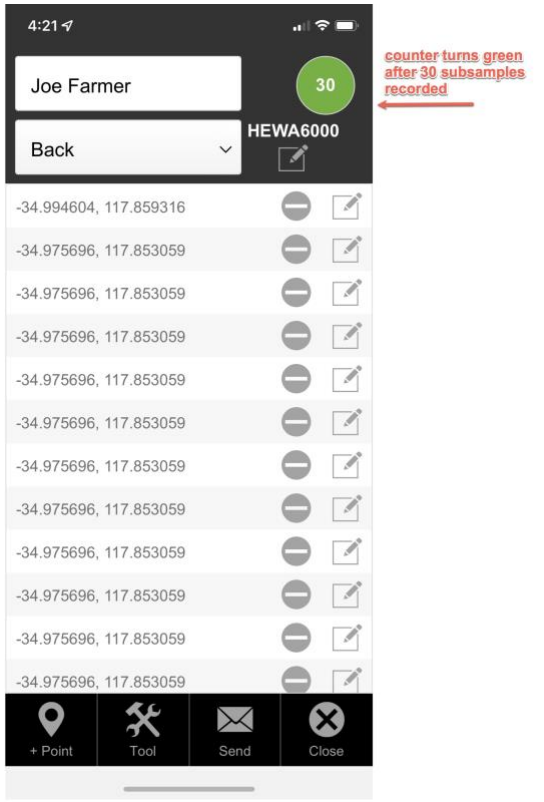


Figure 13. Interface showing collected geolocations for the selected paddock, and a conditionally formatted counter (green 30) with the number of geolocations collected for the selected paddock

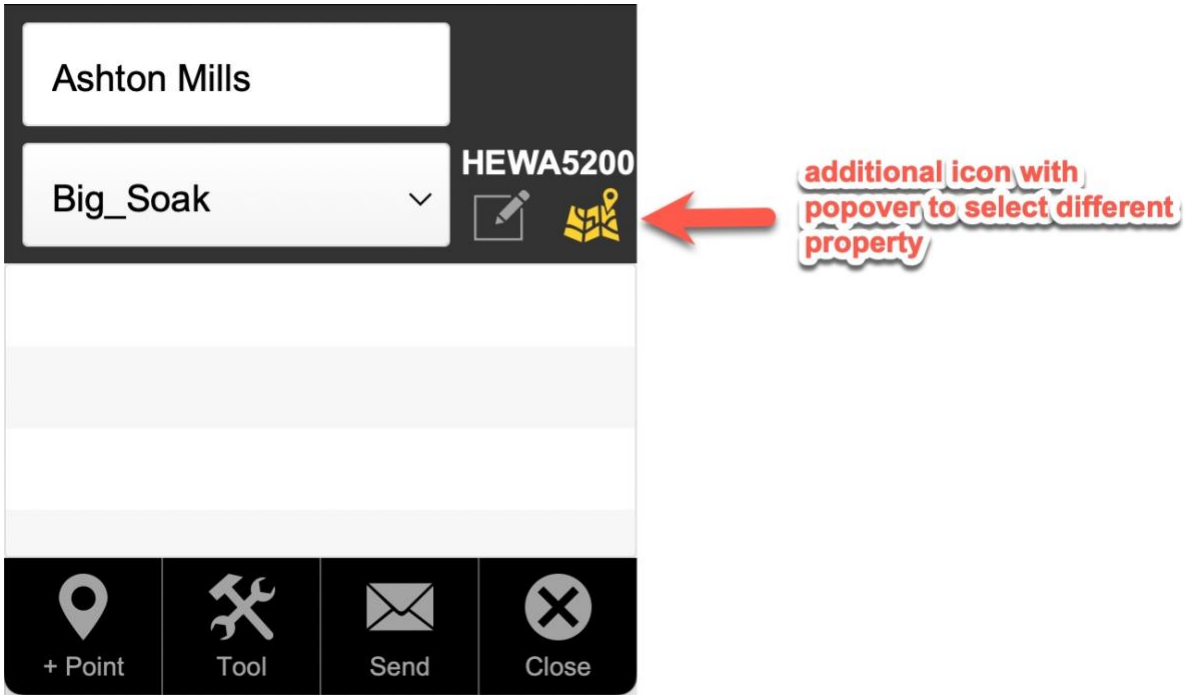


Figure 14. Interface showing icon indicating the farmer has more than one property

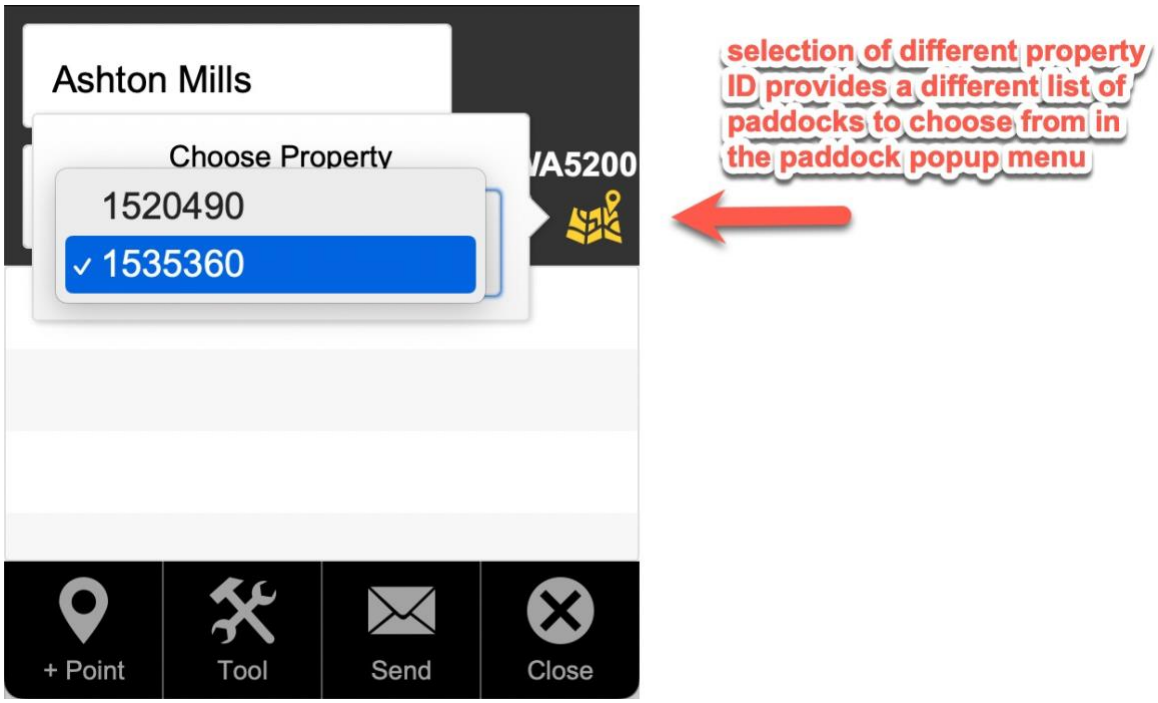


Figure 15. Interface showing popover and popup menu to allow the selection of a different property.

System requirements

The developed system needs to satisfy the functionality documented above, and have a similar look and feel. In addition, the system should be developed as a functional shell without data present, but allow the import of farmer and paddock data from the device. The data for import could be provided either as XLSX or JSON.

When collecting geocoordinates, the app should detect whether location services is switched on for the device, and alert the user to switch this on if necessary. There should be some error checking and alerts to the end user if the collected geocoordinates are 0.0000, 0.0000, or if the current coordinates are not new – for example, cached coordinates from the previous location are used.

The shell should allow for the entry of email addresses (Figure 7) that the final data will be sent to. This will allow us, as the client, to enter relevant email addresses prior to deployment of the app to end users in the event that internal email addresses change.

Once final data has successfully been exported and emailed, the app should include functionality to remove all data from the app so that it can be repopulated with new data in future years should the same farmer enroll in the soil sampling program again.

Final exported data preferred as XLSX, although CSV or JSON are also satisfactory.

It is preferable, although not mandatory that the app is developed using Flutter since this is a platform that my agency is likely to use as a standard in the future, and it seems compatible for a wide range of devices and operating systems.

Advice on deployment of the final solution to Android devices will be welcomed.