

Report

Modelling Permitted Surface Water Use in the Porirua Whaitua catchment

Prepared for GWRC (Client)

By Beca

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Action	Name	Signed	Date
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Units

l/s litres per second

l/d litres per day

Introduction

The following report outlines the methodology and results of applying a model to estimate permitted water use to the Porirua Whitua catchment in the Greater Wellington Region.

Parameters of the model and the analysis undertaken using Geographic Information Systems (GIS) datasets and software tools are detailed.

The source information for much of the GIS data is the Greater Wellington Regional Council.

1 Principles of the model

The principles of permitted water use modelling applied to the wider Wellington Region¹ were used as a basis for the modelling undertaken for the Porirua Whitua.

The previous work identified permitted water uses for animal drinking water, dairy shed operations (for example dairy shed wash down) and individual's reasonable domestic needs (excluding water supplied by municipal or rural water supply network which requires a resource consent).

Based on this the following formula is used for assessing the magnitude of permitted water use on a particular property that is not on the reticulated water network and does not have a domestic bore (**Equation 1**):

$$EPWU = (PopD * DomWU) + (PopDC * DCWU) + (PopBF * BFWU) + (PopDR * DRWU) + (PopSH * SHWU)$$

Where;	EPWU	is the estimated property water use
	PopD	is the number of people on property
	DomWU	is the amount of water used per person (l/d)
	PopDC	is the number of dairy cows on the property
	DCWU	is the amount of water used per dairy cow per day (l/d)
	PopBF	is the number of beef cattle on the property
	BFWU	is the amount of water used per beef cattle per day (l/d)
	PopDR	is the number of deer on the property
	DRWU	is the amount of water used per deer per day (l/d)
	PopSH	is the number of sheep on the property
	SHWU	is the amount of water used per sheep per day (l/d)

The fixed values used by the previous work for water use (DomWU, DCWU, BFWU and DRWU) were applied to the model for GWRC. It was agreed that the fixed value for SHWU previously

¹ Modelled and reported in the study *Modelling the Magnitude of Unconsented Surface Water Use in the Wellington Region (March 2011)* by Beca for Greater Wellington Regional Council

provided by GWRC for estimating Groundwater Use in the Ruamāhanga Whaitua⁶ catchment would be used.

The variables for PopD, PopDC, PopBF, PopDR and PopSH were calculated for each property in the Porirua Whaitua catchment. The properties were then assigned a subcatchment and permitted use was summarised for each subcatchment. The following section outlines the process for calculating these values.

2 Input datasets

The majority of the input datasets used in the model were provided by the Greater Wellington Regional Council. No data was modified as part of the model.

The datasets provided by Greater Wellington Regional Council were:

- Whaitua catchment boundary
- Property boundaries
- Agribase dataset
- Land Cover database
- Landuse database
- Groundwater bore locations
- Rating database

In addition, the following datasets were sourced:

- Reticulated water network for Porirua City Council
- Reticulated water network for Wellington City Council

3 Model development

A diagram illustrating the elements of the model is presented in Figure 1. This is outlined in detail in this section. Domestic water use was calculated at the property level and aggregated up to sub catchment and catchment level. Each property in the Porirua Whaitua catchment was assigned to a sub catchment if the majority of the property was inside one of the identified sub catchments. If a property overlapped multiple sub catchments, the sub catchment which had the largest property area in it was assigned.

3.1 Identification of catchments of interest

Twenty (20) sub catchments were identified in the Porirua Whaitua catchment for estimated permitted and s14(3)(b) water use modelling. These sub catchments were identified based on watersheds provided by GWRC and contours from the LINZ NZ Topo50 map series.

Figure 2 and Table 1 illustrate the selected sub catchments and names used in the modelling.

⁶ Modelled and reported in the study *Modelling Permitted Groundwater Use in the Ruamāhanga Whaitua – Phase 3 report: Summary of model and outputs (August 2015)* by Beca for Greater Wellington Regional Council

Figure 1: Model Diagram

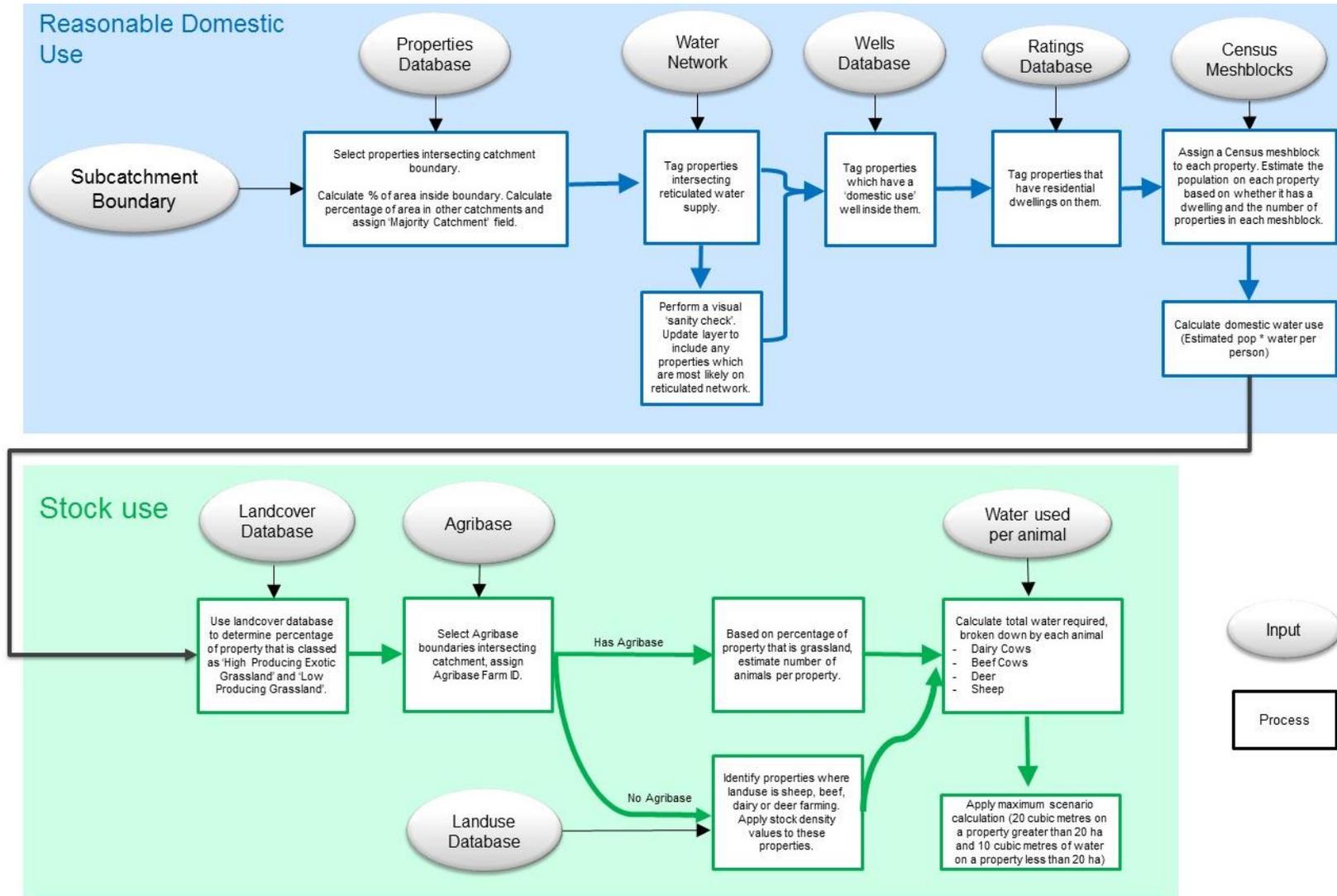


Figure 2: Catchments identified for modelling

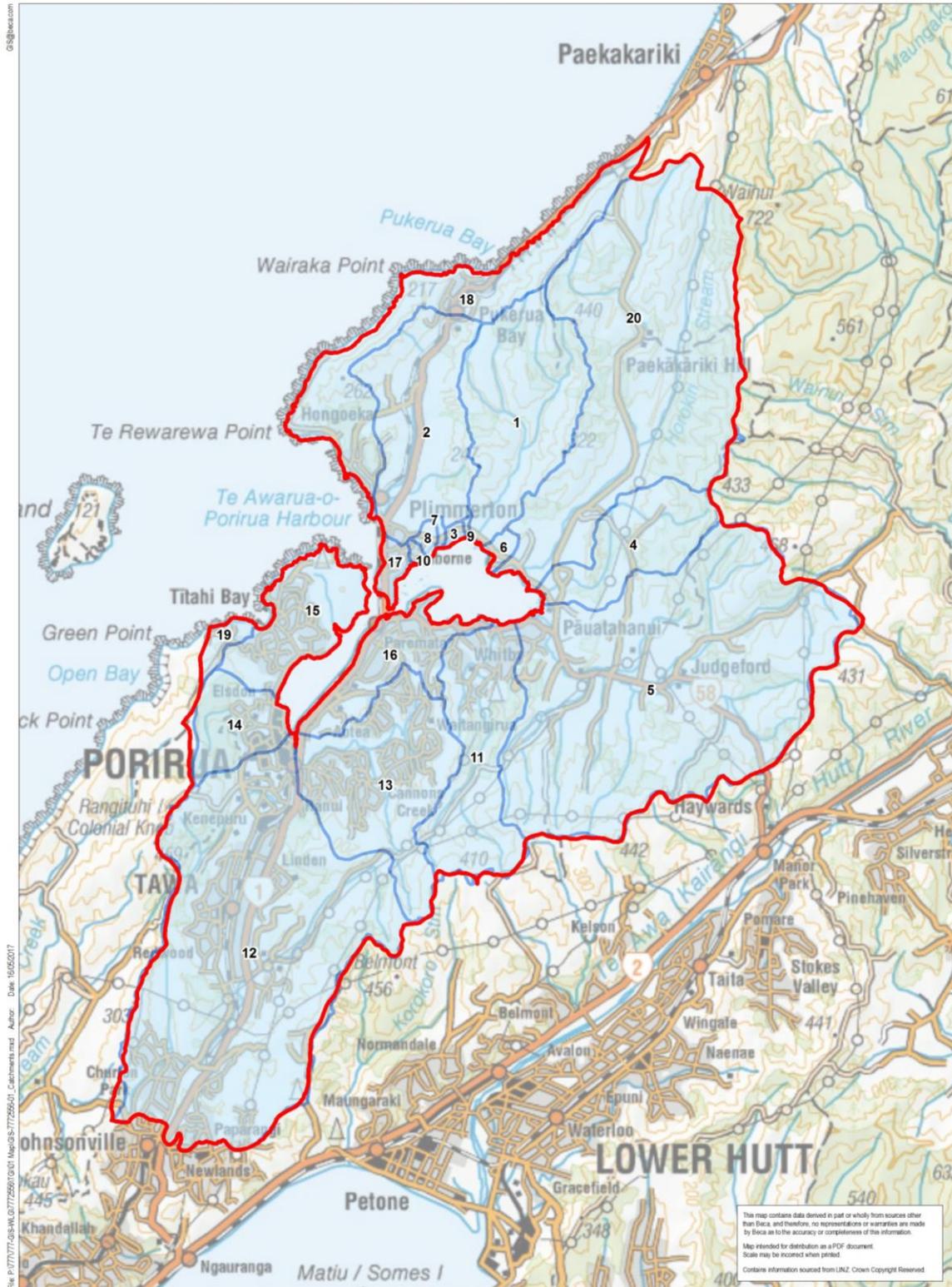


Table 1: Catchments identified for modelling

Map ID	Name
1	Kakaho Stream
2	Taupo Stream
3	Unamed minor stream 6
4	Ration Creek
5	Pauatahanui Stream
6	Unamed minor stream 5
7	Unamed minor stream 3
8	Unamed minor stream 2
9	Unamed minor stream 4
10	Unamed minor stream 1
11	Duck Creek
12	Porirua Stream/Takapu Stream
13	Kenepuru Stream/Cannons Creek
14	Takapuwahia Stream
15	Titahi Bay
16	Paremata
17	Mana
18	Coastal North
19	Coastal South
20	Horokiri Stream

3.2 Estimating domestic water use

The following steps were taken to identify the number of people living on each property.

- i. Properties identified as being part of a reticulated water supply were tagged.

To identify these, the Porirua City Council and Wellington City Council water supply pipes were buffered by 6 metres (to allow for accuracy issues in the datasets) and intersected with the properties dataset. A visual sanity check was performed to include any properties which were most likely on the reticulated water network and exclude any which has been incorrectly tagged.

- ii. Each property with a consented domestic well (identified from the wells database supplied by GWRC) was tagged.

- iii. Any properties with a residential dwelling on them were tagged. Properties with residential dwellings were identified using the ratings database where the improvement description contained any of the following values

APARTMENT	HOME
BACH	HOSPICE
BEDSIT	RESIDENCE
COTTAGE	TOWNHOU
DORMITORY	TOWNHOUS
DWG	TOWNHOUSE
FLAT	UNI
GRANNYFLAT	UNIT

- iv. An estimated population was calculated for each property using 2013 Census meshblock data. The 'usually resident population' in each meshblock in the catchment was divided evenly across properties falling inside the meshblock. An estimated population was only applied to properties which contain a dwelling (as identified in iii) with remaining properties given a value of 0.

Note: Where single properties contain multiple dwellings (for example townhouses, blocks of flats or apartments) the estimated population for the property will be high. Where this occurs it has also been identified that the property is likely to be on a reticulated water system (within the urban extent).

- v. Domestic water use was calculated for each property by multiplying the estimated population by the amount of water used per person. We have used a value of 300 litres per person per day which is consistent with the approach taken in the previous study. This was calculated on properties where there was an estimated population figure, it was not on the reticulated network and did not have a domestic bore. Properties on the reticulated network or with a domestic bore were given a value of 0.

The table below summarises these results by catchment, whereby the column *Estimated Domestic Water Use* represents the total estimated water use derived using the method above and *Final Domestic Water Use*, the estimated water us with the assumption 1 in 5 get their domestic water from surface water and the remaining 4 in 5 from rain water tanks.

Table 2: Estimated Domestic Water Use by catchment

Catchment Name	Estimated Domestic Water Use (excluding rain water tanks) (l/d)	Final Domestic Water Use (l/d)
Outside Catchment	28,387	5,677
Coastal North	28,825	5,765
Coastal South	-	-
Duck Creek	1,893	379
Horokiri Stream	122,842	24,568
Kakaho Stream	6,692	1,338
Kenepuru Stream/Cannons Creek	1,200	240
Mana	2,402	480
Paremata	3,253	651
Pauatahanui Stream	171,425	34,285
Porirua Stream/Takapu Stream	104,545	20,909
Ration Creek	36,429	7,286
Takapuwahia Stream	1,253	251
Taupo Stream	25,984	5,197
Titahi Bay	3,775	755
Unnamed minor stream 1	-	-
Unnamed minor stream 2	-	-
Unnamed minor stream 3	-	-
Unnamed minor stream 4	738	148
Unnamed minor stream 5	11,815	2,363
Unnamed minor stream 6	590	118

3.3 Estimating stock drinking and watering use

Estimated stock water use is also calculated at the property level and aggregated up to sub catchment and catchment level.

The Agribase dataset was provided by GWRC for the purposes of estimating the stock count on each property. Stock counts for beef, dairy, deer and sheep were applied from Agribase where this was available. For farms which do not subscribe to the Agribase dataset, an average stock density was applied to properties where the landuse indicated the presence of stock.

3.3.1 Estimating stock numbers from Agribase data

The following steps were taken to identify the stock numbers on each property from Agribase.

- i. To determine the distribution of stock on each property a grassland area was calculated using the Landcover database. The area was included where the attribute "name2012" was equal to 'High Producing Exotic Grassland' or 'Low Producing Grassland' in the Landcover database and it intersected the property.
- ii. The area of grassland on each Agribase Farm was then calculated using the Landcover database. The area was included where the attribute "name2012" was equal to 'High Producing Exotic Grassland' or 'Low Producing Grassland' in the Landcover database and it intersected the Agribase farm.
- iii. Properties were assigned an Agribase farmID if the property was enclosed by an Agribase farm polygon.
- iv. For each property with an Agribase farmID, a 'Grassland Percent' was then calculated by dividing the grassland area on the property by the total grassland area on Agribase Farm. This gives a proportional representation of how much of the stock from the Agribase dataset is likely to be on a particular property.
- v. Estimated stock numbers were calculated for each stock type (beef, dairy, deer and sheep) by multiplying the grassland percent by the total number of stock on the farm.

3.3.2 Estimating stock numbers based on Landuse

An average stock density per hectare of grassland was calculated as a one off step using the following method.

- i. Agribase farms where the farm type matched Beef cattle farming, Deer farming, Sheep farming, Dairy cattle farming or Mixed Sheep and beef farming were selected.
- ii. For each farm type an average stock density was calculated by dividing the total number of stock by the total area of grassland for that farm type.

The table below illustrates the resulting counts and values.

Table 3: Average Stock Densities per hectare

Stock Type	Total number of animals	Total Grassland Area (ha)	Density Per Hectare
Sheep	12,989	1,105	11.75
Deer	1,221	459	2.66
Beef Cattle	631	727	0.87
Dairy*	0	0	-
Mixed Beef	2,773	6,991	0.39
Mixed Sheep	44,839	6,991	6.41

*There were no dairy farms identified in Agribase in the catchment.

The following steps were taken to estimate stock numbers on properties where no Agribase data was available.

- i. Properties were selected where the landuse was sheep farming, beef farming, deer farming, mixed sheep and beef farming and an Agribase farm had not been assigned.
- ii. Estimated stock numbers were applied by multiplying the grassland area calculated in 2.3.1 above by the density per hectare values in table 3.

3.3.3 Calculating estimated stock water demand

GWRC has requested the following water demand values be applied to each stock type:

- Dairy Cows: 140 l/d
- Beef: 45 l/d
- Deer: 7 l/d
- Sheep: 7 l/d

Applying these values, we can estimate total stock water demand for each catchment:

Table 3: Total estimated stock water demand by catchment

Catchment Name	Estimated Stock Water Use (l/d)
Outside Catchment	176,301
Coastal North	41,898
Coastal South	2,336
Duck Creek	71,259
Horokiri Stream	63,647
Kakaho Stream	44,914
Kenepuru Stream/Cannons Creek	11,636
Mana	-
Paremata	-
Pauatahanui Stream	129,558
Porirua Stream/Takapu Stream	43,629
Ration Creek	12,560
Takapuwahia Stream	667
Taupo Stream	48,776
Titahi Bay	5,943
Unnamed minor stream 1	-
Unnamed minor stream 2	2,295
Unnamed minor stream 3	-
Unnamed minor stream 4	352
Unnamed minor stream 5	2116
Unnamed minor stream 6	-

3.4 Estimating maximum permitted water take

The maximum permitted water take under Rule R 136 of the proposed Plan is 20 cubic metres on a property greater than 20 ha and 10 cubic metres of water on a property less than 20 ha. These permitted amounts are exclusive of water that can be taken for reasonable stock and domestic use. The following method was used to calculate the maximum permitted water take.

- i. Properties which were not on the reticulated network were selected.
- ii. Where the property are was under 20ha, a value of 10,000 l/d was applied, and properties over 20ha, 20,000 l/d.
- iii. Properties on the reticulated water network were given a value of 0.

Note: Some properties have modelled results showing stock numbers as well as reticulated water network connections. These properties will not have been included in the maximum permitted water take calculations due to the identification of reticulated water connection.

4 Model results

4.1 Estimated permitted water use and maximum permitted water take

By summarising the estimated permitted water use and the maximum permitted water take of each property in the catchments, the following results are returned:

Table 4: Estimated permitted water use and maximum permitted water take by catchment

Catchment Name	Total Estimated Permitted Water Use (l/d)	Maximum Permitted Water Use (l/d)
Outside Catchment	181,978	1,610,000
Coastal North	47,663	1,050,000
Coastal South	2,336	10,000
Duck Creek	71,637	420,000
Horokiri Stream	88,215	2,620,000
Kakaho Stream	46,252	290,000
Kenepuru Stream/Cannons Creek	11,876	450,000
Mana	480	90,000
Paremata	651	610,000
Pauatahanui Stream	163,843	4,110,000
Porirua Stream/Takapu Stream	64,538	3,410,000
Ration Creek	19,846	870,000
Takapuwahia Stream	918	140,000
Taupo Stream	53,972	710,000
Titahi Bay	6,698	390,000
Unnamed minor stream 1	-	10,000
Unnamed minor stream 2	2,295	90,000
Unnamed minor stream 3	-	-
Unnamed minor stream 4	500	20,000
Unnamed minor stream 5	4,479	190,000
Unnamed minor stream 6	118	20,000

Appendix A: Data Dictionary

The following table relates to the supplied results spreadsheet. Descriptions are provided for each column.

Field name	Description
parcel_id	The parcel ID from the parcel boundaries input
MajorityCatchName	Catchment that the majority of this property falls in
CatchPercent	Percentage of property inside the specified catchment (as a decimal of 1)
Reticulated	y = on reticulated network n = not on reticulated network
DomesticBore	y = property has a domestic bore n = property does not have a domestic bore
Dwelling	y = property has a dwelling n = property does not have a dwelling
Pop_Estimated	Estimated usually resident population living on this property
DomesticWaterUse	Total Domestic water use for the property
Landuse1	The primary landuse for the property
GrasslandAreaProperty	Total area of grassland on the property (m ²)
GrasslandAreaAgribase	Total area of grassland on the Agribase farm assigned to this property (m ²)
Agri_FarmID	The farmID of the Agribase farm assigned to this property
Agri_GrasslandPercent	The percentage of grassland on the property as a proportion of total grassland on the Agribase farm assigned to the property
Agri_EstBeefNo	Estimated number of Beef cows on the property

Agri_EstDairyNo	Estimated number of Dairy cows on the property
Agri_EstDeerNo	Estimated number of Deer on the property
Agri_EstSheepNo	Estimated number of Sheep on the property
Agri_BeefWaterUse	Estimated beef cow water use (l/day)
Agri_DairyWaterUse	Estimated dairy cow water use (l/day)
Agri_SheepWaterUse	Estimated sheep water use (l/day)
StockWaterUse	Total estimated stock water use (l/day)
TotalWaterUse	Total stock and domestic water use (l/day)
MaxPermitted	Maximum permitted water use (l/day)