Standard Demand Profiles Review Workshop

AGENDA

01 Introduction

02 Study Overview

03 Study Results

04 Variable Consumption

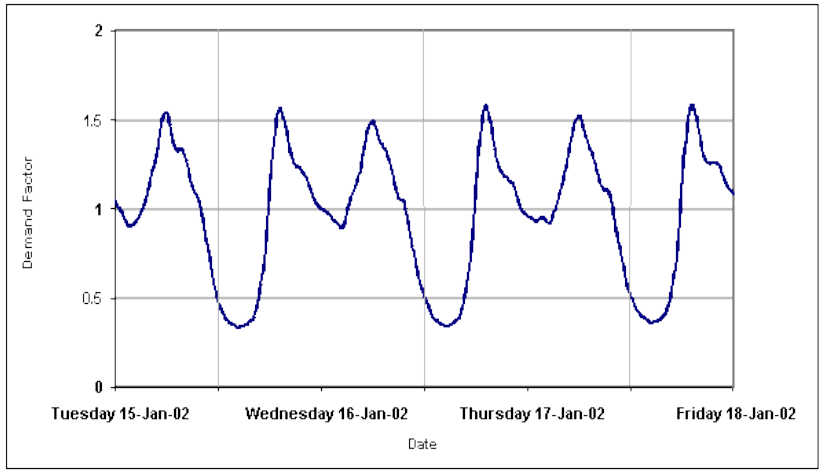
05 Profile Allocation

06 Future

Introduction

Project Aim

The aim of this project was to conduct a review of the existing standard demand profiles used in clean water modelling, to recommend what further work, if any, was required to refresh this dataset.



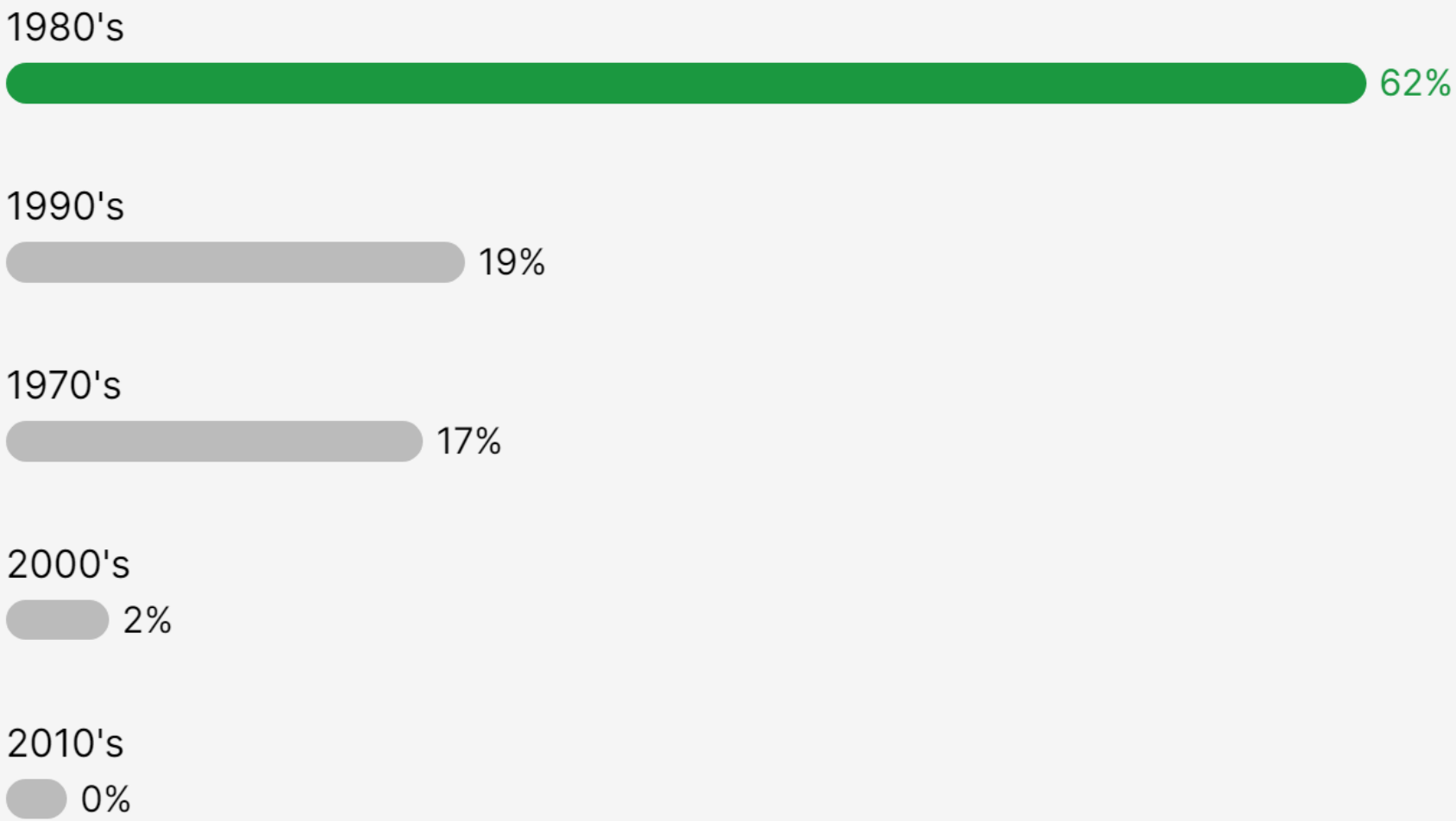
Project Background

- Current standard demand profiles were developed a long time ago.
- Used in the construction of clean water models.
- Are they still relevant and fit for purpose?
- As a result, CwMAG identified the need to review this dataset.
- This fits in with wider remit to create guidance on the construction of hydraulic models.

Active poll

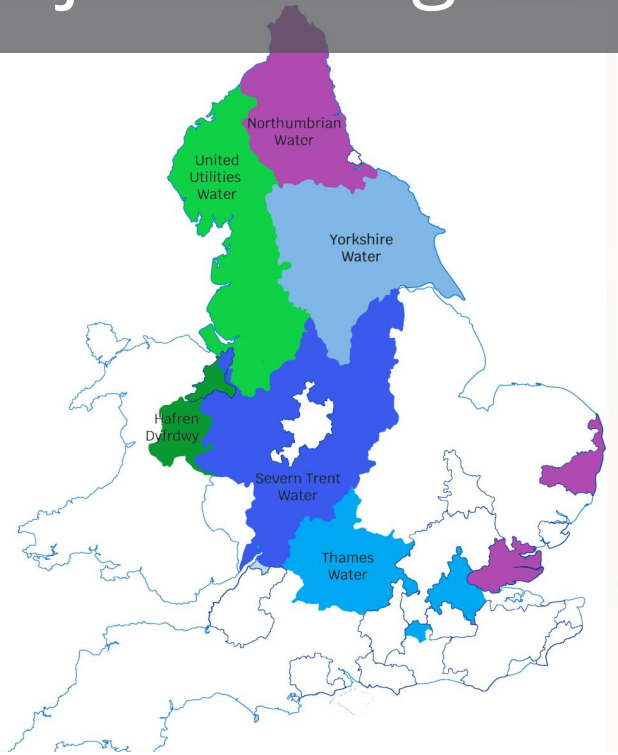
58

Do you know when the Standard Demand Profiles were created?



Project Background

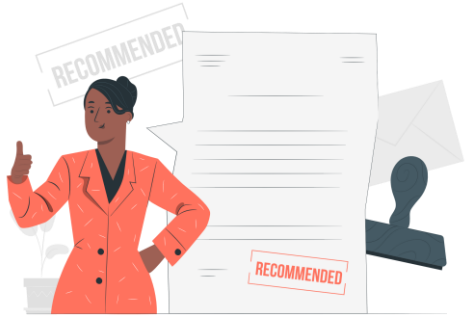
- Crowder Consulting have a breadth and depth of modelling knowledge and expertise through years of experience of working with UK and overseas clients.
- Through the wide use of their Netbase software they have extensive knowledge of working with and analysing customer information and measured data systems.
- As a result, CwMAG approached Crowder Consulting to conduct the review exercise.



Project Objectives

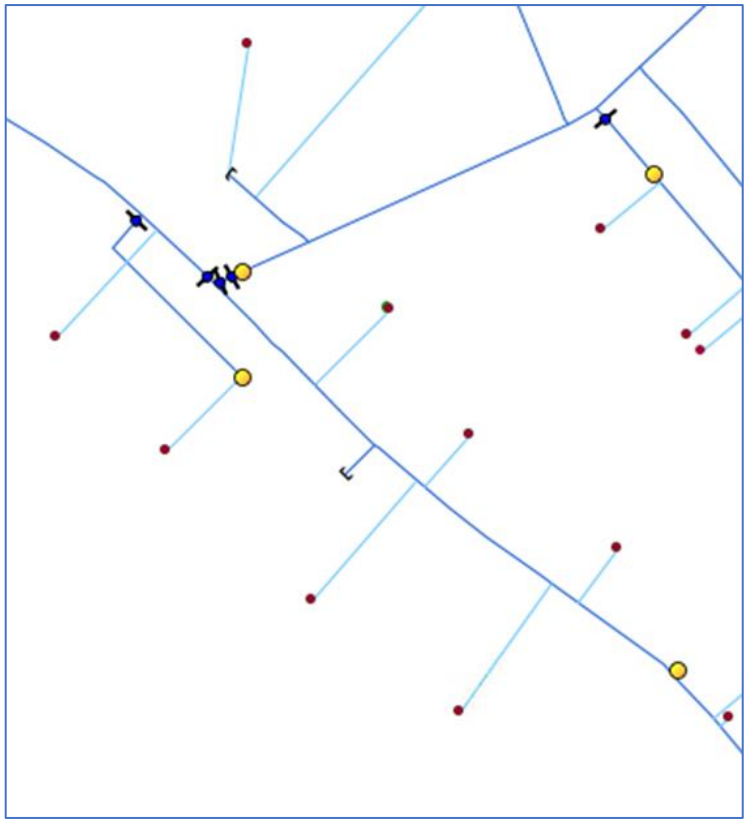
Take of sample set of non-household customers from participating water companies and create cohorts for which unit profiles can be created using their flow time series data.

Compare the unit profiles of these new cohorts against the existing standard demand profiles.



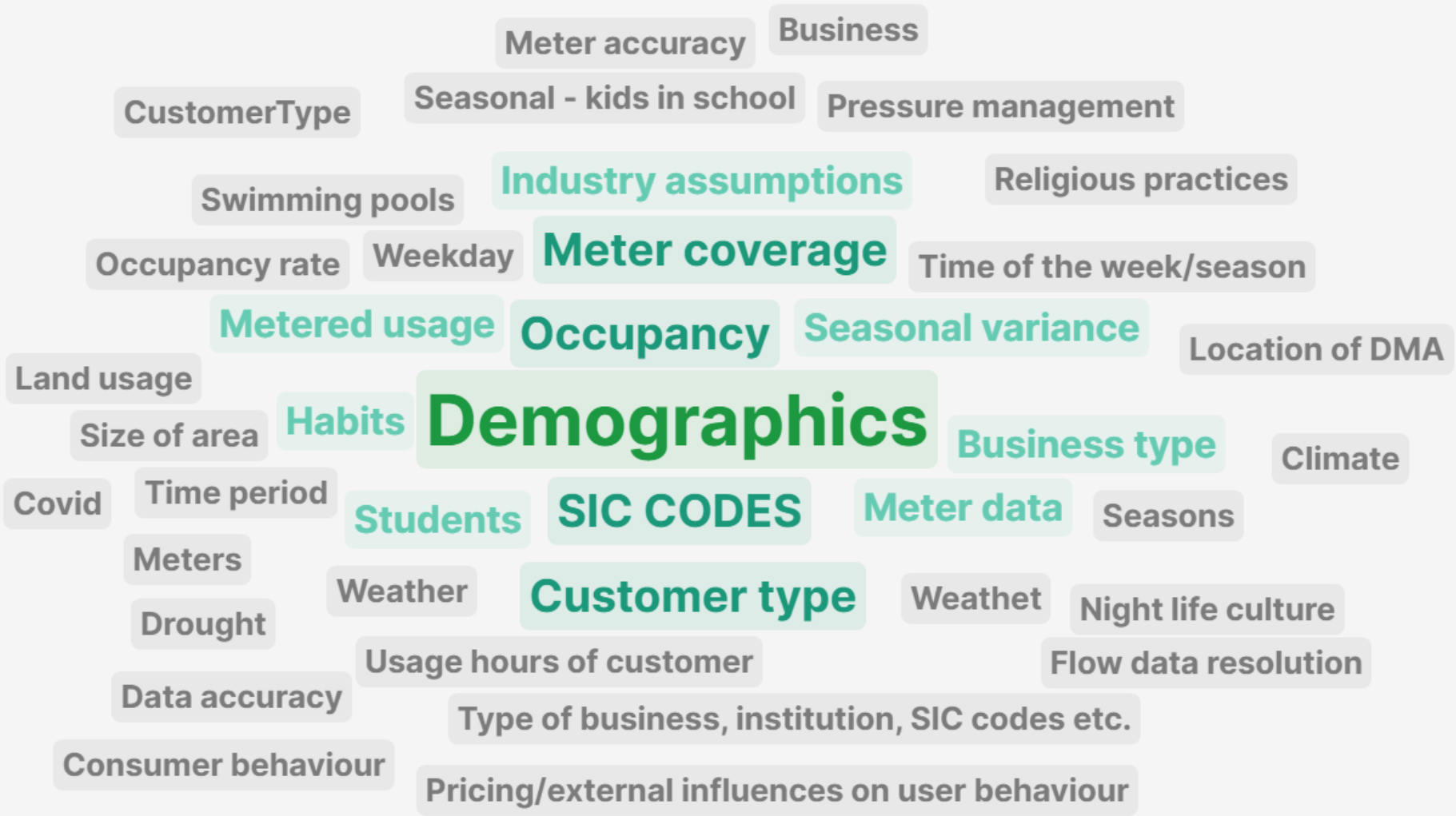
Provide recommendations on what next steps are required to ensure that the standard demand profiles are fit for use in clean water modelling.

Why do we need them?



They allow us to model the hydraulics of the network more accurately by understanding where and **when** demands are taking place.

What influences Standard Demand Profiles?



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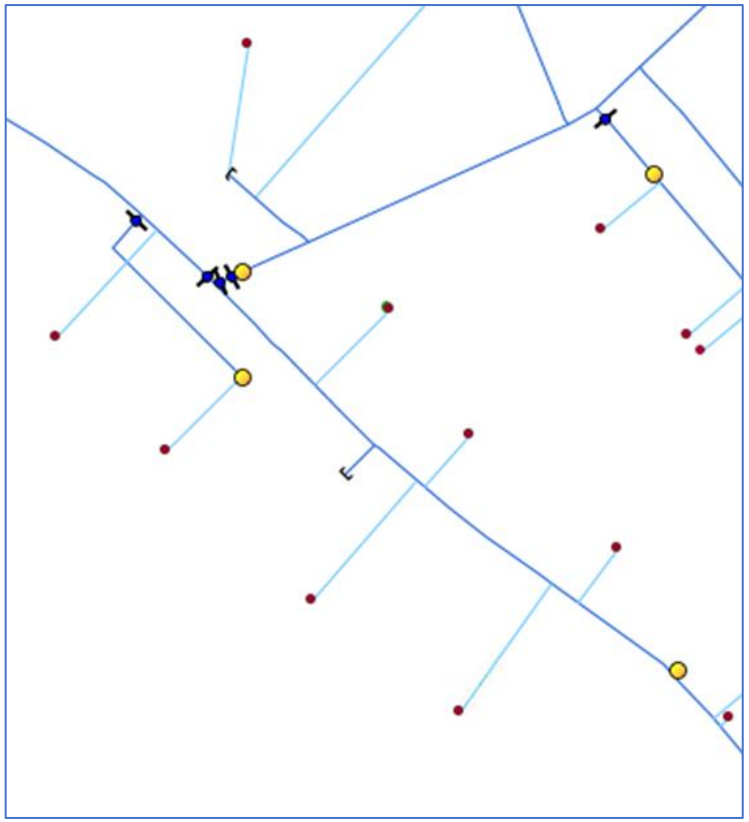
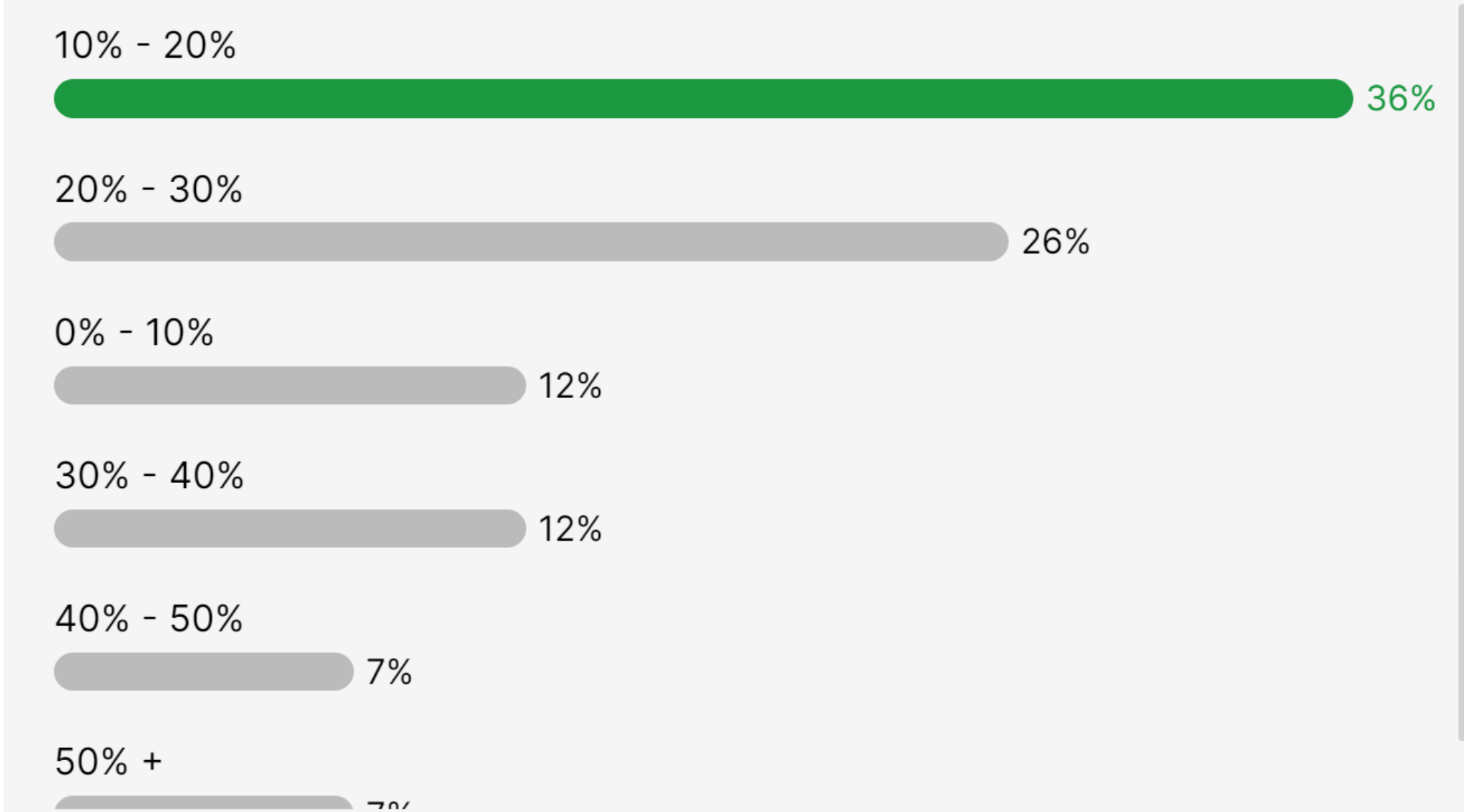
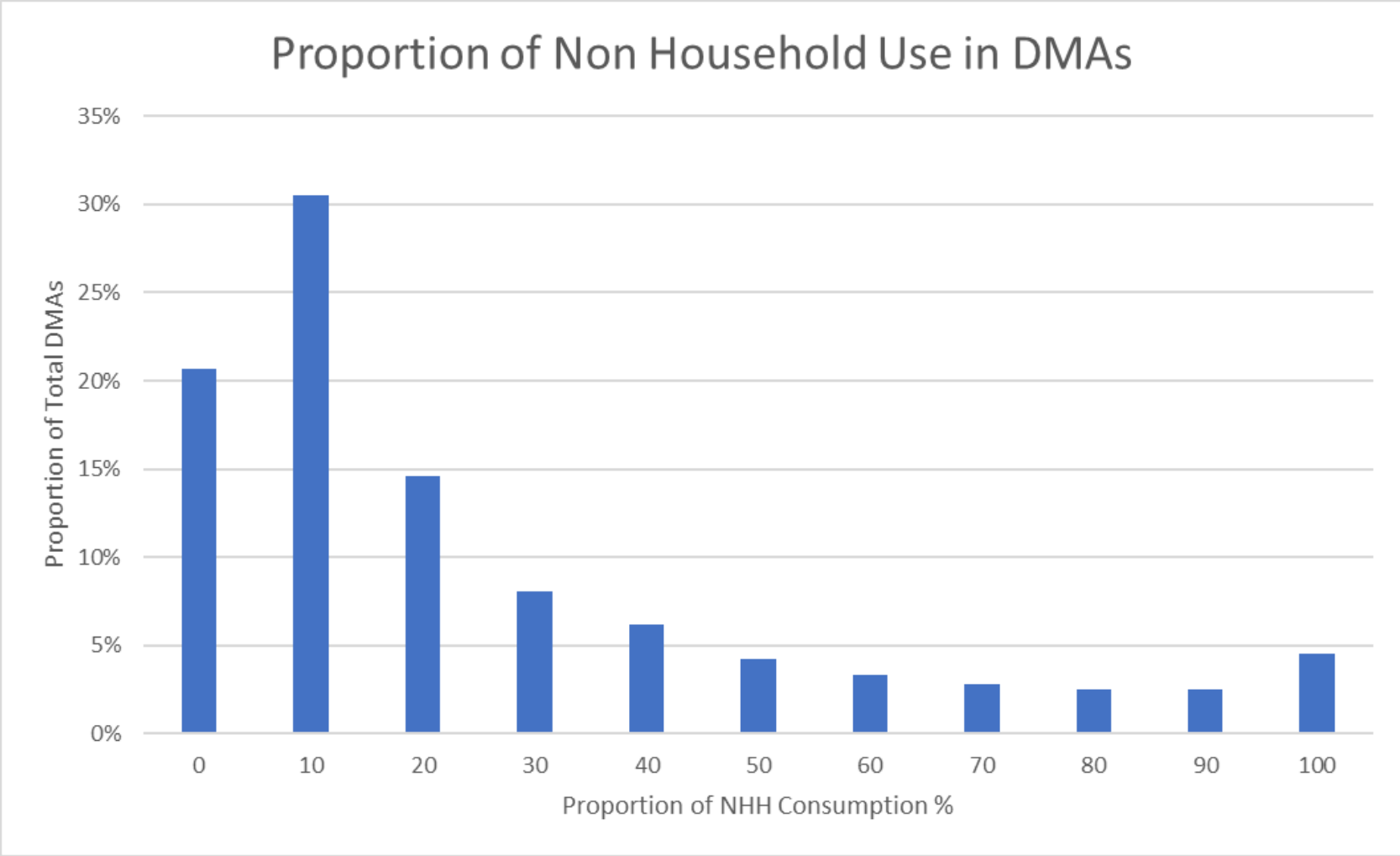


They allow us to model the hydraulics of the network more accurately by understanding where and **when** demands are taking place.

What is the Average Percentage of Non Household Consumption within a DMA?

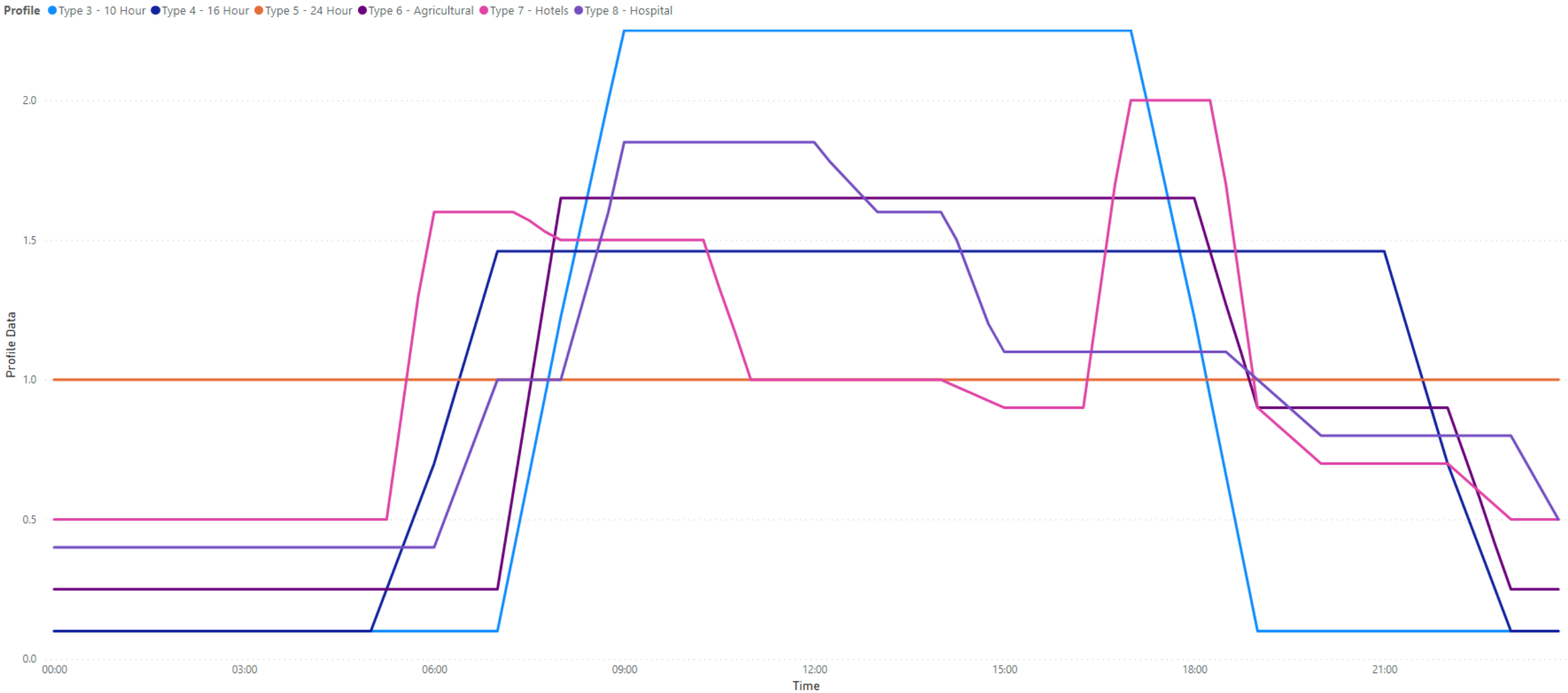


The Influence of NHH Use

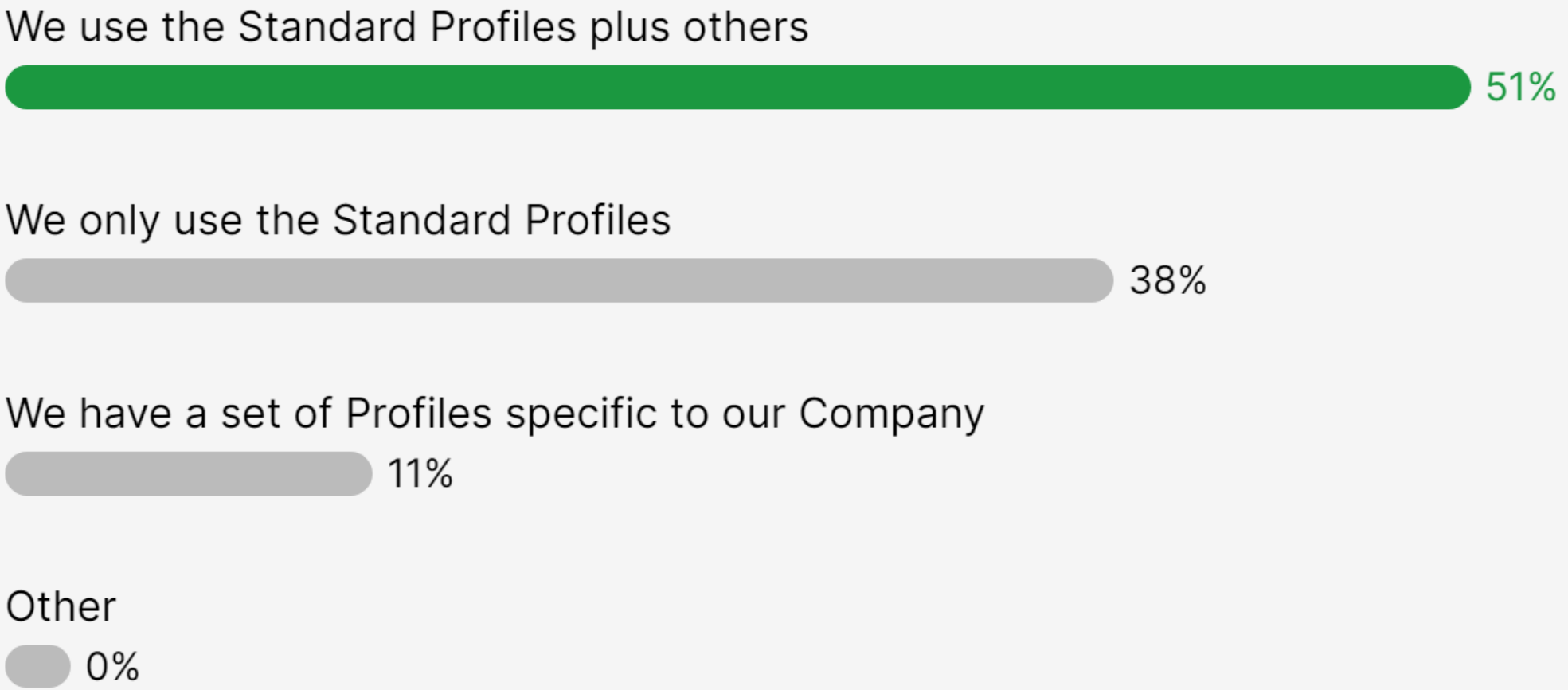


- The proportion of non household use within DMAs is distributed.
- About half of DMAs have 20% of consumption associated to Non Household Use
- Between 20% and 30% of a companies billed consumption is attributed to Non Household Use.

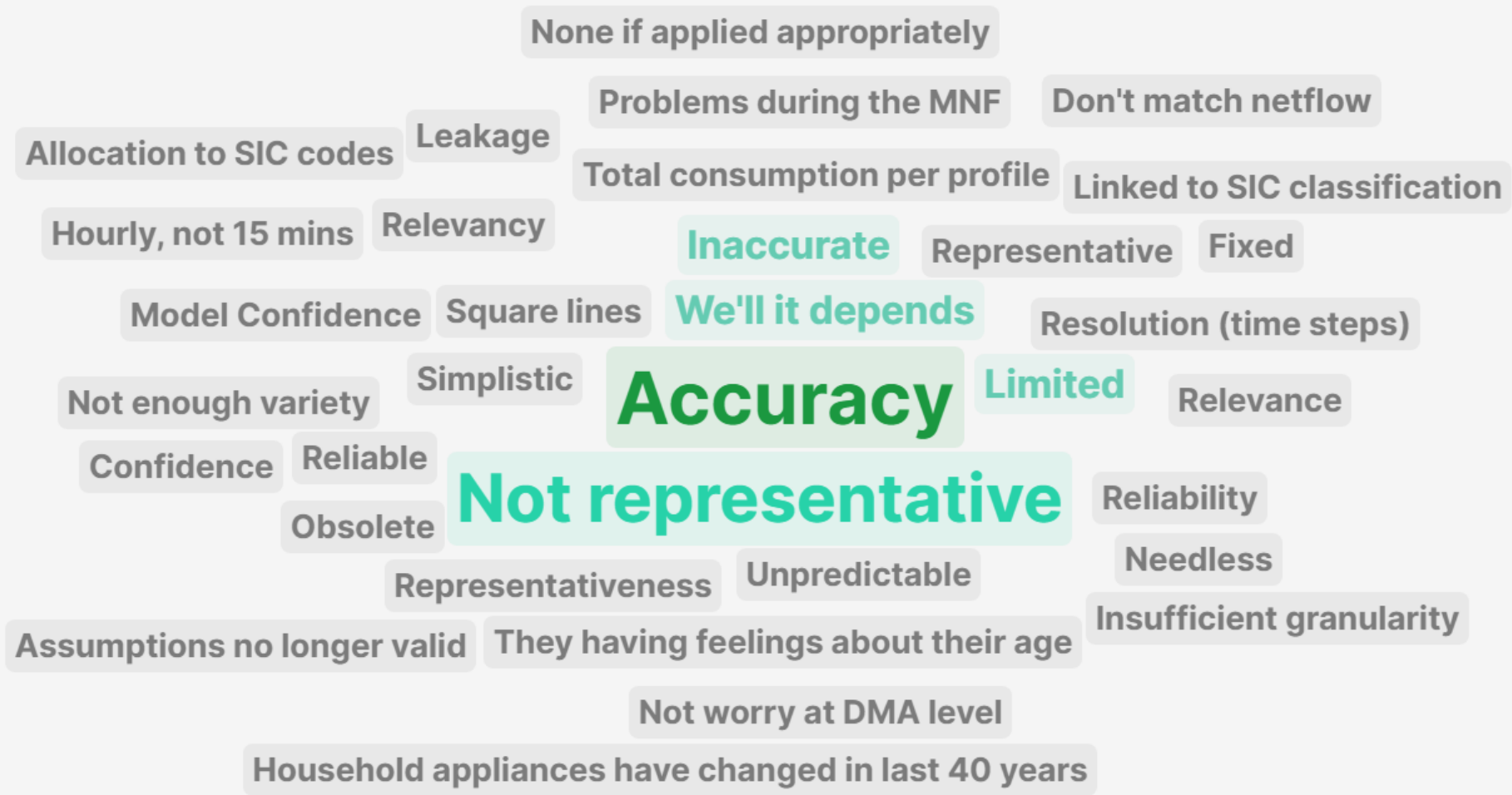
Original Profiles



Do you use the Standard Profiles



What concerns do you have about the Standard Profiles

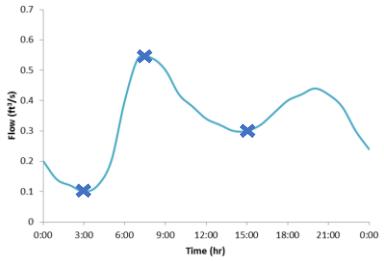


Points of Interest

Assume the sample was small and limited flow logging was conducted

Lower level of meter penetration on non-households that had lower consumption volumes

Based on usage patterns of non-households at the time



It was common to calibrate to 3-points in the day (minimum, average and maximum)

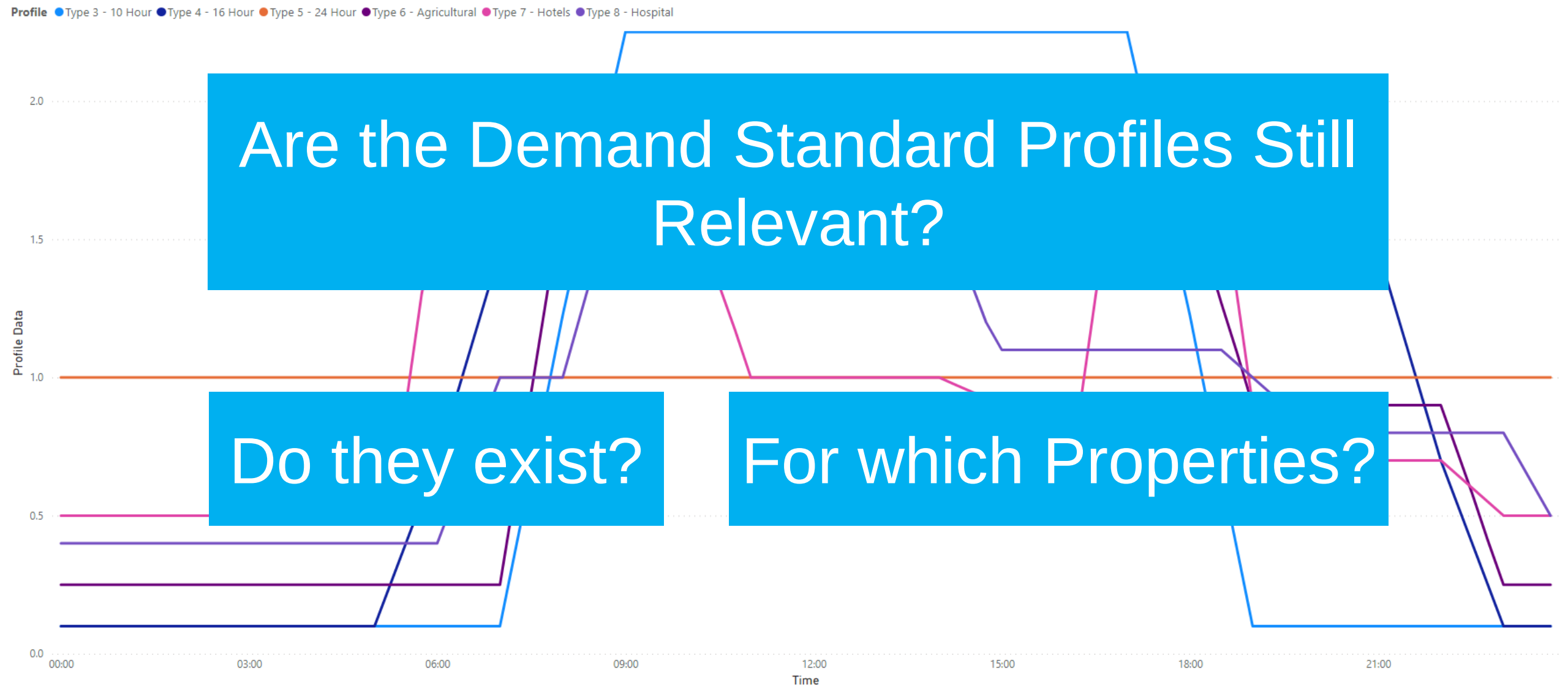
Further Considerations

People	Process	Technology
Knowledge	NHH Type Classification	Fast Logging
Training		Smart Meters
Availability	Updating Profiles	Analytics

Cost £ vs Benefit

Study Overview

Original Profiles

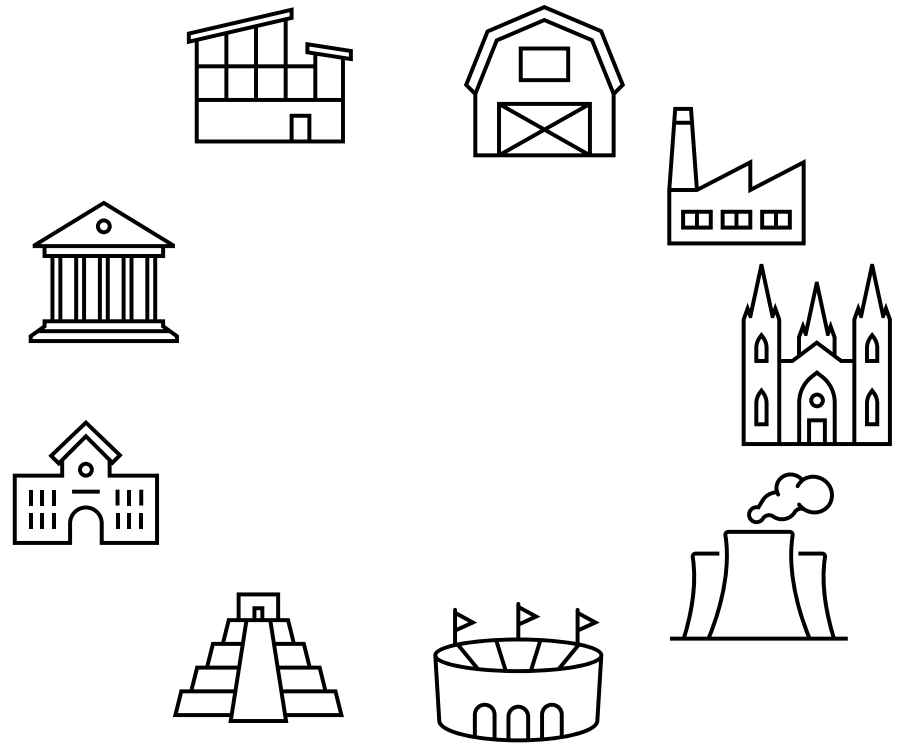


Are the Demand Standard Profiles Still Relevant?

Do they exist?

For which Properties?

Study Overview



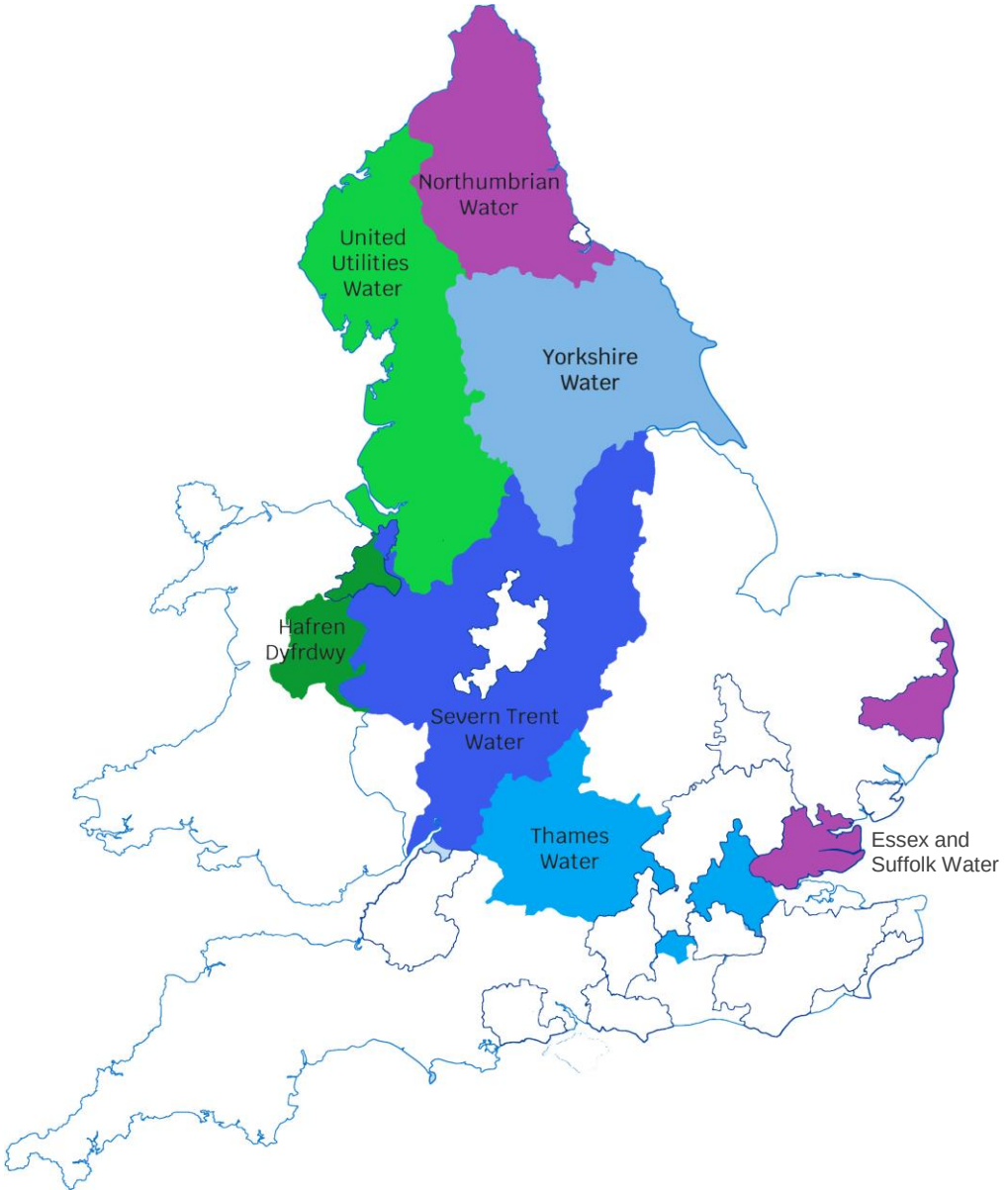
To answer these questions we first had to understand what consumption patterns exist

We collected all the 15 minute time series data for non household customers across 5 major utility groups

The data covered April 2019 to March 2020

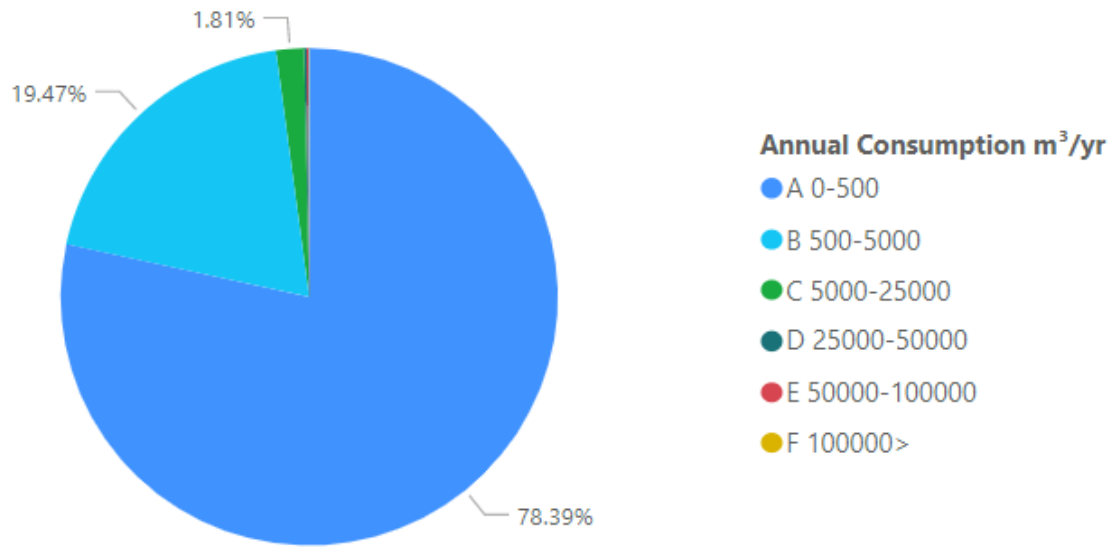
Potential Sample

- **Yorkshire Water**
  1000 Sites
- **Northumbrian Water and Essex & Suffolk Water**
  400 Sites
- **Thames Water**
  5000 Sites
- **United Utilities**
  1500 Sites
- **Severn Trent and Hafren Dyfrdwr**
  1500 Sites

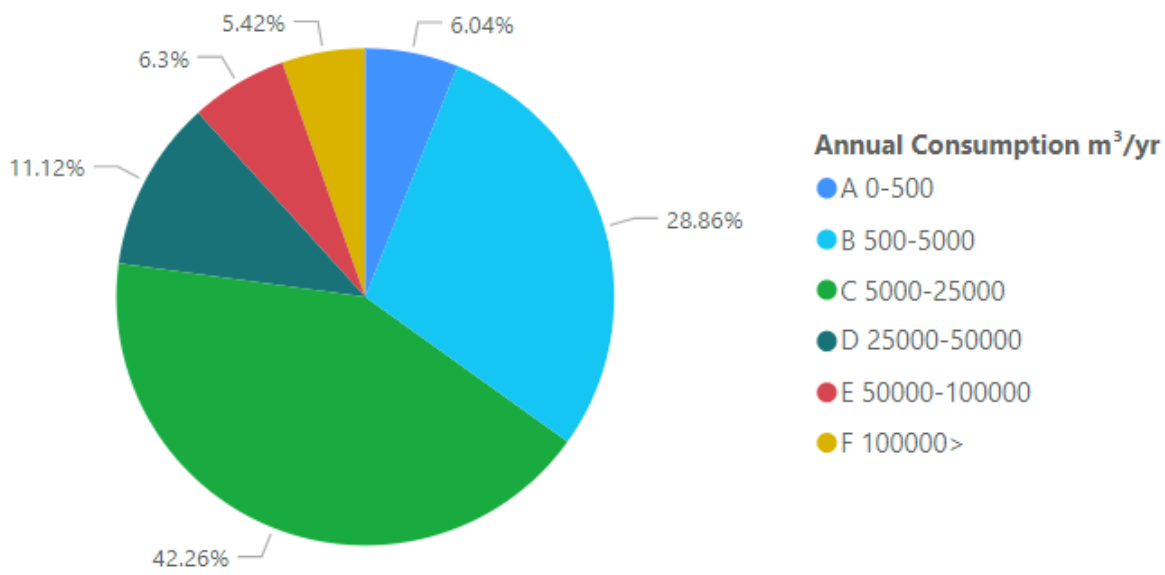


Sample Representativeness

All NHHs Demand Distribution



Sample NHH Demand Distribution



Analysis

Concerns

Unknown level of data quality

How do we group properties?

Utility customer data is not consistent

Over Cautious Validation

Data First Approach

Property Data and Type Keywords

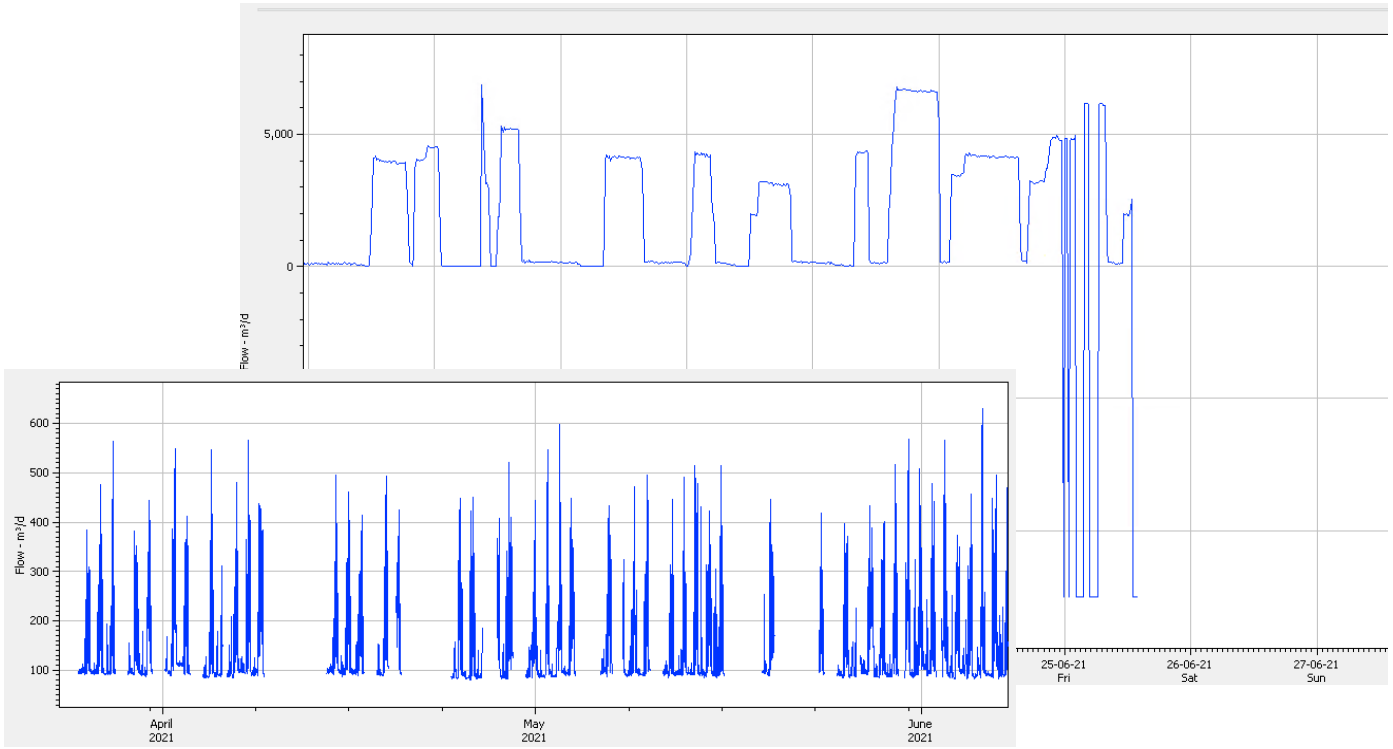
Validation

Data Collation

Validation

To ensure data being passed to the analysis did not have erroneous or invalid data we carried out initial validation to remove obvious errors.

Sites with major differences between logged data and readings were also removed.



Normal Day

Data Collation

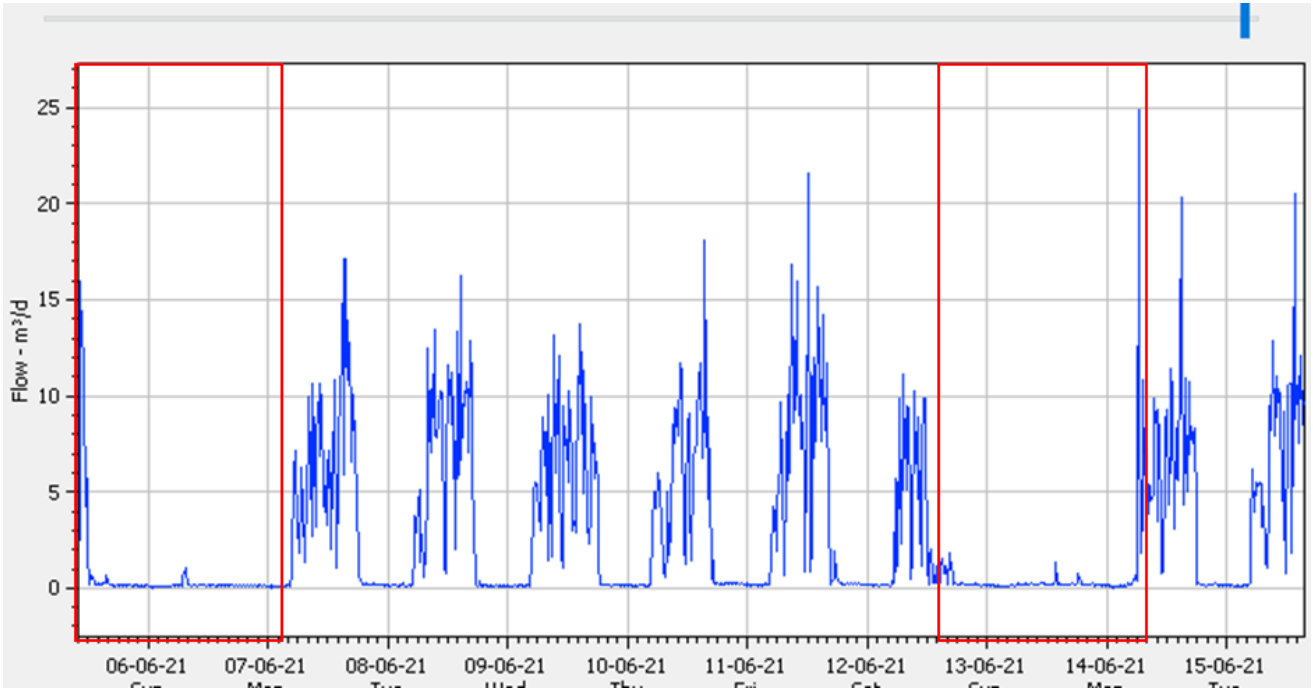
Validation

Normal Day

Standard Profiles Represent
“Normal” Demand

Excluded days included:

- Weekends
- Bank Holidays
- Christmas
- Etc



Weekly Profile

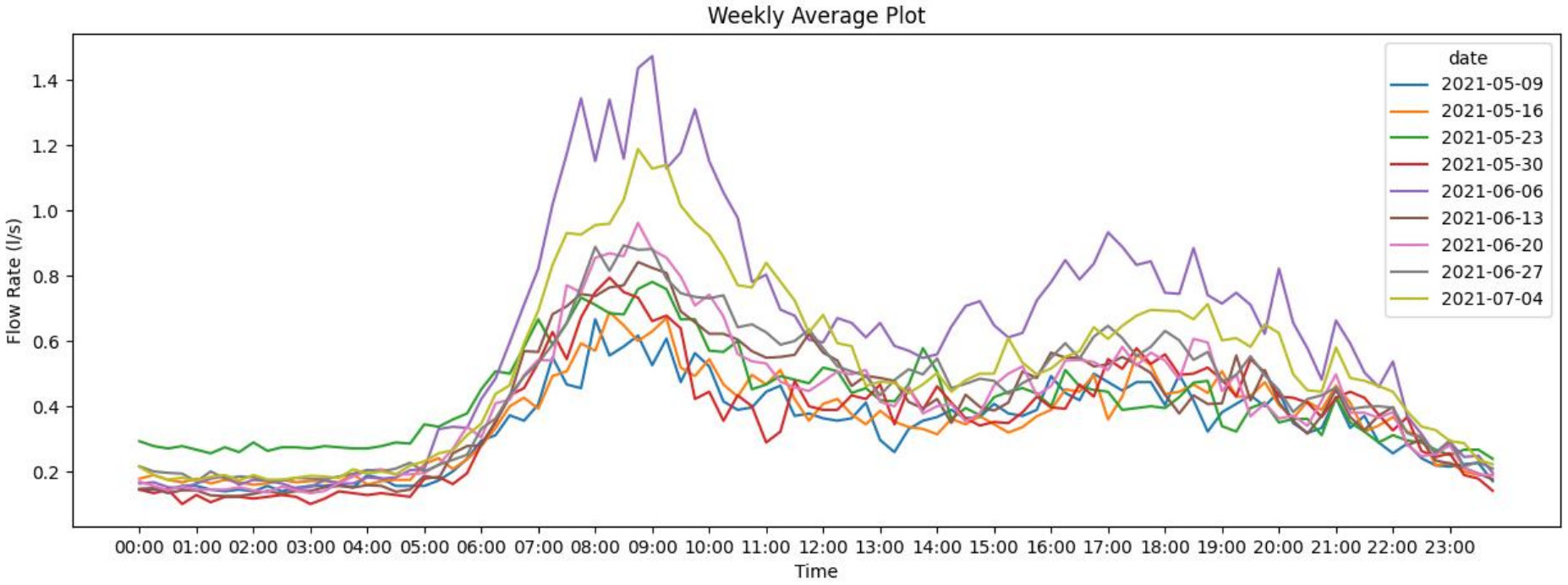
Data Collation

Validation

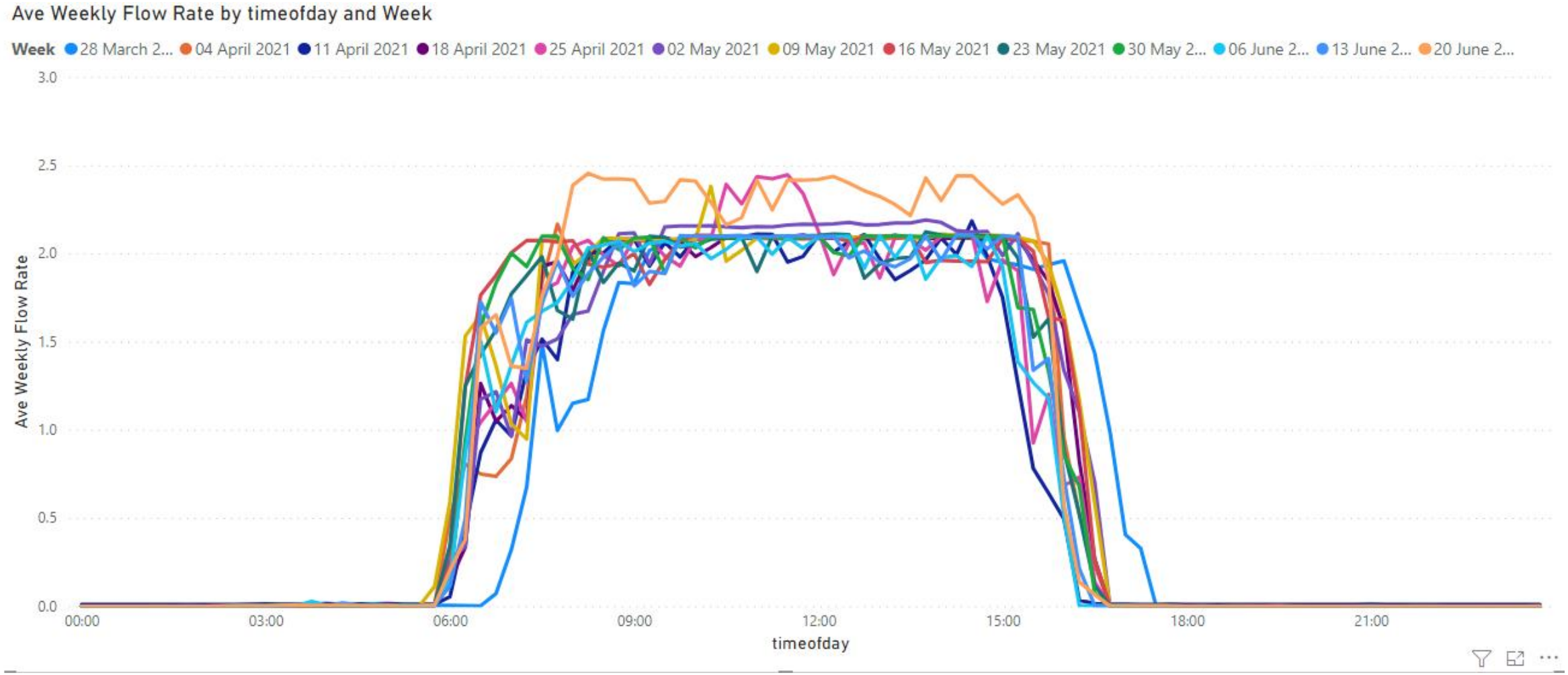
Normal Day

Weekly Profile

For each property we generated a profile for each week.



Profile Examples



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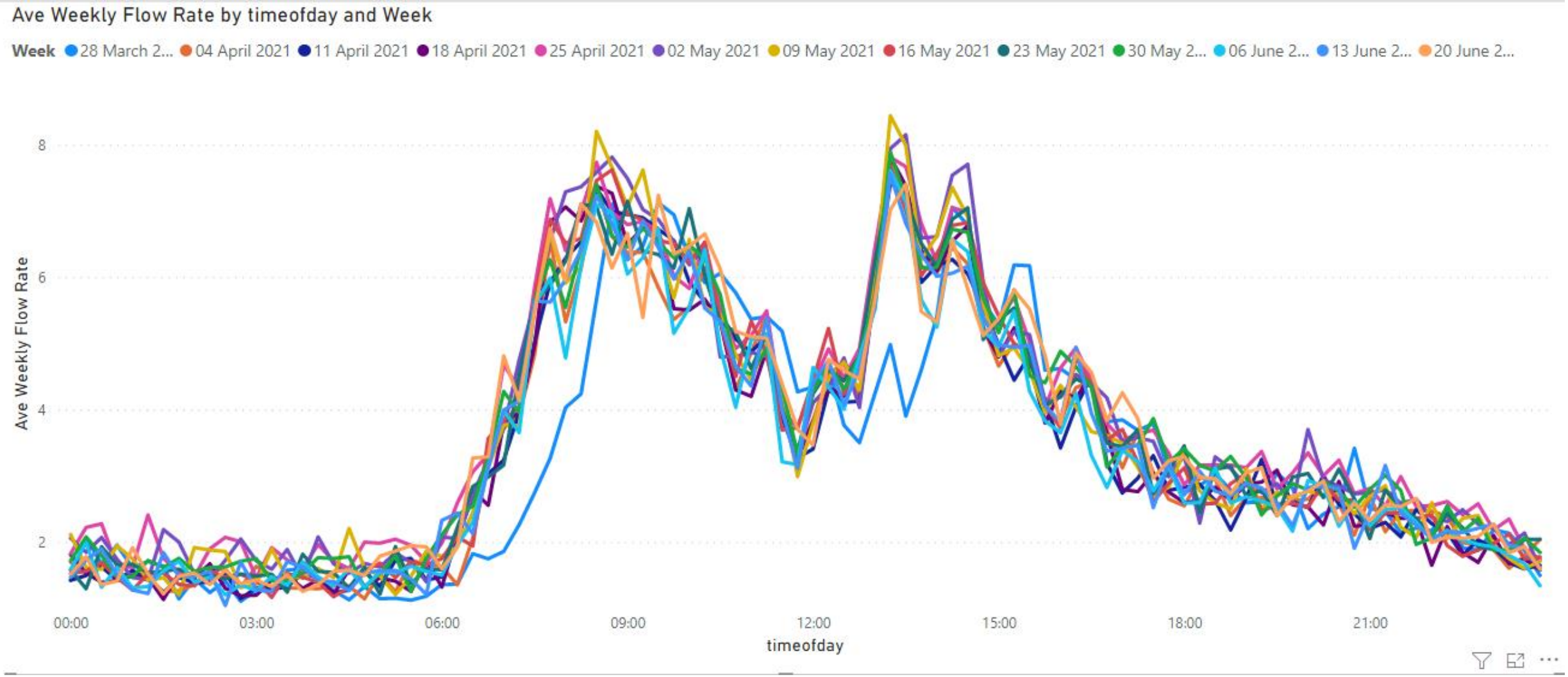

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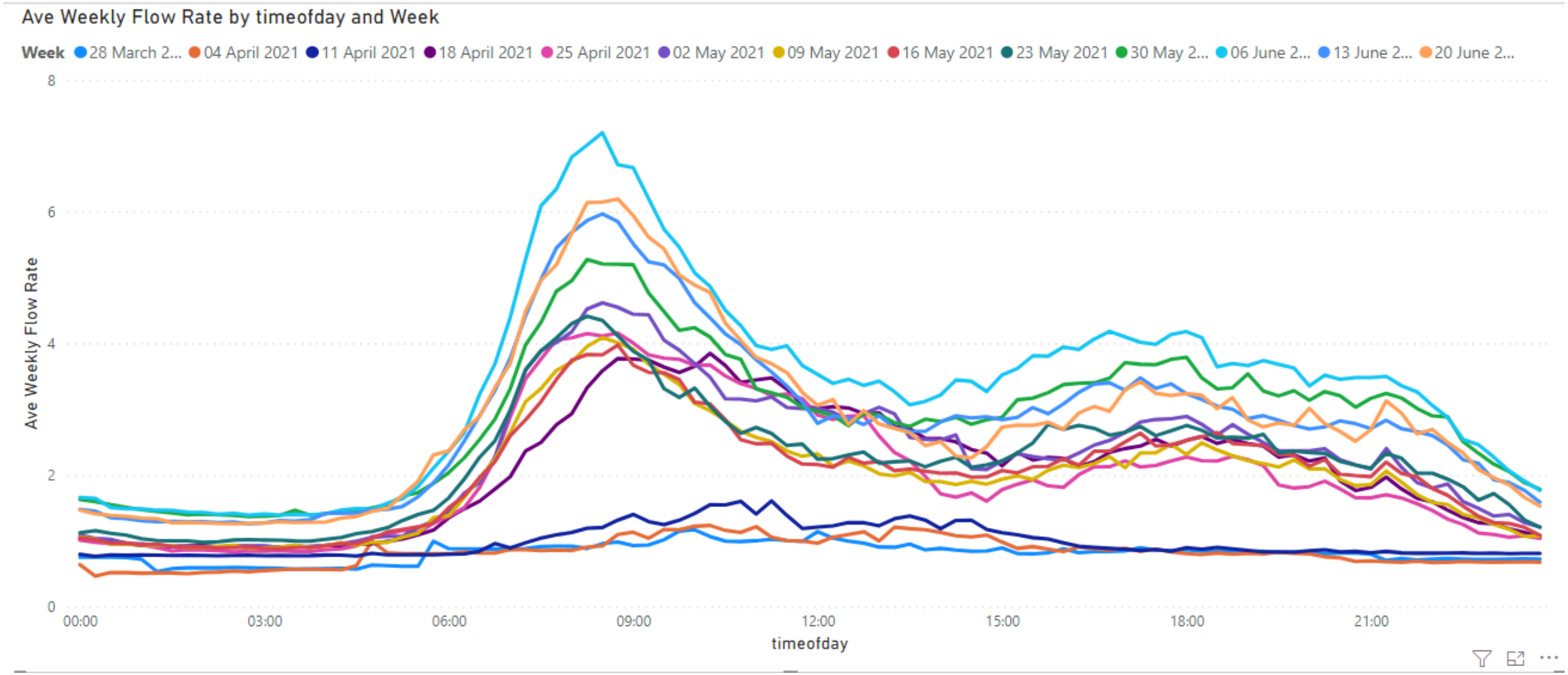

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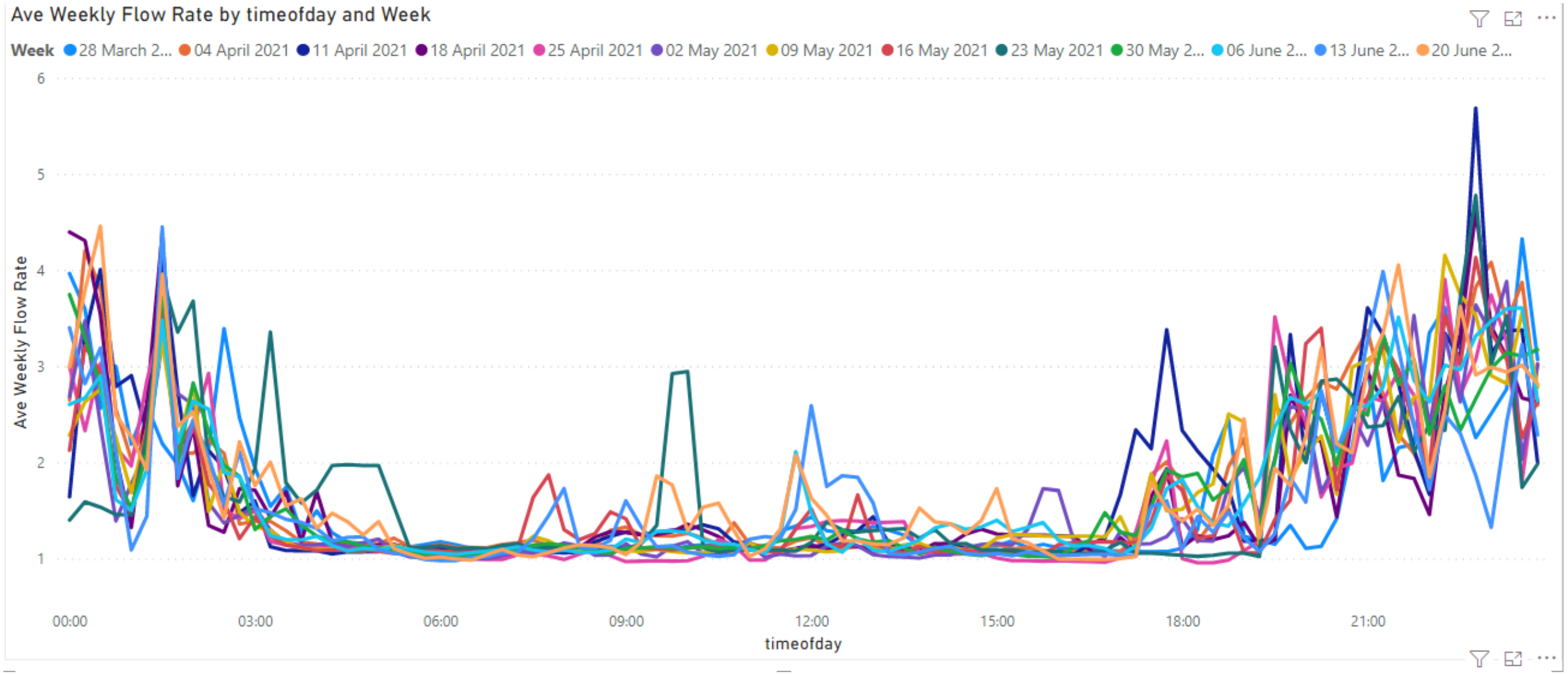
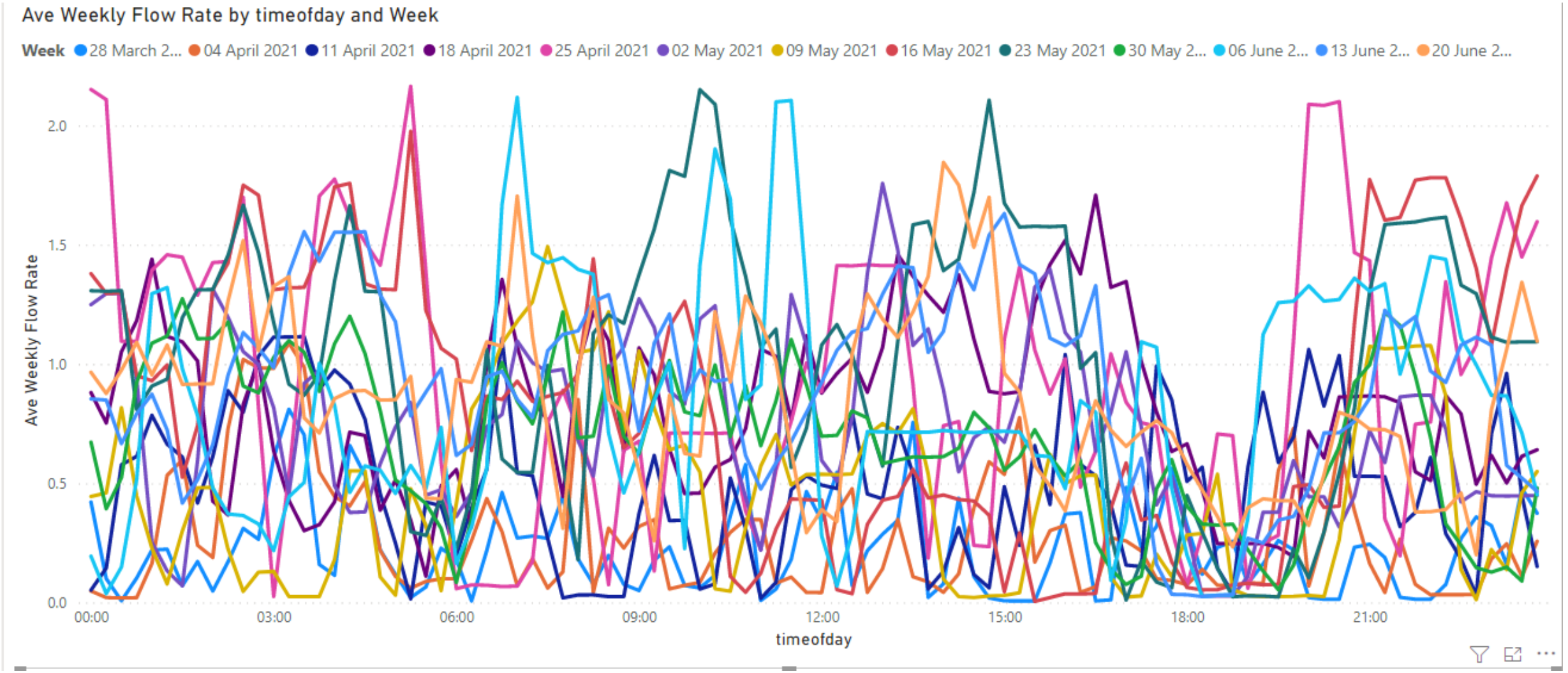


Profile Examples



Seasonal Properties

Data Collation

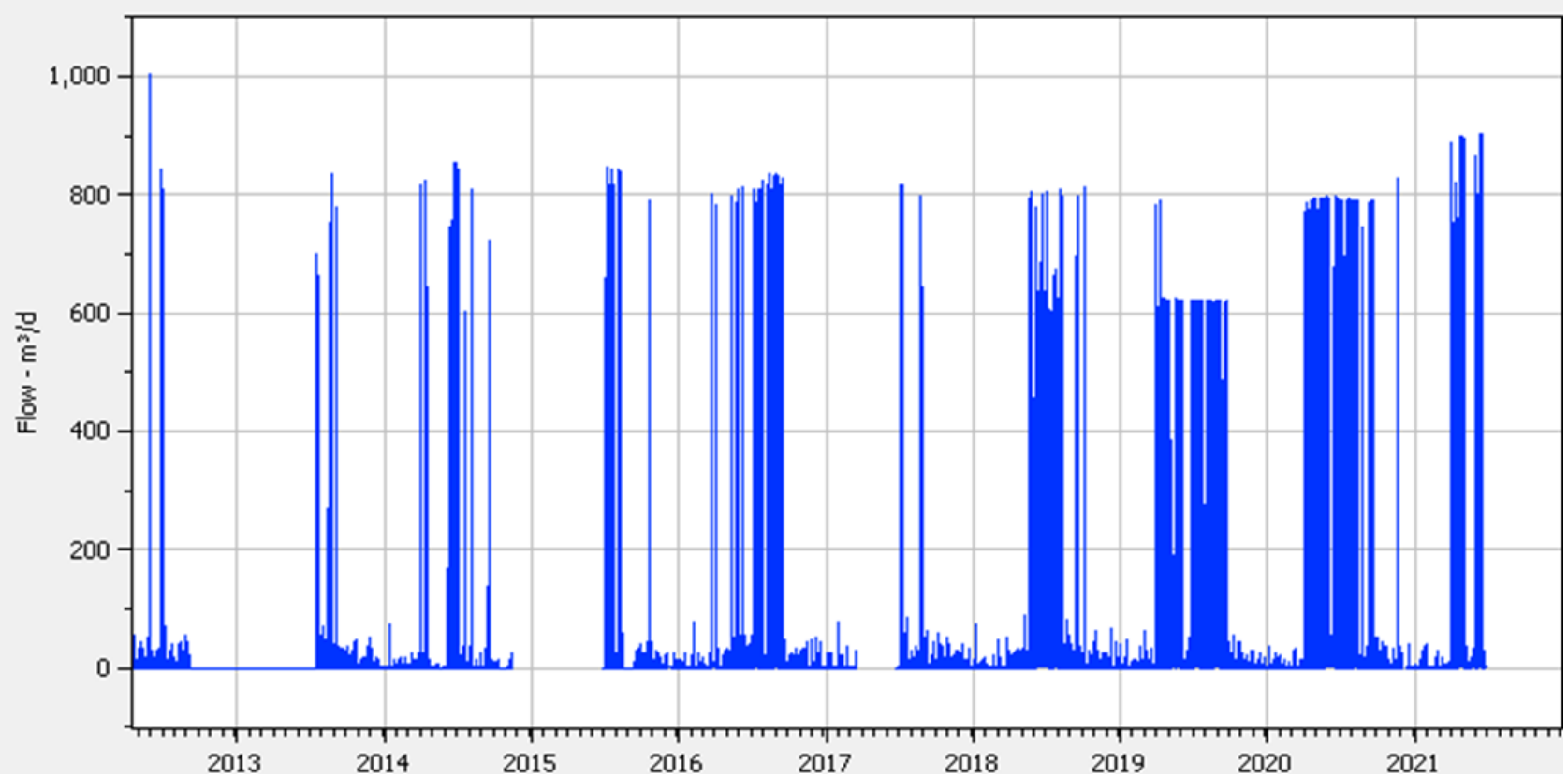
Validation

Normal Day

Weekly Profile

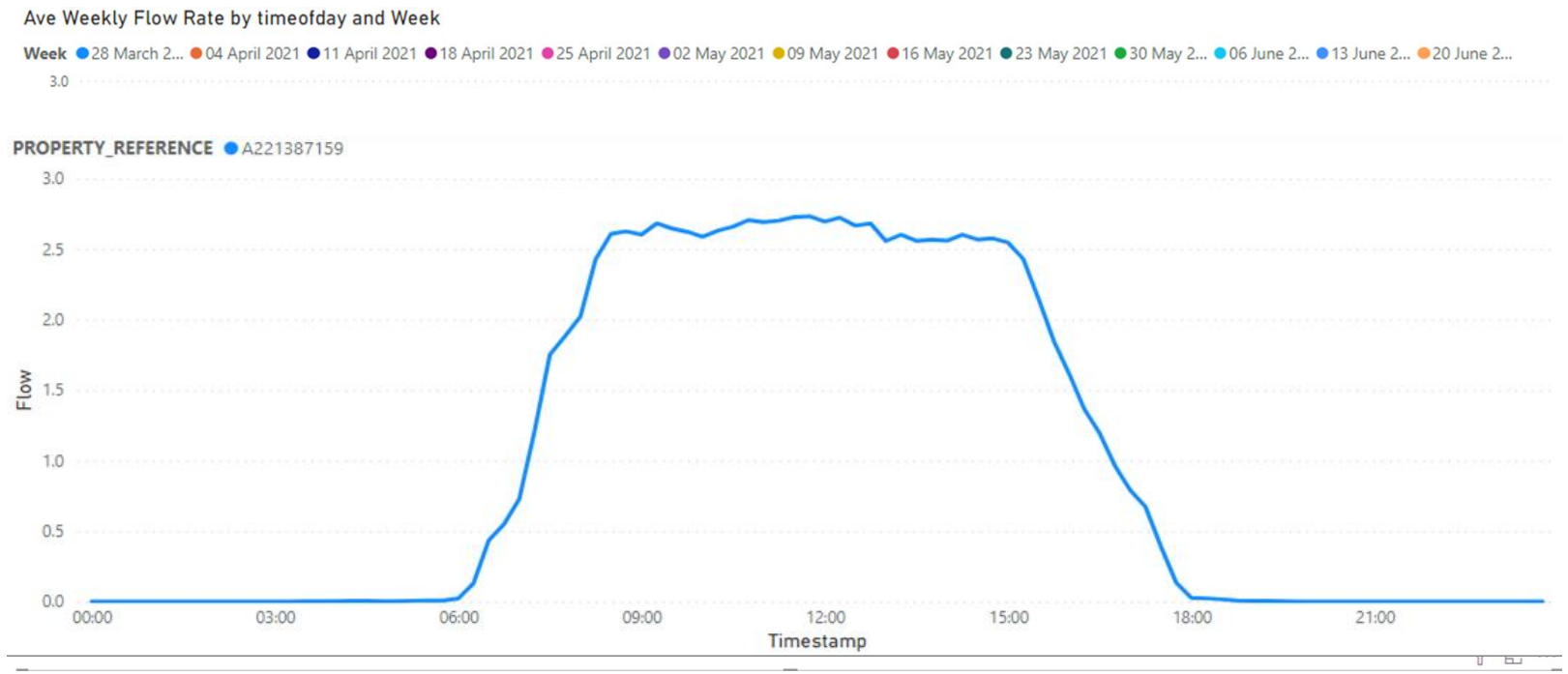
Seasonal Properties

Based on the weekly volume and profiles we flagged properties as seasonal or standard.



Overall Profile

For Standard Properties we generated an overall profile



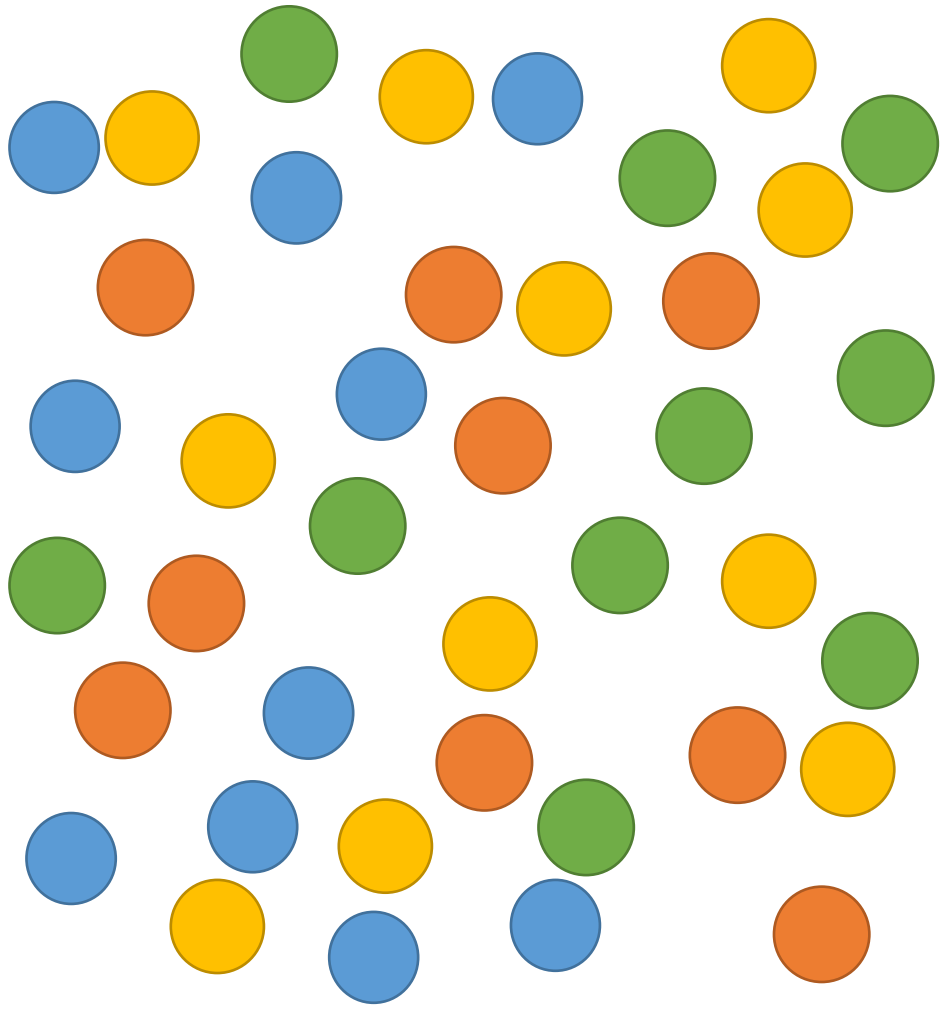
- Data Collation
- Validation
- Normal Day
- Weekly Profile
- Seasonal Properties
- Overall Profile

Profile Grouping

Overall we generated 2400 Property Profiles

These properties had:

- High proportion of consumption logged
- High data availability
- Non-seasonal consumption
- Non-erroneous data
- Flow data matched readings



Data Collation

Validation

Normal Day

Weekly Profile

Seasonal Properties

Overall Profile

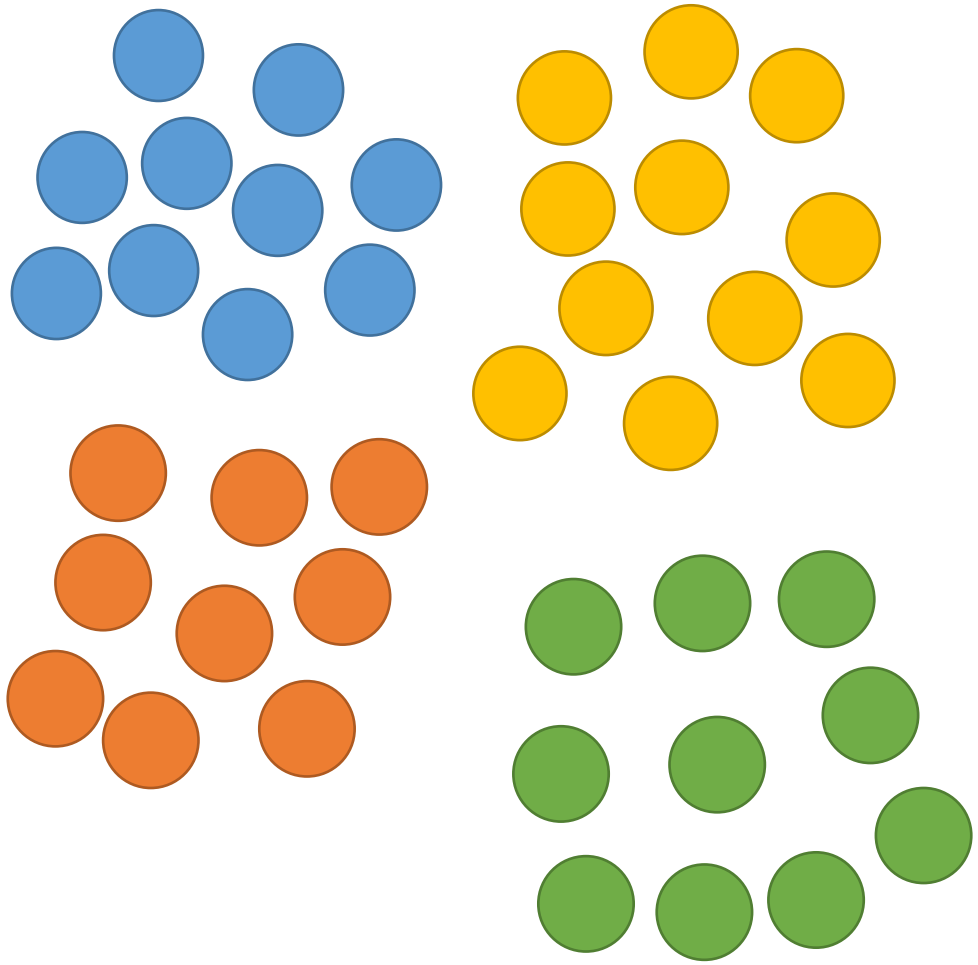
Profile Grouping

Profile Grouping

Property profiles were matched blind based on overall shape.

This reduced expectational bias from the study.

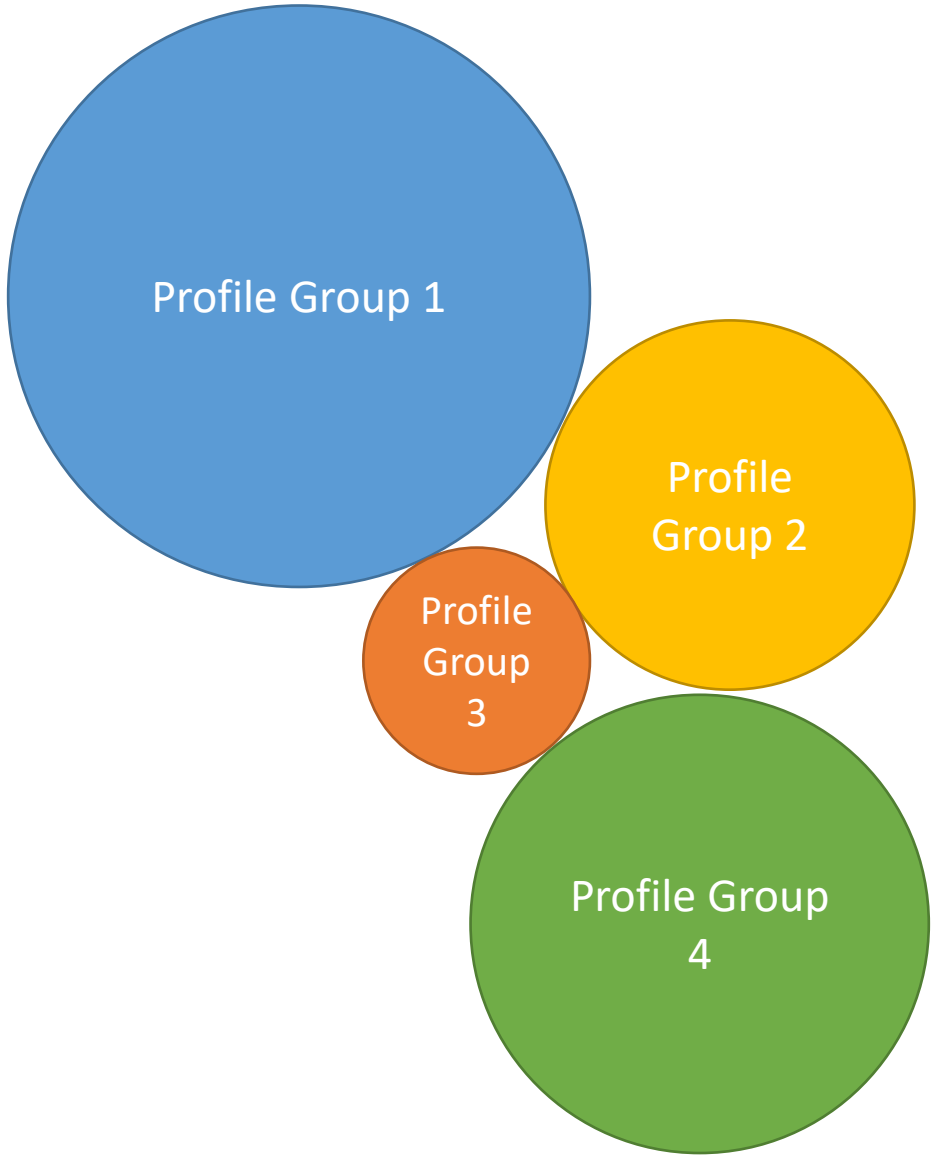
Allows us to see common profiles between property types and multiple profiles for individual properties.



- Data Collation
- Validation
- Normal Day
- Weekly Profile
- Seasonal Properties
- Overall Profile
- Profile Grouping

Profile Grouping

Matched properties were merged to produce Group Profiles



- Data Collation
- Validation
- Normal Day
- Weekly Profile
- Seasonal Properties
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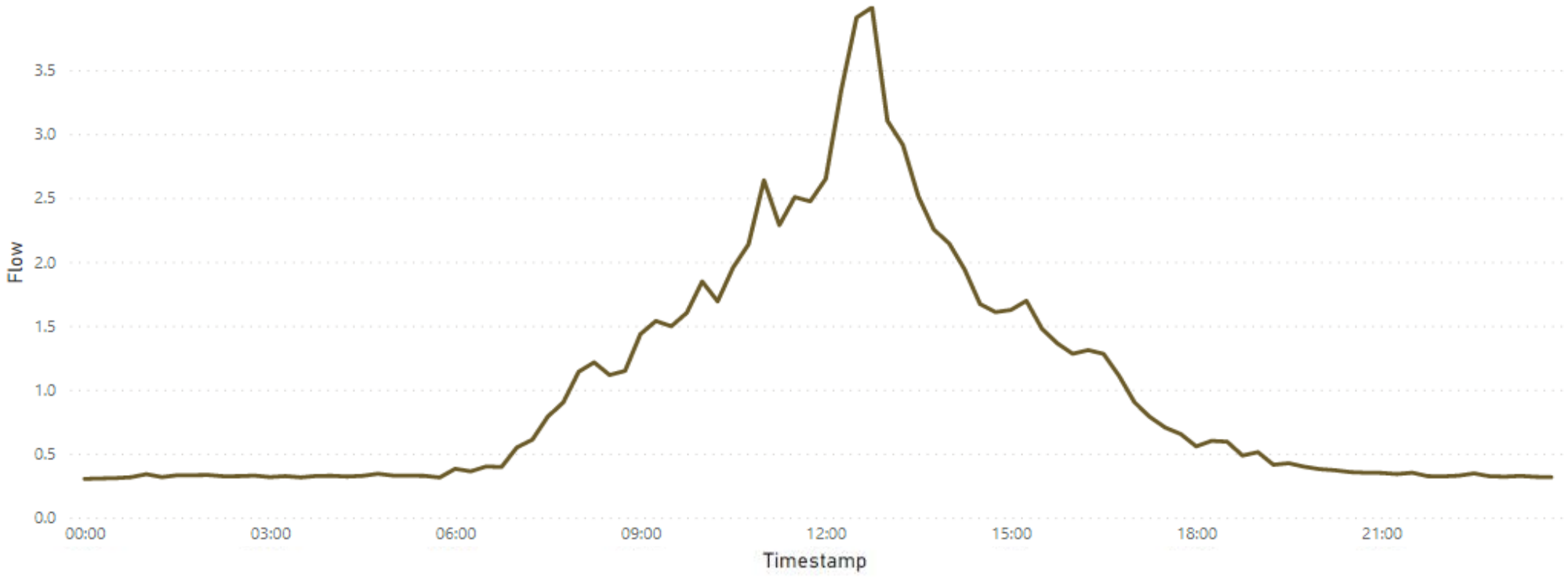
- Profile Grouping

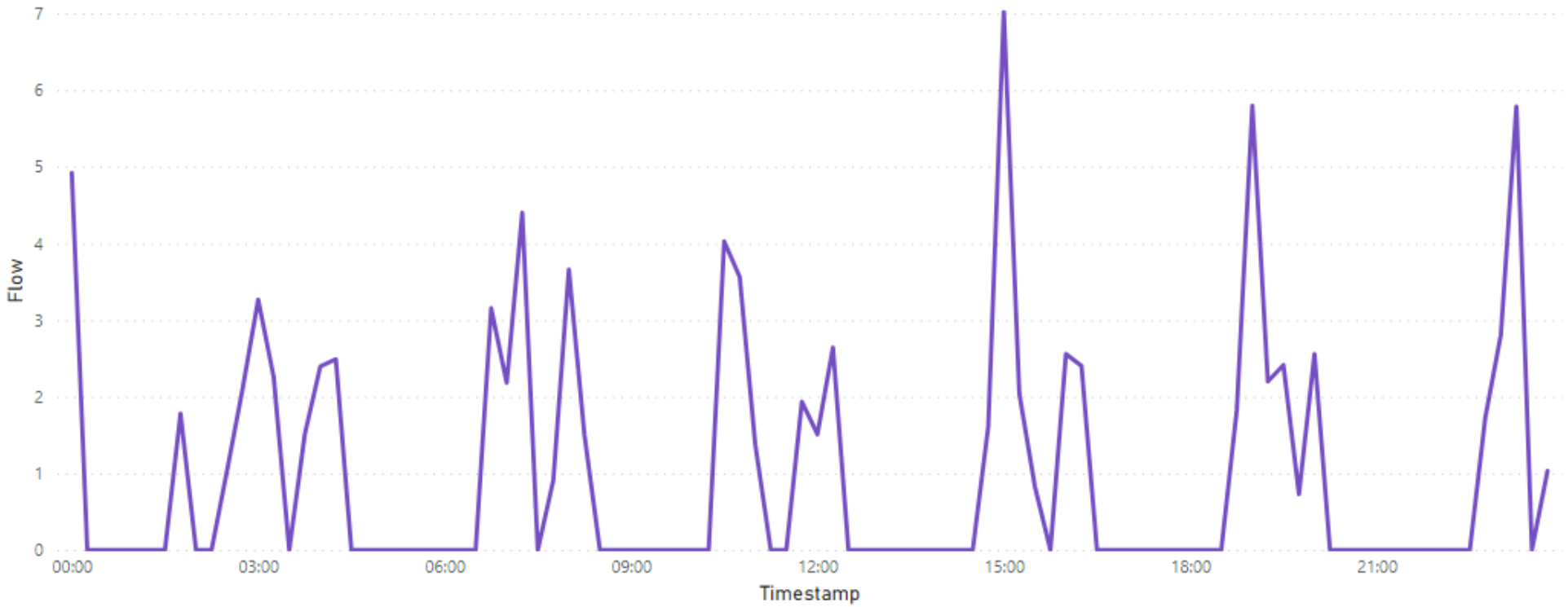
Matched Properties



- Data Collation
- Validation
- Normal Day
- Weekly Profile
- Seasonal Properties
- Overall Profile
- Profile Grouping

Overall 1823 Properties were matched to one other property to create a group

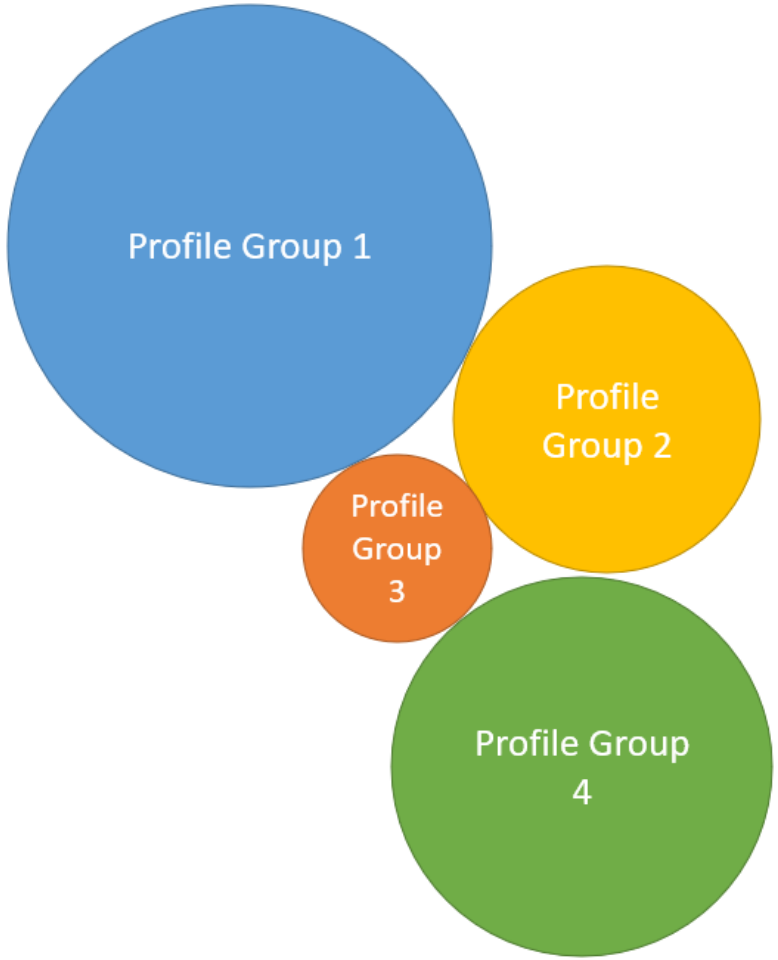
Unmatched Properties

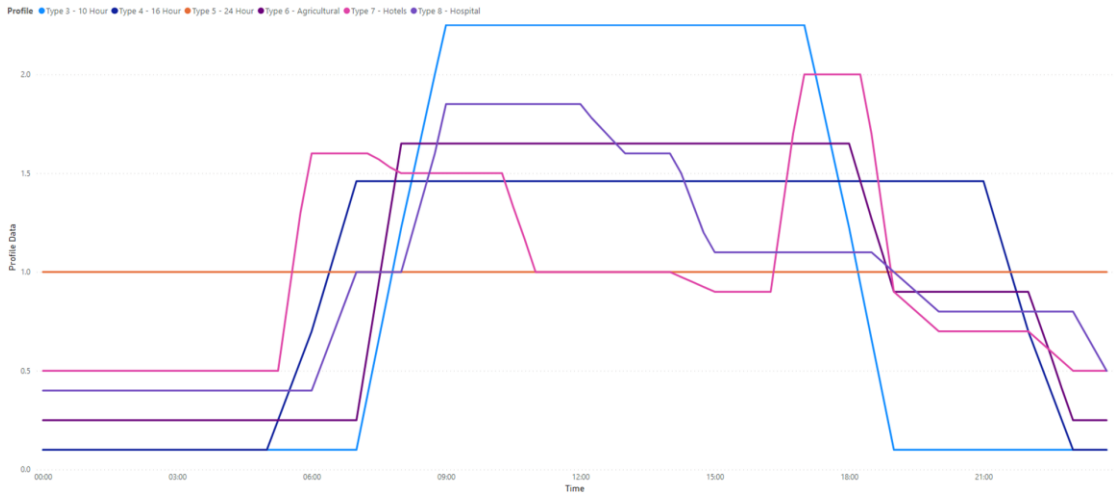


585 Properties were not matched to another property and were not grouped

- Data Collation
- Validation
- Normal Day
- Weekly Profile
- Seasonal Properties
- Overall Profile
- Profile Grouping

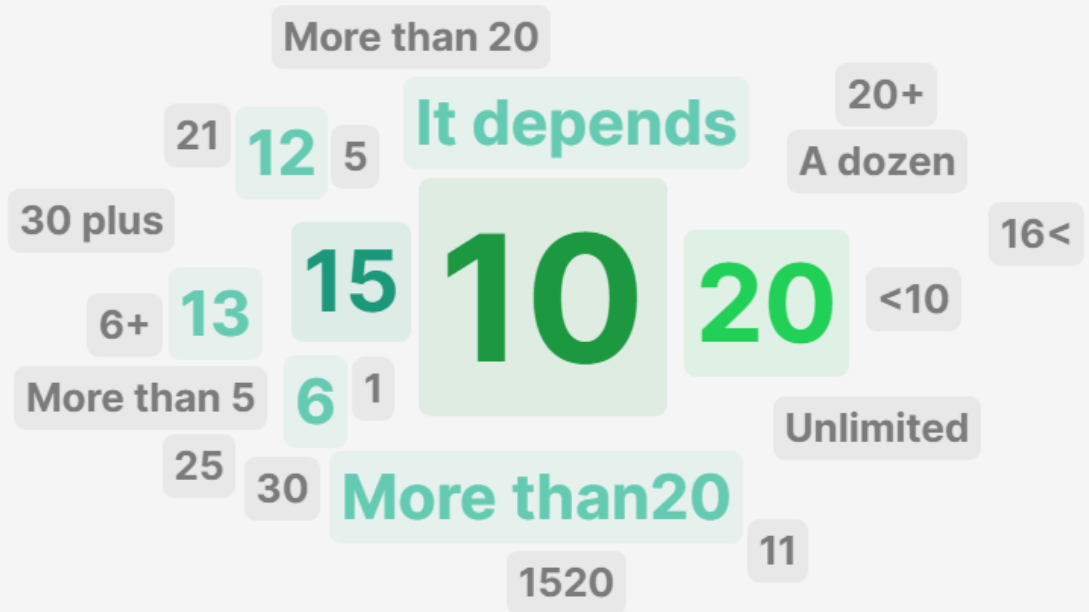
Profile Comparisons





Outputs

How many profiles would too many?



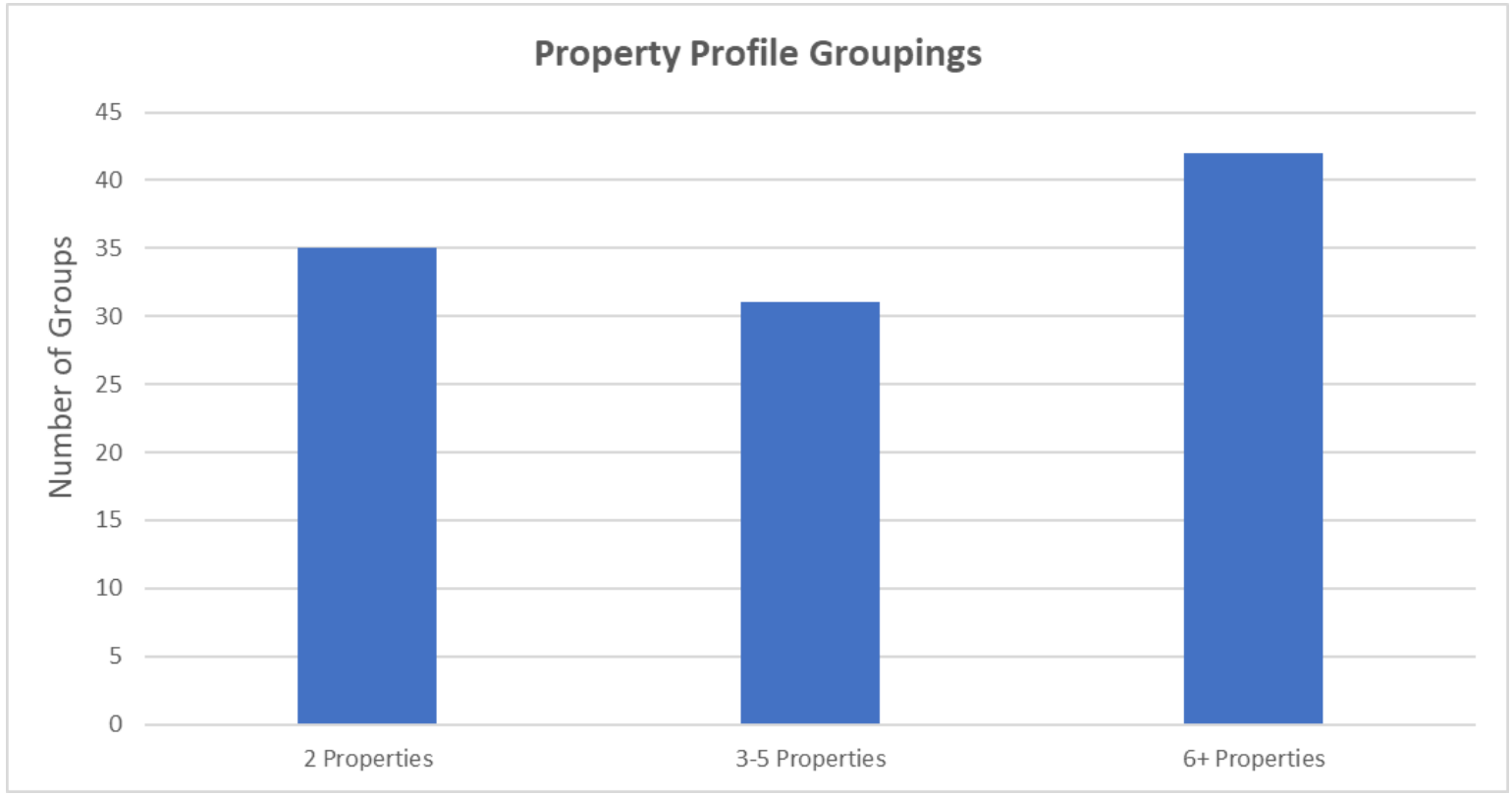
Matching

2408 total property profiles were available to be matched.

585 Properties were not matched to another property.

1823 Properties were matched to at least one other property

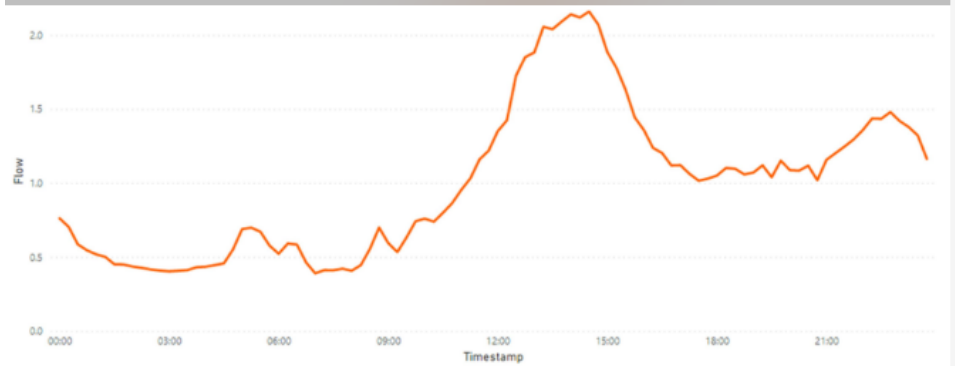
Overall **109** Profiles were generated



Unmatched Properties

585 Properties were not matched to another property.

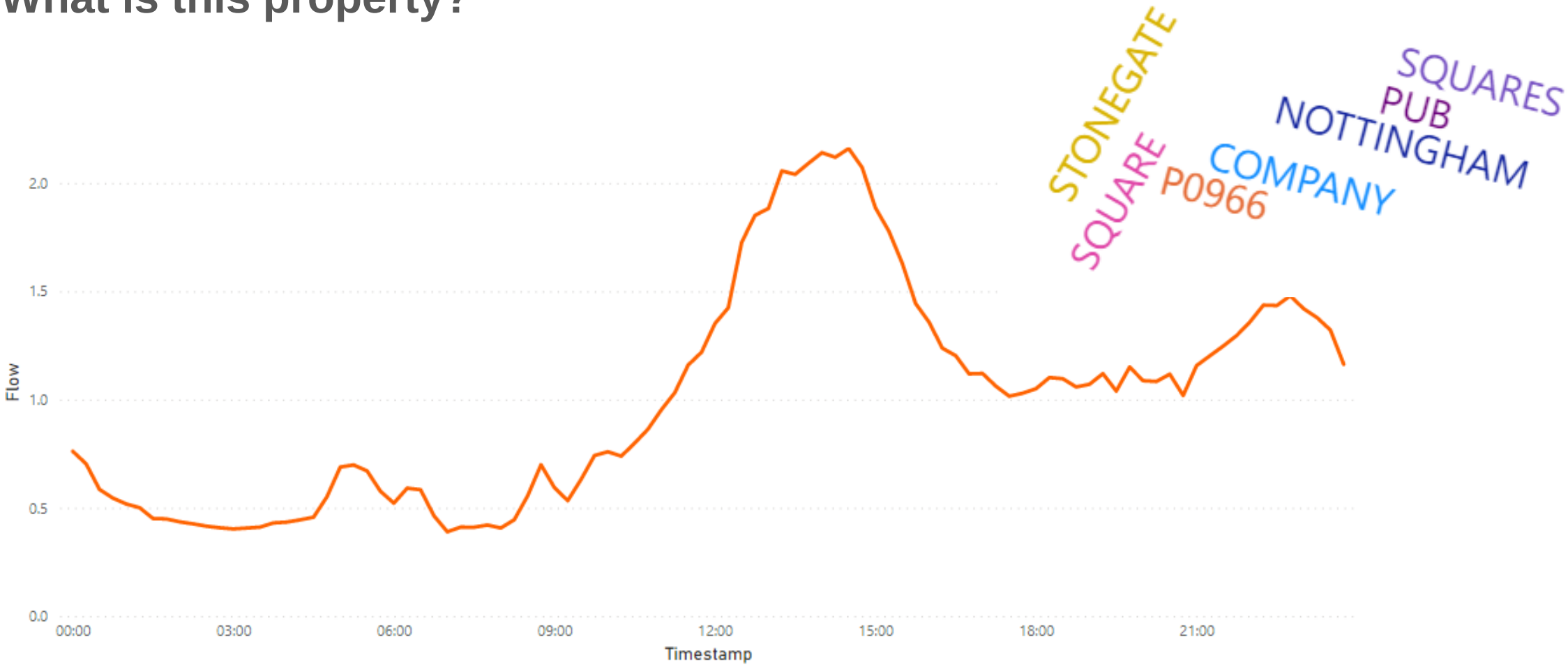
The key words of unmatched properties clearly show processed based water use results in erratic profiles which should potentially be logged as part of the field test.



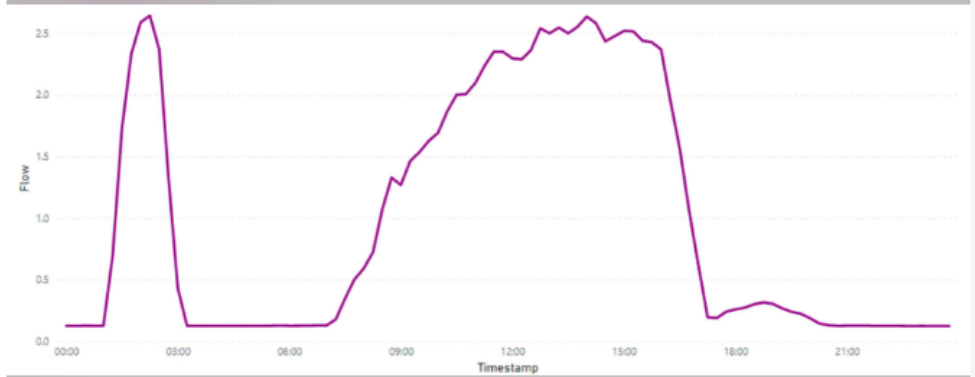
What is this profile?

Unmatched Properties

What is this property?



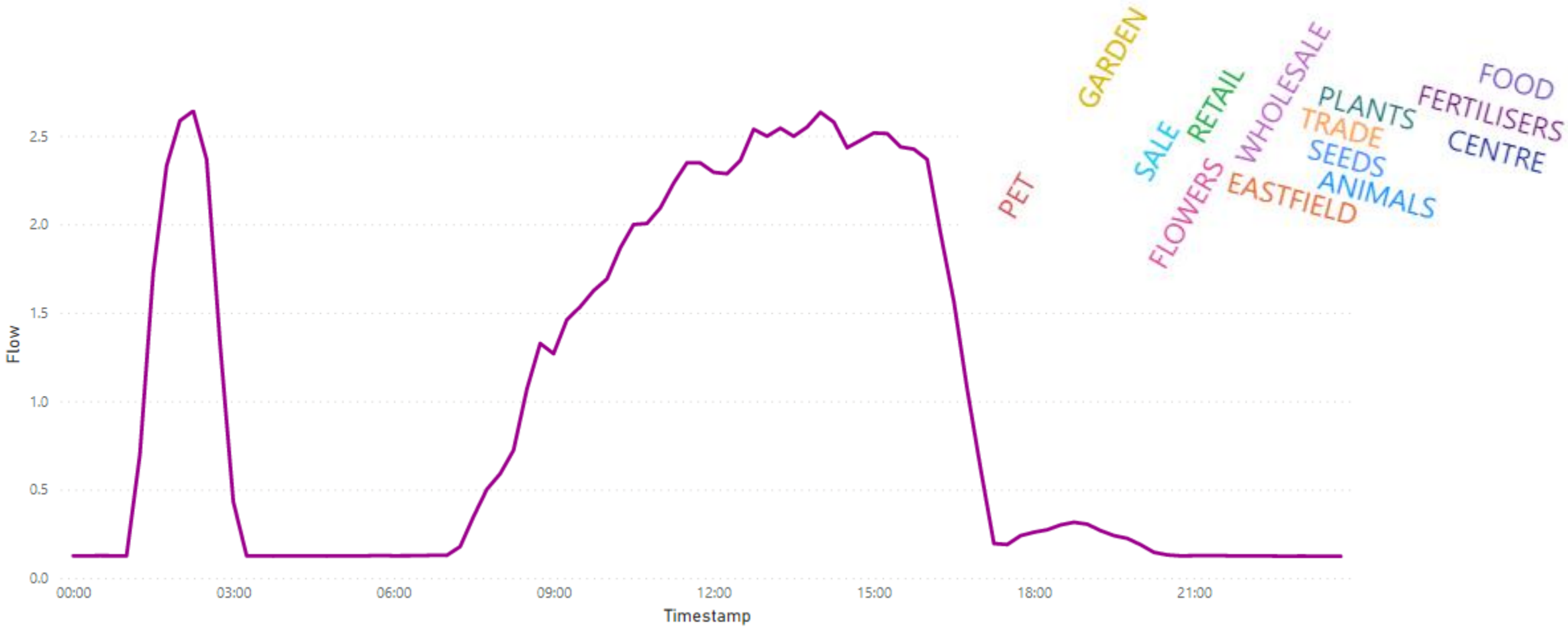
Round 2



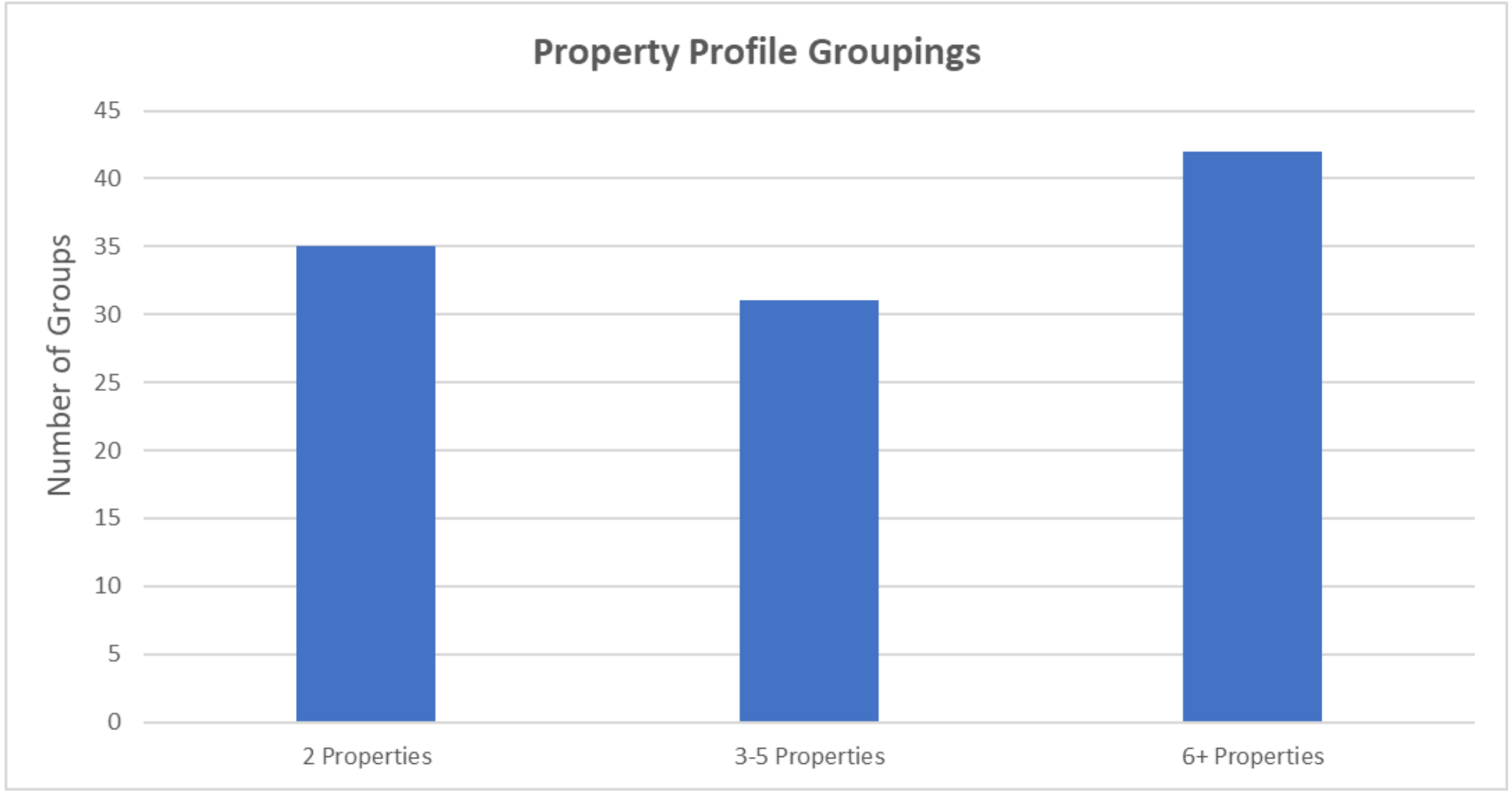
Airport
Hotel
Bakery factory
Fish market
Greggs
Care home
Ice rink
Bakery
Prison
Bakers
Swimming pool
University
School
Leisure
High building
Dairy
Leisure centre
Garden centre
Beach bar

Unmatched Properties

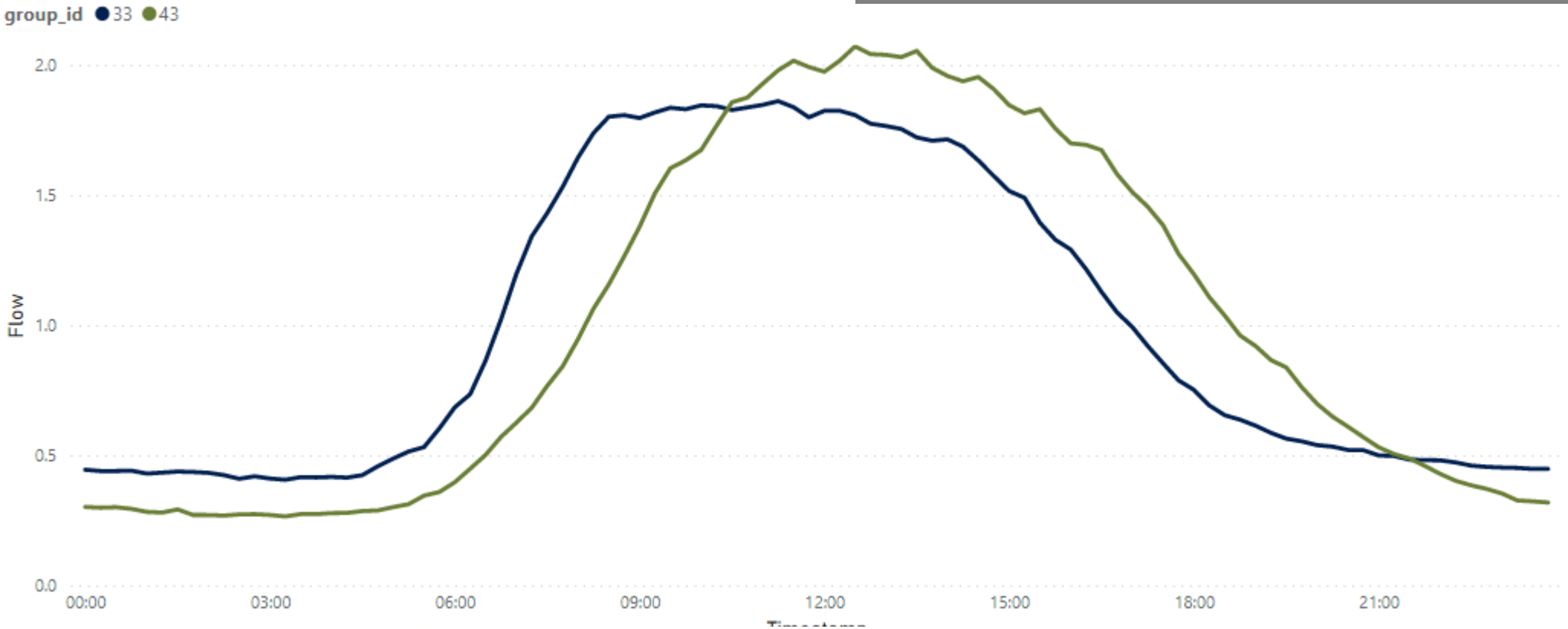
What is this property?



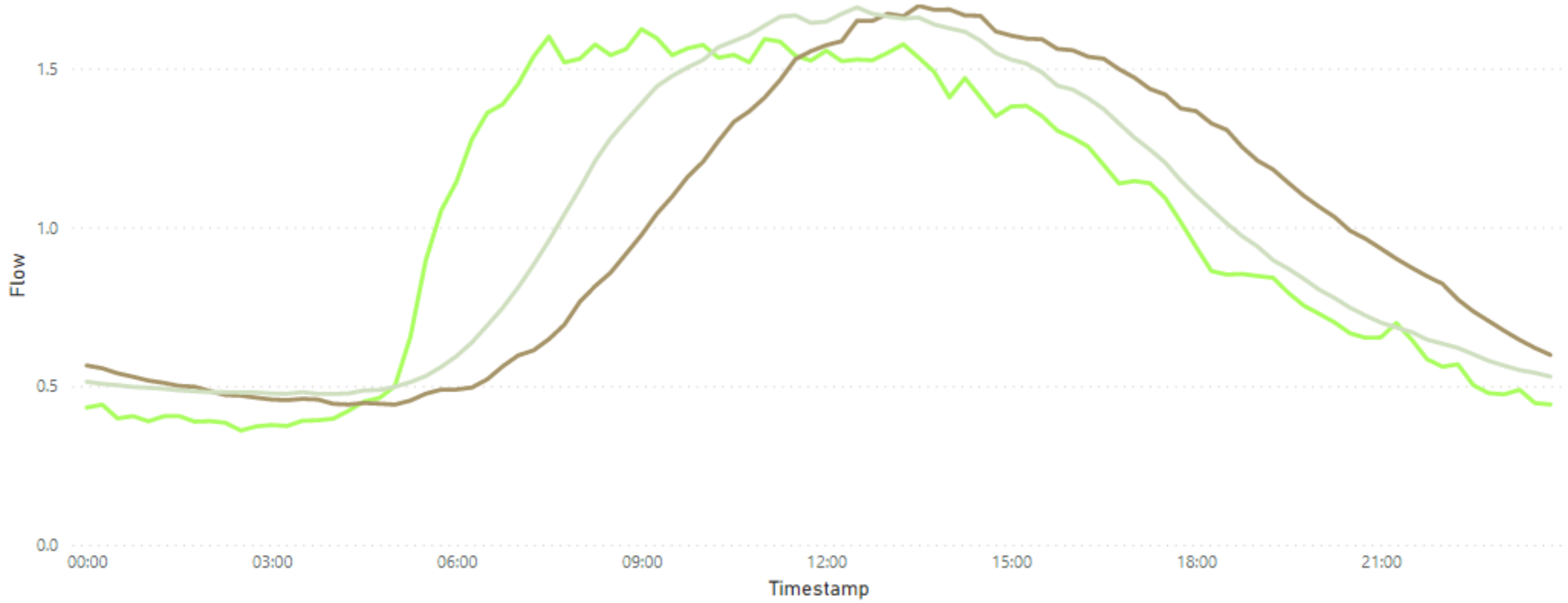
Matching


Property Profile Groupings
Number of Groups
45
40
35
30
25
20
15
10
5
0
2 Properties
3-5 Properties
6+ Properties

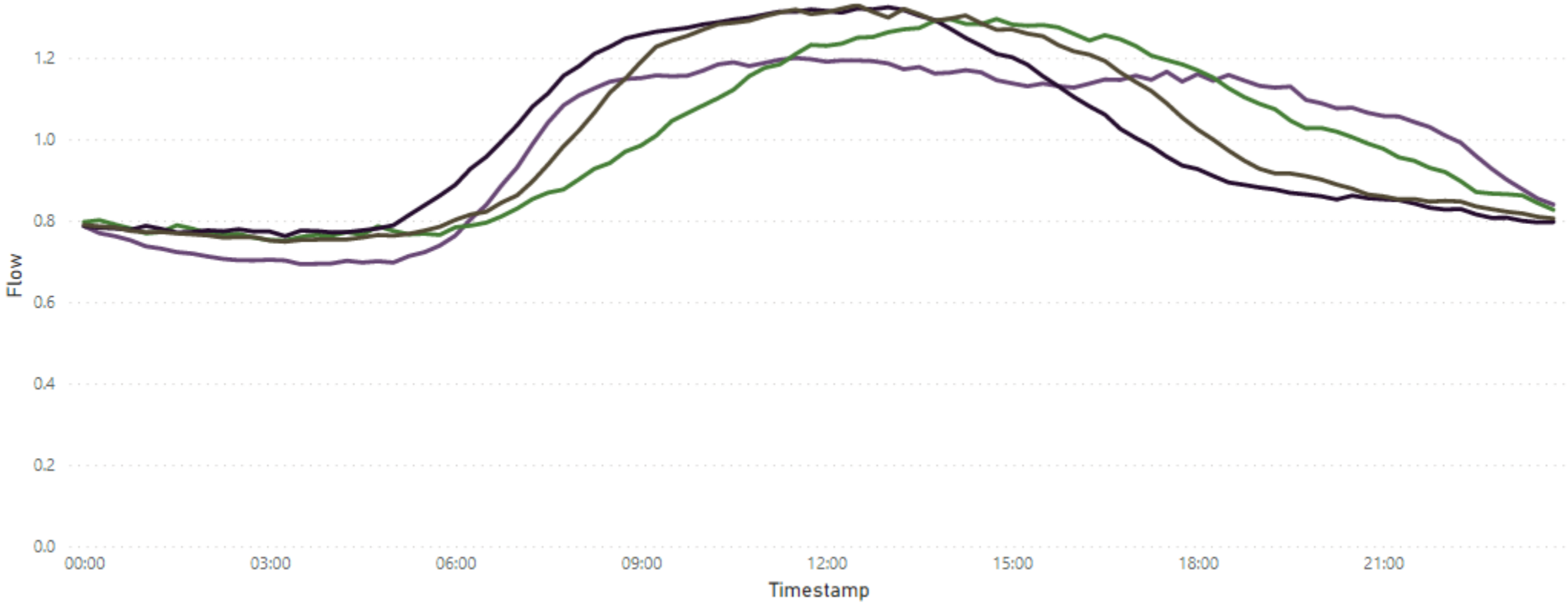
Matched Groups



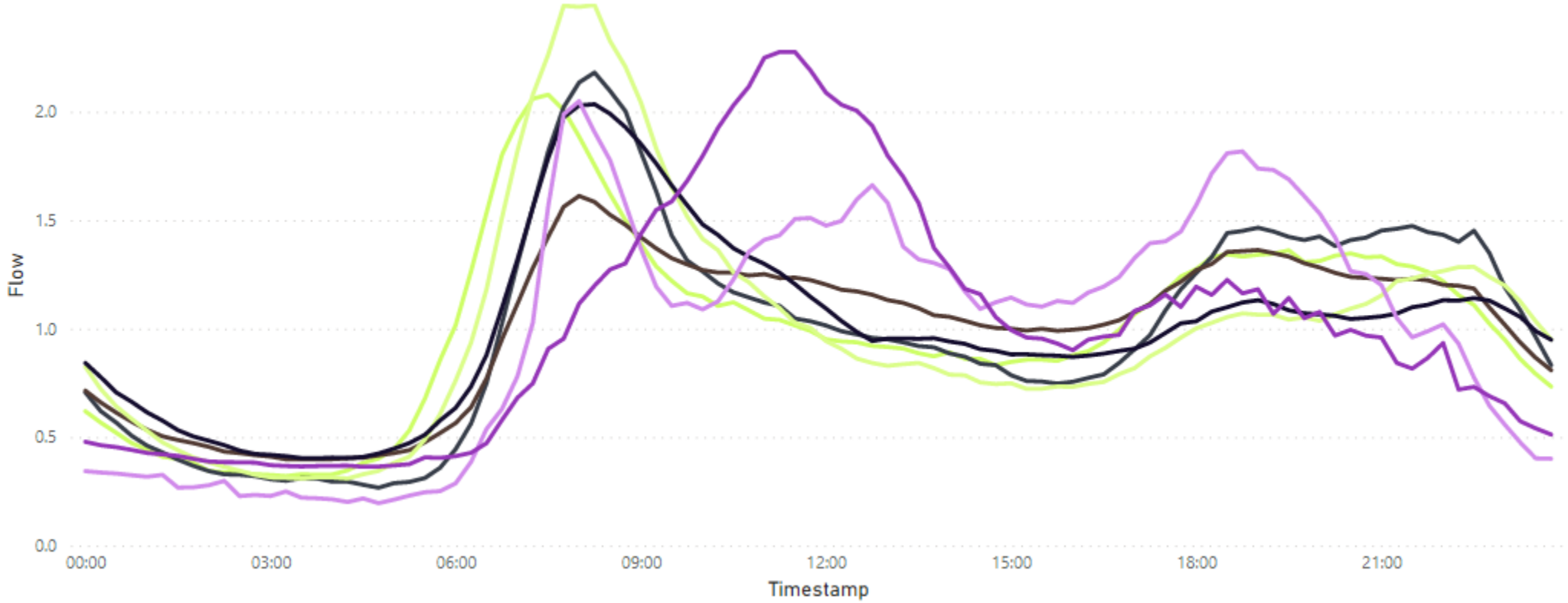
Matched Groups



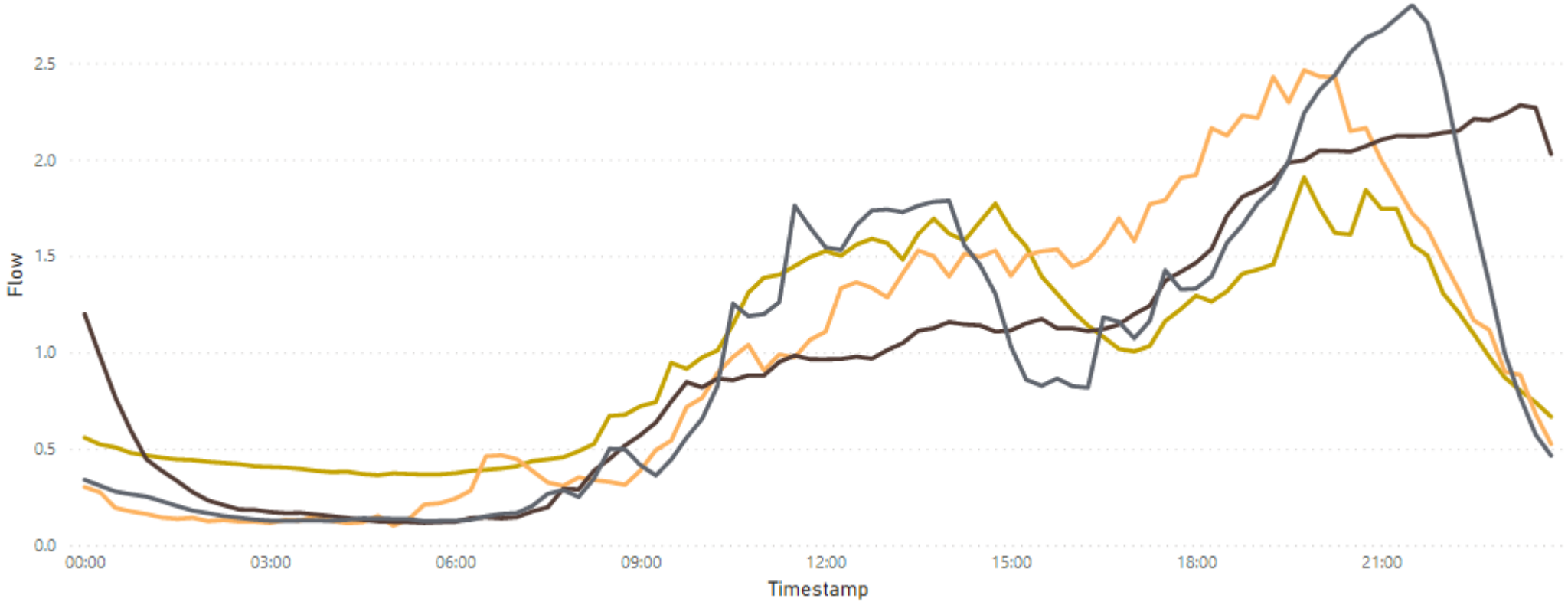
Matched Groups



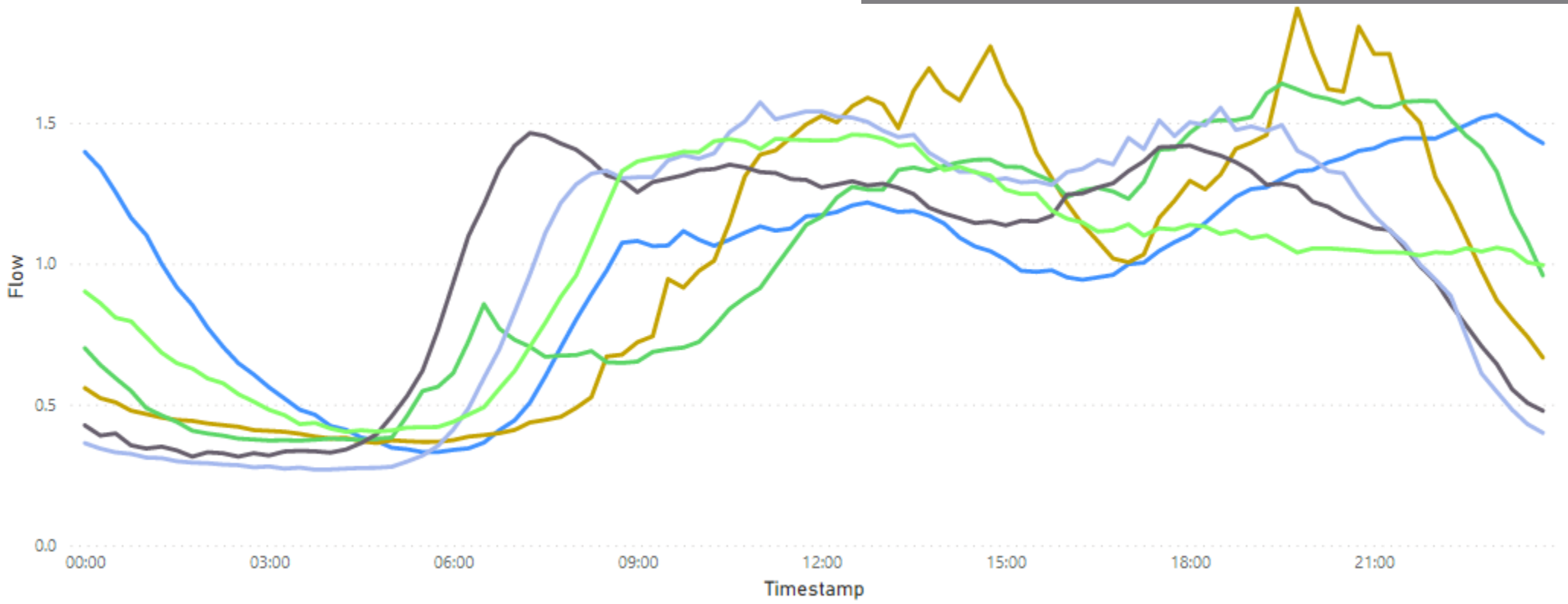
Matched Groups



Matched Groups

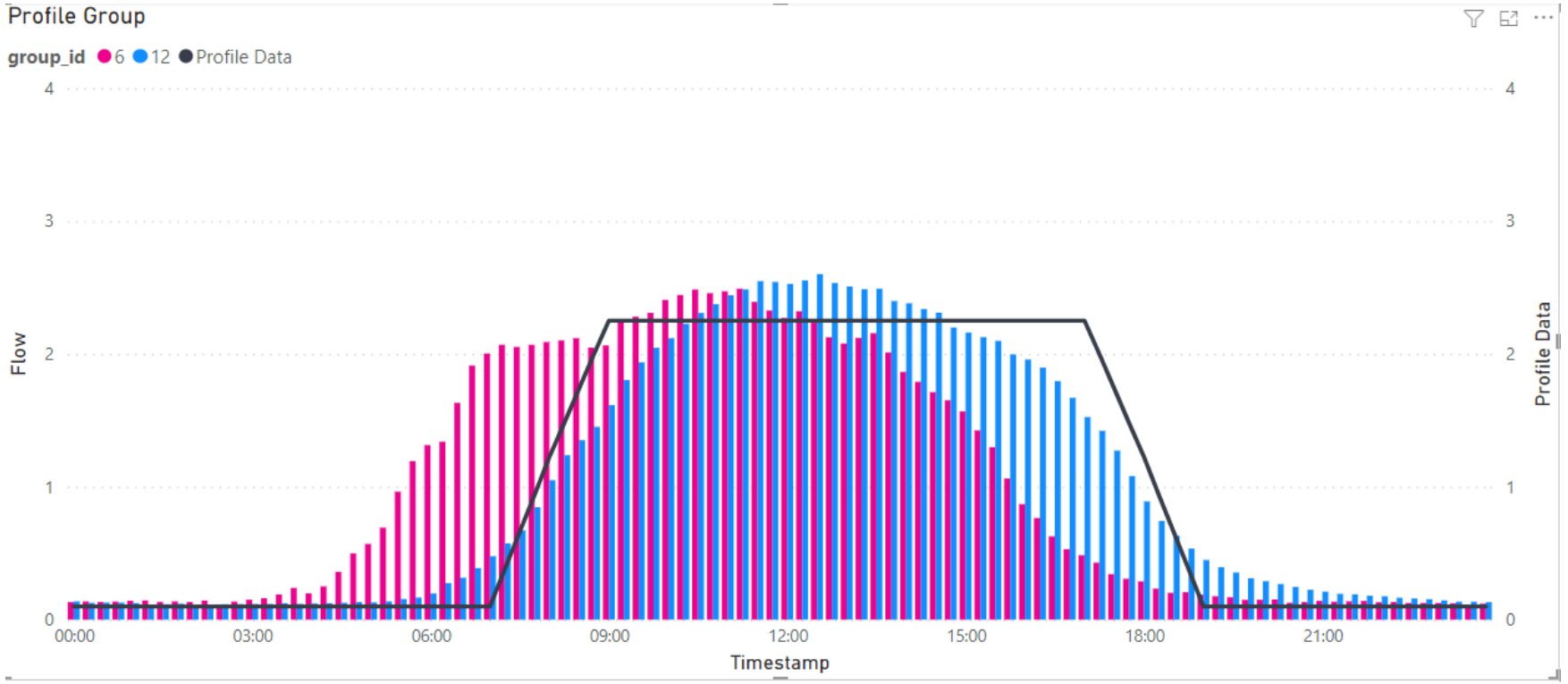


Matched Groups



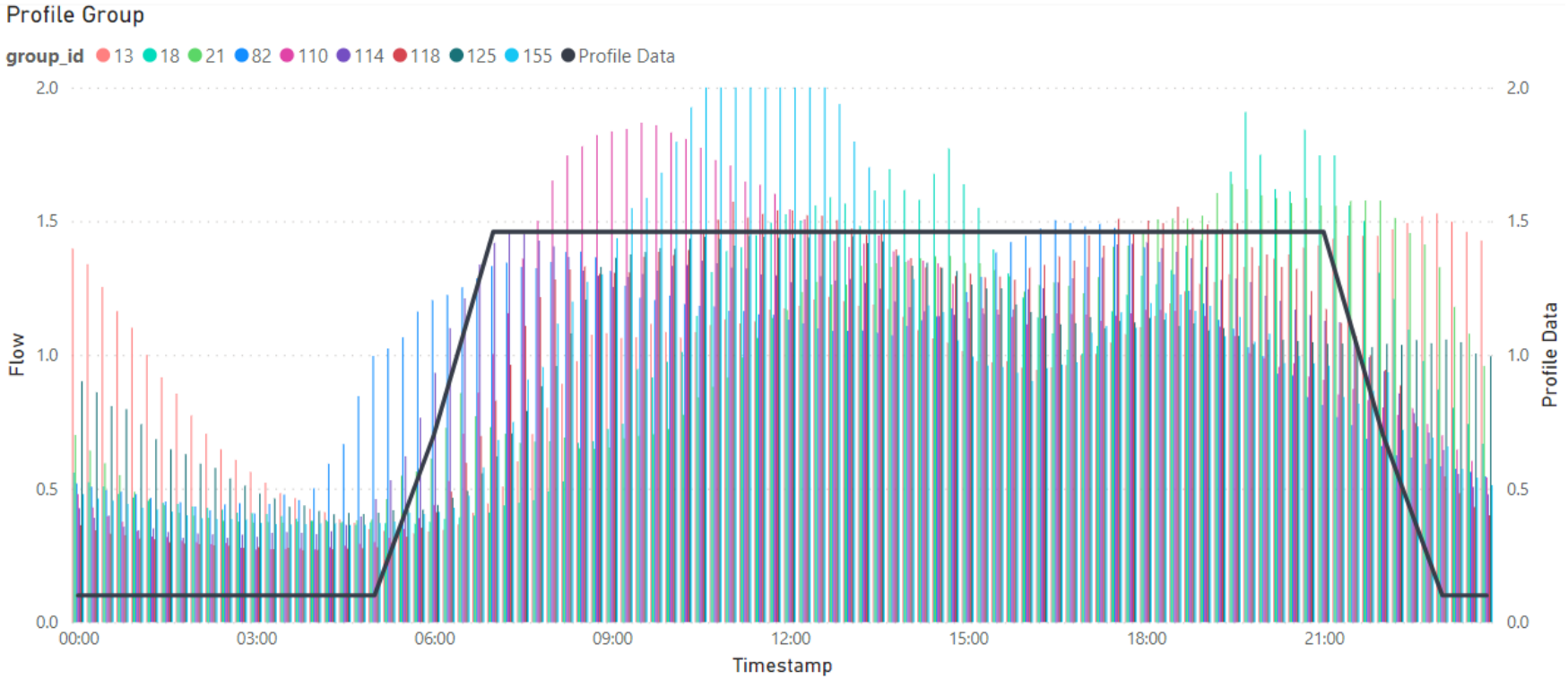
Generated Profiles
VS
Standard Profiles

Type 3 - 10 Hour



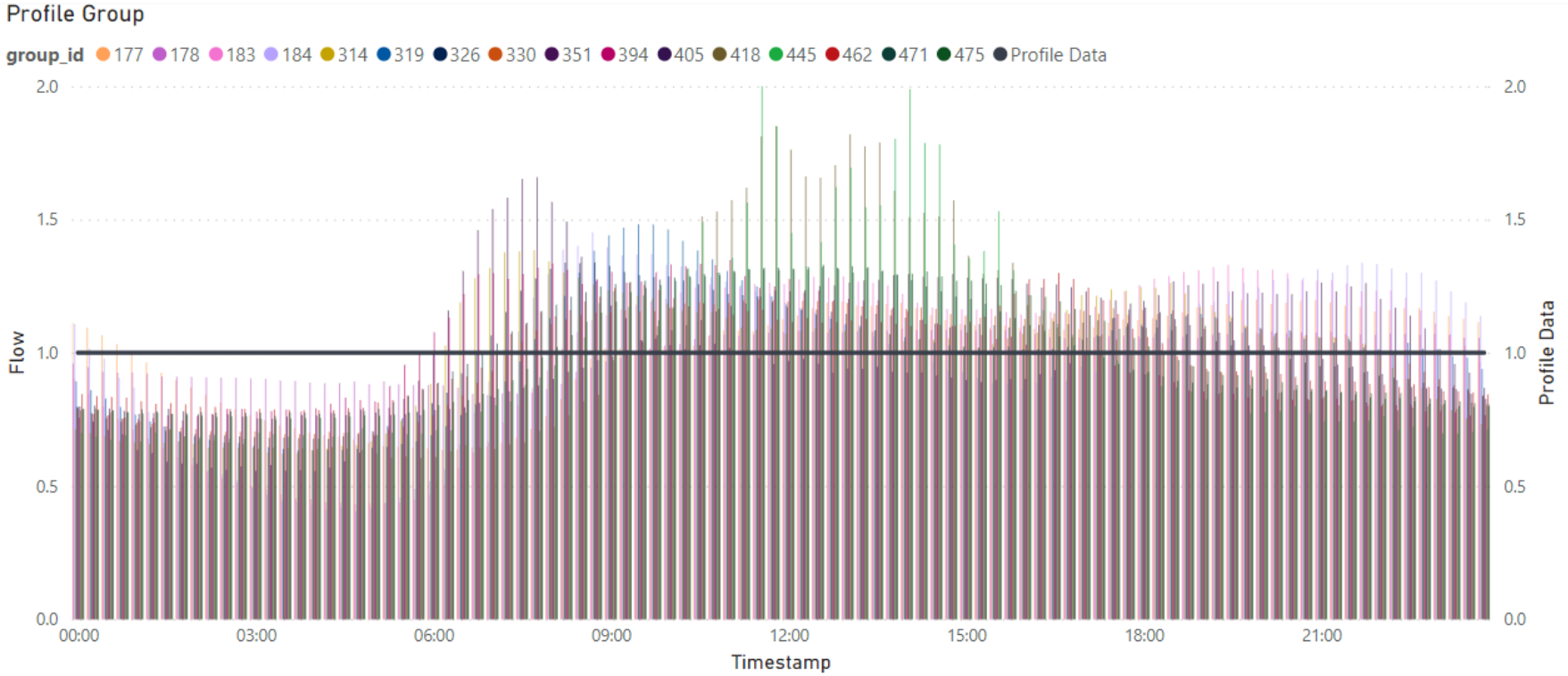
Profile Group Keywords

Type 4 – 16 Hour



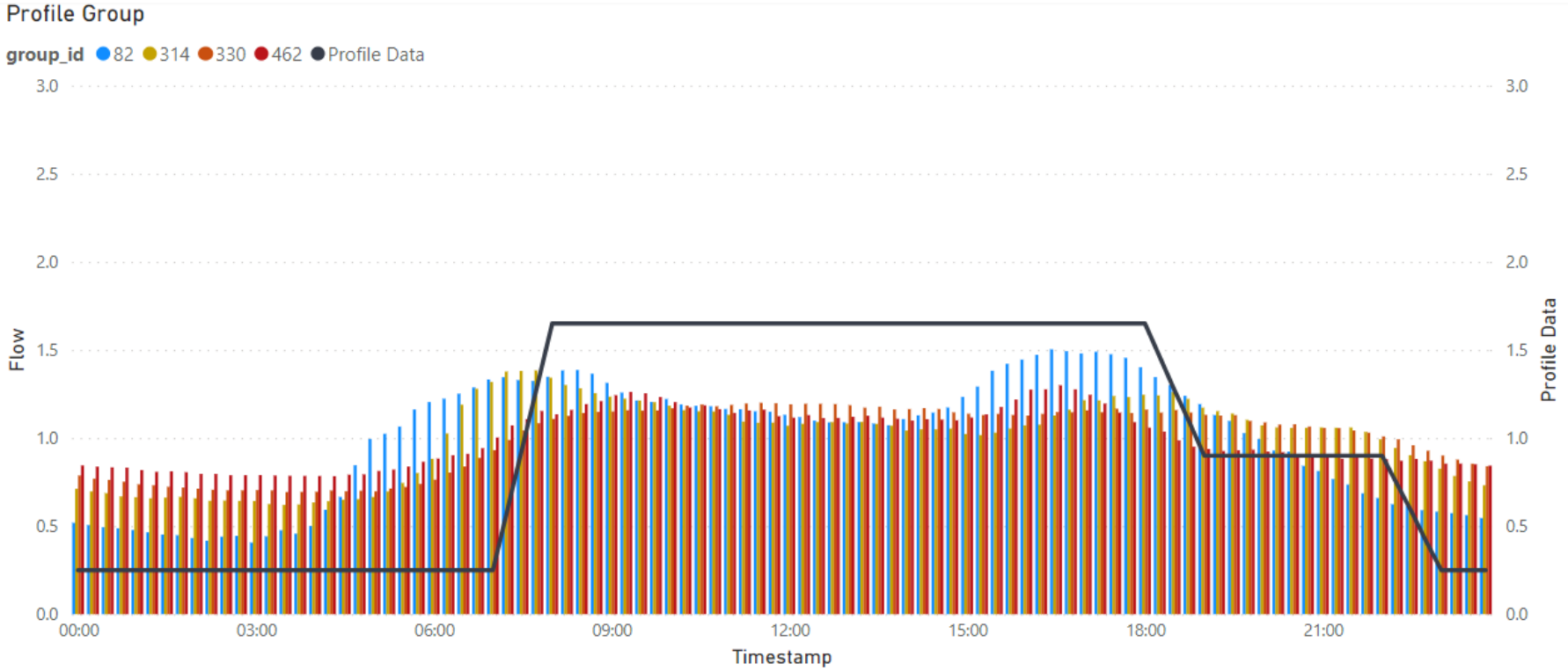
Profile Group Keywords

Type 5 – 24 Hour



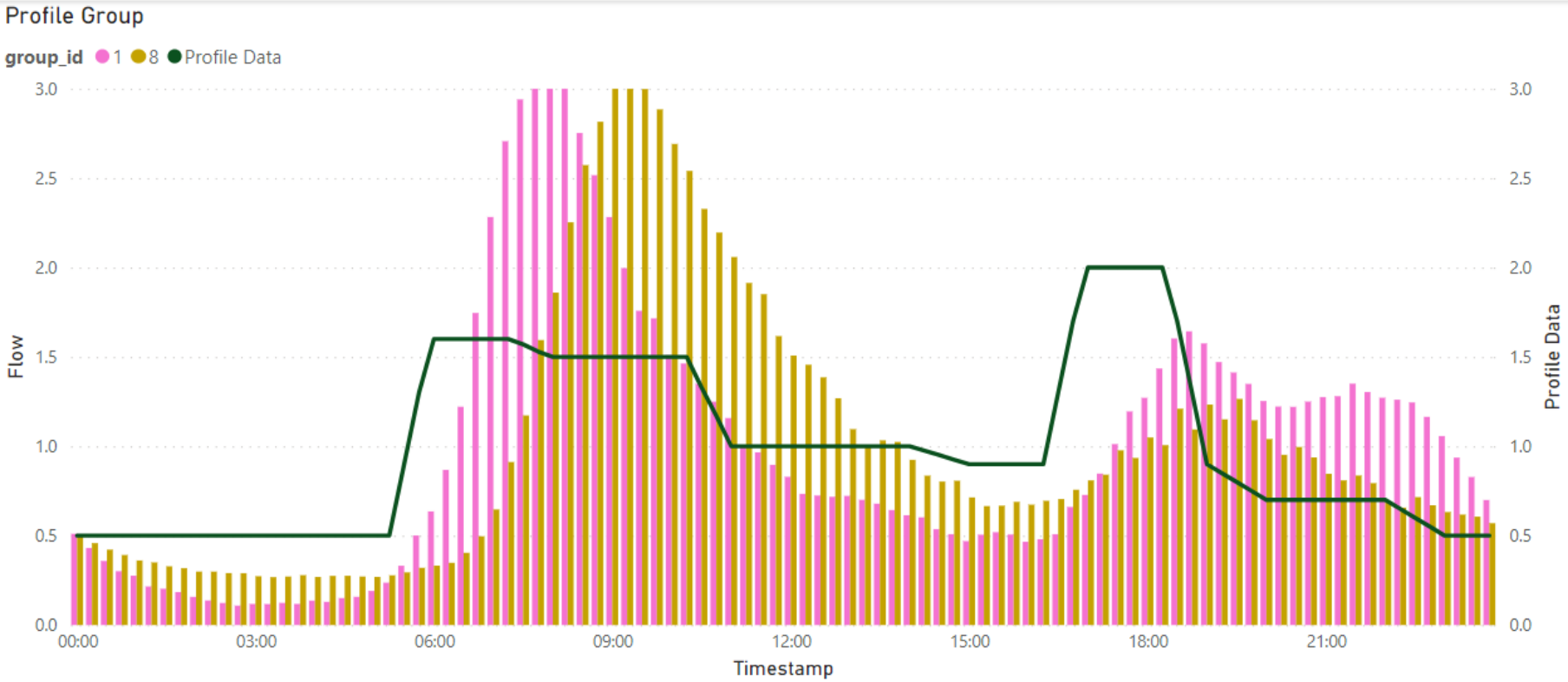
Profile Group Keywords

Type 6 - Agriculture



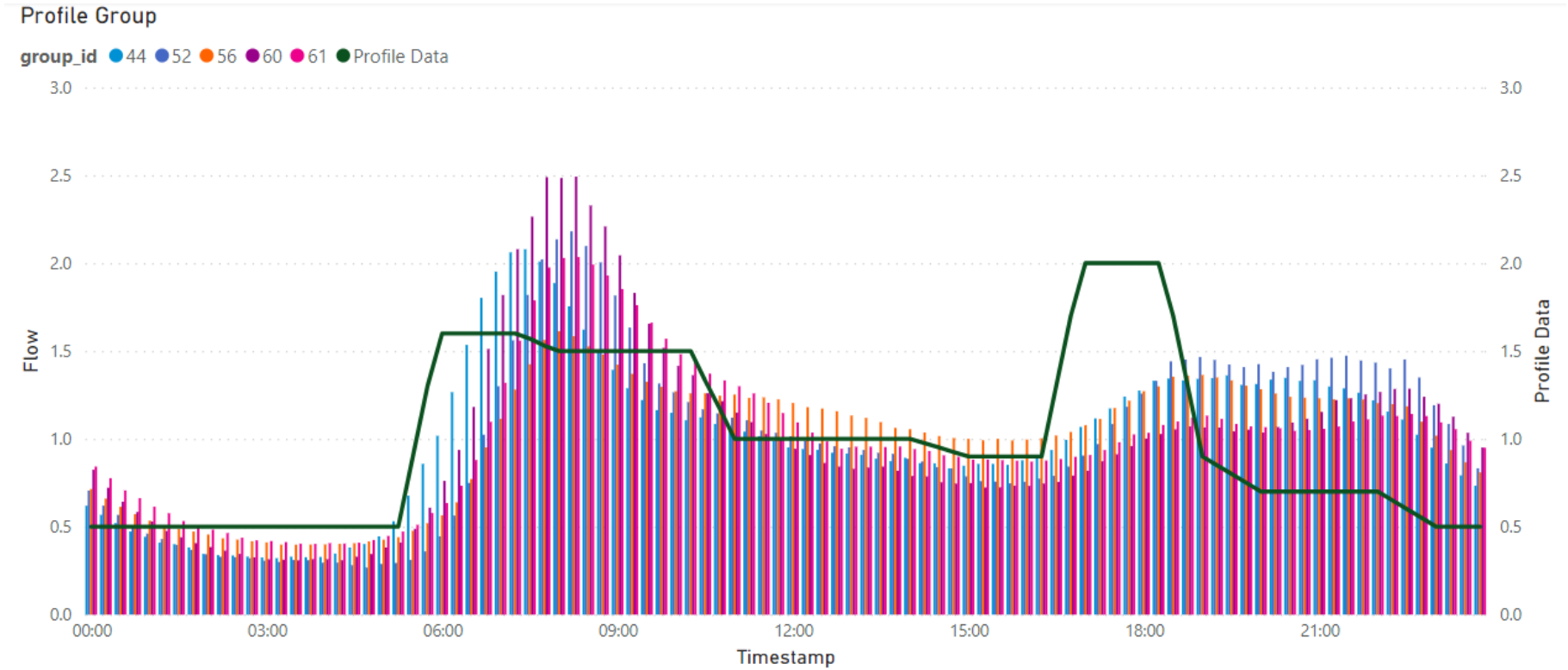
Profile Group Keywords

Type 7 - Hotels



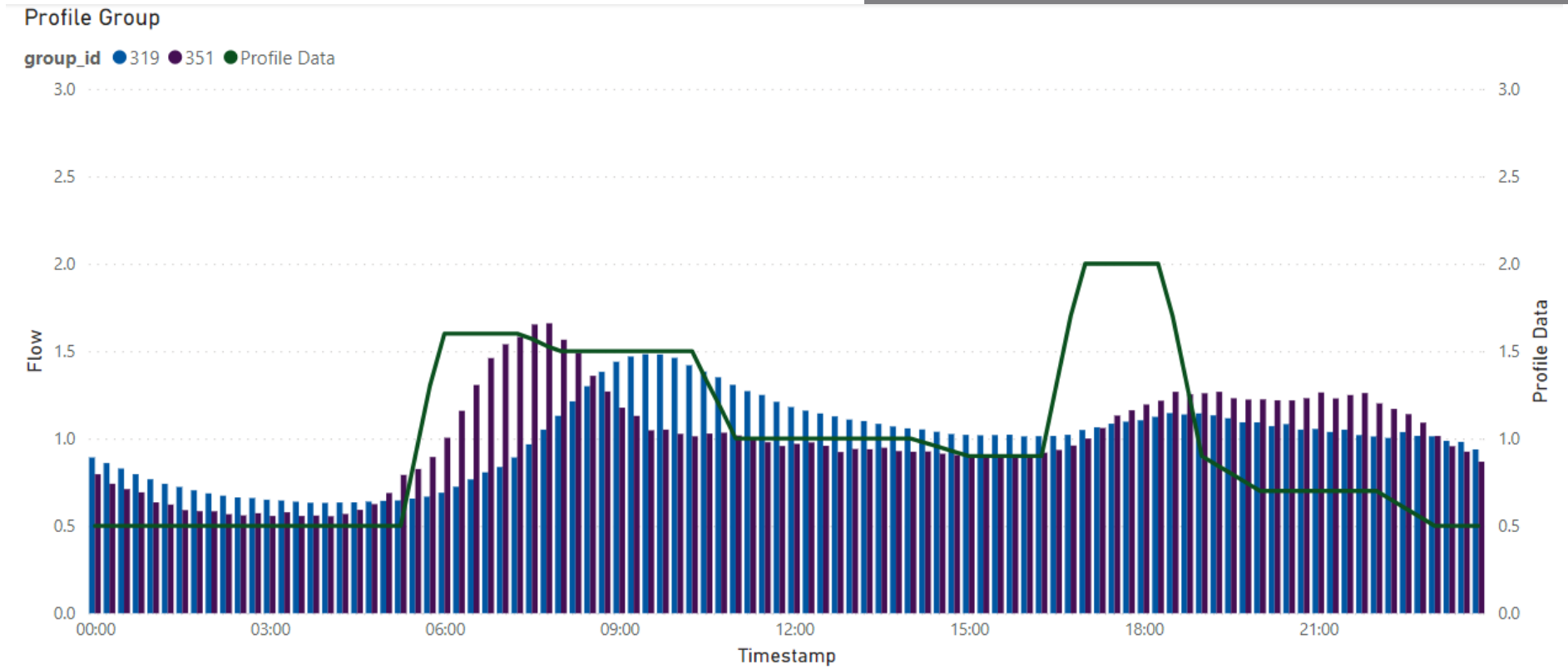
Profile Group Keywords

Type 7 - Hotels



Profile Group Keywords

Type 7 - Hotels

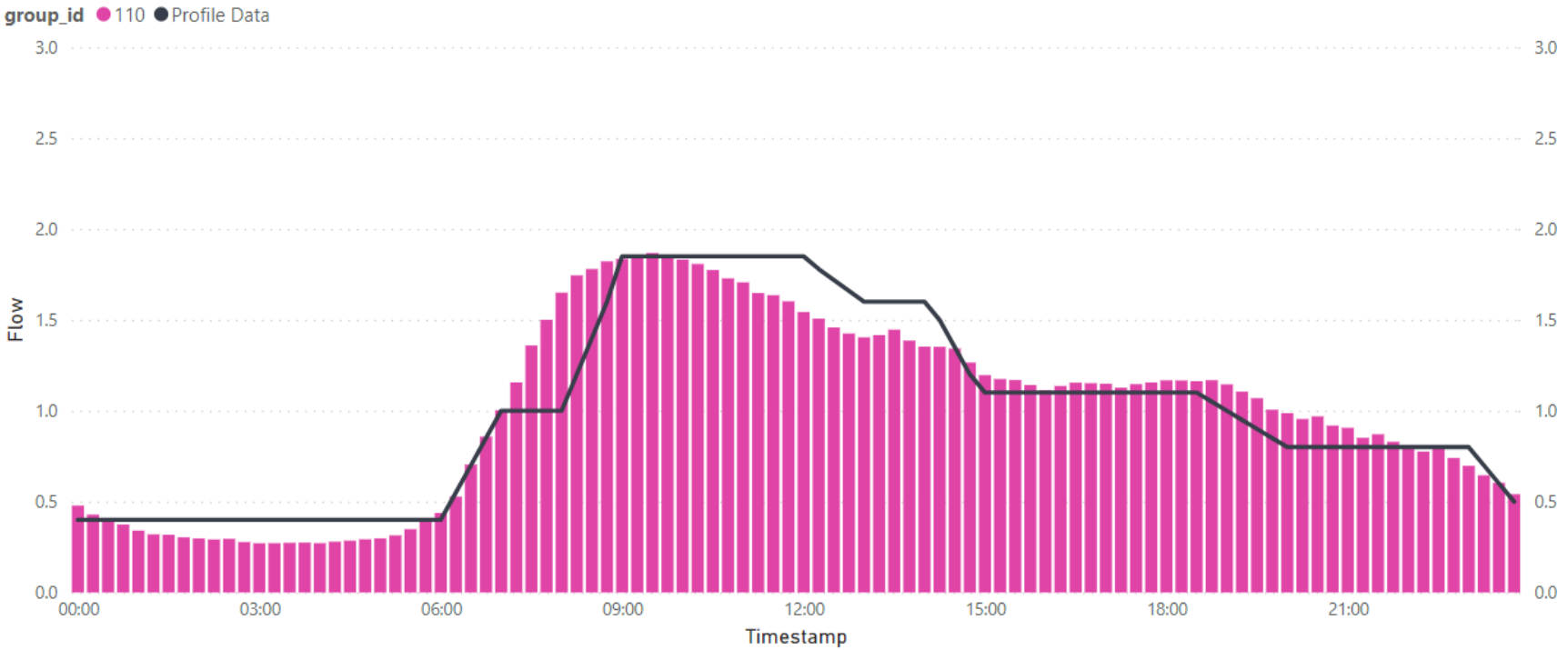


Profile Group Keywords

HOTEL
PARK
CARAVAN
HOTELS
COMMERCIAL
MOTEL
LEISURE
HOLIDAY
HOSPITALITY
VARIOUS
ESTATE
RESIDENTIAL
MISCELLANEOUS
HEREDITAMENT
EDUCATION
ACCOMMODATION
RESORTS
LAKELAND
MANUFACTURING
SERVICE
SELF
SIMILAR
GROUP
APARTMENT
HALL
FOOD
BOURNE
SOUTH
CONTAINED
NHH
MISC
PROPS
MAISONETTE
ACCOMODATION
OFFICE
UNKNOWN
SCHOOL
THORNEY
RUSSELLS
PREMISES
MAYFAIR
MERE
MONTCALM
PARKDEAN
MARGARET
MANOR
GROSVENOR
MULTIPLE
LOCKO
HOLIDAYS
MARTON
MERCURE
WHITBREAD
TAVISTOCK
DANUBIUS
SANDS
ROYAL
THORESBY
PLAZA
TALASH
LOVERIDGE
PENNON
POOLED
SUPPLIES
INCLUDES
ACTIVITIES
SECONDARY
HAWKSTONE
PINE
NUMBER1
LOW
RADLEY
PRESTON
HOME
WASH
WORK
VIL
DIAMOND
BELLE
CROWN
PLC
LAKE
SPORT
FIELD
EVERFLOW
CENTRE
CAVENDISH
ARLINGTON
BROOK
LADY
BROWNS
OPCO
COURT
JUDES
COLLEGE
WATER
AIR
AIRE
DRY
INSTITUTION
SPORTING
FITNESS
FURTHER
EUROPE ST
AMARIS
BARRACKS
CALA
PARKS
SITE
EBBETT
RETAIL
USE
HEMSBY
BEACH
FLAT
FACILITIES
SKIRLINGTON
ACCOMMODATION
GRAN
NIGHTCLUB
MRS
IT
FACTORY
HIGH
NO
MARKET
CARE
FARM
BARTLEWOOD
NATIONAL
BAR
EDGE
ACTIVITY
CENTRE
C
BOURNE
SOUTH
CONTAINED
NHH
MISC
PROPS
MAISONETTE
ACCOMODATION
OFFICE
UNKNOWN
SCHOOL
THORNEY
RUSSELLS
PREMISES
MAYFAIR
MERE
MONTCALM
PARKDEAN
MARGARET
MANOR
GROSVENOR
MULTIPLE
LOCKO
HOLIDAYS
MARTON
MERCURE
WHITBREAD
TAVISTOCK
DANUBIUS
SANDS
ROYAL
THORESBY
PLAZA
TALASH
LOVERIDGE
PENNON
POOLED
SUPPLIES
INCLUDES
ACTIVITIES
SECONDARY
HAWKSTONE
PINE
NUMBER1
LOW
RADLEY
PRESTON
HOME
WASH
WORK
VIL
DIAMOND
BELLE
CROWN
PLC
LAKE
SPORT
FIELD
EVERFLOW
CENTRE
CAVENDISH
ARLINGTON
BROOK
LADY
BROWNS
OPCO
COURT
JUDES
COLLEGE
WATER
AIR
AIRE
DRY
INSTITUTION
SPORTING
FITNESS
FURTHER
EUROPE ST
AMARIS
BARRACKS
CALA
PARKS
SITE
EBBETT
RETAIL
USE
HEMSBY
BEACH
FLAT
FACILITIES
SKIRLINGTON
ACCOMMODATION
GRAN
NIGHTCLUB
MRS
IT
FACTORY
HIGH
NO
MARKET
CARE
FARM
HOLIDAY
HOSPITALITY
VARIOUS
ESTATE
RESIDENTIAL
MISCELLANEOUS
HEREDITAMENT
EDUCATION
ACCOMMODATION
RESORTS
LAKELAND
MANUFACTURING
SERVICE
SELF
SIMILAR
GROUP
APARTMENT
HALL
FOOD

Type 8 - Hospital

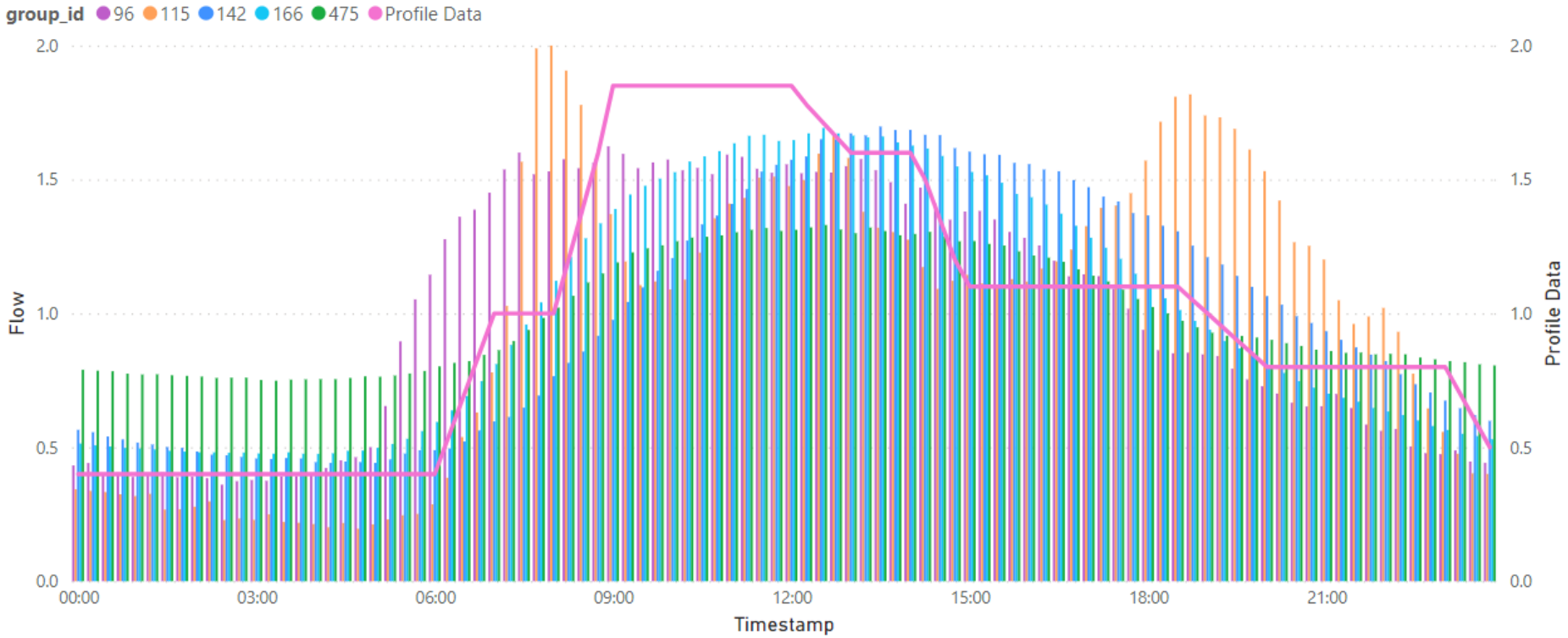
Profile Group



Profile Group Keywords

Type 8 - Hospital

Profile Group



Profile Group Keywords

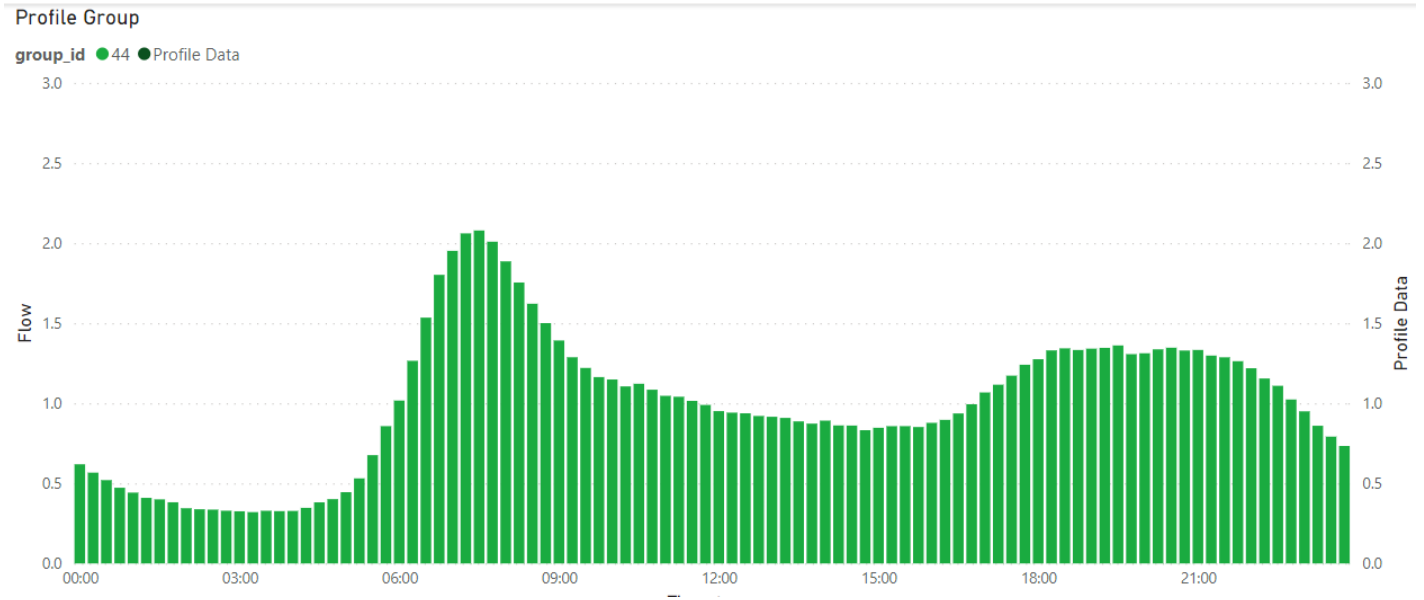
Main Shapes

Shape 1 - Classic Diurnal

This includes hotels, caravan sites, holiday parks, apartments, barracks, farms.

Key points of shapes

- Morning peak – time varies
- Evening small peak
- Length of evening varies



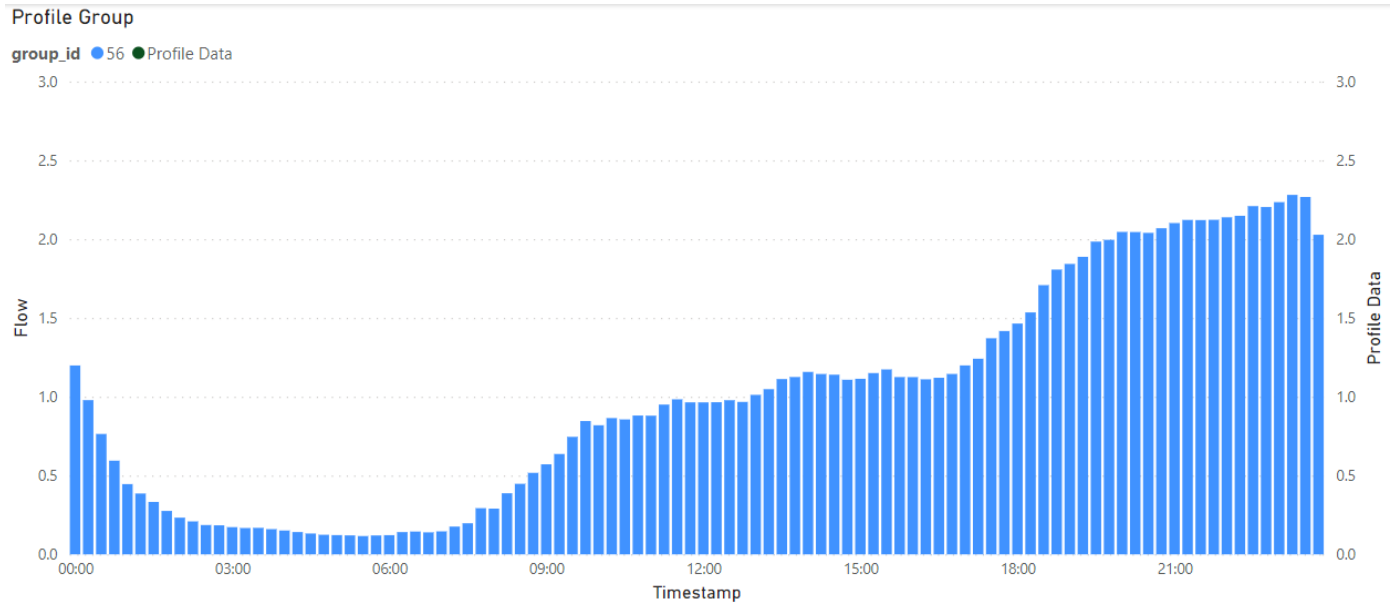
Main Shapes

Shape 2 – Evening Demand

This includes entertainment, restaurants, large shopping centres, university complexes

Key points of shapes

- Evening peak
- Morning small peak
- Length of evening use varies



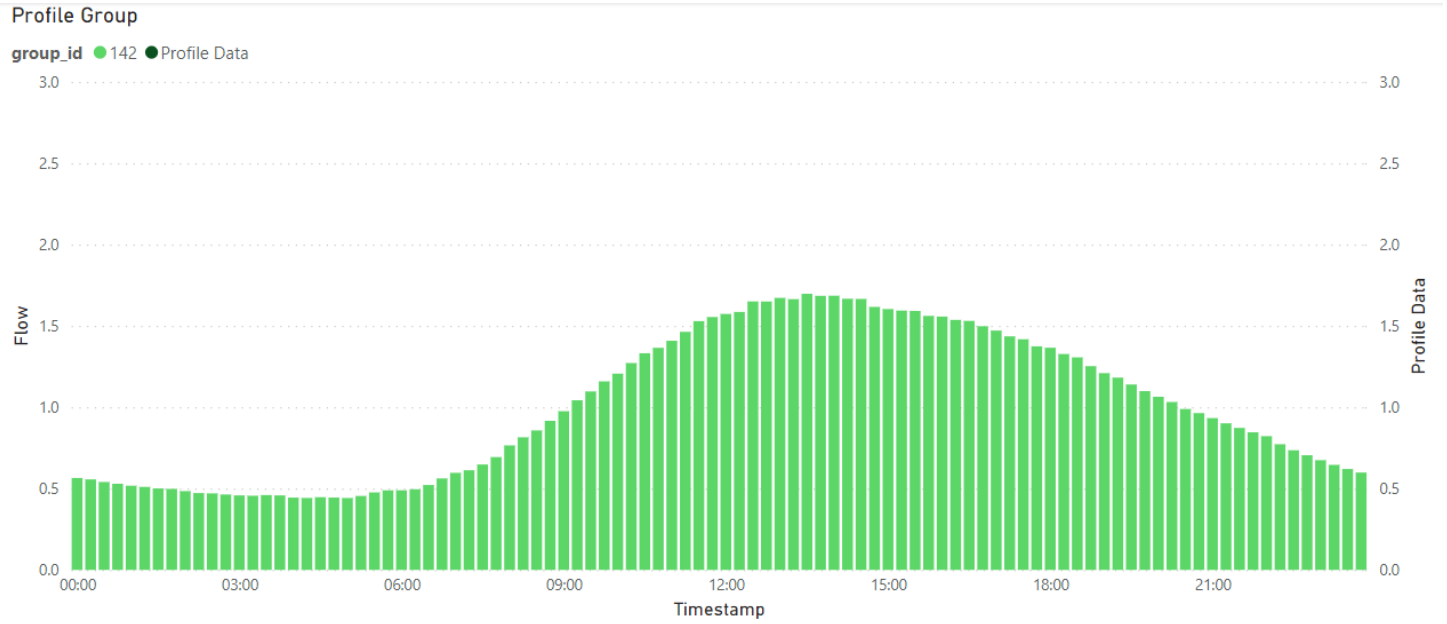
Main Shapes

Shape 3 - Smooth bump

This includes offices, hospitals, prisons, schools

Key points of shapes

- Flat night use
- Slow and steady rise day
- Steady reduction until complete



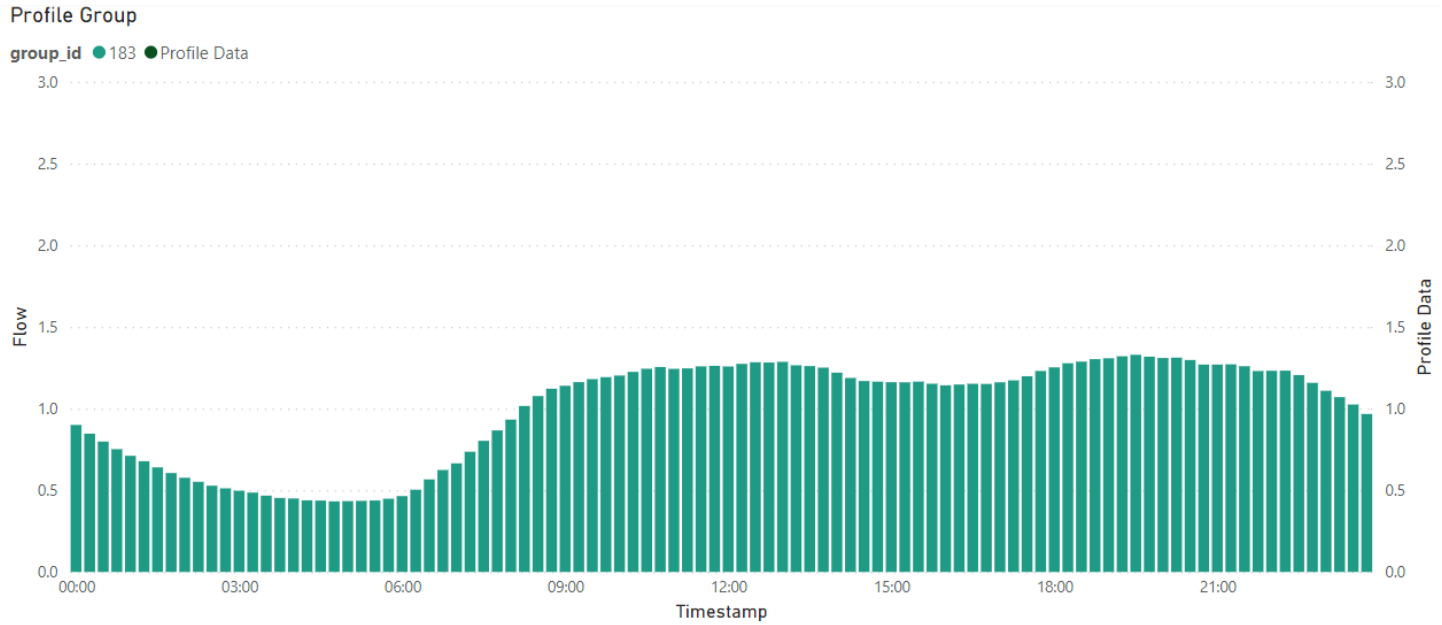
Main Shapes

Shape 4 - Flat day

This includes sports, retail, student accommodation, barracks, hotels, agriculture

Key points of shapes

- Flat night use
- Consistent throughout the day



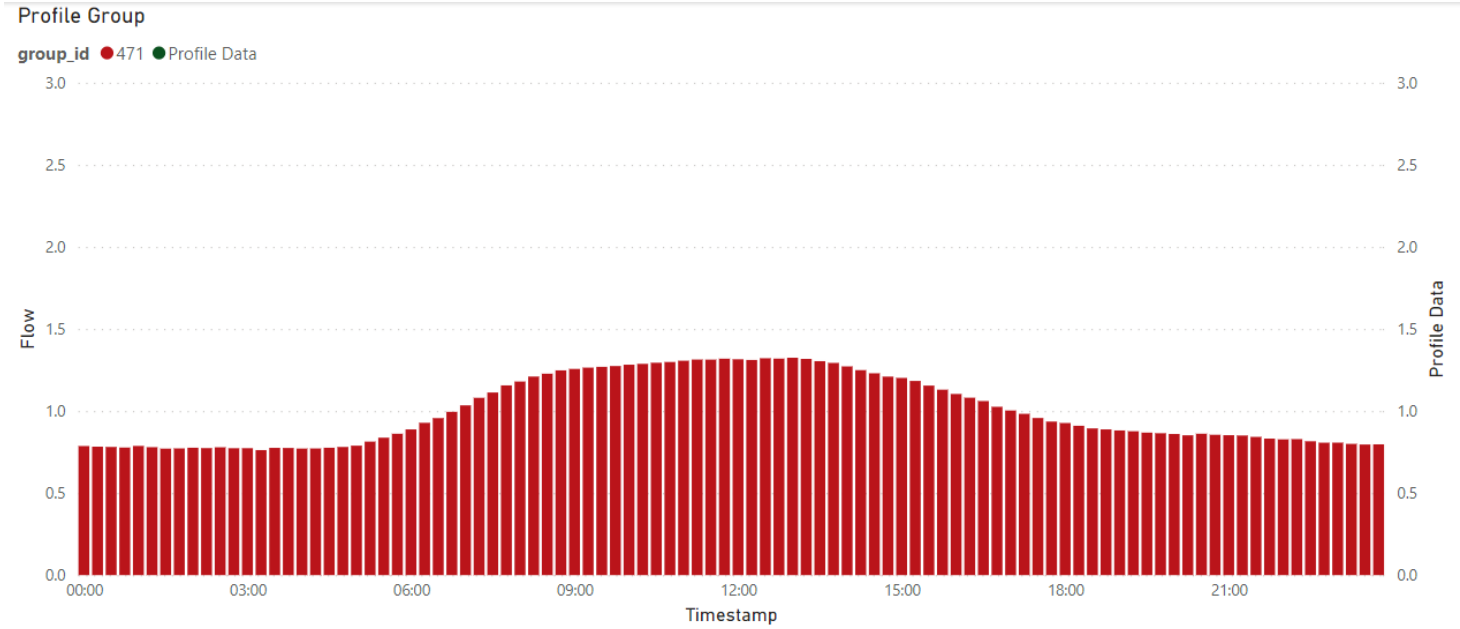
Main Shapes

Shape 5 - 24 hr shifts

This includes factories, quarries, depots, power stations, mining, defence, large hospitals

Key points of shapes

- Large volumes of night use
- Flat night use
- Small rise midday



Conclusions

Of the original profiles reviewed only the 10 hour profile can be seen

Clear common profiles can be seen amongst the data

Curved Rather than Steps

Diurnal Patterns

Varied Start / End Times

Higher Night Use

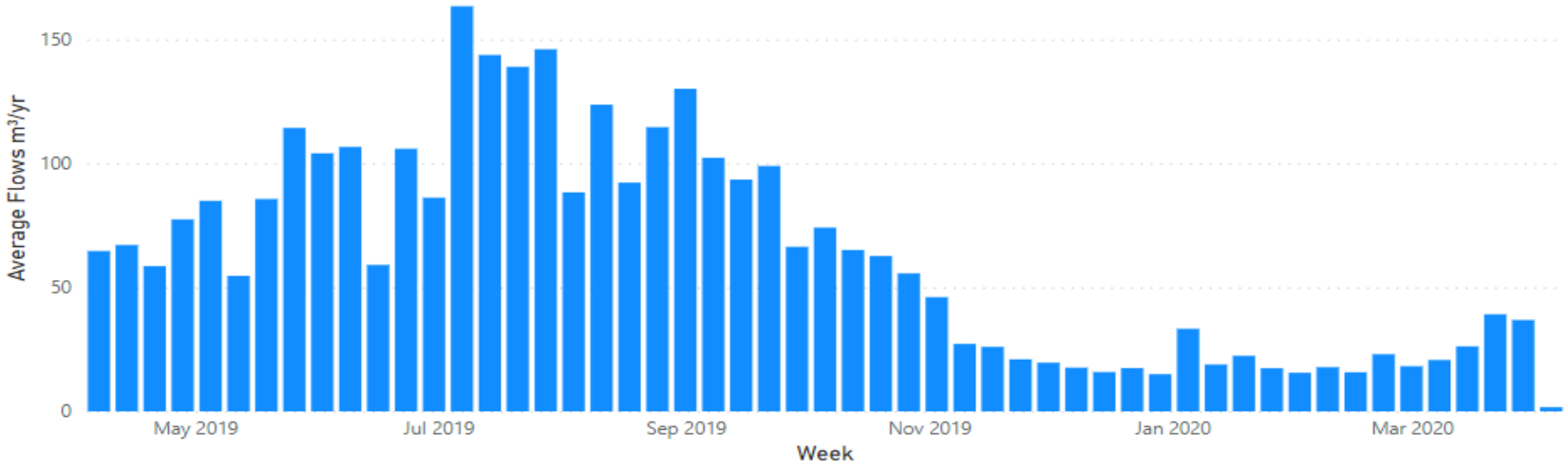
Shared Shapes between Properties

Different shapes amongst Properties

Averaging profiles by type can generate a profile not experienced

Variable Consumption

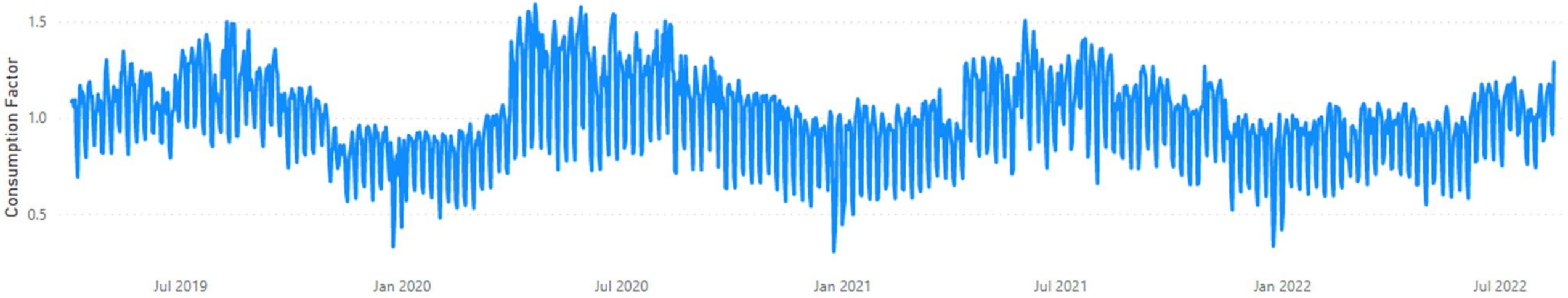
Variable Consumption



375 Properties were excluded due to being flagged as seasonal

This an agricultural property with a clear winter / summer profile

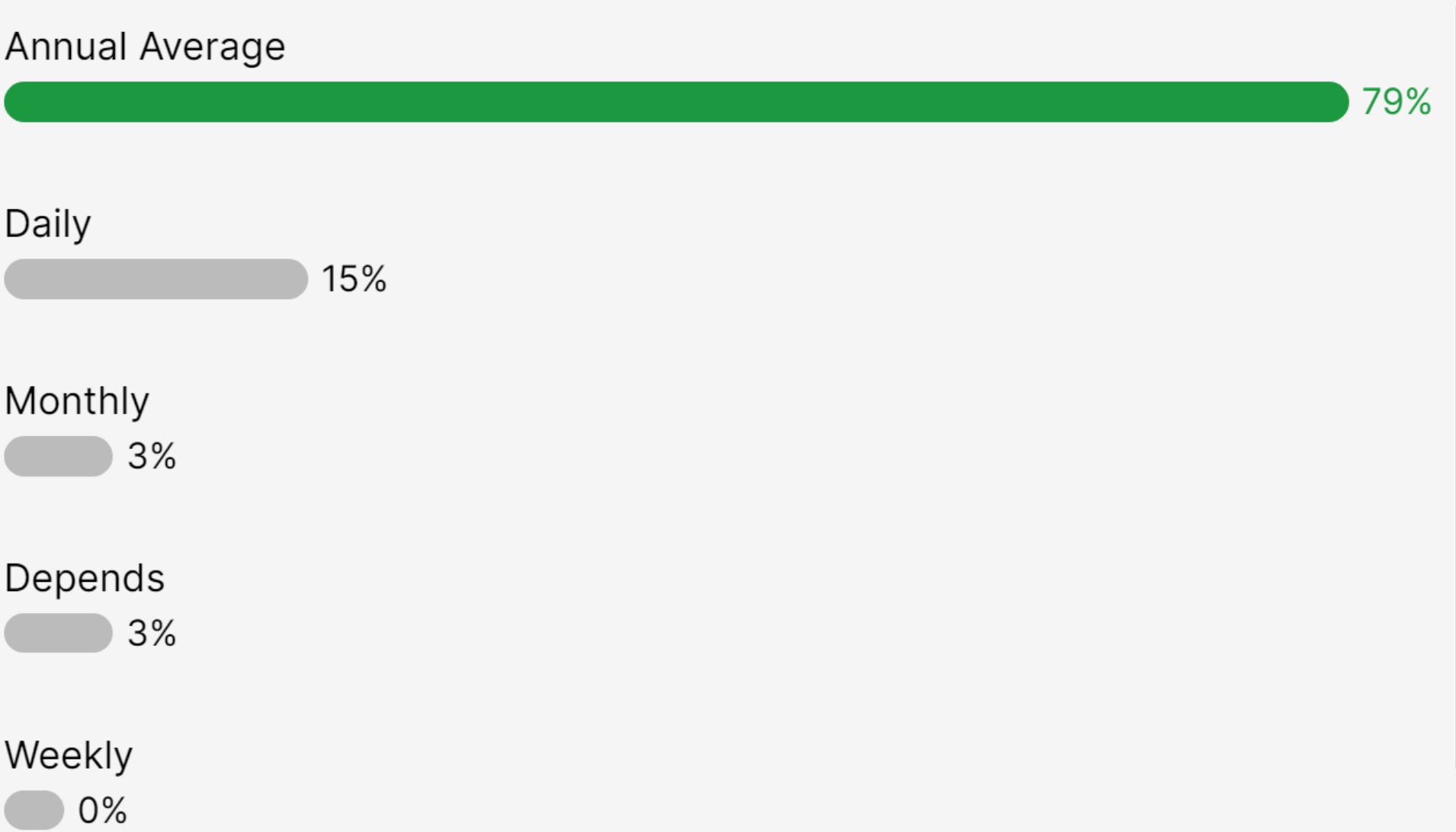
Variable Consumption



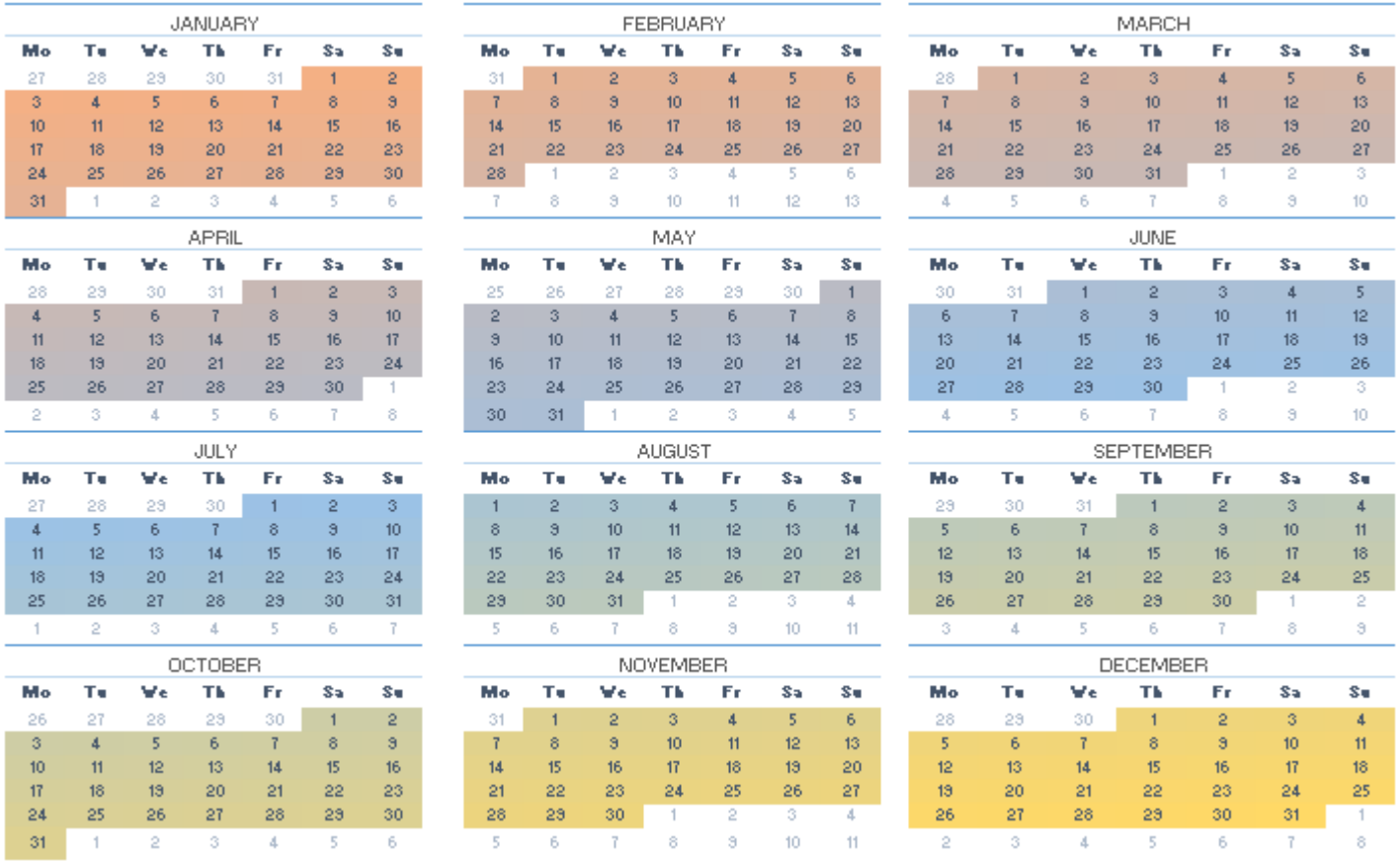
The Summer Trend is repeated consistently each year

Variable Consumption

For non-household consumption which interval do you use for model demands?



Variable Consumption



JANUARY

Mo	Tu	We	Th	Fr	Sa	Su
27	28	29	30	31	1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31	1	2	3	4	5	6

FEBRUARY

Mo	Tu	We	Th	Fr	Sa	Su
31	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	1	2	3	4	5	6
7	8	9	10	11	12	13

MARCH

Mo	Tu	We	Th	Fr	Sa	Su
28	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31	1	2	3
4	5	6	7	8	9	10

APRIL

Mo	Tu	We	Th	Fr	Sa	Su
28	29	30	31	1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	1
2	3	4	5	6	7	8

MAY

Mo	Tu	We	Th	Fr	Sa	Su
25	26	27	28	29	30	1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31	1	2	3	4	5

JUNE

Mo	Tu	We	Th	Fr	Sa	Su
30	31	1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	1	2	3
4	5	6	7	8	9	10

JULY

Mo	Tu	We	Th	Fr	Sa	Su
27	28	29	30	1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31
1	2	3	4	5	6	7

AUGUST

Mo	Tu	We	Th	Fr	Sa	Su
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31	1	2	3	4
5	6	7	8	9	10	11

SEPTEMBER

Mo	Tu	We	Th	Fr	Sa	Su
29	30	31	1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	1	2
3	4	5	6	7	8	9

OCTOBER

Mo	Tu	We	Th	Fr	Sa	Su
26	27	28	29	30	1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31	1	2	3	4	5	6

NOVEMBER

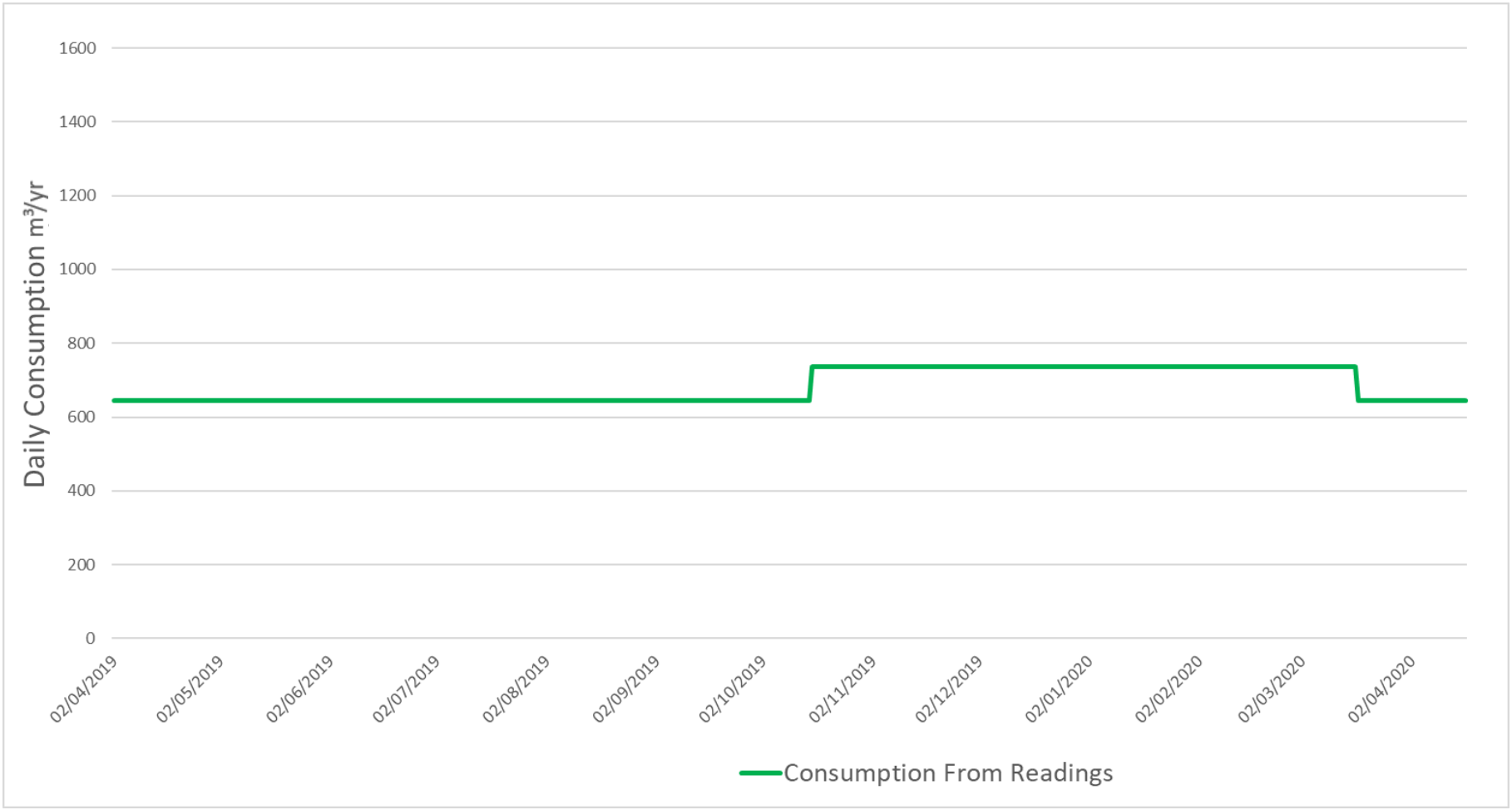
Mo	Tu	We	Th	Fr	Sa	Su
31	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	1	2	3	4
5	6	7	8	9	10	11

DECEMBER

Mo	Tu	We	Th	Fr	Sa	Su
28	29	30	1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	1
2	3	4	5	6	7	8

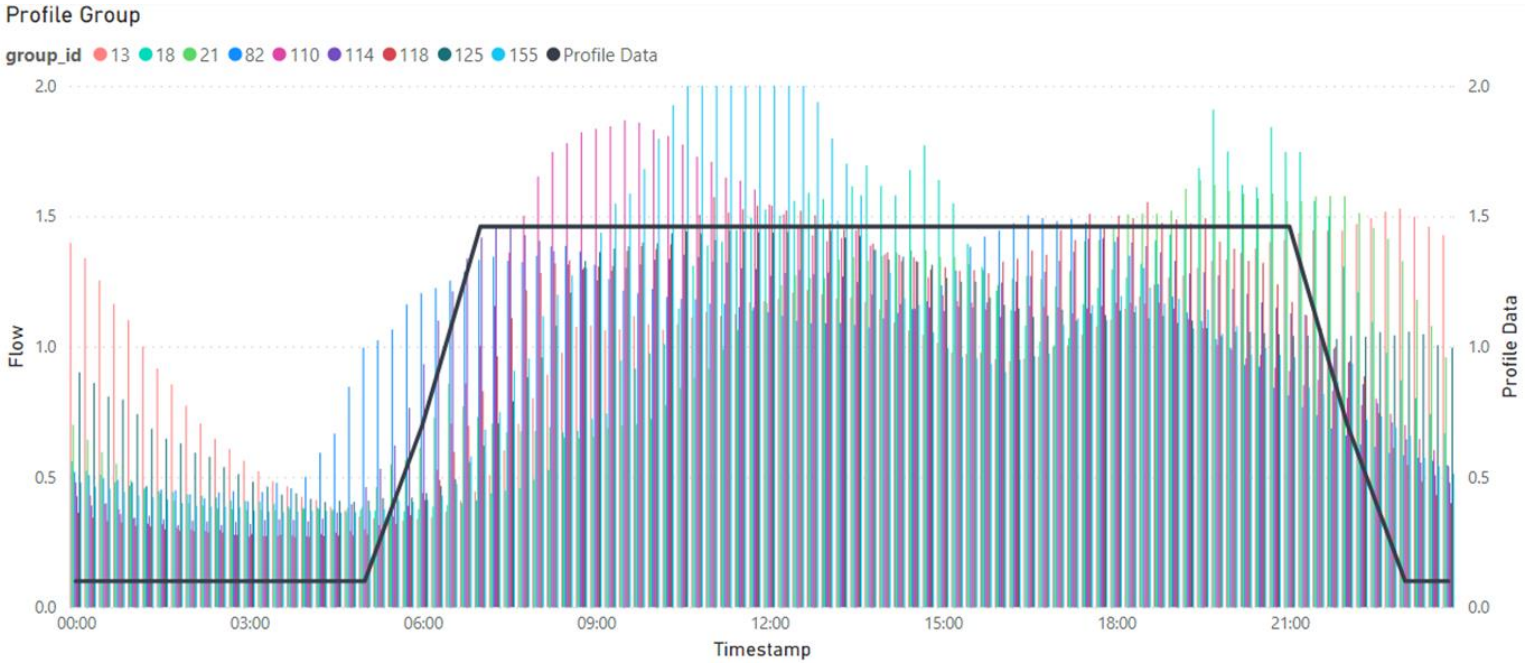
- How often do we get readings?
  - Yearly, 6 months, monthly, daily?
  - hourly?
- Are there types with significant patterns in use we need to be aware of?
  - Weekend / weekday
  - seasonal use
  - weather dependant
  - school holidays

Variable Consumption



Weekday Term Time: 2568 l/day Weekend / School Holidays: 1023 l/day

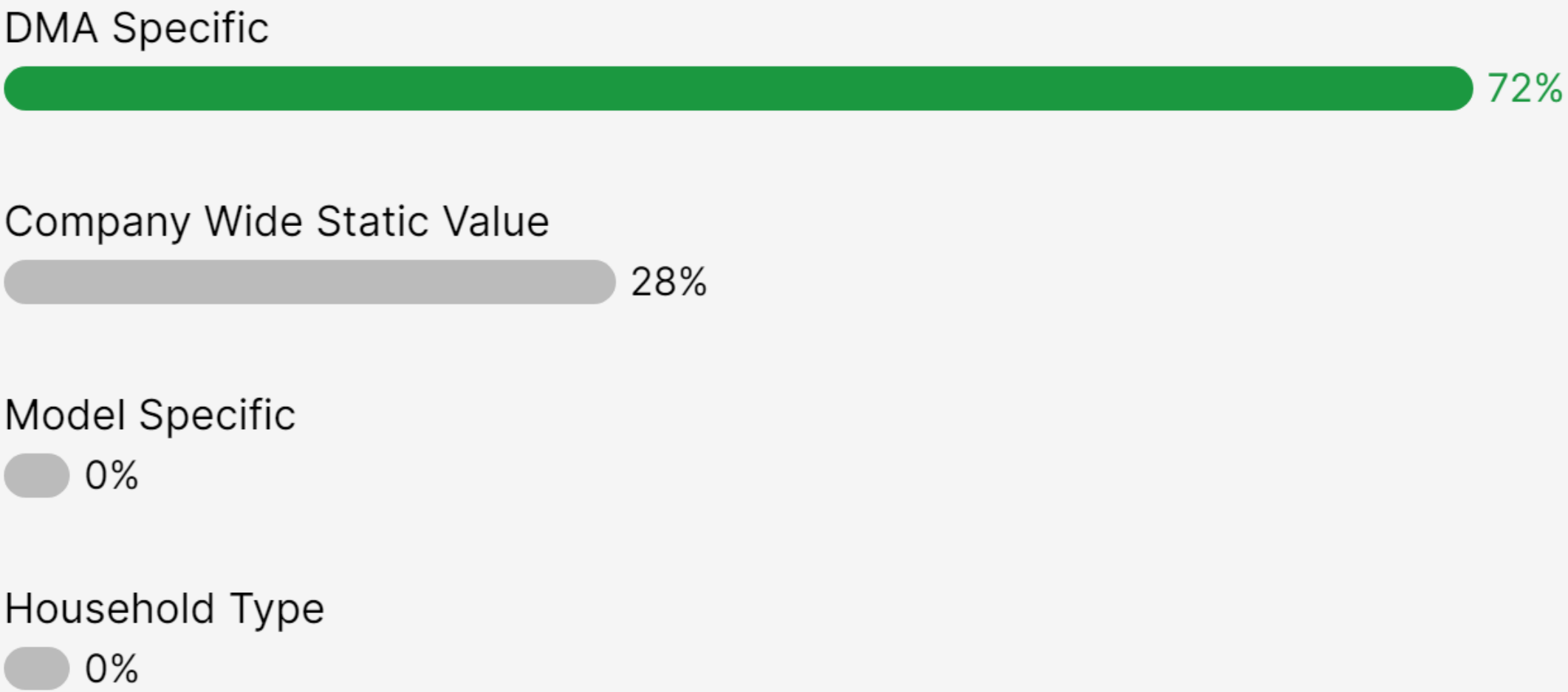
Night Use



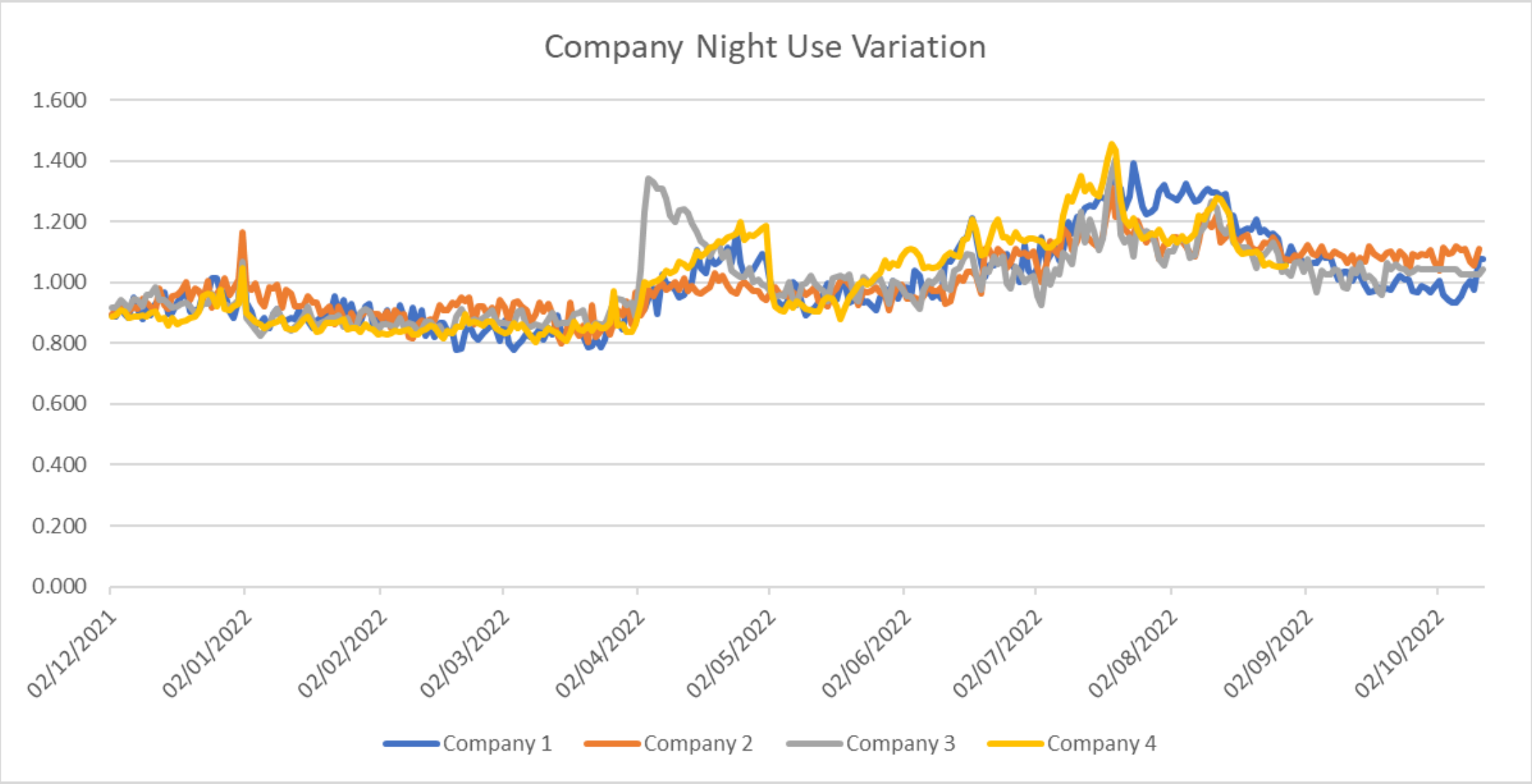
Profile Group Keywords

Night Use is significantly higher compared the existing profiles

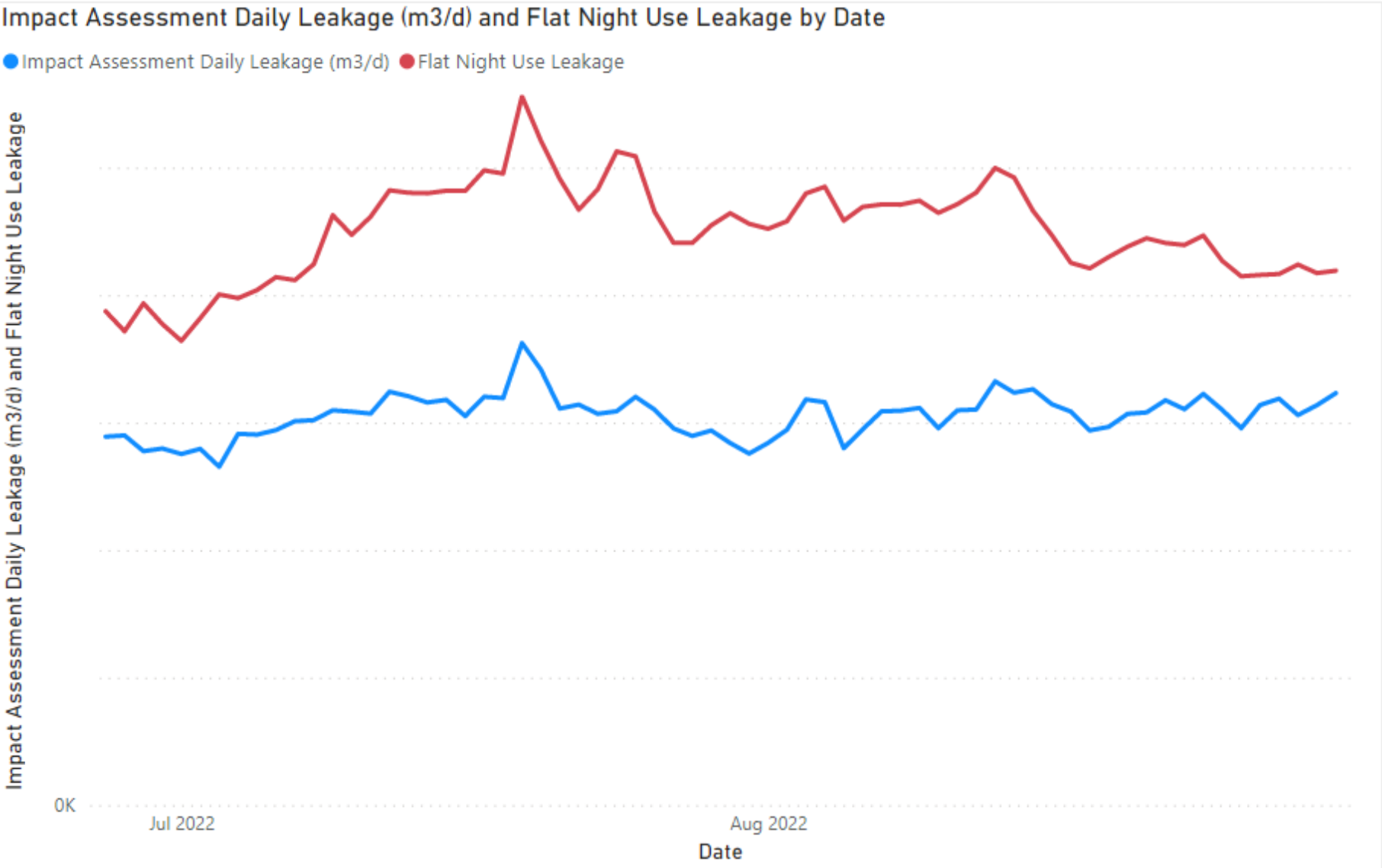
What household night use do you use in your model?

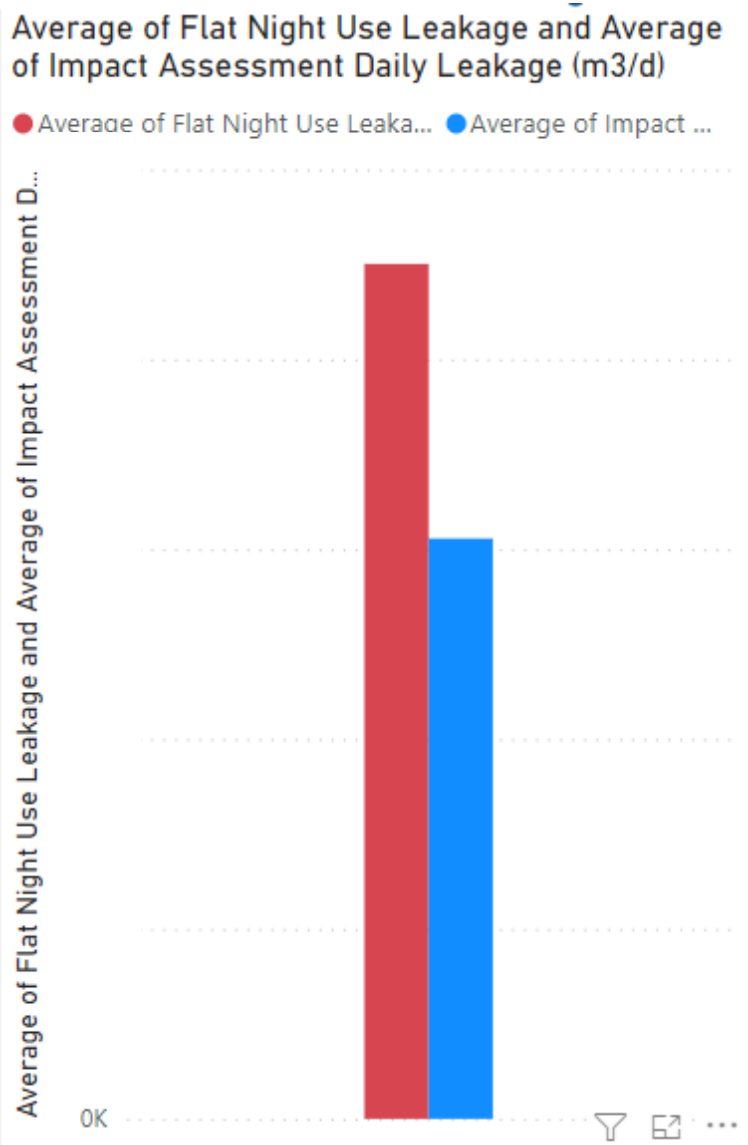


Household Night Use Variation



Night Use Impact





Profile Allocation

Profile Allocation

Property Billing Data

Property Classifications / Codes

Knowledge

Properties

Which profile should be assigned to which property?

Profile 1

Profile 2

Profile 3

Profile 4

Profile 5

Profile 6

How do you assign profiles to properties?

Sic code 6 | Property 4 | Description 3

Anonymous
Property name

Anonymous
Magic 8 ball

Anonymous
SIC code

Anonymous
SIC codes

Anonymous
Description

Common Data Sets

SIC Codes

OS Classification Codes

Utility Billing Data

Data Set Conflicts

Conflicts between the data sets available for classification is common.

OS Classifies this property as a 'CE04','Secondary / High School’.

Other data sets confirmed this is a household.

SIC Codes

The changing structure of the economy means that SIC will constantly lag reality, under-representing newer industries and over-representing ones that are declining in importance.

Grouping of Properties

SIC Code Sections

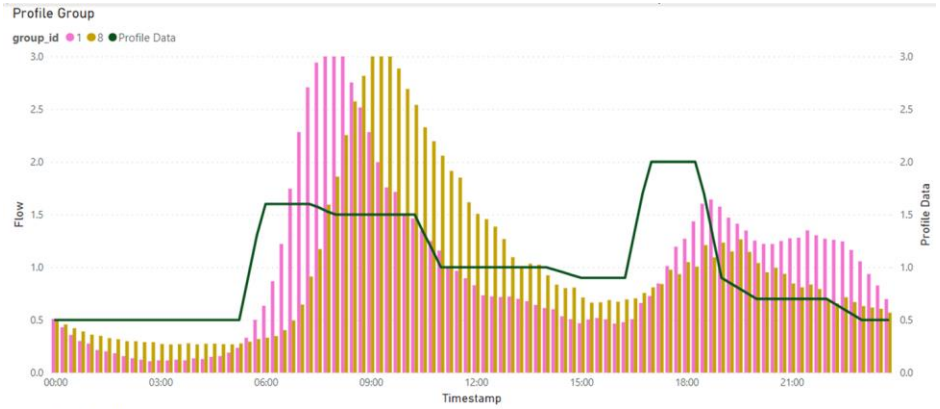
OS / SIC Code Custom Grouping

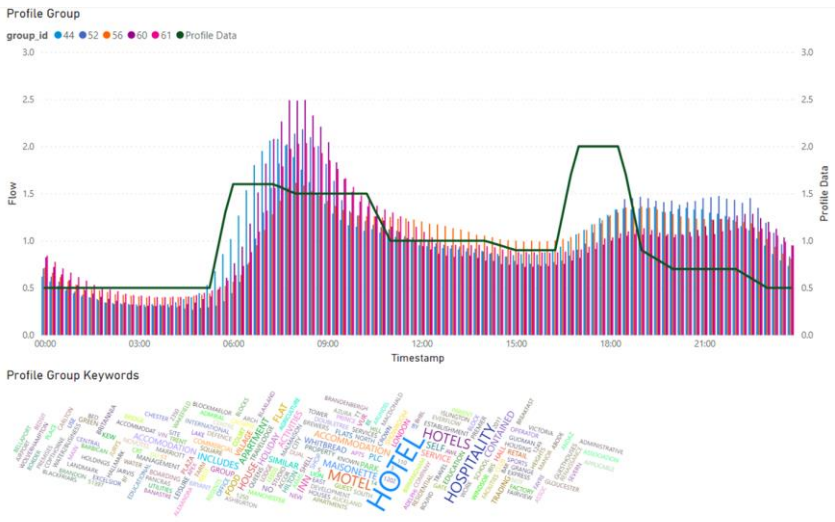
Key Word Analysis

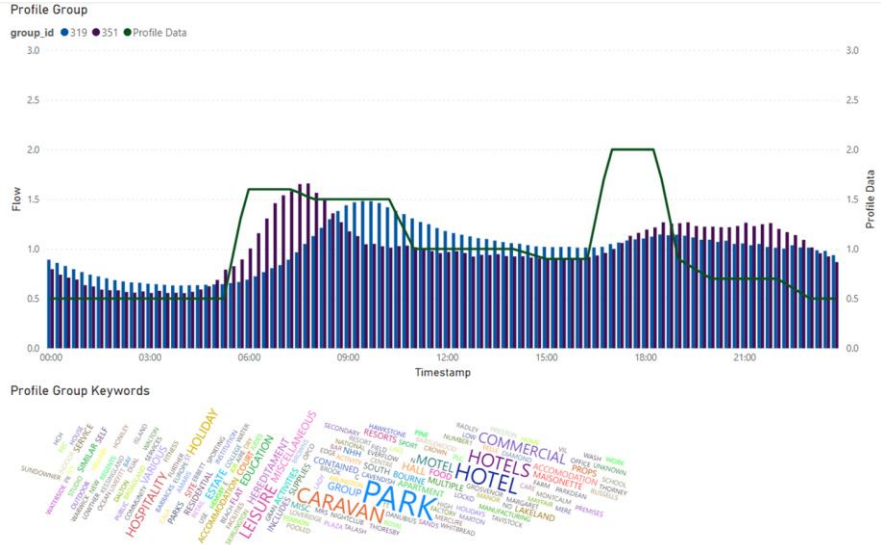
Key Word Issues

Key Word Issues

Further Group Splits







Multiple types exist within classic groupings for properties depending on use.

Hotel and hospitals are clear examples of this.

Why are they different from each other?

Can we flag these differences and apply individual profiles?

Profile Allocation

Property Billing Data

Property Classifications / Codes

Knowledge

Properties

Profile 1

Profile 2

Profile 3

Profile 4

Profile 5

Profile 6

Profile Allocation

Properties

Creating more profiles is only useful if they can be related back to the correct properties.

Profile 1

Profile 2

Profile 3

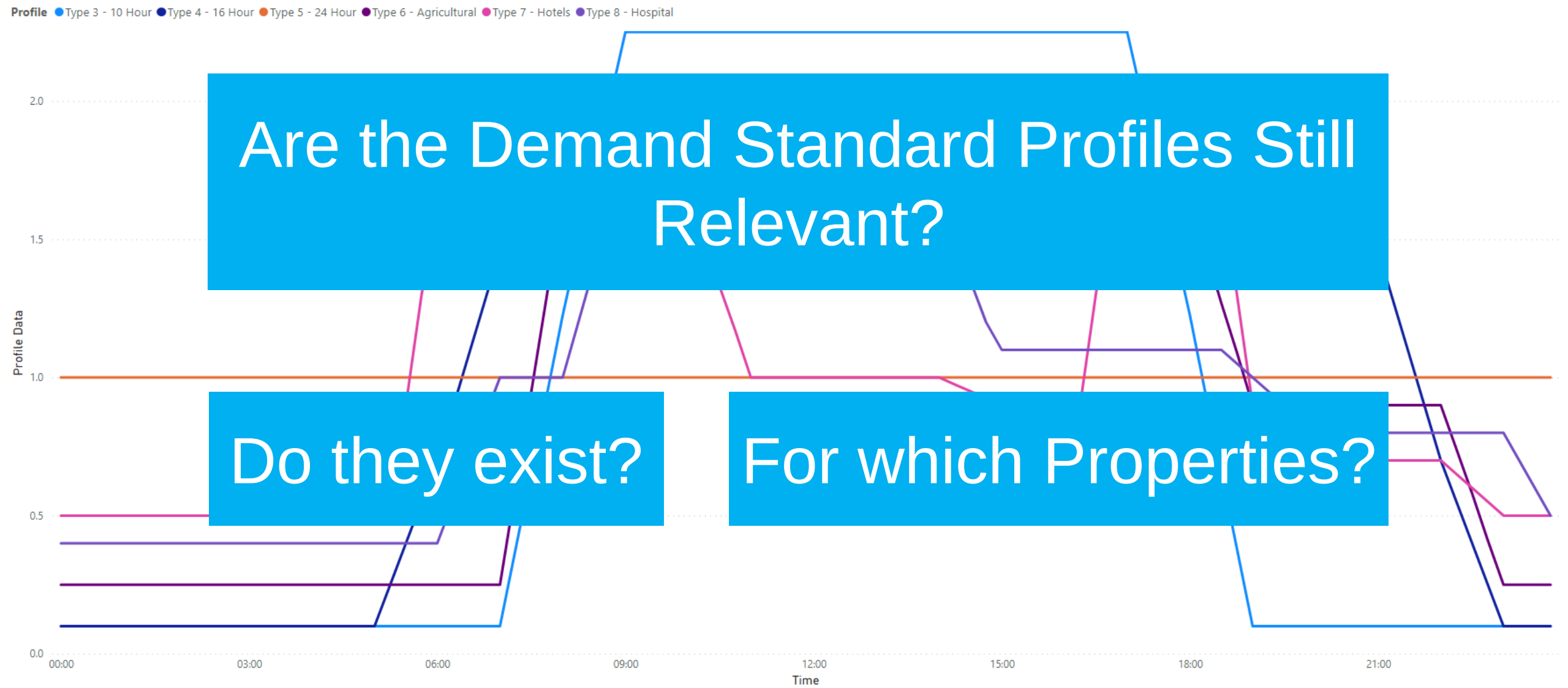
Profile 4

Profile 5

Profile 6

Going Forward

Original Profiles

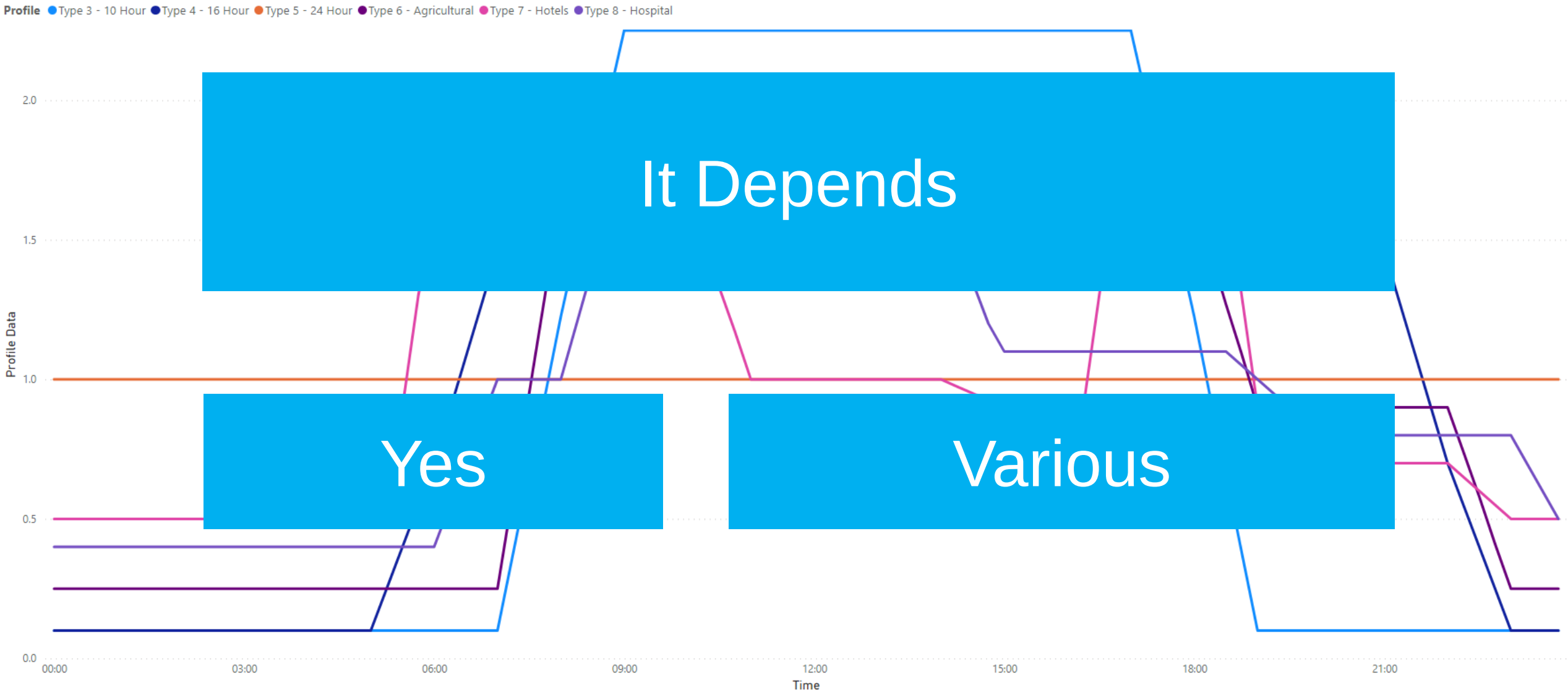


Are the Demand Standard Profiles Still Relevant?

Do they exist?

For which Properties?

Original Profiles

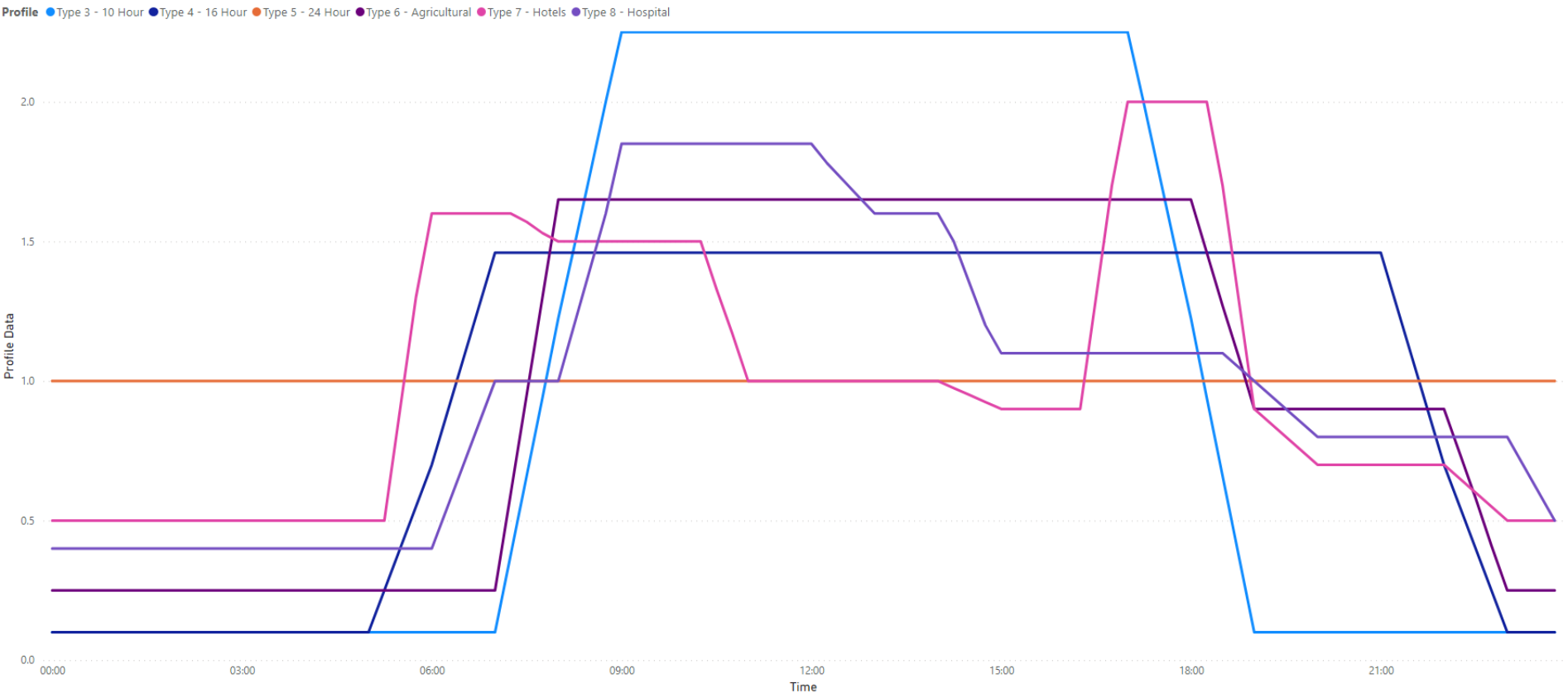


It Depends

Yes

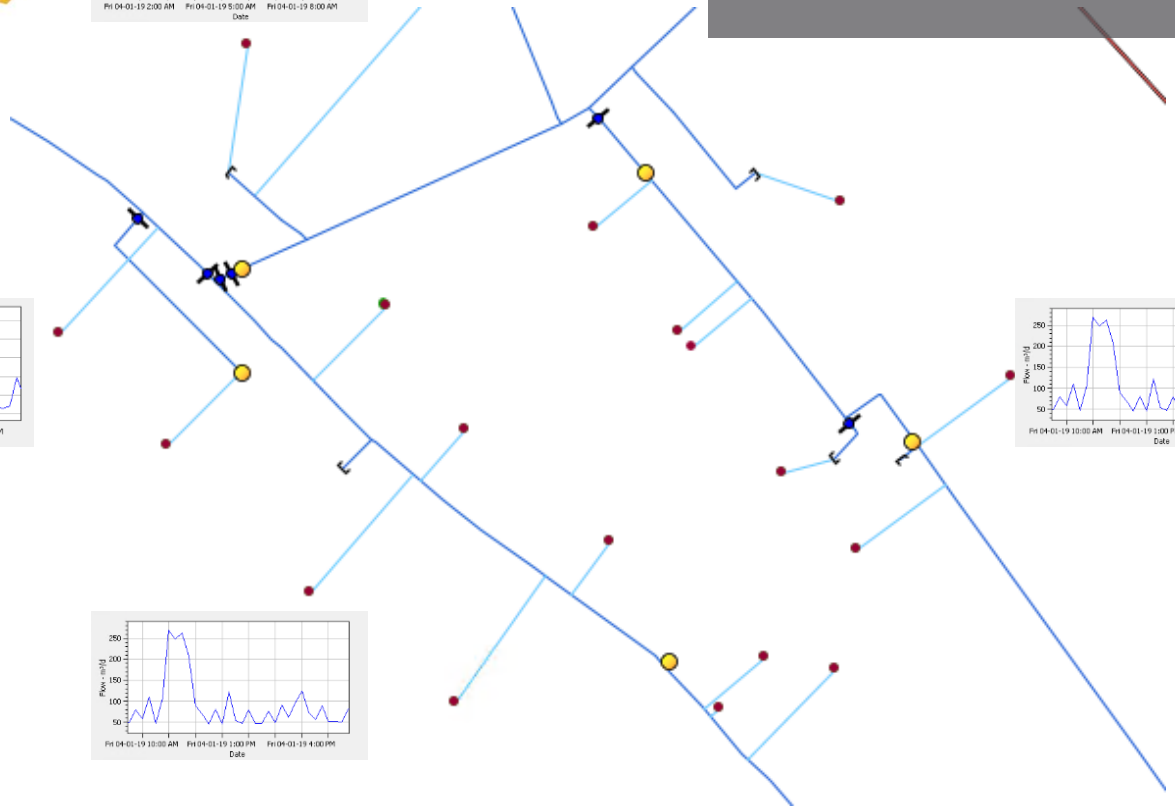
Various

Standard Profile Overview



Standard demand profiles are useful but blunt tools.

Model Demand Accuracy



100%
Standard Profiles

100%
Monitored

Low

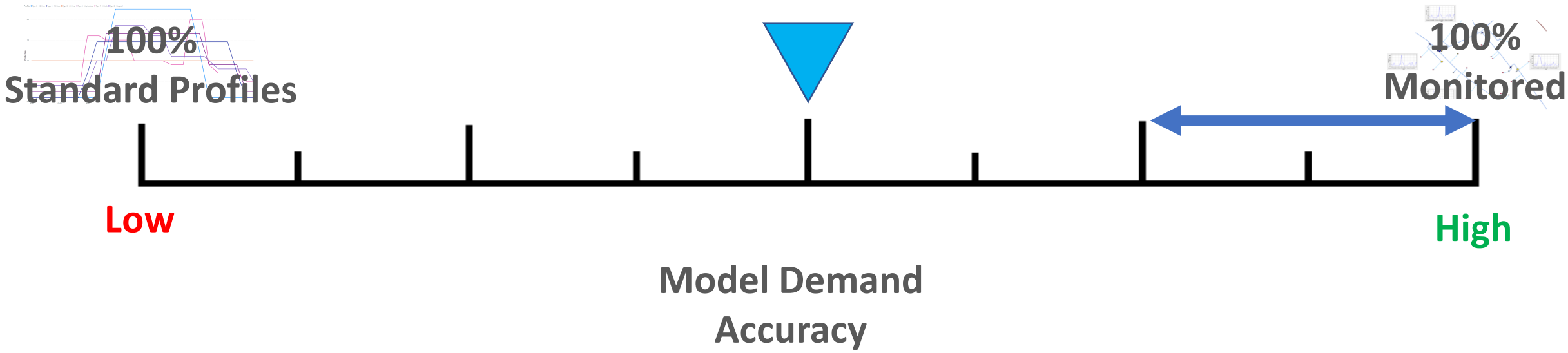
High

Model Demand
Accuracy

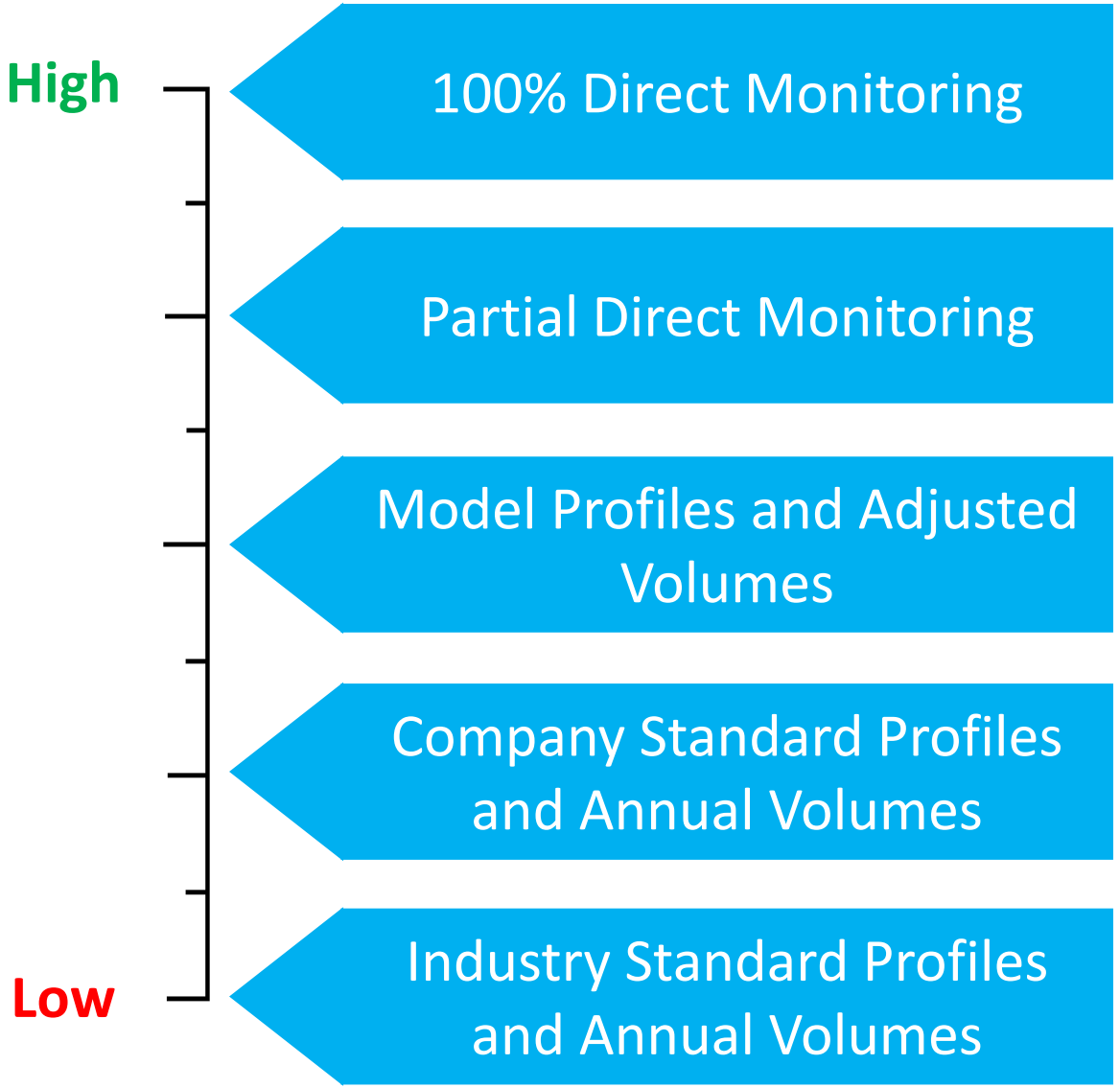
Model Demand Accuracy

Overall the demand accuracy of models is accurate for the majority of cases or we would not have seen the wonderful showcase we have these days.

But how can we go further?



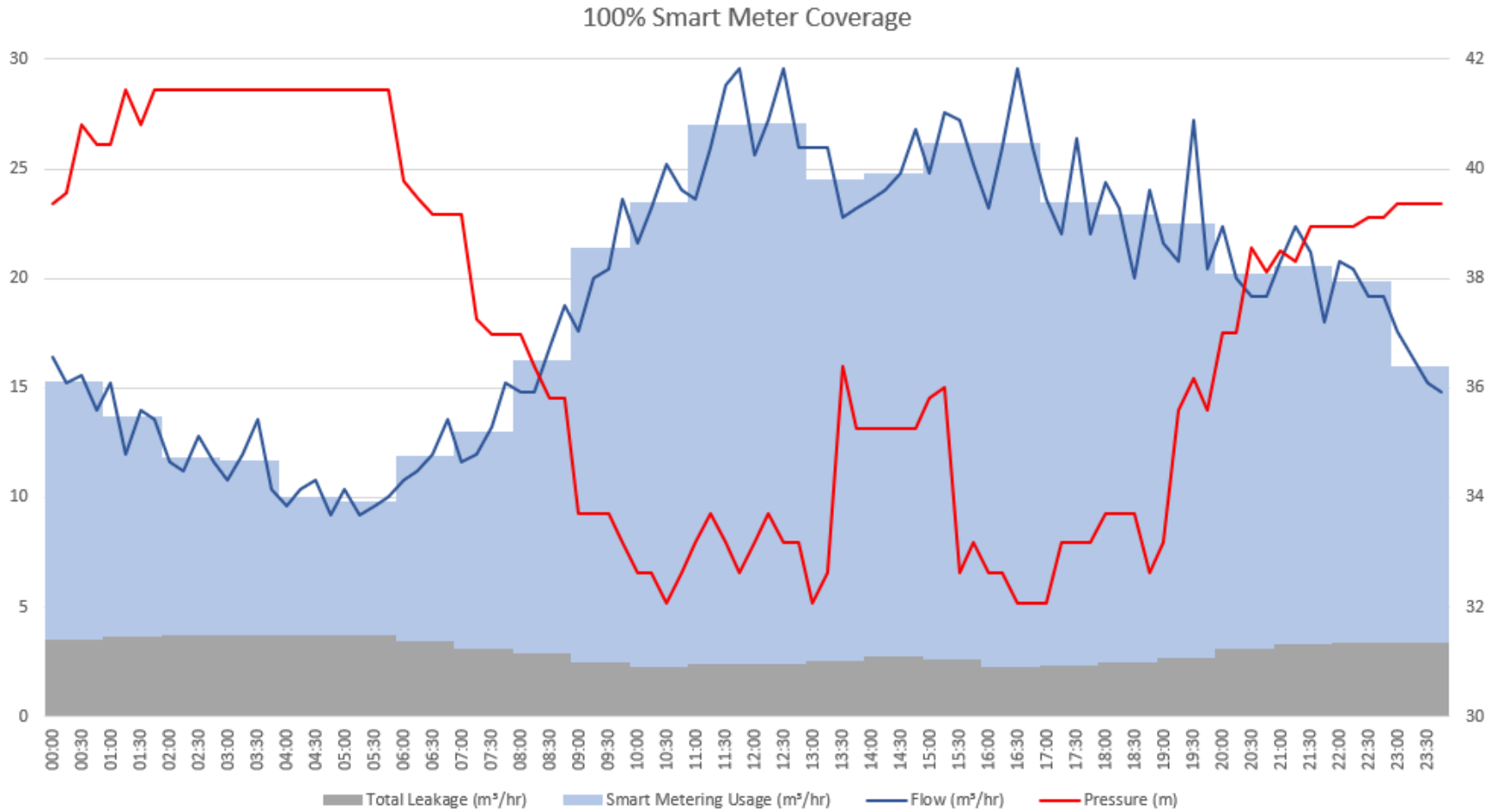
Non-Household Demand



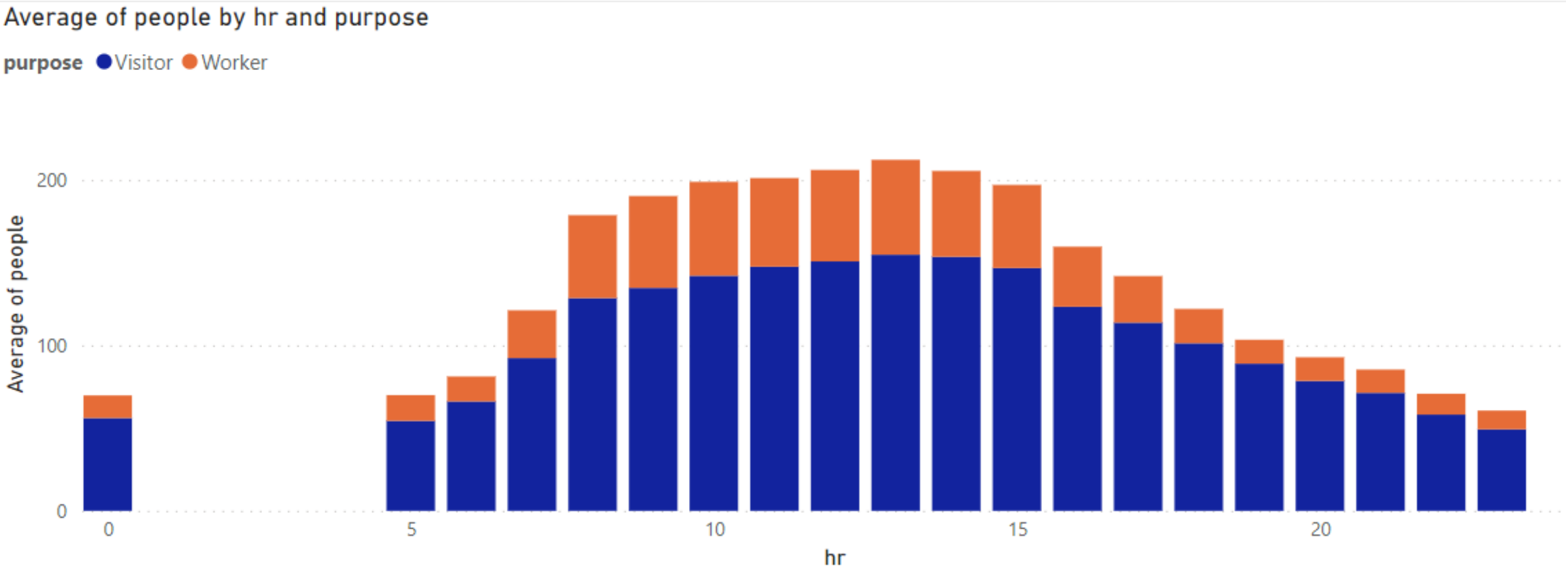
There are clear progressive steps in being able to improve accuracy of profiles and volumes.

Sources

- Permanently logged sites
- Night Use Studies and Monitors
- Fast Logging
- Smart Meter Rollout



3rd Party Sources



Non-Household Demand

High

- 100% Direct Monitoring
- Partial Direct Monitoring
- Model Profiles and Adjusted Volumes
- Company Standard Profiles and Annual Volumes
- Industry Standard Profiles and Annual Volumes

Low

Understanding the journey in terms of analysis, technology and process change is something that we should be looking at progressing.

Ofwat Innovation Fund

Conclusions

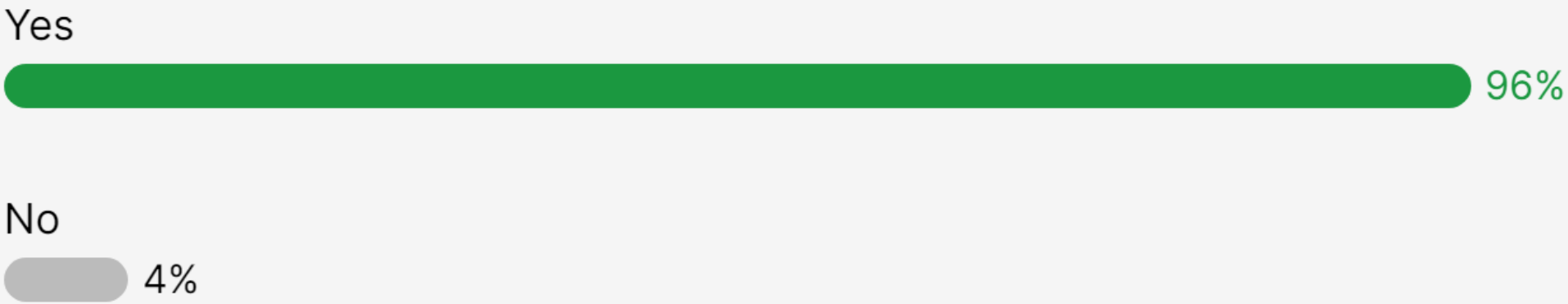
The industry standard profiles need to be refreshed but there are questions that need to be answered.

What level of accuracy is needed?

How are they to be related to properties?

When do they become out of date?

Do we want Industry Standard Profiles?



Active poll

55

Should standard profiles be refreshed on a regular basis?

Active poll

46

Should we move to more Dynamic Standard Profiles?

Thank You