NATIONAL GRID ELECTRICITY DISTRIBUTION

FLEXIBLE OPERATION OF WATER NETWORKS ENABLING RESPONSE SERVICES (FLOWERS)

D5-1 CASE STUDY REPORT ON THE OUTCOMES OF THE CASE STUDY ACTIVITIES

FINAL VERSION 2.0 - 24/01/2023 (D. PENFOLD, G.MAJOR)

1 TABLE OF CONTENTS

2 Project Overview 3
3 Document Purpose 3
4 Executive Summary 3
5 Problem Statement 4
6 Approach 4
7 Perturbation Impacting Factors 5
8 HH Demand Analysis Of Case Study Sites 6
9 Potential Network Benefit 23

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2 PROJECT OVERVIEW

The FLOWERS project, which is primarily a desktop-based analysis, has investigated the potential ability of South West Water's (SWW) network to embed demand flexibility capacity in the time difference (latency) between when drinking water and wastewater is pumped, stored, and treated. It has explored methods of delivering latency flexibility and analysed the feasibility of implementing it on SWW's systems.

The project is also defining the regulatory compliance and commercial viability requirements for the creation of a latency flexibility product, which can be embedded within National Grid Electricity Distribution's (NGED) electricity network control rooms. A recommendations document will be produced identifying the next steps for the development of latency flexibility capacity in ED2.

3 DOCUMENT PURPOSE

This document is one of several that will be published throughout the projects' lifecycle. The specific intention of this document and the contained sections is to focus on the desk top study undertaken on the 6 sites nominated sites.

We will discuss the analysed data and quantify the capacity for latency flexibility available at the identified sites and the fit with NGED's constraint zones requirements to pinpoint areas of greatest potential benefit.

4 EXECUTIVE SUMMARY

For the sites selected for the desktop case study, we considered that most of the identified initiatives are based around pumping operations. The other initiatives at Wastewater treatments sites of perturbing aeration and switching to LED UV have been removed as they are seen to be potential operational risks. Therefore, the sites selected needed to be representative of the different types of operations that could implement perturbed pumping operations.

Table 4-1 Desktop case study sites

TYPE OF SITE	SITE(S)
Wastewater - Sewage Treatment	Ashford, Hayle (has AD Plant)
Wastewater - Mains Distribution	Pottington, Porthgwidden
Drinking Water - Water Treatment	Pynes
Drinking Water - Water Distribution	Dunsford Hill

For each of the above sites we have sought to determine the following regarding the potential pumping flexibility opportunities identified in the D1-1 Feasibility Report:

1. The practical feasibility of implementing flexibility
2. Specific site half hourly (HH) **total** and **pumping** demand
3. The SWW site specific NGED CMZ HH demand reduction requirements
4. Potential HH demand flexibility available at each site
5. Feasible HH demand flexibility available from SWW sites to the NGED CMZ

The six sites have a combined maximum demand (MD) of circa **2.9 MW,** with **1.6 MW** assessed as being due to pumping operations. Therefore, if all the LFA1 suggested pumping perturbations were implemented at the same time then an estimated **1.6 MW** per hour of flexibility could be realised.

In reality it is unlikely that pumping perturbations could be implemented at 100% (all pumps switched off) so taking a sliding scale of implementation from 1% to 50%, the following table 4-2 shows the amount of flexibility could be realised based on the pumping maximum demand.

Table 4-2 Sliding Scale of Implementation Based on Maximum Pumping Demand

Implementation level	1%	5%	10%	25%	33%	50%
kW Flexibility	16	80	160	400	528	800

Applying the same sliding scale on pumping demand during the demand turn down time slots that the specific CMZ's require, the following table 4-3 shows the amount of flexibility could be realised.

Table 4-3 Sliding Scale of Implementation Based on Pumping Maximum Demand at CMZ Required Time Slots

Implementation level	1%	5%	10%	25%	33%	50%
kW Flexibility (Max)	14	70	139	348	460	696
kW Flexibility (Min)	1	5	11	27	35	53

The analysis, as detailed in section 8, of the SWW case study sites' pumping HH demand shows that – when matched with their relevant NGED CMZ's HH Demand reduction requirements and if implementing a 50% pumping perturbation – they could feasibly provide between **53kW** and **696kW** of flexibility, depending on the timeslot, prior to NGED going out to the market.

5 PROBLEM STATEMENT

This report is intended to highlight the complexity of the Water Treatment network and the interdependencies that need to be understood to enable Power flexibility to be realised.

The case study sites have been investigated in further detail with the aim of identifying these interdependencies and what if anything could be implemented to enable the flexibility and what the value of this may be.

The specific NGED CMZs have also been investigated to assess whether the SWW sites could be called upon to reduce the CMZ requirements.

6 APPROACH

HH usage data for each site was sourced and summarised as average HH demand for each month of the year. The requirements of the case study sites' CMZs were sourced and summarised for comparison to the specific sites' operational power demand.

As determined during the LFA 1 workshops and interviews, the assumption at treatment plants is 30% of the maximum demand is pumping and for pumping stations 90% of the sites maximum demand is pumping. Following the more detailed investigation and desk top study it has been identified that pumping at Drinking Water Treatment Works would account for an estimated 66% of the total site demand.

Site meetings with the operational teams were carried out at the case study sites to evaluate the potential of applying demand flexibility. This has brought to life that there are several impacting elements to perturbing the energy usage of SWW sites that need to be considered.

7 PERTURBATION IMPACTING FACTORS

The amount of pumping work being done is driven by numerous external influencing factors as described below.

- Planning for the delivery of flexibility greater than a day ahead of real time will fundamentally be impacted by the recent past weather, forecast weather, forecast demand (drinking water), forecast treatment volumes (wastewater) and the current amount of liquid being processed and stored at the pumping stations and the treatment works.
    - *The flow into the Wastewater treatment works is constant with volumes predominantly driven by rainfall events.*
    - *The flow into and out of Drinking Water treatment works is constant with volumes driven by demand.*
- The rate and volumes that need to be treated, as stipulated by the relevant site licences, could impact the ability to deliver demand flexibility.
- The main load centres, being the treatment works, will not necessarily be able to be perturbed in isolation of the pumping stations that feed into the treatment works or of the pumping stations after the treatment works.
- Wastewater - The level of storage fill of the pumping stations that feed in to the treatment works needs to be known before pumping turn down can be implemented to determine how long the pumps could be turned down for.
    - *The lag time of the flow of liquid from the pumping stations above needs to be considered for implementation of pumping turn down at the treatment sites.*
    - *If the treatment sites are pump distributed post treatment rather than gravity discharged, then the work rate of these distribution pumps will potentially need to be turned down to match the reduced treatment volumes*
- Drinking water - The level of water storage of the distribution reservoirs needs to be known, with forecast demand needing to be understood before pumping of the treated water from the treatment plant can be turned down.

  - *The lag time of the flow of liquid from the extraction points pumping stations needs to be considered for implementation of pumping turn down at the treatment sites.*
  - *If the treatment sites are pump distributed post treatment rather than gravity discharged, then the fill level triggers of the distribution reservoirs need to be held off*

- There is no common methodology for the control of pumping, with some pumping controlled both remotely and on-site. However, the majority of the pumping stations feeding into treatment works are not able to be remotely controlled.
  - *There is not one system in place that would enable the comparison of storage levels at pumping stations to the storage levels at treatment works to enable management of storage between linked sites.*
- For pre-planned demand flexibility, months ahead, the only firm perturbation method would be to source the electricity needs from an alternative source than the electricity network.
  - *Battery storage could be implemented to maximise the benefit of any onsite PV generation by storing the energy generated for use at the peak/constraint time.*
  - *Battery storage could also be used to take advantage of any demand turn up services linked to local over generation which could also support reduction of implementation of ANM.*
  - *Current on-site generators could be utilised, with different fuel to account for the emissions. There is potential to outsource the management of the SWW generator fleet.*
- There is no half hourly sub-metering of the separate operational loads. Therefore, the ability to determine what each operational load's demand is relies on estimates from the on-site teams.

8 HH Demand Analysis Of Case Study Sites

The six sites that were chosen for the deeper desktop case study are:

- Ashford (Wastewater - Sewage Treatment, WW-ST)
- Hayle (Wastewater - Sewage Treatment, WW-ST)
- Pottington (Wastewater – Mains Distribution, WW-MD)
- Porthgwidden (Wastewater – Mains Distribution, WW-MD)
- Pynes (Drinking Water – Water Treatment, DW-WT)
- Dunsford Hill (Drinking Water – Water Distribution, DW-WD)

The project team have evaluated the HH demand of the six case study sites to ascertain the usage patterns by year, by month and by time of day. The project team have then identified the specific NGED CMZ each is connected to, and the associated demand flexibility requirements of the CMZ. These two data sets have been cross-referenced to

identify where the SWW site could be utilised to assist the CMZ and the potential benefit to NGED of this.

8.1 Sites HH Demand Heat Maps

The project team have been able to review HH main meter demand data for the years 2017 – 2021 and as a check of demand trends the team separately reviewed the data for 2022. This data has been converted to a mean average demand for each half hour of the day for every day of the year.

The following section describes the HH demand for each of these case study sites, shown as demand heat maps. Where the heat map shows a green colour, this indicates the lowest demand, amber indicates average demand and red shows highest demand.

8.1.1 Ashford (WW-ST)

Ashford is a sewage treatment works with little onsite renewable generation. The following heat map, Table 8-1, shows the site's mean average **total** HH demand by month for the years 2017-2021. This heat map shows the change in demand by month and identifies the time of year when the site is demanding the highest amount of electricity.

As can be seen, by the red cells, this site has higher than average demand across the summer months from May-September.

Table 8-1 Total Site HH Demand (Monthly Comparison 2017-2021)

Month	00:30	01:00	01:30	02:00	02:30	03:00	03:30	04:00	04:30	05:00	05:30	06:00	06:30	07:00	07:30	08:00	08:30	09:00	09:30	10:00	10:30	11:00	11:30	12:00
Jan	496	502	496	497	499	492	492	483	489	491	484	482	497	506	510	520	521	518	521	520	526	520	521	521
Feb	508	506	506	499	498	498	497	494	495	492	491	494	503	511	511	517	526	532	529	530	537	532	532	529
Mar	516	512	507	505	505	505	502	506	503	500	501	501	513	516	524	530	535	543	538	539	540	539	541	543
Apr	487	485	482	479	482	477	472	475	476	474	491	499	507	515	526	534	531	536	537	535	532	533	533	533
May	490	486	483	478	482	480	475	480	479	482	501	512	520	525	537	547	548	550	547	543	541	540	542	547
Jun	508	507	505	498	497	496	493	493	500	503	510	516	525	532	544	546	550	553	555	557	550	543	550	548
Jul	509	507	502	501	498	500	496	498	502	506	521	528	537	539	544	547	550	554	552	554	553	551	556	560
Aug	510	507	503	500	499	497	499	503	504	506	513	522	523	532	540	549	550	545	550	557	556	557	554	554
Sep	512	513	500	498	499	498	497	494	498	499	503	511	514	519	530	540	539	550	548	548	546	548	545	542
Oct	506	506	503	507	500	500	500	501	502	498	515	522	528	532	534	546	539	538	542	545	545	534	540	537
Nov	505	501	501	502	495	498	496	495	491	494	489	490	509	513	514	518	532	538	538	542	538	529	529	529
Dec	484	480	480	485	478	478	473	474	479	475	473	473	493	502	499	500	510	508	503	505	516	511	514	508

Month	12:30	13:00	13:30	14:00	14:30	15:00	15:30	16:00	16:30	17:00	17:30	18:00	18:30	19:00	19:30	20:00	20:30	21:00	21:30	22:00	22:30	23:00	23:30	00:00
Jan	527	522	517	521	516	523	522	513	489	455	447	455	471	501	502	501	506	497	505	505	501	503	500	499
Feb	535	538	533	538	531	530	529	522	510	506	484	470	470	489	511	513	523	512	517	515	515	514	507	508
Mar	546	541	541	538	535	528	529	524	521	518	519	520	515	515	517	521	528	518	520	517	516	517	516	512
Apr	528	528	523	519	519	512	512	506	501	503	505	508	504	498	496	504	513	500	502	501	501	499	493	490
May	542	535	532	529	532	525	522	521	516	512	511	513	514	506	503	504	513	505	507	502	506	502	499	497
Jun	546	544	544	536	544	537	530	524	523	523	529	524	523	522	522	519	531	521	522	519	523	516	515	507
Jul	550	551	546	539	545	542	532	533	529	525	523	526	523	517	514	510	525	523	523	520	513	508	516	513
Aug	556	550	548	548	545	537	536	532	526	528	524	534	528	524	519	520	534	526	531	521	515	519	517	511
Sep	538	538	538	538	537	536	533	532	528	526	527	523	522	524	524	523	529	521	521	521	520	515	516	514
Oct	536	544	540	546	541	533	532	530	527	522	522	519	519	519	516	517	523	517	522	517	516	518	512	511
Nov	535	535	529	528	531	526	526	523	507	492	486	486	490	512	513	511	518	511	514	509	511	508	507	505
Dec	510	510	506	507	505	508	510	509	497	471	467	469	476	494	487	481	492	487	488	482	488	481	481	481

As a check the team also generated the same heat map for 2022 to assess if the above trend is continuing. Table 8-2 shows the site's total HH demand monthly comparison for 2022. It can clearly be seen that there has been a shift in the highest demand months, with July and August becoming below average, while all other months increased in demand.

Table 8-2 Total Site HH Demand (Monthly Comparison 2022)

Month	00:30	01:00	01:30	02:00	02:30	03:00	03:30	04:00	04:30	05:00	05:30	06:00	06:30	07:00	07:30	08:00	08:30	09:00	09:30	10:00	10:30	11:00	11:30	12:00
Jan	554	556	541	535	545	537	546	529	537	537	536	527	539	545	551	555	567	579	583	587	580	575	578	588
Feb	532	527	526	529	523	532	530	525	522	526	522	527	520	537	554	547	572	590	588	581	576	584	567	564
Mar	526	521	515	513	506	511	515	498	502	504	504	504	500	515	528	531	544	557	561	556	556	555	555	546
Apr	510	490	496	496	490	492	497	482	500	494	511	526	525	519	524	556	567	551	559	548	549	560	546	551
May	540	542	532	542	538	536	537	534	534	535	541	557	547	569	581	582	577	576	577	577	588	574	577	580
Jun	533	534	527	531	524	522	520	509	520	529	541	550	557	564	578	574	567	566	559	568	567	572	574	554
Jul	462	464	466	462	460	456	453	456	459	456	480	486	496	493	495	498	507	504	504	497	507	513	510	513
Aug	483	477	475	478	470	470	471	465	466	478	486	494	494	502	517	521	528	521	529	518	527	520	517	513
Sep	535	517	522	523	515	522	513	520	519	526	527	549	550	562	566	571	576	568	574	577	560	567	569	559
Oct	518	502	513	516	514	520	513	509	508	513	518	525	532	544	549	552	562	558	557	557	543	547	555	549
Nov	547	537	544	549	554	542	540	539	548	541	550	547	552	556	566	569	573	569	561	569	571	571	567	566
Dec	542	543	546	532	530	536	533	534	534	532	545	536	544	561	560	565	576	575	574	578	565	557	570	550

Month	12:30	13:00	13:30	14:00	14:30	15:00	15:30	16:00	16:30	17:00	17:30	18:00	18:30	19:00	19:30	20:00	20:30	21:00	21:30	22:00	22:30	23:00	23:30	00:00
Jan	579	583	579	581	591	583	577	558	545	521	485	488	497	551	571	554	557	551	558	557	550	562	556	556
Feb	571	569	570	573	574	584	572	565	561	550	557	558	541	559	555	553	548	553	548	564	546	546	529	531
Mar	542	538	532	531	527	525	528	526	519	522	526	535	524	524	520	527	525	524	526	529	515	513	510	516
Apr	550	538	549	532	531	531	505	504	507	495	513	513	500	503	498	496	501	504	501	512	505	506	510	496
May	573	572	569	559	570	558	558	561	560	566	558	556	558	565	559	563	559	553	566	550	556	548	554	539
Jun	565	568	559	563	560	558	548	539	551	545	552	550	550	554	557	558	558	547	539	546	549	544	544	529
Jul	512	504	515	509	506	497	486	476	483	489	488	492	475	479	486	480	477	464	465	467	474	465	470	463
Aug	522	522	525	516	516	508	511	513	514	508	504	507	513	516	514	512	505	502	496	498	490	496	490	486
Sep	554	560	545	547	556	532	546	546	527	530	524	532	548	538	545	544	544	547	547	533	541	535	523	533
Oct	546	536	524	545	544	535	538	536	528	541	539	545	549	538	535	550	538	536	534	520	525	541	526	527
Nov	565	566	569	569	566	565	563	560	560	570	558	561	554	556	566	565	557	556	552	548	551	551	548	553
Dec	562	562	553	574	562	561	567	548	547	542	545	543	539	545	568	561	556	560	547	555	541	542	548	533

Then, to enable assessment of the pumping demand the team generated a heat map, Table 8-3, to show at what time of day the above average **pumping** HH demand is seen when compared within month. It can be seen that even though none of the winter months are the peak month – demand spikes in June to October between 17:00 – 19:00 – the site still has significantly above average demand across most of the day from 08:00 – 16:00.

Table 8-3 Pumping Only HH Demand (In Month Comparison 2017-2021)

Month	00:30	01:00	01:30	02:00	02:30	03:00	03:30	04:00	04:30	05:00	05:30	06:00	06:30	07:00	07:30	08:00	08:30	09:00	09:30	10:00	10:30	11:00	11:30	12:00
Jan	164	166	164	164	165	162	162	160	161	162	160	159	164	167	168	172	172	171	172	172	173	172	172	172
Feb	168	167	167	165	164	164	164	163	163	162	162	163	166	169	169	171	174	175	175	175	177	176	175	175
Mar	170	169	167	167	167	167	166	167	166	165	165	165	169	170	173	175	177	179	178	178	178	178	178	179
Apr	161	160	159	158	159	157	156	157	157	156	162	165	167	170	174	176	175	177	177	177	175	176	176	176
May	162	160	159	158	159	158	157	158	158	159	165	169	172	173	177	181	181	181	181	179	179	178	179	181
Jun	168	167	167	164	164	164	163	163	165	166	168	170	173	176	180	180	182	183	183	184	182	179	182	181
Jul	168	167	165	165	164	165	164	164	166	167	172	174	177	178	180	180	182	183	182	183	183	182	184	185
Aug	168	167	166	165	165	164	165	166	166	167	169	172	173	176	178	181	181	180	181	184	184	184	183	183
Sep	169	169	165	164	165	164	164	163	164	165	166	169	170	171	175	178	178	181	181	181	180	181	180	179
Oct	167	167	166	167	165	165	165	165	166	164	170	172	174	175	176	180	178	178	179	180	180	176	178	177
Nov	167	165	165	166	163	164	164	163	162	163	161	162	168	169	170	171	175	177	178	179	177	174	175	174
Dec	160	159	158	160	158	158	156	157	158	157	156	156	163	166	165	165	168	168	166	167	170	169	170	168

Month	12:30	13:00	13:30	14:00	14:30	15:00	15:30	16:00	16:30	17:00	17:30	18:00	18:30	19:00	19:30	20:00	20:30	21:00	21:30	22:00	22:30	23:00	23:30	00:00
Jan	174	172	171	172	170	173	172	169	162	150	147	150	155	165	166	165	167	164	167	167	165	166	165	165
Feb	177	177	176	178	175	175	175	172	168	167	160	155	155	161	169	169	172	169	170	170	170	170	167	168
Mar	180	178	178	178	176	174	175	173	172	171	171	171	170	170	171	172	174	171	171	171	170	170	170	169
Apr	174	174	173	171	171	169	169	167	165	166	167	168	166	164	164	166	169	165	166	165	165	165	163	162
May	179	177	176	174	176	173	172	172	170	169	169	169	170	167	166	166	169	167	167	166	167	166	165	164
Jun	180	180	180	177	180	177	175	173	173	172	175	173	173	172	172	171	175	172	172	171	173	170	170	167
Jul	181	182	180	178	180	179	176	176	174	173	173	174	172	171	170	168	173	173	172	172	169	168	170	169
Aug	183	181	181	181	180	177	177	176	174	174	173	176	174	173	171	171	176	174	175	172	170	171	171	169
Sep	178	178	178	177	177	177	176	176	174	173	174	173	172	173	173	173	175	172	172	172	171	170	170	170
Oct	177	179	178	180	179	176	175	175	174	172	172	171	171	171	170	171	173	170	172	171	170	171	169	169
Nov	177	177	175	174	175	174	174	173	167	162	160	160	162	169	169	169	171	169	170	168	168	168	167	167
Dec	168	168	167	167	167	168	168	168	164	156	154	155	157	163	161	159	162	161	161	159	161	159	159	159

To check if this trend of pumping HH demand has continued in 2022 the heat map, Table 8-4, shows the in-month pumping HH demand for 2022. The data indicates that the sites' above average pumping HH demand has moved to start earlier at 07:00 and tails off sooner at 15:00, but there is still the occasional spike between 17:00 -20:00.

Table 8-4 Pumping Only HH Demand (In Month Comparison 2022)

Month	00:30	01:00	01:30	02:00	02:30	03:00	03:30	04:00	04:30	05:00	05:30	06:00	06:30	07:00	07:30	08:00	08:30	09:00	09:30	10:00	10:30	11:00	11:30	12:00
Jan	183	183	179	177	180	177	180	175	177	177	177	174	178	180	182	183	187	191	192	194	191	190	191	194
Feb	175	174	174	175	173	176	175	173	172	174	172	174	172	177	183	180	189	195	194	192	190	193	187	186
Mar	173	172	170	169	167	169	170	164	166	166	166	166	165	170	174	175	179	184	185	183	183	183	183	180
Apr	168	162	164	164	162	162	164	159	165	163	169	173	173	171	173	183	187	182	185	181	181	185	180	182
May	178	179	176	179	178	177	177	176	176	177	178	184	180	188	192	192	190	190	190	190	194	189	190	191
Jun	176	176	174	175	173	172	172	168	172	174	178	182	184	186	191	189	187	187	184	188	187	189	189	183
Jul	152	153	154	152	152	151	150	150	151	150	158	160	164	163	163	164	167	166	166	164	167	169	168	169
Aug	159	158	157	158	155	155	155	153	154	158	160	163	163	166	171	172	174	172	174	171	174	172	171	169
Sep	177	171	172	173	170	172	169	172	171	174	174	181	181	185	187	188	190	188	189	190	185	187	188	184
Oct	171	166	169	170	170	172	169	168	168	169	171	173	176	180	181	182	186	184	184	184	179	181	183	181
Nov	181	177	179	181	183	179	178	178	181	179	182	180	182	183	187	188	189	188	185	188	189	189	187	187
Dec	179	179	180	175	175	177	176	176	176	176	180	177	180	185	185	186	190	190	189	191	186	184	188	181

Month	12:30	13:00	13:30	14:00	14:30	15:00	15:30	16:00	16:30	17:00	17:30	18:00	18:30	19:00	19:30	20:00	20:30	21:00	21:30	22:00	22:30	23:00	23:30	00:00
Jan	191	193	191	192	195	192	191	184	180	172	160	161	164	182	188	183	184	182	184	184	182	185	184	183
Feb	188	188	188	189	189	193	189	187	185	181	184	184	179	184	183	182	181	182	181	186	180	180	175	175
Mar	179	178	176	175	174	173	174	174	171	172	173	176	173	173	172	174	173	173	174	174	170	169	168	170
Apr	182	178	181	175	175	175	167	166	167	163	169	169	165	166	164	164	165	166	165	169	167	167	168	164
May	189	189	188	184	188	184	184	185	185	187	184	184	184	187	185	186	184	182	187	182	183	181	183	178
Jun	187	187	184	186	185	184	181	178	182	180	182	181	182	183	184	184	184	180	178	180	181	180	180	174
Jul	169	166	170	168	167	164	160	157	159	161	161	162	157	158	160	158	158	153	154	154	156	153	155	153
Aug	172	172	173	170	170	168	169	169	170	168	166	167	169	170	170	169	167	166	164	164	162	164	162	160
Sep	183	185	180	181	183	176	180	180	174	175	173	176	181	178	180	179	179	181	181	176	179	176	173	176
Oct	180	177	173	180	180	176	178	177	174	178	178	180	181	177	176	182	178	177	176	171	173	179	174	174
Nov	186	187	188	188	187	187	186	185	185	188	184	185	183	183	187	186	184	184	182	181	182	182	181	182
Dec	185	186	183	189	185	185	187	181	180	179	180	179	178	180	187	185	184	185	180	183	178	179	181	176

When comparing the pumping HH demand in 2022 versus 2017 – 2021, Table 8-5 shows that pumping HH demand has increased in the majority of time slots in 2022 across all months apart from July and August.

Table 8-5 Change in Pumping HH Demand 2022 vs 2017-2021 Mean Average

Month	00:30	01:00	01:30	02:00	02:30	03:00	03:30	04:00	04:30	05:00	05:30	06:00	06:30	07:00	07:30	08:00	08:30	09:00	09:30	10:00	10:30	11:00	11:30	12:00
Jan	12%	11%	9%	8%	9%	9%	11%	9%	10%	9%	11%	9%	8%	8%	8%	7%	9%	12%	12%	13%	10%	11%	11%	13%
Feb	5%	11%	4%	6%	5%	7%	7%	6%	5%	7%	6%	7%	3%	5%	8%	6%	9%	11%	11%	10%	7%	10%	7%	7%
Mar	2%	2%	2%	2%	0%	1%	3%	-2%	0%	1%	1%	1%	-3%	0%	1%	0%	2%	3%	4%	3%	3%	3%	3%	1%
Apr	5%	1%	3%	3%	2%	3%	5%	2%	5%	4%	4%	5%	4%	1%	0%	4%	7%	3%	4%	2%	3%	5%	2%	3%
May	10%	12%	10%	13%	12%	12%	13%	11%	11%	11%	8%	9%	5%	8%	8%	6%	5%	5%	5%	6%	9%	6%	6%	6%
Jun	5%	5%	4%	7%	6%	5%	5%	3%	4%	5%	6%	7%	6%	6%	6%	5%	3%	2%	1%	2%	3%	5%	4%	1%
Jul	-9%	-8%	-7%	-8%	-8%	-9%	-9%	-8%	-9%	-10%	-8%	-8%	-8%	-9%	-9%	-9%	-8%	-9%	-9%	-10%	-8%	-7%	-8%	-8%
Aug	-5%	-6%	-6%	-4%	-6%	-6%	-6%	-8%	-8%	-6%	-5%	-5%	-6%	-6%	-4%	-5%	-4%	-4%	-4%	-7%	-5%	-7%	-7%	-7%
Sep	4%	1%	4%	5%	3%	5%	3%	5%	4%	5%	5%	7%	7%	8%	7%	6%	7%	3%	5%	5%	3%	3%	4%	3%
Oct	2%	-1%	2%	2%	3%	4%	3%	2%	1%	3%	0%	1%	1%	2%	3%	1%	4%	4%	3%	2%	0%	3%	3%	2%
Nov	8%	7%	9%	9%	12%	9%	9%	9%	12%	10%	13%	12%	8%	8%	10%	10%	8%	6%	4%	5%	6%	8%	7%	7%
Dec	12%	13%	14%	10%	11%	12%	13%	13%	11%	12%	15%	13%	11%	12%	12%	13%	13%	13%	14%	14%	9%	9%	11%	8%

Month	12:30	13:00	13:30	14:00	14:30	15:00	15:30	16:00	16:30	17:00	17:30	18:00	18:30	19:00	19:30	20:00	20:30	21:00	21:30	22:00	22:30	23:00	23:30	00:00	% Change
Jan	10%	12%	12%	11%	14%	11%	11%	9%	11%	15%	9%	7%	6%	10%	14%	11%	10%	11%	10%	10%	10%	12%	11%	11%	10%
Feb	7%	6%	7%	6%	8%	10%	8%	8%	10%	9%	15%	19%	15%	14%	9%	8%	5%	8%	6%	10%	6%	6%	4%	4%	8%
Mar	-1%	0%	-2%	-1%	-2%	-1%	0%	0%	0%	1%	1%	3%	2%	2%	1%	1%	-1%	1%	1%	2%	0%	-1%	-1%	1%	1%
Apr	4%	2%	5%	2%	2%	4%	-1%	0%	1%	-2%	2%	1%	-1%	1%	0%	-2%	-2%	1%	0%	2%	1%	1%	3%	1%	2%
May	6%	7%	7%	6%	7%	6%	7%	8%	8%	11%	9%	9%	9%	12%	11%	12%	9%	9%	11%	10%	10%	9%	11%	9%	9%
Jun	4%	4%	3%	5%	3%	4%	3%	3%	5%	4%	4%	5%	5%	6%	7%	7%	5%	5%	3%	5%	5%	5%	6%	4%	5%
Jul	-7%	-9%	-6%	-6%	-7%	-8%	-9%	-11%	-9%	-7%	-7%	-7%	-9%	-7%	-5%	-6%	-9%	-11%	-11%	-10%	-8%	-8%	-9%	-10%	-8%
Aug	-6%	-5%	-4%	-6%	-5%	-5%	-5%	-4%	-2%	-4%	-4%	-5%	-3%	-2%	-1%	-1%	-5%	-5%	-7%	-4%	-5%	-4%	-5%	-5%	-5%
Sep	3%	4%	1%	2%	3%	-1%	2%	3%	0%	1%	-1%	2%	5%	3%	4%	4%	3%	5%	5%	2%	4%	4%	1%	4%	4%
Oct	2%	-1%	-3%	0%	1%	0%	1%	1%	0%	4%	3%	5%	6%	4%	4%	6%	3%	4%	2%	0%	2%	4%	3%	3%	2%
Nov	6%	6%	7%	8%	7%	7%	7%	7%	10%	16%	15%	16%	13%	9%	10%	11%	8%	9%	7%	8%	8%	8%	8%	9%	9%
Dec	10%	10%	9%	13%	11%	10%	11%	8%	10%	15%	17%	16%	13%	10%	17%	17%	13%	15%	12%	15%	11%	13%	14%	11%	12%

Therefore, to summarize the sites' HH demand Table 8-6 below shows the pumping HH demand at this site that could be available for perturbation.

Table 8-6 Pumping HH demand

	2017 - 2021	2022
• HH mean average demand	170 kW	177 kW
• HH max demand	185 kW (12:00 Jul)	195 kW (14:30 Jan)
• HH min demand	147 kW (17:30 Jan)	150 kW (03:30 - 04:30 July)
• Mean average HH demand during evening grid peak (17:00 – 19:00)	167 kW	175 kW
• Max demand released by a 50% reduction in pumping power demand when needed by the CMZ		97 kW

Demand Flexibility Available for the CMZ

The team then identified the specific NGED CMZ for this site to ascertain when the CMZ requires Power demand reduction. Table 8-7 below identifies the required demand turn down by month and time of day.

Table 8-7 2023-2026 CMZ Demand Reduction Requirement (Average kW)

Month	00:30	01:00	01:30	02:00	02:30	03:00	03:30	04:00	04:30	05:00	05:30	06:00	06:30	07:00	07:30	08:00	08:30	09:00	09:30	10:00	10:30	11:00	11:30	12:00	12:30	13:00	13:30	14:00	14:30	15:00	15:30	16:00	16:30	17:00	17:30	18:00	18:30	19:00	19:30	20:00	20:30	21:00	21:30	22:00	22:30	23:00	23:30	00:00
Jan	-	-	-	-	-	-	-	-	-	-	-	-	-	-	280	2,166	3,402	4,124	5,411	5,578	5,741	5,824	5,799	5,395	6,255	6,174	5,891	4,885	4,477	3,983	3,906	5,100	7,630	11,188	13,393	13,218	11,454	9,419	7,350	4,708	2,662	872	-	-	-	-	-	-
Feb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	98	1,204	2,911	4,545	6,346	7,073	7,404	6,145	5,493	5,534	6,459	6,900	6,804	4,966	4,285	2,898	3,349	6,002	7,650	9,800	11,852	14,715	12,026	10,115	7,943	6,833	3,963	1,827	259	-	-	-	-	-
Mar	-	-	-	-	-	-	-	-	-	-	-	-	-	-	753	1,773	2,509	2,610	3,983	3,980	3,724	3,562	2,998	2,921	3,608	3,288	2,870	1,538	977	694	582	1,921	3,745	6,648	8,555	9,480	11,054	10,470	8,927	6,048	3,713	1,704	125	-	-	-	-	-
Apr	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	191	801	1,974	1,744	1,267	969	1,015	797	89	19	28	-	-	-	-	-	-	-	548	1,220	2,031	2,216	1,705	1,143	1,021	1,069	388	-	-	-	-	-	-
May	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	91	489	1,979	1,851	863	287	373	265	66	-	-	-	-	-	-	-	40	1,776	2,481	1,839	1,923	606	120	-	-	-	-	-	-	-
Jun	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	94	-	57	216	93	-	-	-	-	-	-	-	-	-	-	-	13	-	-	-	-	-	-	-	-	-	-	-	-
Jul	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	69	116	-	1,102	-	-	-	-	548	-	-	-	-	-	-	-	-	844	93	767	642	-	-	-	-	-	-	-	-	-
Aug	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	206	1,116	464	606	893	966	-	91	-	-	-	-	-	-	-	-	300	678	845	514	192	-	-	-	-	-	-	-	-	-
Sep	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	57	636	-	-	-	-	504	183	258	-	-	-	-	-	-	316	1,146	2,040	1,930	1,434	1,260	932	218	-	-	-	-	-	-	-
Oct	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	191	1,116	1,468	2,353	1,906	1,305	1,072	854	916	1,013	961	842	251	166	2,753	282	3,493	6,843	8,373	11,653	11,976	10,918	8,426	6,119	3,496	1,357	101	-	-	-	-	-	-
Nov	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	138	992	938	1,633	1,872	1,681	1,433	1,348	1,476	2,262	2,888	1,153	390	426	362	493	1,770	3,868	8,932	9,500	9,245	8,067	5,935	4,091	2,040	515	-	-	-	-	-	-
Dec	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,576	2,850	3,190	4,400	4,197	3,998	2,748	2,680	2,623	3,687	3,791	3,080	1,973	1,914	2,100	2,499	4,192	8,054	12,171	13,459	12,824	9,585	8,271	6,853	4,274	1,728	703	-	-	-	-	-

By comparing the HH demand during the CMZ demand turn down time slots it is possible to estimate the range of demand flexibility this individual site could provide to the CMZ, assuming a 50% reduction in pumping demand. This is shown in Table 8-8 below.

Table 8-8 Pumping Potential Demand Flexibility (Average kW)

Month	00:30	01:00	01:30	02:00	02:30	03:00	03:30	04:00	04:30	05:00	05:30	06:00	06:30	07:00	07:30	08:00	08:30	09:00	09:30	10:00	10:30	11:00	11:30	12:00	12:30	13:00	13:30	14:00	14:30	15:00	15:30	16:00	16:30	17:00	17:30	18:00	18:30	19:00	19:30	20:00	20:30	21:00	21:30	22:00	22:30	23:00	23:30	00:00
Jan															91	92	93	96	96	97	96	95	95	97	96	96	96	96	97	96	95	92	90	86	80	81	82	91	94	91	92	91						
Feb															91	90	94	97	97	96	95	96	94	93	94	94	94	94	95	96	94	93	93	91	92	92	89	92	92	91	90	91	90					
Mar															87	88	90	92	93	92	92	92	92	90	89	89	88	88	87	87	87	87	86	86	87	88	87	86	86	87	87	86	87					
Apr																92	94	91	92	90	91	92	90	91	91	89								82	85	85	83	83	82	82	83	83					
May																		95	95	95	97	95	95	96	95	94								93	92	92	92	93	92	93								
Jun																				94		94	95	91														91										
Jul																			83	82		85					85											81	78	79	80							
Aug																			87	85	87	86	85	85		86										83	84	85	85	85							
Sep																			95	95					91	92	90								87	86	88	90	89	90	90	90						
Oct																91	93	92	92	92	90	90	92	91	90	88	86	90	90	88	89	88	87	89	89	90	91	89	88	91	89	88						
Nov																94	94	94	92	94	94	94	93	93	93	94	94	93	93	93	92	92	94	92	93	91	92	93	93	92	92						
Dec																93	95	95	95	95	93	92	94	91	93	93	91	95	93	93	94	90	90	90	90	90	89	90	94	93	92	92						

The red highlighted cells shows where the pumping demand is greater than or equal to the CMZ requirements. Table 8-9 below shows the percentage of the CMZ demand turn down requirement that could potentially be fulfilled by the SWW site.

Table 8-9 % of CMZ Requirements that could be fulfilled by the site.

Month	00:30	01:00	01:30	02:00	02:30	03:00	03:30	04:00	04:30	05:00	05:30	06:00	06:30	07:00	07:30	08:00	08:30	09:00	09:30	10:00	10:30	11:00	11:30	12:00	12:30	13:00	13:30	14:00	14:30	15:00	15:30	16:00	16:30	17:00	17:30	18:00	18:30	19:00	19:30	20:00	20:30	21:00	21:30	22:00	22:30	23:00	23:30	00:00
Jan															32%	4%	3%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	1%	1%	1%	1%	1%	1%	2%	3%	10%						
Feb															94%	7%	3%	2%	2%	1%	1%	2%	2%	2%	1%	1%	1%	2%	2%	3%	3%	2%	1%	1%	1%	1%	1%	1%	1%	2%	5%	35%						
Mar															12%	5%	4%	4%	2%	2%	2%	3%	3%	3%	2%	3%	3%	6%	9%	12%	15%	5%	2%	1%	1%	1%	1%	1%	1%	1%	2%	5%	69%					
Apr																48%	12%	5%	5%	7%	9%	9%	11%	100%	100%	100%								15%	7%	4%	4%	5%	7%	8%	8%	21%					
May																		100%	19%	5%	5%	11%	33%	26%	36%	100%								100%	5%	4%	5%	5%	15%	77%								
Jun																				99%		100%	44%	98%														100%										
Jul																			100%	70%		8%					16%										10%	84%	10%	13%							
Aug																			42%	8%	19%	14%	10%	9%		95%									28%	12%	10%	17%	44%								
Sep																			100%	15%					18%	50%	35%							28%	8%	4%	5%	6%	7%	10%	41%						
Oct																48%	8%	6%	4%	5%	7%	8%	11%	10%	9%	9%	10%	36%	54%	3%	32%	3%	1%	1%	1%	1%	1%	1%	1%	3%	7%	88%						
Nov																68%	10%	10%	6%	5%	6%	7%	7%	6%	4%	3%	8%	24%	22%	26%	19%	5%	2%	1%	1%	1%	2%	2%	5%	18%						
Dec																6%	3%	3%	2%	2%	2%	3%	4%	3%	3%	2%	3%	5%	5%	4%	4%	2%	1%	1%	1%	1%	1%	1%	1%	2%	5%	13%						

In summary this site could feasibly respond to calls for flexibility as detailed in the D4-1 Specification and High-Level Architecture Document and provide between **78 kW** and **97 kW** in demand reduction during the CMZ required time slots.

The sequence of tables as seen above is now replicated for each of the case study sites.

8.1.2 Pottington (WW-MD)

Pottington is one of the pumping stations that feeds wastewater into Ashford sewage treatment works, so the project team have produced the same HH demand heat maps to enable a comparison with the treatment works' demand.

As before, the following heat map, Table 8-10, shows the site's mean average **total** HH demand by month for the years 2017-2021. As can be seen this site has higher than average demand across the winter months from November-February.

Table 8-10 Total Site HH Demand (Monthly Comparison 2017-2021)

Month	00:30	01:00	01:30	02:00	02:30	03:00	03:30	04:00	04:30	05:00	05:30	06:00	06:30	07:00	07:30	08:00	08:30	09:00	09:30	10:00	10:30	11:00	11:30	12:00
Jan	72	70	69	70	70	68	69	68	68	67	67	68	69	70	75	80	85	85	84	85	86	86	84	83
Feb	68	68	70	69	71	70	71	68	65	66	66	67	69	72	74	78	81	83	85	85	85	83	81	80
Mar	64	62	61	61	60	60	59	60	60	59	59	61	62	65	70	76	78	79	80	79	77	78	75	70
Apr	41	41	40	40	41	39	38	39	41	44	45	47	51	53	56	59	59	60	58	56	55	56	52	53
May	38	38	37	39	38	38	38	37	38	37	40	42	46	50	53	53	56	55	55	54	53	52	53	53
Jun	38	38	37	36	35	35	37	38	39	40	40	42	46	48	51	51	52	52	52	51	48	47	48	47
Jul	36	36	35	33	31	31	32	33	34	33	35	38	42	45	50	49	48	48	48	49	53	54	50	48
Aug	42	42	42	42	42	43	44	43	45	46	48	47	48	51	53	58	60	57	58	60	60	59	60	60
Sep	48	47	45	44	43	42	43	42	43	44	45	47	54	62	67	66	67	64	64	62	62	60	60	59
Oct	56	56	55	54	52	54	54	55	56	57	59	61	65	69	74	75	75	77	77	75	73	71	69	69
Nov	66	69	68	67	67	66	66	66	64	64	62	63	65	68	71	74	76	78	79	77	77	75	76	77
Dec	82	82	81	81	80	81	80	80	80	79	79	79	80	81	83	89	93	92	91	91	92	94	95	94

Month	12:30	13:00	13:30	14:00	14:30	15:00	15:30	16:00	16:30	17:00	17:30	18:00	18:30	19:00	19:30	20:00	20:30	21:00	21:30	22:00	22:30	23:00	23:30	00:00
Jan	83	82	83	83	79	83	82	79	79	79	78	80	80	83	83	84	83	81	81	80	81	79	77	73
Feb	80	77	77	79	77	76	75	75	74	76	78	79	81	82	81	81	81	78	77	75	75	73	72	70
Mar	69	68	67	67	69	68	69	68	69	69	70	72	74	74	75	75	77	75	74	71	70	70	67	66
Apr	52	52	49	50	51	48	47	48	49	52	53	53	54	54	55	52	51	50	50	48	48	45	43	43
May	49	49	46	47	49	47	46	47	48	50	52	52	53	53	53	52	50	49	50	48	45	42	40	39
Jun	49	47	44	46	46	44	45	46	45	46	45	46	50	50	48	48	47	46	45	44	44	42	41	39
Jul	47	45	45	45	45	43	42	43	45	47	46	48	46	45	45	45	44	44	44	42	40	39	37	36
Aug	56	56	54	55	57	56	52	52	52	53	53	54	55	57	57	55	53	52	50	50	49	47	45	45
Sep	55	54	53	53	55	52	51	52	53	54	56	56	57	57	57	57	54	53	51	51	49	48	48	48
Oct	69	66	67	67	67	65	66	67	68	68	70	70	72	72	73	71	70	68	67	66	63	62	58	57
Nov	73	74	72	75	73	73	73	72	70	74	75	77	78	82	81	78	75	74	74	72	70	71	68	68
Dec	94	95	93	91	91	95	95	91	89	89	90	93	92	95	93	92	91	92	91	89	89	88	86	85

Table 8-11 shows the HH Demand monthly comparison for 2022, and the trend of winter months being the highest demand has changed to now being that all months have a similar demand profile.

Table 8-11 Total Site HH Demand (Monthly Comparison 2022)

Month	00:30	01:00	01:30	02:00	02:30	03:00	03:30	04:00	04:30	05:00	05:30	06:00	06:30	07:00	07:30	08:00	08:30	09:00	09:30	10:00	10:30	11:00	11:30	12:00
Jan	57	53	52	53	53	53	53	55	56	54	53	55	59	60	63	66	70	71	69	69	69	68	68	73
Feb	56	54	53	53	53	57	55	55	54	58	65	62	62	63	66	69	75	85	89	84	78	73	76	73
Mar	43	45	43	40	40	39	38	38	38	38	38	40	42	45	50	56	58	57	56	57	55	54	51	51
Apr	34	33	32	31	32	32	35	34	33	35	36	39	42	44	48	48	50	47	48	46	46	45	42	41
May	30	32	35	34	31	29	27	28	30	32	32	34	41	43	46	45	45	45	46	45	46	46	46	44
Jun	30	29	28	29	28	28	28	28	27	30	31	32	36	39	41	41	44	44	43	44	42	41	41	40
Jul	32	29	28	26	26	26	25	26	25	26	27	29	32	39	47	42	43	42	41	43	40	38	38	37
Aug	27	26	25	25	25	25	24	24	25	26	27	29	31	35	39	41	41	40	40	39	38	44	42	50
Sep	33	33	34	33	32	33	33	32	32	41	38	44	42	44	46	47	48	48	47	47	43	42	40	40
Oct	34	35	34	34	34	40	47	42	38	35	34	38	42	47	49	49	51	51	50	56	60	52	51	46
Nov	82	78	75	81	82	81	78	82	78	84	82	78	79	87	85	90	87	84	86	94	98	93	87	86
Dec	55	62	52	50	52	51	50	50	51	52	53	53	57	59	64	66	67	68	69	70	69	70	69	68

Month	12:30	13:00	13:30	14:00	14:30	15:00	15:30	16:00	16:30	17:00	17:30	18:00	18:30	19:00	19:30	20:00	20:30	21:00	21:30	22:00	22:30	23:00	23:30	00:00
Jan	79	76	77	69	64	65	68	66	64	63	63	65	65	69	66	66	63	63	63	60	60	60	58	58
Feb	72	70	75	67	64	63	63	67	71	72	71	70	71	66	68	65	65	64	64	63	59	58	58	57
Mar	50	52	51	49	48	48	50	50	50	50	50	53	55	57	59	56	52	51	49	47	47	46	44	44
Apr	40	39	39	38	37	38	37	38	38	39	41	42	42	43	42	41	40	38	39	39	39	43	38	35
May	45	51	44	42	38	38	41	43	38	40	41	42	42	40	42	40	39	39	40	36	36	35	33	31
Jun	44	39	39	38	40	41	43	44	47	43	45	44	48	49	47	46	45	42	42	41	40	37	34	32
Jul	36	36	34	34	33	34	33	35	34	35	38	37	38	37	37	35	36	33	34	33	34	37	29	30
Aug	43	38	38	35	35	35	37	37	35	36	36	37	36	36	36	36	35	34	34	33	32	29	29	27
Sep	39	43	44	43	39	40	44	48	49	47	50	46	49	51	51	56	58	44	45	44	41	39	37	35
Oct	45	45	43	45	42	41	43	46	44	46	52	52	52	53	48	45	44	41	41	42	41	39	41	36
Nov	82	82	80	83	85	80	78	81	87	88	88	88	85	87	84	84	81	83	79	79	79	81	81	86
Dec	70	71	70	67	67	65	63	62	63	62	61	62	61	66	67	67	67	62	61	60	59	57	59	60

Heat map Table 8-12 shows at what time of day the above average **pumping** HH demand is seen when compared within month. It can be seen that the site has significant above average demand from 06:30 - 12:00 then again 17:00 – 21:00.

Table 8-12 Pumping Only HH Demand (In Month Comparison 2017-2021)

Month	00:30	01:00	01:30	02:00	02:30	03:00	03:30	04:00	04:30	05:00	05:30	06:00	06:30	07:00	07:30	08:00	08:30	09:00	09:30	10:00	10:30	11:00	11:30	12:00
Jan	65	63	62	63	63	61	62	61	61	61	60	61	62	63	67	72	76	77	75	77	78	77	76	75
Feb	61	61	63	62	64	63	64	61	58	60	60	60	62	65	67	70	73	75	76	76	76	75	73	72
Mar	58	56	55	55	54	54	54	54	54	53	53	55	56	59	63	68	70	71	72	71	69	70	67	63
Apr	37	37	36	36	37	35	34	35	37	40	40	42	46	48	51	53	53	54	52	51	49	50	47	47
May	34	34	34	35	34	34	34	33	34	34	36	38	41	45	48	48	50	49	49	48	47	47	48	47
Jun	34	34	33	32	32	32	33	34	35	36	36	38	42	43	46	46	47	47	47	46	43	42	43	42
Jul	32	33	31	30	28	28	29	30	30	30	31	34	38	41	45	44	43	44	43	44	47	49	45	43
Aug	37	38	38	38	38	39	40	39	40	42	43	43	44	46	48	53	54	52	52	54	54	53	54	54
Sep	43	42	41	40	39	38	39	38	38	39	41	42	49	56	60	60	60	58	57	56	56	54	54	53
Oct	51	51	49	49	47	49	48	50	50	51	53	54	59	62	67	68	67	69	69	68	66	64	62	62
Nov	60	62	61	61	61	60	60	59	58	58	56	57	58	61	64	67	68	71	71	69	69	68	68	69
Dec	74	73	73	73	72	73	72	72	72	71	71	72	72	73	75	80	84	83	82	82	83	85	85	84

Month	12:30	13:00	13:30	14:00	14:30	15:00	15:30	16:00	16:30	17:00	17:30	18:00	18:30	19:00	19:30	20:00	20:30	21:00	21:30	22:00	22:30	23:00	23:30	00:00
Jan	74	73	75	74	71	75	74	71	71	71	70	72	72	75	75	75	74	73	73	72	73	71	69	66
Feb	72	69	69	71	69	68	68	67	67	68	70	71	73	74	73	73	73	70	70	68	67	66	65	63
Mar	62	61	60	60	62	61	62	61	62	62	63	65	67	66	67	67	69	68	66	64	63	63	61	59
Apr	47	47	44	45	46	43	42	43	44	46	47	48	49	49	49	47	46	45	45	44	43	41	39	38
May	44	44	42	42	44	43	41	42	43	45	47	47	48	48	48	47	45	44	45	43	40	38	36	35
Jun	44	42	40	41	42	40	40	42	40	42	41	41	45	45	44	43	42	41	40	40	40	38	37	35
Jul	42	41	40	40	40	39	38	39	40	42	42	43	41	41	41	41	39	40	39	38	36	35	33	33
Aug	50	50	48	50	51	51	47	47	47	48	48	49	49	52	52	50	48	47	45	45	44	43	41	40
Sep	50	48	48	47	49	47	46	47	48	49	50	51	51	52	52	52	49	48	46	46	44	43	43	43
Oct	63	59	60	61	61	59	59	61	61	62	63	63	64	65	66	64	63	61	61	59	56	56	52	51
Nov	66	66	65	67	66	65	66	64	63	66	67	69	70	73	73	70	67	67	67	64	63	64	62	61
Dec	85	85	84	82	82	85	85	82	80	81	81	84	83	86	84	83	82	83	82	80	80	80	78	77

Looking at the in-month pumping HH demand for 2022, Table 8-13 shows the trend holds to the previous pattern.

Table 8-13 Pumping Only HH Demand (In Month Comparison 2022)

Month	00:30	01:00	01:30	02:00	02:30	03:00	03:30	04:00	04:30	05:00	05:30	06:00	06:30	07:00	07:30	08:00	08:30	09:00	09:30	10:00	10:30	11:00	11:30	12:00
Jan	51	47	47	48	48	48	47	49	51	48	48	49	53	54	56	59	63	64	62	62	62	62	61	65
Feb	50	48	48	47	47	51	50	49	48	52	58	56	56	57	59	62	67	76	80	76	70	66	69	66
Mar	39	41	39	36	36	35	34	34	34	35	34	36	38	40	45	50	52	51	50	51	49	49	46	46
Apr	30	30	29	28	29	29	31	31	30	31	32	35	37	39	43	43	45	43	44	42	41	40	38	37
May	27	29	31	31	28	26	24	25	27	29	29	30	37	38	41	40	40	41	41	40	41	42	41	39
Jun	27	26	25	26	25	25	25	25	25	27	28	28	32	35	37	37	39	40	39	40	38	37	36	36
Jul	29	26	25	24	23	24	23	24	23	23	24	26	29	35	42	38	39	38	37	39	36	34	34	33
Aug	24	23	23	22	22	22	22	22	22	24	24	26	28	32	35	37	37	36	36	35	34	40	38	45
Sep	29	29	30	30	29	30	30	28	29	37	34	40	38	39	41	42	43	43	42	42	39	38	36	36
Oct	30	31	31	30	31	36	42	37	35	32	31	34	38	42	44	44	45	46	45	51	54	47	46	41
Nov	74	70	67	72	73	73	70	74	70	76	74	71	71	78	77	81	78	76	77	85	88	83	79	77
Dec	50	56	47	45	47	46	45	45	46	47	48	48	51	53	57	60	60	61	62	63	62	63	62	61

Month	12:30	13:00	13:30	14:00	14:30	15:00	15:30	16:00	16:30	17:00	17:30	18:00	18:30	19:00	19:30	20:00	20:30	21:00	21:30	22:00	22:30	23:00	23:30	00:00
Jan	71	68	69	62	58	58	61	60	58	57	56	58	58	62	60	60	57	57	57	54	54	54	53	52
Feb	65	63	67	60	58	57	57	60	64	65	64	63	64	59	61	59	58	57	57	57	53	53	52	51
Mar	45	47	45	44	43	43	45	45	45	45	45	48	49	51	53	50	46	46	44	43	42	41	39	39
Apr	36	35	35	34	33	34	33	34	35	35	37	38	38	38	38	37	36	35	35	36	35	38	35	32
May	41	46	39	38	34	35	37	39	34	36	37	37	38	36	38	36	36	36	36	33	32	31	29	28
Jun	39	36	35	34	36	37	39	39	42	38	40	40	43	44	42	42	40	38	38	37	36	33	30	28
Jul	32	32	31	31	30	30	30	31	31	31	34	34	34	33	33	31	32	30	31	30	31	33	26	27
Aug	39	34	34	32	31	32	33	33	32	32	33	33	32	32	32	32	32	31	30	30	29	26	26	25
Sep	35	38	39	39	35	36	39	43	45	42	45	41	44	45	46	50	52	40	40	40	37	35	33	32
Oct	40	40	39	40	37	37	38	41	40	42	47	47	47	48	43	41	40	37	37	38	37	35	37	32
Nov	74	73	72	74	77	72	70	73	78	80	79	79	77	78	75	76	73	75	71	72	71	73	73	77
Dec	63	64	63	60	60	58	57	56	57	56	55	56	55	59	60	61	60	56	55	54	53	51	53	54

However, this comparison does show that the site in 2022 vs the mean average for 2017-2021 has a significantly lower pumping HH demand across all time periods and months, except November, which needs further investigation. This could be due to the low levels of rainfall seen during 2022.

Table 8-14 Change in HH Demand 2022 vs 2017-2021 Mean Average

Month	00:30	01:00	01:30	02:00	02:30	03:00	03:30	04:00	04:30	05:00	05:30	06:00	06:30	07:00	07:30	08:00	08:30	09:00	09:30	10:00	10:30	11:00	11:30	12:00	12:30	13:00	13:30	14:00	14:30	15:00	15:30	16:00	16:30	17:00	17:30	18:00	18:30	19:00	19:30	20:00	20:30	21:00	21:30	22:00	22:30	23:00	23:30	00:00	% Change
Jan	-21%	-24%	-24%	-24%	-24%	-22%	-23%	-20%	-17%	-21%	-20%	-19%	-15%	-15%	-16%	-18%	-18%	-17%	-18%	-19%	-20%	-20%	-20%	-12%	-4%	-7%	-7%	-17%	-19%	-23%	-18%	-16%	-19%	-20%	-20%	-19%	-20%	-17%	-21%	-21%	-24%	-22%	-22%	-24%	-26%	-24%	-24%	-21%	-19%
Feb	-18%	-24%	-24%	-23%	-26%	-19%	-22%	-19%	-17%	-12%	-2%	-6%	-9%	-12%	-12%	-12%	-8%	2%	5%	-1%	-8%	-12%	-6%	-9%	-10%	-9%	-3%	-15%	-17%	-17%	-16%	-10%	-5%	-5%	-8%	-11%	-13%	-20%	-16%	-19%	-20%	-18%	-18%	-16%	-21%	-20%	-20%	-19%	-13%
Mar	-33%	-28%	-29%	-34%	-33%	-34%	-36%	-36%	-37%	-34%	-35%	-34%	-32%	-31%	-29%	-26%	-26%	-28%	-30%	-29%	-29%	-30%	-31%	-27%	-28%	-24%	-25%	-27%	-31%	-30%	-26%	-26%	-28%	-27%	-28%	-26%	-26%	-23%	-22%	-25%	-33%	-33%	-34%	-34%	-33%	-34%	-35%	-34%	-30%
Apr	-18%	-18%	-20%	-22%	-21%	-17%	-9%	-12%	-20%	-21%	-20%	-17%	-18%	-18%	-14%	-19%	-15%	-21%	-16%	-18%	-17%	-20%	-20%	-22%	-23%	-25%	-21%	-24%	-28%	-22%	-21%	-21%	-22%	-25%	-22%	-22%	-22%	-21%	-24%	-22%	-22%	-23%	-22%	-19%	-18%	-6%	-11%	-17%	-20%
May	-20%	-14%	-7%	-12%	-18%	-24%	-29%	-25%	-22%	-15%	-21%	-20%	-12%	-14%	-14%	-16%	-20%	-17%	-16%	-16%	-13%	-11%	-14%	-17%	-7%	5%	-6%	-10%	-21%	-19%	-11%	-8%	-21%	21%	-22%	-20%	-20%	-24%	-21%	-23%	-22%	-20%	-21%	-24%	-20%	-17%	-19%	-19%	-17%
Jun	-21%	-24%	-24%	-20%	-21%	-19%	-25%	-26%	-30%	-26%	-21%	-24%	-23%	-19%	-19%	-19%	-16%	-15%	-17%	-13%	-12%	-13%	-16%	-16%	-10%	-15%	-12%	-16%	-14%	-6%	-3%	-6%	5%	-8%	-1%	-3%	-2%	-3%	-3%	-5%	-8%	-6%	-7%	-10%	-13%	-18%	-19%	-13%
Jul	-11%	-19%	-20%	-21%	-17%	-16%	-21%	-20%	-26%	-22%	-23%	-24%	-24%	-15%	-5%	-13%	-11%	-13%	-14%	-11%	-23%	-30%	-25%	-23%	-23%	-21%	-24%	-23%	-26%	-22%	-22%	-20%	-23%	-26%	-18%	-22%	-18%	-20%	-19%	-23%	-18%	-25%	-22%	-21%	-14%	-5%	-20%	-18%	-20%
Aug	-36%	-38%	-39%	-41%	-41%	-42%	-45%	-44%	-45%	-43%	-45%	-39%	-36%	-30%	-27%	-30%	-33%	-31%	-31%	-35%	-37%	-26%	-30%	-16%	-23%	-33%	-30%	-36%	-39%	-37%	-30%	-30%	-32%	-33%	-32%	-32%	-34%	-37%	-38%	-35%	-33%	-34%	-33%	-34%	-35%	-38%	-37%	-39%	-34%
Sep	-33%	-30%	-25%	-25%	-26%	-21%	-23%	-25%	-25%	-5%	-15%	-6%	-21%	-29%	-32%	-29%	-29%	-25%	-27%	-24%	-31%	-29%	-34%	-32%	-29%	-20%	-18%	-19%	-28%	-23%	-14%	-7%	-7%	-14%	-10%	-18%	-14%	-12%	-12%	-2%	8%	-17%	-13%	-14%	-17%	-19%	-24%	-27%	-20%
Oct	-40%	-39%	-38%	-38%	-35%	-25%	-13%	-24%	-31%	-38%	-42%	-37%	-35%	-33%	-34%	-34%	-33%	-34%	-35%	-25%	-17%	-27%	-26%	-34%	-36%	-32%	-35%	-34%	-38%	-37%	-35%	-32%	-35%	-32%	-25%	-25%	-27%	-26%	-34%	-37%	-37%	-39%	-40%	-36%	-34%	-37%	-29%	-37%	-33%
Nov	24%	12%	10%	20%	21%	21%	17%	25%	20%	32%	31%	24%	22%	27%	20%	22%	14%	7%	9%	22%	27%	23%	15%	12%	11%	11%	11%	11%	16%	10%	7%	13%	25%	20%	17%	14%	9%	7%	3%	9%	8%	12%	7%	11%	12%	15%	19%	27%	16%
Dec	-33%	-24%	-35%	-38%	-35%	-37%	-38%	-37%	-37%	-34%	-32%	-33%	-29%	-27%	-24%	-25%	-28%	-26%	-24%	-24%	-25%	-25%	-27%	-27%	-26%	-26%	-25%	-26%	-26%	-32%	-33%	-31%	-29%	-31%	-32%	-33%	-34%	-31%	-28%	-27%	-27%	-33%	-33%	-32%	-34%	-36%	-32%	-29%	-30%

Table 8-15 below summarises the pumping HH demand at this site:

Table 8-15 Pumping HH demand

	2017 - 2021	2022
• HH mean average demand	55 kW	45 kW
• HH max demand	86 kW (19:00 Dec)	88 kW (10:30 Nov)
• HH min demand	28 kW (02:30 - 03:30 Jul)	22 kW (02:00 - 04:30 Aug)
• Mean average HH demand during evening grid peak (17:00 – 19:00)	59 kW	48 kW
• Max demand released by a 50% reduction in pumping power demand when needed by the CMZ		44 kW

Demand Flexibility Available for the CMZ

The team then identified the specific NGED CMZ for this site to ascertain when the CMZ requires demand reduction. Table 8-16 below identifies the required demand turn down by month and time of day.

Table 8-16 2023-2026 CMZ Demand Reduction Requirement (Average kW)

Month	00:30	01:00	01:30	02:00	02:30	03:00	03:30	04:00	04:30	05:00	05:30	06:00	06:30	07:00	07:30	08:00	08:30	09:00	09:30	10:00	10:30	11:00	11:30	12:00	12:30	13:00	13:30	14:00	14:30	15:00	15:30	16:00	16:30	17:00	17:30	18:00	18:30	19:00	19:30	20:00	20:30	21:00	21:30	22:00	22:30	23:00	23:30	00:00
Jan															280	2,166	3,402	4,124	5,411	5,578	5,741	5,824	5,799	5,395	6,255	6,174	5,891	4,885	4,477	3,983	3,906	5,100	7,630	11,188	13,393	13,218	11,454	9,419	7,350	4,708	2,662	872							
Feb															98	1,204	2,911	4,545	6,346	7,073	7,404	6,145	5,493	5,534	6,459	6,900	6,804	4,966	4,285	2,898	3,349	6,002	7,650	9,800	11,852	14,715	12,026	10,115	7,943	6,833	3,963	1,827	259						
Mar															753	1,773	2,509	2,610	3,983	3,980	3,724	3,562	2,998	2,921	3,608	3,288	2,870	1,538	977	694	582	1,921	3,745	6,648	8,555	9,480	11,054	10,470	8,927	6,048	3,713	1,704	125						
Apr																191	801	1,974	1,744	1,267	969	1,015	797	89	19	28									548	1,220	2,031	2,216	1,705	1,143	1,021	1,069	388						
May																		91	489	1,979	1,851	863	287	373	265	66									40	1,776	2,481	1,839	1,923	606	120							
Jun																				94		57	216	93														13									
Jul																			69	116		1,102					548											844		767	642							
Aug																			206	1,116	464	606	893	966		91										300	678	845	514	192								
Sep																			57	636					504	183	258								316	1,146	2,040	1,930	1,434	1,260	932	218						
Oct															191	1,116	1,468	2,353	1,906	1,305	1,072	854	916	1,013	961	842	251	166	2,753	282	3,493	6,843	8,373	11,653	11,976	10,918	8,426	6,119	3,496	1,357	101						
Nov															138	992	938	1,633	1,872	1,681	1,433	1,348	1,476	2,262	2,888	1,153	390	426	362	493	1,770	3,868	8,932	9,500	9,245	8,067	5,935	4,091	2,040	515							
Dec															1,576	2,850	3,190	4,400	4,197	3,998	2,748	2,680	2,623	3,687	3,791	3,080	1,973	1,914	2,100	2,499	4,192	8,054	12,171	13,459	12,824	9,585	8,271	6,853	4,274	1,728	703						

By comparing the HH demand during the CMZ demand turn down time slots it is possible to estimate the range of demand flexibility this individual site could provide to the CMZ assuming a 50% reduction in pumping demand. This is shown in Table 8-17 below.

Table 8-17 Pumping Potential Demand Flexibility (Average kW)

Month	00:30	01:00	01:30	02:00	02:30	03:00	03:30	04:00	04:30	05:00	05:30	06:00	06:30	07:00	07:30	08:00	08:30	09:00	09:30	10:00	10:30	11:00	11:30	12:00	12:30	13:00	13:30	14:00	14:30	15:00	15:30	16:00	16:30	17:00	17:30	18:00	18:30	19:00	19:30	20:00	20:30	21:00	21:30	22:00	22:30	23:00	23:30	00:00
Jan															28	30	31	32	31	31	31	31	30	33	36	34	35	31	29	29	30	30	29	28	28	29	29	31	30	30	28	28						
Feb															30	31	34	38	40	38	35	33	34	33	32	31	34	30	29	28	28	30	32	32	32	31	32	30	30	29	29	29	29						
Mar															23	25	26	25	25	25	25	24	23	23	22	23	23	22	21	22	23	23	22	23	23	24	25	26	26	25	23	23	22						
Apr																22	23	21	22	21	20	20	19	19	18	18									17	18	19	19	19	19	18	18	17						
May																		20	21	20	21	21	21	20	20	23									18	18	19	19	18	19	18							
Jun																				20		18	18	18														22									
Jul																			19	19		17					15											17	17	16	17							
Aug																			18	18	17	20	19	23		17										16	17	16	16	16								
Sep																			21	21					18	19	20								21	23	21	22	23	23	25	26							
Oct																22	23	23	22	25	27	23	23	21	20	20	19	20	19	18	19	21	20	21	24	23	24	24	22	20	20	19						
Nov																41	39	38	39	42	44	42	39	39	37	37	36	37	38	36	35	36	39	40	40	40	38	39	38	38	37	37						
Dec																30	30	31	31	31	31	32	31	31	31	32	31	30	30	29	28	28	28	28	28	28	27	30	30	30	30	28						

The red highlighted cells shows where the pumping demand is greater than or equal to the CMZ requirements. Table 8-18 below shows the percentage of the CMZ demand turn down requirement that could potentially be fulfilled by the SWW site.

Table 8-18 % of CMZ Requirements that could be fulfilled by the site.

Month	00:30	01:00	01:30	02:00	02:30	03:00	03:30	04:00	04:30	05:00	05:30	06:00	06:30	07:00	07:30	08:00	08:30	09:00	09:30	10:00	10:30	11:00	11:30	12:00	12:30	13:00	13:30	14:00	14:30	15:00	15:30	16:00	16:30	17:00	17:30	18:00	18:30	19:00	19:30	20:00	20:30	21:00	21:30	22:00	22:30	23:00	23:30	00:00
Jan															10.1%	1.4%	0.9%	0.8%	0.6%	0.6%	0.5%	0.5%	0.5%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.7%	0.8%	0.6%	0.4%	0.3%	0.2%	0.2%	0.3%	0.3%	0.4%	0.6%	1.1%	3.3%							
Feb															30.2%	2.6%	1.2%	0.8%	0.6%	0.5%	0.5%	0.5%	0.6%	0.6%	0.5%	0.5%	0.5%	0.6%	0.7%	1.0%	0.8%	0.5%	0.4%	0.3%	0.3%	0.2%	0.3%	0.3%	0.4%	0.4%	0.7%	1.6%	11%						
Mar															3.0%	1.4%	1.0%	1.0%	0.6%	0.6%	0.7%	0.7%	0.8%	0.8%	0.6%	0.7%	0.8%	1.4%	2.2%	3.1%	3.9%	1.2%	0.6%	0.3%	0.3%	0.3%	0.2%	0.2%	0.3%	0.4%	0.6%	1.3%	17%						
Apr																11.4%	2.8%	1.1%	1.2%	1.6%	2.1%	2.0%	2.4%	20.7%	95.2%	62.7%								3.2%	1.5%	0.9%	0.9%	1.1%	1.6%	1.8%	1.7%	4.4%						
May																		22.6%	4.2%	1.0%	1.1%	2.4%	7.2%	5.3%	7.7%	34.6%								44.4%	1.0%	0.8%	1.0%	0.9%	3.1%	15.0%							
Jun																				20.9%		32.1%	8.4%	19.1%												100%										
Jul																			26.9%	16.8%		1.6%					2.8%									2.0%	18.3%	2.1%	2.6%							
Aug																			8.8%	1.6%	3.7%	3.3%	2.1%	2.3%		18.7%									5.5%	2.4%	1.9%	3.2%	8.4%							
Sep																			37.1%	3.3%					3.5%	10.5%	7.6%							6.6%	2.0%	1.0%	1.1%	1.6%	1.8%	2.7%	12.0%							
Oct																11.7%	2.0%	1.6%	1.0%	1.3%	2.1%	2.2%	2.7%	2.2%	2.0%	2.1%	2.3%	8.0%	11.2%	0.7%	6.8%	0.6%	0.3%	0.2%	0.2%	0.2%	0.2%	0.3%	0.4%	0.6%	1.5%	18.4%						
Nov																29.6%	3.9%	4.0%	2.4%	2.3%	2.6%	2.9%	2.9%	2.6%	1.6%	1.3%	3.1%	9.5%	9.0%	10.0%	7.1%	2.1%	1.0%	0.4%	0.4%	0.4%	0.5%	0.7%	0.9%	1.9%	7.1%							
Dec																1.9%	1.1%	1.0%	0.7%	0.7%	0.8%	1.2%	1.2%	1.2%	0.9%	0.8%	1.0%	1.5%	1.6%	1.4%	1.1%	0.7%	0.4%	0.2%	0.2%	0.2%	0.3%	0.4%	0.4%	0.7%	1.7%	4.0%						

In summary, this site could feasibly respond to calls for flexibility, as detailed in the D4-1 Specification and High-Level Architecture Document, and provide between **15 kW** and **44 kW** in Power demand reduction during the CMZ required time slots.

Combined Ashford and Pottington Demand Flexibility Available for the CMZ

With Ashford and Pottington sites both being linked into the same CMZ the combined potential effect the sites could have on the CMZ requirements are as seen in Table 8-19 below.

Table 8-19 Pumping Potential Demand Flexibility (Average kW)

Month	00:30	01:00	01:30	02:00	02:30	03:00	03:30	04:00	04:30	05:00	05:30	06:00	06:30	07:00	07:30	08:00	08:30	09:00	09:30	10:00	10:30	11:00	11:30	12:00	12:30	13:00	13:30	14:00	14:30	15:00	15:30	16:00	16:30	17:00	17:30	18:00	18:30	19:00	19:30	20:00	20:30	21:00	21:30	22:00	22:30	23:00	23:30	00:00
Jan															119	121	125	128	127	128	127	126	126	130	131	130	130	127	126	125	126	122	119	114	108	110	111	122	124	121	120	119							
Feb															121	121	128	135	137	134	130	129	128	126	127	125	128	125	123	125	123	123	124	123	124	123	121	122	122	121	120	120	119						
Mar															110	113	116	117	118	117	116	116	115	113	112	112	111	110	108	108	110	109	108	109	109	112	111	112	112	112	110	109	109						
Apr																113	116	112	114	111	111	113	109	109	109	106								99	103	103	101	102	101	100	101	100							
May																		116	116	115	118	116	116	115	115	117								111	110	110	111	111	111	111							
Jun																				114		113	113	109												112										
Jul																			102	101		102					100									98	95	95	97							
Aug																			105	103	104	106	104	107		103	-								100	100	101	101	101							
Sep																			116	116					109	112	110							108	109	109	113	112	113	115	116							
Oct																113	116	115	114	117	117	114	115	111	110	109	106	110	108	107	108	109	107	110	112	113	114	113	110	111	109	107						
Nov																135	133	132	131	136	138	136	133	132	130	130	130	131	132	129	128	129	131	134	132	132	130	131	131	131	128	129						
Dec																123	125	125	126	127	124	124	125	121	124	125	123	125	123	122	122	118	118	117	117	117	116	120	124	123	122	120						

Table 8-20 below shows the percentage of the CMZ demand turn down requirement that could potentially be fulfilled by Ashford and Pottington sites.

Table 8-20 % of CMZ Requirements that could be fulfilled by the sites.

Month	00:30	01:00	01:30	02:00	02:30	03:00	03:30	04:00	04:30	05:00	05:30	06:00	06:30	07:00	07:30	08:00	08:30	09:00	09:30	10:00	10:30	11:00	11:30	12:00	12:30	13:00	13:30	14:00	14:30	15:00	15:30	16:00	16:30	17:00	17:30	18:00	18:30	19:00	19:30	20:00	20:30	21:00	21:30	22:00	22:30	23:00	23:30	00:00
Jan															43%	6%	4%	3%	2%	2%	2%	2%	2%	2%	2%	2%	2%	3%	3%	3%	3%	2%	2%	1%	1%	1%	1%	1%	2%	3%	5%	14%							
Feb															100%	10%	4%	3%	2%	2%	2%	2%	2%	2%	2%	2%	2%	3%	3%	4%	4%	2%	2%	1%	1%	1%	1%	1%	2%	2%	3%	7%	46%						
Mar															15%	6%	5%	4%	3%	3%	3%	3%	4%	4%	3%	3%	4%	7%	11%	16%	19%	6%	3%	2%	1%	1%	1%	1%	1%	1%	2%	3%	6%	87%					
Apr																60%	15%	6%	7%	9%	11%	11%	14%	100%	100%	100%								18%	8%	5%	5%	6%	9%	10%	9%	26%							
May																		100%	24%	6%	6%	13%	40%	31%	43%	100%								100%	6%	4%	6%	6%	18%	92%							
Jun																				100%		100%	52%	100%												100%										
Jul																			100%	87%		9%					18%									12%	100%	12%	15%							
Aug																			51%	9%	22%	17%	12%	11%		100%									33%	15%	12%	20%	53%							
Sep																			100%	18%					22%	61%	42%							34%	10%	5%	6%	8%	9%	12%	53%							
Oct																59%	10%	8%	5%	6%	9%	11%	13%	12%	11%	11%	13%	44%	65%	4%	38%	3%	2%	1%	1%	1%	1%	1%	2%	3%	8%	100%						
Nov																98%	13%	14%	8%	7%	8%	9%	10%	9%	6%	5%	11%	34%	31%	36%	26%	7%	3%	1%	1%	1%	2%	2%	3%	6%	25%							
Dec																8%	4%	4%	3%	3%	3%	4%	5%	5%	3%	3%	4%	6%	6%	6%	5%	3%	1%	1%	1%	1%	1%	1%	2%	3%	7%	17%							

In summary these sites could feasibly respond to calls for flexibility, as detailed in the D4-1 Specification and High-Level Architecture Document and provide between **95 kW** and **138 kW** in Power demand reduction during the CMZ required time slots.

8.1.3 Hayle (WW-ST)

Hayle is another sewage treatment works and has renewable generation assets onsite via Anaerobic Digestion and Combined Heat and Power (CHP). As before, the following heat map, Table 8-21, shows the site's mean average **total** HH Demand by month for the years 2017-2021. As can be seen this site has higher than average demand across the winter months from November-February.

Table 8-21 Total Site HH Demand (Monthly Comparison 2017-2021)

Month	00:30	01:00	01:30	02:00	02:30	03:00	03:30	04:00	04:30	05:00	05:30	06:00	06:30	07:00	07:30	08:00	08:30	09:00	09:30	10:00	10:30	11:00	11:30	12:00
Jan	492	495	477	474	465	462	448	444	439	456	443	451	464	472	473	493	501	531	545	565	554	559	575	578
Feb	534	532	500	532	511	503	514	493	506	507	503	509	517	541	524	555	558	586	590	607	591	586	598	581
Mar	431	432	420	414	419	412	402	409	395	407	399	398	424	423	446	462	476	478	494	498	484	494	476	469
Apr	304	299	303	296	285	284	300	285	288	298	296	313	328	327	367	372	392	405	396	395	386	389	378	361
May	252	242	235	253	240	234	233	238	235	229	232	254	248	263	284	299	320	313	313	323	304	312	300	300
Jun	255	241	230	228	229	233	227	233	226	232	244	239	269	270	299	323	327	334	337	330	322	319	312	300
Jul	214	173	182	193	169	169	191	178	186	179	182	193	207	209	245	283	286	304	301	305	296	298	288	276
Aug	252	234	213	200	205	205	208	208	213	205	205	226	233	235	271	300	323	336	342	342	332	323	302	301
Sep	233	241	233	221	221	218	220	214	218	206	232	243	246	271	291	332	342	350	346	346	338	330	327	302
Oct	321	319	313	303	306	302	301	284	312	311	314	321	346	357	378	395	426	438	421	420	419	402	392	374
Nov	445	451	424	431	437	424	429	421	428	411	428	425	425	444	455	454	479	478	487	484	490	483	478	480
Dec	579	544	560	549	540	563	544	536	544	519	547	528	544	539	546	544	561	567	579	594	609	583	593	583

Month	12:30	13:00	13:30	14:00	14:30	15:00	15:30	16:00	16:30	17:00	17:30	18:00	18:30	19:00	19:30	20:00	20:30	21:00	21:30	22:00	22:30	23:00	23:30	00:00
Jan	555	558	540	531	554	531	507	475	468	455	440	375	423	468	454	639	609	557	531	522	518	497	507	494
Feb	590	563	546	554	554	547	546	524	516	521	492	408	451	506	497	667	664	618	595	596	561	561	558	534
Mar	456	457	446	427	435	434	440	435	445	410	441	349	377	442	424	589	587	479	484	461	451	454	438	431
Apr	357	338	346	339	336	336	329	255	349	263	283	332	317	518	465	378	371	361	364	347	334	332	317	325
May	277	282	276	265	267	282	279	192	271	241	236	307	264	428	383	314	298	305	285	276	278	277	263	261
Jun	290	286	278	259	275	290	276	186	260	244	224	323	255	415	379	317	318	310	305	294	283	283	270	262
Jul	264	265	228	235	220	246	255	128	234	203	184	319	212	372	344	294	281	276	258	262	259	237	230	221
Aug	291	288	280	275	261	284	262	172	263	242	231	338	279	399	402	319	313	311	316	298	297	279	277	249
Sep	302	300	294	276	285	300	289	188	287	241	248	346	268	444	407	324	334	320	305	293	277	275	266	260
Oct	359	377	364	362	373	373	368	299	380	319	313	371	333	491	479	435	409	382	378	379	373	341	355	330
Nov	461	460	465	464	454	445	457	476	472	447	490	393	404	439	424	587	568	506	502	488	480	477	467	443
Dec	577	582	594	569	583	548	557	547	538	543	520	448	494	510	513	645	650	619	621	585	596	572	593	565

Table 8-22 shows the HH Demand monthly comparison for 2022 and the previous trend of winter months being the highest demand continues.

Table 8-22 Total Site HH Demand (Monthly Comparison 2022)

Month	00:30	01:00	01:30	02:00	02:30	03:00	03:30	04:00	04:30	05:00	05:30	06:00	06:30	07:00	07:30	08:00	08:30	09:00	09:30	10:00	10:30	11:00	11:30	12:00
Jan	412	424	430	420	388	417	375	433	400	398	418	398	413	444	427	450	456	471	489	520	473	462	538	527
Feb	336	327	325	327	297	317	317	339	314	332	315	335	338	383	376	410	388	397	415	452	424	485	476	447
Mar	473	469	467	461	415	398	405	405	406	387	380	401	393	418	415	429	462	455	482	490	486	460	507	461
Apr	341	355	336	339	325	331	307	307	304	319	317	331	340	349	373	393	403	422	453	450	431	408	416	398
May	339	319	283	271	272	276	277	272	261	287	286	272	296	294	312	371	351	371	370	378	390	370	379	360
Jun	307	304	282	248	249	258	230	248	244	261	240	260	266	286	291	322	359	375	378	359	376	381	359	328
Jul	425	426	387	362	366	352	369	343	362	334	377	345	380	370	409	416	492	481	486	466	492	494	464	463
Aug	443	432	402	374	357	375	403	391	388	409	400	384	392	394	421	474	491	516	514	528	537	509	487	479
Sep	473	492	443	450	443	436	426	425	432	429	419	434	436	432	492	508	529	561	567	586	551	564	523	520
Oct	424	414	380	368	386	418	425	417	386	408	405	412	414	441	485	488	504	550	562	549	540	504	554	537
Nov	538	508	502	499	487	503	511	479	483	488	489	511	481	503	487	564	521	587	577	547	613	591	563	584
Dec	504	516	538	512	507	517	502	517	480	498	536	541	522	547	524	561	576	562	590	606	605	595	612	580

Month	12:30	13:00	13:30	14:00	14:30	15:00	15:30	16:00	16:30	17:00	17:30	18:00	18:30	19:00	19:30	20:00	20:30	21:00	21:30	22:00	22:30	23:00	23:30	00:00
Jan	553	534	534	553	492	507	477	474	499	468	468	408	390	382	450	404	613	597	482	485	466	430	491	435
Feb	429	455	418	442	418	439	411	432	378	390	358	376	329	346	438	382	596	509	390	375	407	395	384	385
Mar	473	494	460	473	451	445	446	427	470	468	429	418	398	414	478	497	601	618	506	482	503	511	461	473
Apr	369	346	358	358	344	352	337	347	316	344	309	312	440	351	548	454	357	373	378	393	359	355	351	351
May	353	351	359	342	350	346	353	345	299	339	289	310	433	335	422	434	440	363	354	349	355	352	357	336
Jun	323	321	334	336	346	337	333	324	258	333	270	301	428	350	423	505	370	353	352	361	356	338	339	325
Jul	425	447	425	448	434	461	429	448	380	436	412	401	521	440	532	584	498	466	464	466	466	460	453	437
Aug	475	471	458	455	458	452	465	460	404	463	419	434	565	481	573	640	485	507	492	478	494	464	458	451
Sep	509	524	504	531	517	540	506	503	480	506	440	468	601	524	684	678	628	607	591	543	544	527	492	526
Oct	496	485	477	483	486	491	491	464	418	445	423	412	537	465	573	560	546	500	492	478	483	468	446	439
Nov	562	555	599	572	548	555	552	519	567	574	543	547	459	459	502	531	679	636	558	620	578	576	596	535
Dec	613	608	586	594	596	597	570	603	550	595	562	520	465	463	503	517	604	654	603	566	563	555	528	504

Table 8-23 shows at what time of day the above average **pumping** HH demand is seen when compared within month. It can be seen that the site has above average demand from 08:00 - 12:00 then again 19:00 – 22:00.

Table 8-23 Pumping Only HH Demand (In Month Comparison 2017-2021)

Month	00:30	01:00	01:30	02:00	02:30	03:00	03:30	04:00	04:30	05:00	05:30	06:00	06:30	07:00	07:30	08:00	08:30	09:00	09:30	10:00	10:30	11:00	11:30	12:00
Jan	162	163	157	156	153	152	148	146	145	151	146	149	153	156	156	163	165	175	180	187	183	185	190	191
Feb	176	175	165	175	169	166	170	163	167	167	166	168	171	179	173	183	184	194	195	200	195	193	197	192
Mar	142	142	139	137	138	136	133	135	130	134	132	131	140	140	147	152	157	158	163	164	160	163	157	155
Apr	100	99	100	98	94	94	99	94	95	98	98	103	108	108	121	123	129	134	131	130	127	129	125	119
May	83	80	77	83	79	77	77	78	78	76	77	84	82	87	94	99	105	103	103	107	100	103	99	99
Jun	84	79	76	75	76	77	75	77	75	77	80	79	89	89	99	107	108	110	111	109	106	105	103	99
Jul	71	57	60	64	56	56	63	59	61	59	60	64	68	69	81	93	94	100	99	101	98	98	95	91
Aug	83	77	70	66	68	68	69	69	70	68	68	74	77	78	89	99	107	111	113	113	110	107	100	99
Sep	77	80	77	73	73	72	73	71	72	68	76	80	81	90	96	110	113	116	114	114	112	109	108	100
Oct	106	105	103	100	101	100	99	94	103	103	104	106	114	118	125	130	140	144	139	139	138	133	129	123
Nov	147	149	140	142	144	140	141	139	141	136	141	140	140	146	150	150	158	158	161	160	162	159	158	158
Dec	191	180	185	181	178	186	179	177	180	171	181	174	180	178	180	180	185	187	191	196	201	192	196	192

Month	12:30	13:00	13:30	14:00	14:30	15:00	15:30	16:00	16:30	17:00	17:30	18:00	18:30	19:00	19:30	20:00	20:30	21:00	21:30	22:00	22:30	23:00	23:30	00:00
Jan	183	184	178	175	183	175	167	157	154	150	145	124	140	154	150	211	201	184	175	172	171	164	167	163
Feb	195	186	180	183	183	181	180	173	170	172	162	135	149	167	164	220	219	204	196	197	185	185	184	176
Mar	151	151	147	141	143	143	145	143	147	135	145	115	125	146	140	194	194	158	160	152	149	150	144	142
Apr	118	112	114	112	111	111	109	84	115	87	93	110	105	171	153	125	122	119	120	115	110	110	105	107
May	91	93	91	87	88	93	92	63	89	80	78	101	87	141	126	104	98	101	94	91	92	91	87	86
Jun	96	95	92	85	91	96	91	61	86	80	74	107	84	137	125	105	105	102	101	97	93	93	89	86
Jul	87	88	75	77	73	81	84	42	77	67	61	105	70	123	114	97	93	91	85	87	85	78	76	73
Aug	96	95	92	91	86	94	86	57	87	80	76	112	92	132	133	105	103	102	104	98	98	92	91	82
Sep	100	99	97	91	94	99	95	62	95	80	82	114	89	147	134	107	110	106	101	97	92	91	88	86
Oct	118	125	120	119	123	123	121	99	125	105	103	122	110	162	158	143	135	126	125	125	123	112	117	109
Nov	152	152	153	153	150	147	151	157	156	148	162	130	133	145	140	194	188	167	166	161	158	157	154	146
Dec	190	192	196	188	192	181	184	180	177	179	172	148	163	168	169	213	214	204	205	193	197	189	196	186

Then looking at the in-month pumping HH demand for 2022, Table 8-24, the Power demand trend indicates that the previous pattern continues.

Table 8-24 Pumping Only HH Demand (In Month Comparison 2022)

Month	00:30	01:00	01:30	02:00	02:30	03:00	03:30	04:00	04:30	05:00	05:30	06:00	06:30	07:00	07:30	08:00	08:30	09:00	09:30	10:00	10:30	11:00	11:30	12:00
Jan	136	140	142	139	128	138	124	143	132	131	138	131	136	147	141	149	150	155	161	172	156	153	178	174
Feb	111	108	107	108	98	104	105	112	104	110	104	111	112	126	124	135	128	131	137	149	140	160	157	147
Mar	156	155	154	152	137	131	134	134	134	128	126	132	130	138	137	141	152	150	159	162	161	152	167	152
Apr	113	117	111	112	107	109	101	101	100	105	105	109	112	115	123	130	133	139	149	148	142	135	137	131
May	112	105	93	89	90	91	91	90	86	95	94	90	98	97	103	122	116	122	122	125	129	122	125	119
Jun	101	100	93	82	82	85	76	82	80	86	79	86	88	94	96	106	118	124	125	118	124	126	118	108
Jul	140	141	128	120	121	116	122	113	119	110	125	114	125	122	135	137	162	159	160	154	162	163	153	153
Aug	146	142	133	123	118	124	133	129	128	135	132	127	129	130	139	156	162	170	170	174	177	168	161	158
Sep	156	162	146	149	146	144	141	140	143	141	138	143	144	143	162	168	175	185	187	193	182	186	173	172
Oct	140	137	125	121	127	138	140	138	128	135	134	136	137	145	160	161	166	181	186	181	178	166	183	177
Nov	177	168	166	165	161	166	169	158	159	161	161	169	159	166	161	186	172	194	190	181	202	195	186	193
Dec	166	170	178	169	167	171	166	171	159	164	177	178	172	180	173	185	190	185	195	200	200	196	202	191

Month	12:30	13:00	13:30	14:00	14:30	15:00	15:30	16:00	16:30	17:00	17:30	18:00	18:30	19:00	19:30	20:00	20:30	21:00	21:30	22:00	22:30	23:00	23:30	00:00
Jan	182	176	176	183	162	167	157	157	165	154	154	135	129	126	148	133	202	197	159	160	154	142	162	144
Feb	141	150	138	146	138	145	136	142	125	129	118	124	109	114	145	126	197	168	129	124	134	130	127	127
Mar	156	163	152	156	149	147	147	141	155	154	142	138	131	137	158	164	198	204	167	159	166	169	152	156
Apr	122	114	118	118	114	116	111	115	104	113	102	103	145	116	181	150	118	123	125	130	119	117	116	116
May	117	116	118	113	116	114	116	114	99	112	95	102	143	111	139	143	145	120	117	115	117	116	118	111
Jun	107	106	110	111	114	111	110	107	85	110	89	99	141	115	140	167	122	116	116	119	117	112	112	107
Jul	140	147	140	148	143	152	142	148	126	144	136	132	172	145	175	193	164	154	153	154	154	152	150	144
Aug	157	155	151	150	151	149	154	152	133	153	138	143	186	159	189	211	160	167	162	158	163	153	151	149
Sep	168	173	166	175	171	178	167	166	158	167	145	154	198	173	226	224	207	200	195	179	180	174	162	174
Oct	164	160	158	159	160	162	162	153	138	147	139	136	177	153	189	185	180	165	162	158	159	155	147	145
Nov	185	183	198	189	181	183	182	171	187	189	179	181	151	151	166	175	224	210	184	205	191	190	197	177
Dec	202	201	193	196	197	197	188	199	182	196	186	171	153	153	166	171	199	216	199	187	186	183	174	166

As can be seen in Table 8-25, a comparison of the pumping HH demand in 2022 vs the mean average for 2017-2021 shows pumping HH demand is significantly higher across all time periods across all months apart from January and February.

Table 8-25 Change in HH Demand 2022 vs 2017-2021 Mean Average

Month	00:30	01:00	01:30	02:00	02:30	03:00	03:30	04:00	04:30	05:00	05:30	06:00	06:30	07:00	07:30	08:00	08:30	09:00	09:30	10:00	10:30	11:00	11:30	12:00	12:30	13:00	13:30	14:00	14:30	15:00	15:30	16:00	16:30	17:00	17:30	18:00	18:30	19:00	19:30	20:00	20:30	21:00	21:30	22:00	22:30	23:00	23:30	00:00	% Change
Jan	-16%	-14%	-10%	-11%	-16%	-10%	-16%	-2%	-9%	-13%	-6%	-12%	-11%	-6%	-10%	-9%	-9%	-11%	-10%	-8%	-15%	-17%	-6%	-9%	0%	-4%	-1%	4%	-11%	-5%	-6%	0%	7%	3%	6%	9%	-8%	-18%	-1%	-37%	1%	7%	-9%	-7%	-10%	-14%	-3%	-12%	-8%
Feb	-37%	-39%	-35%	-39%	-42%	-37%	-38%	-31%	-38%	-35%	-37%	-34%	-35%	-29%	-28%	-26%	-30%	-32%	-30%	-26%	-28%	-17%	-20%	-23%	-27%	-19%	-23%	-20%	-25%	-20%	-25%	-18%	-27%	-25%	-27%	-8%	-27%	-32%	-12%	-43%	-10%	-18%	-34%	-37%	-27%	-30%	-31%	-28%	-28%
Mar	10%	9%	11%	11%	-1%	-3%	1%	-1%	3%	-5%	-5%	1%	-7%	-1%	-7%	-7%	-3%	-5%	-3%	-1%	0%	-7%	7%	-2%	4%	8%	3%	11%	4%	2%	1%	-2%	6%	14%	-3%	20%	6%	-6%	13%	-15%	2%	29%	5%	4%	11%	13%	5%	10%	3%
Apr	12%	19%	11%	14%	14%	16%	2%	8%	6%	7%	7%	6%	4%	7%	2%	6%	3%	4%	14%	14%	12%	5%	10%	10%	3%	2%	4%	5%	2%	5%	2%	36%	-9%	31%	9%	-6%	39%	-32%	18%	20%	-4%	3%	4%	13%	7%	7%	11%	8%	7%
May	34%	32%	20%	7%	13%	18%	19%	15%	11%	25%	23%	7%	19%	12%	10%	24%	10%	18%	18%	17%	28%	19%	26%	20%	28%	25%	30%	29%	31%	23%	27%	80%	10%	40%	22%	1%	64%	-22%	10%	38%	47%	19%	24%	26%	28%	27%	36%	29%	22%
Jun	20%	26%	23%	9%	9%	11%	1%	7%	8%	12%	-1%	9%	-1%	6%	-3%	0%	10%	12%	12%	9%	17%	19%	15%	9%	12%	12%	20%	30%	26%	16%	21%	74%	-1%	37%	20%	-7%	68%	-16%	12%	59%	16%	14%	15%	23%	26%	19%	25%	24%	15%
Jul	98%	147%	113%	88%	117%	108%	93%	93%	95%	86%	108%	78%	83%	77%	67%	47%	72%	58%	62%	53%	66%	65%	61%	68%	61%	68%	86%	91%	97%	87%	69%	250%	63%	115%	123%	26%	146%	18%	54%	99%	77%	69%	80%	78%	80%	94%	97%	98%	80%
Aug	76%	84%	89%	88%	74%	83%	94%	88%	82%	99%	95%	70%	68%	68%	56%	58%	52%	54%	50%	55%	61%	57%	61%	59%	63%	63%	64%	66%	75%	59%	78%	168%	53%	91%	82%	28%	102%	20%	42%	101%	55%	63%	56%	60%	67%	66%	66%	81%	67%
Sep	103%	104%	90%	104%	101%	100%	93%	99%	99%	108%	81%	79%	78%	59%	69%	53%	55%	60%	64%	69%	63%	71%	60%	72%	69%	75%	71%	92%	81%	80%	75%	168%	67%	110%	78%	35%	124%	18%	68%	109%	88%	90%	94%	85%	96%	92%	85%	102%	80%
Oct	32%	30%	21%	21%	26%	38%	41%	47%	24%	31%	29%	28%	20%	23%	28%	24%	19%	26%	34%	31%	29%	25%	41%	44%	38%	29%	31%	33%	30%	32%	33%	55%	10%	40%	35%	11%	61%	-5%	20%	29%	34%	31%	30%	26%	29%	37%	26%	33%	29%
Nov	21%	13%	18%	16%	11%	19%	19%	14%	13%	19%	14%	20%	13%	13%	7%	24%	9%	23%	19%	13%	25%	23%	18%	22%	22%	21%	29%	23%	21%	25%	21%	9%	20%	28%	11%	39%	14%	4%	18%	-10%	20%	26%	11%	27%	20%	21%	28%	21%	18%
Dec	-13%	-5%	-4%	-7%	-6%	-8%	-8%	-4%	-12%	-4%	-2%	2%	-4%	1%	-4%	3%	3%	-1%	2%	2%	-1%	2%	3%	-3%	6%	4%	-1%	4%	2%	9%	2%	10%	2%	10%	8%	16%	-6%	-9%	-2%	-20%	-7%	6%	-3%	-3%	-6%	-3%	-11%	-11%	-1%

Table 8-26 below summarises the pumping demand at this site:

Table 8-26 Pumping ½ hourly demand

	2017 - 2021	2022
• HH mean average demand	126 kW	146 kW
• HH max demand	220 kW (20:00 Feb)	226 kW (19:30 Sep)
• HH min demand	42 kW (16:00 July)	76 kW (03:30 July)
• Mean average HH demand during evening grid peak (17:00 – 19:00)	121 kW	142 kW
• Max demand released by a 50% reduction in pumping power demand when needed by the CMZ	[redacted]	113 kW

Demand Flexibility Available for the CMZ

The team then identified the specific NGED CMZ for this site to ascertain when the CMZ requires demand reduction. Table 8-27 below identifies the required demand turn down by month and time of day.

Table 8-27 2023-2026 CMZ Demand Reduction Requirement (Average kW)

Month	00:30	01:00	01:30	02:00	02:30	03:00	03:30	04:00	04:30	05:00	05:30	06:00	06:30	07:00	07:30	08:00	08:30	09:00	09:30	10:00	10:30	11:00	11:30	12:00	12:30	13:00	13:30	14:00	14:30	15:00	15:30	16:00	16:30	17:00	17:30	18:00	18:30	19:00	19:30	20:00	20:30	21:00	21:30	22:00	22:30	23:00	23:30	00:00
Jan	6,985	702	9,534	3,490	6,136	3,159	65	-	-	-	137	-	3,717	5,365	5,235	18,499	8,958	14,224	11,458	23,998	8,388	20,857	19,710	17,472	6,536	21,319	14,735	6,800	15,435	5,239	10,199	9,379	62,195	34,750	56,477	41,146	23,877	28,577	15,068	14,869	10,145	6,108	5,497	-	-	-	-	-
Feb	8,289	7,667	8,490	6,623	6,077	3,871	1,367	-	166	75	195	-	7,017	13,290	15,852	20,976	19,454	21,514	20,583	19,473	29,199	14,753	7,607	20,033	3,974	5,336	13,386	12,480	301	-	11,661	17,461	29,636	21,100	46,096	52,445	46,891	33,487	20,908	15,735	11,452	13,398	9,129	5,452	1,540	158	-	-
Mar	-	-	-	-	-	-	-	-	-	-	-	-	-	1,983	3,497	4,174	26,395	23,924	2,957	3,582	-	-	-	-	-	-	-	-	-	-	-	4,395	19,329	31,538	28,518	47,104	37,817	10,690	11,235	6,638	3,543	1,359	-	-	-	-	-	-
Apr	-	-	-	39	438	-	-	-	-	-	-	-	-	1,102	3,068	8,217	7,825	35,032	32,401	20,194	1,307	-	-	-	-	-	-	-	-	-	-	-	-	14,025	27,817	32,238	37,282	14,141	6,535	10,069	8,301	7,652	6,383	425	-	-	-
May	-	-	-	-	528	-	-	-	-	-	-	-	-	3,596	4,235	12,819	14,177	10,476	10,652	10,106	-	3,201	-	-	-	-	-	-	-	-	-	-	-	1,507	16,177	1,605	17,898	20,109	11,872	18,039	14,766	10,950	16,734	9,359	7,483	3,641	868	-
Jun	-	-	-	-	-	-	-	-	-	-	-	-	-	10,766	12,494	13,309	22,940	11,054	1,735	3,888	5,320	-	-	-	-	-	-	-	-	-	-	-	-	2,878	9,309	7,927	14,923	25,099	4,944	192	135	-	-	-	-	-	-	-
Jul	-	-	-	-	-	-	-	-	-	-	-	-	-	4,307	8,507	11,390	14,447	12,311	6,369	276	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3,150	13,954	19,076	20,405	-	-	-	-	-	-	-	-	-	-
Aug	-	-	-	-	-	-	-	-	-	-	-	-	-	5,414	5,484	5,872	14,160	12,224	17,464	18,901	19,554	20,629	7,949	1,754	8,347	2,643	-	-	-	1,646	6,051	-	14,411	18,295	30,736	31,334	39,632	2,912	1,599	784	344	171	-	-	-	-	-	-
Sep	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	539	6,147	12,153	18,984	16,672	10,447	10,947	9,762	3,886	5,946	7,235	4,537	843	8,312	8,000	7,804	14,391	16,115	20,776	16,781	4,821	2,116	1,473	921	11	-	-	-	-	-	-	-	-
Oct	-	-	-	-	-	-	-	-	-	-	-	-	-	2,081	4,797	6,607	3,881	6,083	12,027	10,040	27,677	13,872	15,900	12,286	17,351	22,389	12,202	13,244	8,722	14,167	13,058	16,032	15,092	11,904	19,989	13,018	14,805	13,032	9,607	5,333	3,753	935	-	-	-	-	-	-
Nov	-	-	-	-	-	-	-	-	-	-	-	-	-	1,241	6,739	6,292	4,234	4,866	4,642	11,148	13,697	14,165	26,994	28,337	31,609	30,712	27,641	26,515	21,871	12,450	15,209	41,102	46,577	54,845	63,691	53,978	14,733	11,840	8,928	5,509	2,652	9	-	-	-	-	-
Dec	6,043	8,855	8,489	3,886	9,828	513	-	-	-	-	-	-	949	6,071	9,205	12,327	15,693	22,395	24,459	19,945	18,476	14,787	20,432	21,949	17,027	20,388	17,999	20,352	25,240	10,608	20,043	22,808	29,979	25,613	44,283	45,832	42,596	34,425	25,258	24,729	28,332	14,853	10,688	4,786	116	-	-	-

By comparing the HH demand during the CMZ demand turn down time slots it is possible to estimate the range of demand flexibility this individual site could provide to the CMZ assuming a 50% reduction in pumping Power demand. This is shown in Table 8-28 below.

Table 8-28 Pumping Potential Demand Flexibility (Average kW)

Month	00:30	01:00	01:30	02:00	02:30	03:00	03:30	04:00	04:30	05:00	05:30	06:00	06:30	07:00	07:30	08:00	08:30	09:00	09:30	10:00	10:30	11:00	11:30	12:00	12:30	13:00	13:30	14:00	14:30	15:00	15:30	16:00	16:30	17:00	17:30	18:00	18:30	19:00	19:30	20:00	20:30	21:00	21:30	22:00	22:30	23:00	23:30	00:00
Jan	68	70	71	69	64	69	62					66		73	70	74	75	78	81	86	78	76	89	87	91	88	88	91	81	84	79	78	82	77	77	67	64	63	74	67	###	99	80	80					
Feb	55	54	54	54	49	52	52		52	55	52		56	63	62	68	64	65	68	75	70	80	79	74	71	75	69	73	69		68	71	62	64	59	62	54	57	72	63	98	84	64	62	67	65		
Mar															69	71	76	75	79	81	80													77	71	69	66	68	79	82	99	###							
Apr				56	54									58	62	65	66	70	75	74	71													57	51	51	73	58	90	75	59	62	62	65			
May					45									49	51	61	58	61	61	62		61												56	48	51	71	55	70	72	73	60	58	58	59	58	59	
Jun															48	53	59	62	62	59	62	63												55	45	50	71	58	70	83	61							
Jul															67	69	81	79	80	77	81														68	66	86	73										
Aug															69	78	81	85	85	87	89	84	80	79	78	78	76				77	76		76	69	72	93	79	95	###	80	84	81					
Sep																	87	93	94	97	91	93	86	86	84	86	83	88	85	89	83	83	79	84	73	77	99	86	###	###									
Oct															80	80	83	91	93	91	89	83	91	89	82	80	79	80	80	81	81	77	69	73	70	68	89	77	95	92	90	82	81					
Nov															80	93	86	97	95	90	###	98	93	96	93	92	99	94	90	92	91	86	94	95	90	90	76	76	83	88	###	###	92					
Dec	83	85	89	84	84	85							86	90	87	93	95	93	97	###	###	98	###	96	###	###	97	98	98	99	94	###	91	98	93	86	77	76	83	85	###	###	###	93	93			

The red highlighted cells shows where the pumping demand is greater than or equal to the CMZ requirements. Table 8-29 below shows the percentage of the CMZ demand turn down requirement that could potentially be fulfilled by the SWW site.

Table 8-29 % of CMZ Requirements that could be fulfilled by the site.

Month	00:30	01:00	01:30	02:00	02:30	03:00	03:30	04:00	04:30	05:00	05:30	06:00	06:30	07:00	07:30	08:00	08:30	09:00	09:30	10:00	10:30	11:00
Jan	1.0%	10.0%	0.7%	2.0%	1.0%	2.2%	96%					48.0%		2.0%	1.3%	1.4%	0.4%	0.9%	0.6%	0.7%	0.3%	0.9%
Feb	0.9%	0.7%	0.6%	0.8%	0.8%	1.3%	3.8%		31.3%	73%	26.6%		0.8%	0.5%	0.4%	0.3%	0.3%	0.3%	0.3%	0.4%	0.2%	0.5%
Mar															3.5%	2.0%	1.8%	0.3%	0.3%	2.7%	2.2%	
Apr				100%	12.2%									5.2%	1.6%	0.8%	0.8%	0.2%	0.2%	0.4%	5.4%	
May					8.5%									1.4%	1.2%	0.5%	0.4%	0.6%	0.6%	0.6%		1.9%
Jun															0.4%	0.4%	0.4%	0.3%	0.6%	3.4%	1.6%	1.2%
Jul															1.6%	0.8%	0.7%	0.5%	0.7%	1.1%	29.6%	
Aug															1.3%	1.4%	1.4%	0.6%	0.7%	0.5%	0.5%	0.4%
Sep																	16.2%	1.5%	0.8%	0.5%	0.5%	0.9%
Oct															3.8%	1.7%	1.3%	2.3%	1.5%	0.8%	0.9%	0.3%
Nov															6.5%	1.4%	1.4%	2.3%	2.0%	1.9%	0.3%	0.3%
Dec	1.4%	1.0%	1.0%	2.2%	0.9%	16.7%							9.1%	1.5%	0.9%	0.8%	0.6%	0.4%	0.4%	0.5%	0.5%	0.7%

Month	11:30	12:00	12:30	13:00	13:30	14:00	14:30	15:00	15:30	16:00	16:30	17:00	17:30	18:00	18:30	19:00	19:30	20:00	20:30	21:00	21:30	22:00	22:30	23:00	23:30	00:00
Jan	0.4%	0.4%	0.5%	1.3%	0.4%	0.6%	1.2%	0.5%	1.5%	0.8%	0.9%	0.2%	0.2%	0.1%	0.2%	0.3%	0.3%	0.4%	0.7%	1.0%	1.3%	1.5%				
Feb	1.0%	0.4%	1.8%	1.4%	0.5%	0.6%	22.9%		0.6%	0.4%	0.2%	0.3%	0.1%	0.1%	0.1%	0.2%	0.3%	0.4%	0.9%	0.6%	0.7%	1.1%	4.4%	43.5%		
Mar										0.0%	0.0%	0.2%	0.2%	0.1%	0.2%	0.6%	0.7%	1.2%	2.8%	7.5%						
Apr												0.4%	0.2%	0.2%	0.2%	0.4%	1.4%	0.7%	0.7%	0.8%	1.0%	15.2%				
May												3.7%	0.3%	3.2%	0.4%	0.3%	0.6%	0.4%	0.5%	0.5%	0.3%	0.6%	0.8%	1.6%	6.8%	
Jun												1.9%	0.5%	0.6%	0.5%	0.2%	1.4%	21.2%	45.1%							
Jul													2.0%	0.6%	0.5%	0.4%										
Aug	0.4%	1.0%	4.5%	0.9%	2.9%				4.7%	1.3%		0.5%	0.4%	0.2%	0.8%	0.4%	3.2%	6.6%	10.2%	24.4%	47.3%					
Sep	0.8%	0.9%	2.2%	1.5%	1.1%	1.9%	10.1%	1.1%	1.0%	1.1%	0.6%	0.5%	0.3%	0.5%	2.1%	4.1%	7.7%	12.1%	0%							
Oct	0.7%	0.6%	0.7%	0.5%	0.4%	0.7%	0.6%	0.9%	0.6%	0.6%	0.4%	0.6%	0.6%	0.3%	0.7%	0.5%	0.7%	1.0%	1.7%	2.2%	8.7%					
Nov	0.3%	0.4%	0.3%	0.3%	0.3%	0.3%	0.3%	0.4%	0.7%	0.6%	0.2%	0.2%	0.2%	0.1%	0.1%	0.5%	0.7%	1.0%	2.0%	4.0%	100%					
Dec	0.5%	0.4%	0.6%	0.5%	0.5%	0.5%	0.6%	0.9%	0.5%	0.4%	0.3%	0.4%	0.2%	0.2%	0.2%	0.2%	0.3%	0.3%	0.4%	0.7%	0.9%	2.0%	79.9%			

In summary, this site could feasibly respond to calls for flexibility, as detailed in the D4-1 Specification and High-Level Architecture Document, and provide between **45 kW** and **114 kW** in demand reduction during the CMZ required time slots.

8.1.4 Porthgwidden (WW-MD)

Porthgwidden is one of the pumping stations that feeds wastewater into Hayle sewage treatment works so the project team have produced the same HH demand heat maps to enable a comparison with the treatments works' demand.

Table 8-30 shows the mean average total site HH demand by month for the years 2017-2021. As can be seen this site has higher than average demand across the months of July-February.

Table 8-30 Total Site HH Demand (Monthly Comparison 2017-2021)

Month	00:30	01:00	01:30	02:00	02:30	03:00	03:30	04:00	04:30	05:00	05:30	06:00	06:30	07:00	07:30	08:00	08:30	09:00	09:30	10:00	10:30	11:00
Jan	83	81	80	76	73	68	69	71	70	73	79	78	80	86	94	98	106	108	115	104	116	120
Feb	97	98	94	99	90	87	95	81	78	90	88	81	85	88	101	107	119	122	125	124	118	115
Mar	69	67	60	60	57	54	62	60	56	65	70	60	79	75	90	93	99	105	102	99	95	91
Apr	39	40	37	42	39	43	43	43	41	48	55	59	67	84	90	99	96	93	89	87	80	76
May	43	41	46	48	43	36	36	39	35	41	41	51	59	73	79	88	81	86	81	75	78	62
Jun	34	33	37	31	36	34	32	34	38	41	53	56	80	79	87	96	88	89	82	80	76	72
Jul	42	33	36	38	36	41	38	35	39	39	40	49	66	85	102	111	107	106	101	99	97	91
Aug	49	44	35	40	43	46	54	51	46	56	56	59	80	94	116	121	122	124	121	118	105	100
Sep	47	40	51	44	43	37	41	44	44	47	46	67	75	99	106	118	117	115	114	108	104	97
Oct	59	52	55	58	47	52	51	54	59	58	62	74	87	104	117	123	120	119	125	115	105	105
Nov	78	87	91	85	87	79	82	73	78	76	73	76	87	97	108	105	108	109	111	107	111	101
Dec	105	102	95	99	100	102	104	97	98	95	101	89	102	94	109	118	128	125	138	137	126	126

Month	11:30	12:00	12:30	13:00	13:30	14:00	14:30	15:00	15:30	16:00	16:30	17:00	17:30	18:00	18:30	19:00	19:30	20:00	20:30	21:00	21:30	22:00	22:30	23:00	23:30	00:00
Jan	113	114	106	107	101	112	105	97	102	98	94	97	97	105	97	94	87	97	88	84	93	83	87	85	82	81
Feb	116	117	101	100	101	99	101	99	103	104	97	95	97	106	110	116	104	98	108	103	91	101	100	93	100	95
Mar	92	80	85	82	81	92	88	81	74	85	72	93	93	97	101	103	95	90	89	79	85	84	84	82	74	76
Apr	71	75	58	70	60	67	65	62	70	59	63	66	80	107	77	78	71	69	69	66	67	60	54	52	45	43
May	71	61	66	62	66	68	61	65	65	57	57	58	72	106	72	70	58	63	58	59	55	55	55	46	45	35
Jun	65	70	67	65	66	64	67	64	72	72	72	69	82	93	82	71	68	68	62	57	67	58	54	51	53	34
Jul	83	79	77	73	62	68	67	63	73	81	86	81	87	88	89	79	79	78	76	78	76	70	61	56	44	35
Aug	98	84	86	90	76	72	79	78	86	101	105	105	114	104	103	94	91	87	87	82	76	77	73	61	60	50
Sep	89	87	73	85	75	79	77	81	74	87	82	91	94	90	96	85	73	79	82	71	85	61	68	59	60	55
Oct	101	91	92	88	100	86	83	76	85	76	85	87	93	99	101	88	84	91	85	77	86	75	77	71	67	58
Nov	104	93	97	104	98	100	95	86	93	84	97	98	99	98	107	106	99	93	92	88	92	91	86	103	91	80
Dec	128	117	126	122	114	119	112	111	108	105	107	115	125	124	120	124	117	116	111	108	109	107	99	109	115	119

Table 8-31 shows the total site HH demand monthly comparison for 2022 and the previous trend has changed to December, January and February being above average usage.

Table 8-31 Total Site HH Demand (Monthly Comparison 2022)

Month	00:30	01:00	01:30	02:00	02:30	03:00	03:30	04:00	04:30	05:00	05:30	06:00	06:30	07:00	07:30	08:00	08:30	09:00	09:30	10:00	10:30	11:00
Jan	38	54	34	47	45	37	46	51	39	36	45	48	51	54	65	70	63	85	80	72	76	98
Feb	54	40	45	39	57	43	42	45	40	57	59	56	73	64	90	75	104	107	105	123	121	105
Mar	73	81	49	49	57	49	48	49	40	46	52	48	69	52	76	75	82	91	83	73	89	82
Apr	38	40	45	27	30	45	19	28	31	49	27	55	54	65	80	89	80	86	82	74	66	71
May	32	19	24	23	19	35	22	21	22	27	34	37	46	58	74	64	78	82	68	70	60	64
Jun	26	22	29	20	24	28	28	25	29	26	34	56	47	65	88	71	73	89	75	69	65	65
Jul	34	23	24	17	23	36	23	18	24	30	26	43	43	60	74	68	73	87	71	65	64	67
Aug	33	23	26	17	22	36	25	18	25	29	27	44	43	61	75	67	75	89	71	65	65	66
Sep	33	22	26	18	22	35	24	20	24	28	27	44	42	62	75	68	73	87	73	65	64	66
Oct	32	24	24	17	24	34	24	18	23	31	27	42	44	59	74	68	73	87	70	66	64	66
Nov	32	22	27	17	23	34	25	18	25	29	26	44	43	62	74	67	74	87	70	65	65	66
Dec	89	93	77	71	73	59	77	85	89	80	90	94	97	96	109	120	102	105	118	116	113	113

Month	11:30	12:00	12:30	13:00	13:30	14:00	14:30	15:00	15:30	16:00	16:30	17:00	17:30	18:00	18:30	19:00	19:30	20:00	20:30	21:00	21:30	22:00	22:30	23:00	23:30	00:00
Jan	106	108	104	95	97	64	69	75	72	64	57	67	57	62	62	70	76	60	62	56	70	63	47	63	43	56
Feb	91	87	95	79	94	93	82	80	69	74	63	74	73	70	74	84	83	74	76	63	80	68	70	57	58	51
Mar	67	83	79	64	75	63	81	71	76	81	80	89	71	73	80	76	85	71	76	65	62	88	80	74	81	65
Apr	62	52	63	53	56	56	49	58	62	53	69	63	56	73	80	54	71	56	51	61	48	55	44	40	39	37
May	50	62	49	58	42	59	42	57	47	58	49	60	49	67	64	56	55	54	46	51	54	41	41	32	29	31
Jun	54	59	57	54	46	56	46	55	60	45	60	62	47	67	72	53	56	56	48	52	52	47	43	35	33	35
Jul	51	60	56	53	47	58	46	55	59	47	54	60	47	65	68	50	57	54	43	56	47	49	38	40	28	32
Aug	52	59	56	53	48	58	45	56	58	48	55	60	48	66	68	50	59	54	43	58	45	53	36	39	30	32
Sep	52	60	55	55	46	57	46	54	61	45	56	60	48	65	71	50	57	56	43	56	48	49	40	38	28	31
Oct	52	59	57	52	48	57	46	55	58	48	53	61	46	65	68	49	58	54	43	57	46	51	37	40	29	33
Nov	52	59	56	53	48	57	46	55	58	48	54	61	46	66	69	49	59	54	42	58	45	52	36	39	29	32
Dec	110	120	112	107	103	125	98	92	85	103	78	96	92	91	88	90	91	78	90	82	81	77	93	78	84	92

Table 8-32 shows at what time of day above average pumping demand is seen when compared within month. It can be seen that the site has significant above average demand from 06:30 - 12:00.

Table 8-32 Pumping Only HH Demand (In Month Comparison 2017-2021)

Month	00:30	01:00	01:30	02:00	02:30	03:00	03:30	04:00	04:30	05:00	05:30	06:00	06:30	07:00	07:30	08:00	08:30	09:00	09:30	10:00	10:30	11:00	11:30	12:00
Jan	75	73	72	69	66	61	62	64	63	66	71	70	72	77	84	88	96	97	104	93	104	108	102	102
Feb	87	88	84	89	81	78	85	73	71	81	79	73	77	80	91	97	107	110	112	112	106	104	104	105
Mar	62	60	54	54	51	49	56	54	50	59	63	54	72	67	81	84	89	94	92	89	86	82	83	72
Apr	35	36	33	38	35	39	39	39	37	43	49	53	60	75	81	89	86	84	80	78	72	69	64	68
May	39	37	41	43	39	32	33	35	31	37	37	46	53	66	71	80	73	78	73	67	70	56	64	54
Jun	30	30	34	28	33	30	29	31	34	37	48	51	72	71	78	87	79	80	73	72	68	64	58	63
Jul	38	30	32	34	32	36	34	31	35	35	36	44	59	77	92	100	96	95	91	90	87	82	75	71
Aug	44	40	32	36	39	41	49	46	42	50	50	53	72	84	104	109	110	112	109	106	94	90	88	76
Sep	42	36	46	39	38	33	37	40	40	42	41	60	68	89	95	106	106	104	103	97	94	87	80	79
Oct	53	47	50	52	42	47	46	48	53	52	56	67	78	94	106	111	108	108	112	103	94	95	91	82
Nov	70	78	81	76	78	71	74	66	70	69	65	68	78	88	97	95	97	98	100	96	100	91	93	84
Dec	94	92	85	89	90	91	94	87	88	86	91	81	92	85	98	106	115	112	125	124	113	113	115	105

Month	12:30	13:00	13:30	14:00	14:30	15:00	15:30	16:00	16:30	17:00	17:30	18:00	18:30	19:00	19:30	20:00	20:30	21:00	21:30	22:00	22:30	23:00	23:30	00:00
Jan	95	97	91	101	94	88	92	88	85	87	87	94	88	84	78	87	79	76	84	75	79	77	74	73
Feb	91	90	91	89	91	89	93	93	88	85	88	95	99	104	93	88	98	93	82	91	90	84	90	85
Mar	76	74	73	83	79	73	67	76	65	83	84	88	91	93	86	81	80	72	77	76	76	74	66	68
Apr	53	63	54	61	58	56	63	54	57	59	72	96	69	70	64	62	62	60	60	54	48	47	41	38
May	60	56	59	61	55	59	59	51	51	52	65	95	65	63	52	56	52	53	49	49	49	41	40	32
Jun	60	59	59	57	61	58	65	65	65	62	74	83	74	64	61	61	56	51	60	52	48	46	48	31
Jul	69	66	56	61	60	57	66	73	77	73	78	80	80	71	71	71	69	70	69	63	55	51	40	31
Aug	78	81	69	65	71	70	77	91	94	95	103	94	92	84	82	78	78	73	68	69	66	55	54	45
Sep	65	77	68	71	69	73	67	79	74	82	85	81	87	76	66	71	74	64	77	55	61	53	54	49
Oct	83	79	90	77	75	68	77	68	77	79	84	89	91	79	75	82	77	69	77	68	69	64	60	52
Nov	87	94	88	90	86	77	84	75	87	88	89	88	96	95	89	83	83	79	83	82	77	93	82	72
Dec	113	110	102	107	100	100	98	95	97	104	112	111	108	112	106	104	100	97	98	97	89	98	103	107

Looking at the in-month pumping HH demand for 2022 in Table 8-33, the trend indicates that the previous pattern continues.

Table 8-33 Pumping Only HH Demand (In Month Comparison 2022)

Month	00:30	01:00	01:30	02:00	02:30	03:00	03:30	04:00	04:30	05:00	05:30	06:00	06:30	07:00	07:30	08:00	08:30	09:00	09:30	10:00	10:30	11:00	11:30	12:00
Jan	35	48	31	42	40	33	41	46	35	32	40	43	46	48	58	63	57	76	72	64	68	88	95	97
Feb	48	36	41	35	52	39	38	40	36	51	53	50	66	57	81	67	93	96	95	111	109	94	82	78
Mar	66	73	44	44	51	44	43	44	36	41	47	43	62	47	69	67	74	82	75	66	80	74	60	75
Apr	34	36	40	25	27	41	17	25	28	44	24	50	48	58	72	81	72	78	74	67	60	64	56	47
May	29	17	22	21	17	32	20	19	20	25	31	33	42	53	67	58	70	73	61	63	54	58	45	56
Jun	24	20	26	18	22	25	26	22	26	24	30	51	42	58	79	63	66	80	67	62	58	59	49	53
Jul	30	21	22	16	21	32	21	16	22	27	24	39	39	54	66	61	65	79	64	58	57	60	46	54
Aug	29	21	24	15	20	32	22	16	22	26	24	39	39	55	67	60	67	80	64	58	59	59	47	53
Sep	30	20	23	16	20	31	22	18	21	25	25	40	38	56	68	61	66	78	66	58	58	60	46	54
Oct	29	22	22	16	21	31	22	16	21	28	24	38	40	53	66	61	65	79	63	59	57	59	47	53
Nov	29	20	24	16	21	31	23	16	22	26	24	40	38	55	67	61	67	79	63	59	58	59	47	53
Dec	80	83	69	64	66	53	69	76	80	72	81	84	87	87	98	108	92	94	106	105	101	102	99	108

Month	12:30	13:00	13:30	14:00	14:30	15:00	15:30	16:00	16:30	17:00	17:30	18:00	18:30	19:00	19:30	20:00	20:30	21:00	21:30	22:00	22:30	23:00	23:30	00:00
Jan	94	86	87	57	62	67	65	57	52	60	51	56	56	63	69	54	56	50	63	57	42	56	39	50
Feb	85	71	85	84	73	72	62	67	57	67	66	63	66	76	74	66	69	56	72	61	63	52	53	46
Mar	71	58	68	57	73	63	69	73	72	80	64	66	72	69	77	64	69	59	56	79	72	66	73	58
Apr	57	48	51	50	44	52	56	48	62	56	50	66	72	49	64	50	46	55	44	49	39	36	35	33
May	44	52	37	53	38	51	42	52	44	54	44	60	57	51	49	48	42	46	49	36	37	29	27	28
Jun	52	49	42	50	41	50	54	41	54	56	43	60	65	48	51	51	44	47	47	42	39	31	30	31
Jul	51	48	43	52	42	49	53	42	48	54	42	59	62	45	52	49	39	51	42	44	34	36	25	29
Aug	51	47	43	52	40	50	52	43	49	54	43	60	61	45	53	49	38	52	40	48	32	35	27	28
Sep	49	50	41	51	41	48	55	41	51	54	43	58	64	45	52	50	39	50	43	44	36	34	26	28
Oct	51	47	43	52	41	49	52	43	48	55	42	59	62	45	52	48	39	51	41	46	33	36	26	29
Nov	50	47	43	51	41	50	52	43	48	55	42	60	62	44	53	49	38	52	41	47	33	35	26	29
Dec	101	96	93	112	88	83	76	93	71	86	83	82	80	81	82	70	81	73	73	69	84	70	76	83

As can be seen in Table 8-34, a comparison of the site HH demand in 2022 vs the mean average for 2017-2021 shows demand is significantly lower across the majority of time periods and months.

Table 8-34 Change in HH Demand 2022 vs 2017-2021 Mean Average

Month	00:30	01:00	01:30	02:00	02:30	03:00	03:30	04:00	04:30	05:00	05:30	06:00	06:30	07:00	07:30	08:00	08:30	09:00	09:30	10:00	10:30	11:00	11:30	12:00
Jan	-54%	-34%	-57%	-39%	-39%	-46%	-34%	-28%	-45%	-51%	-43%	-38%	-37%	-37%	-31%	-29%	-41%	-21%	-31%	-31%	-35%	-19%	-7%	-5%
Feb	-44%	-34%	-52%	-61%	-36%	-50%	-56%	-45%	-49%	-37%	-33%	-32%	-14%	-28%	-11%	-30%	-13%	-12%	-15%	-1%	2%	-9%	-22%	-26%
Mar	6%	21%	-20%	-18%	-1%	-11%	-23%	-19%	-28%	-30%	-25%	-20%	-13%	-31%	-15%	-20%	-18%	-13%	-19%	-26%	-6%	-9%	-27%	4%
Apr	-3%	1%	22%	-34%	-22%	5%	-55%	-35%	-25%	2%	-51%	-7%	-20%	-23%	-12%	-10%	-16%	-8%	-8%	-15%	-18%	-6%	-13%	-31%
May	-25%	-53%	-47%	-53%	-56%	-1%	-38%	-46%	-37%	-34%	-16%	-27%	-21%	-20%	-6%	-27%	-4%	-6%	-16%	-6%	-23%	3%	-29%	3%
Jun	-21%	-33%	-23%	-35%	-34%	-17%	-11%	-28%	-24%	-35%	-37%	0%	-42%	-18%	1%	-27%	-16%	-1%	-8%	-14%	-14%	-9%	-16%	-16%
Jul	-20%	-31%	-33%	-54%	-35%	-12%	-38%	-48%	-39%	-22%	-35%	-11%	-34%	-29%	-28%	-38%	-32%	-17%	-30%	-35%	-34%	-27%	-38%	-24%
Aug	-34%	-48%	-26%	-57%	-48%	-23%	-54%	-65%	-47%	-48%	-52%	-26%	-46%	-34%	-36%	-45%	-39%	-29%	-41%	-45%	-38%	-34%	-47%	-30%
Sep	-29%	-45%	-50%	-58%	-49%	-6%	-42%	-54%	-47%	-41%	-41%	-34%	-44%	-37%	-29%	-42%	-38%	-25%	-36%	-40%	-38%	-31%	-42%	-31%
Oct	-46%	-54%	-56%	-70%	-50%	-35%	-52%	-66%	-60%	-47%	-57%	-43%	-49%	-43%	-37%	-45%	-40%	-27%	-44%	-43%	-39%	-37%	-49%	-34%
Nov	-59%	-74%	-70%	-79%	-74%	-57%	-69%	-75%	-68%	-62%	-64%	-42%	-51%	-37%	-31%	-36%	-31%	-20%	-37%	-39%	-42%	-35%	-50%	-37%
Dec	-15%	-9%	-19%	-28%	-26%	-42%	-26%	-12%	-9%	-16%	-11%	5%	-5%	2%	0%	2%	-20%	-16%	-15%	-15%	-11%	-10%	-14%	3%

Month	12:30	13:00	13:30	14:00	14:30	15:00	15:30	16:00	16:30	17:00	17:30	18:00	18:30	19:00	19:30	20:00	20:30	21:00	21:30	22:00	22:30	23:00	23:30	00:00	% Change
Jan	-2%	-11%	-4%	-43%	-34%	-23%	-30%	-35%	-39%	-31%	-41%	-41%	-36%	-25%	-12%	-38%	-29%	-34%	-25%	-24%	-47%	-26%	-48%	-31%	-31%
Feb	-6%	-20%	-7%	-6%	-19%	-19%	-33%	-29%	-35%	-22%	-25%	-34%	-33%	-27%	-20%	-25%	-30%	-39%	-12%	-33%	-30%	-39%	-42%	-46%	-28%
Mar	-7%	-22%	-7%	-32%	-7%	-13%	2%	-4%	11%	-4%	-24%	-25%	-21%	-26%	-10%	-21%	-15%	-18%	-27%	5%	-6%	-10%	11%	-14%	-14%
Apr	8%	-24%	-7%	-18%	-24%	-7%	-12%	-11%	10%	-5%	-30%	-32%	3%	-30%	-1%	-18%	-26%	-8%	-28%	-8%	-19%	-24%	-15%	-14%	-15%
May	-26%	-7%	-37%	-13%	-31%	-13%	-28%	2%	-14%	4%	-32%	-37%	-12%	-19%	-6%	-14%	-20%	-13%	-1%	-26%	-24%	-30%	-34%	-11%	-20%
Jun	-14%	-17%	-30%	-13%	-32%	-14%	-16%	-37%	-17%	-10%	-42%	-28%	-12%	-25%	-17%	-17%	-22%	-9%	-22%	-18%	-20%	-32%	-38%	1%	-20%
Jul	-27%	-27%	-23%	-15%	-31%	-14%	-20%	-42%	-38%	-26%	-46%	-26%	-23%	-37%	-27%	-31%	-44%	-28%	-39%	-30%	-38%	-29%	-37%	-7%	-30%
Aug	-34%	-41%	-38%	-20%	-43%	-29%	-32%	-52%	-48%	-43%	-58%	-37%	-34%	-46%	-35%	-38%	-51%	-29%	-41%	-31%	-51%	-36%	-49%	-37%	-40%
Sep	-25%	-35%	-39%	-28%	-40%	-33%	-18%	-48%	-31%	-35%	-49%	-28%	-27%	-41%	-22%	-29%	-47%	-21%	-43%	-19%	-41%	-36%	-53%	-43%	-36%
Oct	-38%	-40%	-52%	-33%	-45%	-28%	-32%	-37%	-38%	-30%	-50%	-34%	-32%	-44%	-31%	-41%	-50%	-26%	-47%	-33%	-52%	-44%	-57%	-44%	-42%
Nov	-42%	-49%	-51%	-43%	-52%	-36%	-37%	-43%	-45%	-37%	-53%	-32%	-36%	-54%	-41%	-41%	-54%	-34%	-51%	-43%	-58%	-62%	-68%	-60%	-48%
Dec	-11%	-12%	-9%	5%	-12%	-17%	-22%	-2%	-27%	-17%	-26%	-26%	-26%	-28%	-22%	-33%	-19%	-24%	-26%	-28%	-6%	-29%	-27%	-23%	-16%

Table 8-35 below summarises the pumping demand at this site:

Table 8-35 Pumping ½ hourly demand

	2017 - 2021	2022
• HH mean average demand	73 kW	52 kW
• HH max demand	125 kW (12:00 July)	112 kW (12:00 Jan)
• HH min demand	28 kW (17:30 Jan)	15 kW (03:30 July)
• Mean average HH demand during evening grid peak (17:00 – 19:00)	85 kW	59 kW
• Max demand released by a 50% reduction in pumping power demand when needed by the CMZ		56 kW

Demand Flexibility Available for the CMZ

Reviewing the specific NGED CMZ for this site, Table 8-36 below identifies the required demand turn down by month and time of day.

Table 8-36 2023-2026 CMZ Demand Reduction Requirement (Average kW)

Month	00:30	01:00	01:30	02:00	02:30	03:00	03:30	04:00	04:30	05:00	05:30	06:00	06:30	07:00	07:30	08:00	08:30	09:00	09:30	10:00	10:30	11:00	11:30	12:00	12:30	13:00	13:30	14:00	14:30	15:00	15:30	16:00	16:30	17:00	17:30	18:00	18:30	19:00	19:30	20:00	20:30	21:00	21:30	22:00	22:30	23:00	23:30	00:00
Jan	6,980	702	9,534	3,490	6,136	3,159	65	-	-	-	137	-	3,717	5,365	5,235	18,499	8,958	14,224	11,458	23,998	8,388	20,857	19,710	17,472	6,536	21,319	14,735	6,800	15,435	5,239	10,199	9,379	42,195	34,750	56,472	41,146	23,877	28,577	15,068	14,869	10,145	6,108	5,497	-	-	-	-	-
Feb	6,289	7,667	8,490	6,623	6,077	3,871	1,367	-	166	75	195	-	7,037	13,290	15,852	20,076	19,454	23,514	20,583	18,473	28,199	14,753	7,607	20,033	3,874	5,336	13,386	12,480	301	-	11,661	17,461	29,636	21,100	46,096	52,445	45,891	33,487	20,808	15,735	11,452	13,398	9,129	5,452	1,540	150	-	-
Mar	-	-	-	-	-	-	-	-	-	-	-	-	-	1,983	3,497	4,174	26,395	23,924	2,957	3,582	-	-	-	-	-	-	-	-	-	-	4,395	18,329	31,538	28,518	47,104	37,837	10,690	11,235	6,638	3,543	1,359	-	-	-	-	-	-	-	-
Apr	-	-	-	39	438	-	-	-	-	-	-	-	1,102	3,968	8,217	7,825	35,032	32,401	20,194	1,307	-	-	-	-	-	-	-	-	-	-	-	-	-	14,025	27,817	32,298	37,262	14,141	6,535	10,069	8,301	7,652	6,383	425	-	-	-	-
May	-	-	-	-	528	-	-	-	-	-	-	-	3,596	4,235	12,819	14,172	10,476	10,652	10,106	-	3,201	-	-	-	-	-	-	-	-	-	-	-	-	1,507	16,172	1,605	17,898	20,109	11,872	18,039	14,766	10,950	16,734	9,359	7,483	3,641	868	-
Jun	-	-	-	-	-	-	-	-	-	-	-	-	-	10,766	12,494	13,309	22,940	11,054	1,715	1,888	5,320	-	-	-	-	-	-	-	-	-	-	-	-	2,879	9,309	7,927	14,923	25,099	4,944	392	135	-	-	-	-	-	-	-
Jul	-	-	-	-	-	-	-	-	-	-	-	-	-	4,307	8,507	11,390	14,447	12,311	6,969	274	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3,350	11,954	19,078	20,405	-	-	-	-	-	-	-	-	-	-
Aug	-	-	-	-	-	-	-	-	-	-	-	-	-	5,414	5,484	5,872	14,160	12,224	17,464	18,901	19,554	20,629	7,949	1,754	8,347	2,641	-	-	-	-	1,646	6,051	-	14,411	18,295	30,736	11,334	19,632	2,912	1,599	784	344	171	-	-	-	-	-
Sep	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	539	6,147	12,153	18,984	16,672	10,447	10,947	9,762	3,886	5,946	7,235	4,537	843	8,312	8,000	7,804	14,391	16,115	20,776	16,781	4,821	2,116	1,473	921	11	-	-	-	-	-	-	-	-
Oct	-	-	-	-	-	-	-	-	-	-	-	-	-	2,081	4,797	6,607	3,881	6,083	12,027	10,080	27,677	13,872	15,909	12,286	17,351	22,389	12,203	13,244	8,722	14,167	13,058	16,032	13,092	11,904	19,989	13,018	14,805	13,032	9,607	5,333	3,753	935	-	-	-	-	-
Nov	-	-	-	-	-	-	-	-	-	-	-	-	-	1,241	6,739	6,292	4,234	4,866	4,642	31,148	33,697	34,165	26,994	28,337	31,609	30,712	27,641	26,515	21,871	12,450	15,209	41,102	46,577	54,845	63,691	53,978	14,733	11,840	8,928	5,509	2,652	9	-	-	-	-	-
Dec	6,043	8,855	8,489	3,886	9,828	511	-	-	-	-	-	949	6,071	9,205	12,327	15,693	22,395	24,459	19,945	18,476	14,787	20,432	21,949	17,027	20,388	17,999	20,352	15,240	10,608	20,045	22,808	29,979	25,613	44,283	45,832	42,596	34,425	25,258	24,729	28,332	14,853	10,688	4,786	116	-	-	-

By comparing the HH demand during the CMZ demand turn down time slots it is possible to estimate the range of demand flexibility this individual site could provide to the CMZ, assuming a 50% reduction in pumping demand. This is shown in Table 8-37 below.

Table 8-37 Pumping Potential Demand Flexibility (Average kW)

Month	00:30	01:00	01:30	02:00	02:30	03:00	03:30	04:00	04:30	05:00	05:30	06:00	06:30	07:00	07:30	08:00	08:30	09:00	09:30	10:00	10:30	11:00	11:30	12:00	12:30	13:00	13:30	14:00	14:30	15:00	15:30	16:00	16:30	17:00	17:30	18:00	18:30	19:00	19:30	20:00	20:30	21:00	21:30	22:00	22:30	23:00	23:30	00:00
Jan	17	24	16	21	20	17	20					22		24	29	31	28	38	36	32	34	44	48	49	47	43	44	29	31	34	32	29	26	30	26	28	28	31	34	27	28	25	31	28				
Feb	24	18	20	18	26	19	19		18	25	26		33	29	40	34	47	48	47	55	54	47	41	39	43	36	42	42	37		31	33	28	33	33	31	33	38	37	33	34	28	36	31	32	26			
Mar															34	34	37	41	37	33	40													40	32	33	36	34	38	32	34	29						
Apr				12	14									29	36	40	36	39	37	33	30													28	25	33	36	24	32	25	23	27	22	25				
May					9									26	33	29	35	37	31	32		29												27	22	30	29	25	25	24	21	23	24	18	19	14	13	
Jun															39	32	33	40	34	31	29	29												28	21	30	32	24	25	25	22							
Jul															33	31	33	39	32	29	29														21	29	31	22										
Aug															34	30	34	40	32	29	29	30	24	26	25	24	21				26	22		27	21	30	31	23	26	24	19	26	20					
Sep																	33	39	33	29	29	30	23	27	25	25	21	26	21	24	27	20	25	27	22	29	32	23	26	25								
Oct															33	31	33	39	32	30	29	30	23	27	26	24	21	26	21	25	26	21	24	27	21	29	31	22	26	24	19	26	21					
Nov															33	30	33	39	32	29	29	30	23	27	25	24	21	26	21	25	26	22	24	28	21	30	31	22	27	24	19	26	20					
Dec	40	42	35	32	33	27							44	43	49	54	46	47	53	52	51	51	50	54	50	48	46	56	44	42	38	47	35	43	41	41	40	40	41	35	41	37	36	35	42			

The red highlighted cells shows where the pumping demand is greater than or equal to the CMZ requirements. Table 8-38 below shows the percentage of the CMZ demand turn down requirement that could potentially be fulfilled by the SWW site.

Table 8-38 % of CMZ Requirements that could be fulfilled by the site.

Month	00:30	01:00	01:30	02:00	02:30	03:00	03:30	04:00	04:30	05:00	05:30	06:00	06:30	07:00	07:30	08:00	08:30	09:00	09:30	10:00	10:30	11:00	11:30	12:00	12:30	13:00	13:30	14:00	14:30	15:00	15:30	16:00	16:30	17:00	17:30	18:00	18:30	19:00	19:30	20:00	20:30	21:00	21:30	22:00	22:30	23:00	23:30	00:00
Jan	0.2%	3.4%	0.2%	0.6%	0.3%	0.5%	32%				15.7%		0.7%	0.5%	0.6%	0.2%	0.4%	0.3%	0.3%	0.1%	0.5%	0.2%	0.2%	0.3%	0.7%	0.2%	0.2%	0.5%	0.2%	0.6%	0.3%	0.3%	0.1%	0.1%	0.0%	0.1%	0.1%	0.1%	0.2%	0.2%	0.2%	0.5%	0.5%					
Feb	0.4%	0.2%	0.2%	0.3%	0.4%	0.5%	1.4%		10.8%	34%	13.5%		0.5%	0.2%	0.3%	0.2%	0.2%	0.2%	0.3%	0.2%	0.3%	0.3%	0.5%	0.2%	1.1%	0.7%	0.3%	0.3%	12.2%		0.3%	0.2%	0.1%	0.2%	0.1%	0.1%	0.1%	0.1%	0.2%	0.2%	0.3%	0.2%	0.4%	0.6%	2.1%	17.2%			
Mar															1.7%	1.0%	0.9%	0.2%	0.2%	1.1%	1.1%												0.0%	0.0%	0.1%	0.1%	0.1%	0.1%	0.3%	0.3%	0.5%	1.0%	2.2%					
Apr					31%	3.1%								2.6%	0.9%	0.5%	0.5%	0.1%	0.1%	0.2%	2.3%														0.2%	0.1%	0.1%	0.1%	0.2%	0.5%	0.2%	0.3%	0.4%	0.3%	5.8%				
May						1.6%								0.7%	0.8%	0.2%	0.2%	0.4%	0.3%	0.3%		0.9%													1.8%	0.1%	1.9%	0.2%	0.1%	0.2%	0.1%	0.1%	0.2%	0.1%	0.2%	0.2%	0.4%	1.5%			
Jun															0.4%	0.3%	0.2%	0.2%	0.3%	1.8%	0.7%	0.6%													1.0%	0.2%	0.4%	0.2%	0.1%	0.5%	6.5%	16.1%						
Jul															0.8%	0.4%	0.3%	0.3%	0.3%	0.4%	10.5%															0.6%	0.2%	0.2%	0.1%									
Aug															0.6%	0.5%	0.6%	0.3%	0.3%	0.2%	0.2%	0.2%	0.1%	0.3%	1.4%	0.3%	0.8%				1.6%	0.4%		0.2%	0.1%	0.1%	0.3%	0.1%	0.9%	1.5%	2.4%	7.6%	11.8%					
Sep																6.1%	0.6%	0.3%	0.2%	0.2%	0.3%	0.2%	0.3%	0.6%	0.4%	0.3%	0.6%	2.5%	0.3%	0.3%	0.3%	0.2%	0.2%	0.1%	0.2%	0.7%	1.1%	1.7%	2.7%	0%							
Oct															1.6%	0.6%	0.5%	1.0%	0.5%	0.2%	0.3%	0.1%	0.2%	0.2%	0.2%	0.1%	0.1%	0.2%	0.2%	0.3%	0.2%	0.2%	0.1%	0.2%	0.2%	0.1%	0.2%	0.2%	0.2%	0.3%	0.4%	0.7%	2.2%					
Nov															2.7%	0.5%	0.5%	0.9%	0.6%	0.6%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.2%	0.1%	0.1%	0.1%	0.1%	0.0%	0.0%	0.1%	0.2%	0.2%	0.3%	0.3%	1.0%	100%					
Dec	0.7%	0.5%	0.4%	0.8%	0.3%	5.2%							4.6%	0.7%	0.5%	0.4%	0.3%	0.2%	0.2%	0.3%	0.3%	0.3%	0.2%	0.2%	0.3%	0.2%	0.3%	0.3%	0.3%	0.4%	0.2%	0.2%	0.1%	0.2%	0.1%	0.1%	0.1%	0.1%	0.2%	0.1%	0.1%	0.2%	0.3%	0.7%	36.0%				

In summary, this site could feasibly respond to calls for flexibility, as detailed in the D4-1 Specification and High-Level Architecture Document, and provide between **9 kW** and **56 kW** in Power demand reduction during the CMZ required time slots.

Combined Demand Flexibility Available for the CMZ

With Hayle and Porthgwidden sites both linked to the same CMZ the potential combined effect the sites could have on the CMZ requirements is as seen in Table 8-39 below.

Table 8-39 Pumping Potential Demand Flexibility (Average kW)

Month	00:30	01:00	01:30	02:00	02:30	03:00	03:30	04:00	04:30	05:00	05:30	06:00	06:30	07:00	07:30	08:00	08:30	09:00	09:30	10:00	10:30	11:00	11:30	12:00	12:30	13:00	13:30	14:00	14:30	15:00	15:30	16:00	16:30	17:00	17:30	18:00	18:30	19:00	19:30	20:00	20:30	21:00	21:30	22:00	22:30	23:00	23:30	00:00
Jan	85	94	86	90	84	85	82					87		97	100	106	103	116	116	118	112	120	136	136	138	131	132	120	112	117	111	107	108	107	103	95	92	94	109	94	129	124	111	109				
Feb	80	72	74	72	75	72	71		70	80	78		89	92	102	101	111	114	116	130	124	127	119	113	113	111	111	115	106		99	105	91	98	92	94	87	95	110	96	133	112	100	92	99	91			
Mar															103	104	113	116	117	114	120													117	103	102	102	103	117	114	133	131						
Apr					68	67								87	97	105	102	108	112	108	101													85	76	84	108	82	122	100	82	89	84	89				
May						53								75	85	90	93	98	92	94		90													83	70	81	100	81	94	96	93	83	83	76	77	72	72	
Jun															87	85	92	102	96	90	91	92													83	66	80	103	81	95	109	83							
Jul															101	99	114	119	112	106	110															89	96	117	95										
Aug															103	108	115	125	117	116	118	114	104	105	104	101	97				103	98		103	91	101	124	102	121	130	99	110	101					
Sep																120	132	127	126	120	123	110	113	109	111	104	113	106	113	111	103	105	110	94	106	131	109	139	137									
Oct															113	111	116	130	124	120	118	113	115	115	108	104	100	105	101	106	107	98	93	101	91	97	119	99	121	117	109	108	102					
Nov															114	123	119	136	127	120	130	127	116	123	118	115	120	120	111	116	117	107	118	122	111	120	107	98	109	112	131	131	112					
Dec	123	127	124	116	117	112							130	133	136	147	141	140	150	152	150	149	151	150	151	148	143	154	142	140	132	146	126	141	134	127	116	117	124	120	140	145	136	128	135			

Table 8-40 below shows the percentage of the CMZ demand turn down requirement that could potentially be fulfilled by Hayle and Porthgwidden sites.

Table 8-40 % of CMZ Requirements that could be fulfilled by the sites.

Month	00:30	01:00	01:30	02:00	02:30	03:00	03:30	04:00	04:30	05:00	05:30	06:00	06:30	07:00	07:30	08:00	08:30	09:00	09:30	10:00	10:30	11:00	11:30	12:00	12:30	13:00	13:30	14:00	14:30	15:00	15:30	16:00	16:30	17:00	17:30	18:00	18:30	19:00	19:30	20:00	20:30	21:00	21:30	22:00	22:30	23:00	23:30	00:00
Jan	1.2%	13.4%	0.9%	2.6%	1.4%	2.7%	100%					63.8%		2.6%	1.9%	2.0%	0.6%	1.3%	0.8%	1.0%	0.5%	1.4%	0.7%	0.7%	0.8%	2.0%	0.6%	0.8%	1.6%	0.8%	2.1%	1.0%	1.2%	0.3%	0.3%	0.2%	0.2%	0.4%	0.4%	0.6%	0.9%	1.2%	1.8%	2.0%				
Feb	1.3%	0.9%	0.9%	1.1%	1.2%	1.9%	5.2%		42.1%	100%	40.1%		1.3%	0.7%	0.6%	0.5%	0.6%	0.5%	0.6%	0.7%	0.4%	0.9%	1.6%	0.6%	2.9%	2.1%	0.8%	0.9%	35.1%		0.8%	0.6%	0.3%	0.5%	0.2%	0.2%	0.2%	0.3%	0.5%	0.6%	1.2%	0.8%	1.1%	1.7%	6.4%	60.7%		
Mar															5.2%	3.0%	2.7%	0.4%	0.5%	3.9%	3.4%													0.4%	0.4%	0.2%	0.3%	1.0%	1.0%	1.7%	3.8%	9.7%						
Apr				100%	15.3%									7.9%	2.5%	1.3%	1.3%	0.3%	0.3%	0.5%	7.7%													0.6%	0.3%	0.3%	0.3%	0.6%	1.9%	1.0%	1.0%	1.2%	1.3%	21.0%				
May					10.1%									2.1%	2.0%	0.7%	0.7%	0.9%	0.9%	0.9%		2.8%												5.5%	0.4%	5.1%	0.6%	0.4%	0.8%	0.5%	0.6%	0.8%	0.5%	0.8%	1.0%	2.0%	8.3%	
Jun															0.8%	0.7%	0.7%	0.4%	0.9%	5.2%	2.3%	1.7%												2.9%	0.7%	1.0%	0.7%	0.3%	1.9%	27.7%	61.2%							
Jul															2.3%	1.2%	1.0%	0.8%	0.9%	1.5%	40.1%														2.7%	0.8%	0.6%	0.5%										
Aug															1.9%	2.0%	2.0%	0.9%	1.0%	0.7%	0.6%	0.6%	0.5%	1.3%	5.9%	1.2%	3.7%				6.2%	1.6%		0.7%	0.5%	0.3%	1.1%	0.5%	4.2%	8.1%	12.6%	32.0%	59.1%					
Sep																	22.3%	2.1%	1.0%	0.7%	0.7%	1.2%	1.0%	1.2%	2.8%	1.9%	1.4%	2.5%	12.6%	1.4%	1.4%	1.3%	0.7%	0.7%	0.5%	0.6%	2.7%	5.2%	9.4%	14.9%								
Oct															5.4%	2.3%	1.8%	3.3%	2.0%	1.0%	1.2%	0.4%	0.8%	0.7%	0.9%	0.6%	0.4%	0.9%	0.8%	1.2%	0.8%	0.8%	0.6%	0.8%	0.8%	0.5%	0.9%	0.7%	0.9%	1.2%	2.1%	2.9%	10.9%					
Nov															9.2%	1.8%	1.9%	3.2%	2.6%	2.6%	0.4%	0.4%	0.3%	0.5%	0.4%	0.4%	0.4%	0.4%	0.4%	0.5%	0.9%	0.7%	0.3%	0.3%	0.2%	0.2%	0.2%	0.7%	0.9%	1.3%	2.4%	4.9%	100%					
Dec	2.0%	1.4%	1.5%	3.0%	1.2%	21.9%							13.7%	2.2%	1.5%	1.2%	0.9%	0.6%	0.6%	0.8%	0.8%	1.0%	0.7%	0.7%	0.9%	0.7%	0.8%	0.8%	0.9%	1.3%	0.7%	0.6%	0.4%	0.6%	0.3%	0.3%	0.3%	0.3%	0.5%	0.5%	0.5%	1.0%	1.3%	2.7%	100%			

In summary these sites could feasibly respond to calls for flexibility, as detailed in the D4-1 Specification and High-Level Architecture Document, and provide between **53 kW** and **154 kW** in Power demand reduction during the CMZ required time slots.

8.1.5 Pynes (DW-WT)

Pynes is a drinking water treatment works with a small amount of renewable generation. Table 8-41 shows the mean average total site HH demand by month for the years 2017-2021. As can be seen this site has a fairly even HH demand across most months with April and May being minimally lower.

Table 8-41 Total Site HH Demand (Monthly Comparison 2017-2021)

Month	00:30	01:00	01:30	02:00	02:30	03:00	03:30	04:00	04:30	05:00	05:30	06:00	06:30	07:00	07:30	08:00	08:30	09:00	09:30	10:00	10:30	11:00	11:30	12:00	12:30	13:00	13:30	14:00	14:30	15:00	15:30	16:00	16:30	17:00	17:30	18:00	18:30	19:00	19:30	20:00	20:30	21:00	21:30	22:00	22:30	23:00	23:30	00:00
Jan	842	870	843	828	809	802	785	769	764	762	761	781	791	803	822	837	860	881	898	906	925	927	935	921	910	908	896	892	863	858	856	848	813	636	594	597	614	736	858	879	884	921	941	928	916	920	911	873
Feb	852	876	857	840	821	816	798	784	791	783	772	774	781	799	821	843	874	897	908	908	911	914	910	903	897	904	889	866	851	846	843	859	853	689	625	648	676	793	936	954	974	982	989	975	964	962	938	896
Mar	855	907	901	890	864	844	825	815	805	795	775	765	760	784	817	839	867	875	874	881	890	894	889	884	885	885	882	864	864	876	879	865	850	740	672	689	712	792	922	941	949	963	958	951	954	938	925	894
Apr	854	838	819	801	794	783	760	750	741	739	734	744	778	780	795	814	826	841	861	865	855	849	844	841	845	834	820	814	816	817	794	704	695	635	573	642	689	746	853	880	893	915	918	916	905	881	857	885
May	885	871	833	812	795	768	753	743	734	723	731	747	772	794	807	833	840	843	865	868	863	863	867	860	861	855	844	830	828	835	802	680	670	618	564	629	674	745	845	880	897	899	900	901	894	871	842	884
Jun	913	887	861	837	822	800	797	800	791	766	761	773	807	837	855	859	866	872	875	879	882	890	892	894	889	876	854	850	848	855	837	736	732	678	615	690	753	808	906	939	965	967	968	962	946	923	880	931
Jul	929	921	900	876	856	859	854	833	825	815	821	828	837	848	856	859	861	867	873	881	888	894	901	905	906	914	909	913	907	900	888	788	781	720	692	764	818	867	942	953	953	951	947	948	943	921	922	939
Aug	906	881	860	834	824	808	782	769	768	770	766	771	784	794	817	832	848	864	883	885	893	894	899	879	870	881	889	877	874	881	880	739	709	662	635	715	777	828	883	906	929	931	937	941	934	894	893	923
Sep	904	885	872	860	845	836	820	803	791	795	787	795	824	843	849	845	852	873	874	873	861	858	869	873	878	861	859	856	848	846	816	701	706	675	651	712	790	847	907	917	938	942	944	931	928	892	875	927
Oct	864	851	831	822	819	821	822	803	786	772	774	786	812	843	850	867	878	877	877	876	868	863	870	857	847	842	863	875	875	861	846	714	705	652	604	674	727	774	880	906	930	926	935	939	923	896	874	895
Nov	847	867	849	831	819	814	811	808	801	798	792	786	793	807	829	863	891	901	901	902	901	909	920	916	900	898	906	898	888	888	880	854	834	704	640	656	677	760	900	917	923	937	954	957	934	919	905	881
Dec	824	869	864	830	807	802	793	785	766	749	745	761	767	801	833	853	859	866	872	883	893	891	882	872	854	854	862	868	877	874	855	842	801	649	603	611	628	732	863	891	912	931	938	940	930	922	900	842

Table 8-42 shows the total site HH demand monthly comparison for 2022. The previous trend continues, with a definite demand increase seen in July and August.

Table 8-42 Total Site HH Demand (Monthly Comparison 2022)

Month	00:30	01:00	01:30	02:00	02:30	03:00	03:30	04:00	04:30	05:00	05:30	06:00	06:30	07:00	07:30	08:00	08:30	09:00	09:30	10:00	10:30	11:00	11:30	12:00	12:30	13:00	13:30	14:00	14:30	15:00	15:30	16:00	16:30	17:00	17:30	18:00	18:30	19:00	19:30	20:00	20:30	21:00	21:30	22:00	22:30	23:00	23:30	00:00
Jan	980	989	960	963	956	921	896	878	872	869	881	888	890	898	928	952	998	1,034	1,047	979	935	956	975	1,010	1,004	1,022	991	986	973	955	965	994	999	986	980	1,042	1,058	1,055	1,066	1,073	1,057	1,047	1,022	1,031	1,041	1,051	1,028	998
Feb	970	980	962	916	910	925	919	893	852	868	911	921	929	938	995	1,013	1,047	1,071	1,084	1,071	1,076	1,066	1,054	1,064	1,051	1,005	1,061	1,076	1,084	1,041	1,003	1,040	1,083	1,079	1,070	1,060	1,030	1,021	1,030	1,093	1,092	1,110	1,082	1,073	1,073	1,022	1,001	975
Mar	957	937	922	898	868	852	893	860	814	803	813	806	862	958	1,016	1,046	1,070	1,084	1,111	1,113	1,045	1,028	1,062	1,084	1,101	1,066	1,039	1,039	1,037	1,019	1,019	1,015	1,057	1,074	1,095	1,054	1,031	1,025	996	998	1,036	1,062	1,039	1,019	1,009	1,011	996	993
Apr	823	832	824	818	807	775	786	773	755	776	854	872	925	969	998	998	995	1,029	1,053	1,018	994	940	917	929	932	879	877	888	892	921	926	915	947	982	1,011	1,042	1,035	974	899	930	923	914	895	885	897	888	885	866
May	839	783	744	755	755	745	757	760	787	777	784	777	874	945	988	992	1,003	1,013	990	952	902	882	904	906	828	818	812	847	816	867	897	940	938	923	958	933	938	978	997	1,018	1,001	998	973	972	921	890	880	867
Jun	866	869	885	852	815	741	728	701	671	709	769	825	896	940	934	913	957	958	952	948	981	1,009	1,025	1,039	1,049	994	998	1,003	1,010	1,023	1,015	995	1,010	1,026	1,057	1,063	1,036	1,014	989	987	1,003	1,003	977	952	899	870	844	841
Jul	990	968	952	969	933	915	887	873	861	869	885	871	946	1,042	1,089	1,098	1,111	1,122	1,131	1,119	1,131	1,122	1,118	1,120	1,126	1,106	1,092	1,101	1,100	1,085	1,107	1,109	1,104	1,131	1,143	1,118	1,112	1,102	1,070	1,048	1,057	1,050	1,057	1,054	1,045	1,039	1,005	992
Aug	1,100	1,112	1,087	1,076	1,067	1,055	999	967	971	970	973	990	1,035	1,031	1,075	1,092	1,112	1,133	1,133	1,123	1,158	1,181	1,222	1,192	1,173	1,144	1,133	1,119	1,118	1,113	1,096	1,099	1,098	1,109	1,122	1,130	1,101	1,099	1,104	1,131	1,145	1,115	1,091	1,126	1,132	1,126	1,112	1,076
Sep	1,005	969	957	943	942	921	895	863	823	880	887	877	932	1,006	1,065	1,076	1,065	1,058	1,051	1,065	1,085	1,077	1,046	1,039	1,040	1,008	1,038	1,065	1,067	1,092	1,106	1,072	1,075	1,079	1,053	1,096	1,051	1,083	1,129	1,072	1,096	1,022	1,068	1,053	1,043	1,039	1,049	1,025
Oct	836	781	747	735	746	723	744	766	760	747	732	727	780	806	837	861	915	931	932	909	885	865	862	889	894	866	837	816	832	892	933	949	946	942	943	963	974	950	941	903	902	918	897	913	943	943	910	864
Nov	957	964	972	927	913	897	882	867	847	834	827	870	869	885	950	1,019	1,020	1,023	1,057	1,077	1,028	989	1,014	1,051	1,075	1,094	1,099	1,089	1,081	1,103	1,050	1,074	1,088	1,047	1,061	1,092	1,128	1,098	1,090	1,134	1,144	1,112	1,069	1,040	1,012	983	951	945
Dec	1,058	1,055	1,009	1,014	996	952	953	960	942	927	925	928	956	988	1,030	1,073	1,082	1,084	1,114	1,140	1,137	1,124	1,142	1,117	1,098	1,088	1,093	1,100	1,101	1,106	1,136	1,157	1,084	1,059	1,067	1,090	1,074	1,082	1,082	1,095	1,116	1,122	1,129	1,113	1,080	1,037	1,038	1,025

Table 8-43 shows at what time of day the above average pumping demand is seen when compared within month. It can be seen that the site has above average demand from 09:00 - 15:00, then significant above average demand 19:30 – 00:00.

Table 8-43 Pumping Only HH Demand (In Month Comparison 2017-2021)

Month	00:30	01:00	01:30	02:00	02:30	03:00	03:30	04:00	04:30	05:00	05:30	06:00	06:30	07:00	07:30	08:00	08:30	09:00	09:30	10:00	10:30	11:00	11:30	12:00	12:30	13:00	13:30	14:00	14:30	15:00	15:30	16:00	16:30	17:00	17:30	18:00	18:30	19:00	19:30	20:00	20:30	21:00	21:30	22:00	22:30	23:00	23:30	00:00
Jan	556	574	557	547	534	529	518	508	504	503	502	515	522	530	542	552	568	581	593	598	611	612	617	608	601	599	592	589	570	566	565	560	537	420	392	394	405	486	566	580	583	608	621	612	605	607	601	576
Feb	563	578	565	555	542	539	527	517	522	517	510	511	515	528	542	556	577	592	599	599	602	603	601	596	592	597	586	572	562	558	557	567	563	455	412	428	446	524	618	630	643	648	653	643	636	635	619	592
Mar	564	598	595	588	570	557	544	538	531	525	512	505	501	518	539	554	573	578	577	581	587	590	587	583	584	584	582	571	570	578	580	571	561	488	443	455	470	523	609	621	626	636	632	628	630	619	611	590
Apr	564	553	540	529	524	517	501	495	489	488	485	491	513	515	524	537	545	555	568	571	564	560	557	555	558	551	541	537	539	539	524	465	459	419	378	424	455	493	563	581	590	604	606	605	598	581	565	584
May	584	575	550	536	525	507	497	490	484	477	483	493	510	524	533	550	554	557	571	573	570	570	572	568	568	564	557	548	547	551	529	449	442	408	372	415	445	492	558	581	592	593	594	595	590	575	556	583
Jun	603	586	569	552	542	528	526	528	522	506	502	510	532	552	564	567	571	575	578	580	582	587	589	590	586	578	563	561	559	564	552	486	483	447	406	455	497	533	598	619	637	638	639	635	624	609	581	614
Jul	613	608	594	578	565	567	563	549	545	538	542	546	552	559	565	567	569	572	576	582	586	590	595	597	598	603	600	602	598	594	586	520	515	475	457	504	540	572	622	629	629	628	625	626	623	608	608	620
Aug	598	581	568	550	544	533	516	507	507	508	506	509	517	524	539	549	560	570	583	584	590	590	593	580	575	582	587	579	577	582	581	488	468	437	419	472	513	546	583	598	613	615	619	621	616	590	590	609
Sep	597	584	576	568	558	552	541	530	522	525	519	525	544	557	560	558	562	576	577	576	569	566	574	576	580	568	567	565	560	558	539	463	466	446	430	470	521	559	598	605	619	621	623	615	612	589	578	612
Oct	570	561	548	542	541	542	542	530	518	510	511	519	536	556	561	572	579	579	579	578	573	569	574	566	559	556	570	577	578	569	558	471	465	430	399	445	480	511	581	598	614	611	617	620	609	591	577	591
Nov	559	572	561	549	540	537	535	533	529	527	523	519	523	533	547	569	588	595	594	596	595	600	607	605	594	593	598	593	586	586	581	564	551	465	422	433	447	502	594	605	609	618	630	632	617	606	597	582
Dec	544	574	570	548	532	529	524	518	506	494	492	502	506	528	550	563	567	571	576	583	589	588	582	576	564	564	569	573	579	577	565	556	529	428	398	403	415	483	570	588	602	615	619	620	614	608	594	556

Looking at the in-month pumping HH demand for 2022 in Table 8-44, the demand trend indicates that the above average pumping demand no longer has a fixed pattern.

Table 8-44 Pumping Only HH Demand (In Month Comparison 2022)

Month	00:30	01:00	01:30	02:00	02:30	03:00	03:30	04:00	04:30	05:00	05:30	06:00	06:30	07:00	07:30	08:00	08:30	09:00	09:30	10:00	10:30	11:00	11:30	12:00
Jan	647	653	634	635	631	608	591	580	576	573	581	586	587	593	613	628	659	683	691	646	617	631	643	667
Feb	641	647	635	605	600	610	607	589	562	573	601	608	613	619	657	668	691	707	715	707	710	704	696	702
Mar	632	618	609	593	573	562	589	568	537	530	537	532	569	633	671	690	706	715	733	735	690	678	701	715
Apr	543	549	544	540	533	512	519	510	498	512	563	576	610	639	658	659	657	679	695	672	656	621	605	613
May	553	517	491	498	498	491	500	502	519	513	517	513	577	624	652	655	662	669	654	628	596	582	597	598
Jun	572	573	584	562	538	489	481	462	443	468	508	545	591	620	616	602	632	632	628	625	647	666	676	686
Jul	653	639	628	640	616	604	585	576	568	573	584	575	624	688	718	724	733	740	746	739	746	740	738	739
Aug	726	734	717	710	704	696	660	638	641	640	642	653	683	681	710	721	734	748	748	741	764	779	806	787
Sep	663	640	632	622	622	608	591	569	543	581	585	579	615	664	703	710	703	698	694	703	716	711	690	686
Oct	552	515	493	485	493	477	491	505	502	493	483	480	515	532	552	568	604	614	615	600	584	571	569	587
Nov	631	636	642	612	602	592	582	572	559	550	546	574	574	584	627	672	673	675	698	711	678	653	669	694
Dec	698	696	666	669	657	629	629	634	622	612	610	613	631	652	680	708	714	715	735	753	750	742	754	738

Month	12:30	13:00	13:30	14:00	14:30	15:00	15:30	16:00	16:30	17:00	17:30	18:00	18:30	19:00	19:30	20:00	20:30	21:00	21:30	22:00	22:30	23:00	23:30	00:00
Jan	663	675	654	651	642	630	637	656	660	651	647	688	698	696	703	708	697	691	675	681	687	694	679	658
Feb	694	664	700	710	715	687	662	687	715	712	706	700	680	674	680	722	721	733	714	708	708	675	661	644
Mar	726	704	686	686	685	673	673	670	698	709	723	696	680	676	657	659	684	701	685	672	666	667	657	655
Apr	615	580	579	586	589	608	611	604	625	648	667	688	683	643	593	614	609	603	591	584	592	586	584	572
May	546	540	536	559	539	572	592	620	619	609	632	616	619	645	658	672	661	659	642	642	608	587	581	572
Jun	692	656	658	662	667	675	670	657	667	677	698	702	684	669	652	651	662	662	645	628	594	574	557	555
Jul	743	730	721	727	726	716	730	732	729	747	754	738	734	727	706	692	698	693	698	696	689	686	663	655
Aug	774	755	748	738	738	734	723	725	724	732	741	746	726	725	728	747	755	736	720	743	747	743	734	710
Sep	686	665	685	703	704	721	730	708	709	712	695	723	694	714	745	708	723	675	705	695	688	686	692	676
Oct	590	572	553	538	549	589	616	626	624	621	622	636	643	627	621	596	595	606	592	603	623	622	601	570
Nov	710	722	726	719	714	728	693	709	718	691	700	721	744	725	720	748	755	734	706	686	668	649	628	624
Dec	725	718	721	726	726	730	750	763	715	699	704	719	709	714	714	723	736	741	745	734	712	685	685	677

As can be seen in Table 8-45 a comparison of the pumping demand in 2022 vs the mean average for 2017-2021 shows that the site in 2022 has a significantly higher pumping demand across all time periods and months, with a specific spike seen from 16:00 until 19:00.

Table 8-45 Change in HH Demand 2022 vs 2017-2021 Mean Average

Month	00:30	01:00	01:30	02:00	02:30	03:00	03:30	04:00	04:30	05:00	05:30	06:00	06:30	07:00	07:30	08:00	08:30	09:00	09:30	10:00	10:30	11:00	11:30	12:00
Jan	16%	14%	14%	16%	18%	15%	14%	14%	14%	14%	16%	14%	13%	12%	13%	14%	16%	17%	17%	8%	1%	3%	4%	10%
Feb	14%	14%	12%	9%	11%	13%	15%	14%	8%	11%	18%	19%	19%	17%	21%	20%	20%	19%	19%	18%	18%	17%	16%	18%
Mar	12%	3%	2%	1%	0%	1%	8%	6%	1%	1%	5%	5%	13%	22%	24%	25%	23%	24%	27%	26%	17%	15%	19%	23%
Apr	-4%	-1%	1%	2%	2%	-1%	3%	3%	2%	5%	16%	17%	19%	24%	26%	23%	20%	22%	22%	18%	16%	11%	9%	10%
May	-5%	-10%	-11%	-7%	-5%	-3%	1%	2%	7%	7%	7%	4%	13%	19%	22%	19%	19%	20%	14%	10%	5%	2%	4%	5%
Jun	-5%	-2%	3%	2%	-1%	-7%	-9%	-12%	-15%	-7%	1%	7%	11%	12%	9%	6%	11%	10%	9%	8%	11%	13%	15%	16%
Jul	6%	5%	6%	11%	9%	7%	4%	5%	4%	7%	8%	5%	13%	23%	27%	28%	29%	29%	30%	27%	27%	26%	24%	24%
Aug	21%	26%	26%	29%	29%	31%	28%	26%	26%	26%	27%	28%	32%	30%	32%	31%	31%	31%	28%	27%	30%	32%	36%	36%
Sep	11%	10%	10%	10%	12%	10%	9%	7%	4%	11%	13%	10%	13%	19%	25%	27%	25%	21%	20%	22%	26%	25%	20%	19%
Oct	-3%	-8%	-10%	-11%	-9%	-12%	-9%	-5%	-3%	-3%	-5%	-7%	-4%	-4%	-2%	-1%	4%	6%	6%	4%	2%	0%	-1%	4%
Nov	13%	11%	14%	12%	12%	10%	9%	7%	6%	4%	4%	11%	10%	10%	15%	18%	15%	14%	17%	19%	14%	9%	10%	15%
Dec	28%	21%	17%	22%	23%	19%	20%	22%	23%	24%	24%	22%	25%	23%	24%	26%	26%	25%	28%	29%	27%	26%	30%	28%

Month	12:30	13:00	13:30	14:00	14:30	15:00	15:30	16:00	16:30	17:00	17:30	18:00	18:30	19:00	19:30	20:00	20:30	21:00	21:30	22:00	22:30	23:00	23:30	00:00	% Change
Jan	10%	13%	11%	10%	13%	11%	13%	17%	23%	55%	65%	75%	72%	43%	24%	22%	20%	14%	9%	11%	14%	14%	13%	14%	17%
Feb	17%	11%	19%	24%	27%	23%	19%	21%	27%	57%	71%	63%	52%	29%	10%	15%	12%	13%	9%	10%	11%	6%	7%	9%	19%
Mar	24%	20%	18%	20%	20%	16%	16%	17%	24%	45%	63%	53%	45%	29%	8%	6%	9%	10%	8%	7%	6%	8%	8%	11%	16%
Apr	10%	5%	7%	9%	9%	13%	17%	30%	36%	55%	76%	62%	50%	30%	5%	6%	3%	0%	-2%	-3%	-1%	1%	3%	-2%	13%
May	-4%	-4%	-4%	2%	-1%	4%	12%	38%	40%	49%	70%	48%	39%	31%	18%	16%	12%	11%	8%	8%	3%	2%	5%	-2%	10%
Jun	18%	13%	17%	18%	19%	20%	21%	35%	38%	51%	72%	54%	38%	26%	9%	5%	4%	4%	1%	-1%	-5%	-6%	-4%	-10%	10%
Jul	24%	21%	20%	21%	21%	21%	25%	41%	41%	57%	65%	46%	36%	27%	14%	10%	11%	10%	12%	11%	11%	13%	9%	6%	19%
Aug	35%	30%	27%	28%	28%	26%	25%	49%	55%	67%	77%	58%	42%	33%	25%	25%	23%	20%	16%	20%	21%	26%	24%	17%	30%
Sep	18%	17%	21%	24%	26%	29%	36%	53%	52%	60%	62%	54%	33%	28%	25%	17%	17%	9%	13%	13%	12%	17%	20%	11%	21%
Oct	6%	3%	-3%	-7%	-5%	4%	10%	33%	34%	44%	56%	43%	34%	23%	7%	0%	-3%	-1%	-4%	-3%	2%	5%	4%	-4%	3%
Nov	20%	22%	21%	21%	22%	24%	19%	26%	30%	49%	66%	66%	67%	44%	21%	24%	24%	19%	12%	9%	8%	7%	5%	7%	18%
Dec	29%	27%	27%	27%	26%	27%	33%	37%	35%	63%	77%	78%	71%	48%	25%	23%	22%	20%	20%	18%	16%	13%	15%	22%	28%

Table 8-46 below summarises the pumping demand at this site:

Table 8-46 Pumping ½ hourly demand

	2017 - 2021	2022
• HH mean average demand	555 kW	650 kW
• HH max demand	653 kW (21:30 Feb)	806 kW (11:30 Aug)
• HH min demand	372 kW (17:30 May)	443 kW (04:30 Jun)
• Mean average HH demand during evening grid peak (17:00 – 19:00)	457 kW	690 kW
• Max demand released by a 50% reduction in pumping power demand when needed by the CMZ	[redacted]	382 kW

Demand Flexibility Available for the CMZ

Reviewing the specific NGED CMZ for this site to ascertain when the CMZ requires demand reduction, Table 8-47 below identifies the required demand turn down by month and time of day.

Table 8-47 2023-2026 CMZ Demand Reduction Requirement (Average kW)

Month	00:30	01:00	01:30	02:00	02:30	03:00	03:30	04:00	04:30	05:00	05:30	06:00	06:30	07:00	07:30	08:00	08:30	09:00	09:30	10:00	10:30	11:00	11:30	12:00
Jan	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	826	3,235	5,239	7,623	8,912	8,920	8,796	8,725	8,374
Feb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	740	1,950	5,905	9,597	8,933	8,349	8,067	8,553
Mar	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	204	1,066	713	1,056	1,477	2,117	2,110
Apr	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,944	-	-	-
May	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jun	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jul	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aug	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sep	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oct	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nov	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	300	1,432	1,728	1,604	1,863	1,589	1,571
Dec	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	353	1,637	3,139	4,024	3,800	3,439	2,885	2,744

Month	12:30	13:00	13:30	14:00	14:30	15:00	15:30	16:00	16:30	17:00	17:30	18:00	18:30	19:00	19:30	20:00	20:30	21:00	21:30	22:00	22:30	23:00	23:30	00:00
Jan	9,550	8,710	8,123	7,309	6,520	6,082	5,664	6,018	8,429	11,939	13,988	14,064	12,832	10,534	7,484	4,156	827	-	-	-	-	-	-	-
Feb	9,141	9,067	8,078	6,940	5,864	5,023	4,689	5,207	7,723	8,400	10,988	13,528	12,306	10,107	7,571	2,982	431	-	-	-	-	-	-	-
Mar	1,964	1,649	1,003	19	-	-	-	-	439	1,319	2,918	4,380	6,278	5,819	3,593	813	-	-	-	-	-	-	-	-
Apr	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
May	-	-	-	-	-	-	-	-	-	-	-	1,670	-	-	-	-	-	-	-	-	-	-	-	-
Jun	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jul	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aug	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sep	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oct	-	-	-	-	-	-	-	-	-	671	3,083	3,341	1,660	366	-	-	-	-	-	-	-	-	-	-
Nov	2,801	2,702	2,007	1,276	718	602	652	1,627	4,774	9,399	11,070	10,408	8,739	6,309	3,261	778	-	-	-	-	-	-	-	-
Dec	3,372	3,038	2,410	1,627	1,344	1,269	1,782	3,432	7,154	10,684	11,600	11,059	8,854	6,575	3,859	1,012	-	-	-	-	-	-	-	-

By comparing the HH demand during the CMZ demand turn down time slots it is possible to estimate the range of demand flexibility this individual site could provide to the CMZ assuming a 50% reduction in pumping demand. This is shown in Table 8-48 below.

Table 8-48 Pumping Potential Demand Flexibility (Average kW)

Month	00:30	01:00	01:30	02:00	02:30	03:00	03:30	04:00	04:30	05:00	05:30	06:00	06:30	07:00	07:30	08:00	08:30	09:00	09:30	10:00	10:30	11:00	11:30	12:00	12:30	13:00	13:30	14:00	14:30	15:00	15:30	16:00	16:30	17:00	17:30	18:00	18:30	19:00	19:30	20:00	20:30	21:00	21:30	22:00	22:30	23:00	23:30	00:00
Jan																314	329	341	346	323	309	316	322	333	331	337	327	325	321	315	318	328	330	325	324	344	349	348	352	354	349							
Feb																	346	353	358	353	355	352	348	351	347	332	350	355	358	343	331	343	357	356	353	350	340	337	340	361	360							
Mar																		358	367	367	345	339	350	358	363	352	343	343					349	355	361	348	340	338	329	329								
Apr																					328																											
May																																				308												
Jun																																																
Jul																																																
Aug																																																
Sep																																																
Oct																																		311	311	318	321	314										
Nov																		338	349	355	339	326	335	347	355	361	363	359	357	364	346	355	359	345	350	361	372	362	360	374								
Dec																	357	358	368	376	375	371	377	369	362	359	361	363	363	365	375	382	358	349	352	360	354	357	357	361								

The red highlighted cells shows where the pumping demand is greater than or equal to the CMZ requirements.

Table 8-38 below shows the percentage of the CMZ demand turn down requirement that could potentially be fulfilled by the SWW site.

Table 8-49 % of CMZ Requirements that could be fulfilled by the site.

Month	00:30	01:00	01:30	02:00	02:30	03:00	03:30	04:00	04:30	05:00	05:30	06:00	06:30	07:00	07:30	08:00	08:30	09:00	09:30	10:00	10:30	11:00	11:30	12:00	12:30	13:00	13:30	14:00	14:30	15:00	15:30	16:00	16:30	17:00	17:30	18:00	18:30	19:00	19:30	20:00	20:30	21:00	21:30	22:00	22:30	23:00	23:30	00:00
Jan																38.0%	10.2%	6.5%	4.5%	3.6%	3.5%	3.6%	3.7%	4.0%	3.5%	3.9%	4.0%	4.5%	4.9%	5.2%	5.6%	5.5%	3.9%	2.7%	2.3%	2.4%	2.7%	3.3%	4.7%	8.5%	42.1%							
Feb																	46.7%	18.1%	6.1%	3.7%	4.0%	4.2%	4.3%	4.1%	3.8%	3.7%	4.3%	5.1%	6.1%	6.8%	7.1%	6.6%	4.6%	4.2%	3.2%	2.6%	2.8%	3.3%	4.5%	12.1%	83.7%							
Mar																		100%	34.4%	51.5%	32.7%	23.0%	16.5%	16.9%	18.5%	21.3%	34.2%	100%					79.5%	26.9%	12.4%	7.9%	5.4%	5.8%	9.1%	40.5%								
Apr																					11.1%																											
May																																				18.4%												
Jun																																																
Jul																																																
Aug																																																
Sep																																																
Oct																																		46.3%	10.1%	9.5%	19.4%	85.7%										
Nov																		100%	24.4%	20.6%	21.1%	17.5%	21.1%	22.1%	12.7%	13.4%	18.1%	28.2%	49.7%	60.4%	53.2%	21.8%	7.5%	3.7%	3.2%	3.5%	4.3%	5.7%	11.0%	48.1%								
Dec																	100%	21.8%	11.7%	9.3%	9.9%	10.8%	13.1%	13.4%	10.7%	11.8%	15.0%	22.3%	27.0%	28.7%	21.1%	11.1%	5.0%	3.3%	3.0%	3.3%	4.0%	5.4%	9.3%	35.7%								

In summary, this site could feasibly respond to calls for flexibility, as detailed in the D4-1 Specification and High-Level Architecture Document, and provide between **308 kW** and **382 kW** in Power demand reduction during the CMZ required time slots.

8.1.6 Dunsford Hill (DW-WD)

Dunsford Hill is one of the pumping stations that feeds wastewater into Pynes water treatment works so the project team have produced the same HH demand heat maps to enable a comparison with the treatments works demand.

Table 8-50 shows the mean average HH demand by month for the years 2017-2021. As can be seen this site has higher than average demand across the summer months June - September.

Table 8-50 Total Site HH Demand (Monthly Comparison 2017-2021)

Month	00:30	01:00	01:30	02:00	02:30	03:00	03:30	04:00	04:30	05:00	05:30	06:00	06:30	07:00	07:30	08:00	08:30	09:00	09:30	10:00	10:30	11:00	11:30	12:00	12:30	13:00	13:30	14:00	14:30	15:00	15:30	16:00	16:30	17:00	17:30	18:00	18:30	19:00	19:30	20:00	20:30	21:00	21:30	22:00	22:30	23:00	23:30	00:00
Jan	88	80	69	56	51	47	44	44	42	45	48	52	60	63	67	75	83	88	92	100	106	109	112	114	114	113	114	116	118	114	108	104	84	65	65	66	69	89	106	113	116	116	113	110	108	101	96	92
Feb	135	132	127	117	108	103	96	89	83	78	78	84	89	94	104	115	127	136	144	150	151	156	157	158	163	166	165	164	158	157	158	159	145	122	121	122	125	148	164	165	165	164	163	160	158	153	148	143
Mar	112	104	93	87	82	74	67	65	64	66	65	68	70	71	73	83	96	111	123	133	139	139	139	140	142	143	145	148	146	145	146	142	134	117	117	119	120	133	144	142	142	143	142	140	136	129	126	118
Apr	90	81	75	72	71	69	65	63	61	61	69	82	92	102	113	125	135	145	154	160	162	160	160	159	156	155	156	155	156	155	146	128	126	128	132	151	163	164	162	161	162	156	150	141	133	128	116	101
May	123	114	108	101	96	92	88	85	83	84	95	109	122	131	138	149	164	173	177	182	187	188	186	183	181	180	177	176	176	176	171	158	159	162	165	178	180	179	177	176	179	178	176	171	165	157	143	131
Jun	160	155	151	147	140	139	136	130	129	131	135	145	156	165	177	192	203	210	214	219	224	222	219	216	212	207	205	205	202	202	196	188	189	192	193	208	213	215	218	215	212	209	204	197	190	185	177	167
Jul	183	169	159	155	151	145	141	138	136	138	143	152	156	168	183	196	204	212	219	219	222	222	220	219	221	220	218	222	225	228	226	212	211	209	212	227	234	234	229	227	223	217	214	212	208	200	194	189
Aug	171	164	160	156	149	144	138	130	124	120	127	129	133	147	160	176	190	199	205	211	214	218	219	217	215	212	211	212	213	213	207	198	201	202	204	221	230	235	237	234	227	220	211	204	202	202	196	184
Sep	118	110	105	102	99	96	93	91	92	93	100	105	117	139	150	158	166	174	180	183	187	189	189	188	187	183	185	187	184	180	172	156	155	157	159	182	189	195	195	189	184	178	173	167	162	154	144	134
Oct	120	112	108	104	104	103	100	99	98	102	109	110	118	128	139	152	159	166	173	181	187	189	189	186	180	180	180	177	176	173	164	155	154	153	152	163	170	174	177	177	175	171	165	160	157	152	147	137
Nov	172	160	148	139	135	133	130	122	116	113	113	116	120	126	137	149	161	173	182	192	196	199	200	198	196	192	190	189	193	199	197	186	163	145	144	145	145	166	183	192	195	194	190	188	183	180	179	181
Dec	93	81	67	60	55	51	50	51	51	52	56	59	63	67	69	80	88	96	107	116	123	129	133	135	139	141	141	140	140	135	132	124	109	96	94	93	95	110	127	133	128	123	118	114	113	112	107	98

Table 8-51 shows the HH Demand monthly comparison for 2022 and the previous trend continues.

Table 8-51 Total Site HH Demand (Monthly Comparison 2022)

Month	00:30	01:00	01:30	02:00	02:30	03:00	03:30	04:00	04:30	05:00	05:30	06:00	06:30	07:00	07:30	08:00	08:30	09:00	09:30	10:00	10:30	11:00	11:30	12:00	12:30	13:00	13:30	14:00	14:30	15:00	15:30	16:00	16:30	17:00	17:30	18:00	18:30	19:00	19:30	20:00	20:30	21:00	21:30	22:00	22:30	23:00	23:30	00:00
Jan	81	71	63	57	54	47	44	43	40	38	36	38	43	52	66	74	80	88	99	104	111	115	118	118	118	117	115	114	117	118	122	118	104	96	95	96	100	106	106	102	100	102	101	96	93	88	82	82
Feb	62	56	50	46	46	46	46	46	46	49	53	57	61	66	69	76	82	86	94	100	107	115	120	123	125	129	130	130	129	123	114	107	100	93	91	90	86	85	87	93	92	94	92	93	92	84	79	69
Mar	60	53	45	38	35	32	29	29	26	25	25	27	30	39	49	55	62	67	71	79	87	90	94	97	97	96	96	92	90	90	92	91	88	75	64	61	62	71	80	83	86	87	84	76	74	69	67	68
Apr	60	53	49	45	43	42	39	38	37	39	45	56	63	69	75	79	86	94	101	108	116	121	123	126	129	130	131	132	130	129	126	123	123	123	123	121	118	118	118	117	117	112	108	102	97	89	80	69
May	74	70	65	57	52	48	45	43	42	43	47	57	66	69	76	80	88	98	102	105	109	111	112	112	113	112	108	108	108	107	106	99	97	96	97	101	103	103	103	103	103	102	100	97	92	88	86	81
Jun	120	112	107	103	98	94	89	84	84	83	92	100	111	119	127	134	140	148	153	156	160	164	167	173	175	175	175	175	175	176	176	173	173	171	170	170	169	167	166	166	165	161	158	149	143	142	135	132
Jul	145	141	132	126	124	120	118	120	114	117	119	124	131	136	142	149	155	157	158	160	162	164	165	167	166	167	167	167	167	166	163	159	156	156	157	157	156	158	160	161	160	160	159	158	159	159	156	152
Aug	153	147	145	144	135	131	124	118	119	120	127	132	138	142	148	153	157	163	169	172	174	176	180	182	184	186	189	190	188	186	189	191	191	189	188	188	187	188	188	188	188	187	185	178	174	173	172	162
Sep	147	140	133	128	124	121	123	126	124	124	124	129	134	141	151	156	164	167	169	174	175	177	179	180	181	181	180	181	180	181	182	181	179	179	179	178	178	179	179	177	177	173	172	167	162	160	155	154
Oct	32	27	24	24	24	25	29	31	36	39	40	46	48	49	51	55	60	62	63	64	64	64	64	65	65	65	67	67	69	72	72	71	72	74	74	75	73	72	70	69	65	60	57	55	52	45	41	35
Nov	126	121	116	109	106	103	102	100	102	102	103	104	106	111	117	119	123	128	131	134	141	146	150	153	154	157	159	158	158	157	157	157	153	149	149	148	147	147	147	145	144	143	143	141	139	139	135	131
Dec	70	72	68	67	68	68	63	60	57	54	54	51	51	54	58	76	83	85	88	91	93	91	91	90	89	90	90	91	89	87	85	79	78	81	78	77	82	86	86	86	86	86	86	86	78	72	66	74

Table 8-52 shows at what time of day the above average demand is seen when compared within month. It can be seen that the site has significant above average demand from 09:00 - 16:00, then again from 18:00 – 22:00.

Table 8-52 Pumping Only HH Demand (In Month Comparison 2017-2021)

Month	00:30	01:00	01:30	02:00	02:30	03:00	03:30	04:00	04:30	05:00	05:30	06:00	06:30	07:00	07:30	08:00	08:30	09:00	09:30	10:00	10:30	11:00	11:30	12:00	12:30	13:00	13:30	14:00	14:30	15:00	15:30	16:00	16:30	17:00	17:30	18:00	18:30	19:00	19:30	20:00	20:30	21:00	21:30	22:00	22:30	23:00	23:30	00:00
Jan	79	72	62	51	46	42	40	40	38	40	43	47	54	57	60	67	75	80	83	90	96	98	101	102	103	102	102	105	106	102	97	93	75	58	58	60	62	80	96	101	104	104	102	99	97	91	86	83
Feb	122	119	114	105	98	93	86	80	75	70	70	75	80	85	94	104	115	123	130	135	136	140	141	142	147	150	149	147	142	141	142	143	131	110	109	110	113	133	148	149	148	148	147	144	142	137	133	128
Mar	100	93	83	78	73	67	60	59	57	59	58	61	63	64	66	75	87	99	110	119	125	125	125	126	128	128	131	133	131	130	131	127	121	105	106	107	108	120	129	128	128	129	128	126	122	116	113	106
Apr	81	73	67	65	64	62	59	56	54	55	63	74	83	92	102	113	122	131	138	144	146	144	144	143	140	140	140	139	140	140	131	115	113	115	118	136	147	147	146	145	145	141	135	127	120	115	104	91
May	111	102	97	91	86	83	79	76	74	76	86	98	110	118	124	134	148	155	159	164	168	169	167	165	163	162	159	158	158	158	154	142	143	145	148	160	162	161	160	158	161	160	158	154	149	141	129	118
Jun	144	140	136	132	126	125	122	117	116	118	122	131	140	148	159	173	182	189	193	197	202	200	197	194	191	187	185	184	182	181	176	169	170	173	174	187	192	194	196	193	191	188	184	177	171	167	159	150
Jul	164	152	143	139	136	131	127	124	123	124	128	137	140	151	164	177	184	191	197	197	200	200	198	197	199	198	196	200	203	206	203	191	190	188	191	204	210	210	206	205	201	196	193	191	187	180	174	170
Aug	154	148	144	140	134	130	124	117	112	108	114	116	120	132	144	158	171	179	185	189	193	196	197	195	194	191	189	190	192	192	187	178	180	182	184	199	207	211	213	211	205	198	190	184	182	182	177	166
Sep	106	99	95	92	90	86	84	82	82	84	90	95	105	125	135	142	149	157	162	165	168	170	170	169	168	165	167	168	166	162	155	140	139	141	143	163	170	175	175	170	165	160	155	151	146	138	129	120
Oct	108	101	97	94	93	92	90	89	88	92	98	99	106	115	125	137	143	150	156	163	168	171	170	168	162	162	162	160	158	155	147	139	138	137	137	147	153	156	159	159	158	154	148	144	141	137	133	123
Nov	155	144	133	126	121	119	117	110	105	102	101	104	108	113	124	134	145	156	164	172	177	179	180	178	177	172	171	170	174	179	177	167	147	131	130	130	131	149	165	173	176	174	171	169	165	162	161	163
Dec	84	72	60	54	49	46	45	46	46	46	50	53	57	60	62	72	79	87	96	105	110	116	120	122	125	127	127	126	126	121	118	112	98	86	85	84	85	99	115	120	115	111	106	102	102	101	96	89

Looking at the in-month demand for 2022, Table 8-5 show that the previous trend continues, except from August onwards the above average demand continues across 16:00 – 21:00.

Table 8-53 Pumping Only HH Demand (In Month Comparison 2022)

Month	00:30	01:00	01:30	02:00	02:30	03:00	03:30	04:00	04:30	05:00	05:30	06:00	06:30	07:00	07:30	08:00	08:30	09:00	09:30	10:00	10:30	11:00	11:30	12:00	12:30	13:00	13:30	14:00	14:30	15:00	15:30	16:00	16:30	17:00	17:30	18:00	18:30	19:00	19:30	20:00	20:30	21:00	21:30	22:00	22:30	23:00	23:30	00:00
Jan	73	64	57	52	49	42	39	38	36	35	33	34	39	47	59	66	72	79	89	93	99	104	106	106	106	105	104	103	105	106	110	107	94	87	86	86	90	95	95	92	90	92	91	86	84	80	74	74
Feb	56	50	45	41	42	42	41	41	41	44	48	52	55	59	62	68	74	78	84	90	96	104	108	110	113	116	117	117	116	111	103	96	90	83	82	81	78	77	79	84	83	85	83	84	83	76	71	62
Mar	54	48	41	34	32	29	26	26	24	22	22	24	27	35	44	50	55	60	64	72	78	81	84	87	87	86	86	83	81	81	83	82	79	67	58	55	56	64	72	75	78	78	75	69	67	62	60	61
Apr	54	48	44	40	38	38	35	34	33	35	40	51	56	63	68	71	77	84	91	97	104	109	111	114	116	117	118	118	117	116	113	111	110	111	111	109	106	106	106	106	106	101	97	92	87	80	72	62
May	67	63	59	52	47	43	40	39	38	38	42	51	60	63	68	72	79	88	92	94	98	100	101	101	101	101	97	97	97	97	95	89	87	86	87	91	93	93	93	93	93	91	90	87	83	80	77	73
Jun	108	101	96	93	88	84	80	76	75	74	82	90	100	107	114	121	126	133	137	140	144	148	150	156	157	158	158	157	158	159	158	156	155	154	153	153	152	151	150	150	149	145	142	134	129	128	121	119
Jul	131	127	118	114	112	108	106	108	103	105	107	112	118	122	128	134	140	141	142	144	146	147	148	150	150	150	150	150	151	149	146	143	141	140	142	142	141	142	144	144	144	144	143	142	143	143	141	137
Aug	138	132	131	129	121	118	112	106	107	108	115	119	124	128	133	138	142	147	152	155	157	158	162	164	165	168	170	171	169	168	170	172	171	170	169	169	168	169	169	169	169	168	166	161	157	156	154	146
Sep	132	126	120	115	111	109	111	113	112	112	112	117	121	127	136	141	148	150	152	156	158	159	161	162	163	163	162	163	162	163	164	163	161	161	161	160	160	161	161	160	159	156	154	150	146	144	140	138
Oct	29	25	22	21	22	23	26	28	32	35	36	42	43	44	46	49	54	56	56	57	57	57	58	59	58	59	60	60	62	65	65	64	65	67	66	68	65	64	63	62	58	54	51	49	47	41	37	32
Nov	114	109	104	98	95	93	92	90	92	92	92	93	96	100	105	107	111	115	118	121	127	131	135	138	139	141	143	142	142	142	141	142	138	134	134	133	133	133	132	130	130	129	129	127	125	125	122	118
Dec	63	64	61	60	61	61	56	54	51	48	49	46	46	48	52	68	75	77	79	82	84	82	82	81	80	81	81	81	80	78	76	71	71	73	71	70	74	78	77	78	78	78	78	77	70	65	60	66

As can be seen in Table 8-54, a comparison of the site pumping demand in 2022 vs the mean average pumping demand for 2017-2021 shows that the site in 2022 has a significantly lower demand across all time periods and months, with October demand being uncommon.

Table 8-54 Change in Power Demand 2022 vs 2017-2021 Mean Average

Month	00:30	01:00	01:30	02:00	02:30	03:00	03:30	04:00	04:30	05:00	05:30	06:00	06:30	07:00	07:30	08:00	08:30	09:00	09:30	10:00	10:30	11:00	11:30	12:00	12:30	13:00	13:30	14:00	14:30	15:00	15:30	16:00	16:30	17:00	17:30	18:00	18:30	19:00	19:30	20:00	20:30	21:00	21:30	22:00	22:30	23:00	23:30	00:00	% Change
Jan	-8%	-11%	-8%	2%	6%	0%	-1%	-3%	-5%	-14%	-24%	-27%	-29%	-17%	-1%	-2%	-4%	0%	7%	4%	4%	6%	5%	4%	3%	3%	1%	-2%	-1%	4%	13%	14%	25%	49%	47%	44%	45%	20%	-1%	-10%	-13%	-12%	-11%	-13%	-13%	-13%	-14%	-11%	1%
Feb	-54%	-11%	-61%	-61%	-57%	-55%	-52%	-49%	-45%	-37%	-32%	-31%	-31%	-30%	-33%	-34%	-36%	-37%	-35%	-33%	-29%	-26%	-24%	-23%	-23%	-23%	-21%	-21%	-18%	-21%	-27%	-33%	-31%	-24%	-25%	-26%	-31%	-43%	-47%	-44%	-44%	-43%	-44%	-42%	-41%	-45%	-47%	-52%	-36%
Mar	-46%	-49%	-51%	-57%	-57%	-56%	-57%	-55%	-59%	-62%	-62%	-60%	-58%	-45%	-33%	-33%	-36%	-40%	-42%	-40%	-37%	-35%	-33%	-31%	-32%	-33%	-34%	-38%	-38%	-38%	-37%	-35%	-35%	-36%	-45%	-48%	-48%	-47%	-45%	-41%	-39%	-39%	-41%	-45%	-46%	-47%	-47%	-43%	-42%
Apr	-34%	-35%	-34%	-38%	-40%	-39%	-40%	-39%	-39%	-37%	-36%	-32%	-32%	-32%	-33%	-37%	-37%	-35%	-35%	-33%	-28%	-24%	-23%	-21%	-17%	-16%	-16%	-15%	-16%	-17%	-13%	-3%	-3%	-4%	-6%	-20%	-28%	-28%	-27%	-27%	-27%	-28%	-28%	-28%	-27%	-31%	-31%	-32%	-26%
May	-39%	-38%	-40%	-43%	-45%	-48%	-49%	-49%	-49%	-50%	-51%	-48%	-46%	-47%	-45%	-47%	-46%	-43%	-42%	-43%	-42%	-41%	-40%	-39%	-38%	-38%	-39%	-39%	-39%	-39%	-38%	-37%	-39%	-41%	-41%	-43%	-43%	-42%	-42%	-41%	-42%	-43%	-43%	-43%	-44%	-44%	-40%	-38%	-42%
Jun	-25%	-28%	-29%	-30%	-30%	-33%	-35%	-35%	-35%	-37%	-32%	-31%	-29%	-28%	-28%	-30%	-31%	-30%	-29%	-29%	-28%	-26%	-24%	-20%	-18%	-16%	-15%	-15%	-13%	-13%	-10%	-8%	-9%	-11%	-12%	-18%	-21%	-22%	-23%	-23%	-22%	-23%	-23%	-24%	-25%	-23%	-24%	-21%	-23%
Jul	-20%	-17%	-17%	-18%	-18%	-17%	-16%	-12%	-16%	-15%	-17%	-18%	-16%	-19%	-22%	-24%	-24%	-26%	-28%	-27%	-27%	-26%	-25%	-24%	-25%	-24%	-23%	-25%	-26%	-27%	-28%	-25%	-26%	-26%	-26%	-31%	-33%	-32%	-30%	-29%	-28%	-27%	-26%	-25%	-24%	-20%	-19%	-20%	-24%
Aug	-10%	-10%	-9%	-8%	-10%	-9%	-10%	-9%	-4%	0%	0%	2%	4%	-3%	-8%	-13%	-17%	-18%	-18%	-18%	-19%	-19%	-18%	-16%	-15%	-12%	-10%	-10%	-12%	-13%	-9%	-4%	-5%	-6%	-8%	-15%	-19%	-20%	-21%	-20%	-17%	-15%	-12%	-13%	-14%	-14%	-13%	-12%	-12%
Sep	24%	27%	26%	25%	24%	27%	32%	37%	35%	33%	24%	23%	14%	1%	0%	-1%	-1%	-4%	-6%	-5%	-6%	-6%	-5%	-4%	-3%	-1%	-3%	-3%	-2%	0%	6%	16%	16%	14%	12%	-2%	-6%	-8%	-8%	-6%	-4%	-3%	-1%	0%	0%	4%	8%	15%	4%
Oct	-73%	-76%	-77%	-77%	-77%	-76%	-71%	-68%	-63%	-62%	-63%	-58%	-59%	-62%	-63%	-64%	-62%	-63%	-64%	-65%	-66%	-66%	-66%	-65%	-64%	-64%	-63%	-62%	-61%	-58%	-56%	-54%	-53%	-51%	-52%	-54%	-57%	-59%	-60%	-61%	-63%	-65%	-65%	-66%	-67%	-70%	-72%	-74%	-64%
Nov	-27%	-24%	-22%	-22%	-21%	-22%	-22%	-18%	-13%	-10%	-9%	-11%	-11%	-12%	-15%	-20%	-23%	-26%	-28%	-30%	-28%	-27%	-25%	-23%	-22%	-18%	-16%	-17%	-18%	-21%	-20%	-15%	-6%	3%	3%	2%	2%	-11%	-20%	-24%	-26%	-26%	-25%	-25%	-24%	-23%	-24%	-28%	-19%
Dec	-24%	-11%	1%	12%	25%	34%	27%	18%	11%	4%	-3%	-15%	-20%	-19%	-16%	-5%	-5%	-12%	-18%	-22%	-24%	-29%	-32%	-34%	-36%	-36%	-36%	-36%	-36%	-36%	-36%	-37%	-28%	-16%	-17%	-17%	-14%	-22%	-32%	-35%	-33%	-30%	-27%	-25%	-31%	-36%	-38%	-25%	-23%

Table 8-55 below summarises the pumping Power demand at this site:

Table 8-55 Pumping ½ hourly demand

	2017 - 2021	2022
• HH mean average demand	131 kW	98 kW
• HH max demand	213 kW (19:30 Aug)	172 kW (16:00 Aug)
• HH min demand	38 kW (04:30 Jan)	21 kW (02:00 Oct)
• Mean average HH demand during evening grid peak (17:00 – 19:00)	140 kW	110 kW
• Max demand released by a 50% reduction in pumping power demand when needed by the CMZ		72 kW

Demand Flexibility Available for the CMZ

Reviewing the specific NGED CMZ for this site to ascertain when the CMZ requires demand reduction. Table 8-56 below identifies the required demand turn down by month and time of day.

Table 8-56 2023-2026 CMZ Demand Reduction Requirement (Average kW)

Month	00:30	01:00	01:30	02:00	02:30	03:00	03:30	04:00	04:30	05:00	05:30	06:00	06:30	07:00	07:30	08:00	08:30	09:00	09:30	10:00	10:30	11:00	11:30	12:00	12:30	13:00	13:30	14:00	14:30	15:00	15:30	16:00	16:30	17:00	17:30	18:00	18:30	19:00	19:30	20:00	20:30	21:00	21:30	22:00	22:30	23:00	23:30	00:00
Jan	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	826	3,235	5,239	7,623	8,912	8,920	8,796	8,725	8,374	9,550	8,710	8,123	7,309	6,520	6,082	5,664	6,018	8,429	11,939	13,988	14,064	12,832	10,534	7,484	4,156	827	-	-	-	-	-	-	-
Feb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	740	1,950	5,905	9,597	8,933	8,349	8,067	8,553	9,141	9,067	8,078	6,940	5,864	5,023	4,689	5,207	7,723	8,400	10,988	13,528	12,306	10,107	7,571	2,982	431	-	-	-	-	-	-	-
Mar	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	204	1,066	713	1,056	1,477	2,117	2,110	1,964	1,649	1,003	19	-	-	-	-	439	1,319	2,918	4,380	6,278	5,819	3,593	813	-	-	-	-	-	-	-
Apr	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,944	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
May	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,670	-	-	-	-	-	-	-	-	-	-	-	-
Jun	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jul	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aug	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sep	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oct	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	671	3,083	3,341	1,660	366	-	-	-	-	-	-	-	-	-	-
Nov	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	300	1,432	1,728	1,604	1,863	1,589	1,571	2,801	2,702	2,007	1,276	718	602	652	1,627	4,774	9,399	11,070	10,408	8,739	6,309	3,261	778	-	-	-	-	-	-	-
Dec	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	353	1,637	3,139	4,024	3,800	3,439	2,885	2,744	3,372	3,038	2,410	1,627	1,344	1,269	1,782	3,432	7,154	10,684	11,600	11,059	8,854	6,575	3,859	1,012	-	-	-	-	-	-	-

By comparing the HH demand during the CMZ demand turn down time slots it is possible to estimate the range of demand flexibility this individual site could provide to the CMZ assuming a 50% reduction in pumping demand. This is shown in Table 8-57 below.

Table 8-57 Pumping Potential Demand Flexibility (Average kW)

Month	00:30	01:00	01:30	02:00	02:30	03:00	03:30	04:00	04:30	05:00	05:30	06:00	06:30	07:00	07:30	08:00	08:30	09:00	09:30	10:00	10:30	11:00	11:30	12:00	12:30	13:00	13:30	14:00	14:30	15:00	15:30	16:00	16:30	17:00	17:30	18:00	18:30	19:00	19:30	20:00	20:30	21:00	21:30	22:00	22:30	23:00	23:30	00:00
Jan																33	36	40	44	47	50	52	53	53	53	53	52	52	52	53	55	53	47	43	43	43	45	48	48	46	45							
Feb																	37	39	42	45	48	52	54	55	56	58	58	58	58	56	51	48	45	42	41	40	39	38	39	42	42							
Mar																		30	32	36	39	41	42	43	43	43	43	41					39	34	29	28	28	32	36	38							
Apr																					52																											
May																																				46											
Jun																																															
Jul																																															
Aug																																															
Sep																																															
Oct																																		33	33	34	33	32								
Nov																		58	59	60	64	66	68	69	69	71	72	71	71	71	71	71	69	67	67	66	66	66	65							
Dec																	37	38	40	41	42	41	41	41	40	41	41	41	40	39	38	36	35	36	35	35	37	39	39	39							

The red highlighted cells shows where the pumping demand is greater than or equal to the CMZ requirements. Table 8-58 below shows the percentage of the CMZ demand turn down requirement that could potentially be fulfilled by the SWW site.

Table 8-58 % of CMZ Requirements that could be fulfilled by the site.

Month	00:30	01:00	01:30	02:00	02:30	03:00	03:30	04:00	04:30	05:00	05:30	06:00	06:30	07:00	07:30	08:00	08:30	09:00	09:30	10:00	10:30	11:00	11:30	12:00	12:30	13:00	13:30	14:00	14:30	15:00	15:30	16:00	16:30	17:00	17:30	18:00	18:30	19:00	19:30	20:00	20:30	21:00	21:30	22:00	22:30	23:00	23:30	00:00
Jan																4.0%	1.1%	0.8%	0.6%	0.5%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.7%	0.8%	0.9%	1.0%	0.9%	0.6%	0.4%	0.3%	0.3%	0.3%	0.5%	0.6%	1.1%	5.4%							
Feb																	5.0%	2.0%	0.7%	0.5%	0.5%	0.6%	0.7%	0.6%	0.6%	0.6%	0.7%	0.8%	1.0%	1.1%	1.1%	0.9%	0.6%	0.5%	0.4%	0.3%	0.3%	0.4%	0.5%	1.4%	9.6%							
Mar																		14.7%	3.0%	5.0%	3.7%	2.8%	2.0%	2.1%	2.2%	2.6%	4.3%	100%					9.0%	2.5%	1.0%	0.6%	0.4%	0.6%	1.0%	4.6%							
Apr																					1.8%																											
May																																				2.7%											
Jun																																															
Jul																																															
Aug																																															
Sep																																															
Oct																																		5.0%	1.1%	1.0%	2.0%	8.8%								
Nov																		19.2%	4.1%	3.5%	4.0%	3.5%	4.3%	4.4%	2.5%	2.6%	3.6%	5.6%	9.9%	11.7%	10.9%	4.4%	1.4%	0.7%	0.6%	0.6%	0.8%	1.1%	2.0%	8.4%							
Dec																	10.6%	2.3%	1.3%	1.0%	1.1%	1.2%	1.4%	1.5%	1.2%	1.3%	1.7%	2.5%	3.0%	3.1%	2.1%	1.0%	0.5%	0.3%	0.3%	0.3%	0.4%	0.6%	1.0%	3.8%							

In summary this site could feasibly respond to calls for flexibility, as detailed in the D4-1 Specification and High-Level Architecture Document, and provide between **28 kW** and **72 kW** in Power demand reduction during the CMZ required time slots.

Combined Demand Flexibility Available for the CMZ

With Pynes and Dunsford sites both linked to the same CMZ the combined potential effect the sites could have on the CMZ requirements are as seen in Table 8-59 below.

Table 8-59 Pumping Potential Demand Flexibility (Average kW)

Month	00:30	01:00	01:30	02:00	02:30	03:00	03:30	04:00	04:30	05:00	05:30	06:00	06:30	07:00	07:30	08:00	08:30	09:00	09:30	10:00	10:30	11:00	11:30	12:00	12:30	13:00	13:30	14:00	14:30	15:00	15:30	16:00	16:30	17:00	17:30	18:00	18:30	19:00	19:30	20:00	20:30	21:00	21:30	22:00	22:30	23:00	23:30	00:00
Jan																347	365	381	390	370	358	368	375	386	384	390	379	377	373	368	373	381	377	369	366	387	394	396	399	400	394								
Feb																	382	392	400	398	403	404	402	406	403	390	409	414	416	399	382	391	403	398	394	390	379	375	379	403	402								
Mar																		388	399	403	384	380	393	401	407	395	386	384					388	388	390	375	368	370	365	367								
Apr																					380																											
May																																			354												
Jun																																															
Jul																																															
Aug																																															
Sep																																															
Oct																																		344	344	352	354	346									
Nov																		395	408	416	403	392	402	416	424	432	434	430	428	435	417	425	428	413	417	427	438	429	426	439								
Dec																	394	396	407	417	417	412	418	409	403	400	401	404	403	404	413	417	393	386	387	394	391	396	396	400								

Table 8-60 below shows the percentage of the CMZ demand turn down requirement that could potentially be fulfilled by Ashford and Pottington sites.

Table 8-60 % of CMZ Requirements that could be fulfilled by the sites.

Month	00:30	01:00	01:30	02:00	02:30	03:00	03:30	04:00	04:30	05:00	05:30	06:00	06:30	07:00	07:30	08:00	08:30	09:00	09:30	10:00	10:30	11:00	11:30	12:00	12:30	13:00	13:30	14:00	14:30	15:00	15:30	16:00	16:30	17:00	17:30	18:00	18:30	19:00	19:30	20:00	20:30	21:00	21:30	22:00	22:30	23:00	23:30	00:00
Jan																42.1%	11.3%	7.3%	5.1%	4.1%	4.0%	4.2%	4.3%	4.6%	4.0%	4.5%	4.7%	5.2%	5.7%	6.1%	6.6%	6.3%	4.5%	3.1%	2.6%	2.8%	3.1%	3.8%	5.3%	9.6%	47.6%								
Feb																	51.7%	20.1%	6.8%	4.1%	4.5%	4.8%	5.0%	4.7%	4.4%	4.3%	5.1%	6.0%	7.1%	7.9%	8.2%	7.5%	5.2%	4.7%	3.6%	2.9%	3.1%	3.7%	5.0%	13.5%	93.4%								
Mar																		100%	37.4%	56.5%	36.4%	25.7%	18.5%	19.0%	20.7%	24.0%	38.5%	100%					88.5%	29.4%	13.4%	8.6%	5.9%	6.4%	10.1%	45.1%								
Apr																					12.9%																											
May																																			21.2%												
Jun																																															
Jul																																															
Aug																																															
Sep																																															
Oct																																		51.3%	11.2%	10.5%	21.3%	94.5%									
Nov																		100%	28.5%	24.1%	25.1%	21.0%	25.3%	26.5%	15.1%	16.0%	21.6%	33.7%	59.5%	72.2%	64.0%	26.1%	9.0%	4.4%	3.8%	4.1%	5.0%	6.8%	13.1%	56.5%								
Dec																	100%	24.2%	13.0%	10.4%	11.0%	12.0%	14.5%	14.9%	11.9%	13.2%	16.7%	24.8%	30.0%	31.8%	23.2%	12.2%	5.5%	3.6%	3.3%	3.6%	4.4%	6.0%	10.3%	39.5%								

In summary these sites could feasibly respond to calls for flexibility, as detailed in the D4-1 Specification and High-Level Architecture Document and provide between **344 kW** and **439 kW** in Power demand reduction during the CMZ required time slots.

9 POTENTIAL NETWORK BENEFIT

By SWW implementing the perturbations i.e. holding pumping off, via the use cases (methods) as explained in the D4-1 Specification and High-Level Architecture Document (INSERT LINK), the case study sites could generate a potential maximum demand shift of **1.6 MW** from a total max demand of 2.9 MW.

As discussed earlier, it is unlikely that all the perturbations could be implemented at the same time everywhere. Taking a sliding scale of implementation from 1% to 50%, Table 9-1 shows the amount of flexibility could potentially be realised at each site.

Table 9-1 Sliding Scale of Implementation Based on Pumping Maximum Demand at CMZ Required Time Slots

Site Type	Current Pumping Max Demand (kW)	Current Pumping Max Demand at CMZ Requirement Time Slots (kW)	Perturbation Activation Level (kW Flex)					
			1%	5%	10%	25%	33%	50%
Wastewater								
Ashford (WW ST)	195	195	2	10	19	49	64	97
Pottington (WW MD)	88	88	1	4	9	22	29	44
Hayle (WW ST)	226	226	2	11	23	56	74	113
Porthgwidden (WW MD)	112	112	1	6	11	28	37	56
Drinking Water								
Pynes (DW-WT)	806	763	8	38	76	191	252	382
Dunsford Hill (DW-WD)	172	143	1	7	14	36	47	72

As can be seen in Table 9-3 below the SWW case study sites – when matched with their relevant NGED CMZs requirements and if implementing a 50% pumping perturbation – could feasibly provide, between **53kW** and **696kW** of flexibility prior to NGED going out to the market.

Table 9-2 Combined SWW Case Study Sites Pumping kW Flexibility in CMZ Requirement Slots

Month	00:30	01:00	01:30	02:00	02:30	03:00	03:30	04:00	04:30	05:00	05:30	06:00	06:30	07:00	07:30	08:00	08:30	09:00	09:30	10:00	10:30	11:00	11:30	12:00	12:30	13:00	13:30	14:00	14:30	15:00	15:30	16:00	16:30	17:00	17:30	18:00	18:30	19:00	19:30	20:00	20:30	21:00	21:30	22:00	22:30	23:00	23:30	00:00
Jan	85	94	86	90	84	85	82					87		97	219	574	594	624	634	616	597	614	637	652	654	651	641	623	612	611	610	610	604	590	577	592	597	612	632	615	643	243	111	109				
Feb	80	72	74	72	75	72	71		70	80	78		89	92	223	222	621	641	653	662	658	660	649	645	643	626	648	653	645	524	604	619	618	619	610	607	587	592	611	619	654	232	219	92	99	91		
Mar															213	217	229	621	633	634	621	496	507	514	518	507	496	494	108	108	110	109	496	614	602	590	581	585	594	593	243	241	109					
Apr				68	67									87	97	219	219	221	226	219	592	113	109	109	109	106								184	179	188	210	185	223	200	183	189	84	89				
May					53									75	85	90	93	213	207	209	118	206	116	115	115	117								194	180	545	211	192	205	207	93	83	83	76	77	72	72
Jun															87	85	92	102	96	204	91	205	113	109										83	66	80	216	81	95	109	83						
Jul															101	99	114	119	214	208	110	102				100								89	194	212	190	97									
Aug															103	108	115	125	222	219	222	219	208	213	104	205	97				103	98		103	190	202	225	203	222	130	99	110	101				
Sep																	120	132	242	242	120	123	110	113	218	223	213	113	106	113	111	103	105	219	203	215	244	221	251	252	116							
Oct															113	224	231	245	239	238	235	226	229	226	218	212	206	216	209	212	215	207	200	555	547	563	588	557	230	228	218	215	102					
Nov															114	258	253	663	666	672	671	655	651	671	672	677	684	682	671	681	662	661	677	669	659	679	675	658	666	683	260	260	112					
Dec	123	127	124	116	117	112							130	133	136	270	660	661	683	696	691	685	694	680	678	673	667	683	669	666	667	682	638	644	639	639	624	632	644	644	262	265	136	128	135			

Table 9-4 below shows the percentage of the CMZ demand turn down requirement that could potentially be fulfilled by Ashford and Pottington sites.

Table 9-3 % of CMZ Requirements that could be fulfilled by the case study sites

Month	00:30	01:00	01:30	02:00	02:30	03:00	03:30	04:00	04:30	05:00	05:30	06:00	06:30	07:00	07:30	08:00	08:30	09:00	09:30	10:00	10:30	11:00	11:30	12:00	12:30	13:00	13:30	14:00	14:30	15:00	15:30	16:00	16:30	17:00	17:30	18:00	18:30	19:00	19:30	20:00	20:30	21:00	21:30	22:00	22:30	23:00	23:30	00:00
Jan	1.2%	13.4%	0.9%	2.6%	1.4%	2.7%	100%					63.8%		2.6%	3.9%	7.0%	2.4%	3.4%	2.3%	2.4%	1.5%	2.7%	1.8%	1.9%	2.0%	3.0%	1.8%	2.3%	3.4%	2.4%	4.1%	2.9%	2.4%	0.9%	0.9%	0.7%	0.9%	1.4%	1.5%	2.6%	3.5%	2.2%	1.8%	2.0%				
Feb	1.3%	0.9%	0.9%	1.1%	1.2%	1.9%	5.2%		42.1%	100%	40.1%		1.3%	0.7%	1.4%	1.0%	2.7%	2.3%	2.0%	1.8%	1.4%	2.3%	3.1%	1.9%	3.3%	2.9%	2.3%	2.7%	6.2%	6.6%	3.1%	2.2%	1.4%	1.6%	0.9%	0.8%	0.8%	1.1%	1.7%	2.4%	4.1%	1.5%	2.3%	1.7%	6.4%	60.7%		
Mar															7.8%	4.1%	3.4%	2.1%	2.2%	8.3%	7.4%	9.8%	9.9%	10.2%	9.3%	10.3%	12.8%	32%	11.1%	15.6%	18.9%	1.7%	2.2%	1.6%	1.5%	1.0%	1.1%	2.2%	2.5%	4.4%	3.4%	7.9%	86.9%					
Apr				100%	15.3%									7.9%	2.5%	2.6%	2.5%	0.6%	0.7%	1.0%	11.3%	11.1%	13.7%	100%	100%	100%								1.3%	0.6%	0.5%	0.5%	1.2%	2.9%	1.8%	1.9%	2.4%	1.3%	21.0%				
May					10.1%									2.1%	2.0%	0.7%	0.7%	2.0%	1.9%	1.7%	6.4%	5.1%	40.4%	31.0%	43.3%	100%								12.6%	1.0%	9.5%	1.1%	0.9%	1.6%	1.1%	0.6%	0.8%	0.5%	0.8%	1.0%	2.0%	8.3%	
Jun															0.8%	0.7%	0.7%	0.4%	0.9%	11.1%	2.3%	3.8%	52.3%	100%										2.9%	0.7%	1.0%	1.4%	0.3%	1.9%	27.7%	61.2%						
Jul															2.3%	1.2%	1.0%	0.8%	1.7%	2.9%	40.1%	9.2%				18.3%								2.7%	1.5%	1.1%	0.9%	15.1%									
Aug															1.9%	2.0%	2.0%	0.9%	1.8%	1.2%	1.1%	1.1%	1.0%	2.4%	5.9%	2.4%	3.7%				6.2%	1.6%		0.7%	1.0%	0.6%	1.8%	1.0%	7.1%	8.1%	12.6%	32.0%	59.1%					
Sep																	22.3%	2.1%	2.0%	1.2%	0.7%	1.2%	1.0%	1.2%	5.0%	3.6%	2.8%	2.5%	12.6%	1.4%	1.4%	1.3%	0.7%	1.3%	0.9%	1.1%	3.6%	6.2%	9.2%	13.6%	51%							
Oct															5.4%	4.5%	3.0%	4.6%	2.8%	1.7%	2.1%	0.8%	1.6%	1.3%	1.6%	1.2%	0.9%	1.7%	1.6%	1.9%	1.5%	1.3%	0.9%	2.5%	2.1%	1.6%	2.3%	2.4%	1.2%	1.7%	3.3%	5.6%	10.9%					
Nov															9.2%	3.7%	3.5%	12.1%	8.4%	8.1%	1.9%	1.8%	1.8%	2.2%	2.0%	1.8%	2.0%	2.3%	2.4%	3.0%	4.9%	3.6%	1.4%	1.0%	0.9%	0.8%	1.0%	2.4%	3.5%	5.8%	4.3%	9.8%	100%					
Dec	2.0%	1.4%	1.5%	3.0%	1.2%	21.9%							13.7%	2.2%	1.5%	1.9%	3.5%	2.4%	2.1%	2.5%	2.6%	3.3%	2.7%	2.5%	2.8%	2.5%	2.8%	2.8%	3.6%	4.8%	2.7%	2.2%	1.4%	1.3%	0.9%	0.9%	1.0%	1.3%	1.8%	2.1%	0.9%	1.7%	1.3%	2.7%	100%		