



Real Estate Potential Assessment and Peak Electrical Energy Load Forecast

Ketron Island Microgrid Study

*Ketron Island, WA
October 27, 2025*



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1 Executive Summary

Tacoma Public Utilities (TPU) is seeking to analyze and evaluate commercially available, feasible non-wire alternatives to provide electric power to Ketron Island, Washington. This Real Estate Potential and Peak Electrical Energy Load Forecast report provides technical analysis of the island's current and potential peak electric loads. Several factors were evaluated in the assessment of the overall development potential of Ketron Island to inform the load forecasts, including historical trends, availability of water and wastewater treatment, zoning, public services, and accessibility.

There are impediments to development on Ketron Island including limited accessibility, limited ability to install septic systems, the potential for saltwater intrusion into new wells and needed improvements to the existing water system. Centralized water treatment is not available on the island, and future development of such facilities was determined to not be reasonably foreseeable. The soil types and slopes on the island are an impediment to the development of private septic systems, which require approvals through the Tacoma - Pierce County Department of Health. Most of the existing platted parcels are not of sufficient size to support onsite residential septic systems. The existing water supply system is also approved through Tacoma - Pierce County Department of Health for 22 single-family residences and currently serves 13 single-family residences, nine of which are occupied by full-time residents. There is also one confirmed private residential well on the island associated with an active residential construction project. Constraints are evidenced by the lack of new residential construction since 1977 and the overall lack of demand for properties on the island. While some small, weekend-use cabins have been built more recently, the last was built in 2012. Based on historic growth and the challenges to development on the island, growth on the island is likely to remain unchanged for the 20-year planning horizon of this study.

In terms of a potential high growth the report considered both septic and water supply constraints. There are currently approximately 126 acres of the total 221 platted acres that are held by two entities (Alaska Northwest Industries, Inc. and TDL Development LLC) associated with one family. If future development were to occur these properties have the most potential. Development was considered for re-subdivision of the 126 acres held in common ownership to 2-acre lots to accommodate septic systems which resulted in a maximum development potential of 60 homes. However, limited availability of water was determined to be the primary factor limiting growth. For the purpose of defining a high-growth development scenario, this report assumes that development would be limited to 23 single family residences. This includes the one known private residential well with active residential construction and the 22 approved service connections disclosed in the Ketron Island Water, Inc. (KIWI), Water Facilities Inventory Form filed with the Washington State Department of Health (Appendix B). The high-growth scenario would assume that any part-time or non-residential water connections would be upgraded to full-time, single-family residences.

The electrical load projections are based on the two real estate growth-rate scenarios. The scenario based on current growth rate leads to no additional electrical load (108 kilowatts),

while the scenario based on high growth rate leads to a peak load of 249 kilowatts, approximately 2.2 times the largest demand observed on the island over the last 5 years. The high growth rate scenario also increases the daily energy usage (kilowatt hours) by approximately 2.3 times the observed consumption.

Both peak load and energy usage are critical when designing a microgrid system. Peak load is used to determine the required capacity of the system, and the energy usage is needed for evaluating the required storage. The peak demand is utilized to size generators or peak battery discharge from the microgrid to ensure that the load requirements are met during worst-case conditions. The energy consumption is utilized to size battery energy storage or fuel capacity to provide adequate energy for the period without discharging all energy prior to refueling/recharge. The projected values in this report will be used to evaluate the electrical infrastructure upgrades needed to support Ketron Island.

2 Scope

Tacoma Public Utilities (TPU) is seeking to analyze and evaluate commercially available, feasible non-wire alternatives to provide electric power services to Ketron Island, Washington. As part of these efforts, this Real Estate Potential and Peak Electrical Energy Load Forecast report is intended to provide technical analysis of the island's current and potential peak electric loads. The report compiles available information to aid in the analysis of the real estate development limitations and potential future electrical loads for Ketron Island over a 20-year planning horizon. The report also provides four peak load (kilowatt [kW]) and daily energy usage (kilowatt-hour [kWh]) forecasts (annualized 20-year forecasts) combining two development scenarios (based on current development and high-growth development) and two weather scenarios (normal weather and severe weather). This analysis will be used to inform microgrid alternative options to meet the expected load and enable TPU to satisfy the requirements of Washington State Department of Commerce grant funding.

3 Real Estate Development Potential Assessment

Various factors were evaluated in the assessment of the overall development potential of Ketron Island, including historical trends, availability of water and wastewater, zoning, public services, and accessibility. The following sections discuss each of these factors.

3.1 Development History of Ketron Island

Ketron Island has undergone several attempts at development over the last century but has remained primarily undeveloped. Ketron Island was purchased by J.C. Morris in 1946 with the intention of turning the existing infrastructure of 60 cabins and a lodge into a resort. The resort remained operational for only 3 years, after which the island was redeveloped for single-family residential use, with the first homes being built in the 1960s. The last effort to develop the island was undertaken in the late 1990s but was abandoned when the developers became embroiled in legal issues (US v. Cooley, 2003 and US v. Fain, 2003).

The growth of the Ketron Island community has remained largely unchanged over the years. After his acquisition of the island, J.C. Morris subdivided the central and northern portions of the island into 259 single-family residential lots ranging in size from approximately 8,000 to 27,000 square feet (SF). The southern portion of the island is a single parcel of over 50 acres. Information from the Pierce County Assessor's office indicates that there are 101 landowners, 13 single-family residences, three finished cabins, and three unfinished cabins. According to the 2020 U.S Census Bureau Decennial Census, the total population of Ketron Island was 20 individuals. Over 90 percent of the lots on the island are vacant.

To estimate future demand, a review of historical lot sale data was undertaken. The ownership and sales data beginning in 1997 was available from the Pierce County

Assessor's Office. Overall, turnover has been historically low but steady on the island, averaging approximately four transactions per year over the past 20 years. Although there have been lots sold every year, the last single-family residence was built in 1977 (per the Pierce County Assessor). Per the Pierce County Assessor, smaller cabins (finished and unfinished have been added as recently as 2012. Additionally, several yurts and small recreational use structures have been constructed, some of which do not appear to have electrical service.

It should be noted that the majority of the transactions have been between island residents increasing their holdings and/or were tax sales. These transactions are shown in Table 1.

Table 1. Historic Lot Transactions

Year	# of Transactions	# of Lots	Square Feet	Acres
2025	3	3	32,729	0.751
2024	4	4	54,511	1.251
2023	4	6	84,003	1.928
2022	5	11	115,038	2.641
2021	9	14	2,722,046	62.490
2020	11	16	252,700	5.801
2019	8	8	131,675	3.023
2018	10	12	162,886	3.739
2017	5	5	102,387	2.350
2016	1	1	20,490	0.470
2015	5	7	2,188,532	50.242
2014	1	1	18,707	0.429
2013	4	5	77,528	1.780
2012	4	4	49,137	1.128
2011	1	1	9,900	0.227
2010	5	6	83,305	1.912
2009	1	1	11,000	0.253
2008	3	3	51,400	1.180
2007	2	2	552,480	12.683
2006	3	3	55,514	1.274
2005	17	25	348,980	8.011

In regard to total acreage sold, the years 2021 and 2015 stand out. In 2021, approximately 57 of the total 62 acres sold were transferred between related corporate entities in a non-arms-length transaction. In 2015, the largest single tract on the island (approximately 50 acres with a single-family residence) was sold, so although a large amount of acreage was noted, it represented the sale of a single lot.

Further, it was noted that the total number of transactions increased in the period from 2018 through 2021; however, it was determined that the majority of the transactions were sales of lots to existing islanders and not to new landowners.

3.2 Factors Impacting Development Potential

Numerous factors determine the most likely development scenario for any property. These include zoning, topography, utility availability, and accessibility. The following sections discuss each of these factors as they impact the overall development potential of Ketron Island.

3.2.1 Development Code

Ketron Island is located in unincorporated Pierce County. The Pierce County Comprehensive Plan (Pierce County 2025a) and the Anderson – Ketron Islands Community Plan address growth on Ketron Island (Pierce County 2009a, 2009b). The Community Plans section of the Comprehensive Plan spells out how to coordinate consistency between community plans and the Comprehensive Plan, which is a requirement of the Comprehensive Plan and the Growth Management Act (GMA).

The majority of Ketron Island is zoned R10, Rural Residential (see Figure 1). The residential density for the R10 zoning is one dwelling unit per 10 acres. Per Title 18A of the Pierce County Development Regulations, rural residential areas serve:

...as a buffer between urbanized areas and resource land. They can supply lands that may be added to an urban growth area over time. The Rural Residential zones also allow for commercial and industrial uses related to and dependent upon natural resources and public and commercial recreational and associated uses related to the outdoors, along with rural residential, agricultural, and other resource uses.



Figure 1. Ketron Island Zoning Map (Pierce County 2025d)

The higher density of lots on Ketron Island is due to lots platted prior to the current code. Additionally, at the time those lots were developed, it was anticipated that the island would be served with municipal utilities. Although development on a less than 10-acre site would currently be allowed, any development must still meet development criteria including septic, water, critical areas and land use compliance as well as other County requirements.

Approximately 4 acres along the eastern shore are zoned Rural Neighborhood Centers (RNC). This area encompasses the island's marina. This zoning designation includes areas with established commercial uses that provide limited convenience shopping and services, meet the daily needs of the surrounding rural area, provide immediate access

onto state routes and major or secondary arterials, and serve the everyday needs of the island residents.

An area in the north central portion of the island is zoned Agricultural Resource Lands (ARL). This zoning classification includes lands dedicated primarily to commercial production of agricultural products and is applied to lands outside urban growth areas that meet certain criteria.

The zoning of the island is designed to maintain the island's rural character and natural attributes including the native forests, open spaces, and extensive shoreline. This is supported by the long- and short-term goals established through the Pierce County Comprehensive Plan (Pierce County 2025a) and the Anderson – Ketron Islands Community Plan (Pierce County 2009a).

Regulated Areas

Following recent coordination with Pierce County, it was noted that the presence of critical areas constrains the development potential on Ketron Island. These features include wetlands, streams, and landslide hazard areas, all of which may be subject to local, state, and federal regulations. Additionally, portions of Ketron Island are located within Pierce County's shoreline jurisdiction and are regulated under Pierce County's Shoreline Master Program. Consideration of these regulated areas is essential for understanding the feasibility of future development.

3.2.2 Water and Wastewater Availability

Wastewater/Septic

The lack of sanitary sewer service is a major limiting factor for the development of Ketron Island. Although a sewer system was initially constructed on Ketron Island to service residential development, the Washington State Department of Ecology never certified the system. It was eventually found to be leaking, and the system was shut down and dismantled (Ketron Island Homeowners Association, intervenor, V. Lundgren 1999). The residences that were tied into the system were allowed to install private septic systems, although many had to acquire additional lots to be able to do so (Pierce County 2009a).

While individual septic systems are allowed on Ketron Island, they are required to meet the minimum lot sizes, and the lots must also have suitable soils to support proper drainage of the system (Tacoma-Pierce County 2025b). According to the Natural Resources Conservation Service (NRCS), there are nine different soil classifications on Ketron Island, all of which are rated as "very limited" for supporting septic systems or sewage lagoons (NRCS 2019). The major contributing factors for this rating are depth to saturated zone, slopes, and slow water movement (Appendix A). Figure 2 depicts the different soils as mapped by the NRCS, and Appendix A provides supplemental details according to soil type.

Approximately 85 acres on Ketron Island are classified as 24D – Neilton gravelly loamy sand, 8 to 25 percent slopes, which is closest to the Category 1 soil type as defined in Washington Administrative Code 246-272A-0220. Developments within this category require a minimum lot size of 1 acre for septic. The remainder of the island has varying

soil conditions consistent with Categories 5 and 6 soil types. Developments in these areas are required to be a minimum of 2 acres for septic.

As noted previously, the majority of the lots on the island are 8,000 to 27,000 SF (0.18 to 0.62 acre) in size, which is smaller than the size required for the installation of a septic system. The existing residences were granted exceptions to build their septic systems when the original wastewater system was decommissioned. Septic systems for new residences would be required to conform to the current minimum lot size and setbacks in accordance with the Pierce County Unified Development Code. This would also include cabins and mobile homes. Recreational vehicles are generally considered a temporary use and do not require septic connections.

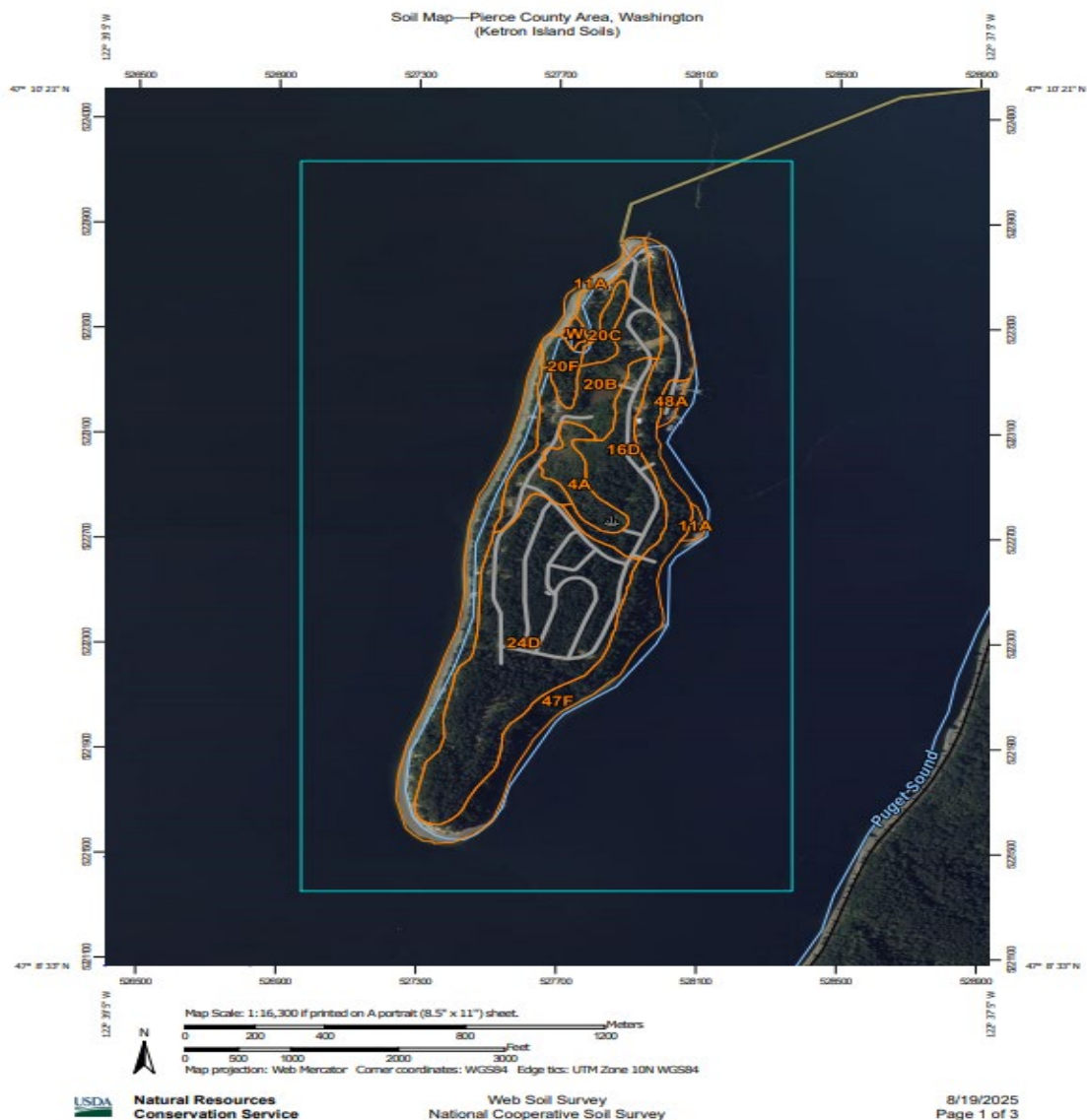


Figure 2. NRCS Soil Map

Based on a 2-acre minimum lot size required for septic development on Ketrone Island, the 126 acres of platted land considered available for development could be potentially developed into approximately 60 lots. Construction of a new community wastewater system that would support higher development densities is considered not reasonably foreseeable within the planning horizon of this study.

Water

According to the Washington State Department of Ecology, there are two mapped active water wells on Ketrone Island that provide service to existing residents, one of which is operated and maintained by Ketrone Island Water, Inc. (KIWI) (Ecology 2025). The other is a private well located on an existing undeveloped property with an active residential construction project. The well operated by KIWI was completed in 1956 and the other well was excavated in 2017 (Ecology 2025). KIWI was incorporated by island residents who acquired the rights to the water system after the proponents of the attempted redevelopment in the 1990's became embroiled by legal issues (US v. Cooley and US v. Fain, 2003). KIWI maintains a water distribution system that provides water to Island residents and includes one water tower that is centrally located on the island. The number of current connections maintained by KIWI is shown in Table 2. Based on discussions with residents, the existing water system consists of 1-inch laterals and portions of the island are unable to achieve the 20 PSI of water pressure needed for the permits associated with residential water supply. The location of the distribution laterals was not known at the time this report was developed.

In Pierce County a residential development seeking a building permit will need approval from the Tacoma-Pierce Department of Health for both water service and septic before an application will be accepted by Pierce County for consideration. The Department of Health processes approvals for water systems first and then reviews septic systems for approval. Therefore, residential development cannot advance without an approved water source.

Table 2. KIWI Water Utility Connections

Connection Type	Active Connections
Full Time	9
Part Time	4
Non-Residential	4
Total	17

According to the most recent Water Facilities Inventory Form filed by KIWI with the Washington State Department of Health (Appendix B), the utility operates a 762-foot-deep well with a capacity of 200 gallons per minute. Active service connections include nine full-time single-family residences, four part-time single-family residences, and four non-residential connections associated with recreational and/or transient accommodations

(e.g., campsites, RV sites). These active connections make up 17 of the approved 22 connections (see Table 2 and Appendix B).

New wells require approvals by the Tacoma-Pierce County Department of Health prior to and after installation (Tacoma-Pierce County 2025a). Water quality testing is required prior to commissioning a well. Additionally, the Department of Health mandates minimum setbacks from wastewater facilities, both private and public. These include:

- Fifty feet from a septic tank, septic holding tank, septic containment vessel, septic pump chamber, and septic distribution box.
- Fifty feet from building sewer, public sewer, collection, and nonperforated sewer distribution lines except building drains.
- One hundred feet from the edge of a drain field, proposed drain field that has been approved by a health authority, and reserve drain field areas.
- One hundred feet from all other sources or potential sources of contamination except for solid waste landfills including saltwater intrusion areas.

According to information available from the Tacoma-Pierce County Department of Health, Ketron Island is listed as a “No Well Zone” due to the potential for saltwater intrusion (Tacoma-Pierce County 2025c). Given this classification, it would be difficult for new wells to be permitted even if setback requirements can be met. However, there are provisions in the regulations that allow for variances, particularly when the well can be proven to meet standards set forth by the Department of Health.

For the purposes of this report, it is assumed that the availability of fresh water is the primary limiting factor to development on the island. Although there are mechanisms to allow for an expansion of the KIWI water system beyond the 22 approved service connections, additional capital investment would be required to expand the system. Coordination with Tacoma-Pierce County Department of Health confirmed that there are no known plans or applications to expand the existing water system. As a function of development potential, the existing KIWI water system has a maximum approved capacity of 22 full-time single-family residences as disclosed in the KIWI Water Facilities Inventory Form (Appendix B). There is also one known private well associated with an active residential construction project. Tacoma-Pierce County Department of Health cannot guarantee that all active wells are mapped on Ketron Island and indicated that other private wells may be present.

3.2.3 Electrical Power

Ketron Island’s electric power is sourced from the Town of Steilacoom Electric Utility. The Ketron Island feed from the Town of Steilacoom passes through a Bonneville Power Administration (BPA) meter at which point Tacoma Power takes ownership of the distribution system feeding Ketron Island. From this meter, the main feed to Ketron Island is a three-phase submarine cable extending approximately 4,000 feet horizontally beneath the Puget Sound.

The submarine cable transitions to an overhead primary distribution system on a riser structure (Figure 3) near the northeast shore of the island. The distribution system on

Ketron Island is comprised of approximately 5,500 feet of overhead three-phase primary and 3,100 feet of overhead single-phase primary. The electric customers are primarily served with overhead transformers and single-phase overhead service lines. The number of current connections maintained by TPU is shown in Table 3.



Figure 3. Submarine Cable Riser Structure

Table 3. Electric Utility Meters

Meter Type	Active Meters
Full Time	8
Part Time	10
Commercial	6
Total	24

3.2.4 Services

Other than by private watercraft, the only way to access Ketron Island is by utilizing the Pierce County ferry system. At one time, the ferry service provided nine direct trips daily between Steilacoom, Washington, and Ketron Island but this service has dwindled since the 1980s (Pierce County 2025c). The Pierce County ferry system currently provides a triangular run that goes from Steilacoom to Anderson Island and then to Ketron Island. This ferry service runs only three times per day on weekdays. Additionally, ferry

passengers departing Ketron Island are required to provide advanced notice to the ferry system operator. The current schedule is shown in Table 4. Ferry passengers are prohibited from carrying flammable liquids on Pierce County Ferries. These prohibited liquids include gasoline, propane, LPG, JP5, kerosene, and others. The ferry system supports fuel deliveries to Anderson Island with dedicated ferry for gasoline and propane fuel tankers on the first and third Monday of each month.

Table 4. Ferry Schedule

Departing Steilacoom	Departing Anderson Island	Departing Ketron Island
5:45 AM	6:20 AM	6:40 AM
10:35 AM	11:10 AM	11:30 AM
7:20 PM	7:55 PM	8:15 PM

The current schedule would not be considered viable for a typical commuter who works on the mainland. Although Pierce County has budgeted for maintenance of the ferry terminal on Ketron Island (Figure 4), there are no plans to expand the service to the island at this time (Pierce County 2025c).



Figure 4. Ketron Island Ferry Terminal

Due to the small number of residents and limited access to the island, there are no public services available. Police, fire, and emergency medical services (EMS) must be called from the mainland and can travel only on the next regularly scheduled ferry. For solid waste disposal, island residents take their waste to the mainland. There are no public schools on the island.

There are no commercial services on Ketron Island. The island lacks stores, employment opportunities, and supply outlets, making it difficult for residents or potential developers to sustain daily life or business operations without traveling off the island.

3.3 Field Review

A field visit to the island was conducted on September 5, 2025, to review the topographical characteristics of the island, electrical and water infrastructure, and existing facilities. The team spoke with several island residents. These conversations gave insights into both the past and present conditions of the island as well as the islanders' perspectives on how they see future development on the island.

3.4 Meetings

In addition to field review, meetings occurred with representatives from Pierce County Planning and Public Works and Tacoma-Pierce County Health Department. These meetings clarified and informed the understandings of the limitations identified in this report. KIWI representatives did not respond to outreach by the time this report was completed.

3.5 Real Estate Conclusions

There are significant limitations to further development of Ketron Island. The island has limited accessibility, with only three scheduled ferry trips per weekday, which impacts public services such as fire, police, and EMS. Island residents otherwise have no access to these public services on the island. In addition, there are no commercial services on the island.

The impact of development constraints on the island is demonstrated by the lack of overall demand for properties. Historic development has been limited. There has been an average of approximately four real estate transactions per year, with the majority of those occurring between island residents. The last single-family residence was built in approximately 1977. Some small, weekend-use cabins have been built more recently, but according to the Pierce County Assessor's office, the last was built in 2012. During the field review, new residential construction was observed on one property. This property is permitted for septic and has its own water supply, making it a unique property relative to the rest of the island.

The island's soil and topography limit the ability to install septic systems. Single-family residential homes built prior to the decommissioning of the wastewater facility were allowed to construct private septic systems, but new systems would be required to meet all current requirements and would have to be approved by the Tacoma-Pierce County Department of Health. The soil types on the island make septic approvals challenging to

achieve and difficult to anticipate. Further, outside of the acreage owned by Alaska Northwest Industries, Inc. and TDL Development LLC there are only 7 landowners with enough assembled acreage to support the minimum lot size of 2.0 acres required for a septic system. The majority of the individual lots range in size from approximately 6,500 to 42,700 SF.

There are currently approximately 126 acres held by Alaska Northwest Industries, Inc. and TDL Development LLC and these lots are the most likely properties for future development. Although the majority of the other lots are currently vacant, their ownership is held by almost 100 different owners, and they are not considered to be available for assembling into larger lots that could potentially be developed. While unlikely, a development could be possible through the re-subdivision of the 126 acres held in common ownership. However, this report has determined that septic availability is not the primary limitation to development.

The island is currently served by a municipal water corporation that is owned by the landowners. The potential for saltwater intrusion complicates the ability to drill new municipal or private water wells. Expansion of the existing water system would require capital investment by KIWI, which would ultimately be paid by the system customers in some fashion and there are no known plans for expansion.

For the purpose of defining a high-growth development scenario, this report assumes that growth would be limited to 23 single-family residences which includes the 22 connections disclosed in the KIWI Water Facilities Inventory Form and the one known private well for a single-family residence currently under construction (Appendix B). The high-growth scenario would assume that any part-time or non-residential water connections would be upgraded to full-time, single-family residences. In addition to the 9 existing single-family residential water connections, 4 part-time residences would be converted to full-time single-family residences, 4 non-residential water connections would also be converted to full-time single-family residences (See Table 2). The KIWI system has capacity for 5 additional full-time single-family residences for a total of 22 single family residences. The one private well would increase the total number to 23 full-time single-family residences.

Due to the development constraints discussed above and the lack of development over the previous 50 years, new development that requires additional electrical service is considered unlikely over the 20-year planning horizon of this study. Projected growth is anticipated to be zero as a base scenario for analysis.

4 Energy and Peak Demand Load Forecasts

4.1 Historical Usage

Historical electric usage data was provided by TPU to analyze past loading and forecast projected future loading. The data provided included readings from the BPA meter that measures the total power delivered to Ketron Island as well as 24 TPU meters for the individual premises on the island. These two data sets were analyzed and used in conjunction with the real estate findings to forecast 20-year annualized peak loading and daily energy consumption for two development scenarios (based on current development

and high-growth development) and two weather scenarios (normal weather and severe weather). The following sections discuss the analysis and results.

4.1.1 Electric Load Classification

The 24 individual meters on Ketrón Island are located at 18 residential and six commercial premises. The residential electric loads include 8 year-round residences and 10 seasonal residences based on usage trending from the individual TPU meters. The commercial electric loads consist of water wells and pumps operated by KIWI to support the residential homes, electric services for the marina, and one electric service for the ferry terminal.

4.1.2 Electric Energy Consumption

Figure 5 shows the total daily kWh usage since January 1, 2020. The graph is overlaid with the daily temperatures and average 20-year historical temperatures. All temperature data was obtained from NOAA's Online Climate Database for the Tacoma Number 1, WA US weather station (NOAA 2025). The kWh readings displayed in Figure 5 are from the BPA meter feeding Ketrón Island.

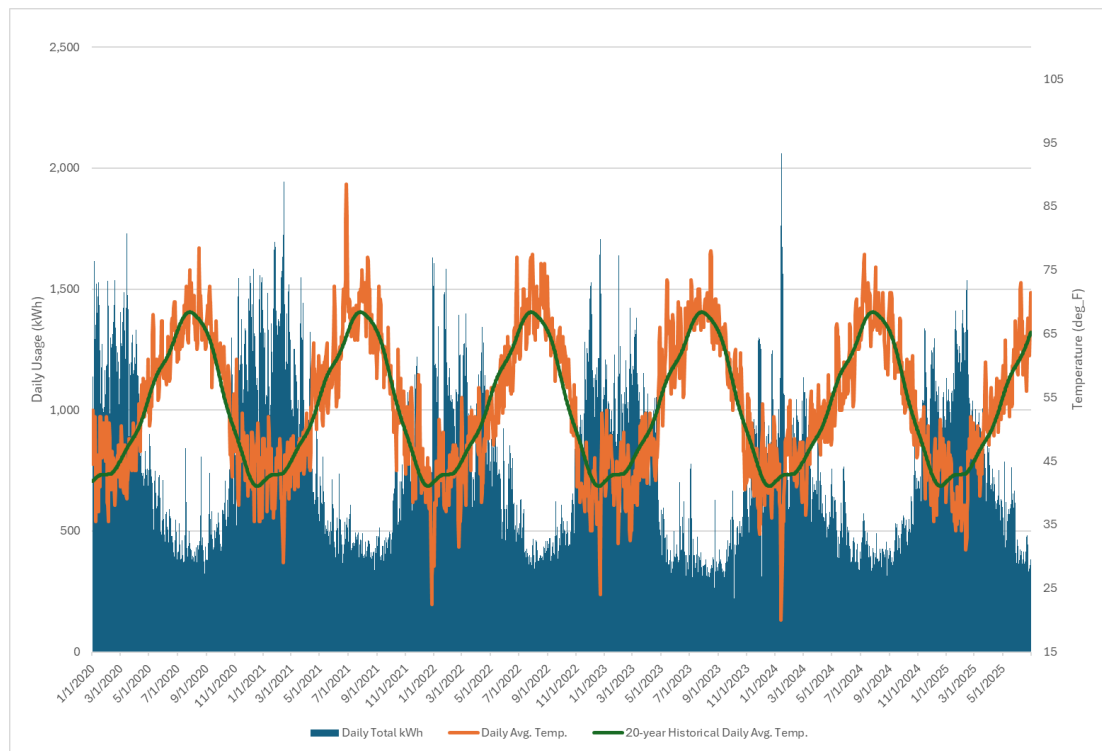


Figure 3. Daily Usage (kWh) vs. Temperature

As shown in Figure 5, Ketrón Island is winter-peaking, with most of its electrical usage occurring in the months of November through March. The peak daily kWh aligning with the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Standard 169, 99 percent annual heating design temperature (25.2 degrees Fahrenheit

[°F]) for Gray AFF, WA weather station (ASHRAE 2025) was 1,763 kWh, which occurred on January 12, 2024. This value is the baseline normal weather case for annual kWh forecasting. A scatter plot of energy consumption versus temperature is shown in Appendix D.

The peak daily kWh usage over the past 5 years was 2,061 kWh, which occurred on January 13, 2024, during an extreme cold weather event (20°F). This event was the coldest average daily temperature in the past 20 years. This maximum daily usage of 2,061 kWh is 1.17 times larger than the 1,763 kWh base weather case. This 1.17 factor is the extreme weather case for the annual kWh forecast. Appendix C includes the 4-day load profile of this extreme weather event.

The TPU data showed that there were eight residential premises with full-time annual usage. These residences accounted for 80 percent of the total annual usage. The daily maximum consumption for new residential homes was calculated by taking 80 percent of the baseline normal weather case (1,763 kWh) and dividing it by the eight full-time residential homes. This approach resulted in a daily maximum consumption of approximately 176 kWh per residential home. This value will be the usage growth rate per residential home for the annual kWh forecast and assumes that a new home would have the same energy consumption characteristics as the homes currently on the island. This assumption was made due to new homes being approximately 20% larger than homes built in the 1960's and the Energy Use Intensity (EUI) factor of new homes being approximately 20% less than the existing homes on the island. This is described in further detail in section 4.1.3.

4.1.3 Peak Demand

Figure 6 shows the total peak demand (kW) since January 1, 2020, as well as the daily temperatures and average 20-year historical temperatures. The kW readings displayed in Figure 6 are from the BPA meter feeding Ketron Island. The kW values were based on the maximum hourly kWh reading for each day. A scatter plot of peak demand versus temperature is shown in Appendix E.

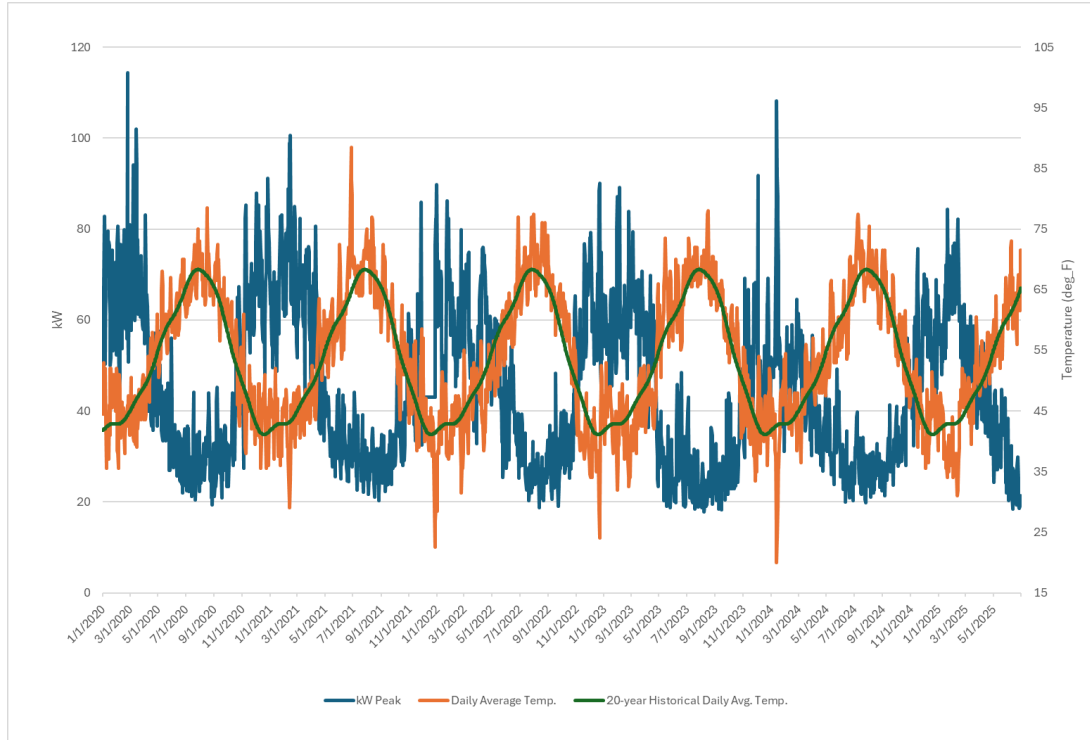


Figure 4. Peak Demand (kW) vs. Temperature

The peak demand follows the same trend as daily usage, with the highest peaks occurring during the winter months. Over the past 5 years, the highest peak demand was 114 kW, which occurred on February 24, 2020. The average temperature that day was 46°F, which was 2 degrees above the historical average temperature. This peak does not correlate to extreme temperatures; however, after further research, it was learned that there was an emergency response event on the island that day, and this event was considered an outlier and excluded from the peak demand analysis.

During the extreme cold weather event on January 13, 2024, the peak demand was 108 kW. This peak demand occurred during a 20-year historical low average daily temperature of 20°F and will be used as the extreme peak demand for future forecasting.

The electrical load corresponding to the ASHRAE 99 percent design temperature (25.2°F) nearest this peak event was 85 kW. The extreme peak demand of 108 kW is 1.3 times higher than 85 kW baseline peak demand for the design temperature. This 1.3 factor will be used as the extreme weather peak demand factor for future forecasting. Figure 7 shows the extreme cold weather event and how this factor was determined.

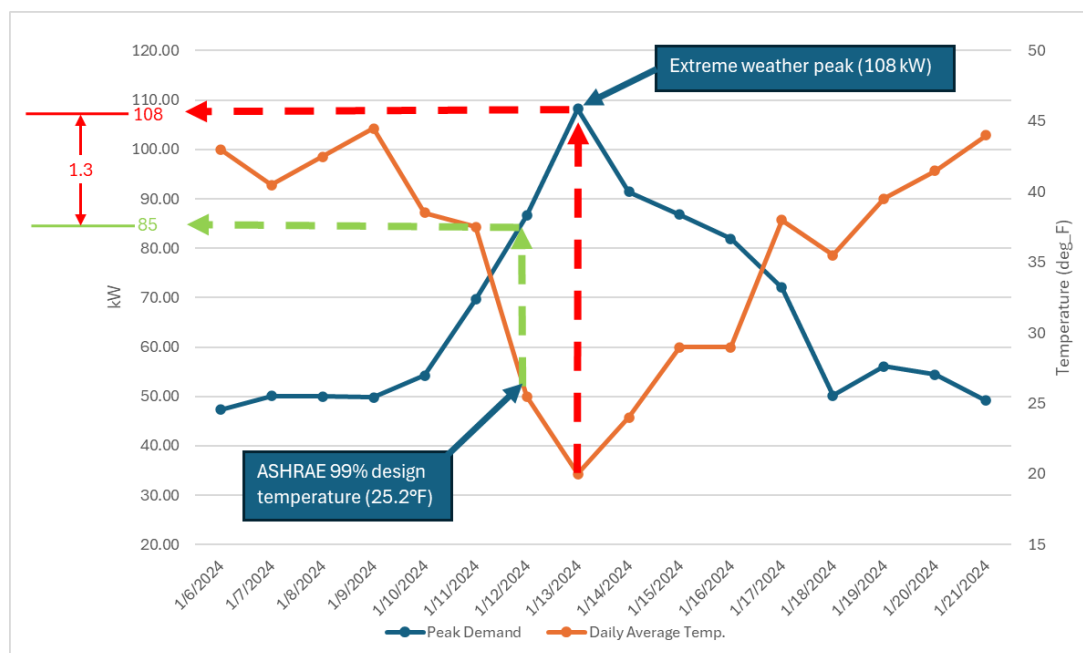


Figure 5. January 13, 2024, Extreme Cold Weather Event

Three types of analysis were conducted to determine the most feasible approach for future peak demand forecasting. These included peak demand based on usage from the 24 TPU meters, ASHRAE (2020 and 2021) and National Electrical Code (NEC 2023) peak demand calculations for residential homes, and Energy Use Intensity (EUI) calculations. The following section explains these methods and their results.

Peak Demand Meter Usage Method

Table 5 summarizes the peak demand data for the residential and commercial premises based on the individual automated metering infrastructure meter readings.

Table 5. Peak Demand Summary (kW)

Premise Type	Minimum	Maximum	Average	Sum of Non-Coincident Peaks
Residential	0.1	32.4	13.7	246
Commercial	2.6	11.8	6.0	36
Combined			12.5	282

The combined sum of the individual non-coincident peaks shown in Table 5 is 282 kW. This value, divided by the coincident peak meter demand (108 kW) from February 24, 2020, produces a diversity factor of approximately 2.6. The future annual peak demand (kW) will be calculated using the following formula. In the following formula, the commercial

average peak demand is divided by the number of residential electric services to capture the potential commercial load growth as part of the residential growth it supports.

$$PD_F = \frac{\sum PD_I + (PD_{RA} + PD_{CA} / R_E) * R_N}{DF}$$

Where:

PD_F = Future peak demand

$\sum PD_I$ = Sum of individual peak demands

PD_{RA} = Residential average peak demand

PD_{CA} = Commercial average peak demand

R_E = Number of existing residential services

R_N = Number of new residential services

DF = Diversity factor

Peak Demand ASHRAE and NEC Calculation Methods

The median residential home size (excluding cabins) on Ketron Island is approximately 2,500 SF, and most of the homes were built in the 1960s and 1970s. The estimated new home size for future development will be 3,000 SF. This value was determined based on National Renewable Energy Laboratory (NREL) ResStock data from 2024 Release 2. Units in ASHRAE climate zone 4C, single-family detached units, electrically heated are approximately 2200 SF for homes built in 2010-2019, and 1800 SF for homes built in 1970-1979 (NREL 2024). This results in homes being built about 20% larger today than in the 1970s.

ASHRAE (2021 and 2020) data was used for determining heating loads, and NEC (2023) calculations were used to determine peak demand for a 3,000-SF home with all-electric heat and typical appliances. The future peak demand was calculated by replacing the PD_{RA} value in the equation above with the NEC calculated value.

Peak Demand EUI Method

The EUI method calculates the peak demand based on the EUI of the existing homes to standard EUI factors for new construction and their floor area ratio. The following formula was used to calculate the future peak demand:

$$PD_F = PD_{BL} + \frac{R_N}{R_E} R_{EUI} R_{Floor\ Area} PD_{BL}$$

Where:

$$PD_F = \text{Future peak demand}$$
$$PD_{BL} = \text{Baseline Peak Demand}$$
$$R_{Floor\ Area} = \text{Avg. floor area new construction/Avg. floor area existing}$$
$$R_{EUI} = \text{New construction EUI/Existng stock EUI}$$
$$R_E = \text{Number of existing residential services}$$
$$R_N = \text{Number of new residential services}$$

Using the NREL ResStock data from 2024 Release 2, units in ASHRAE climate zone 4C, single-family detached units, electrically heated, built in 2010 with heat pumps would have an EUI in the range of 5–10 with an average of 7.3 (NREL 2024).

Peak demand growth using these methods is discussed in Section 4.2.3.

4.2 Future Projected Electrical Load

4.2.1 Current Growth Rate

As shown in Figure 5 and Figure 6, the electric usage and peak demand have been trending downward over the past 5 years. This downward trend may be associated with improved appliance efficiencies, reduced annual occupancy of residential homes, and more moderate temperatures. Because of this downward usage trend and the minimal development in the past 20 years, the forecasted growth rate based on current trends was determined to be 0 percent growth over the next 20 years. The forecasted energy usage and peak demand in 2045 values based on 0 percent growth are shown in Table 6 and Table 7, respectively.

Table 6. Projected Energy Usage (No Growth)

Description	2045 Energy Usage (kWh)
Daily Average	757
Daily Maximum Normal Weather	1,763
Daily Maximum Extreme Weather	2,061

Table 7. Projected Peak Demand (No Growth)

Description	2045 Peak Demand (kW)
Maximum Normal Weather	85
Maximum Extreme Weather	108

4.2.2 High Growth Rate

As described in Section 3.5 of this report, the high growth rate is projected to be 14 additional full-time single-family residences over the next 20 years. This is based on the existing acreage that is available to develop and the current water and septic restrictions. As previously indicated, this growth is considered unlikely, but a fraction of that growth may be possible.

Table 8 summarizes the existing daily energy usage and the forecasted 20-year daily usage in 2045 based on this high growth rate.

Table 8. Projected Daily Usage (High Growth)

Description	Existing Energy Usage (kWh)	Projected 2045 Energy Usage (kWh)
Daily Average	757	1,811
Daily Maximum Normal Weather	1,583	4,227
Daily Maximum Extreme Weather	2,061	4,941

4.2.3 Peak Demand Method Results

Table 9 shows the 20-year calculated peak demand results based on 14 additional full-time single-family residences for each analysis method discussed in Section 4.1.3.

Table 9. Peak Demand Analysis Results

Analysis Type	Peak/New Home (kW)	Diversity Factor	Normal Weather Peak (kW)	Extreme Weather Peak (kW)
Usage Data Method	21.7	2.6	200	260
ASHRAE and NEC Methods	44	2.6	321	417
EUI Method	9	N/A	207	269

As shown in Table 9, the 20-year forecasts for the usage data method and EUI method produce similar results of 200 kW and 207 kW for normal weather and 260 kW and 269 kW for extreme weather, respectively. The ASHRAE 169-2020 and NEC 2023 methods produced high results and are not considered feasible because the peak demand per new home far exceeded the maximum peak from the current usage data.

The usage data method will be used to forecast future peak demand (Table 10) because it most closely represents the actual usage per full-time island residence, and it incorporates a diversity factor that is unique to the island.

Table 10. Projected Peak Demand (High Growth)

Description	Existing Peak Demand (kW)	Projected 2045 Peak Demand (kW)
Maximum Normal Weather	85	200
Maximum Extreme Weather	108	260

Electric vehicle load growth and load reductions due to appliance efficiencies were not included in growth rate calculations strictly due to the variability of the electric load and the nature of the current residences on the island. Most homes are seasonal, and the ferry schedule does not cater well to daily commuters, which reduces the likelihood that existing and future residents would own and benefit from electric vehicles.

5 Conclusion

Overall, any significant increase in electrical load on Ketron Island is unlikely. The island has development challenges, primarily with water and wastewater requirements, limited transportation, and the lack of public services.

Two growth-rate scenarios were determined: one based on current growth and one based on high growth. The scenario based on current growth rate was determined to be no additional growth in the next 20 years, which was based on the declining electrical load over the past 5 years and minimal development in the past 20 years. The high growth rate scenario was determined to be an increase of 14 full-time single-family residences over the next 20 years. This determination was based on the number of approved connections for water service that could be supplied to the residences and one off-grid residence converting to the utility.

Due to challenges outlined in this report, it is unlikely that any further development will occur on Ketron Island in the foreseeable future, therefore it is recommended that the future electrical infrastructure upgrades be sized to support the current growth rate of 0% (Table 6 and Table 7) and have provisions to support the projected high growth values (Table 8 and Table 10).

6 References

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- 2025c Pierce County Water Quality. <https://piercecowa.maps.arcgis.com/apps/webappviewer/index.html?id=ea09ff7335974c20b89590db2586bf84>

U.S. v. Cooley / U.S. v. Fain. 68 Fed.Appx. 804 (9th Cir. 2003) UNITED STATES of America, Plaintiff--Appellee, v. Catherine COOLEY, Defendant--Appellant. United States of America, Plaintiff--Appellee, v. Charles Joseph Fain, Defendant--Appellant. Nos. 01-30444, 01-30453. D.C. Nos. CR-01-05120-JET, CR-01-05120-JET-01. United States Court of Appeals, Ninth Circuit. June 17, 2003

Appendix A: Sewage Disposal–Ketrion Island, Washington

Sewage Disposal–Pierce County Area, Washington					
Map Symbol and Soil Name	Acres	Septic Tank Absorption Fields		Sewage Lagoons	
		Rating Class & Limiting Features	Value	Rating Class & Limiting Features	Value
4A - Bellingham Silty Clay Loam	9.8	Very Limited Ponding Depth to saturated zone Slow water movement	1.00 1.00 1.00	Very Limited Ponding Depth to saturated zone	1.00 1.00
11A Coastal Beaches	5.1	Very Limited Flooding Depth to saturated zone	1.00 1.00	Very Limited Flooding Depth to saturated zone Slope	1.00 1.00 0.80
16D - Hartine gravelly ashy sandy loam 15 to 30% slopes	24	Very Limited Depth to saturated zone Slope Slow water movement	 1.00 1.00 0.50	Very Limited Slope Depth to saturated zone Seepage	 1.00 1.00 0.50
20B - Kitsap silt loam 2 to 8% slopes	33.2	Very Limited Depth to saturated zone Slow water movement	 1.00 1.00	Very Limited Depth to saturated zone Slope Seepage	 1.00 0.68 0.50
20C - Kitsap silt loam 8 to 15% slopes	4.3	Very Limited Depth to saturated zone Slow water movement Slope	 1.00 1.00 0.63	Very Limited Slope Depth to saturated zone Seepage	 1.00 1.00 0.50
20F - Kitsap silt loam 30 to 65% slopes	5.4	Very Limited Depth to saturated zone Slow water movement Slope	 1.00 1.00 1.00	Very Limited Slope Depth to saturated zone Seepage	 1.00 1.00 0.50
24D - Neilton gravelly loamy sand 8 to 15% slopes	85.3	Very Limited Filtering capacity Seepage, bottom layer Slope Large stones	 1.00 1.00 1.00 0.01	Very Limited Slope Seepage Large stones	 1.00 1.00 0.63
47F - Xerochrepts 45 to 70% slopes	75.1	Very Limited Slope Seepage, bottom layer	 1.00 1.00	Very Limited Slope Seepage	 1.00 1.00
48A - Urban Land 0 to 5% slopes	2.1	Unrated		Unrated	
W - Water	1.3	Unrated		Unrated	

Source: USDA Natural Resources Conservation Service: Soil Survey Area: Pierce County Area, Washington, Version 20, August 27, 2024 (Page 2-4).

Appendix B: Water Facilities Inventory Form

ONE FORM PER SYSTEM

Submission Reason: No Change

[illegible]



WATER FACILITIES INVENTORY (WFI) FORM - Continued

1. SYSTEM ID NO.	2. SYSTEM NAME	3. COUNTY	4. GROUP	5. TYPE
38350 9	KETRON ISLAND WATER INC	PIERCE	A	TNC

	ACTIVE SERVICE CONNECTIONS	DOH USE ONLY! CALCULATED ACTIVE CONNECTIONS	DOH USE ONLY! APPROVED CONNECTIONS
25. SINGLE FAMILY RESIDENCES (How many of the following do you have?)		13	22
A. Full Time Single Family Residences (Occupied 180 days or more per year)	9		
B. Part Time Single Family Residences (Occupied less than 180 days per year)	4		
26. MULTI-FAMILY RESIDENTIAL BUILDINGS (How many of the following do you have?)			
A. Apartment Buildings, condos, duplexes, barracks, dorms	0		
B. Full Time Residential Units in the Apartments, Condos, Duplexes, Dorms that are occupied more than 180 days/year	0		
C. Part Time Residential Units in the Apartments, Condos, Duplexes, Dorms that are occupied less than 180 days/year	0		
27. NON-RESIDENTIAL CONNECTIONS (How many of the following do you have?)			
A. Recreational Services and/or Transient Accommodations (Campsites, RV sites, hotel/motel/overnight units)	4	4	0
B. Institutional, Commercial/Business, School, Day Care, Industrial Services, etc.	0	0	0
28. TOTAL SERVICE CONNECTIONS		17	22

29. FULL-TIME RESIDENTIAL POPULATION												
A. How many residents are served by this system 180 or more days per year?	9											

30. PART-TIME RESIDENTIAL POPULATION	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
A. How many part-time residents are present each month?	8	8	8	8	8	8	8	8	8	8	8	8
B. How many days per month are they present?	10	10	10	10	10	10	10	10	10	10	10	10

31. TEMPORARY & TRANSIENT USERS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
A. How many total visitors, attendees, travelers, campers, patients or customers have access to the water system each month?												
B. How many days per month is water accessible to the public?												

32. REGULAR NON-RESIDENTIAL USERS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
A. If you have schools, daycares, or businesses connected to your water system, how many students, daycare children and/or employees are present each month that are NOT already included in the residential population?												
B. How many days per month are they present?												

33. ROUTINE COLIFORM SCHEDULE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
	1	0	0	1	0	0	1	0	0	1	0	0

34. NITRATE SCHEDULE	QUARTERLY	ANNUALLY	ONCE EVERY 3 YEARS
(One Sample per source by time period)		S01	

35. Reason for Submitting WFI:	
☐ Update - Change ☐ Update - No Change ☐ Inactivate ☐ Re-Activate ☐ Name Change ☐ New System ☐ Other _____	

36. I certify that the information stated on this WFI form is correct to the best of my knowledge.	
SIGNATURE: _____	DATE: _____
PRINT NAME: _____	TITLE: _____

<u>WS ID</u>	<u>WS Name</u>
38350	KETRON ISLAND WATER INC

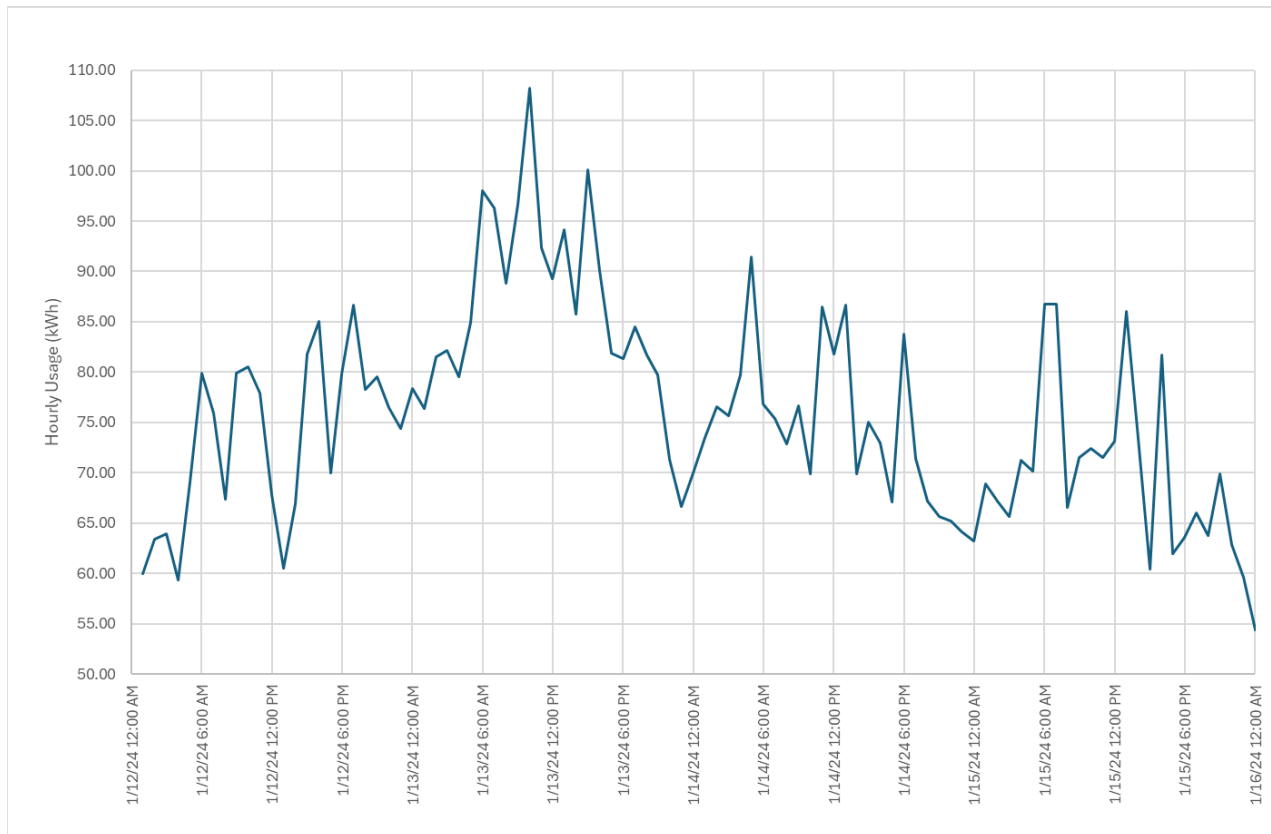
Total WFI Printed: 1



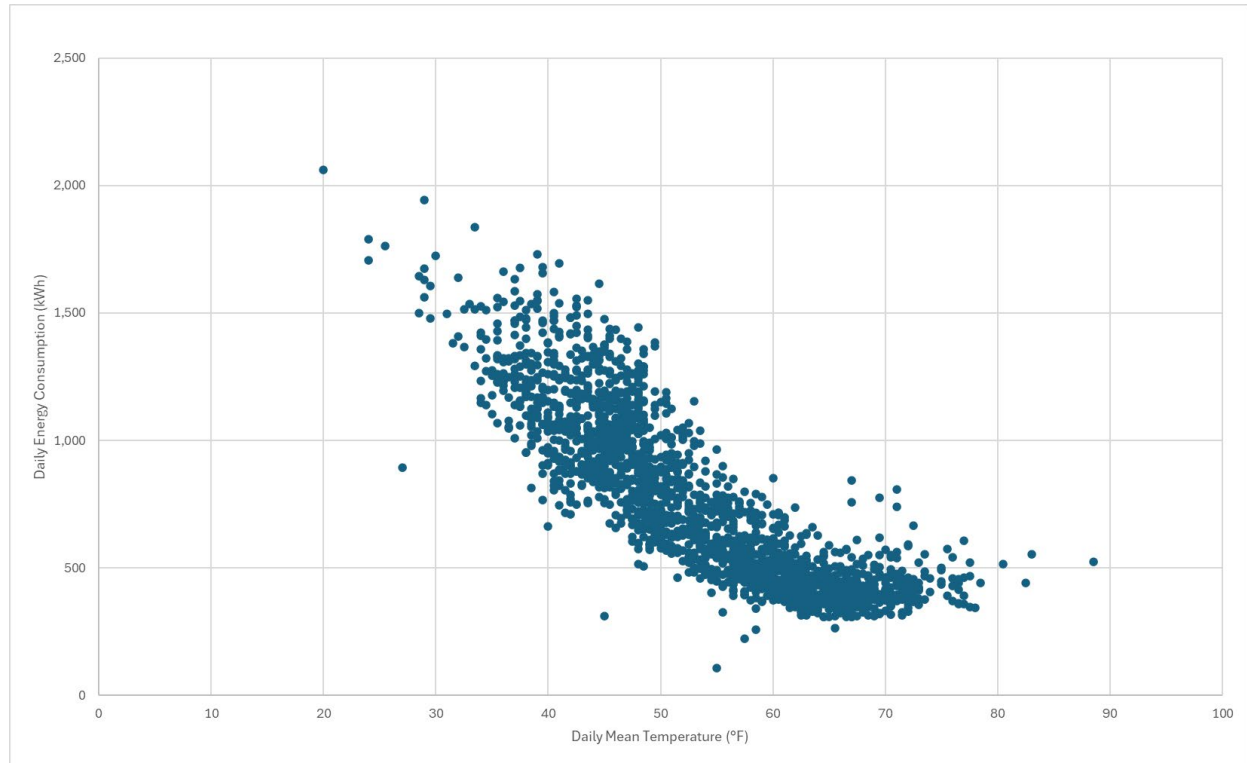
Water Facilities Inventory (WFI)

Report Create Date: 9/11/2025
Water System Id(s): 38350
Print Data on Distribution Page: ALL
Print Copies For: DOH Copy
Water System Name: ALL
County: -- Any --
Region: ALL
Group: ALL
Type: ALL
Permit Renewal Quarter: ALL
Water System Is New: ALL
Water System Status: ALL
Water Status Date From: ALL To ALL
Water System Update Date ALL To ALL
Owner Number: ALL
SMA Number: ALL
SMA Name: ALL
Active Connection Count From: ALL To: ALL
Approved Connection Count ALL To: ALL
Full-Time Population From: ALL To: ALL
Water System Expanding ALL
Source Type: ALL
Source Use: ALL
WFI Printed For: On-Demand

Appendix C: Extreme Weather Event Load Profile



Appendix D: Energy Consumption vs. Temperature Scatter Plot



Appendix E: Peak Demand vs. Temperature Scatter Plot

