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Monitoring Warm Wastewater and Evaporation Fans - A Brilliant Duo

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Idaho National Laboratory

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Monitoring Warm Wastewater and Evaporation Fans – *A Brilliant Duo*

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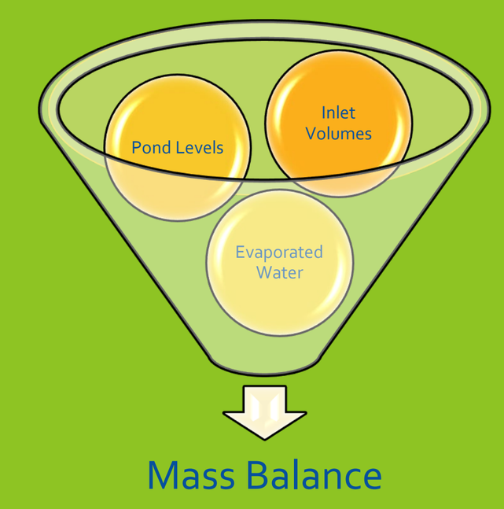
Introduction + Objectives

The Advanced Test Reactor (ATR) is renowned for its fascinating features and intricate implications. The nature of being a nuclear reactor implies the generation of nuclear waste; considerations must be made to consolidate and manage the waste. As it pertains to ATR, warm wastewater is generated. Warm wastewater is classified as a low-level radioactive waste that does not contain any significant chemical contaminates. The majority of warm wastewater comes from the ATR Primary Coolant System (PCS), as it absorbs radioactive material. The warm wastewater is then pumped into the evaporation ponds and the contamination within it precipitates into a sludge that comes to reside at the bottom of the ponds. To do scheduled maintenance on the pond liners, water must entirely be removed from the ponds. Therefore, knowing what is coming in and out of the ponds with a mass balance is a necessity. In 2023, evaporation fans were integrated into the ponds to expedite the evaporation process (*Figure 1*). The phenomena of an increased evaporation rate is from the fans providing airflow that lowers the humidity at the water to air interface, so the water evaporates easier. It must be known if these fans are an effective asset or not, given they only operate during the summers and at wind speeds below 25 mph.

Methods + Resources

The data compiling methods can be summarized into 4 categories:

- ***Waste system data sheets***
- ***Manual pond surveying***
- ***Amassed data via excel***
- ***NOAA weather reports***



Regarding the mass balance, the following equation can be used:

Accumulation = Gain – Loss + Generation – Consumption

It can be assumed that there are no generation nor consumption terms as there is an absence of chemical reactions that would suggest so. This leaves 3 terms: accumulation (pond levels), gain (inlet volumes), and loss (evaporated water). The pond levels were found with the data sheets. Previous data sets over the past 5 years were collected via physical files, on EDMS, or from a provided email. Present data collection was done through manual pond surveying and data was recorded every Monday when possible (*Figure 2*). Weather data and the inlet volumes were found with NOAA weather reports and provided excel sheets, respectively. Weather data was needed to analyze evaporation fan usage. Excel sheets were also used to calculate evaporation rates.

Results + Conclusions

Data for the inlet volumes, pond levels, evaporated water, and wind speeds are shown below (*Figures 3-6*). Based on the data, it is reasonable to make some conclusions. First, the amount of inlet water being added to the ponds has decreased over the past 5 years (*Figure 3*). This will be helpful with the objective of draining the ponds as less water is being added to the warm wastewater ponds means less cumulative water will have to be evaporated in the future. The pond levels have increased from 2021-2023 only to start decreasing in 2024 (*Figure 4*). These findings could be attributed to the combination of the water inlet rates alongside the water evaporation rates, even if the evaporated water data is rather irregular (*Figure 5*). Yet, the current trendline trajectory suggests an increase in the evaporation rates, which is indicative that the evaporation fans are effective for removing water from the ponds. However, it is probably more logical to say that this data is inconclusive until more is collected. The annual average maximum wind speed each summer at ATR frequently exceeds 25 mph (*Figure 6*). Hence, at the very least, the fan operational threshold should be increased for more effective use in the future summers.

Figure 1: Evaporation fans on the west pond.

Figure 2: Manual surveying of the west pond.

FIGURE 3: YEARLY AVERAGE WATER INLET RATES SINCE 2019

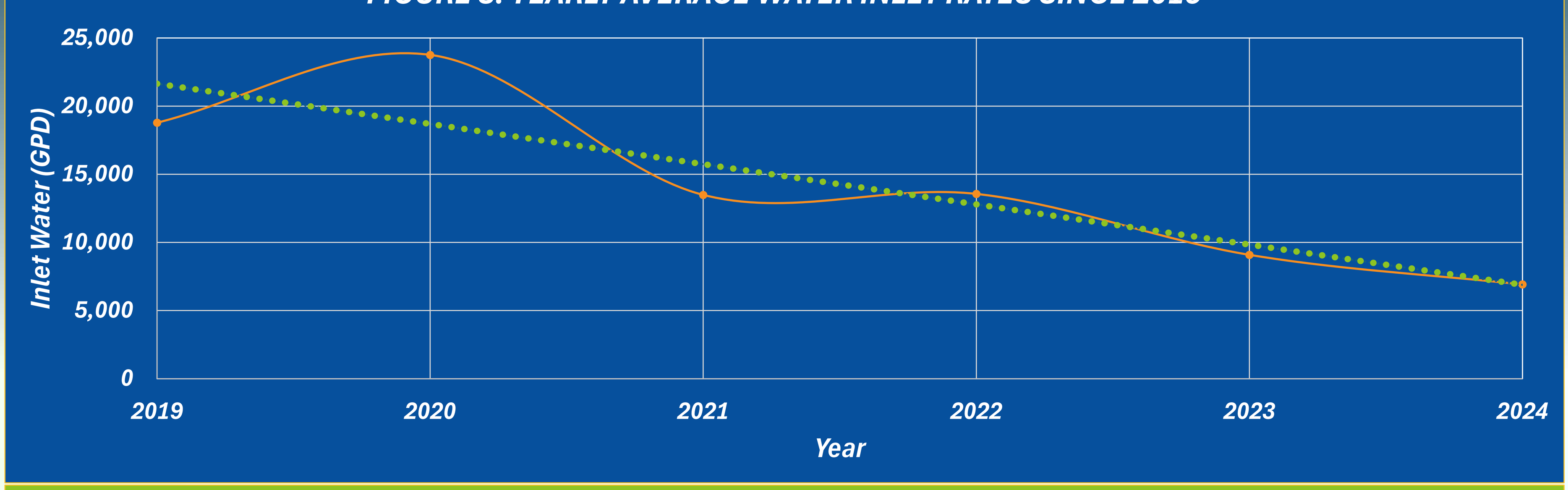


FIGURE 4: THE FINAL RECORDED WATER LEVELS FOR EACH YEAR SINCE 2019

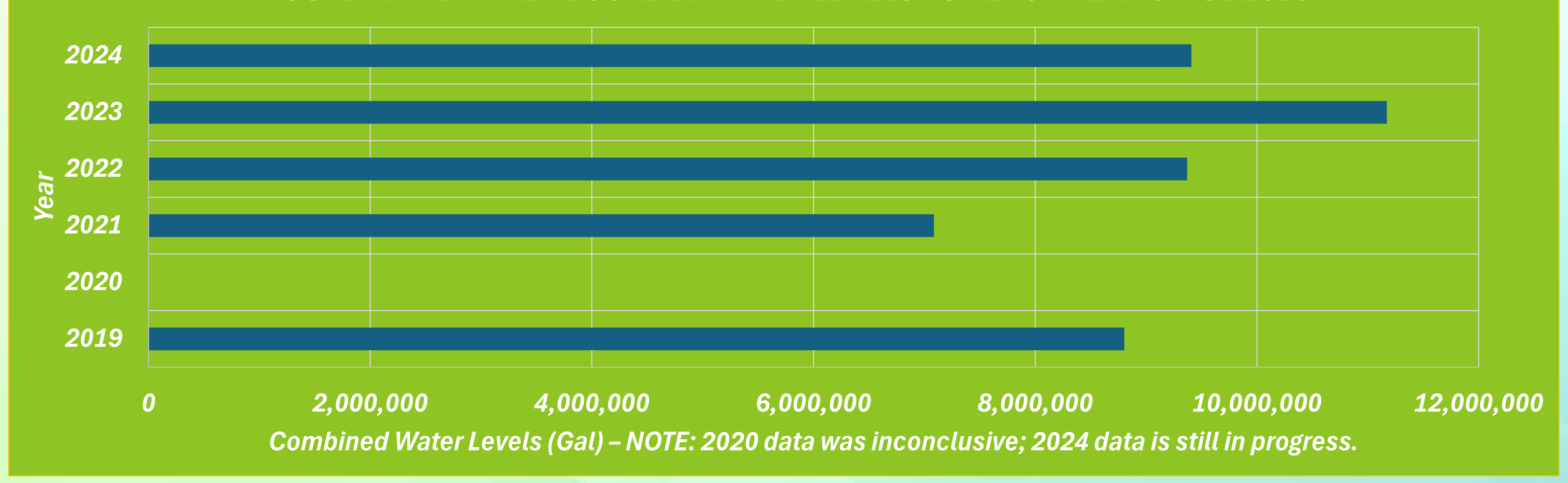


FIGURE 5: WATER EVAPRATION RATES SINCE 2019

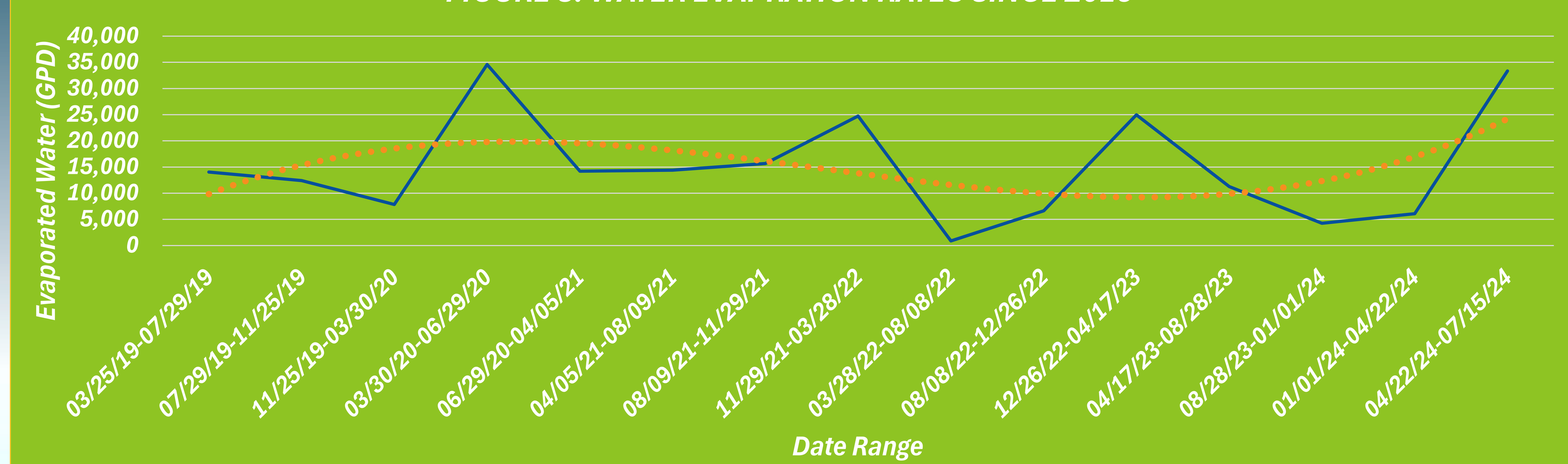
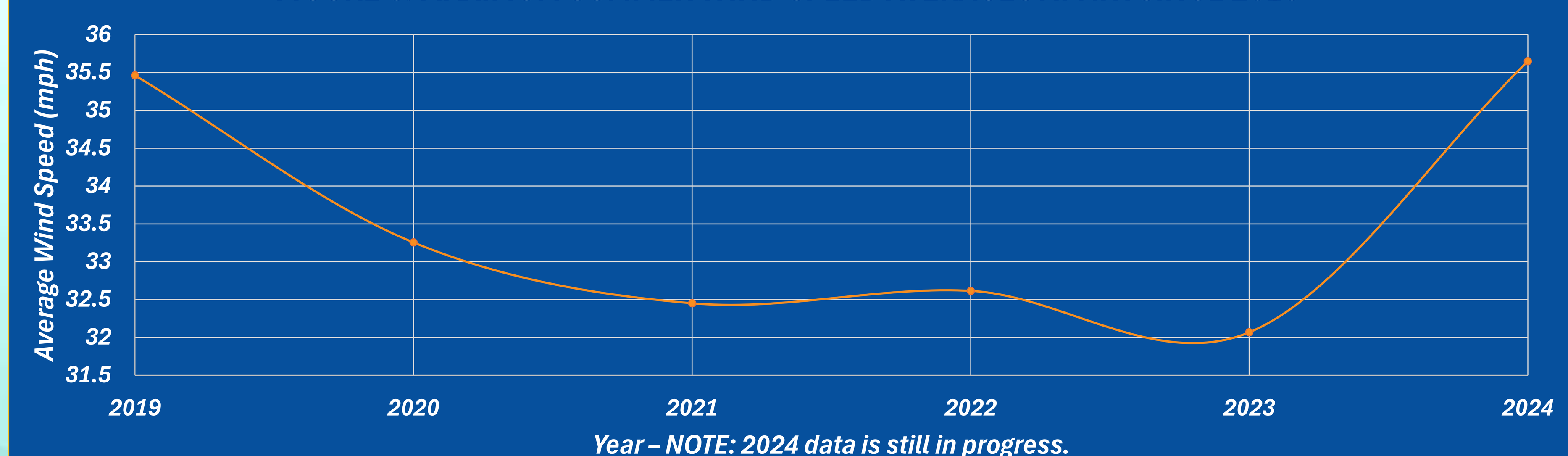


FIGURE 6: MAXIMUM SUMMER WIND SPEED AVERAGES AT ATR SINCE 2019



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