GROUNDWATER SUSTAINABILITY STUDY
by the Chebeague Climate Action Team (CCAT)

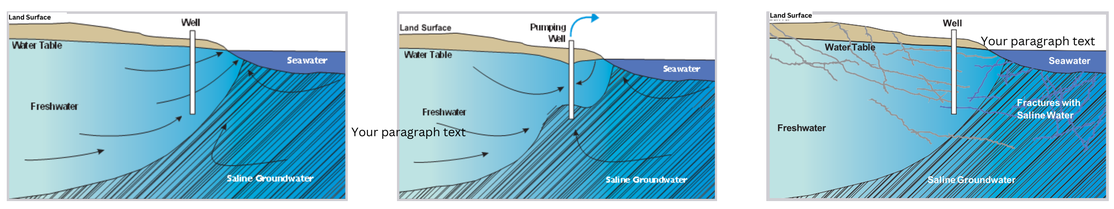
Why do a groundwater sustainability study?

Groundwater wells are the sole source of drinking water on the island. Many of the wells on the island rely on the fractured bedrock aquifer as their water source. Being able to quantify the island's water balance and local vulnerability in a changing climate is fundamental to protecting the island's water supply now and into the future.

Of particular concern to Chebeague are the climate-related risks of **sea water intrusion** due to sea level rise and changes in groundwater levels, quality, and availability due to variable precipitation patterns such as **intense rainfall** and **droughts**.

Sea Water Intrusion

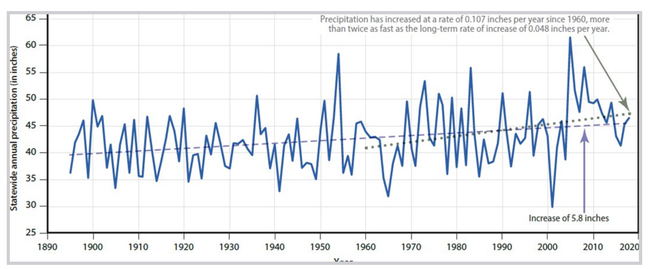
Sea water intrusion occurs when salty water is drawn into a freshwater aquifer. Sea water can infiltrate freshwater aquifers at depth due to landward migration caused by sea level rise and/or pumping effects. In a fractured bedrock aquifer, a single fracture can deliver saltwater to the well. Identifying areas where sea water intrusion risk is high and managing well spacing and withdrawals can help minimize degradation of the water quality.



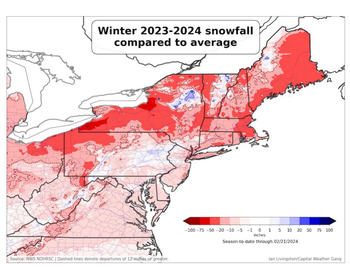
Sea Water Intrusion Caused by Pumping
Image Credit: Government of British Columbia 2016, *Best Practices for Prevention of Saltwater Intrusion*

Intense Rainfall and Decreasing Snowpack

More frequent and intense precipitation events can result in increased runoff and less infiltration. When rainfall follows a dry period, it often carries a higher than normal load of pollutants which may be washed into the groundwater supply. Two-inch rain days were up 49% when comparing averages between 1958 and 2022, while 5-inch days were up 102%. (Fernandez, 2022). Maine has also begun to experience ***snow droughts*** characterized by periods of abnormally thin snowpack. As winter temperatures generally continue to increase in Maine, winters become shorter, total snowpack may decrease, and spring runoff important for groundwater recharge may diminish, leading to more potential challenges with drought through the summer.



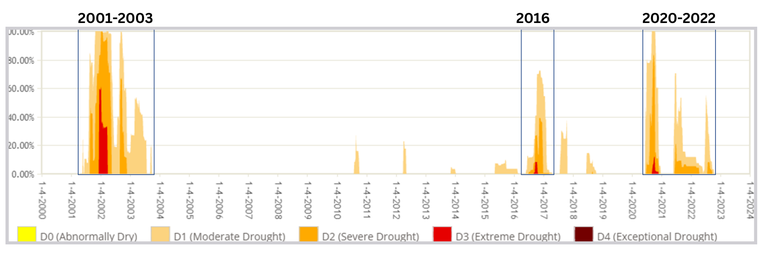
Precipitation Trends in Maine
Image Credit: Fernandez et al. 2020, *Maine's Climate Future*



Snow Drought in Maine 2023-24
Image Credit: (Ian Livingston/Capital Weather Gang, 2024

Droughts

Droughts stress drinking water supplies and pose threats to agriculture, ecosystems, and fire danger. Climate predictions suggest that global warming will make short term droughts more frequent and intense. Maine experienced droughts in 2001-2003, 2016 and 2020-2022.



Recent Historic Droughts in Maine
Image Credit: Gordon 2024, *Maine's Changing Hydrologic Cycle*

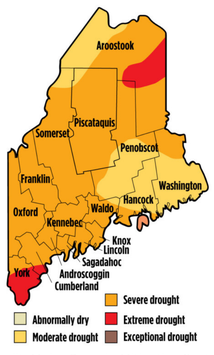
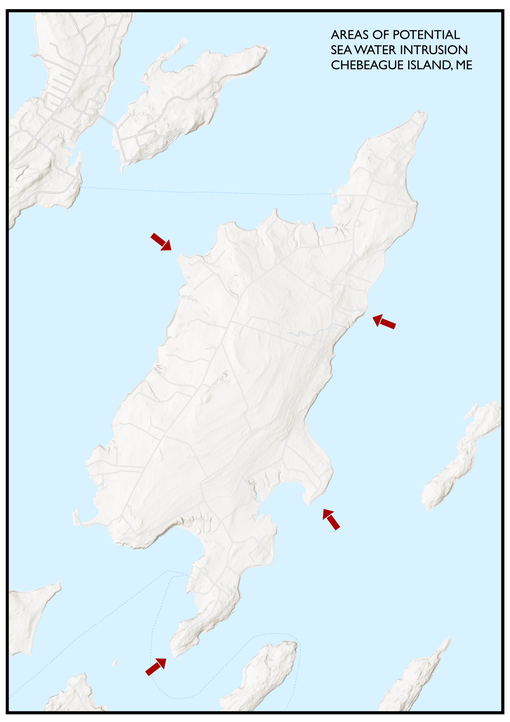
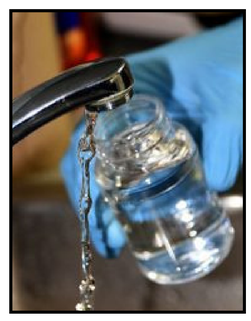


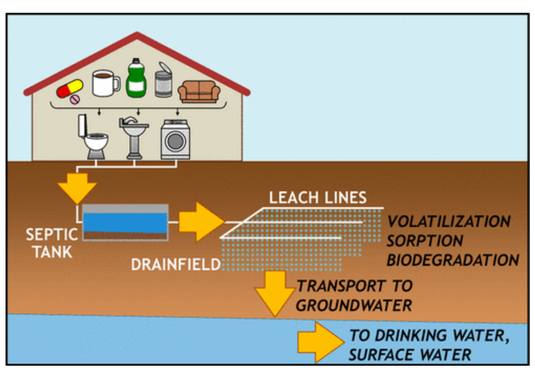
Image Credit: *Maine Drought Mitigation Center*

What has the Chebeague Climate Action Team done so far?

In the Summer of 2023 CCAT collected information on wells and septic systems through an online survey and mailing to homeowners. They also sampled over 140 wells for bacteria and chloride. Total coliform bacteria were detected in about 45% of water samples tested, and E. coli bacteria were detected in about 5% of the water samples tested. Chloride concentrations ranged from 5 mg/L to greater than 200 mg/L in the water samples tested in this study. The 2023 study, and previous studies, indicate that sea water intrusion impacting at least the following areas on Chebeague: *Division Point, Central Landing, Rose's Point* and *Deer Point*.







What is left for the CCAT to do on the Groundwater study?

Water Balance and Carrying Capacity

All of our drinking water on Chebeague comes from precipitation that seeps into the ground. Only about 5-15% of the precipitation percolates into the ground to recharge our groundwater aquifer. Ensuring that this recharge can replenish the aquifer and is not polluted is essential to the sustainability of our groundwater resources. Soil types, landcover, well and septic system data will be used to assess the carrying capacity of the groundwater system. This will help identify areas where continued development, existing or increased housing density may not support sustainable groundwater use.

Vulnerability of the Water Supply to Potential Climate Impacts

The last step of the study is to evaluate potential climate impacts on groundwater recharge rates (i.e., more intense storms, higher runoff rates, increased transpiration and evaporation, longer drought periods etc.) and potential impacts of flooding and sea water intrusion due to storm surge and sea level rise.