



# Spatial and Temporal Analyses of the Relationship between Groundwater, Salinity & Rainfall Amounts, Timing, & Intensity in the Northern Guam Lens Aquifer



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The Northern Guam Lens Aquifer (NGLA) provides 80% of Guam's drinking water. Total withdrawal by all producers is currently about 45 million gallons per day (mgd), against a currently estimated sustainable yield of about 80 mgd. The anticipated military buildup during the next decade is expected to require an additional 5-6 mgd of drinking water to support the new military activities alone, and additional economic growth on the island will certainly further increase demand for municipal and private production as well.

Recent study of the temporal trends in salinity show long-term increases in most wells and substantial increases since 2006 at some wells. The reason for the observed increases in the salinity of wells tapping the NGLA is not know. It may be the result of changes in pumping volume and pumping distribution across the aquifer, or changes in the character of Guam's rainfall, which has undergone substantial changes across the decades of the 1990s into the 2000s. There have also been some dramatic changes in Guam's climate during the past two decades (air and sea temperature rise, substantial – 12 cm – sea level rise, and abrupt changes to the typhoon distribution). It is possible that these climatic changes (whether temporary or permanent) are having (or will have) effects (possibly adverse) to the quantity and quality of the water in the NGLA.

The proposed project will compile and evaluate historical and current data from existing sources to support statistical and graphical analyses of well data and local climate data. Spatial relationships and trends will be identified by using GIS applications to display them on 2-D and 3-D maps of the aquifer and Guam's groundwater production infrastructure. The data

will thus be evaluated to determine not only the current distribution of relatively low- and high-chloride zones in the aquifer, but also the historical spatial and temporal trends in the relationships between chloride concentrations in Guam's freshwater lens and production wells on the one hand, and spatial and historical trends in production rates and recharge on the other hand. The resulting graphics, maps, and analyses will be published as a WERI technical report, which will be placed on WERI's website. The work will be done primarily in WERI's meteorology and hydrology laboratories, by a WERI-sponsored graduate research assistant under the supervision of WERI hydrologists. If separate funding can be obtained from other local and federal sources, this project will be augmented by piloting a new methodology to the determination of chloride profiles in existing and perhaps additional new deep penetrating observation wells. Enhanced climatic monitoring by the local water agency, WERI, and the Guam EPA at well sites across the NGLA can also be leveraged to supply data for the study.

The objectives of this project are to:

1. Update the analyses of historical trends in chloride profiles observed in the CWMP observation wells;
2. Update the analyses of historical trends in water levels and chloride concentrations documented in Guam's production wells, alongside the record of production rates;
3. Compile the rainfall and evaporation histories for the applicable portions of the aquifer;
4. Compare the patterns and trends of the data sets.