# A proposal to the SCAMA GUAC/AZDWR: Optimization of the water resources management in the Upper Santa Cruz River

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We propose a scope of work that aims to identify an optimal water resources management plan for the Upper Santa Cruz River. This scope of work will address the following - often competing - objectives:

1) Optimize water withdrawal from the microbasins to meet the annual demand and increase their operational reliability.
2) Identify management plans that minimize cost mainly because of reliance on alternative more expensive resource (e.g. Portrero well field).
3) Maintain groundwater levels that meet SCAMA management goals.

In addition, given the tools and methodology that will be described in the following, it is feasible to identify a water storage capacity that would be needed to store excess water available during plentiful times. This storage facility can be used to offset dry years and be used to recharge in times of declining water levels which will further advance the water resources management task.

The scope of work proposed herein is taking advantage of two previous projects. The first, funded by the SCAMA AZDWR in 2005, lead to the development of a hydrologic modeling framework by HRC that represents the region climatic variability and can be used to assess various water resources management schemes in the Upper Santa Cruz River. The second, funded by NOAA, and in collaboration with University of Arizona (UA) Water Resources Research Center, investigated the impact of future projected climate on the water resources. The study used the modeling framework, developed in a previous study, in conjunction with eight climate models that were carefully selected for

the region by the Atmospheric Sciences Department, UA. These regional climate models were selected for their capability to simulate significant drivers of regional climate.

The above mentioned climate projection study concluded that the Upper Santa Cruz River region will experience an increase in year-to-year variability of winter precipitation. This increased variability implies higher frequency of both very dry and very wet winters. The study also concluded there will be an increase in the frequency of dry summers. These future climate projections obviously further complicate the water resources management task with increases the natural variability and consequent reduction in reliability for meeting the annual target supply goal.

An additional pertinent conclusion from the HRC-WRRC study is that various microbasin management strategies have significant impact on the long term water supply reliability and the amount of recharge that will occur in the microbasins from the Santa Cruz River. In other words, we demonstrated that it is possible to identify a water management strategy that will increase groundwater recharge and water supply reliability. Thus, the modeling framework can be used as a tool to assess long term quantity, duration, and frequency of water shortage and to plan for long term needs including evaluating new storage proposals.

**Scope of Work**

The proposed study will be conducted using likely hydrologic scenarios that represent both historic and future climate change projections and with and without the proposed new storage facility. The study tasks will include the following steps:

1. Convene meeting of ADWR, GUAC and City of Nogales to define water management objectives for the micro-basins, alternative groundwater sources and storage.
2. Modify the modelling framework to accept varied pumping rates and prepare it to be wrapped within an optimization algorithm.
3. Develop the decision variables within the model for optimization in cooperation with ADWR/GUAC and City of Nogales.
4. Present of initial results and elicit feedback.

5. Incorporate information received in Task 3 and perform the optimization study and analysis of the results.
6. Present of results and recommendations for management planning. Inputs to the management plan will likely to include a strategy for pumpage that will optimize recharge and increase supply reliability. It will identify locations for new wells that will have the largest benefit and recommend the optimal reservoir capacity that is needed for storage.
7. Document the study outcomes in a final report.

We envision a two-year study duration with an estimated cost ~$90,000

**Potential Future Work**

This project will provide a foundation for stronger links between HRC's modeling framework and ADWR GW model. Linkage would enable a detailed spatial analysis of management impact on specific locations within the microbasins. There are two options for this link to be established 1) a full integration of the GW model into the framework to replace the currently used simplified groundwater model. This option requires time commitment from ADWR. An alternative option is 2) to conduct a sensitivity analysis and analyze a few cases with the ADWR GW model. This will generate datasets that can be used to develop suitable empirical associations between the simplified model and the ADWR GW model. In other words, analyzing the spatial variability of the output from the ADWR GW model and associate these patterns with the simplified model. This option, if selected, requires a minimal staff time from ADWR.

An additional issue to be addressed is to determine groundwater thresholds that have to be sustained to maintain riparian vegetation health. To address this issue we would organize an expert workshop that will yield an outline and future recommendations.