Provided by Clay Duffie, June 2018

Consideration for the TAC as criteria for determining "what constitutes negative impacts of over-drafting", and potential criteria for State Water Plan.

First of all, overdraft, depletion and negative impact needs defining. Could use drawdown to top of aquifer.

The following could be considered:

1. Unacceptable levels of drawdown in the aquifer
2. Pumping that would exceed the safe yield of the aquifer and create a condition of overdraft, depletion, or negative impact to the aquifer
3. Reductions in pumping capacity/ lowering of water levels at other water supply wells in the area
4. Water quality degradation, including salt water intrusion and the movement of any contaminant plumes
5. Land subsidence
6. Reductions in baseflow to surface water bodies and impact on groundwater-supported Ecosystems
7. Whether there can be mitigation of negative impacts, through the use of alternative water supplies and implementation of BMP/ conservation practices

Groundwater Drawdown

Provide maps and tables in the technical report that detail the drawdown that would result from pumping.

 Predictive simulations of drawdown in the original USGS model indicated that increases in pumping either from existing wells or new wells in the area would result in potentially over 100 feet of drawdown when compared to normal pumping conditions within the radius of influence of the proposed groundwater extractions. Further, the hydrogeologic report supporting the permit application should include figures of the potentiometric surface of the aquifer under the conditions of no pumping, pumping at all existing water supply wells, and with all existing pumping wells including the well proposed. If pumping is seasonal, then potentiometric surface figures for low pumping and high pumping conditions should be provided.

The additional simulations should include a scenario in which all other groundwater users extract at their maximum permitted pumping rates. This additional "worst case" scenario should be run with and without the proposed well pumping

Water Budget

It is recommended that the water budget be considered.

 A water budget (and the basis for the values in the budget) for the area of interest, including estimates for recharge (including direct infiltration, stream bed loss, return flows, underflow into the defined area of interest, etc.), discharge (pumping, evapotranspiration, underflow out of the basin, stream discharge, ocean discharge, etc.), available storage, storage capacity (vadose zone), native safe yield (i.e., the amount of natural recharge to the area of interest), and changes in storage with current and proposed pumping in the area of interest.

- The allocation of safe yield by acre within the area of interest.
- The analysis should also include hydrographs of wells in the area, in particular showing how wells responded to the recent drought that occurred during the period from 1998 to 2002 (see Campbell and Coes, 2010).

Pumping Capacity at Existing Wells

It is recommended evaluation of the effect of the increased drawdown at each existing water supply well and the impact on maximum well yields, specific capacity, well casing degradation (if groundwater levels fall below the top of screen), and additional lift costs associated with lower groundwater levels.

Water Quality Degradation

- The impact of the proposed pumping on any salt water intrusion along the coast - including the use of an added conservative solute salt water transport package to the groundwater flow model.
- The potential for upwelling of any brackish connate groundwater present at depth within the area of interest.
- Changes in total dissolved solids (TDS) concentrations at existing water supply wells, based on the modeling and/or other analysis. This may include a sampling program to assess any changes in groundwater quality that may result from proposed long-term pumping.
- Identification of any groundwater contaminant plumes or other water quality considerations within the area of interest
- Evaluation of any changes in plume migration - direction and velocity - and the potential impact on existing water supply wells, surface waters, and groundwater-dependent ecosystems. The evaluation should be analytical, as multi-component solute transport modeling may not be warranted at this time.
- Sensitivity analysis for groundwater flow conditions (i.e. direction and velocity), and only conservative salt water solute transport for saline intrusion.

Subsidence

- Description of the lithologic conditions within and above the aquifer, throughout the area of interest, and the potential for reversible and permanent subsidence.
- Estimates of subsidence based on soil properties and projected drawdowns throughout the area of interest. An evaluation of subsidence within the groundwater model to evaluate subsidence resulting from the proposed pumping.
- Sensitivity analysis (as described above), including the subsidence package.

Surface Water and Ecosystem Impacts

- Identification of any surface water bodies (including the ocean) that receive groundwater as baseflow from the aquifer being pumped, if any.

 Identification of any sensitive ecological habitats that are dependent on groundwater, both surface water receiving baseflow and shallow groundwater supported marshes or other habitats.

 Evaluation of changes in baseflow to these surface water bodies and groundwater levels beneath habitats supported by shallow groundwater.

 Impacts on any surface water bodies and groundwater-supported ecosystem that receive groundwater baseflow, should the baseflow have increasing TDS concentrations from saline intrusion.

Mitigation of negative impacts

Use of alternative water supplies

The following should be considered:

1. Availability of surface water – conjunctive use
2. Use of reuse or reclaimed water
3. Direct or indirect potable reuse
4. Groundwater recharge
5. Use of aquifer storage and recovery

Use of best management practices (BMP) and conservation

1. Irrigation techniques
2. Water audits/ water loss determinations
3. Conservation measures