Defining Water Supply Reliability
for the
Lower Santa Cruz River (LSCR) Basin Study
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The concept of reliability in Reclamation's Basin Study Program

The first step in a Reclamation Basin Study is projecting future water supply and demand within a basin. The next step is an "*Analysis of how existing water and power infrastructure and operations will perform given any current imbalances between water supply and demand and in the face of changing water realities due to climate change (including extreme events such as floods and droughts) and population growth*". The term "*reliability analysis*" has been used as short-hand to convey this requirement.

Considering reliability for the Lower Santa Cruz Basin (Tucson Active Management Area)

There are many ways to define water supply reliability, and therefore it is important to stay focused on our project's objectives of assessing climate and population change impacts on water supply and demand and avoid adding unnecessary complexity to our approach. The American Water Works Association defines water supply system reliability in terms of the probability of shortages that could result from failures of a system's physical components. This definition is focused almost entirely on engineered components of water delivery systems rather than the actual availability of water supplies. The AWWA definition is also strongly skewed towards surface-water based systems; it notes that reliability can be increased by adding facilities, storage, pumping capacity, pipelines.

This relatively narrow view of water supply reliability is probably not appropriate to the Lower Santa Cruz River Basin (Tucson Active Management Area or TAMA), where groundwater supplies play a major role. The LSCR Basin Study is focused in large part on the implications of climate change on both surface water and groundwater supplies. This brief paper proposes that we think of reliability for the purposes of this study in terms of three elements, described below:

1) long-term physical water supply availability for delivery to water users (municipal, industrial, agricultural), which in the TAMA may actually be translated to sufficient groundwater supplies to meet demands over a period of time,

2) reliability for the purposes of sustaining and potentially enhancing environmental quality and biodiversity, and

3) reliability for the purposes of sustaining or creating cultural and recreational features that are important to the broader Tucson community.

Why this view of reliability?

A broader view of water supply reliability incorporates the full spectrum of water supplies and management options that lead to a flexible set of future options (e.g., conjunctive management, integrated water supply management, "one water," etc.) in addition to the engineered components. In this context, reliability is considered in the context of multiple factors, including population growth and associated changes in demand, climate change, energy supplies, environmental and regulatory considerations, as well as infrastructure. This broader view allows consideration of a full set of regional supply and demand management alternatives and the potential for innovative approaches that reflect the community's objectives.

With this broad array of water supply considerations, the definition of reliability for the LSCR Basin Study needs to incorporate not just reliability of CAP supplies, but also of local surface

water and groundwater systems. Because the groundwater model for the Tucson AMA focuses only on the deep aquifers (containing substantial sediment and water in storage), and because the majority of the riparian systems are not contained within the geographic area of the groundwater model, we are considering potential impacts of climate change on surface flows and groundwater outside the area traditionally modelled. As climate models overwhelmingly predict higher temperatures, the concept of reliability should incorporate potential increases in demand associated with increased heat for municipal, industrial, agricultural and environmental demands, in addition to water supply requirements of ongoing changes in the economy and land use.

What about the goal of safe-yield?

Because the groundwater aquifers of the Tucson Basin are our primary storage system, and because we have both local and imported supplies, the issue of reliability is very different from other regions where there are relatively short-term supplies held in surface reservoirs. The Safe Yield Goal of the Groundwater Management Act (Act) and the associated Assured Water Supply (AWS) Rules of the ADWR require a basin-wide balance between groundwater withdrawals and supplies, which helps manage imbalances at a large scale (though the exact definition of safe-yield into the future is still the subject of some debate). With some exceptions, the Act does not require that individual sub-basins or planning areas within the AMA be managed to address local declines so long as the AWS Rules are met. This LSCR Basin Study will identify where those imbalances may occur and options to address that problem.

How might reliability change in the future?

Reliability problems for human water needs are not likely to be sudden onset events in the LSCR Basin, but rather-longer term differences between supply and demand that occur in sub-areas within the Basin. In contrast, changes in climate could have significant and potentially near-term impact on riparian and aquatic systems, which are not protected through state law, in a relatively short period of time.

Risks to municipalities, industry and agriculture include cutbacks to Central Arizona Project (CAP) supplies caused by increased temperatures and changes in precipitation, and by policy changes such as the recently adopted Drought Contingency Plan. Although the Tucson area water users have large, reliable CAP entitlements, a combination of growth in demand and cutbacks in supply could force providers to recover their stored groundwater credits to meet demands. Infrastructure to recover and treat these supplies will be necessary to use groundwater credits as a supply and may be necessary to address projected imbalances in supply and demand.

In the context of enhancing reliability as we are defining it in this LSCR Basin Study, there may also be adaptation options that are designed to meet other objectives, such as preservation of riparian habitat, or improving environmental quality and biodiversity. Adaptation options could also be focused on improving or sustaining culturally important features or recreational opportunities. These options could include integrated efforts that include infrastructure development, policy and management changes, and/or regulatory changes.

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