Luke AFB water rights ramifications of: Hydrographic survey report for the Gila River Indian Reservation, Watershed File Report No. L8-58-001, In Re The General Adjudication of the Gila River System and Source, by Arizona Dept. of Water Resources. Dec 1996.

Executive Summary

The subject Arizona Department of Water Resources (ADWR) report is a thorough preliminary effort at determining how much water is needed to irrigate all practicably irrigable acreages (PIA) on the Gila River Indian Reservation (GRIR). ADWR identified 178,880 acres suitable for irrigation. An existing Gila River Indian Community (GRIC) Master Plan previously identified 146,330 acres suitable for irrigation (requiring 771,600 acre-feet of water per year). ADWR compared the two sets of acreages, and identified 129,030 acres common to both.

ADWR determined that irrigating the common acres would require 676,120-877,260 acre-feet per year, depending upon assumed irrigation and conveyance efficiencies. How much water would actually be required for those acres is a function of efficiencies and the crops that would be used. Furthermore, the GRIC master plan indicates the possibility of converting some agricultural lands to non-agricultural uses--reducing PIA and PIA water requirements.

ADWR feels that determining the water needed for PIA should include economic evaluation. The inference is: if irrigation does not yield a positive net return, is it practicable? Whether or not irrigating the acreages mentioned above can yield a positive net economic return is debatable. Preliminary ADWR estimates indicate that total production costs exceed total returns. However, different assumptions on crops, prices, efficiencies, and system design could change this result.

ADWR also estimated the amount of water currently potentially available to support increased GRIR irrigation. ADWR estimated that a total of 505,500 acre-feet is annually available--from groundwater, GRIR surface water and Central Arizona Project (CAP) water. This is less than the above-mentioned volumes assumedly needed for growing appropriate crops on all suitable lands.

GRIC response to the study results depends partially on how important a favorable cost-benefit analysis is to having land declared 'practicably irrigable'. If a positive net return is necessary, GRIC might to try to: select a subset of acres and irrigation system design that would yield a smaller per acre cost; or select crops that can yield a greater gross return per acre. Either change could reduce total water need. Regardless of the importance of a favorable net economic return, GRIC might propose that it should be able to pump more groundwater than ADWR assumed because of the increased aquifer recharge resulting from importing CAP water to GRIR.

GRIR is somewhat upstream of Luke AFB (LAFB) in terms of groundwater and surface water flow directions. Implementing the 505,500 acre-feet water management

strategy in toto would probably not harm groundwater supplies near LAFB, unless GRIR use of CAP water somehow prevents that water from being used nearer to LAFB and recharging the aquifer there. Effects of GRIC employing the three potential water sources are discussed individually below.

The ADWR-assumed 27,100 acre-feet per year increase in GRIR pumping is designed to prevent GRIR groundwater levels from continuing to rise (as they have recently due to aquifer recharge from irrigation). ADWR does not recommend mining the aquifer beyond its current recharge rate because of potential consequences involving water quality, land subsidence and aquifer dewatering under adjacent lands. The assumed groundwater pumping increase will probably not cause groundwater levels near LAFB to decline from current levels, even without recharge due to CAP importation to GRIR (although water levels downstream of GRIR would gradually rise if pumping is not increased).

The ADWR-assumed 27,400 acre-feet per year increase in using surface water originating on GRIR will probably reduce groundwater recharge on GRIR. It could also reduce surface water flows downstream. The effect on groundwater levels near LAFB is probably minor.

The ADWR-assumed CAP water use (173,100 acre-feet per year) by GRIR can potentially cause increased groundwater flow from GRIR (and in the general direction of LAFB). This could occur because increasing irrigation with imported CAP water will increase deep percolation and aquifer recharge. However, it is uncertain whether GRIR or other organizations will be permitted to increase groundwater pumping if aquifer recharge increases. The ADWR report does not mention any allowance for increasing groundwater pumping due to increased recharge resulting from CAP water import.

With the available information, it is difficult to state whether GRIR use of CAP water will increase or reduce potential water availability for LAFB. The result depends upon how and where the CAP water would be used and distributed if not employed by GRIR, and how other GRIR water use might change. Wherever CAP water is used for irrigation it will increase aquifer recharge and groundwater availability--if other water sources and uses are unchanged.

Future LAFB groundwater level changes resulting from different future water management scenarios can be estimated using an existing ADWR groundwater simulation model as modified by USU/DBIE. Model modifications include using smaller cells near LAFB. Scenarios would differ in the assumed spatial distributions of groundwater extraction and recharge. Estimating other effects of water management decisions could require other computational tool(s).

Background and Overview of Study Procedures

Winters v. United States, 207 U.S. 564 (1908) assures to Indian reservations sufficient Indian Land Reserved Water Rights to retain the value and adequacy of the reservation lands. Arizona v. California, 373 U.S. 546 (1963) describes the right's quantity as "enough water...to irrigate all the practicably irrigable acreage on the reservations." According to 753 P.2d 76, 101 (Wyoming 1988) and 492 U.S. 406 (1989), the magnitude of Indian reserve water rights is "the amount of water necessary to irrigate all of the reservation's practicably irrigable acreage".

The Gila River system is currently being adjudicated. Several Indian reservations lie within the watershed. The judge presiding over the general adjudication requested "a technical analysis of the possible extent of federal reserved rights based upon practicably irrigable acreage (PIA)" (ADWR, 1996a, p 1-3). The subject report by the Arizona Dept. of Water Resources (ADWR) is a beginning step in addressing this request for the area of the Gila River Indian Reservation (GRIR) (Ibid, p 1-5 and 3-2).

In performing the study, ADWR focused "only on the federal reserve rights claimed by the Gila River Indian Community (GRIC) as measured by the practicably irrigable acreage standard. This does not mean that the tribe may not claim rights based upon other principals; those types of claims are simply beyond the scope of this report and will be studied at a later date." (Ibid, p 1-3).

This preliminary ADWR study did not include the detailed irrigation system design and analysis needed to accurately predict the economic viability of potential agricultural development--a fundamental element of determining PIA (Ibid, p 1-7). Such a detailed irrigation project design is beyond the scope of a preliminary study.

In the study, ADWR:

- identified arable land with the potential for irrigation development. This consists of farmable size tracts of arable soils (soils that can support commercial plant life) of topography adequate for agriculture, not including lands already permanently committed to other uses. (Ibid, p 3-1).
- estimated the expected economic return of commercial farming operations on those arable lands.
- estimated currently utilized water and unused or under-utilized water resources that potentially are physically available. Potentially physically available resources include groundwater existing beneath the reservation, water obtainable from the Central Arizona Project (CAP), and unappropriated surface water susceptible to capture (Ibid, p 1-7). ADWR did not consider surface waters that would have reached the GRIR except that they are being captured and used upstream.

Study Conclusions

Current water use and irrigated acreages

Table 1 indicates that current GRIR water use averages 277,900 acre-feet per year (Ibid, p 5-35). This includes groundwater, surface water and other water resources. The 23,500 acre-feet of currently developed other water resources includes water entering the GRIR through Salt River Project (SRP) drains, deliveries satisfying a Maricopa Contract, and Chandler treatment plant effluent. It does not include CAP waters delivered to GRIR in 1990-91.

In 1994 there were about 61,095 irrigated acres on GRIR, requiring about

278,620 acre-feet of water (Ibid, p 2-9). Non-agricultural use of water required about 5,833 acre-ft.

Potential irrigable acreages

ADWR concluded that there are about 178,770 acres suitable for irrigation and stated that this value should be used when considering irrigation proposal validity (Ibid, p 3-28). However, a 1985 GRIC Master Plan proposed irrigated agricultural development on fewer acres--146,330 (Franzoy-Corey Engineers & Architects, 1985).

Potential water requirements

Estimating irrigation water needs requires assuming a crop mixes and patterns and irrigation and water conveyance efficiencies. The GRIC Master Plan specifies that their proposed 146,330 acres would require 771,600 acre-feet of water per year.[1] They assumed a particular crop mix and a 5.27 acre-foot per acre duty of water. Based upon current central Arizona cropping patterns and irrigation practice, ADWR assumes an average 5.24 acre-foot per acre water duty is most appropriate for prediction.

When one considers only the lands on which both ADWR and Master Plan agree, the proposed irrigated area totals 129,030 acres (65,650 newly developed acres, 2,285 redeveloped acres, and 61,095 existing developed acres) (Ibid, p 4-18). ADWR believes this could require 877,260 acre-feet of water annually, assuming new lands are more efficiently irrigated than old lands.[2] However, if existing water conveyance and irrigation system efficiency is improved to yield an average 5.24 foot water duty, the total need of the 129,030 acres would be only 676,120 acre-feet.

The GRIC Master Plan mentions possible commercial ventures that could reduce the amount of water needed for GRIR irrigated agriculture. These include constructing: a National Football League stadium, a Jai-Alai Fronton, a full service regional airport, and a resort.

There is uncertainty concerning the magnitude of potential irrigation water requirements because there is uncertainty about how much land will be irrigated, the crops that will be irrigated and the efficiency of the final irrigation system designs. In addition, there is uncertainty concerning whether it is economically practicable to irrigate those lands.

Economic cost-benefit analysis is needed before water rights are granted. If irrigation on some of the lands cannot be profitable, one should probably not expect those lands to be irrigated for long. Therefore, why should water rights be provided for

---

[1] Assumed was a water duty of 5.27 acre-feet per acre (3.2 acre-feet per acre of consumptive use, 75% farm irrigation efficiency, and 81% combined distribution efficiency) (Ibid, p 4-17).

[2] Assumed are water duties of: new land (5.24 feet); redeveloped land (6.64 feet, assuming existing 64% conveyance efficiency); and existing land (8.48 feet, obtained by dividing 279,545 acre-feet by 32,960 active acres).

irrigating those lands?

Preliminary economic evaluation

ADWR developed four alternative plans for developing irrigated agriculture on the 146,330 acres (the total acreage proposed by the Master Plan). The lowest per-acre development cost of any alternative was $8713. This requires an annual net return of $291 (exclusive of development costs) to pay for the development (Ibid, p 4-18). As shown below, $291 exceeds the anticipated net return from irrigated acreages likely to be developed at the GRIR.

The net return of the crop mix assumed in the GRIC Master Plan is $217 per acre in 1994 dollars.[3] These returns represent the "upper limit of the amount that can be paid toward irrigation development since no return to risk is considered" (Ibid, p 4-14). On the other hand, after analyzing several irrigation projects in central Arizona, ADWR determined that one could reasonably expect a $282 per acre net return, excluding water and land costs (Ibid, p 4-20).

If annual return is less than the assumed $291 per acre required for development, the potential irrigation might not be economically practical. Changing the assumed water delivery costs and crop returns changes predictions of economic practicality. However, even if it is economically feasible to irrigate the 146,330 acres, the physical and legal availability of the necessary water to do so should be evaluated.

Potentially available water

Less water is reasonably available for GRIR irrigation than either the GRIC Master Plan or ADWR feel are needed for areas considered for irrigation. ADWR estimates that 505,500 acre-feet per year is the total that can be reasonably available for GRIR (Table 1).

Included in the 505,500 acre-feet is 173,100 acre-feet committed to GRIR from CAP, and 27,400 acre-feet of additional potentially developable surface waters (from spills past Ashurst-Hayden dam on the Gila River, Santa Cruz Wash, and the East Maricopa Floodway) (Ibid, p 5-33). Not addressed is the economic feasibility of capturing the 27,400 acre-feet.

Also included in the 505,500 acre-feet is the increased use of groundwater. Groundwater levels are currently rising because of deep percolation resulting from irrigation and leaky water distribution systems. ADWR feels that pumping an additional 27,100 acre-feet per year will, on the average, prevent further significant groundwater rises. Extracting this groundwater near recharge sources will prevent the development of extensive cones of depression. Not considered is the additional groundwater recharge that might result from the increased CAP water use (the more recharge, the more groundwater pumping is possible without unacceptable consequences).

---

[3] ADWR did not consider either government price supports or subsidies for non-producing acreages.

**Possible effects on Luke AFB water supply
(of GRIR water management evaluated by ADWR)**

Increased GRIR use of groundwater or Gila River water can potentially reduce surface water flows and groundwater levels near Luke AFB (LAFB). Most of the GRIR lies within the region addressed by a Salt River Valley Groundwater Flow Model (ADWR, 1993,1994). ADWR estimated that in 1900 and 1989 (ADWR, 1993, 1994) as well as in 1993 (ADWR, 1996b, Plate 4) groundwater flow near the Gila River flowed generally to the northwest between South Mountain and the Sierra Estrella toward the Salt River. The Gila River intersects the Salt River at a location somewhat southeast of LAFB. The GRIR is generally upstream of LAFB in terms of groundwater and surface water flow directions.

Increased importation of/irrigation with CAP water will cause increased deep percolation and aquifer recharge. Therefore, increased use of CAP water by GRIR can cause increased groundwater flow from GRIR (and in the general direction of LAFB). It is unclear whether GRIR or other organizations might be permitted to pump more groundwater if aquifer recharge increases. Increased GRIR use of CAP water might also increase surface flows on or leaving GRIR.

It is unclear whether GRIR use of CAP water can adversely affect LAFB. I assume that employing CAP water on GRIR will reduce or prevent its use elsewhere. Wherever it is used for irrigation it will increase aquifer recharge and groundwater availability. Predicting the effect of GRIR CAP water use on LAFB requires knowing where and how the CAP water will be distributed and used if GRIR does not employ it. Some effects of different water management strategies can be estimated using an groundwater model prepared by ADWR (1994, 1995) and modified by USU.

Table 1. Current water use and reasonably available water (ADWR, 1996a, p 5-35).

Water Source	Current Annual Volume (acre-feet)	Potential Annual Volume (acre-feet)
Currently developed groundwater	113,800	113,800
Additional groundwater without overdraft		27,100
Currently developed surface water	140,600	140,600
Potential future surface water resources		27,400
Currently developed other water resources	23,500	23,500
Future CAP water resources		173,100
TOTAL	277,900	505,500

References

Arizona Dept. of Water Resources. 1996a. Hydrographic survey report for the Gila River Indian Reservation, Watershed File Report No. L8-58-001, In Re The General Adjudication of the Gila River System and Source.

Arizona Dept. of Water Resources. 1996b. Hydrographic survey report for the Gila River Indian Reservation, Watershed File Report No. L8-58-001, Map Volume, In Re The General Adjudication of the Gila River System and Source.

Corell, S. W. and Corkhill, E. F. 1994. A regional groundwater flow model of the Salt River Valley - Phase II, Phoenix Active Management Area, numerical model, calibration and recommendations. Arizona Dept. of Water Resources, Hydrology Division Modeling Report No. 8.

Corkhill, E. F. and Corell, S. W. 1993. A regional groundwater flow model of the Salt River Valley - Phase I, Phoenix Active Management Area, hydrogeologic framework and basic data report. Arizona Dept. of Water Resources, Hydrology Division Modeling Report No. 6.

Franzoy-Corey Engineers & Architects. 1985. Gila River Indian Community Master Plan Report for Land and Water Use, November 1985. U.S. Bureau of Indian Affairs, 3 vols..