Water Conservation Potentials in Floodwater Management

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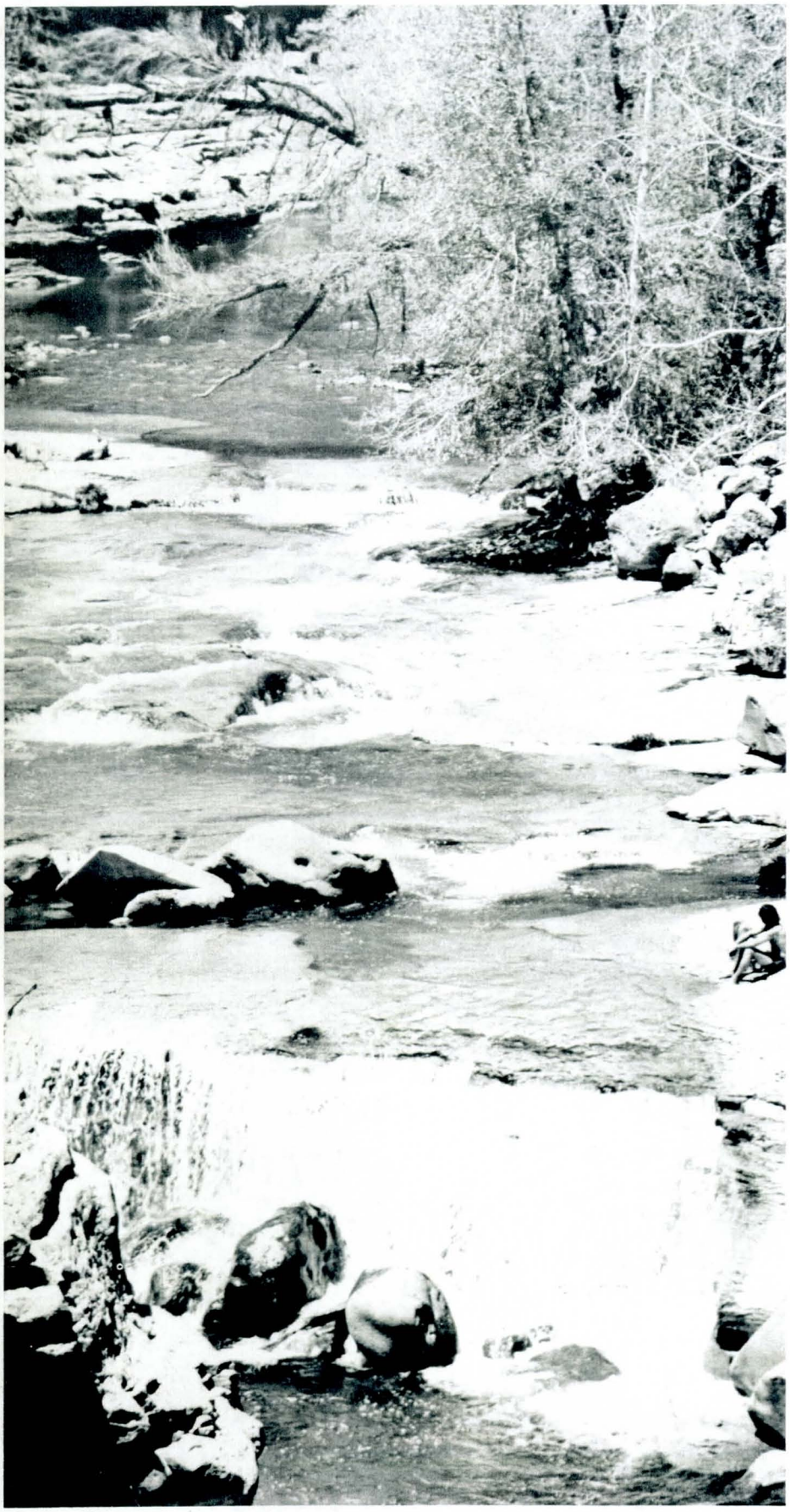

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WATER CONSERVATION POTENTIALS IN FLOODWATER MANAGEMENT

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From the title of this presentation, "Water Conservation Potentials in Floodwater Management", it would seem almost axiomatic that great benefits in such an activity would be derived.

When first approached on making this presentation I was delighted. My time had finally come to fully exercise my background in both flood control and water conservation to boldly outline for you today the great benefits and unquestioned need for such a program. From that point forward I have been in quicksand. There is reason to believe that in evaluating any given proposal to utilize floodwater for the recharge of our groundwater, some almost insurmountable constraints would be encountered.

It can be said that there is a great need and that potentially great benefits could be derived from the recharge of our groundwater utilizing floodwaters. I offer to you the fact that in our recent series of major floods that something in excess of 3 million acre feet of water has passed through the greater Phoenix metropolitan area as much as a half-million acre feet of it was naturally recharged. However, that extremely large amount that arrived in Painted Rock was both lost to the water users of this area and became a nuisance and negative economic impact upon all of the farming interests downstream from Painted Rock.

Of course, it must be recognized that most of the flows which arrived at Painted Rock originated in the Salt and Verde system. In addition, some came down the Gila River and some significant amounts originated in the North Phoenix - Agua Fria watersheds.

In considering the viability of utilizing floodwaters to recharge our groundwater basin I think we have to give consideration to at least three specific areas of concern. These are technical, economic and institutional constraints.

TECHNICAL CONSIDERATIONS

To be able to recharge water, obviously, you must have a source of water and a method of controlling that source at least to some degree.

The Salt River Project reservoir system provides some control over flows from that watershed. However, quite obviously, that reservoir system and the water interests involved present institutional constraints which will be discussed later. In the New River and Phoenix City streams project study, the Corps of Engineers considered the feasibility for developing a groundwater recharge system. This system was found to be hydrologically infeasible. The water availability on an annual basis average was simply not sufficient to warrant further investigation. The infeasibility of this system resulted primarily from that fact that the release rates from the flood control structures involved, namely, Cave Buttes, Adobe and New River dams are low enough that even at spillway crest level, most if not all of the outflow will be claimed by downstream water rights holders or will be lost to natural infiltration or evaporation prior to reaching the mouth of the Agua Fria River. The two existing dams, Dreamy Draw and Cave Buttes and the proposed Adobe and New River dams are designed for flood control only and not for water conservation. The channels located immediately below the dams are at present to be left in their natural state and will remain so until private owners or other jurisdictions encroach and channelize them.

Another consideration, and probably one of the principal problems in evaluating the underground storage of floodwaters is the lack of existing hydrogeological data which would yield actual dimensions of certain aquifers granting a means of determining to whom the benefits of such groundwater recharge would be accrued.

A question which exists in this area is whether an increase in infiltration in the Lower Agua Fria watercourse will result in an increase in groundwater recharge. Since the depth to groundwater in this region is in many cases between 200 and 400 feet it is safe to assume the hydroscopic water requirement is quite large. This would indicate that most of the infiltrated water might well be absorbed near the surface and retained there rather

than recharge the groundwater basin. It is assumed, however, that in the vicinity of the more extensively developed agricultural lands, irrigation may have kept the soils wetter and this condition would not hold true. It would be necessary, however, to make a determination as to whether increased infiltration would result from groundwater recharge or if the water would simply be absorbed near the surface and go to feed existing vegetation cover.

INSTITUTIONAL CONSTRAINTS

In discussing the subject matter with several knowledgeable individuals around this valley I have come to the conclusion that the meaning of "surplus floodwaters" is so difficult to define that it really becomes an academic exercise. The water rights which apparently exist in each watershed within the Salt River Valley so far exceed the normal water supply that it is hard to imagine a time or circumstance where any of the water rights holders would be inclined to grant the use of their water rights for purposes of groundwater recharge within a pumping area to which they had no guaranteed access.

Recognizing this, it would appear that in the Salt River system, unless the Salt River Project itself would wish to get into a water conservation program almost strictly for its own water users benefit, that no reasonable program could be implemented upstream from the Agua Fria River. Since there are high groundwater conditions from that point downstream for some distance it would appear that a common interest recharge of the groundwater aquifers in the Salt River is simply not feasible. In consideration of the implementation of a recharge program utilizing Cave Creek it must be recognized that Salt River Project claims the water rights to all flows in Cave Creek. Recent construction in that watershed by the Flood Control District and Corps of Engineers now makes it possible for the Salt River Project to accommodate most flows from Cave Creek in the Arizona Canal without endangering the integrity of that canal. Since the maximum outflow from Cave Buttes Dam will now be 500 cfs, a diversion of the first 500 cfs flow in Cave Creek will provide a means of conveying flows across the Arizona Canal diversion channel into the Arizona Canal. All flows in excess of 500 cfs will be of such a short diversion and such an infrequent nature that the implementation of a recharge program depending upon them would be quite infeasible. The implementation of a program utilizing flows from Skunk Creek and/or New River downstream from Adobe Dam and New River Dam respectively, might be technically and maybe even economically feasible. However, it must be recognized that downstream water users also have water rights to these flows.

ECONOMIC CONSTRAINTS

The economics of groundwater recharge are simply a comparison of the costs of installation and operation of a facility versus the benefits to be derived from such a facility. If it is worthwhile – it must be profitable. This kind of artificial groundwater recharge has been taking place in other parts of the country and in other locations around the world for many decades. However, I don't know of any place off hand where a profitable or economically feasible groundwater recharge program has been based entirely upon the use of floodwaters.

In considering the costs of such a project, first you have to make the basic decision on what type of facility you want to construct. There are various ways of approaching this ranging from simple spreading in the existing watercourses to pressure injection wells. Obviously, surface spreading is far less expensive if the situation is right. In surface spreading you have the choice as to whether to try to perform your recharge operation within the existing stream, channel or perhaps a modified stream channel or whether you want to construct an off channel spreading basin operated in conjunction with a diversion structure. The onstream facility is generally much less expensive but it probably would not be as effective since you would tend to lose it each time there are flows of a significant size.

There are also economics of scale to consider. In general, one large facility would be more economical to operate than a number of smaller facilities with the same total operating capacity. Without belaboring the subject of costs, I will quickly outline those which I would see inherent to the development of a groundwater recharge system. These would, of course, start with the studies and design which would be necessary. These would include engineering, geology, hydrology, the cost of plans and specifications and the cost of preparing an environmental impact statement. Another very important and possibly the most expensive in some cases, would be the cost of the land that would be required to be dedicated to this use. In considering the land, of course, you have to not only consider what the land will cost you at the present time but consider the fact that the land will be dedicated to that use in perpetuity. There is a cost related to certain treatment works that would be necessary in

conserving floodwaters. It is almost certainly necessary to add a flocculant to floodwaters to remove sediment. In extreme cases it is even possible that the water would have to be filtered. There is a cost for measurement – staff gauges, recorders, observation wells, conductivity meters, whatever. If your recharge system involves the use of dams and reservoirs to store stormwaters during periods of peak flow then at least a portion of the cost of the dam and reservoir has to be figured as part of the recharge cost. Within your recharge facility you must have conveyance systems, canals, pipelines, siphons. If the environmental impact statement says there are adverse impacts you will have costs for mitigation measures. Of course, if you intend to use injection wells or dry wells these are also expensive to operate and maintain as well as to install.

Operation costs are for the most part eaten up in salaries and wages. Overtime pay, for instance, must be a very serious consideration because we all know it always rains at night and on weekends and when floodwaters are your source of recharge you work when it rains. There is, of course, a cost incurred for all operating equipment which may include various types of vehicles, electrical generators, aerators, bulldozers, office equipment and sampling equipment. There will be various materials and supplies, such as fuel, flocculants, recorder graphs, data sheets, rubber boots, flashlight batteries, etc. There is also cost for utilities and possible fuel for heating and cooling.

A very pronounced influence on your cost of operation is whether you operate during or after a storm. If you can operate totally on post-storm conservation of controlled releases from reservoirs you can obviously perform this spreading operation with far less manpower than you need if you spread the water during the uncontrolled period of the flood. During the storms the uncontrolled flow varies very widely in quality and in quantity and you must therefore have a much larger staff in order to be able to handle the peaks.

One of the primary considerations in the maintenance of such a facility would be of course the removal of colloidal sediments. There would be cost for weed control, gopher control, vector control, as well as public control. There is constant need for repair and replacement of internal flow control structures, access roads and levees. The use of injection wells will require significant investments in redeveloping and cleaning wells from time to time.

The operating costs are also impacted by your institutional constraints. You can't operate a recharge system in a vacuum. You need information and information costs money. You need to know how much water you are recharging, quality of that water you are recharging, and how the water that you are recharging is being used or distributed throughout the aquifer. All of these things are quite important in trying to maintain agency support.

One other consideration, of course, is liability. It is necessary to decide whether to pay insurance premiums or be self insured. Regardless of your decision, you will have legal fees of one kind or another. It is almost without question that there will be claims related to water rights and/or land ownership involved in this sort of an operation. It would appear then that the least costly element of a groundwater recharge operation utilizing floodwater would be the water itself. That is, it appears to be free. Assuming that you don't pay for a water right for your recharge facility, then I suppose that's true. However, because the operational costs related to increasing the quality or decreasing the sediment content of floodwaters can be so high it is entirely possible that the cost of this process might exceed the current value of water. There are those of course who say that water should be saved regardless of the first costs of that effort. I believe that noble statement would be denied and refuted repeatedly when the bills for such an effort started to roll in.

I think, in summary, it is safe to say that under the right conditions, groundwater recharge through the use of floodwaters can be an efficient and economical way of augmenting a natural water supply. It can also be very expensive under adverse conditions, and can be virtually impossible under institutional and legal constraints which we have existing in this valley. There are many arguments that can be made to indicate that we are wasting our time. But let's face it – when floodwater flows through the Salt River Valley and into Painted Rock Reservoir there isn't a question that it is no longer a potential benefit to this valley but, in fact, has become a threat to the Welton-Mohawk irrigation district and Yuma County. I am optimistic that reasonable technical considerations in future years will overcome the many constraints – legal - institutional - and economic – to provide for conserving at least a portion of the flood flows now lost.