

METROPOLITAN OPERATED DISTRICT FOR SEWAGE  
EFFLUENT - IRRIGATION WATER EXCHANGE

by

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INTRODUCTION

In 1974 the City of Tucson wastewater treatment plant is processing municipal wastewater at the rate of about 38,000 acre-feet per year, most of which is discharged to the normally dry channel of the Santa Cruz River. In past years, some of the treated wastewater has been used for irrigating field and forage crops on approximately 2,000 acres of land in the Cortaro area, a few miles downstream; the present landowners, however, have virtually ceased irrigating and the wastewater goes unused except for small quantities being utilized on the City treatment plant farm. The legal and economic background of these conditions has been described previously (e.g., Cluff et al., 1971; 1972).

When the existing effluent contract between the City and the landowners expires in 1975, and with settlement of pending litigation on the contract, this wastewater will be available for application to beneficial use. Several kinds of use would be possible, but use for irrigation of existing farmland in the Avra-Marana area (Figure 1) seems particularly attractive, for several reasons. Conveyance to the farms can be accomplished by gravity flow. No tertiary treatment is needed for irrigating the crops presently grown in the area. The nutrients which have been contributing to nitrate concentration in the ground-water reservoir along the Santa Cruz River would be beneficial to the farm operation in terms of fertilizer requirements. And the use of wastewater for irrigation water requirement would correspondingly reduce the quantity of high quality ground water pumped for irrigation and would conserve it for municipal or other uses.

An exchange of this wastewater for ground water for use in the City system would be a viable alternative to the present practice, whereby the City must purchase farmland in Avra Valley and retire it from irrigation in order to acquire the ground water for conveyance to the Tucson basin. If no exchange agreement were made, the wastewater would simply be allocated to irrigation use and an equivalent amount of ground water would be conserved in place and would be available for future pumping and utilization.

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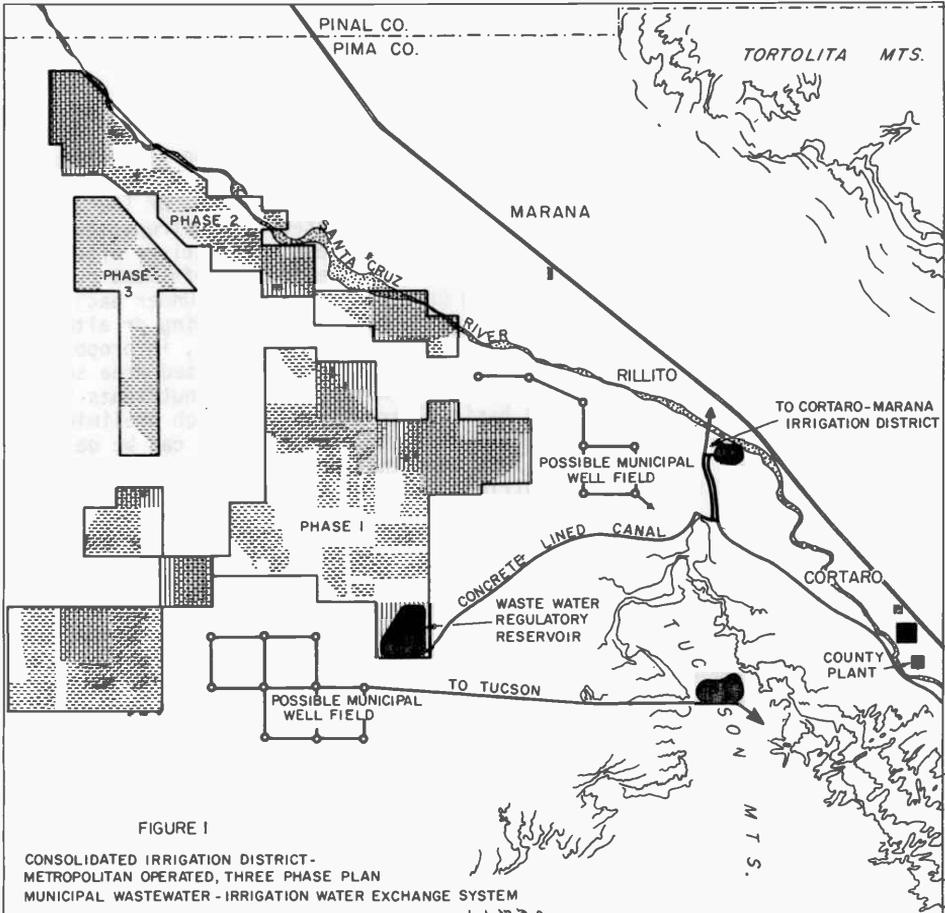


FIGURE I  
 CONSOLIDATED IRRIGATION DISTRICT -  
 METROPOLITAN OPERATED, THREE PHASE PLAN  
 MUNICIPAL WASTEWATER - IRRIGATION WATER EXCHANGE SYSTEM  
 11732

AVRA VALLEY - MARANA REGION NEAR TUCSON, ARIZONA.

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EXPLANATION

- ||||| STATE OWNED LANDS
- ▨ GROUNDWATER IRRIGATED LANDS
- ▣ WASTEWATER TREATMENT PLANT

## ALTERNATIVE ORGANIZATIONAL MECHANISMS FOR WASTEWATER EXCHANGE OR SALE

Under either an exchange or an ordinary contract for sale and delivery of the wastewater, the irrigated area receiving and using it would necessarily have to be unified and could take various forms. The receiving agency could be (1) an existing irrigation district, (2) an expanded or newly organized district embracing existing irrigated lands, or (3) a proposed consolidated district owned and/or operated by a metropolitan water management agency. To varying degrees, these alternatives offer the capability of distributing all or most of the treated effluent over irrigated acreages of crops now being grown in that area. Under each system, the efficiency of wastewater use depends upon blending or alternating effluent with ground water during the growing season, in proportions which rely in turn upon cropping pattern and size of irrigated area served, in order to achieve optimal application of water and plant nutrients to each crop. In each of the three basic alternatives for which preliminary engineering cost estimates have been made, treated effluent can be delivered to the irrigated area at a cost less than that presently incurred by the farmer, particularly when the nutrient value of the wastewater is considered.

The first alternative, an existing irrigation district, is exemplified by the Cortaro-Marana Irrigation District, which extends from the vicinity of Cortaro to the Pinal County line north of Marana (Figure 1). This district has a completely concrete-lined canal and lateral system and a high efficiency of distribution. Interest has been expressed by the District in obtaining wastewater for use in the Marana area, but some problems are evident. The conveyance canal from the Cortaro well field to the Marana region is not of sufficient capacity to carry both the pumped water and the effluent. In addition, a considerable acreage of lettuce is irrigated, for which the secondary effluent cannot be used. Resolution of this obstacle perhaps would require a feasibility study and cost analysis to determine if the existing system could accommodate alternate deliveries of ground water and effluent to the vegetable acreage and field crop acreage, respectively, and whether or not a partial dual system would be required to deliver the two classes of water.

The second alternative, a new or expanded district, would require organizational and legal procedures or changes. Expansion of the existing district may be difficult to impose upon the established internal pattern of power contracts, water rights, land ownership, assessments, and administrative authority. As to formation of a new district, preliminary indications based on a series of meetings with farming interests show a division of sentiment on the desirability of organizing a district solely for the purpose of contracting with the municipality for use of effluent.

CONSOLIDATED IRRIGATION DISTRICT -  
METROPOLITAN OPERATED

The third alternative organizational medium for using the wastewater in irrigation is the Consolidated Irrigation District-Metropolitan Operated (CIDMO), proposed by Cluff et al. (1972). Whereas the City of Tucson has been purchasing farmland in Avra Valley in order to secure pumping rights, and evidently can do so without regard to the exact location of the land within the valley, it was proposed that some of the land purchases be concentrated in the northern part of the valley, incorporating presently irrigated land parcels in relatively compact blocks. Some of the farmed lands are privately owned and some are State lands being farmed on agricultural leases. Once sufficient farmed acreage were consolidated, the municipal agency would own or control all lands within CIDMO, and would contract wastewater to lease tenants. Additionally, some lands remaining in private ownership, if within reasonable proximity to the CIDMO distribution system, could be incorporated under appropriate contract terms for utilization of the wastewater.

The exchange feature, or double transfer of water, can be instituted in this system by development of one or more municipal well fields adjacent to CIDMO, from which ground water would be conveyed to Tucson for domestic use (Figure 1).

The tentative CIDMO boundaries as shown in Figure 1 were so designed as to exclude high-cost land likely to be subdivided in near-future suburban expansion, and most of the area included in the district is "flood-prone" and apparently not subject to imminent residential subdivision, industrialization, or other intensive use.

The boundaries of CIDMO also are designed to include three parts which represent three "time phases", such that increasing increments of wastewater would be used as more becomes available. The inclusion of an approximate total of 20,000 acres of irrigated land in the three phases of the district represents effective utilization of the projected 1995 level of wastewater production.

CONCLUDING OBSERVATIONS

The concept of CIDMO as a management alternative is being pursued by City and County officials responsible for water supply and wastewater management. If it is implemented as illustrated in Figure 1 or in similar form, it will be operated or controlled by the Metropolitan Utilities Management Authority, which at this writing is in process of formation by merger of technical staffs and creation of a joint policy board representing both City and County authority. It has been suggested that, in actual operation of CIDMO as a wastewater utilization facility, the University of Arizona be granted an advisory role on technical aspects of the operation, and that some part of the facility be reserved for conducting long-term

field experiments and continuing research on efficient use of the wastewater in the crop/soil/water system.

With respect to management objectives, the wastewater use facility would be operated in such manner as to (1) maximize the quantity of wastewater use through all seasons of the year and (2) maximize efficiency of use of wastewater on the crops grown, in terms of both crop irrigation requirement and crop nutrient requirement, through irrigation scheduling and deliveries and cropping pattern adjustments. These objectives may not appear to be compatible with the profit maximization motive of the individual farmer, and suitable provisions will have to be written into wastewater sales agreements to assure coordination in practice between wastewater supplier and wastewater user. Achievement of conformity of objectives will be enhanced by continued field research as recommended above, accompanied by economic analyses of the actual operation.

#### ACKNOWLEDGMENTS

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