PUMPBACK SYSTEMS

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Introduction

There are two good reasons for considering the use of a pumpback system on surface-irrigated farms.

Studies have shown surface runoff is often 20 to 30 percent of water delivered. The amount varies with soil type, slope, crop grown, time of year, and management. Although this water can often be reused downstream, confining the water to the farm should reduce the amount needed at the delivery. This, in turn, will maintain greater river flows.

Recent legislation affecting the quality of return flows will, if enforced, require the removal of suspended materials which cause turbidity. Water analysis and experience indicate the improbability of meeting the standards by using settling basins where cultivated crops are grown. The alternative is to confine the water to the farm. Recycling also prevents the loss of soil from the farm. Studies of return flows for an irrigation season have shown losses, often ranging from one to two tons of soil per acre, with some surface soil losses many times this amount. Surface soils are usually high in phosphorus and may contain chemical residues and other properties harmful to downstream use.

Settling Ponds

Although settling ponds probably will not lower turbidity levels to meet downstream requirements, they can remove most of the suspended solids. Studies show 90 to 95 percent of the soil loads from field return flows can be removed within a two- to four-hour holding period. Small ponds or sump systems will require less land and will return the soil back to the field requiring less cleaning of the sump. Pumping dirty water will require more frequent pump repair, however.

Larger reservoir systems will facilitate water cleaning and allow for more flexibility in use of the water. The minimum-sized reservoir should store about one-third of the normal delivery for about six hours. For a one cubic foot per second delivery, this would require about 7,000 cubic feet of storage. Long, narrow, and deep reservoirs are generally preferred. Deepness reduces land area required and when sides are steep, weed growth is reduced. A narrow (the width of the tractor and scraper used for cleaning) reservoir, with water entering in one end and leaving the other, allows more settling opportunity.

Larger reservoirs and pumping systems will be required if water is not pumped continuously. Continuous pumping requires the least reservoir space and adjustments in water management, especially where continuous flows are received from the main source.

Design of System

Several decisions must be made:

1. Will the return flows be pumped continuously to augment the original head or allowed to collect and used separately?

2. Will the return flow be pumped all the way back or to separate and/or lower fields?

3. Will the return flow be applied through a sprinkler system or utilized in the present method of distribution?

Figure 1 shows an idealized return flow system.

On farms where the delivery is a long distance or at a considerable elevation above the tail water collecting point, pumping to a lower elevation or a shorter distance may be preferable.

A competent engineer should be consulted for determining the kind and size of pipe to use. Where elevation differences and friction losses do not exceed about 30 feet, concrete pipe can be used. Otherwise, PVC, asbestos cement, steel, etc., may be used. The engineer should select the pipe size and type based on annual cost, considering amortizing capital and anticipated power needs.

Selection of the proper pump also requires the services of a competent engineer. He will need to consider the amount of water to be pumped in a specific time period, the differences in elevation from the low water level to the highest point of delivery, and the headloss from friction through the pipe. A centrifugal pump will probably be adequate for most return flow systems if pumping is continuous or if self-priming can be utilized; otherwise a single-stage, turbine-type will be better.

System Cost

Capital cost will vary widely depending on slope and topography of the farm and method of recycling. At 1975 prices, the cost for a reservoir pumping setup and pipelines will be about $30 per acre, but could be about $10 more per acre if a turbine pump is used.

Power cost also will vary, but probably will not exceed $1 per acre per year. Annual costs by amortizing and power costs should range from $4 to $5 per acre per year. Cost per acre will usually be higher where smaller acreages are involved, and/or pumping of field return flow is not continuous.

Precautions

Recycling without using some method of cutback and redistribution will tend to cause an overirrigation at the upper end of runs and possibly over the entire field. This in turn can leach valuable plant nutrients. Preventing return flows may require irrigation districts to divert additional water to provide supplies to users further down the canal system. Individual irrigators should be able to cut back their demands from the district, however, and avoid this. An effective settling pond will need periodic cleaning. The frequency will depend upon size in relation to amount of land being irrigated and the amount of erosion occurring.

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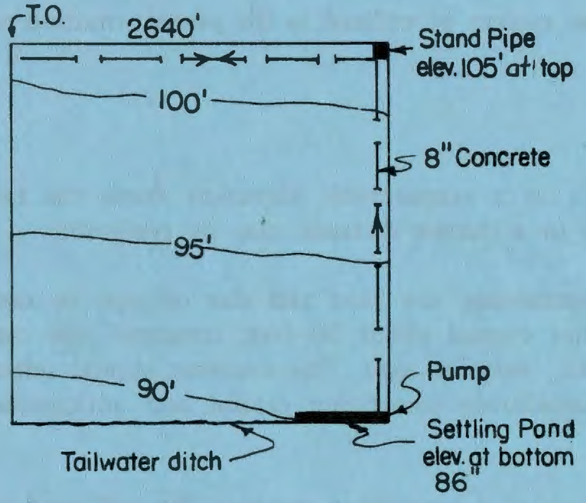
Pumpback Systems



EXAMPLE DESIGN

160 acres
3.5 cfs continuous flow
25% normal runoff
depth of pond 4' (elev. 86")
dif. in elevation 19' (105"–86")

amount to pump: 25% X 3.5 cfs = 0.875 cfs
= 394 gpm

8" concrete pipe with rubber gaskets was selected based on lowest annual cost

Pump

Friction loss in pipe	13.2'
Elevation Dif. (sump to standpipe)	19.0
Head dif.	32.2

$$H\,P = \frac{\text{gpm X head}}{\text{3,960 X eff.}}$$

$$4.6 = \frac{394 \text{ X } 32.2}{3{,}960 \text{ X } .70}$$

Select 5 HP motor

Capital Cost

Reservoir	$ 300	1,000 yds^3 @ .30–will store 1/3 of flow for 6 hours
Pipe installed	3,600	$1.07/ft + laying and trenching
Pump and motor	650	
Miscellaneous	300	screens, valves, wiring
	$4,850 ÷ 160 = $30.31 per acre	

Annual Costs

Reservoir	$ 300 ÷ 30 years	$ 10
Pipe	3,600 ÷ 20 years	180
Pump and motor	650 ÷ 10 years	65
Miscellaneous	200 ÷ 10 years	20
Electricity		65 (more if power source not near)
Maintenance @ .03 cents		145
Interest on 1/2 invest.–salv. @ .09 cents		
$\frac{4850 - 500}{2}$ x .09		195
		$680 ÷ 160 = $4.25 per acre per year

This example may or may not be typical of your needs. Labor costs for distributing the tail water should be added to annual costs when extra labor is required.