Water for the World

Choosing Between Gravity Flow and Pumps
Technical Note No. RWS. 4.P.1

Water can be delivered from one point to another in four basic ways: hauling, pumping, gravity flow or a combination of these methods. Hauling is the least efficient method. It is labor intensive, very costly, and provides only minimal quantities of water. Pumping may require a great deal of energy and usually is more expensive to operate and maintain than gravity flow. Gravity flow is efficient, requires no additional energy and is economical to operate and maintain. It may, however, be expensive to construct initially.

Gravity flow systems usually restrict the source to a specific location. Pump systems provide much more flexibility in locating a source. A source suitable for gravity flow is more likely to require treatment than one using a pump because it is likely to be a spring or a surface source. Because of its dependability and low operation and maintenance costs, if the water is of satisfactory quality gravity flow should always be considered. The final decision to use a particular means of moving water must be based on comparison of costs including operation and maintenance as well as construction costs.

Evaluating Gravity Flow Versus Pumps

To choose between gravity flow and pumps, each type of system should be evaluated. Factors which should be included in this evaluation are:

- The amount of water needed by the village,
- The amount of water the source can produce,
- The water quality,
- The difference in elevation between the source and the highest point in the system, usually the top of the storage tank,
- The distance between the source and the point of storage,
- The obstacles between the source and the village,
- The alternative water sources that are available or could be made available,
- The type of power available and its cost,
- The estimated pumping head.

Worksheet A can be used to tabulate the needed information for all sources. A map should be made of the area identifying the sources in relation to the homes to be served. Any good, clear existing map can be used. The map should show land elevations, existing homes and buildings, roads and streets. Swamps, high groundwater areas, and rock zones should be added to the map. Digging trenches for pipes in such places will be difficult and costly.

Once the necessary information is obtained, gravity flow and pumped transmission lines can be compared and cost estimates, including operation and maintenance costs, can be compared. See "Designing a System of Gravity Flow," RWS.4.D.1, and "Determining Pumping Requirements," RWS.4.D.2, for information about how to size the respective systems.

Worksheet B is a form that can be used to make cost estimates for the transmission line. Prepare an estimate for each possible source. Worksheet C can be used to compare the costs of developing one source among two, three or more possible sources. When a satisfactory source from which water can be moved by gravity is found, every effort should be made to use it. Added pipeline length which may be required will be less costly in the long run than a pumped transmission line.

Worksheet A. Data Required for Choosing Between Gravity Flow and Pumps

1. Estimated present water needs in liters:

	Number of			Unit use		Total
Population	Persons	_____	x	_____	=	_____
School	Students	_____	x	_____	=	_____
Church	Attendees	_____	x	_____	=	_____
Large animals such as cows, oxen		_____	x	_____	=	_____
Small animals such as sheep, goats		_____	x	_____	=	_____
Public watering fountains		_____	x	_____	=	_____

Total present needs = _____

2. Estimated future water use:

Use a 20 year design life. If no better information is available, use a population growth factor of 2 times the present population and an increase in animals of 1.25 times the present number. In addition, assume an increase in the rate of water use of 2 times the present use.

Population	Present use _____	x 4 =	_____	liters
Institutions & public fountains	Present use _____	x 2 =	_____	liters
Animals	Present use _____	x 1.25 =	_____	liters

Total future water use = _____ liters/day

3. For each possible water source, determine or judge:

Water quality ______________________________

Sustained yield in liters per day ______________________________

Difference in elevation between source and highest point in system ______________________________

Distance between source and storage ______________________________

Obstacles between source and village ______________________________

Ease of construction of source protection and pipeline ______________________________

Worksheet B. Estimated Cost of Transmission Line Pump/Gravity Flow Delivery System

Item	Quantity	Unit Cost	Total Cost
Transmission Line Materials			
8-inch PVC pipe	____ m	____	____
6-inch PVC pipe	____ m	____	____
8-inch gate valve & box	____	____	____
6-inch gate valve & box	____	____	____
4-inch flush valve	____	____	____
Pressure reducing valves	____	____	____
Power source (electricity)	____	____	____
(fuel engine)	____	____	____
Pump & Controls	____		____
Pumphouse	____	____	____
Storage tank (____ m^3)	____	____	____
Transmission Line Materials			____
Labor			
Lay water lines	____	____	____
Construct pumphouse	____	____	____
Construct storage tank	____	____	____
Construct water source	____	____	____
(dug well)	____	____	____
(spring)	____	____	____
(surface)	____	____	____
Install pump	____	____	____
Install motor	____	____	____
Labor			____
Equipment			
Pickup truck	____	____	____
Dump truck	____	____	____
Front end loader	____	____	____
Trencher	____	____	____
Backhoe	____	____	____
Crawler tractor	____	____	____
Compressor	____	____	____
Other ________	____	____	____
________	____	____	____
Equipment			____
Cost Summary			
Sub-total Materials			____
Sub-total Labor			____
Sub-total Equipment			____
Sub-total project cost			____
Add contingency 20%			____
Total Project Cost			____

Worksheet C. Comparison of Costs for Transmission Lines

Source	Type System Gravity/Pump/Both	Transmission Line Cost	O&M Cost
A. ________	________	________	________
B. ________	________	________	________
C. ________	________	________	________
D. ________	________	________	________
E. ________	________	________	________
F. ________	________	________	________
G. ________	________	________	________

Source Selected ________________

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