WATER SUPPLY

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Ground Water : — The rainfall that percolates below the ground surface, passes through the voids of the rocks and joins the water table. These voids are generally inter-connected permitting the movement of the ground water. But in some rocks, they may be isolated and thus, preventing the movement of water between the interstices. But it is evident that the mode of occurrences of ground water depends largely upon the type of formation.

In fact, all the materials of variable porosity near the upper portion of the earthen crust can be considered as a potential storage place for ground water and hence might be called as the ground water reservoir.

Various forms of under-ground sources : —

The under-ground water is generally available in the following forms : —

(1) Infiltration galleries
(2) Infiltration wells
(3) Spring and
(4) Wells including tube-wells.

(1) Infiltration galleries : — Infiltration galleries and horizontal tunnels constructed at shallow depths (3 to 5mts.) along the tank of the river through the water bearing strata. They are sometimes called the horizontal wells.

(2) Infiltration Wells : — Infiltration wells are the shallow wells, constructed in series along the banks of the rivers, in order to collect the river water seeping through the bottoms and these wells are generally constructed of brick masonry with open joints. They are generally covered at top and kept open at bottom and for inspection purposes manholes are provided in the top cover. The various infiltration wells are connected by porous pipes to a swamp well called jack well. When the water reaching the jack well from different infiltration wells is tilted, treated and distributed to the consumers.

(3) Springs : — The natural outflow of ground water at the earthen surface is said to form a spring. The springs are generally capable of supplying very small amount of water and are therefore, generally not regarded as sources of water supply. But good developed springs may sometimes be used as water supply sources for small towns, especially in hilly areas.

Formation and types of springs : —

(a) Gravity springs (b) Surface springs and (c) Artesian springs.

(4) Wells— A water wall is a hole usually vertical, excavated in the earth for bringing ground water to the surface. The wells may be into two types.
(a) Open wells and (b) Tube wells.

(a) Open wells— Smaller amount of ground water has been utilized from ancient times by open wells. The yield of an "Open Well" is limited because such wells can be excavated only to a limited depth where the ground water storage is also limited. In such a well, the water can be withdrawn only at the critical velocity for the soil. Higher velocities can not be permitted and the limit placed on velocity also limits the maximum possible safe discharge of an "Open Well'.

The open wells may be classified into the following two types : —

(i) Shallow Wells and (ii) Deep Wells.

(i) Shallow Well— Shallow Wells are those which rest in a pervious stratum and draw their suppliers from the surrounding materials. The "Shallow Well" might be having more depth than a "Deep Well". A shallow well draws water from the top most water bearing stratum, its water is liable to be contaminated by the rain water percolating in the vicinity and may take with its minerals on organic matters.

(ii) Deep Well— A Deep Well is one which rests on an impervious "Mota" layer and draws its supply from the previous formations lying below the mota layer through a bore hole made into the "Mota". The main advantage of such a "mota" layer lies in giving structural support to the open well resting on its surface. The "mota" layers are generally found throughout the Indo-Gangetic plain and are generally found in different thickness and depths at different places. The water in a deep well is not liable to get such impurities and infections, but greater quantities of ground water yielding high specific yield.

The nomenclature of shallow and deep well is purely technical and has nothing to do with the actual depth of the well.

Formation and types of well : — Three main types of well.

(1) Gravity well (2) Pressure well and (3) Gallery.

The construction point of view, the open wells may classified in the following three types—

Type—I Wells with an impervious lining such as masonry lining and are generally resting on a mota layer.

Type—II Wells with a pervious lining such as dry brick on stone lining and fed through the pores in the lining.

Type—III No linning at all, a Kachha Well.

(b) Tube-Well— The tube well is assuring greater and greater importance for tapping out ground water resources. Larger discharges can be obtained by getting a larger velocity as well as a larger cross-sectional area of the water bearing stratum. Deep tube-wells are generally constructed by Government and are called State tube-wells. The depth of such wells, generally vary from 50m to 500m and may yield as high as 200 to 220 lts. / Besides deep tube-wells. Shallow tube-wells are also constructed by cultivators; their depths generally vary from 20m to 40m.

Tube-Wells are generally 4 (four) types : —

(1) Strainer wells (2) Cavity wells (3) Slotted wells and (4) Purported pipe wells.

Out of these four types the strainer type tube-wells are the most important and widely used in India.

Maintenance of Wells : — Among the causes of well failure that must be guarded against are : —

(1) Over pumping (2) Lowering of the water table (3) Clogging or collapse of screen (4) Leaky drop pipe (5) Leaky casing (6) Clogging of the sand or crevices of the aquifer (7) Corrosion and (8) Worn pump.

The clogging and incrustation of screens, frequently produced by over pumping is probably the cause of most well failures in sand and gravel. Over pumping is difficult to specify, but if a screen is clogging the well is being over pumped. Over pumping results also in pumping of sand, lowering the water level in the well and lowering the ground-water table surrounding the well. Pumping of sand may result also from, or may be the cause of collapse of the screen or the casing.

The lowering of the ground water table by overdrafts on the well field cannot always be avoided. As the water level is lowered, the specific capacity of the well is decreased. It may be necessary to increase the length of the drop pipe in the well, to increase the depth of the well, or both, in order to maintain the same rate of discharge from the well.

Clogging or collapse of the screen may be indicated by the pumping of sand, either with or without symptoms caused by the clogging of the screen.

Leaky casings may admit undesirable water, or they may allow good water to escape from the well into “thieving” strata. A leaky drop pipe on a worn pump will be indicated by a loss of capacity of the pump at known speeds of operation. Thieving strata may be detected by lagging the well. Leaky drop pipes and worn pumps can be observed by pulling them from the well periodically for inspection.

Developing of Wells : — By the development of a well is meant the restoration or increase of its capacity. An attempt to restore the failing capacity of well should be made only after a study of the costs involved and the probable results. It may be costly to construct a new well.

A well may be developed by— (1) Removing, cleaning and replacing the screen, (2) Removing the screen and basting, (3) Without removing the screen, i.e. (a) Surging (b) Acidizing (c) Over pumping (d) Jet cleaning or blasting and (e) Reconstructing.

(1) Removing, cleaning and replacing the screen—

Screens that have been removed may be cleaned on the surface of the ground with acid or by brushing and repairs may be to the screen.

(2) Removing the screen and basting—

The development of wells by blasting is most successful in consolidated material in which crevices are opened and inter-connected by the shock of the blast.

(3) Without removing the screen—

(a) Surging—to surge a well is to cause water to flew rapidly from the well into the ground or alternatively, to over pump the well and to force water into the ground from the well. The principal purpose of surging a well is to dislodge clogging and incrusting materials from the screen.

Immediately after the well has been surged, it should be strongly and continuously pumped until all dislodged material has been removed from the well. Otherwise the improvement resulting from surging will be only temporary. Surging is not always successful, occasionally causing loss of the wells. If the top of the well causing sealed, compressed air can be discharged in to it forces water violently back through the screen. If air permitted to follow through into the aquifer, it may cause "air logging" or clogging of the aquifer with pockets of air.

(b) Chemical Treatment—Chemicals are used in the restoration of well capacity to dissolve substances deposited in the sand surrounding the screen and on the screen. Deposited and clogging substances include calcium carbonate, the oxides of iron and other metals, and clay, still and organic substances. Chemicals used in treatment include acids where the metal of the screen will not be attacked by them. But brass or bronze may be treated with muratic acid, while iron requires nitric acid. Chemicals may prove effective and economical in the cleaning of pipes, but they should be used with full knowledge of the conditions and results. Acids may be used successfully, particularly in small pipes, for the removal of deposits of calcium carbonate, provided an inhibitor is combined with the acid. Acid may be allowed to stand in the well from 1 to 24 hrs. during which time the well may be gently surged intermittently for short period of time. The well should be bailed clean of all dislodged material and the acid removed by flushing the well with water or neutralizing with lime, sod wash, or other chemical followed by through flushing with water until all traced of chemicals are removed.

Chlorine has been added to wells to remove incrustants resulting from the activity of iron bacteria. After completion of chemical treatment the well should be cleaned and flushed as recommended above, after acidizing.

(c) Jet cleaning—In jet cleaning, a high pressure jet of water is directed from the inside of the well against the inside of the screen to dislodge clogging material and drive it back into the aquifer.

Almost all wells pump some sand. It should be removed before passing into pumps on into the distribution system.

DESIGN OF A STRINER TUBE-WELL : —

The design of a strainer type tube well essentially consists of designing the size of the tube, the size of the bore hole, the length of the strainer and the type and horse power of the pumping arrangement required to lift the water. The design consideration for these major three parts of a tube-well.

(1) Size of the Tube (2) Size of the Bore Hole and
(3) Length of the strainer.

Water Supply : —

(1) Size of the Tube—

The diameter of the tube pipe is decided from the considerations of permissible flow velocity through the tube. The strainers are installed at different levels, the velocity of water in a tube of a fixed size will not constant but will be increasing towards the top. Hence, it is theoretically possible to reduce the size of the tube from top towards the bottom, such that the velocity is more or less constant throughout the tube length. The velocity through the tube may be limited between 1.5m/sec. to 4.5m/sec. Knowing the design discharge of the tube-well and the velocity, the area of the tube and hence its diameter can be easily calculated. The nearest available size in the market may then be used.

(2) Size of the Bore Hole—

Normally, the size of the bore hole should be at least 5cm. bigger than the size of the tube, so as to facilitate the lowering of the tube in the hole.

(3) Length of the Strainer—

After deciding the diameter of tube, the length of the strainer required to obtain the design discharged may be calculated for in confined and confined aquifer The next step is to select a strainer with design, shape and size of the openings that will not clog, will provide structural strength and will permit subsequent surging and developmental work on the well. But the length of a strainer should not be usually specified in advance of the construction of the well, in order that the length may be adjusted to the thickness of the aquifer that is penetrated. The strainer may be made as long as the aquifer is thick, but not over 40ft. to 60ft.

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