



Sub-Intakes and other types of wells for Collecting Water

1. Intakes for collecting surface water:-

A water works intake is a device or structure placed in a surface water source to permit the withdrawal of water from the source. They are used to draw water from lakes, reservoirs or rivers in which there is either a wide fluctuation in water level or when it is proposed to draw water at the most desirable depth.

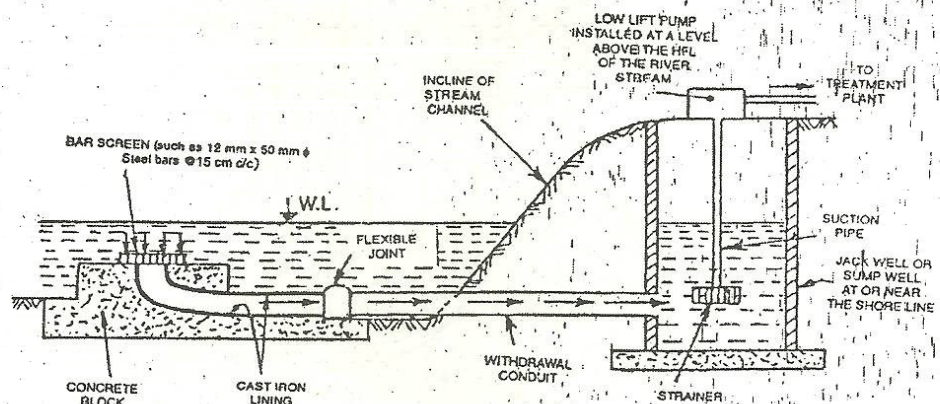
Thus the basic function of an intake structure is withdrawing water safely from the surface source over a predetermined range of pool levels and then to discharge this water into the withdrawal conduit (normally called intake conduit).

1.1 Types of Intakes

Various types of intakes that are commonly being used are described below:

- (a) Simple Submerged Intakes;
- (b) Intake Towers;
- (c) Mediums Size River Intakes; and
- (d) Moveable and floating intakes.

(a) Simple submerged Intakes-A simple submerged intake consists of a simple concrete block supporting the starting end of the withdrawal pipe as shown in Fig-1 below.



The withdrawal pipe is generally taken up to the sump well at shore, from where the water is lifted by pumps. The intake opening is generally covered by screen so as to prevent the entry of debris etc into the withdrawal conduit. Submerged intakes are cheap and therefore widely used for small water supply projects drawing water from streams or lakes having relatively little change in water surface elevation throughout the year.

(b) Intake Towers-Intake towers are generally used on large projects and on rivers or reservoirs where there are large fluctuations of water level. Gate controlled openings at various levels called ports, are generally provided in these concrete towers, which may help in regulating the flow through the towers. There are two types of intake towers

- (i) Wet intake towers; and
- (ii) Dry intake towers

(i) Wet Intake towers-A typical section of wet intake tower is shown in Fig-2 below

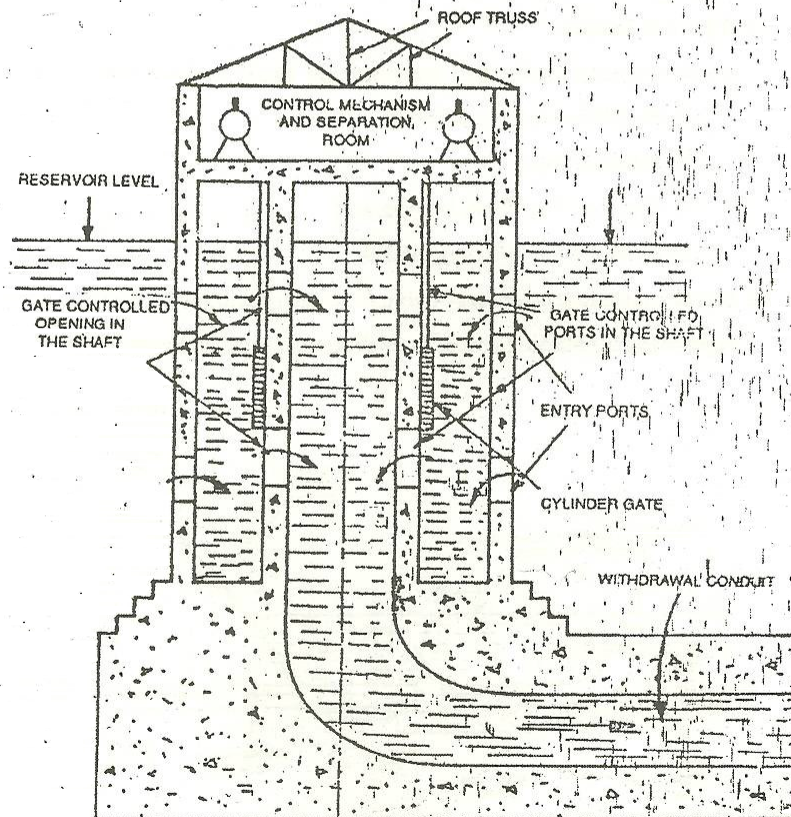
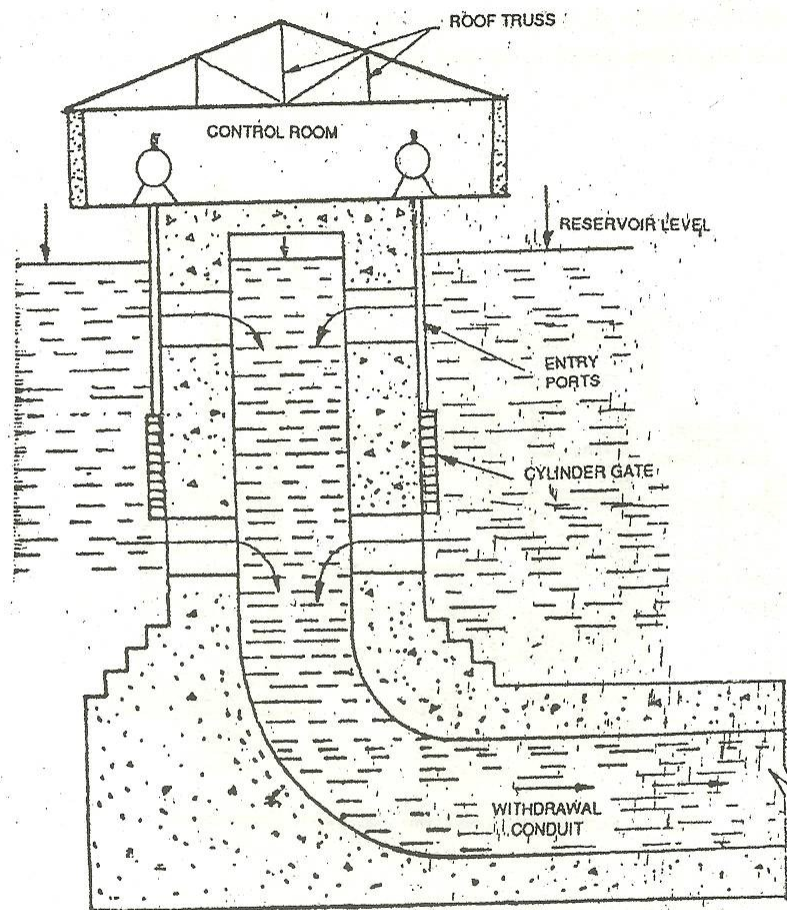


Fig-2

Wet intake tower standing in the river or reservoir.

In a wet intake tower, water enters directly into the tower through the entry ports and then it enters into the conduit pipe through separate gate controlled openings.

(ii) **Dry Intake Tower-** In a dry intake tower, the water is directly drawn into the withdrawal conduit through the gate entry ports as shown below in Fig-3



Dry intake tower standing in the river or reservoir..

Fig-3

A dry intake tower will, therefore, have no water inside the tower if its gates are closed, whereas the wet intake tower will be full of water even if its gates are closed. When the entry ports are closed, a dry intake tower will be subjected to additional buoyant forces and hence, must be of heavier construction than the wet intake towers.

(c) **Medium Sized River Intake Structures**-Medium size intake structures are constructed for withdrawing water from almost all rivers and are a via media between the submerged intakes (usually adopted for small streams) and intake towers (usually adopted for reservoirs). River intake structure can be broadly classified into following two types:

- (i) Twin well type
 - (ii) Single well type
- (i) **Twin well type**- This is the most commonly used type of river intake which is generally constructed on almost all types of rivers. Typical details of such an intake structure are shown in Fig-4. More detailed plan and sections of such an intake are shown in Fig-5 below.

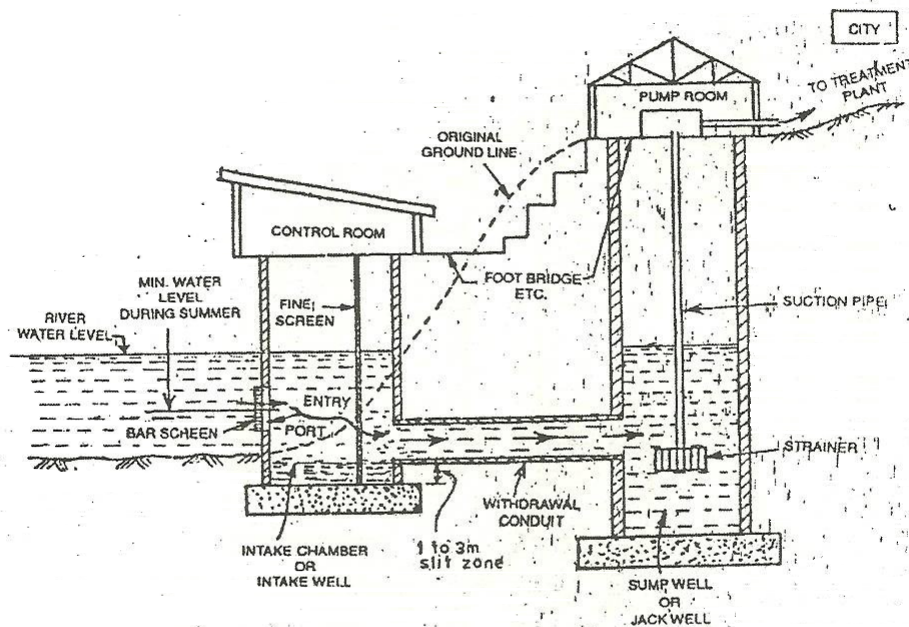


Fig. Section of a typical twin well type of a river intake.

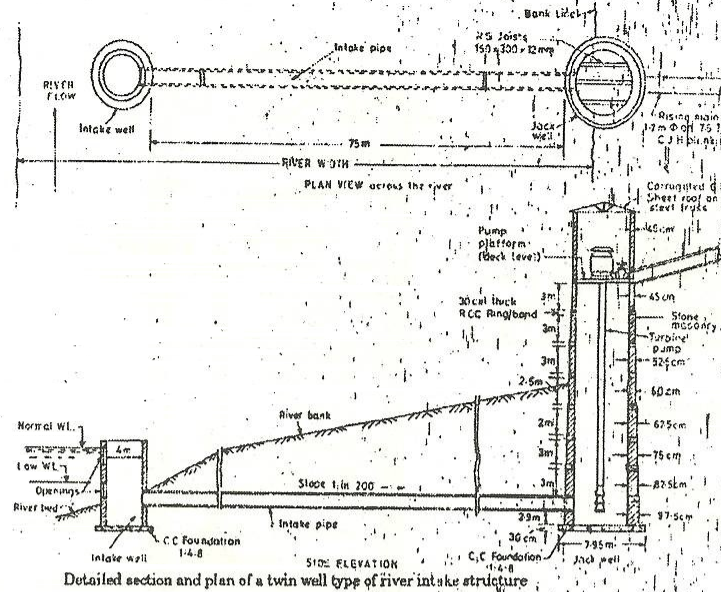


Fig-5

As can be seen from these figures such a typical river intake structure consists of

- (a) An intake well;
- (b) An inlet pipe;
- (c) A jack(sump) well

The intake well or collector well is a circular or more preferably an oblong well (rectangular well with circular end) located in the river bed somewhat away from the river bank so that it always remains surrounded with water even during low flow stage. This intake well is connected to the jack well (sump well), which is constructed on the river bank, by an inlet pipe. Water entering the jack well from the intake pipe is lifted by pumps and is fed into the rising main through the delivery pipe of the pump.

- (ii) Single well type- In alluvial rivers, water is usually ponded up by constructing a weir across the river. From the up stream side of such a weir, a channel may sometimes be taken off. The water entering this off take channel may then be collected and lifted for supply. The intake structure for collecting water in such a case shall then be located in this off take channel. In such situation the intake structure may be constructed across the off take channel in the form of a single jack well (sump well) provided with direct entry ports as shown in Fig-6 below.

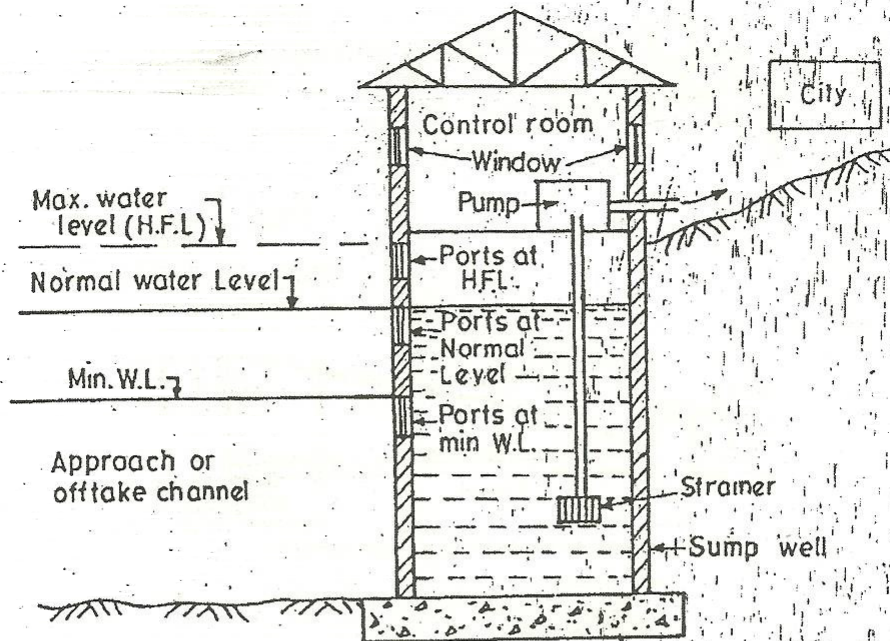


Fig. Section of a Single Well Type of a river intake to be located across an off-take channel or an approach channel.

This arrangement will eliminate the construction of a separate intake well and the inlet pipe, as required in twin well type. Openings or ports fitted with bar screens are provided in the jack well itself. The sediment entering this intake will usually be less since clearer water will enter the off-take channel. This is a type of intake which is generally used in railway.

(d) **Moveable and Floating Intakes-** In this type, intake arrangements are fixed on a moveable and floating platform when it is not possible to construct any structure on the river bed.

1.2 Factors Governing Location of Intake

Following factors should be considered for locating the intake:

- (i) The intake must be located in the purer zone of the source so that the best possible quality of water is withdrawn from the source thereby reducing the load on the treatment plant.

- (ii) Absence of current that will threaten the safety of the intake.
- (iii) As far as possible, the site should be near the treatment plant so that the cost of conveying water to the supply line is less.
- (iv) The intake must never be located at the downstream or in the vicinity of the point of disposal of waste water. When it becomes necessary to locate the intake in the close proximity of the disposal of drain etc, it is advisable to construct a weir upstream of the disposal point and install the intake up stream of the barrage.
- (v) The site should be such as to permit greater withdrawal of water, if required at a future date. Thus there should be sufficient scope for future additions and expansions.
- (vi) The intake must be located at a place from where it can draw water even during the driest period of the year. Thus the intake must be located in deep waters sufficiently away from the shore line.
- (vii) The intake site should remain easily accessible during floods and should not get flooded. Moreover, the flood water should not be concentrated in the vicinity of the intake.
- (viii) Possibilities of damage by moving objects and other hazards should not be there.

1.3 Design Considerations

- (i) The intake structures design should provide for withdrawal of water from more than one level to cope up with seasonal variations of depth of water. Undersluices should be provided for release of less desirable water held in storage.
- (ii) In the design of intake, a generous factor of safety must be allowed as forces to be resisted by intakes are known only approximately. Undermining of foundations due to water currents or overturning pressure, due to deposits of silt against one side of an intake structure, are to be avoided.
- (iii) The entrance of large objects into the intake pipe is prevented by coarse screen or by obstruction offered by small openings in the crib work placed around the intake pipe.
- (iv) Fine screens for the exclusion of small fish and other small objects should be placed at an accessible point.
- (v) The area of openings in the intake crib should be sufficient to prevent an entrance velocity greater than about 0.15 to 0.20 m/sec to avoid carrying settleable matter into the intake pipe.

- (vi) Withdrawal conduits/penstock entrance pipes should be designed and controlled to prevent air from entering the suction pipe by keeping a depth of water over the port of at least three times the diameter of the port opening.
- (vii) The section of the intake well below the level of the intake pipe helps to provide space for accumulation of silt and sediment. This depth may be kept about 1 m to 3 m.
- (viii) The conduit for conveying water from the intake should be led to a jack/sump well in or near the pumping station. For conduits laid under water, standard CI/RCC pipe may be used.
- (ix) The flow velocity through the withdrawal conduit is generally kept as about 1.2 to 1.5 m/sec, and this helps in determining the area and diameter of the withdrawal conduit. The dia of inlet pipe however should not be less than 450 mm.
- (x) The horizontal crosssectional area of the suction/sump well should be generally five times the vertical crosssectional area of the intake conduit.
- (xi) The intake conduit should be laid on a continuously rising or falling grade to avoid accumulation of air or gas pockets of which otherwise restrict the capacity of the conduit. These pipes are to be laid with a gentle slope of 1 in 200 or so, towards the jack well.
- (xii) The diameter of the sump well may be kept about 5 times of the dia of inlet pipe and the bottom of the sump well should be kept at about 2 to 4 m below the lowest water level in the well to accommodate pumps.
- (xiii) To prevent vortex formation in the sump well, the intake pipes should approach the side walls of the sump readily at right angles.
- (xiv) The sump well should be founded on a hard strata with a bearing capacity of not less than 450 KN/M².

2. Infiltration Galleries and wells:-

2.1. Infiltration gallery:- These are constructed in water bearing strata. The gallery obtains its water from water bearing strata by various porous drain pipes. A collecting well at the downstream end of the gallery serves as the sump from where the infiltrated supply is pumped out. The gallery laid perpendicular to the flow of sub-surface water yields maximum quantity. Quality of water is normally reasonably good and only disinfection may be required.

2.2. Infiltration well:- Infiltration wells are usually sunk in series in the banks of river. They are generally constructed of masonry with open joints. The infiltration wells in turn are connected by porous pipes to a collecting sump (jack well). There can be large yield of water from these

wells. Quality of water varies with quality of water in river, depth, and distance of well from river bank.

2.3. Radial Collector Wells:- Radial collector well consists of a cylindrical well of reinforced concrete construction, 4-5 metre in diameter going into the water bearing medium to as great a depth of the substrata as possible. In the collector wells the radial pipes which are slotted steel pipes normally 200mm to 300mm diameter are driven horizontally at about 7 meters below the water table in the well. The length of the steel pipes will be determined by the requirement of water and yield of the aquifer i.e. the water bearing medium in the subsoil. The drain pipes are made of short lengths of pipes 2.4 meters each which are welded to each other. The pipes are driven horizontally by means of suitable pin jacks placed in the well.

Desanding operation is required to be done after driving of the radial pipes. Desanding is done by inserting another tube into the drain tubes and blast of compressed air to separate the fine particles of alluvium. The radial collector wells have higher efficiency of drawing the ground water compared to ordinary wells. This type of wells are able to obtain high yields of water depending on the strata and depth of submergence. This is normally provided in alluvial beds of major rivers. Such type of wells may also be provided in non-alluvial beds of rivers in case required thickness and extent of aquifer is ascertained after conducting bore hole test, electrical resistivity survey etc.

It is mentioned that for getting preliminary idea regarding variation of thickness and extent of aquifer, electrical resistivity survey is to be conducted. However to confirm the exact thickness of the aquifer, test drilling is also required to be done.

Though the initial cost of the radial collector well is very much on the higher side as compared to the conventional intake well because of provision of horizontal lateral strainers in radial collector wells but maintenance cost of this system is negligible. Moreover life of such well is also much more than the life of conventional intake well.

This has got the approval of PCE

DA: Fig. of infiltration gallery, infiltration well and radial collector well.

Qual
12.12.2018
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Chief Engineer/Works

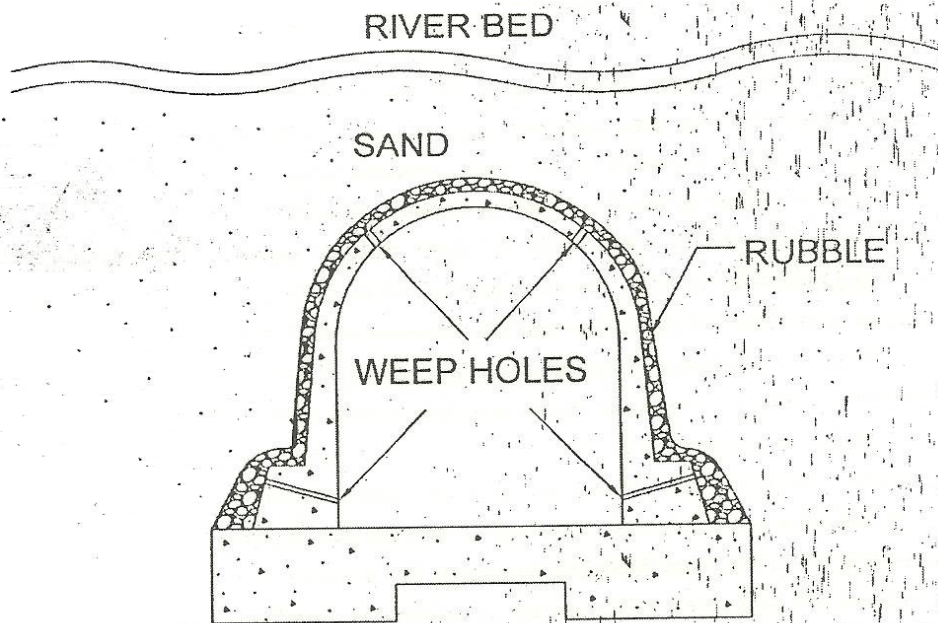
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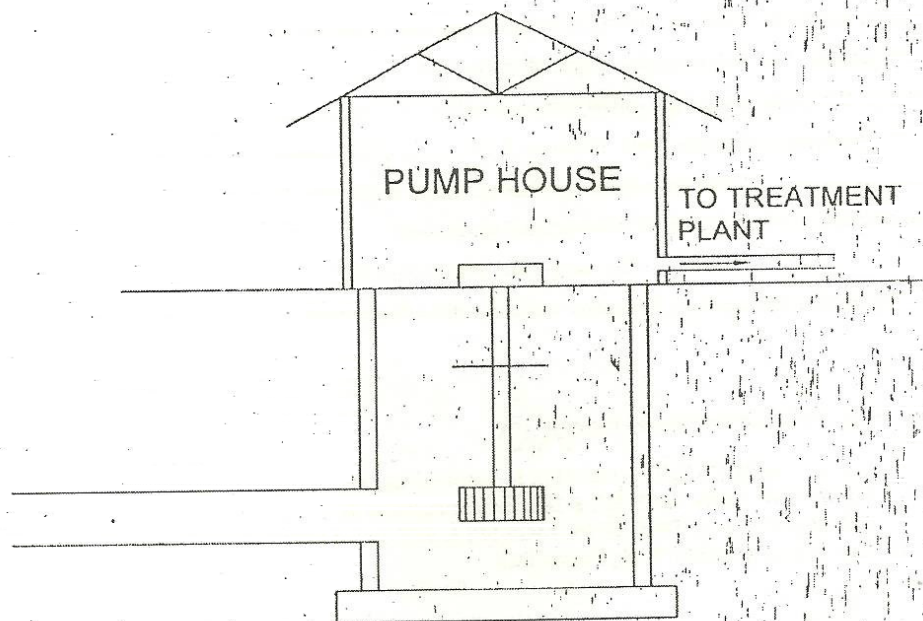
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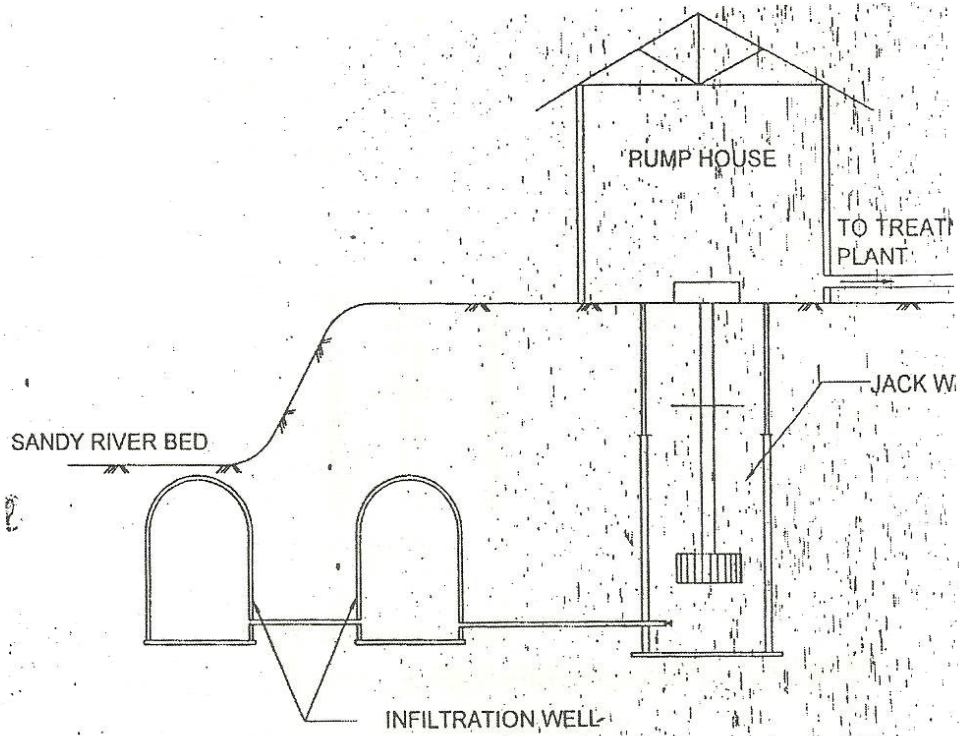
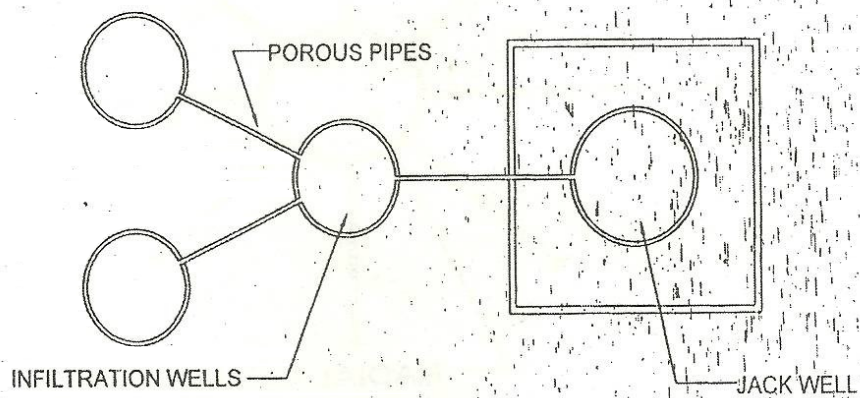
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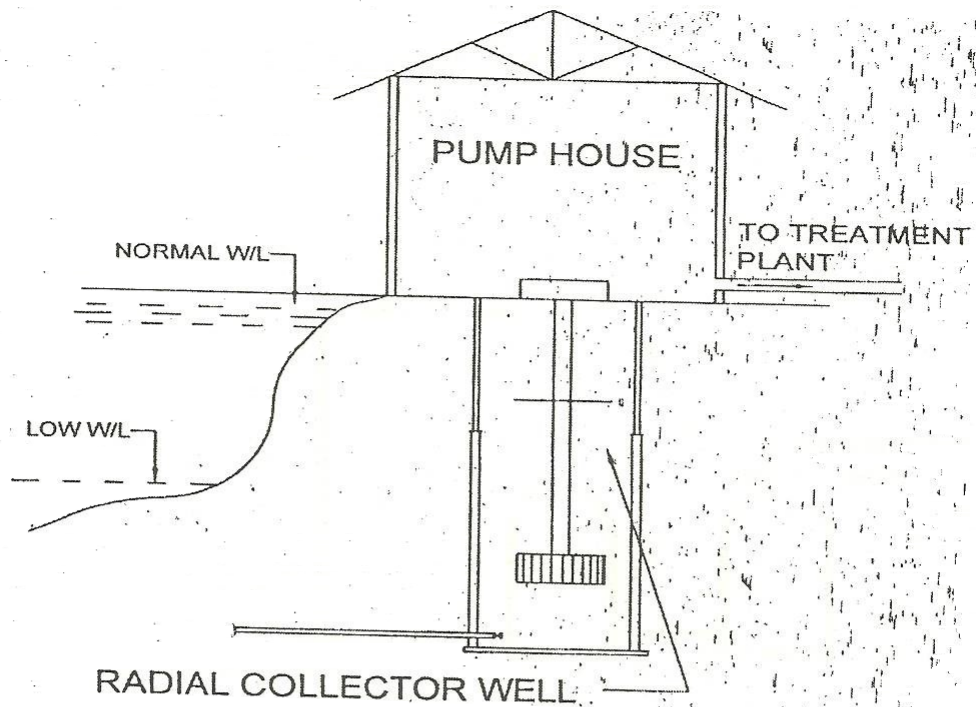
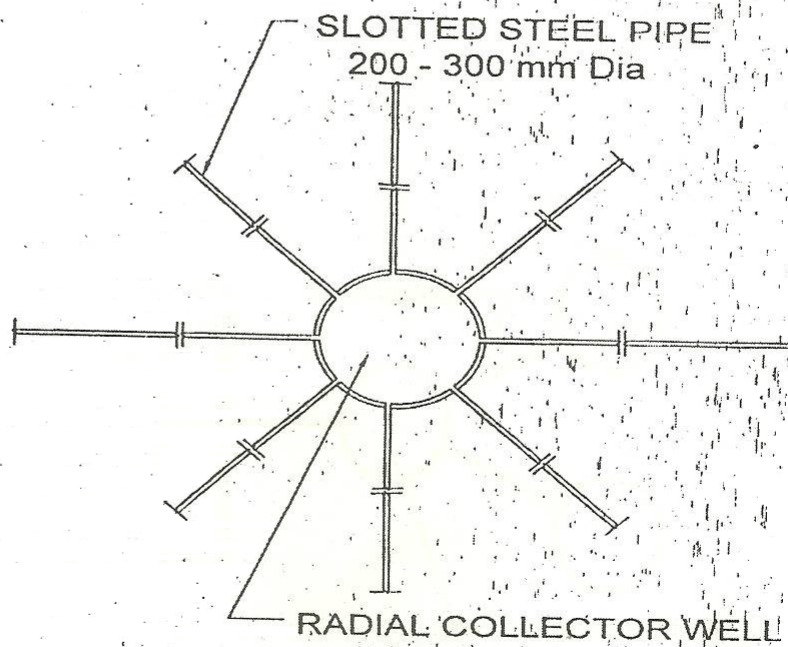
INFILTRATION GALLERY



SECTION



PLAN AND VERTICAL SECTION OF INFILTRAION WELLS



RADIAL COLLECTOR WELL