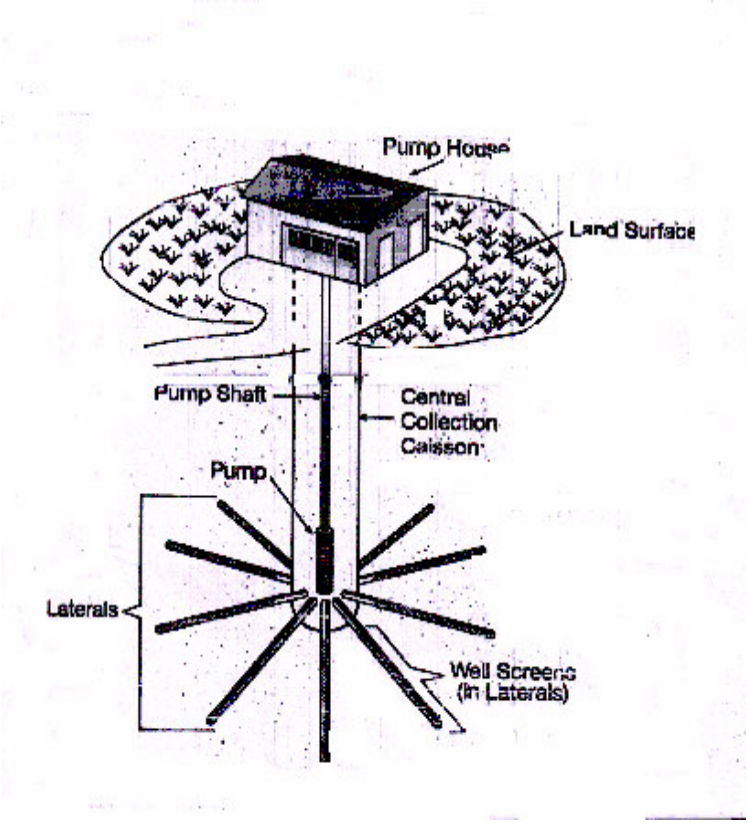
RADIAL COLLECTOR WELL



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Under the kind guidence of

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And patronage of

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INTRODUCTION –

South Eastern Railway' has its infrastructure at the junction station " Kharagpur settlement for the 'Water supply" to about 75000, population along with all other demands of day-to day works for railways. Considering higher limits of Iron content, fluoride content, calcium content, collators, organisms etc in the existing source of water, a "Water Treatment Plant" of 2.4 MGD capacity was proposed by the division and got sanctioned by the "Railway Board at a cost of Rs.3.50 crores.

But finally a detailed estimate was prepared for the above treatment plant at a cost of Rs.5.33 crores and the sanction obtained from the competent authority. Since there is acute shortage in supply of water it is suggested by the division,further to go for a "Radial Collector Well" i.e. an "Intake Well" of 5.0 million gallon per day capacity with horizontal strainer pipes to be pushed into a long stretch of aquifer all around the well in the bank of river "Cosseye" near the existing water supply point as a permanent measure.

Ground water is used as a potential source of dinking water wherever possible. In comparison with surface water, groundwater is well protected against type of pollution and is of relatively good quality. However explorable potential of ground water sources is limited as regard to quantity.

As ground water potential is decreases day by day, River bank filtration (RBF) placed an important role. RBF is a low cost and efficient alternative water treatment for drinking water application. It has been used to produce drinking water by inducing surface water to flow down ward through sand bed into a pumping well. During this process potential contaminants are filtered from the water, significantly improving water quality. It is a reliable method of decreased cost to the community without increase the risk of human health.

In RBF radial collector well or production well which are placed near the banks of the river, pump large quantity of water.

Redial collector well are horizontal perforated conduits that collect ground water principally from surface water filtration.

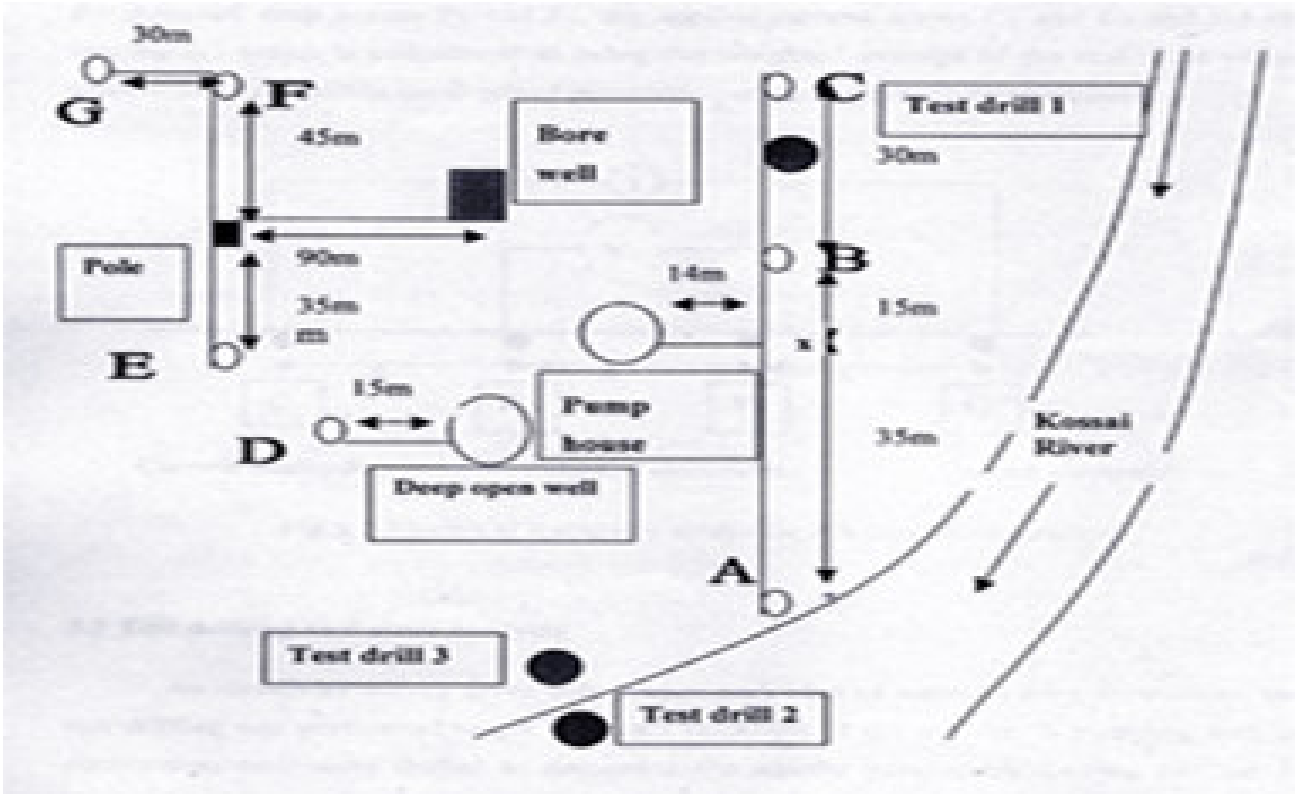
The pumping action creates a pressure head difference between the river bed and the aquifer, which induces the water from the river to flow down ward through the porous media into the pumping well.

The pump water is a mixture of both ground water originally present in the aquifer and infiltrated surface water from the river.

SCOPE OF ENGINEERING CONSULTANCY WORK-

A sponsored consultancy project was offered to IIT/ KHARAGPUR to study the feasibility of a Radial Collector well for the desired capacity of 5.0 MGD in the bed of Cosseye River.

Electrical resistively survey was conducted for getting preliminary idea regarding variation of thickness and extent of aquifer, accordingly site was chosen close to the river which was hydraulically connected to the aquifer. 7 (seven) locations were selected.



SITE PLAN FOR RESISTIVITY TEST & TEST BORE WELL

It was found from the resistively test that the thickness of aquifer to be more (10-15m) near the river and reduced gradually away from the river.

As the resistively survey gives only preliminary idea of water bearing formation test drilling was conducted to find the exact thickness of the aquifer, for which test drilling was conducted in 3 place as mentioned in above plan and sample were also collected from different depth of the well for sieve analysis to determine the physical properties of the aquifer. It is

observed that a continuous layer of medium coarse with some fine sand exist at 15.0m from the river bed. Effective size of aquifer materials was mostly 0.25mm. The value of uniformity co-efficient was found to range from 3.24 to 8.0 where radial collector is to be installed. Hence aquifer material is found to be well graded.\

Moreover to determine the aquifer parameter a pumping well and one observation well were drilled. Pumping test was conducted to determine the hydraulic properties of the aquifer. Time draw down data of pumping test was analyzed using the straight line method of Cooper and Jacob. The transmissivity of aquifer was found to range between 2592.06 to 2633.76 m^2 per day in rainy season and 2098.4 to 2115.2m^2 per day in summer season. The hydraulic conductivity was found to be 135m/day to 165m/day.

Further more MODFLOW model was used to simulate the flow path around the proposed collector well. By running modflow model the flow path was visualized.

QUALITY OF WATER-

The water collected at different depth such as 1.5m, 4.0m, 8.0m, 12.0m from the pumping well as well as from river also by means of water sampler. The major water quality parameter analyzed were **odour, PH, cations** and **anions**. The PH value of the water found to be 6.68-6.87 for both rainy and summer season, which is suitable for drinking purpose. The cations such Na^{+}, NH_4^{+}, K^{+}, Mg^{++}, Fe^{+++}, Ca^{++} and anions such as F^{-}, Cl^{-},NO_3^{-}, $SO_4^{--}$and PO_4^{---} of the well were within allowable limit as compared to river water. Therefore on the basis of water quality test it was seen that quality of river water was improved as it was trapped through river bank filtration process. On the basis of water quality, it was decided to place the laterals at a depth of 8.0m from the river bed and the location of the caisson should be as close to the river as possible.

The proposed collector well is to be very closed to water source there by the entrance velocity is assumed as 0.5cm/sec which is generally used. The diameter of the laterals is recommended as 300mm. Considering the open area of 20%, discharge will be 10750.33 GPD per

metre length of lateral. As the required capacity of the radial collector is to be 5.0MGD, the length of laterals is determined as 796.18m.

Since there will be over lapping between the joints of two lateral segments the length of laterals required will be 10% extra. Total no of laterals is to be 12nos in two layer to be placed in staggered and equal spaced at 30^0. Thus the length of each lateral was to be 34.0m with 4.0m blind pipe at tail end.

Laterals were determined by the following-

The diameter of the laterals is recommended as 300mm. Considering the open area of strainer pipe is 20%.

Total open area in the strainer for water flow (A) = π*L*D x % open area
(where L = lateral length, D =Dia of lateral)
A= π*1*0.3(dia of pipe)x20%x50%(due to future blockage) = 0.0942sqm. (Here L=1m)
Discharge (Q) in 1m. Length of strainer
= Available open area x Entrance velocity of water (0.5cm/sec.)
= 0.471litre/Sec = 40694.4 litre/day
= 314.0GPH

So for 5.0 MGD capacity with 20 Hrs pumping per day (5MGD/20=250000GPH),
Required length of strainer =250000/314 = 796.18m.
Including blind pipe in the well face of 4m.
Total length of lateral comes to 892m (796.18+24*4) (24nos laterals).

MS STRAINER PIPE(300mm) DIA

Scope of work with cost involvement-

As the scope and technical concept of the scheme has changed from "*Water Treatment Plant"* of 2.4MGD to "Radial Collector Well" of 5 MGD capacity, revised estimate was prepared with all new items of work at a cost of Rs.6.82 Crores over all.

Civil : 4.84 crore,
Electrical : 1.85 Crore
S & T : 0.13 Crore.

The tender of Engineering works has been accepted on 22/11/2005 by the Railway in favour of M/s ACME Engineers Co-operative Society.

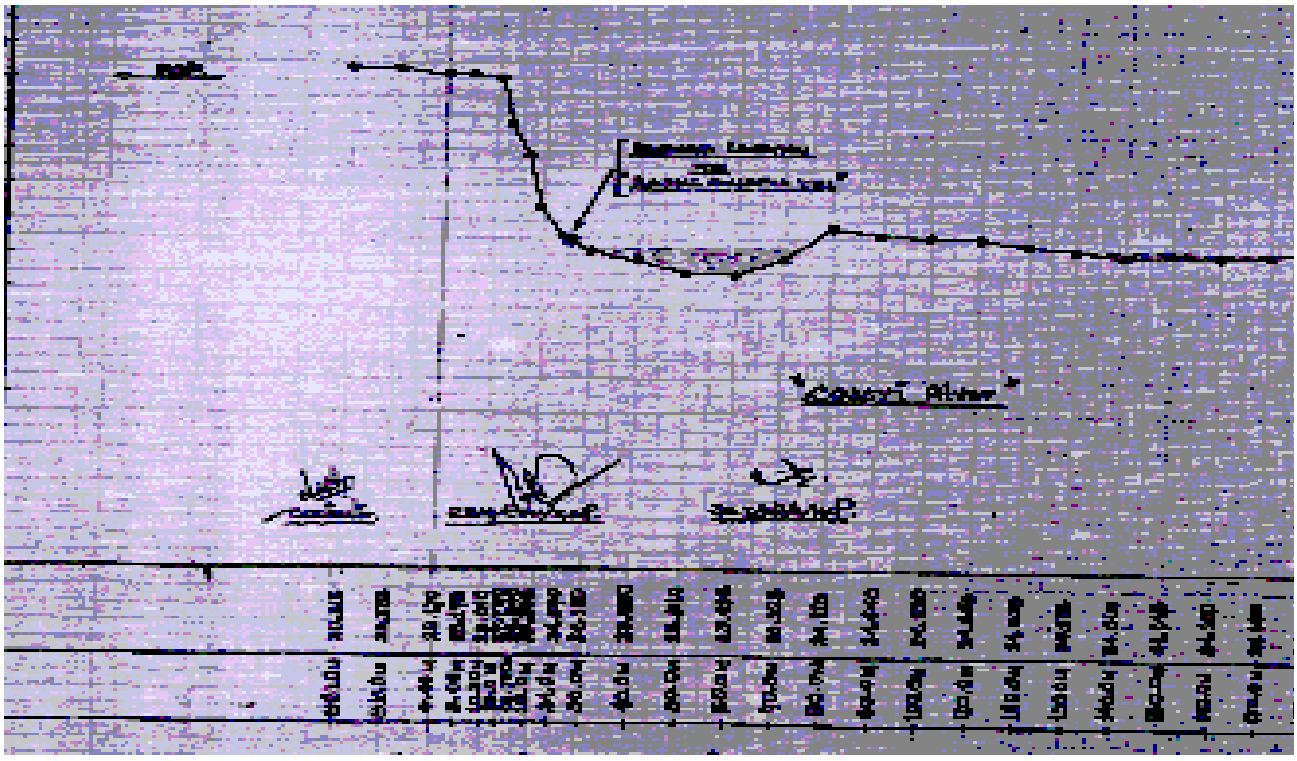
STRUCTURAL DESIGN CONSIDERATION-

Intake well along with a overhead pump house and approach bridge will all accessories is done under and eminent engineer Mr. K. Bishi, of M/s ACME Engineers,the Railway Contractor

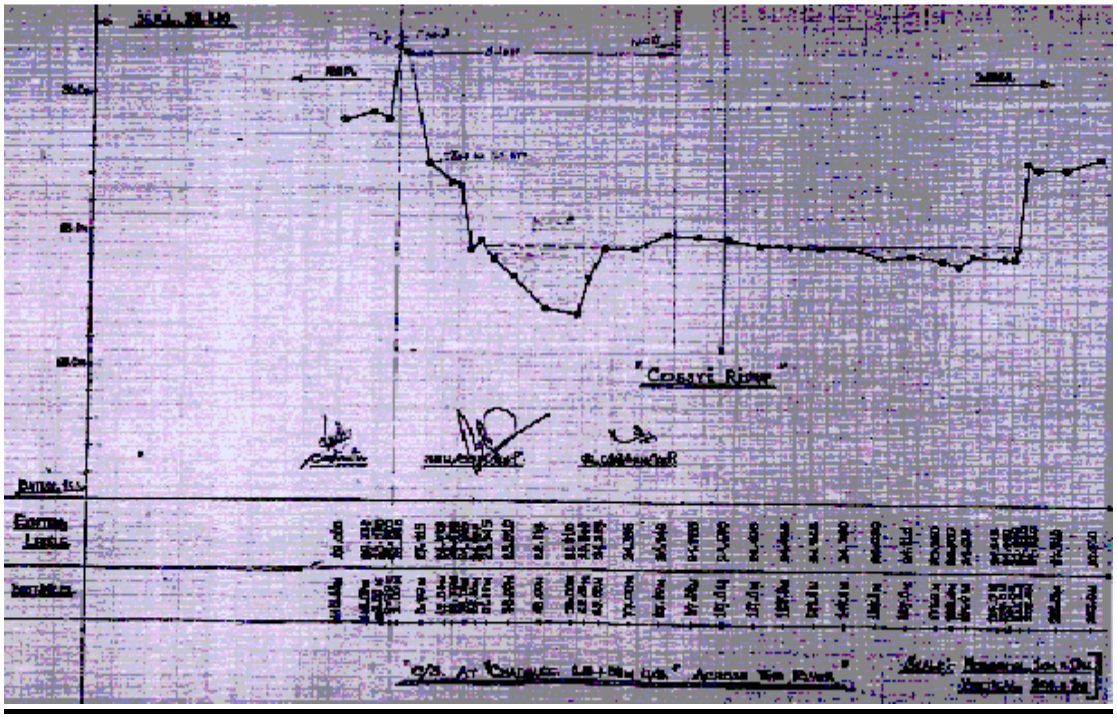
TO design the structural drawing of a RADIAL COLLECTOR WELL the following exercise was done in the proposed location(as decided)in the cosseye river

Sample of soil collected at different depth to determine bearing capacity of soil (penetration test, soil classification etc)

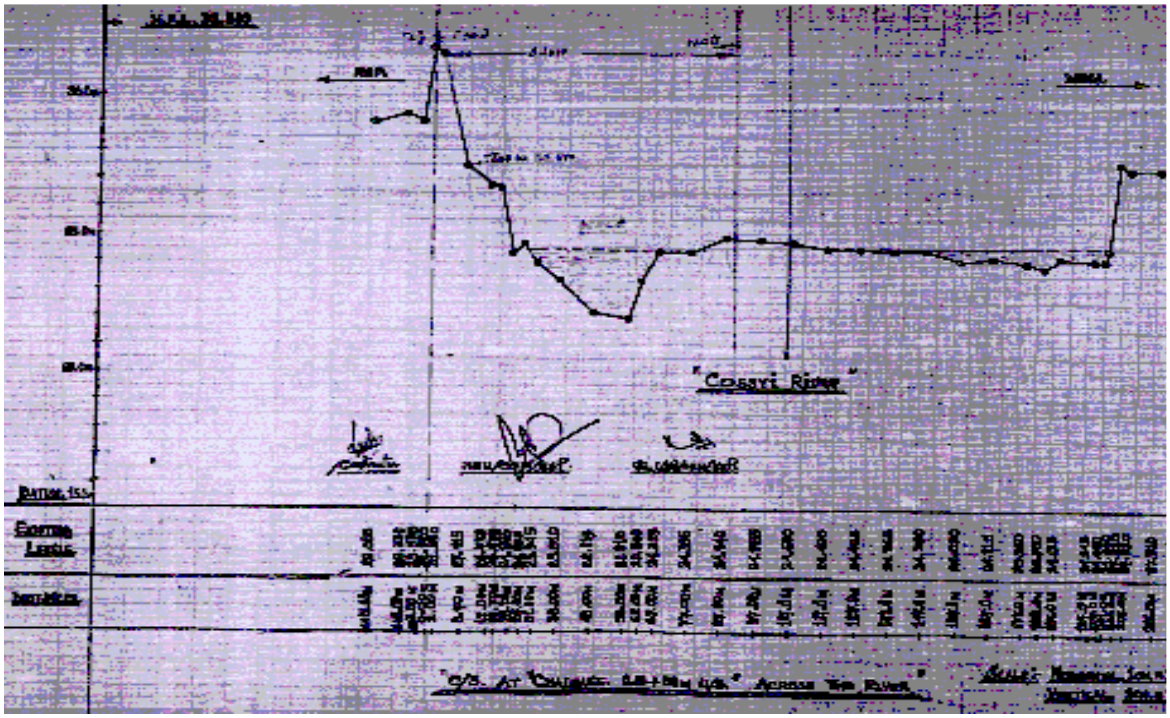
X-section of river covering the proposed location was taken for measuring of scouring depth , velocity of the river flow etc. as shown below-



X-section of River at centre line of well



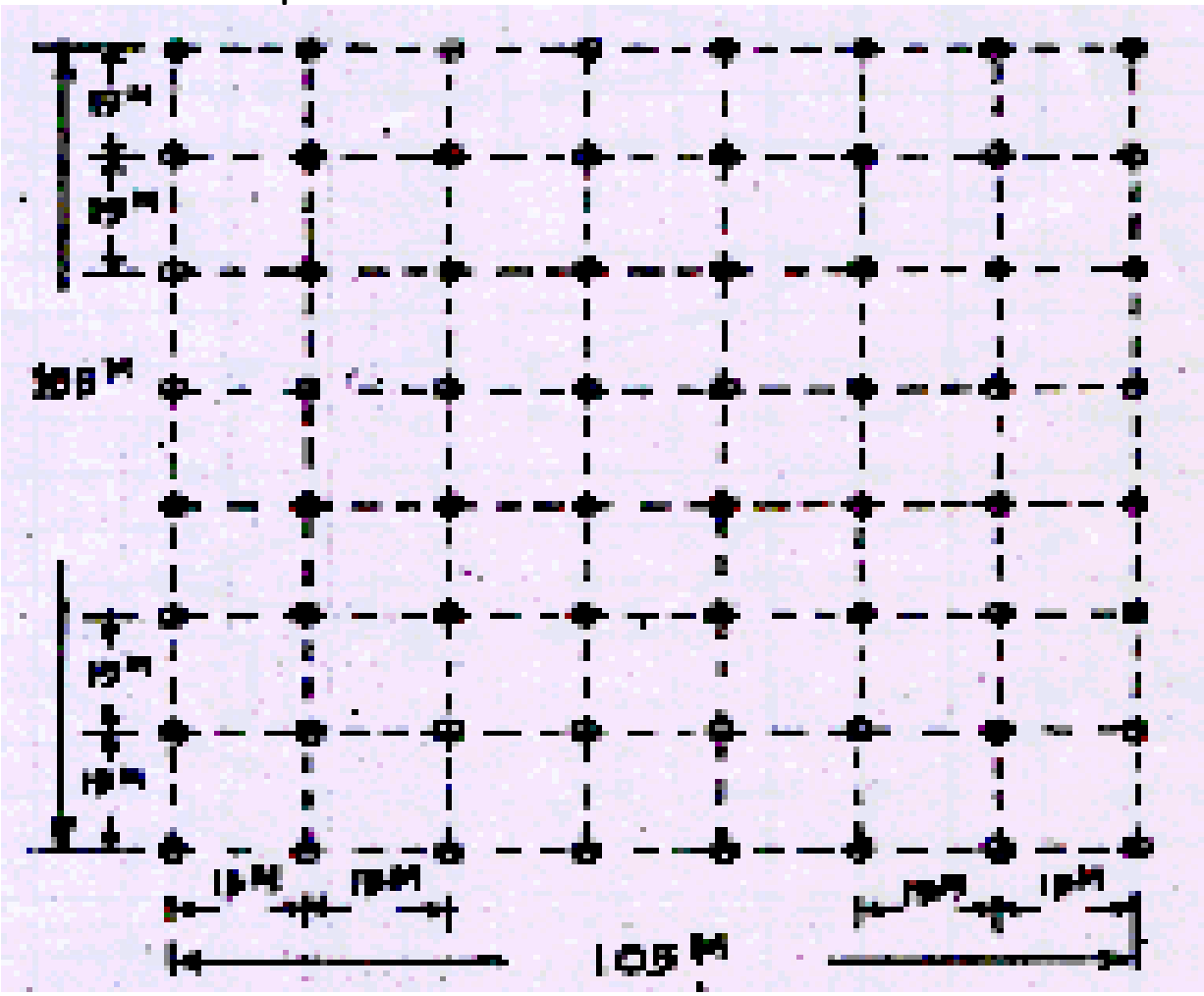
X-SECTION AT 50.0M D/S



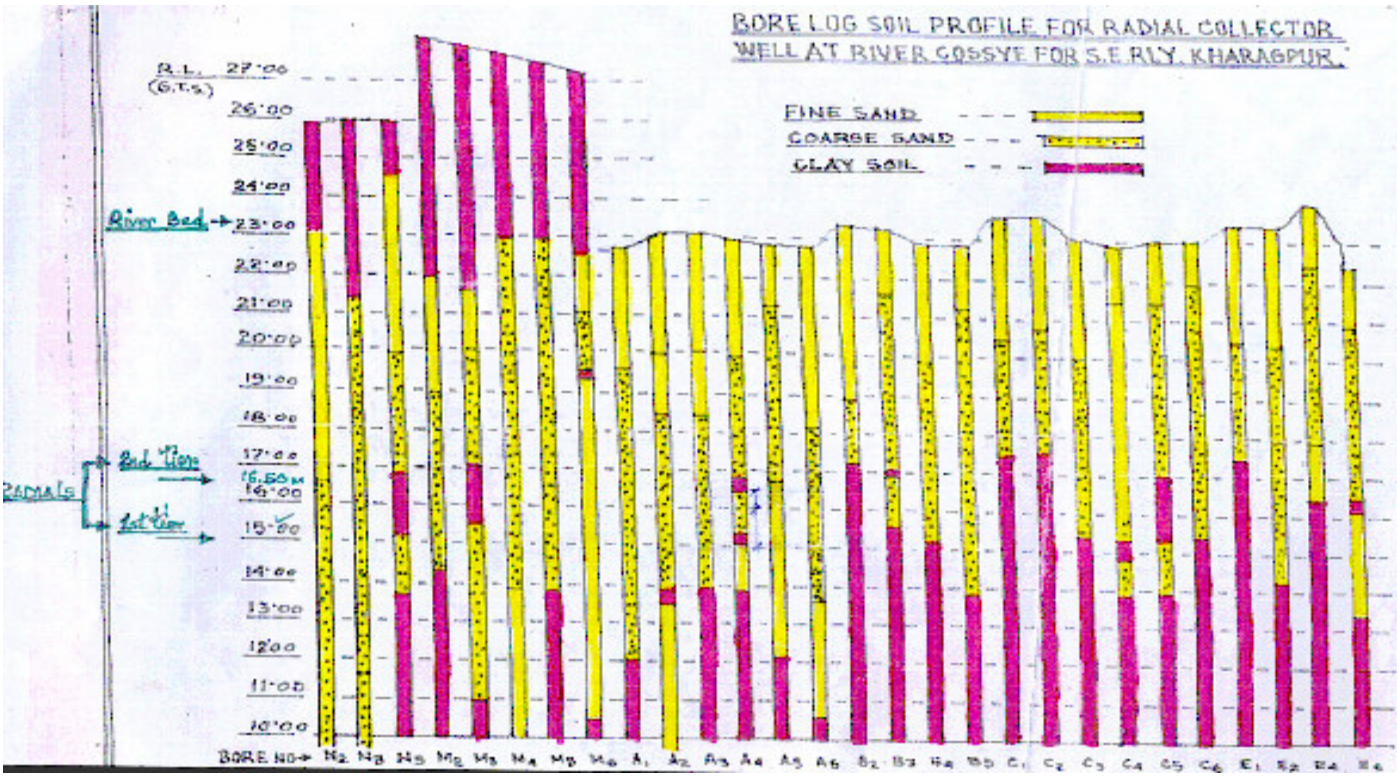
X-SECTION AT 50.0M U/S

A DRIVE TO FINDING AQUIFER-

For confirmation of continuous stretch of aquifer around the intake well about 54 bore holes in a stretch of 125m x 125m have been executed for examining the soil strata in a continuous stretch. This work was done for the availability of water table all around the well as advised by IIT/KGP and the expert consultancy of the Agency. This work helped for pushing of Radial Pipes all around.

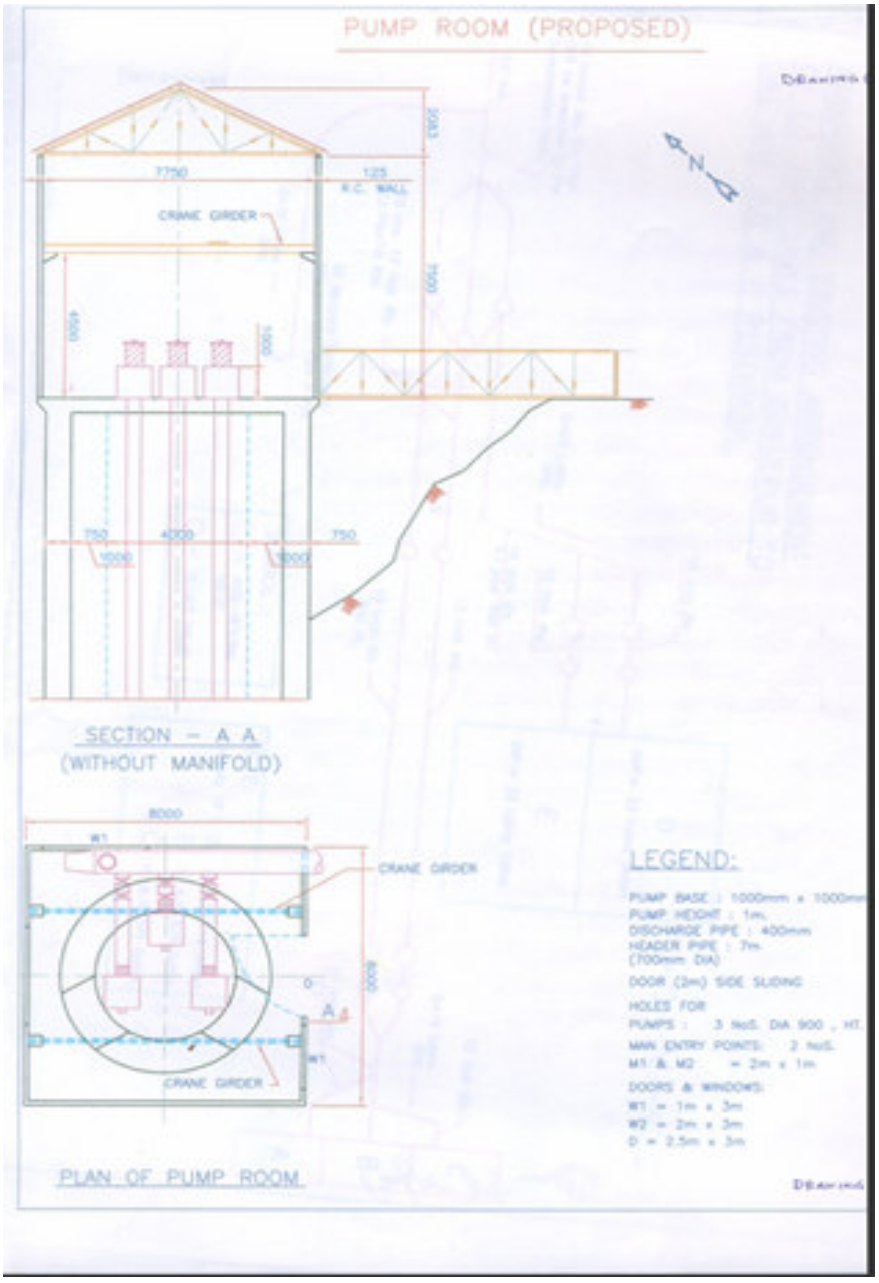


LAYOUT PLAN OF TEST BORE HOLE



BORE LOG SOIL PROFILE

DESIGN OF PUMPING MAIN- Pumping main along with the distribution of water supply from the well to the existing Reservoir at a distance of 12 Km. is sponsored through the consultancy project offered to Sri Dibyendu Roychowdhury, Retd. CEE/Kolkata Municipal Corporation. Two nos. of Turbine pump of 1.25MGD capacity per hour with 20 hrs. working is proposed for pumping of water. A spare pump of same capacity is proposed as stand by.



LAY OUT OF PUMP HOUSE

PROJECT CONSTRUCTION REPORT OF RADIAL COLLECTOR WELL -

MAKING OF ISLAND-

Making of steel cutting edge using steel plate of 500mm width, 12mm thick

Dressing leveling of site for Placed brick in order of width along the circumference of a circle of dia 8.15m. for well curb.,

PLACEING OF 'CUTTING EDGE-

It is placed on the brick top and welded the pieces (6 nos.) and made to a 'circular shape" of dia 8.15m.

Providing reinforcement for the well curb 28mm dia bars vertically placed(36Nos) equally spaced and fixed with the cutting edge by welding and bolting as specified and coffer dam all around was made.

Anchored bar of 28mm dia equally spaced welded in staggered to the vertical outer bar for inside reinforcement of staining wall and whole reinforced finally achieved for well curb.

Though the whole assembly is the structural part of the well curb is now ready for concreting and concreting work executed for the bottom of the well curb. Concreting was done as per the design mix of M-25 grade with water cement ratio of 0.43. Cube test was conducted for 7 days and 28 days and the strength obtained is18.60N/mm^2 and 32.60N/mm^2 which are satisfactory slump of the concrete kept as 25-35mm.design mix proportion as per lab test is 1:1.3:2.90 by weight.

After concreting of well curb further reinforcement was placed for the staining wall of 1000mm width from RL-10.40m to RL-20.00m and than the thickness of staining was reduced to 750mm from RL-20.00m to RL-24.80m.During casting of staining wall 500mm dia holes are kept at desired location(RL-15.00 & 16.50) around the well in staggered for placement of laterals by providing suitable means.

SINKING OF WELL-

Work of sinking of well is simultaneously progressed with the casting of staining wall) by mud pumping and compressors working with the help of sinkers and reached upto desired depth of 14.40m.

There after bottom plug of the well to be executed by trime pipe. After completion of bottom plugging and after lapse of adequate period dewatering the well and filled the well with dry sand upto the desired depth of the well. Than casting of bottom cap done.

Before executed further lift of staining wall ,the radial strainer pipes (laterals) are to be pushed on all 24nos of hole provided during execution of wall of well.

There are two independent rows of radials proposed one is at RL-15.00m & other is at 16.50m.which are at 6.32m&7.825m below the river bed of RL-22.825m the radials pipes of 300mm (inner dia) of 10mm thickness (m.s.) also brought to the site in a cutting length piece of 2.50m each .On each 2.50m length of pipes with slotted holes of 2400nos of size 75mmx2.5mm, is made in 20nos rows@120nos of holes on each row.

Before pushing of laterals a guide pipes (port holes) of 350mm diais to be provided in each block holes of 500mm dia . Properly grouted in concrete mortar.

A BULLET HEAD of cast steel 300mm dia is initially to be welded to a 2.50m length pipes on its one end and to be placed inside the port holes made earlier of size 350mm dia , properly fixed with rubber liner of 12mm thick.

Driving of radial pipes on horizontal push in jack pushing method by compressor running will

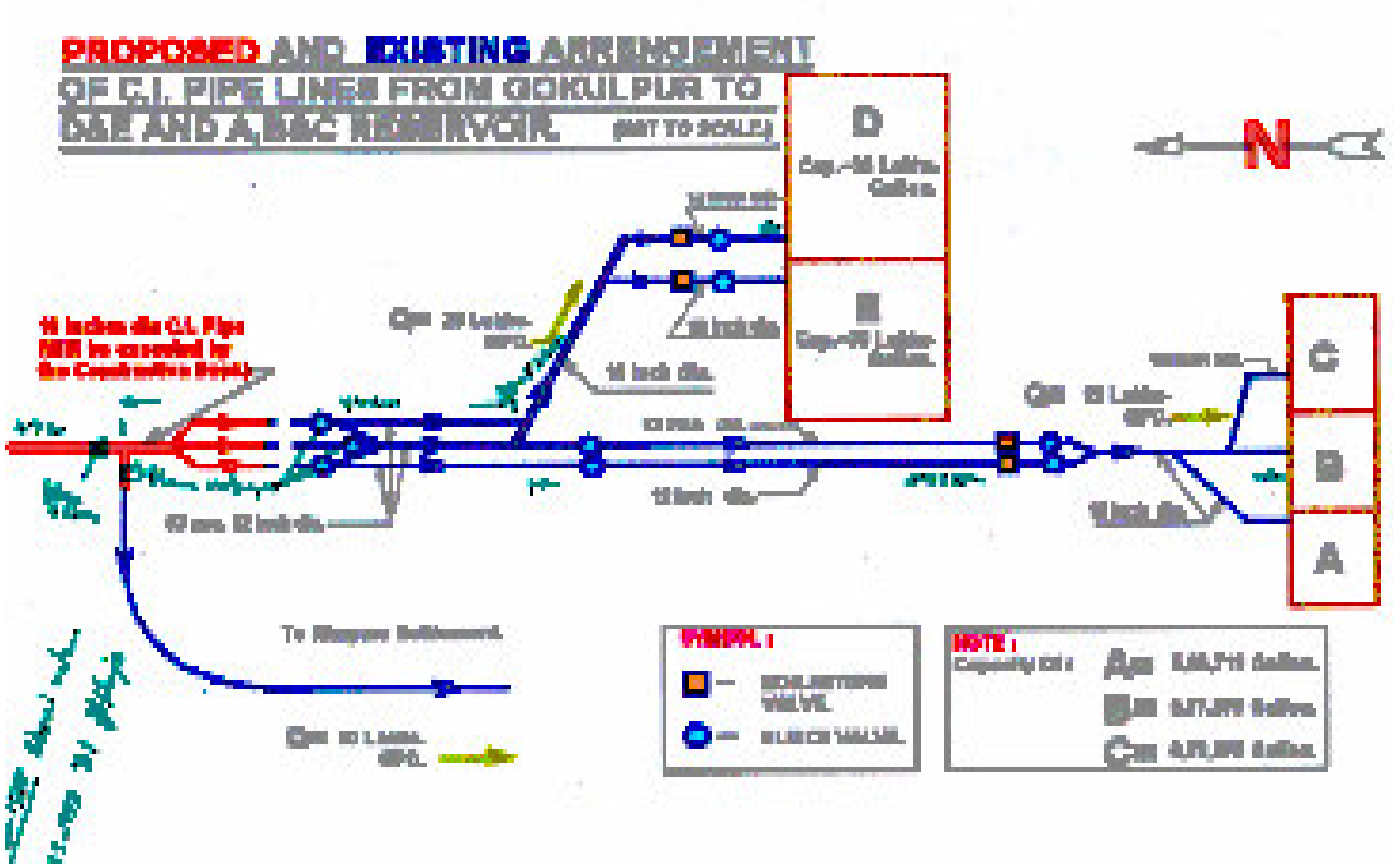
be under taken on entire pipe pushing operation to the surrounded sand strata of the well, till its obstructed ahead in the specified strata . The lateral of 2.5mlength will be added one after another by spot welding in specified way inside the well during pushing of pipes .thus each laterals of proposed length of 36.0m on top tier i,e 16.50m & 38.0m on bottom tier at 15.00m including 4.0m of blind pipe in 12nos on each tier will gradually be pushed , finally the recommended length of about 890.0m are to be provided. To facilitated jack pushing in side the well of dia 6.0m length in piece are considered as 2.5m.

On completion of each radials pushing up to required length, one butter fly valve will be provided inside the wall face of the pipes already pushed & should be kept close, to stop incoming flow of the water through radials . Thus one after one pushing of radials should be continue to the well. For dewatering of water enters through radials pipes pushing in progress are to be continue till the completion of fixing of radials

Out of total height of staining wall of the intake well of 23.60m over well curb, the overhead pump to be constructed as per drawing.

After completion of pump house foundation of 3nos turbine pump along with other arrangement to be executed along with path way connected from bank to the well to be done.

Then the delivery pipe line from pump to the existing delivery pipe line to be connected as per the drawing.



COCLUSION-

The life is assumed as 100 years as predicted by IIT/KGP where as the existing well and deep tube well at about 12-15 years as experienced.

Initial cost of conventional intake well or deep tube well are much lesser than this system which is due to provision of horizontal lateral strainers.

Maintenance cost of this system is negligible.

No further storage arrangement required as it can be directly supplied to distribution system as the water collected from this system are filtered through river bed filtration. Only chlorination of water is required for time to time to prevent contamination during transportation through pipe line and if required booster chlorination to be done.

THANK YOU