Ground Water Hydrology

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Module No # 04
Lecture No # 17
Well Protection/Rehabilitation/Testing for yield (Contd.); Artificial Ground Recharge: Concept and Methods

Welcome to this lecture number 18 in fact this is at start with spillover of lecture number 17 in which few topics could not be completed and so that is they are well protection well rehabilitation and well testing for heal and after dealing with this topics.

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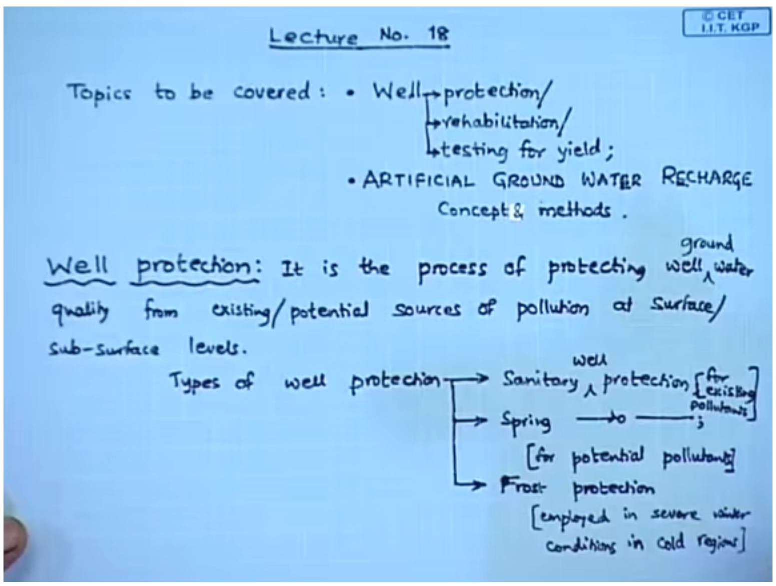

So this lecture will move on to the new module that is one artificial ground water recharge and so specifically in this lecture it starts with the concept and methods. And so now let us start with the well the topic on well protection and here so the protection so essentially so it is a process or mechanism wherein we protect the well water quality.

So basically well here we can more precisely we may also write well ground water quality because after all the wells they do yield ground water only and so this from either existing sources of pollution or potential source of pollution. So which may exist either at or above the ground level or below the ground level so that mean which may exist either both the ground or below the ground.

So basically so this well protection is preventive as well as curative process curative phenomena and for existing pollutant pollution sources it is a preventive it is a curative phenomena and for potential pollutant pollution sources it is a preventive phenomena and there are different types of well protection. So depending upon the purpose as well as the type of well for which it is as well for which it is as type of season also.

So here we can classify so this protection into three major categories the first one is the what is known as sanitary well protection as a name itself says so there is always say the in the water supply schemes. So there is they are always in even though it is unavoidable so the undesirable by product of waste water as well as waste water system. So they will be in around and vicinity of this the water supply system so therefore especially near the wells.

So there is need for protecting the wells from existing pollutants which will be generally found in the waste water system which may be say severe or which may be any man hole or which may be any other facility or carrying a waste water that may be a domestic water or industry water or a combination of both so this so there is a need to protect well from the protect the well water quality that is the ground water quality and that is precisely known as sanitary well protection.

And then coming on to the next is one so here this is the spring well protection and this is basically a preventive phenomena wherein a spring which generally releases say possibly the best quality of ground water and so it needs to be protected from potential sources of pollutant pollution. So and here so basically it is prevent it is a preventive process of preventive mechanism and thirdly there is also what is known as frost protection.

So this frost protection is employed in severe winter conditions in cold regions. So here what happens is in case of winter especially around the December January. So they most of the northern hemisphere as well as that June and July in significant part of the southern hemisphere. So they are subjected to severe cold and this problem is getting aggravated because of the impact of the climate change.

And so here what happens is so this many wells they do get affected by this frost so basically the values may fully the groundwater which is stored in the wells it may pull in freeze and so it may be difficult to harness or the extract this ground water through this pipeline system which is which starts from the ground water is well so therefore there is a need for protecting the wells from getting affected by frost which may stop or which may break the continuity of water supply scheme in a cold region especially during winter seasons.

So now coming to this sanitary well protections so let me discuss here the one typical schematic diagram of a sanitary well protection where in a well is in protected from an existing source of pollutant.

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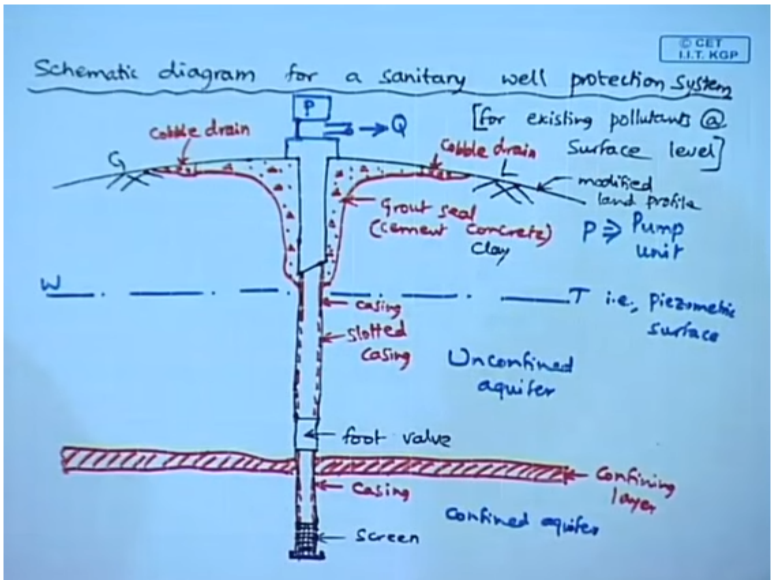

And here so this one so schematic diagram for a sanitary well protection system and here say the so in this case systems a safe or a existing pollutants at surface level of course this is reasonable simpler but if the pollutants are existing at the subsurface level then it makes it much more complicated. So in this case so here let us so this is the ground level of course here it is generally wells they may not have this kind of poor mount.

May be for protection so it may be so this is the ground level and here this is the piezometric surface or the water table WT so that is piezometric surface. And here so next we will in this case so there is the bell which may have say a kind of a casing and then so there may be so this is a so this casing will extend even below this may also and so here we may have a foot wall and so this is a further and have a so this is a lowermost position is the screen.

And then so this is the screen cap just at the bottom of this one and so this is a so this is the foot wall so this is screen and so here so again. So let me show this with a casing is a let me show this casing with the of course may be may be and they so let us say this well is drawing its water from unconfined aquifer as well as confined aquifer.

And here in this case say this is the confining layer which is the bottom confining layer for the unconfined aquifer and the top confining layer for the confined aquifer and so this is a and here this is the unconfined aquifer so this is the so here you can say this is slotted casing and here so this continues we can say this is a casing regular casing and then so this is the foot wall screen and then so here there is a so now so this is there is what is called as grout seal.

So this is a cobble drain so here this is also Kabul drain and then this is the grout seal with a cement concrete grouting and followed by and so here let us say this is the here let us say so this is the outlet. So this is the outlet and above this so there is a pumping unit so this is P so this B represents pump unit and this case to this is the grout seal. And so this is the dimension of the grout may typically vary say and here it could be so the formation could be clay and so this is and here this is a confined aquifer.

So like this here so here what is he grout seal which almost extends up to the normal water table level as well as the cobble drain which is in and around this one the grout seal. So this is which is a cement concrete grout seal so this is a so this will prevent as a well as they modification of ground slope so that the water the polluted water does not seep or infiltrated into the well and then thereby that it causing the deterioration of the where ground water quality.

So here so this is a so here let me also write this is the modified and profile or say grout profile as well as cobble drain. So this is silly they will eventually succeed in preventing the water from this now let us go to the second schematic diagram for spring well protection.

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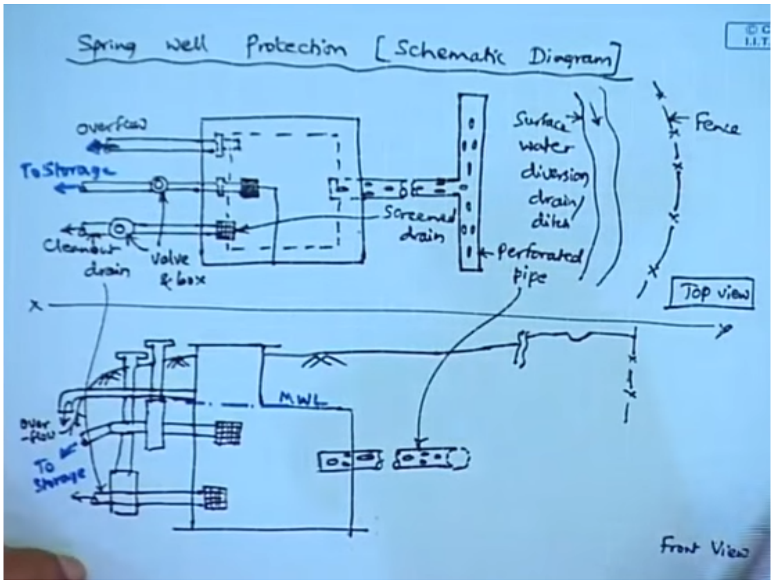

In this case it is let us say schematic diagram so in this case so let me so draw this is the top view and then so here let me draw from view. So in the top view so essentially we have so there is a and overflow pipe so this is overflow so you may want to denote this one. Next there is storage so there is also another pipe which takes to storage so this is to storage.

So there is a third pipe which will take the water which is basically clean out drain so this is a and in the front view so obviously the clean out drain as to be at the bottom the storage has to be in the middle and the storage has to be at the top. So this is obviously the common sense and so here in the top view and in this case another thing that is screened drain and then this case there is a so here this is the screened drain.

And so these are value and box and next is so here there is a pipe which runs a perforated casing pipe. So essentially this is a perforated pipe and then there is also a surface water diversion ditch so this is the surface water diversion or say ditch and then so here there is barbed wire fencing or any other suitable fencing so this is the fence. So this is in the top view and now let me show the same thing in the front view.

So here so that is the so here we have the MWL maximum water level and so this is a so here there is a screen drain and this one. So there is a so this Volvo box so this is a clean out so this is a clean out drain here which is in the 80 this one and the top and this is in the front room and this clean out drain. So this will take you and here we have that screened so this is the clean out drain and then followed by the storage so for the storage.

So there will be a pipe so this is a to storage so here this is the valve and of course here also there is a another screen drain is required and then so there is just above the maximum water level so there is a this overflow wall workflow pipe. So this is overflow just above the maximum water level and here in this case that perforate pipe so it runs like this and then so this is the perforated pipe and in the elevation so this will be so this s the perforated pipe in the front view and here we have.

So this is the drain so this is the ground level so in this case let us say this is our ground level so this is the valve to be operated. Obviously both the walls have to be above the ground and here so in this is the so it goes like this and so there is a break like and in this case so this is a surface ditch or drain.

And then followed by a fence here so this is a typical spring well protection system so here in this so any potential this one so the pollutants are removed to the surface water drain and then so this through the perforated pipe. So only clean water is allowed to enter the spring and then so let us say okay. So this is a front view of a typical schematic diagram for spring well protection.

So next this frost that is a frost drainage I am sorry fast well protection so this is a very common especially in the winter season in cold areas. And so here obviously so there will be a mechanism to ensure that the water table temperature does not fall below the freezing point and there by the water supply is ensure even the coldest the winter day and of course whatever your precautions we take so that's nature always show that it is the real boss many times and then so the cold winter storm so you know how difficult it is especially in cold regions.

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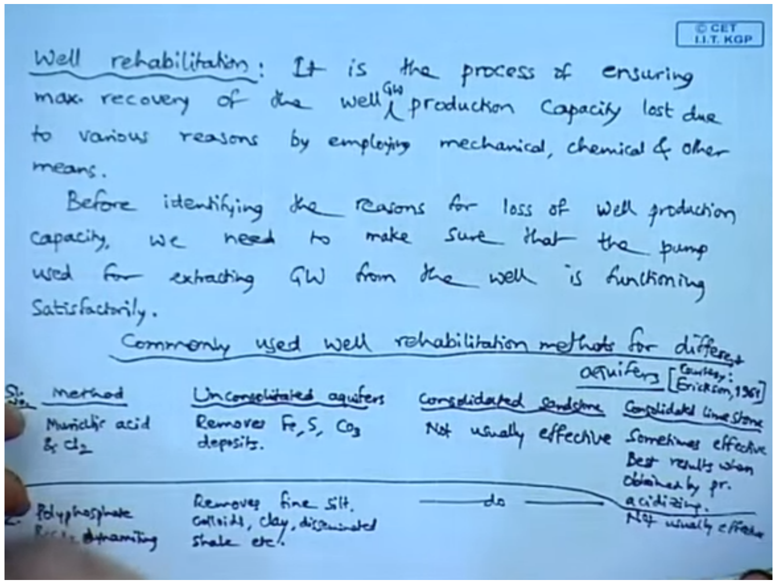

So that is so this completed the well protection and now we will go to this well rehabilitation and so in this so this well rehabilitation basically it is it is the process of ensuring maximum recovery of the well ground water production capacity loss due to various reasons by employing mechanical, chemical and other means. Basically what happens is in well rehabilitation so with time generally there is a very significant there is a strong possibility that the well production capacity well yield or specific capacity.

So it goes on decreases so in this well rehabilitation what is done is appropriate mechanical procedures or appropriate chemicals or even other means are used so that the loss most commonly used law in the well production well ground water production capacity is a minimized so thereby so most of the well the lost production ground water production capacity of the well is restored.

So that is well rehabilitation and of course many times so this is even before we ensure that the production capacity of well is restored we need to ensure that the pump which is extraction the water from the well is a properly function. So before identifying the reasons for a loss of well production capacity we need to make sure that the pump used for extracting ground water from the well is functioning satisfactory.

So this is the very important point so once we ensure that the pump is function properly so only then we can attribute any loss in the well capacity to various that is subsurface phenomena which might taking place below the ground level which as a result of which the well the ground water production capacity of the valley has a received a significant beating. So this is a well rehabilitation and so here say some of the most commonly that is the commonly used well rehabilitation methods for different aquifers.

And here will say this is method so let us briefly so this is so this is by so this is courtesy ERICSON and so this is a it was proposed by ERICSON in nineteen sixty one. So here this is a first column represents method and then say this is a unconsolidated aquifers. Then consolidated sand stone and then lastly consolidated lime stone so these are the three different formations and for each of them so how the method so in the first method is that the here you can also say this is serial number the first is it is known as muriatic acid and this and chlorine CL2.

So this incase of unconsolidated aquifer it removes a F, E, S then CO3 deposits that is carbonate deposits and whereas same muriatic acids followed by chlorine so this is for a consolidated and soon not usually effective. And similarly for a consolidated lime stone so this is a sometimes effective best results when obtained by that is a pressure acidizing so this is one this one and followed by the second method is a poly phosphate followed by chlorine dynamitic.

And this one in case of unconsolidated aquifer it removes fine silt, clay or say colloids clay and this one that is the disseminated shell etc. Whereas same thing again here in case of consolidated sandstone so this poly phosphate as well as chlorine dynamiting that is also not usually effective and here also this is in this case also this is a not usually effective. So like that there are the other this one that is methods are also there that is other four more methods are there.

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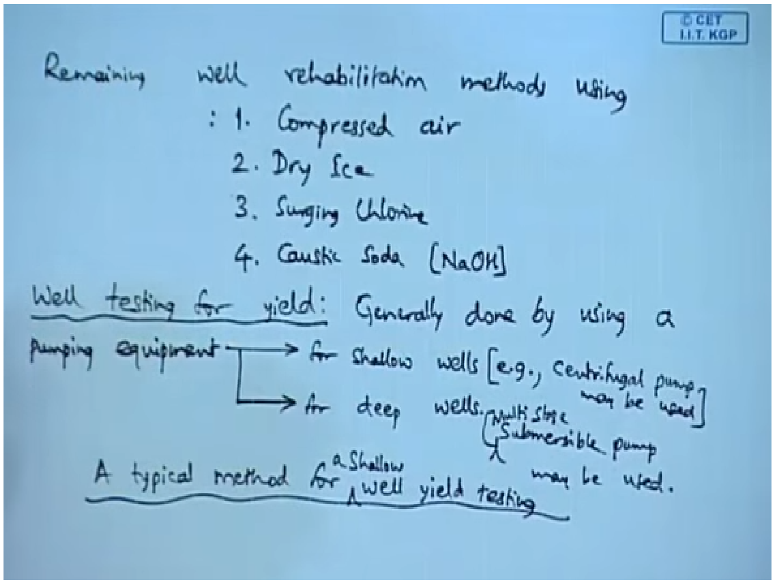

So the remaining well rehabilitation methods using it is one compressed air two that is dry ice that is obviously solidified carbon oxide and then third is a surging chlorine and followed by lastly caustic soda that is a NAOH. So these are also used this one so the so this will complete this rehabilitation and of course for want of time are not able to give much this one and next we will go to that is the well testing for yield.

So in this case so this is a very important aspect of well in and here so what is done is the yield tested by appropriate by using appropriate methodology using the appropriate that is materials and okay. And so therefore here so this this pumping generally done by using a a pumping equipment and in this case so it typical so this pumping equipment so which may be say for shallow wells and say for deep wells. For shallow wells the pumping equipment will be different so it may use as a centrifugal pump.

Whereas for a deep well we have to use some submersible I am excuse me submersible pump that too multi-stage submersible pump say for example here that is a centrifugal may be used in this case it is a multistage may be used and so here let me show a typical that is method for a well yield testing for a shallow well. So here what is done is say suppose this is the start new this one.

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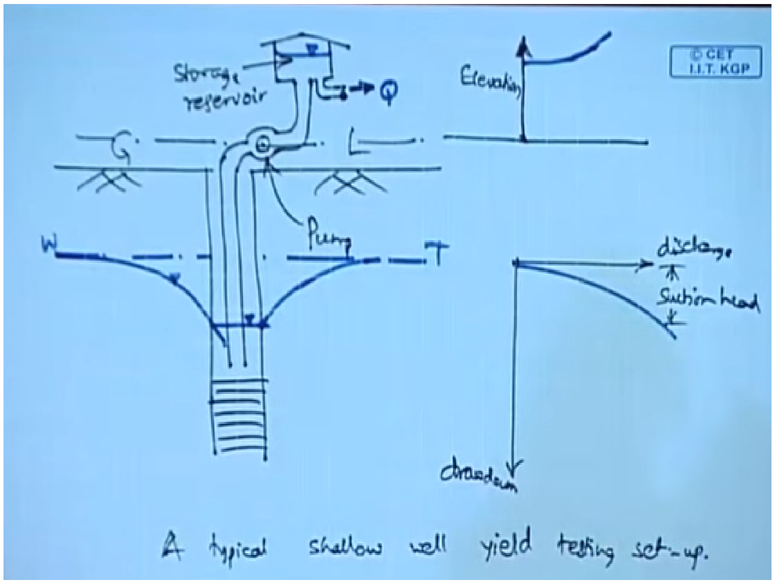

In this case it typical so this is the ground level and here we have the well and here we have the pipe so through which so this is a storage reservoir. So this is a here you can say this is the water supply this one so this is a storage reservoir and then this is the pump and then this is a ground surface and then the static water table. So here this is the water table and after this pumping so the so there will be a formation of cone of depression and this is this one.

And below this so there is a screen and here so the typically so this is the pump axis and from the pump axis so this is the storage water level. And here let me indicate the water level in the this and here what happens is this is a like this so this is the elevation so this in this graph so this vertical axis represent elevation then so this is the frictional loss and here so in this one the if you plot the so of course here so this is the discharge and then this is the drawdown.

And in this case this discharge versus drawdown so this curve will be having a something like so this kind of a plot and this one is the static or section head so we take this one so this is the of course so this is a typical shallow well yield testing setup and so obviously so this is the so this completes and obviously we go for a deeper tube wells so then we have to go for submersible pumps could be multistage submersible pumps and so on.

So therefore it complicates things this one and whereas so avoid this complication so a simple a this is typical shallow well yield testing equipment is shown in the schematic diagram. So this will complete the chapter on that is the well hydraulics and I am sorry the module the third module on well hydraulics.

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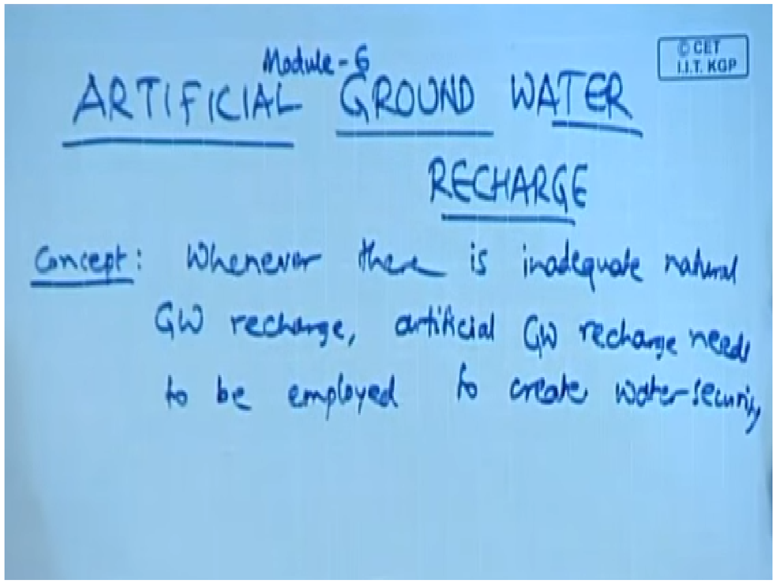

And so I also take this opportunity to start this the new module that is the artificial ground water recharge which is a so this is a module six and the advance well hydraulics is the third module which we discussed till now so the modules four, five as well as the seven and eight will be dealt by my colleague professor ANIRBAN DHAR and I will be in this lecture as well as in the subsequent two lectures I will be discussing briefly this artificial ground water recharge.

And here let us come to this concept whenever there is inadequate natural ground water recharge artificial ground water recharge needs to be employed to create water security and here so coming to this so this basically the concept and coming to the other this one and will in the next class we will discuss with the methods of this one there are various like in the surface level spreading and other methods are there and creating this artificial mounds recharge mounds or induced recharge.

And various things are there so which will be discussing in the in a next lecture so I thank you and so we will meet for the next lecture thank you.