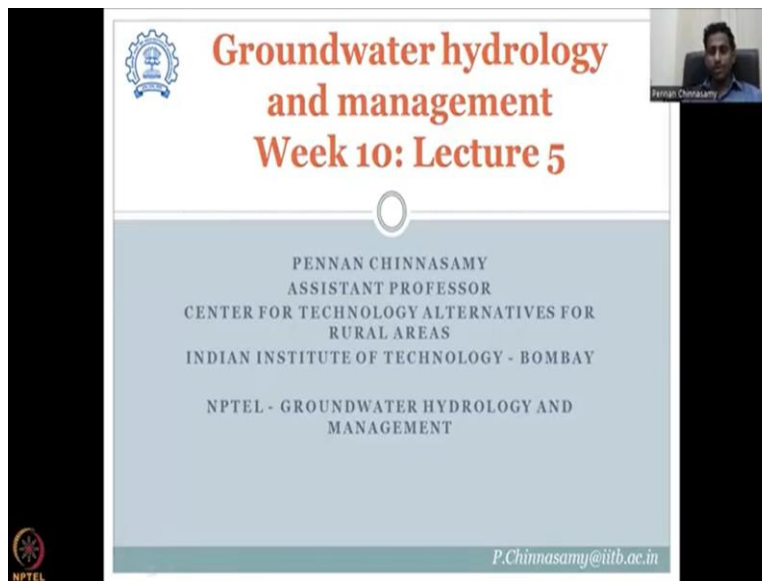


Ground Water Hydrology and Management
Professor Pennan Chinnasamy
Centre for technology Alternative for Rural Areas
Indian Institute of Technology, Bombay
Week 10
Lecture 5
Groundwater data – Map and grid

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Hello everyone, welcome to NPTEL course on Groundwater Hydrology and Management. This is week 10 lecture 5. In this week, we have started to look at the groundwater resources data, so that we can tie all the information that we collected in class in the some product. It is good to understand the theory, but also we need to understand by data what is available. So that we can make good estimations, recommendation plans and preserve groundwater which is very important. In the last lectures we have looked at the aquifer type, the materials, the acreage, how much area it is spread, the key dominant materials, the types the layering all these things we have seen. Then we looked at groundwater table fluctuations to understand how much storage is there.

In the last class, we looked at the groundwater resources. Basically, how much groundwater is available the annual draft and how much is taken out of this groundwater availability, the net availability, the draft is how much you take out from the net availability the pumping data is used. So, the last lecture we saw, we looked at groundwater level data. So, the level data is used to estimate how much groundwater draft is taken. And out of the groundwater draft bifurcations are done to see how much is given for agriculture, domestic use, industry news etcetera. All

these are well captured in this data set. And all we have to do is carefully take the area that we are interested in at India scale the whole district, the block any scale that we want, we have to take it carefully out and then look at it for in detail.

So, this is very important to understand how much groundwater we have, and how much draft is taking place. So, that is what we covered in the last class.

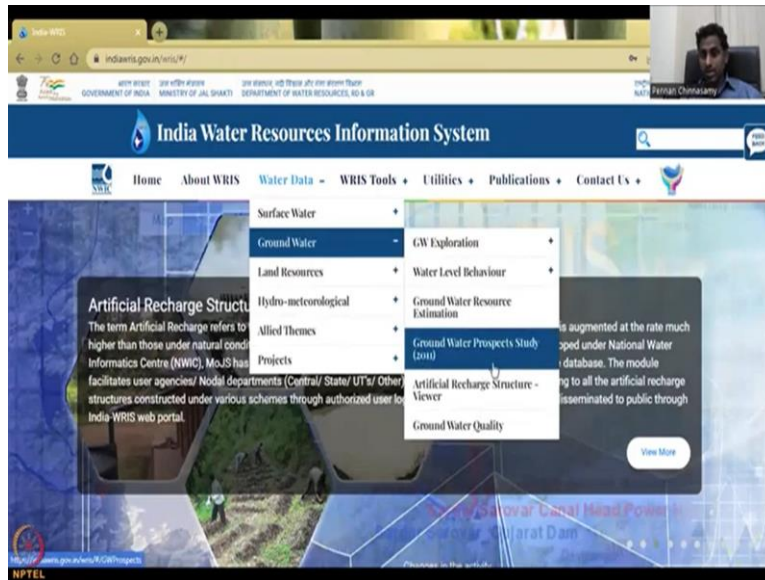
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The slide is titled "WRIS - GW Prospects". It includes a "Steps" section with a red bullet point. The main content is a map of India with a red area indicating groundwater prospects, accompanied by a legend and a data table. Below this is a smaller map showing a detailed view of a region. The NPTEL logo is in the bottom left corner, and the source "WRIS" is in the bottom right corner. A small video inset in the top right corner shows a man speaking.

It is also necessary to understand where the future groundwater is and how to extract that information. So that is what we will be doing in today's lecture of the WRIS data portal. We will be looking at groundwater prospects basically, where water can be taken and how much water can be taken. How is this estimated, this is estimated using the previous data that we discussed in the same lecture series. Basically your aquifer type the depth of aquifer the thickness of the aquifer rainfall I have not looked at the rainfall data with you but there is also the same website. And also the storage how much specific yield storage thickness all these parameters are taken into account.

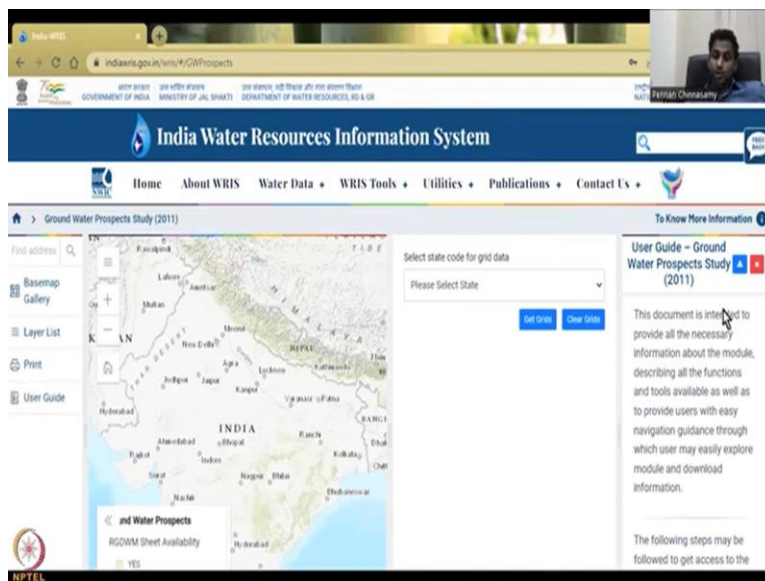
The steps are carefully given in the website. So, let us go through the website with you join me in clicking slowly through the website and we will see how we could estimate these values.

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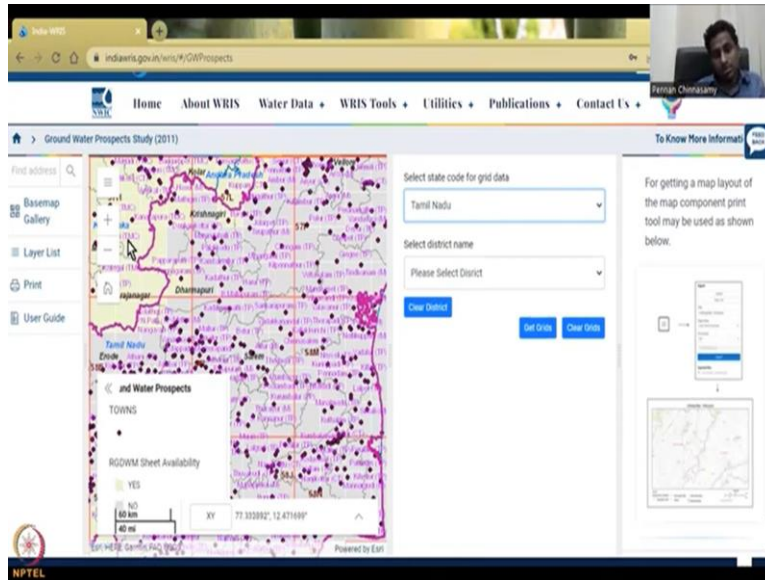


Let me share the screen, so we are at the WIRS website. Again we go to WIRS data, we go to groundwater, we are finished exploration, we are finished water level behavior and groundwater resource estimation. Now we will look at groundwater prospects study it is a study taken from 2011. The remaining two we will discuss in the next week lecture series which is artificial recharge structures and run water quality.

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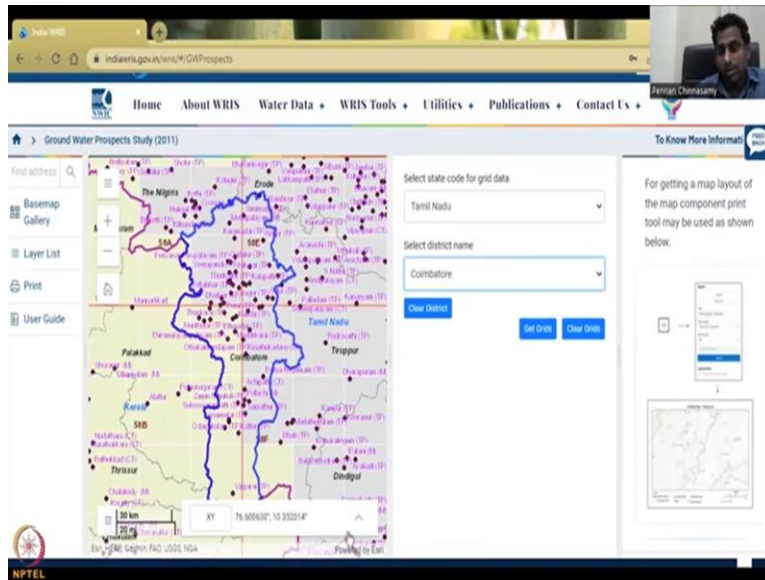
So the webpage has come up and as I said on your left always you have your Base Map Layer list print etcetera. On your right you have the menu or step by step how you should do even



So let us take a state as usual let us take Maharashtra it is not sometimes arranged in a particular order. So sometimes you will see not in alphabetical order, but let us see they have Maharashtra they do not so let us do Tamil Nadu just wait for it will populate. So, now you have a grid you see the entire state is being cut in a big grid.

So grid is something like your graph sheet you have a grid and within the grid there are smaller boxes. So each box is a tile and you can actually take the data out. So if you see when I zoom in there are towns that dot means towns where the towns are and is there the data available RGDM sheet which is a groundwater resource development data is there is it there if it is yes it is in a particular light pink color if it is not is a dark pink color. So there is some data here there is no data there etcetera.

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So let us select a district, let us say Chennai and acquire Coimbatore because it is on the dry belt. So you see you have some areas where you have groundwater the resource and then you can say get grids. So now it will populate where the grids are available with the groundwater data. For example, these other grid names, each grid has its own name right now, you cannot see what is the grid name, you can only see the major grid which is 58E, so 58E is this grid, and then 58 A is this grid within the grid, you have B15 etcetera. So let us select in this region what we have. So this is the major grid, the green one, and then you have the sub grids and as I said, it tells you if the data is available or not.

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The top screenshot displays the India-GRIS web application interface. The main map shows the Coimbatore district in green. A dropdown menu labeled 'Select district name' is set to 'Coimbatore'. Below it, a table lists 5SK Grids with columns for 'S. No.', 'Grid ID', and 'Download'. The table contains the following data:

S. No.	Grid ID	Download
5	5SB15	Download
6	5SB14	Download
7	5SP03	Download
8	5SP04	Download

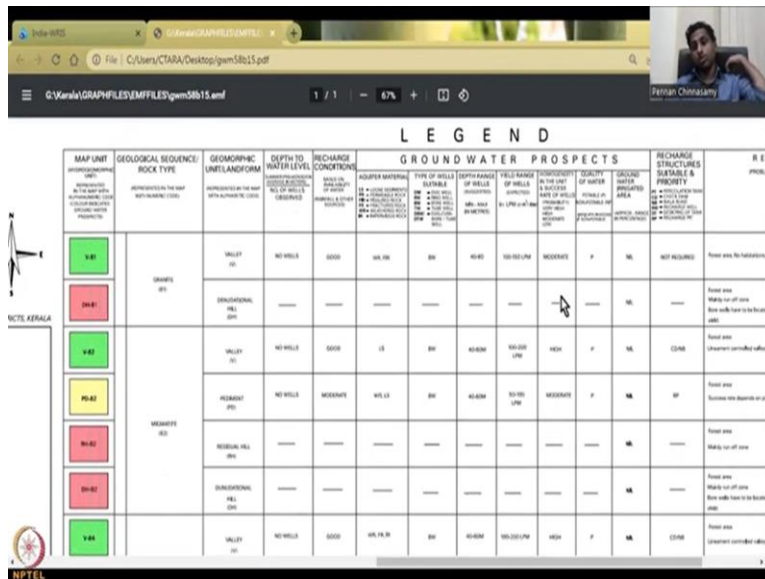
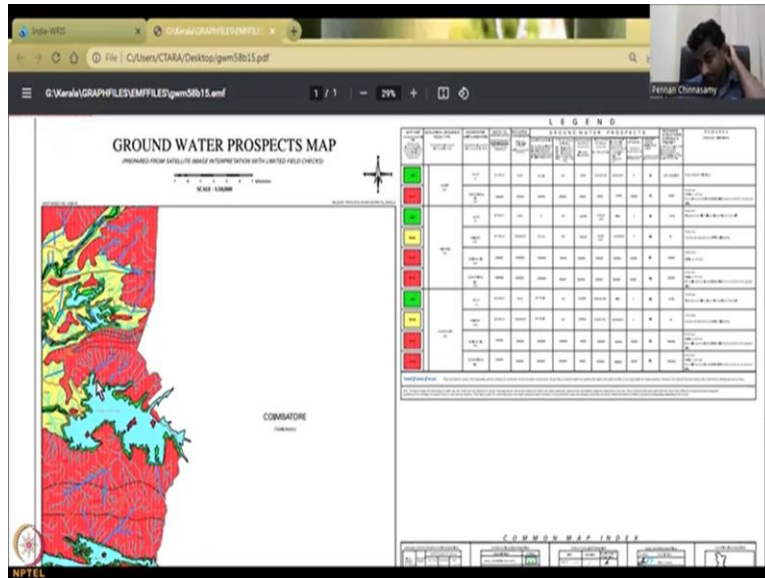
The bottom screenshot shows a modal dialog box titled 'Kindly state your purpose of downloading this data.' with a 'Submit' button. The dialog contains the following form elements:

- Purpose:** Radio button options for 'Government official', 'Professional', 'Student', 'Academician', 'NGO', and 'Other'. 'Academician' is selected.
- Information:** Input fields for 'Enter Name' and 'Enter Email Address'.

So I am going to click first one just to see if there is a data and it goes zooms in that is Coimbatore one part Valparai and you have towns is it unnamed some legend is unnamed. Do you have the data I think is yes, green, no is not green. So let us I think it has data so you can download the data. So when you go in and download, you will find more of what that data has as a map let me show you download as PDF. And then again, I get academics give my name it will download as a PDF like a report. And in that report, you will be able to find out how this groundwater is stored. I am going to put it on my desktop and then take it out I have clicked it will just open in a minute. So take some time so do not worry about that. So I am just walking

through with you on doing this data set. It is a bit fun, so sometimes do not just download everything. Just see how it is.

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So here it is that district what we saw and each color is given, so they are given different colors to show you like a map what it is. And because you are in PDF you are able to zoom in it is a very detailed map on groundwater prospects prepared from satellite image interpretation with limited field checks. So they are very particular do not claim that none of this is the best map they say that yes, we have done it, but with limited field checks. So, what does it tell you the map units are green, red, green, and inside the green if you see it is either line going like this or a

straight line. So, all these different aspects are given for you to understand that the each coloring is different instead of using 10 to 15 colors, they will use straight lines or dashed lines or dots like that.

Then you have the geology sequence what is the geology in that particular area it is granite. So, in the previous one, we saw this aquifer material or aquifer type, so, that is given here what type of land formation it is it is a valley of valleys like this. So, as I said the western part is on the camera side, and then you come down to Coimbatore some part of Coimbatore on the hillside but most part is still not there. So, that is the valley this is called the Valley U shaped places called the Valley and in the depth to water levels, it says no wells are there data has not entered recharge conditions is it good moderate based on their metrics.

Aquifer material is what type of material is it WR which is weather drop, weather drop will have more water or is it loose material. And then you have the type of wells what type of wells are found at this location we have BW and BW it is given here as bore well. So, you can see that even though it is in a hilly region where there is lot of rainfall and some rain shadow region, people do not use shallow wells, they go for deep wells because it is for them it is easier to put a deep well and then extract all the water. So, you will see all these bore wells included not much deep come bore well I have seen in this area physically in the field visits, there are a lot of dumbbells. But as far as the data suggests, it is not fully field checked.

So do not worry about where it is and how it is here we are right on the Coimbatore with some data is not there which is fine. And then we have the depth range of wells how deep it is 40 to 60 meters so it is a deep well as a deeper goes 40 to 60 meters that is what they are saying. And then the yield range of the wells is given 100 to 150 liters per minute or meter cube per day. So, if it is a big well and it is given a lot of water people run it for a long time and then they put it as meter cube per day. Whereas most of the time it is liters per minute how much it is pumping so they will run it for one hour or two hours whether they have note down the pumping volume in the wells. Then quality of water is a good portable means can you drink the water can you use it for domestic use or not portable indicate reasons why not portable non non and portable.

So, everything is given here of whatever they use. Sorry I missed this one which is homogeneity of the unit access is it across the Areapura Is it the same material the material that you find here? Yes means homogeneous. Moderate means some places it is homogeneous no means it is not

homogeneous. So you can see that most of the places are moderate and high which means good homogeneity across the quality of water is there as potable. And then you have groundwater irrigated area is negligible because they have good rainfall maybe they are not doing groundwater irrigation.

But then why is the pump so deep, why they are using deep wells they could use dug wells. So, that data is not carefully put or also the irrigation is not needed, because most of this time it is raining. So that rainfall is enough to recharge the soil and grow the crops. Recharge structures is it needed, percolation tanks, if so, what type of recharge structures. So now are they giving recommendations, what type recharge structures can we give? Is it not required? Because what levels are good? Or do you want percolation dams, check dams, Nylabones recharge, wells desilting tank or recharge pits.

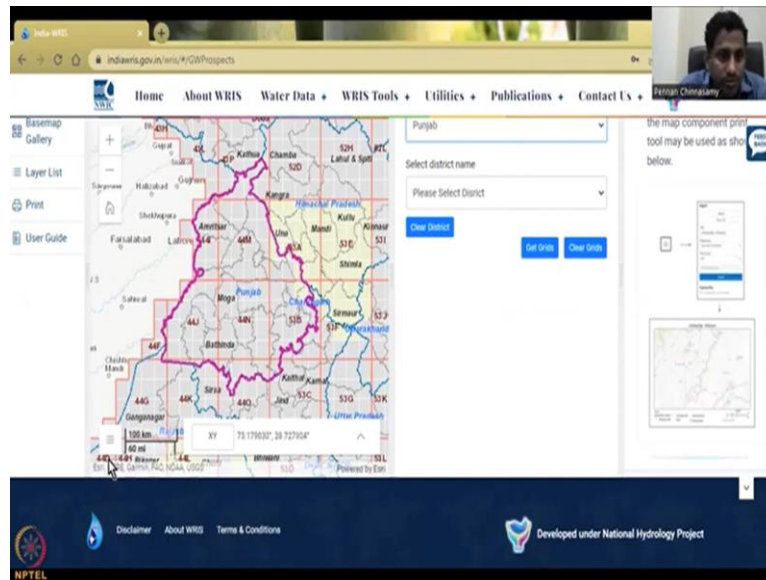
All these are given, see each recharge structure goes with a recharge need and the type of the soil or the material, you need to have rainfall, I have explained this in class and you also need to have a lot of structure in the rock and the soil material to hold the water. And this is where you need to balance both these aspects to find a particular recharge structure type. They have done this for you the groundwater board and given you the details of what can be used. Good, then also we can look at what is the remarks forest areas no habitations forest areas. So, it is the remarks given by problems limitations and or the field survey person who did it, they might have found some issues for example, the groundwater wells were not able to be checked, sometimes I have seen locks put on these wells, people do not want us to monitor it.

And if it is only the groundwater board data, then it is fine everyone can monitor. Sometimes access is denied it is around it they put a lot of structures so you miss the groundwater well and sometimes your well is tampered which means the instrument inside is taken out or some stones are put on the well that you cannot see it. These type of things sometimes happen not knowingly because right there is some agriculture or they're building a house they did not know there was a groundwater monitoring tube there they just put all the rubber. So all these problems can be put in this area mainly run off zone, borewells have to be located identify locations zone for expected yield. So all these prospects are given in this map.

So this map mostly has captured the Kerala side of the Western Guds not the Coimbatore site. But again it is useful because it has given you good data about what is available. And this is not a

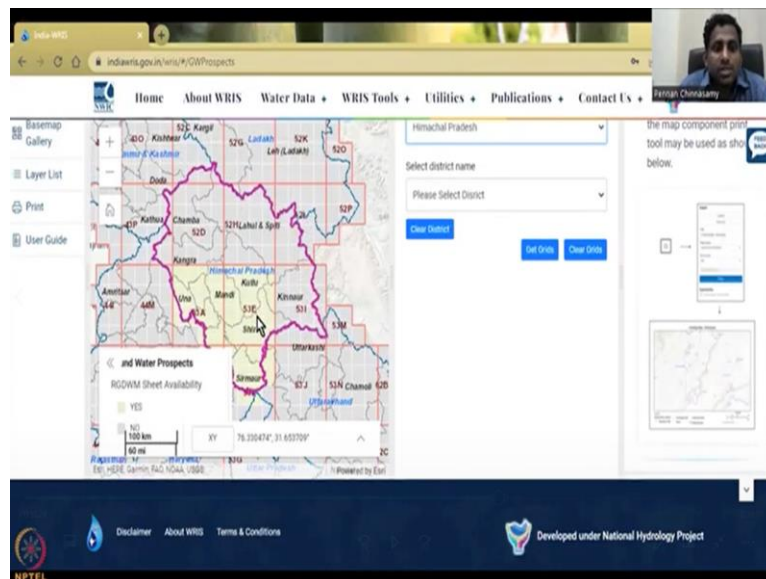
GIS layer it is a GIS converted to a PDF so which means you can you do not need a software you just need a PDF viewer take it and put it in your report you can cite it.

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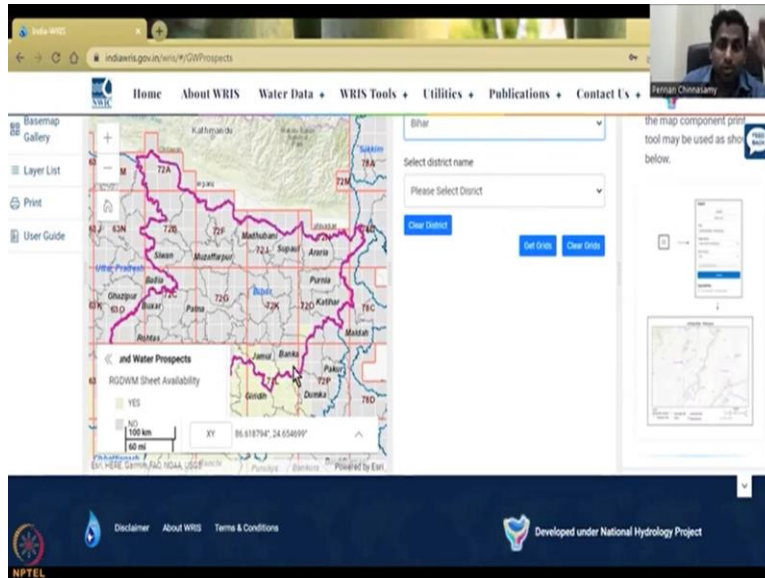
So let us take one more example in Punjab for example. There are two clear grids clear the district and then go to the state let us say Punjab is there yes Punjab is there. So now the computer went the software has taken us to Punjab. Now it says some only some is available if you look at the coloring yes and no the no color is more.

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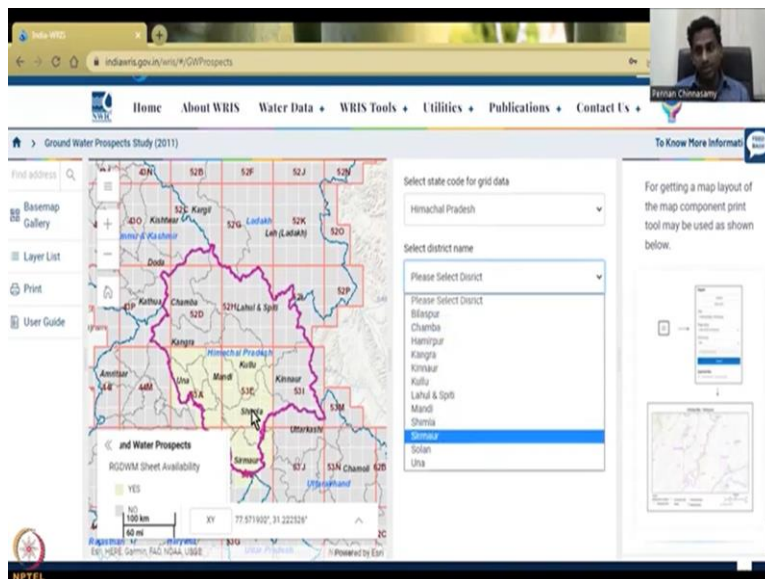
So I would go to Himachal just because we do not have the data even in Himachal not much covered.

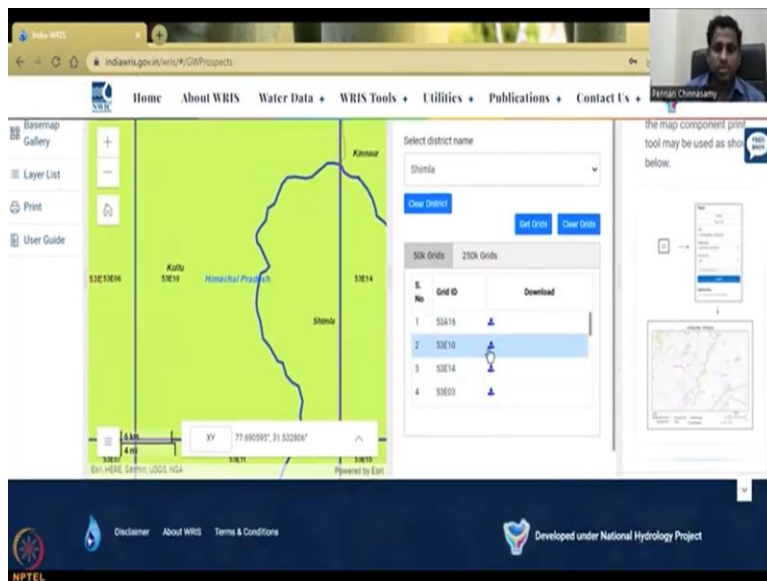
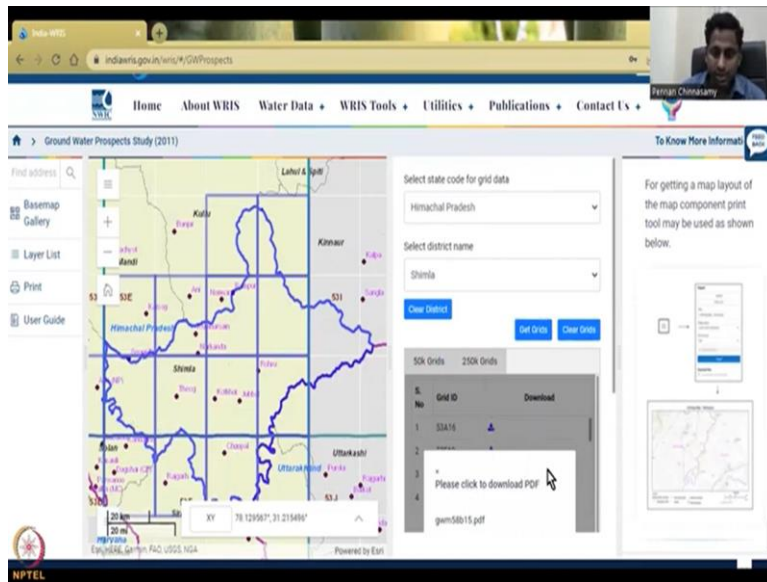
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So let us go to Bihar. So I think the color is different in different screens. So just I would say download the data and then see if it works or not in your system if the data is available or not so I think Himachal Pradesh will stick because this area we do have 53E is good Shimla is good. So let us take Shimla if I went fast and doing it again.

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I go to select grid code for the state so I selected Himachal then I come here it has populated all the districts in Himachal. I go to Shimla, why did I go to Shimla? Because somewhere here I see a bright color meaning there could be data. So let us put Shimla and then get grids, good. Now we will close we can select a grid here or you can select it here. So let us select 5314 let us do the 50k 50k means the resolution is different. So I am going to 5310 coming in this side. Yes, data is available, if I click this 50 310 another box can open asking me to download the data.

MAP UNIT	GEOLOGICAL SEQUENCE	GEOMORPHIC UNIT/LANDFORM	DEPTH TO WATER LEVEL	RECHARGE CONDITIONS	GROUND WATER PROSPECTS					RECHARGE STRUCTURES	REMARKS		
					ADIAPER SYSTEM	TYPE OF WELLS	DEPTH RANGE	YIELD RANGE	DISCHARGE				
MC		River Channel Deposits	Thickness and extent may vary over a period of time		
MC-19		River Terrace	No table	Good	LS	70'	20-300'	50-100 gpm	Moderate	F	MS	...	Thickness and extent may vary over a period of time
MC-19		Alluvial Fan	No table	Moderate	LS	70'	50-100'	50-100 gpm	Moderate	F	MS	...	Prospect is limited, better yields are expected in some
MC-19		Modest Cones	No table	Moderate	LS-100-150'	80'	50-100'	50-100 gpm	Moderate	F	MS	...	Prospect is limited, high yields are expected in some
MC-19		High Cones	No table	Moderate	LS-100-150'	70'	50-100'	50-100 gpm	Moderate	F	MS	...	Prospect is limited, high yields are expected in some
MC-19		Structure of MC-19/20	No table	Poor	MS	80'	50-100'	< 10 gpm	Low	F	MS	...	Wells, some of them, Prospects are limited to yields
MC-19		Structure of MC-19/20	No table	Poor	MS	80'	50-100'	< 10 gpm	Low	F	MS	...	Wells, some of them, Prospects are limited to yields

I am going to store it again opening the data. So, this has a very good representation and all the prospects are given. So, if you look at it you have the stream networks also mapped where the river flows and along the rivers this lineaments the blue lines are where cracks are there, remember Himachal has a lot of hilly region.

So, it has a lot of these cracks in the water that can cracks in the rock that can store water. So, this map is pretty good, and you can see other maps that can be used with it the coloring, where in India it is so, all of this has been done for you, all you have to do is cite it properly, do not just copy these maps into your work and say it is your work the government has done it for you so always cite.

Here you have the copyright information who to cite all these things. So, this is a great exercise for you to use this groundwater resource map and then understand the potential the regions where the recharge can happen. For example, let us take this region the light blue versus the red, if I come back this side you can understand that the light pink the light pink has see the numbers so many more, so the light pink and the red. So, the light pink has four water recharge conditions, so, there is nothing that you can do and that is why you see all these cracks in the surface and right next to the pink color the dark reds we saw are a little bit better.

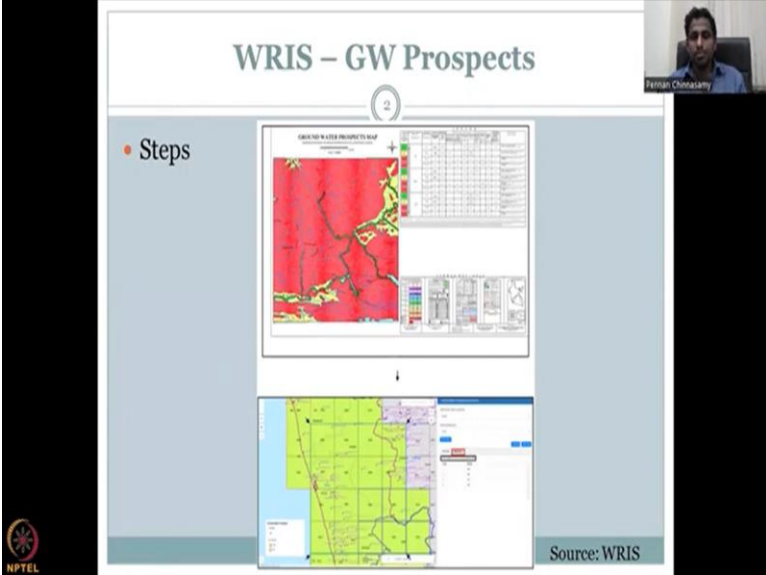
So, you can see the recharge the links everything because of the material type you could say that it is a little bit better, but still because it is on that region along the hills, it is not good. But if you come down from down or up only some regions in the yellow color or having moderate to good

recharge conditions. And if the recharge is high you have tube wells rather than borewells tubewells are also going into the deep aquifer but not too deep, it is limited and so energy consumption is less water usage is good.

Then you have the flow rate which is 80 to 200 meters I am sorry this is your depth of the of the well which is at 200 meters. And then when you go to the red zone the depth increases the yield is very high 50 to 100 liters per minute whereas in the red it is only less than 10 liters per minute and then the recharge conditions homogeneity etcetera. The good thing is the water quality has always been good portable. For example, in Nepal conditions in the same hilly regions, you will see polluted water mix into the groundwater and it is not portable. So, you have to be careful in understanding the differences between potable which can be used for drinking and non potable.

And not many reaches such as can be put on the hilly regions that is why they put a dash which means nothing or you can do some DG dug wells or ST, ST is your small scale dug wells low priority not high priority they say is very low. I would recommend you to read through the user books to understand more on these terms and how they estimate these values. So now I am going to go back to my presentation.

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The screenshot shows a presentation slide titled "WRIS - GW Prospects" with a small video inset of a man in the top right corner. The slide content includes:

- A heading "Steps" with a red bullet point.
- A central graphic titled "GROUNDWATER PROSPECT MAP" which consists of a map with a red and yellow color scheme, a data table, and a legend.
- A smaller map below the main one, showing a different geographic area.
- A source attribution "Source: WRIS" at the bottom right.
- An NPTEL logo in the bottom left corner.

So what steps did we do? We have identified the groundwater prospect map. We have learned how to read it and you can download the data as needed. So this the grid file. This came from each grid file after the district after the state that you take.

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WRIS – GW Artificial Recharge

- Area
- Type of structures
- Mapping

Source: WRIS

Recap of Week 10

- GW Data access
 - Aquifer 2D
 - Type/material/depth
 - GW data (State/CGWB)
 - Data trends
 - GW resources
 - GW Artificial Recharge

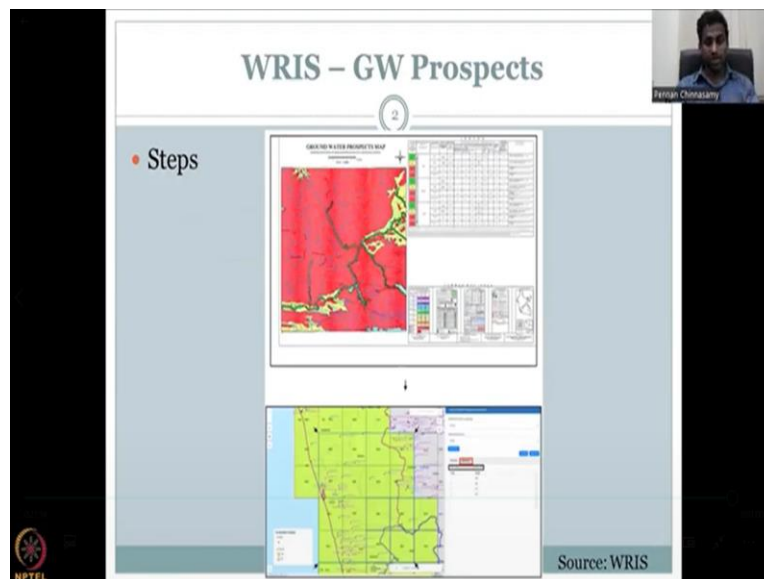
So I will do the artificial recharge in the next week in groundwater Lecture Series 11. I will also teach you about the other groundwater reports that you can access for quick learning. And one more thing is satellite data, I will look into how you can estimate groundwater using satellite. It is a very cool tool, I will show you the live satellite, how it looks at the earth, and how you could take the data out and use it. You would need GIS but again, we are not getting into that part. So I'll just give an introduction.

So, the recap of the big 10. We have looked at aquifer to be mapping, where we discuss about the type the material and the depth to the groundwater. We looked at the groundwater data from both

the state and the central groundwater board. We have understood that not all wells, even though you have 33,000 wells, not all are used for monitoring only 15,000 wells are used and of the 15,000 there are some which monitor the Deep aquifer and whereas some monitor only the shallower aquifer or many. Then we looked at the data trends, we understood that for India, it is almost in the safe condition because 60 percent critical issues are happening or 60 percent of the waters only use semi critical level we are. But if you zoom into districts and zoom into certain blocks, you will find that the groundwater data is extracted more than the recharge which is not sustainable.

Then we looked at the groundwater resources assessment, where each block has a groundwater assessment of how much groundwater is recharged, how much water is taken and out of the how much water is taken what is the percentage use for irrigation, what is the percentage use for domestic and industrial. They clump together but again, there are some breakups of these data that you get find. The groundwater artificial recharge is a very necessary aspect for which you need to understand the geology, the groundwater setting.

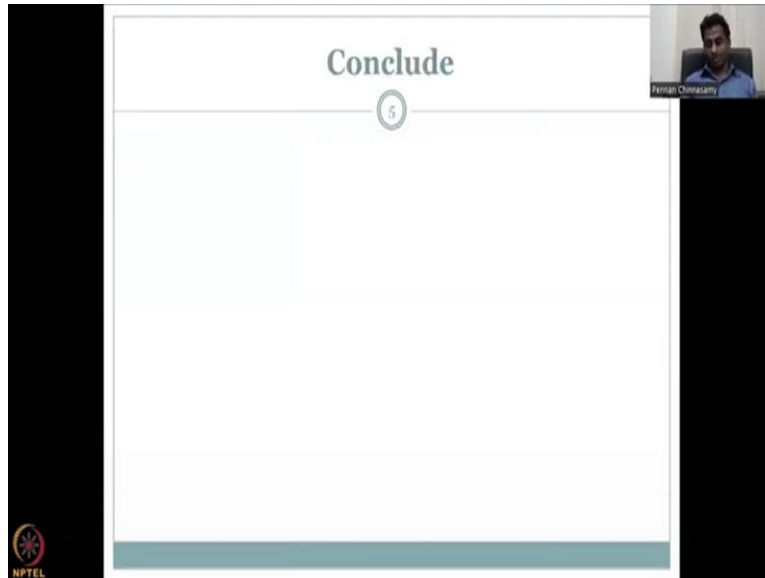
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And that is what we looked at in today's lecture by going through these maps, the groundwater prospects maps. Now, if you have a high prospect, that is where you are going to go and put your groundwater recharge, so, the link is we have set up all the data. Now we have understood where

the groundwater potential is high. The next lecture we will look at where the groundwater recharge structures have been placed, and what are the benefits.

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With this, I would conclude today's lecture. Thank you.