Watershed Management

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Module No. # 07

Lecture No. # 30

Environmental Guidelines for Water Quality Management

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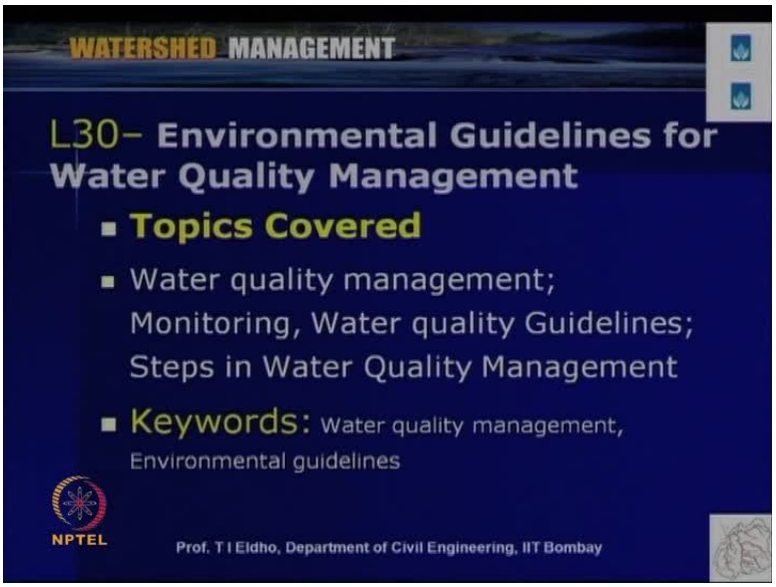

[FL] and welcome back to the video course on watershed management. In module number 7, on management of water quality, in lecture number 30, today we will discuss about the environmental guidelines for water quality management. Some of the important topics covered in this lecture include - water quality management; Monitoring, Water quality guidelines, and steps in Water Quality Management.

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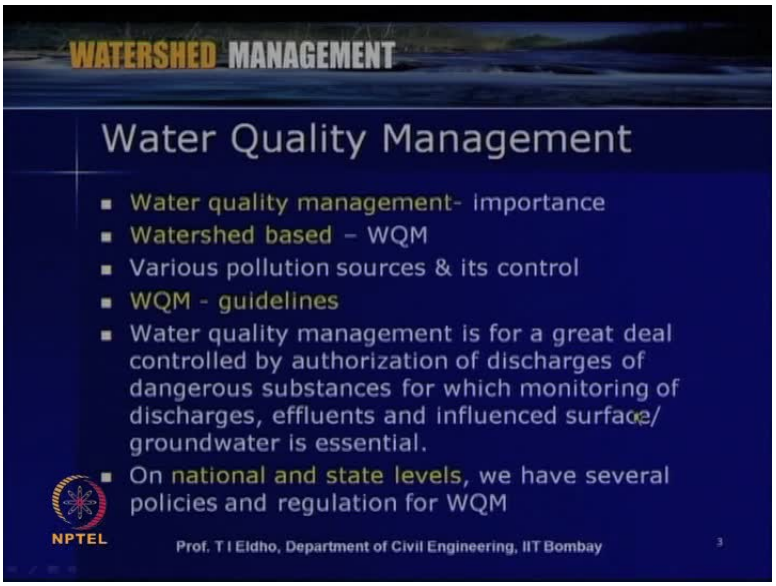

So, the keywords for today's lecture: water quality management and environmental guidelines. So, as we discussed earlier, so, this water quality management is whether to deal with most of the time watershed based water quality management. So, it is one of the important issues which we have to deal in water related issues like water resource management or water watershed based water resource management, etcetera.

So, it is not only the quantity of the water but quality of the water is also important. So, that is what we had discussed in the last few lectures. So, as we discussed for surface water or ground water, there are various sources of pollution like, say ground water or surface water; pollutions sources can be different.

And then we will be discussing about how we can control this pollution, and then, wherever polluted, how we can remediate.

So, that is what we were discussing in the last few lectures. So, now, as far as water quality management is concerned, as we discussed in one of the earlier lectures.

So, we need a very strict guidelines so that we can go according to that guideline. So, first of all the guideline means as far as the water quality is concerned, what are the parameter values which we can go maximum or minimum, and what are the other things as far as the parameters are concerned.

So, that is one thing, and then, what frequently, what the frequency of taking the samples so that we should know. We have to constantly monitor the whether it is surface water or ground water, whether the quality is maintaining or not.

So, that way we have to see, and then, what are the methodologies which we can adopt to keep these water quality management. So, that way we need a guidelines as far as the water quality management is concerned.

So, water quality management is for a great deal controlled by authorization of discharges of dangerous substances, for which, monitoring of discharges effluents and influenced by surface or ground water is essential.

So, if we consider surface water like river water or lake water or if you consider ground water, then we have to see that, say as far as, say if we once we have to put certain, say measures, say I mean the guidelines like, say this much should be the quality or say various parameters the maximum limit or minimum limit.

Once we specify, and then, this say we have to strictly follow this through certain guidelines, and then, say authorities, say we have to strictly monitor these, what way it is going whether the pollution is taking place or whether pollution is reduced or whatever way, so, we have to see that some like a state pollution control board authorities or central pollution control board authorities. So, like that various authorization agencies should look into the quality issues or the pollution problems.

So, that way, when we look into water quality management and water quality management guidelines, so, there can be the guidelines related to national level like, say for example, in India central pollution control board is there which is the authorized agency to look into the various water quality management issues and then its guidelines formulations.

And similarly, we can have also state level. So, various states, say we can have various policies, and then, regulations as far as the water quality management is concerned.

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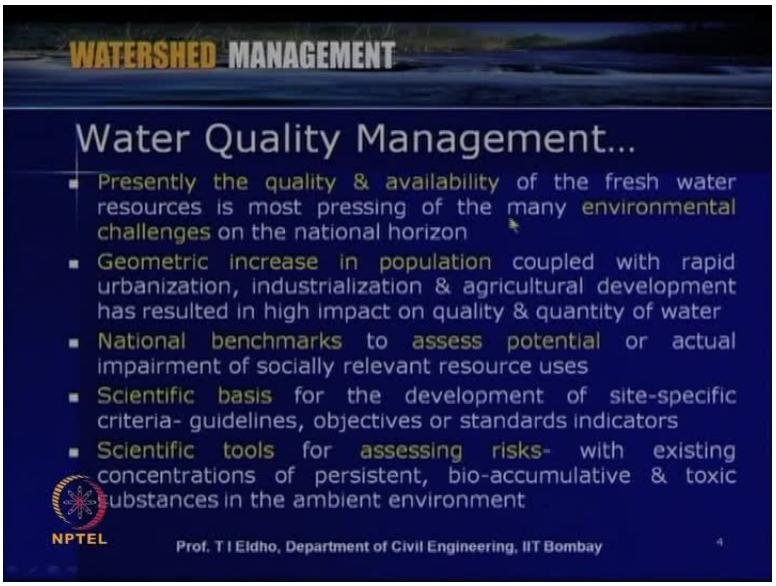

So then, say presently say as we can see presently the quality and availability of the fresh water resource is most pressing of the many environmental challenges, say for example national horizon. Say if we consider India or either any country is concerned, say the quality of the freshwater whatever we are getting. So, that is the availability as well as the quality is the main issue.

So, now as the population is increasing, say like geometric increase in population coupled with a rapid urbanization, industrialization and agricultural development. So, this has resulted in high impact on quality and quantity of water.

So, as we discussed in some of the previous lectures, quantity is a main issue, whether sufficient quantity of water is available. Say for example, for domestic industrial agricultural or the recreation purposes, and then, for each purposes or each uses as we have seen earlier, there are certain norms as far as the various parameters are concerned, say the maximum limit of minimum limit

So, the quality that way is a main issue especially in a country like India where the population is exploding, and then, numbers of new new cities are coming and rapid urbanization is taking place.

So, that way there should be national benchmarks to assess the potential or actual impairment of socially relevant resource uses such as water resource, say it is the quantity of the water and the quality of the water.

So, there should be national benchmark. So, that way we can see that the bureau of Indian standards has come up with certain guidelines as far as the water quality management is concerned, and then, say the various parameters, whatever they, for, as a drinking or other purpose, how we have to we should have.

So, that way, there should be as far as total water quality, total water quality management is concerned. We have to see the norms are available and these norms are strictly followed as far as the management is concerned. So, there should be scientific basis for the development of site specific criteria so that these criteria called guidelines, and then, objectives or standards indicators.

So, as we have seen, certain indicators or standards should be there to achieve the quality of the water, say for example drinking water standards or any other for any other use. So, scientific tools for accessing risk like with existing concentration of persistent or bio-accumulative and toxic substances in the ambient environment.

As far as environment is concerned, whether it is air, water or soil, so we have to come up with certain tools to assess the risk, say for example, we have to monitor the various parameters as far as water quality is concerned, and then, there should be scientific tools to assess the whether we are meeting the said guidelines. So, that way numbers of issues are there as far as water quality management is concerned.

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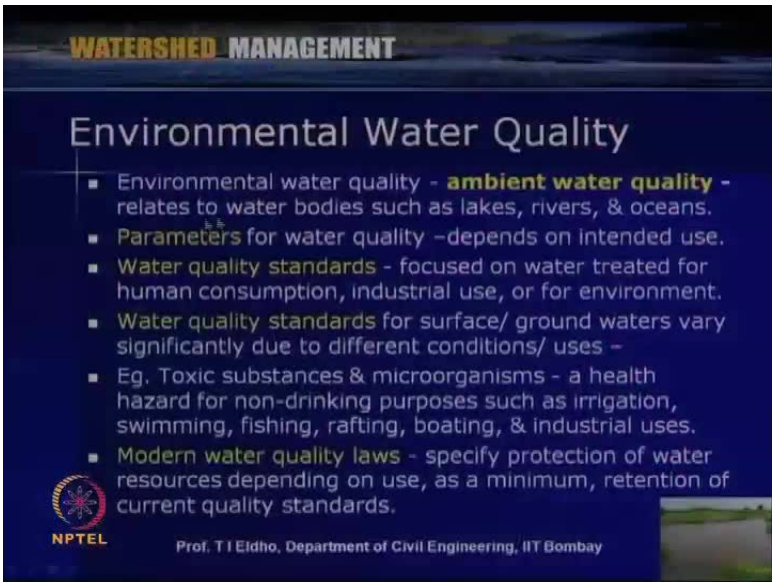

When we deal with the water quality management, generally we call it as environmental water quality. So, environmental water quality means the ambient water quality relates to water bodies, such as, lakes, rivers, oceans or aquifers. We say that the water quality which is very much related to the environment, whether it is a the aquatic body like lakes, rivers, ocean or whether it is the ground water systems.

So, we have to see that the ambient water quality and its environmental values or particular values are met. So, parameters for water quality as we discussed earlier, this depend on the intended use. So, as we have seen earlier, we have, for example, if you are using water for drinking purpose, then that the guidelines which we will be setting for various parameters will be different, then for example, the, if you are using for agriculture purposes.

So, water quality standards - we have to mention depending upon the intended use. So, water quality standards - these are focused on water treated for human consumption or industrial use or for the environment like an ecological needs.

So, we have to see the standards as far as water qualities standards are concerned; whether it is human consumption or industrial use or ecological needs. We have to see water, first of all we have to set the standards, and then, we have to continuously

monitor, and then, see that the standards are met for the for the particular water which we are utilizing for a particular purpose.

So, water quality standards - we can see that there will be standards for surface water or ground water, and this may vary significantly due to different conditions or the uses. For example, surface water generally we take from the rivers, lakes or reservoirs, but in ground water we are pumping out from the aquifer system. So, that way, the standards slightly vary depending upon the use or depending upon the extraction of the water is concerned. Say for example, the hardness of the water industrial purpose.

If we have to see the hardness of the water, then the ground water is concerned. When you are pumping, then the hardness may be higher depending upon the location from which we are pumping. So, that way the water quality standards may change whether according to surface water or ground water.

So then, say also like, for example, the toxic substances and microorganisms, which is a health hazard for non-drinking purposes, such as, irrigation, swimming or fishing, rafting boating and industrial use. So, this will be, all these things, the standards will be different depending upon the intended use, and then, whether it is depending upon the source also like surface water, ground water, it will be varying.

So then, say if you consider the modern water quality laws, so, this modern water quality law specify the protection of water resource depending upon use. As we have seen, whether it is ground water, there may be certain specific norms as far as the protection is concerned or if it is surface water, there may be some other specific norms. So, like, say for example, depending upon the use as minimum or retention of current quality standards.

So, like that, there will be variations as far as the water quality laws or its management is concerned. So then, as we were discussing, so, as far as water quality is concerned, we should have certain guidelines, and then, when we are preparing this guidelines, we have to first depending upon our objectives; we have to set the goals, and then, we have to see the specific guidelines to achieve this goals.

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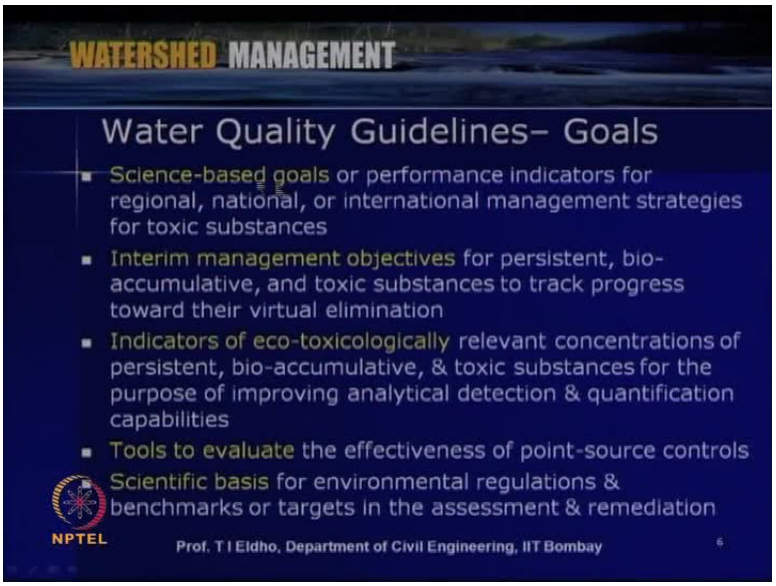

So, let us look what are the important goals as far as water quality guidelines are concerned. So, these are given in the slides - so, science based goals, like different kinds of goals can be there; science based goals or performance indicators, for example, regional, national or international management strategies for toxic substances.

So, if you consider specific type of toxic substance, we have to see this standards or the guidelines may vary for the, for the particular region or particular nation or international standards may be varying depending upon what kind of use or for example, the American standards will be different from European standards or it will be different from Indian standards.

Then interim management objectives, say for persistent bio-accumulative and toxic substance to track progress towards their virtual elimination. Say for example, say some specific toxic substances we have to virtually eliminate or the bio-accumulative or bio-organism, we have to eliminate from the particular water which we are using.

So, accordingly, we have to set the goals, and then, indicators of eco-toxicology like relevant concentrations of persistent or bio-accumulative or toxic substances for the purpose of improving analytical, detection and quantification capabilities are needed.

When we set the specific goals as far as the water quality guidelines are concerned, so, accordingly, we should have the tools to evaluate the effectiveness of point source, controls or the non-point sources controls are concerned.

So, as we discussed that the pollutant source can be point-source or non-point pollutant sources. So, the point sources - we can easily identify and then we can evaluate it and then we can try to control it.

So, that way we can set our water quality guidelines depending upon, say from where the pollutant source can come, whether it is point source or it is a non-point source; accordingly, we can set our goals.

And then, that way there should be a scientific basis for environmental regulations and benchmarks or targets in the assessments and remediation.

So, when we deal with water quality management, we should have specified environmental regulations or rules or laws, and then, we should have the benchmarks, say that this should be the particular limit of particular substances in a water; in the water which is for specified use or say for example, the waste water coming from industrial source or the municipal source so that should meet certain criteria, certain guidelines or certain standards before it is put into rivers, lakes or to the to the ocean.

So, that way, there should be certain benchmarks or targets as far as the water quality management issues are concerned and this can be either for assessment or it can be for remediation also.

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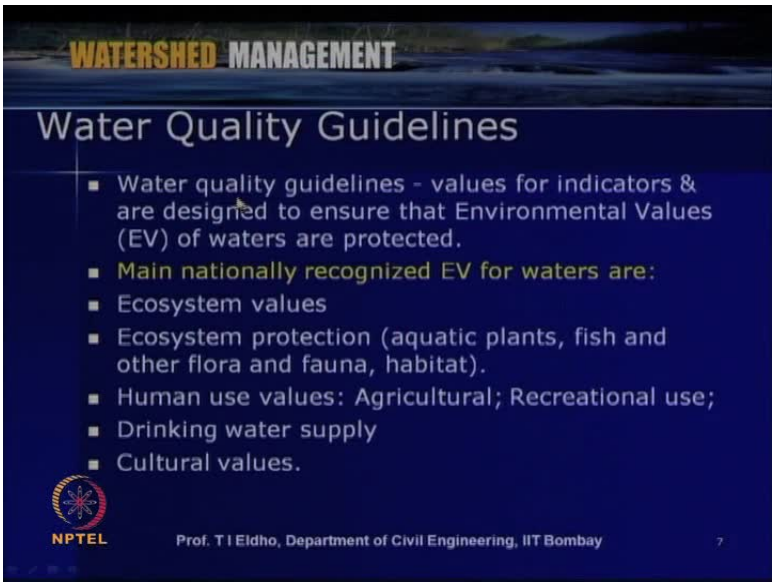

So, now, let us look into various issues related to water quality guidelines. So, water quality guidelines actually as we discussed this guidelines shows values for indicators and are designed to ensure that various environmental values of waters are protected.

Say for example, if we consider in particular water for drinking or other purpose, arsenic limit or fluoride limit or the total dissolved solids limit or b o d limit or c o d limit, like that we have to specify the indicators, and then, accordingly, the environmental values to be specified, and we have to ensure that this are met for the particular samples which we will be doing as the water quality monitoring is concerned.

So, there will be as far as the environmental values are concerned, main nationally recognized environmental values for waters or say for example, ecosystem values, so, the water which we are using for ecological needs or ecological water use.

So, for that the certain specified environmental values we can prescribe, and then, ecosystem protection, say like, say we can come up with guidelines as far as the aquatic plans are concerned or fishing is concerned or say the habitat or the ecosystems or the maintenance of the rivers and lakes are concerned. We can come with a certain the guidelines with respect to the specified environmental values are concerned.

And then, human use values, like for example, water usage for agricultural or recreational use, so, accordingly, we can put the specific guidelines.

And then, of course, some of the stringent guidelines will be formed drinking water supply. So, we should meet specified quality requirement as far as the drinking water usage is concerned.

And then, it can be for even for cultural values, say for example, say for religious purpose, when we are using some location of the river or some lakes, so then we have to specify what are the water quality guidelines for the particular use or particular; when we do monitoring or when we do sampling, what should be the guidelines.

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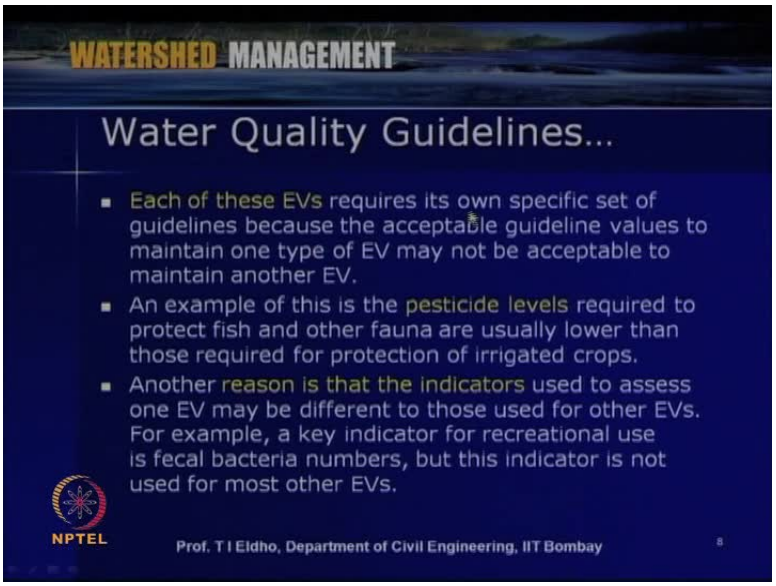

So, now, each of this environmental value requires its own specific set of guidelines, because the acceptable guidelines or guideline values to maintain one type of environmental values may not be acceptable to maintain another environmental value.

So, this environmental value, what we discussed that depends upon the particular usage or particular source like as we discussed. Say for example, the, if we consider pesticides levels in the say aquatic system, this pesticides levels required to protect the fish and other fauna are usually lower than the those required for protection of irrigated crops. Say the pesticides which we are putting, say to protect the crops itself.

So for that the limits, for the crops or for the irrigation issues are concerned, that will be different. Then what we consider pesticides levels, when we deal with the fish, fish habitats or other flora and fauna are concerned.

So, now, another reason is that the indicators used to access one environmental values may be different to those used for another environmental value. So, the environmental values depending upon the source of the water, and then, the usage these environmental values vary. Say for example, a key indicator for recreational use is a fecal bacteria numbers, but this indicator is not used for most other environmental values like agricultural purposes or ecological needs.

So, like that the water quality guidelines it will vary or the environmental value which we have to specify that also varies.

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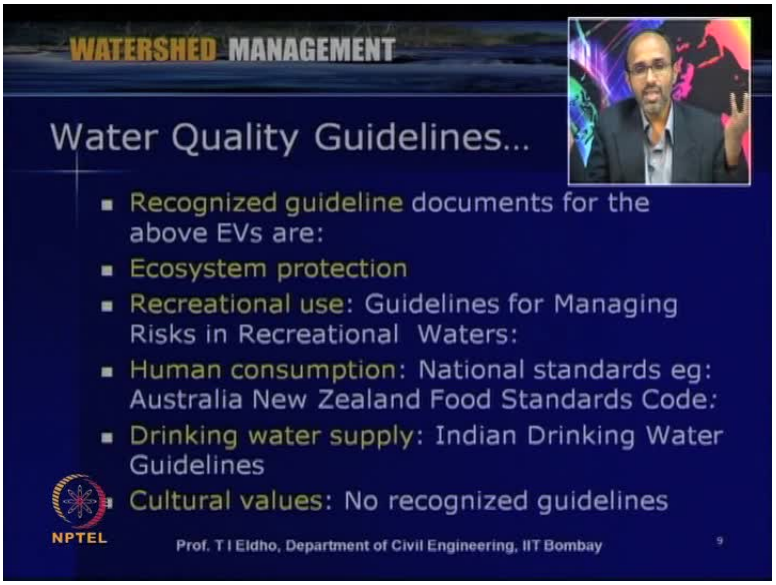

So, as far as water quality guidelines are concerned, say we have to come up with the rules and regulations or laws. So, we have to come with come up with the documents as far as the various usage or various sectors are concerned, and then, it should be authorized, it should be from authorized agencies like pollution control boards or other government agencies so that that can be strictly implemented as far as the various environmental values or various guidelines are concerned.

So, it can be for ecosystem protection or say for example, recreational use, say for example guidelines for managing risk in recreational waters. So, for example, if you for swimming purpose or is it is for boating purpose.

So, what kind of recreational use water is used? Accordingly, we can come up with certain values or guidelines as far as the environmental values are concerned; then human consumptions like national standards.

So, of course, as we discussed, say bureau of Indian standards or European standards, so like that various national standards are available, say Australia, New Zealand, food standards code, etcetera.

So, there accordingly we can set our guidelines. Then drinking water supply, for example, in drinking water guidelines, we can come up with a specified guidelines, and then, we can see that this guidelines are met or not.

And then as far as cultural values are concerned, also if it is required, we can come up with a specified guideline, but generally this we have to see that what qualities met with respect to certain standards, but strict and, strict and strict regulations are not set as far as the cultural values are concerned.

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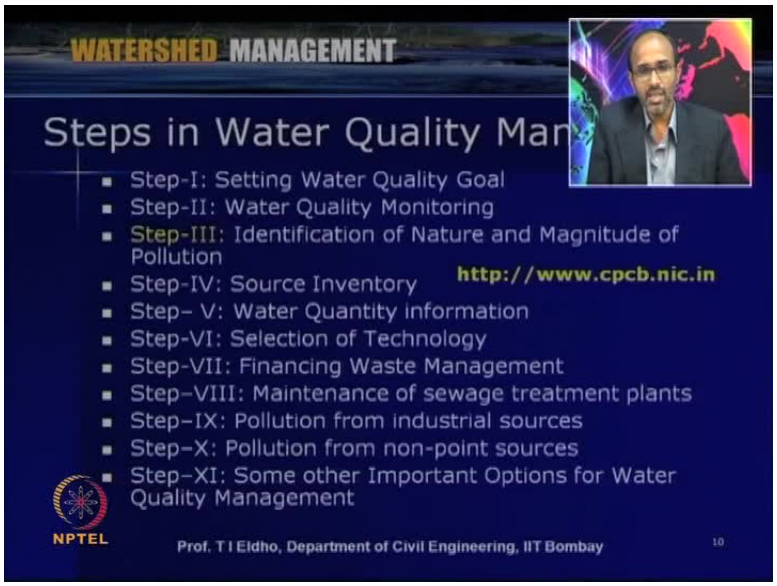

So, now, let us look into various steps in water quality management. So, while setting the water quality management, guidelines or the environmental guidelines, so, we have to go in a systematic way step by step procedure should be adopted so that we will be meeting the international standards or international guidelines as far as the water quality is concerned.

So, and then also, say the, we have to start with we have to first come up with a plan, how to develop such guidelines or the, say to meet this water quality management issues.

So, we may have to interact with the various stakeholders or we have to do lot of field survey, and then, frame these laws and then put into the public. Again, the water quality management guidelines or environmental guidelines, and then, take their opinion also other than the, of course, from the experts we have to take the opinion, and then, finally, we have to come up with the guidelines as far as the water quality management is concerned.

And that should be publicized, and then, we have to see that these guidelines are met by various stakeholders like industries or the public are concerned. So, that way, we have to go through a step by step procedure as far as the water quality management issues are concerned.

So, here, as per the central pollution control board government of India has given in this website. So, they have come up with about eleven steps as far as the water quality management is concerned. So, it starts from step number 1 setting water quality goal, and then, step number 2 water quality monitoring, and then, step number 3 identification of nature and magnitude of pollution.

Then next one is source inventory, and step number 5: water quantity information, say what kind of, what is the quantity of available water and what type of water, whether it is surface water, ground water or where is the source of these; then step number 6 selection of technology.

Step number 7: financing waste management; step number 8: maintenance of sewage treatment plants; step number 9: pollution from industrial sources; step number 10: pollution from non-point sources, and finally, some other important options for water quality management.

So, generally, say when we are setting the guidelines for water quality management, we have to come up with a document, and then, that once the document is prepared, so to assure this water quality the issues are or water quality control measures are met. We have to, say go through a systematic procedure. So, as given by the central pollution

control board government of India, these are some of the eleven steps which we have to follow as far as the water quality management is concerned.

So, now, we will discuss each of the steps in detail so that we can understand, say how each steps are important and what are the important things we have to look when we look into the water quality management issues are concerned.

So, this is actually, specifically made by central pollution control board government of India, and for other countries also, there may be these kinds of guidelines as far as the water quality management issues are concerned.

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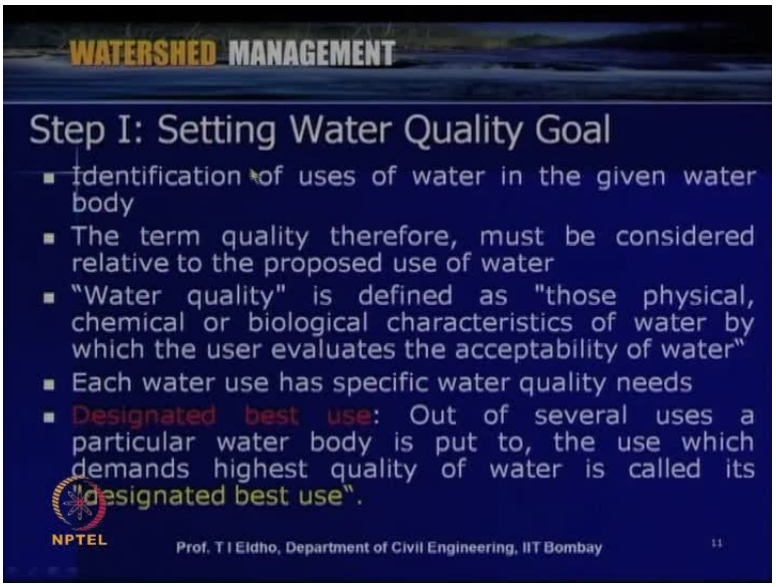

So, first, let us look into step number one. So, step number one is mainly setting the water quality goals. As we discussed, before going for any kind of activities related to water quality management, we have to set the goals. So, this goal - we can derive based upon the international standards like world health organizations or FAO norms or various norms.

So, we can, say study all these things, and then, what are depending upon the sources of water for specified usage or what kind of, according to what kind of intended use, so, we can set our goals. So, once the water quality goals are set, we have to see those goals we are meeting for the specified uses.

So, now, let us look what are the important water quality goals which we have to set. First one is identification uses of water in the given, say water body. So, say like, say for example, river or lake is concerned, say what are the, say specified uses as far as the water is concerned, whether it is used for irrigation purpose or it is used for the drinking purpose or industrial uses like that.

And then, the term quality therefore must be considered relative to the proposed use of water. So, as we have seen, each usage has got its own specified norms are there. So, according to those norms, we have to see that we have to consider the quality as far as when we set the water quality goals.

Water quality as we discussed earlier is defined as those physical, chemical or biological characteristics of water by which the user evaluates the acceptability of water. So, depending upon whether it is for drinking purpose or whether it is irrigation purpose or for industrial purpose, say we will be setting certain goals or certain norms or certain criteria and then, accordingly, the whether we are meeting those specified criteria, so, the user can evaluate.

So, that way, the setting of the water quality goals is very important. So, each water use has specific water quality needs, so, as we already discussed earlier. So, for example, designated best use means out of several uses, a particular water body is put to the use which demands highest quality of water is called its designated best use.

Say for example, if you consider the, consider the water in a reservoir, so, the designated best use, so, the water in the, from the reservoir may be used for drinking purpose; may be used for irrigation purpose; may be used for recreation purposes.

Say out of this, say for example, the water quality goals are concerned, may be most, say the most important goals will be as far as the drinking water purposes.

So, that way the highest quality of the water, say what is needed is for drinking purpose. So, that norm, we will be keeping, and that is the designated best use as far as the water in the reservoir is concerned.

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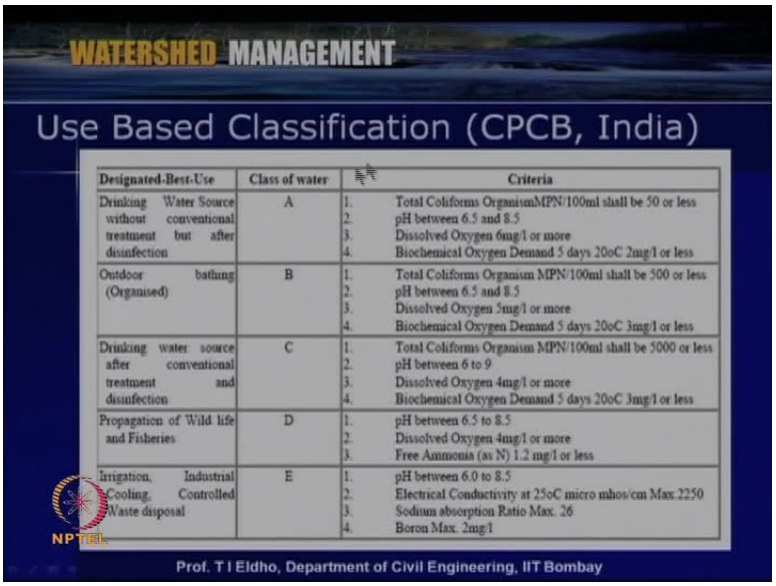

So, as we discussed earlier, say according to central pollution control board and Government of India based upon the use, various classifications have been done. So, this, we have already discussed earlier. So, accordingly five classes of water we can define – A, B, C, D, E; so, the designated best use, say for example drinking water source which is class A. The criteria can be a total coliform organisms.

So, this should be 100 ml or so 100 ml shall be 50 or less. Then pH should be between 6.5 to 8.5 dissolved oxygen; should be 6 milligram per liter or more; BOD should be five days 20 degree centigrade should be less than 2 milligram per liter.

So, like that, this is for drinking water use and class A water as per central pollution control board norms; then class B is outdoor bathing. So, here, the criteria are related to total coli form organisms should be less than 500 per 100 ml water.

And pH is same 6.5 to 8.5, and dissolved oxygen should be say 5 milligram per liter or more, and BOD should be 3 milligram per liter or less. So, this is for class B which is for outdoor bathing. Then class C is for drinking water source after conventional treatment and disinfection. So, the water which is taken from here will be going through a treatment process, and then, it will be also disinfection also will be done.

So, there, the, say as far as the source is concerned, the total coliform, say organisms per 100 ml shall be, for example, five thousand or less then pH can be 6 to 9 dissolved oxygen, 4 milligram per liter or more, and BOD 3 milligram per liter or less.

So, but here, this water as shown here, this water will be going through conventional treatment and disinfections. So, that way, say whatever the requirement will be met, but in the class A, it is only disinfection is done but no other treatment is done.

And then class D - it is for propagation of wildlife and fisheries. So, there the pH, can, between 6.25 and 8.5 dissolved oxygen should be 4 milligram per liter or more.

Then like free ammonia is concerned 1.2 milligram liter or less, like that various norms can be there, and then, the last one is class E where water for irrigation or industrial cooling or controlled waste disposal; there again pH, electrical conductivity, pH can be same range, electrical conductivity can be up to maximum 2250.

And then, sodium absorption ratio maximum 26, like that. So, like that, we can say based upon the class of water or the based upon the source or based upon the intended use, we can set the criteria, and that say accordingly the water quality goals in the first step we can set, and that will be the deciding criteria later stage to see that whether this quality goals are met or not met.

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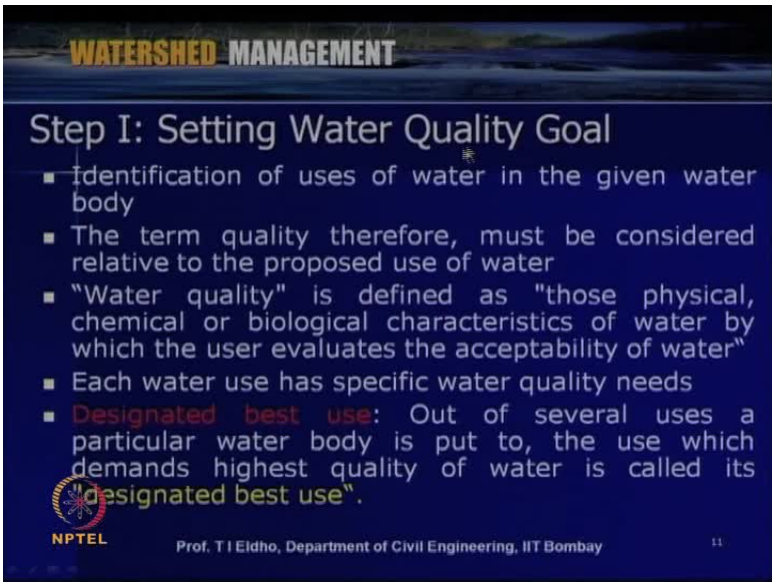

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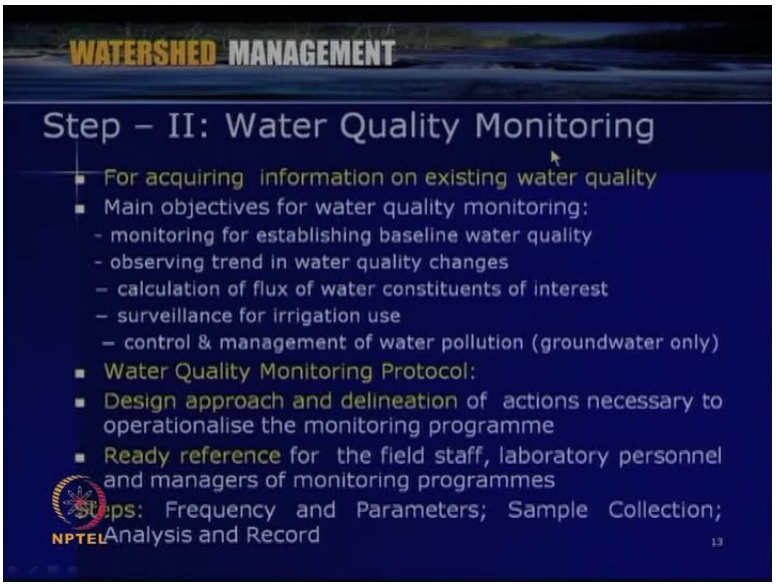

So then, that is about the first step. First step was on setting water quality goals, and now, second one is water quality monitoring. So, once we set the goals, so as we discussed in the step number 1. So, now various sources like surface water source like rivers, lakes or reservoirs or the ground water aquifers, and we have to continuously monitor for the water quality, and then, see that for the intended use the quality is meeting that particular goals or particular values so that we have to see.

So, that way step number 2 is also a very important. So, for acquiring information on existing water quality, so what is the present stage? So, we have to go for sampling, and then, we have to see whether the particular samples are meeting the criteria.

So, main objectives for water quality monitoring can monitoring for establishing baseline water quality. So, certain minimum baseline we can keep and then we can see whether that we are meeting. Then observing trends in water quality changes, say from one season to another season, some from summer to monsoon season or monsoon to spring season or winter season how the parameters are changing.

So, that way observing the trend, and then, calculation of flux of water constituents of interest; then surveillance for irrigation use and control and management of water pollution, say ground water only, say as far as if any pollutant source is there, how we can control it and then how we can go for remediation.

So, like that, we have to do the water quality monitoring and we have to get the information. So, water quality, so, water quality monitoring is concerned also there are certain specified protocols have been specified by various agencies like in India central pollution board. So, we have to see that this protocol are met.

We are taking samples, and then, when we are measuring it, and then, try to put into as far as the set goals are concerned. Then design approach and delineation of actions necessary to operationalize the monitoring program.

So, we should have network of collection of the samples, and then, monitoring it continuously, say specified days or specified period and then this data should be available.

So, ready reference for the field staff should be there; field staff or laboratory personnel should be or manager should be there as far as monitoring programs are concerned. So, we have to set guidelines; we have to set the norms for water quality monitoring and that norms the field personnel or the laboratory personnel, who field personnel collect the samples and laboratory persons, say test this sample and the managers are controlling all those things. So, that way, a ready reference should be available as far as the various norms or various guidelines as far as water quality monitoring is concerned.

So, as far as water quality monitoring is concerned, the various steps are so we have to see the frequency of monitoring, and then, what are the important parameters to be considered as far as the monitoring is concerned, and then, we have to specify the sample collection, procedure and then how to keep the samples, and then, how to take into lab, and then, how to analyze the samples, and then, how we can record it appropriately so that, the, this, this will be available as guidelines and that the field staff or the laboratory personnel or the managers will be controlling the things according to the set guidelines as far as water quality monitoring is concerned.

So, now, as far as monitoring is concerned, there are certain specified protocols related to the frequency, say how many times in a week or in a day or in a season we have to collect the samples, and then, what are the important parameters we have to test. So, accordingly specified monitoring protocols are available.

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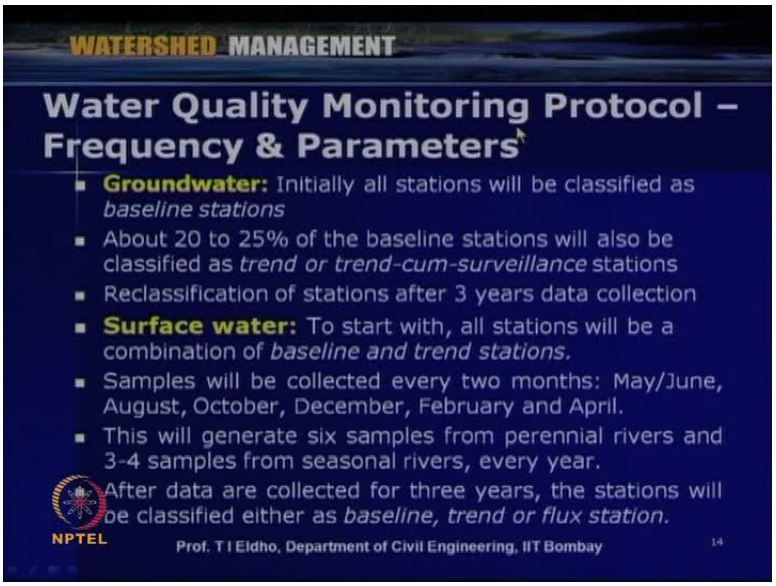

So, let us look into some of these important protocols as specified by central pollution control board. For example, if ground water is concerned, initially all stations will be classified as baseline stations. So, as far as ground water is concerned, we may select the, we may collect the samples from dug well or bore well or very deep tube wells, and then, initially, we keep these stations as baseline stations and about 20 to 25 percent of this baseline stations will also be classified as trend or trend-cum-surveillance stations.

So, in about one fourth of this baseline station, very frequently or we take the samples and monitor in a very systematic way and so that we can identify how the trend is as far as the water quality is concerned. So, this station we can call it as trend-cum-surveillance stations.

Then, say after few years, say for example, three years as per as specified by central pollution control board, this stations we can reclassify, and then, may be some other stations can be chosen as far as a, whether it is as a baseline station or surveillance stations are concerned.

And now, as far as surface water is concerned, to start with all stations will be combinations of baseline and trend stations. So, as far as from wherever we take the samples, we can classify as either baseline stations or the trend stations.

So, the, we can have a combinations of this baseline and trend stations, and then, samples will be collected, say at least every two months, say like, say in India during May June or then august, October, December, February, April, like that.

So, this is according to the seasonal variation like monsoon season or this May June summer season; then monsoon season; then spring season, autumn season, like that. So, the sample will be collected, this will generate at least six samples from, for example, rivers are concerned perennial rivers and three four samples from seasonal rivers every year.

So, accordingly, when we collect the samples and then monitoring, so we get large number of samples, and then, say we get the data in a systematic way from these either baseline stations or the trend stations.

Then, after the data collected for, say for example, three years station will be classified either as baseline or trends or flux stations. So, according to the guidelines specified by central pollution control board, so we can for surface water, or ground water is concerned, we can have the baseline stations or the trend-cum-surveillance stations.

And then, this can vary, say we can rotate between those stations for particular area, particular zones or particular region is concerned, we can have that kind of flexibility. So, that way, we have to strictly follow the water quality monitoring protocol and then, so, also we have to see this frequency, how frequently we are collecting the samples and analyzing, and then, what kind of parameters we will be looking.

So that definitely depends upon what the intended use, for example, it is for drinking water purpose, there will be the parameters, will be number of parameter will be more and the frequency should be more, but, for example, irrigation or recreation purpose, the frequency can be less like that.

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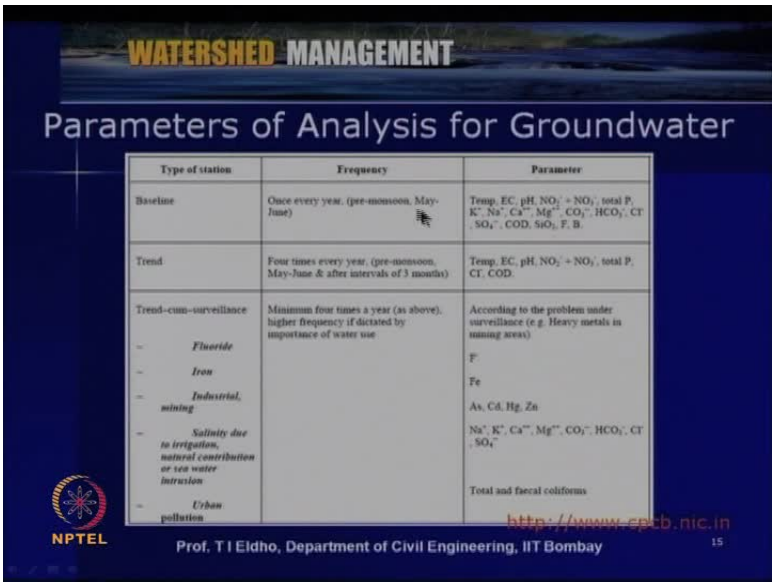

Say, now, say for example, the various parameters, say for example, ground water, if we are collecting ground water for various uses, for example, the type of stations can be baseline or trend or trend cum surveillance. Then frequency can be for baseline; it can be once every year or pre-monsoon mainly between May and June.

And various parameters like temperature, electro-conductivity, pH, etcetera, we can look into. Then trend, say generally it can be four times every year pre-monsoon may, June and after intervals of three months. So, all these parameters, some of the important parameters which we will be checking or monitoring.

Then trend-cum-surveillance stations here minimum four times a year we have to collect the data, and then, we have to analyze for various important parameters like fluoride, iron, industrial mining, soil, salinity, etcetera, and these are some of the important parameters like iron content, arsenic, say cadmium, say mercury, etcetera and total and fecal coliforms, etcetera.

So, that way, depending upon whether it is surface water or ground water, we can identify the type of stations, then frequency and the parameters.

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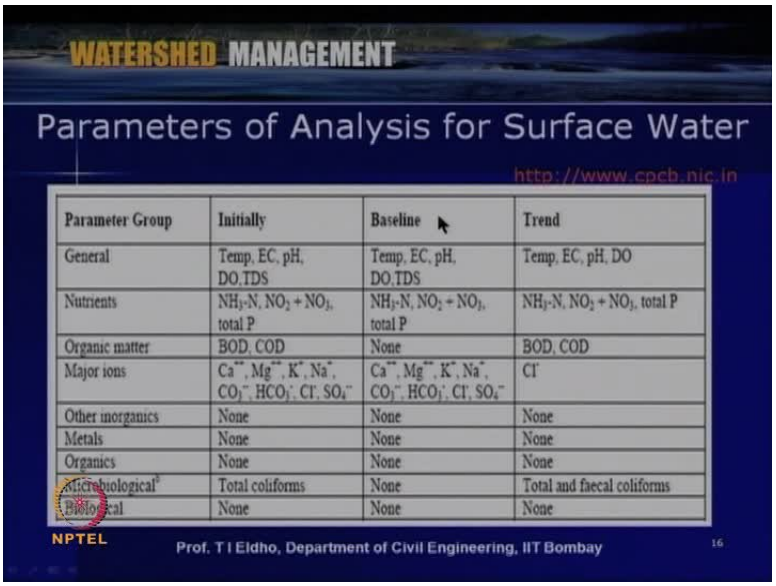

So, that was about for the ground water. Now, in this slide, if you consider the parameter analysis for surface water, so surface water here again the parameters are grouped, then initially the various parameters, then baseline or trend.

So, generally, what we do for temperature, electrical conductivity, pH, dissolved oxygen, total dissolved solids for all. Then, nutrients are concerned, various initially or baseline trend, and organic matter is concerned, initially we have to check BOD COD.

Then again trend is concerned, BOD COD, so then major ions. Other in-organics are concerned, how to deal; then micro biological parameters are concerned, like total coliforms or total and fecal coliforms, how to deal, so, like that.

Then biological are concerned, generally in say none of these things are considered. Since we assume that these thing, biological things, the things are not there for the particular water we consider, say for the intended use.

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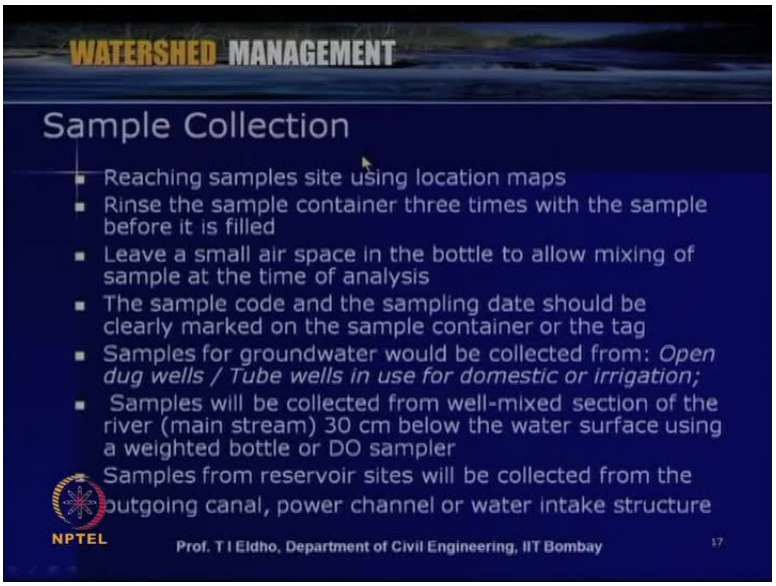

So, now, as far as this step is concerned, the water quality monitoring is concerned. Another important issue is that how to take the samples. So, sample collection is one of the important issue so that we have to collect the samples, appropriately store it, appropriately, and then, sent to the laboratories for various testing purposes so that we will get appropriate results which we, through which we can make sure that the guidelines are met or not.

So, now, the sample collections are concerned, say reaching sample site using location maps. So, this for particular locations specified by the state control board, pollution control board or central pollution control board, how to reach those sampling sites. So, that will be available.

Then we can use specified sampling bottles depending upon the intended water quality which we are going to check. So, first we rinse the sample container three times with the sample before it is filled, then leave a small air space in the bottle to allow mixing of sample at the time of analysis. Then a sample, code and sampling data should be clearly marked on the sample container or the tag so that everything will be met properly so that the particular we identify these site location through specified codes and date like that.

Then samples for ground water, say for example, would be collected from open dug wells or tube wells in use for domestic or irrigation purposes. Then samples will be

collected from well-mixed section of the river, say for example, main stream are concerned thirty centimeter below the water surface using a weighted bottle or dissolved oxygen sampler.

Then samples from reservoir sites will be collected from the outgoing canal or power channel or water intake structure. So, like that, there will be, say specified environmental guidelines or guidelines will be there for sample collections. So, frequency of the sampling and then the analysis are concerned.

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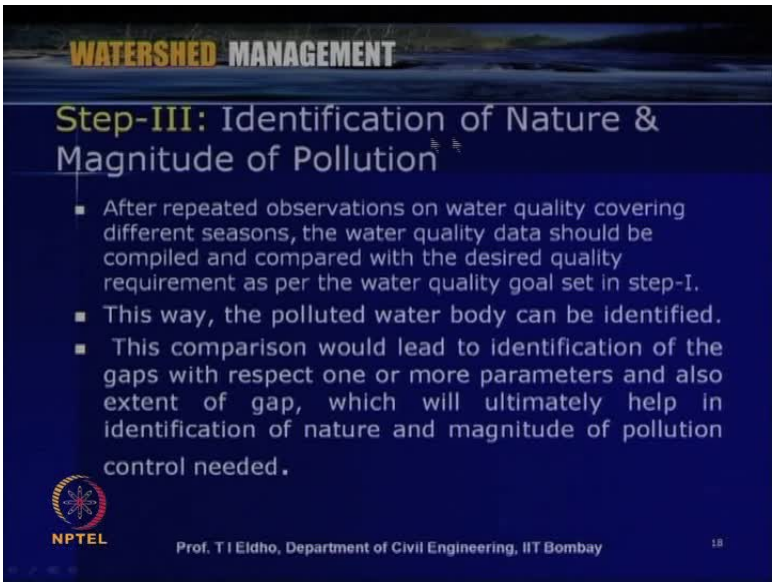

So, all those things we have to meet in this step number two. Now, the step number 3 is identification of nature and magnitude of pollution. So, here after repeated observations or water quality covering different seasons, the water quality data should be compiled and compared with the desired quality requirement as per the water quality goals set in step number one.

So, here, say, we have to do the testing and then see that whether water quality criteria are met. So, this way the polluted water body can be easily identified. So, where the particular location surface water, ground water is concerned, where it is polluted. Then this comparison would lead to identification of the gaps with respect to one or more parameters and also extent of gap, which will ultimately help in identification of nature and magnitude of pollution control needed.

So, that is the identification of nature and magnitude of pollution step number 3 is concerned.

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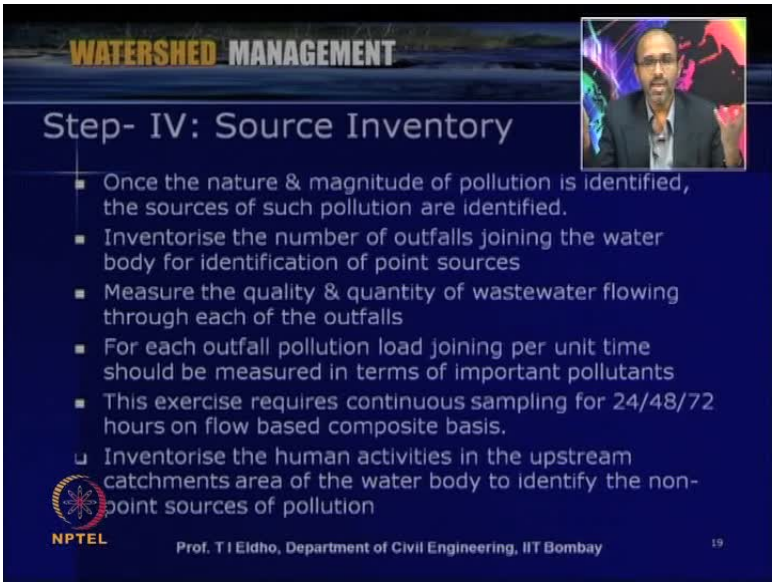

Now step number 4 is related to the source inventory. So, once the nature and magnitude of pollution is identified, the sources of such pollution are identified. Then in inventory we have to make an inventory of the number of outfalls joining the water body for identification of point sources.

So, from where this pollution is coming, how the movement is taking place. So, all this we have to identify, so, source inventory should be there. So, measure the quality and quantity of waste water flowing through each of these outfalls, and then, for each outfall, pollution load joining per unit time should be measured in terms of important pollutants. So, this exercise requires continuous sampling, for example, 24 hours or 48 hours or 72 hours like one day, two day or three days on flow based composite basis.

So, accordingly, we have to see, then we have to make the inventories. So, inventories the human activities in the upstream catchment area of the water body to identify the non-point sources of pollution.

So, the pollution source once we identify, we have to identify whether it is point source or it is non-point source of pollution, and then, again we have to continuously monitor

and take samples, and then, look from where it is coming from and how the movement is taking place so that we can go for various measures.

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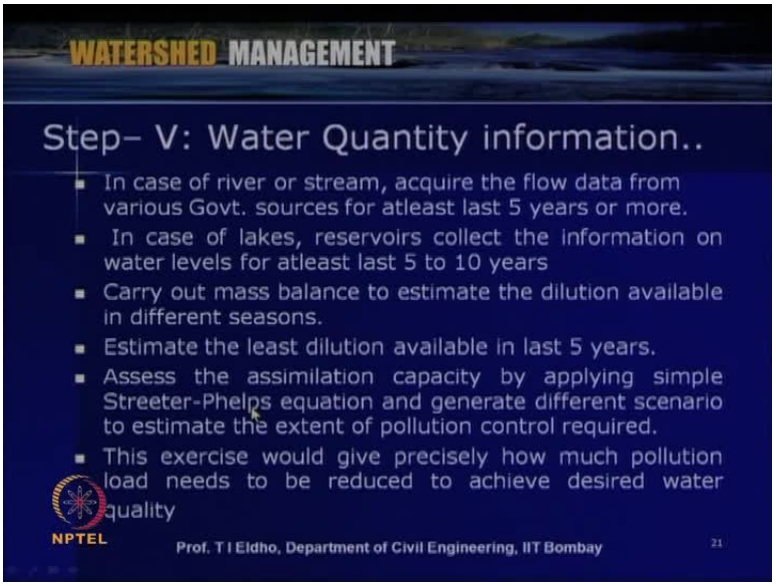

And then, next one is step number 5 - the water quantity information. So, these issues we have already discussed earlier. So, in case of river or stream, we have to acquire the flow data from various government sources, and then, see how the system is these source of water.

In case of lakes and reservoirs, we have to collect the information on water levels of at least five to ten years; then carry out mass balance; then estimate the least dilution available in last five years; then asses the assimilation capacity by applying simple Streeter Phelps equation, for example dissolved oxygen is concerned.

Then this exercise would give precisely how much pollution load needs to be reduced. Then, say in case of river or stream, we have to acquire the flow data, and then, in case of lakes, we get the data.

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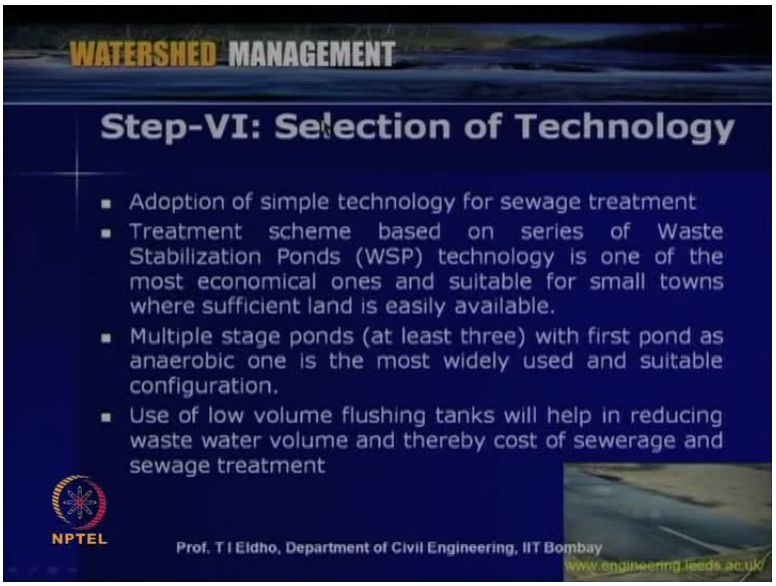

And then step number 6 is selection of technology. So, what kind of technologies we have to choose to reduce the pollution or to improve the water quality.

So, here, the adaption of simple technology for sewage treatments mainly the waste water treatment is concerned, how to treat the sewage. Then treatment scheme based on series of waste step stabilization ponds technology and we have to look for most economical ones.

Then multiple stage ponds with, say for example, at least three ponds with first pond as anaerobic and one is the most widely used and suitable configuration, and then, use of low volume flushing tanks will help in reducing the waste water volume, and thereby, cost of sewage and then sewage treatment.

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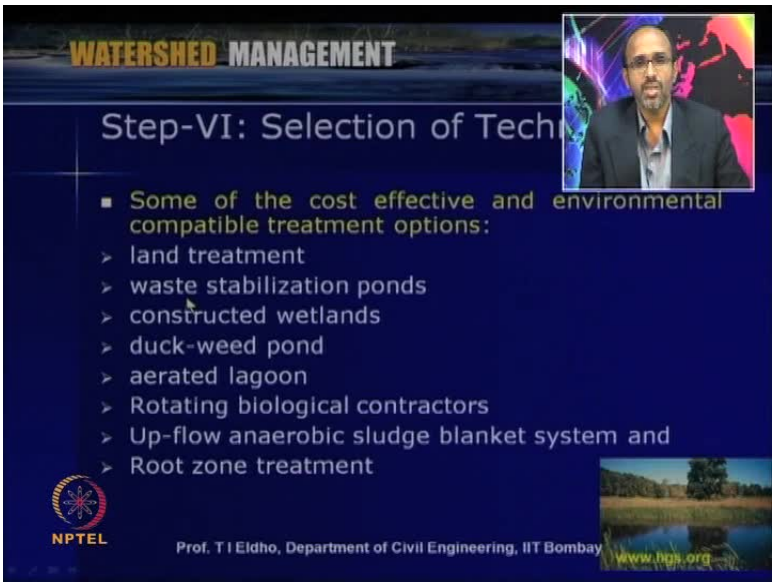

So, like that, we have to select these specified technologies. So, some of the cost effective and the environmental compatible treatment options can be like land treatment, waste stabilization ponds, constructed wetlands, duck-weed ponds, aerated lagoon, rotating biological contractors, up-flow anaerobic sludge blanket systems, root zone treatment like that.

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So, accordingly, the suitable technology we can choose for the specified case, and then, we can reduce the pollutant load coming to the system, and step number seven is

financing the waste management. So, we have to see how much money is available, how we can economically do the things.

So, in India with fast urbanization waste water quantity is approximately about thirteen thousand million liters per day. So, each milliliters per day cost about rupees ten millions for establishing the treatment facilities, and about forty millions for collection facilities, then operation and maintenance may vary about ten percent of the above cost.

The major part of the cost on waste management should be borne by urban population according to the polluter pay principle. So, now, most of the environmental guidelines or water quality guidelines stick into polluter pay principle. So, accordingly, we have to see the financing of the water quality or waste management is concerned. So, polluter pay principle has two benefits - it reduces waste and treatment and can provide source of revenue for financing waste water treatment investment.

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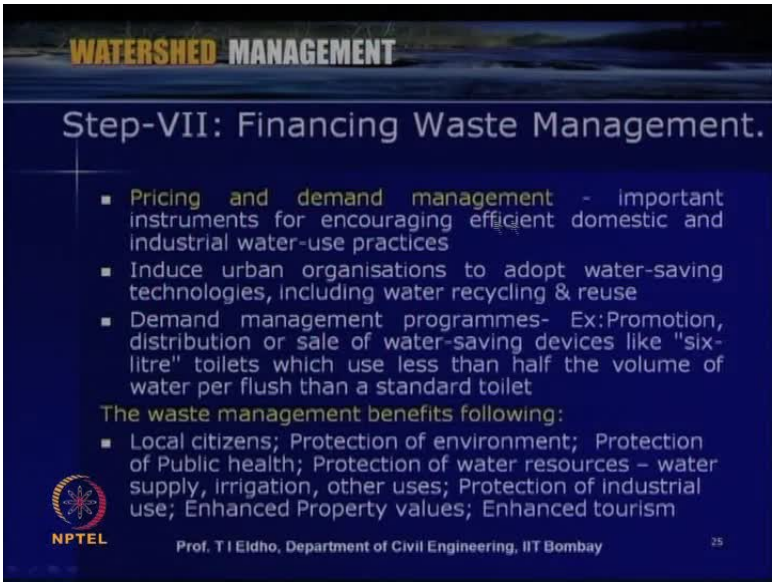

So, like that we can look into the financing waste management. Then pricing and demand management is concerned, we have to see that important instruments for encouraging efficient domestic and industrial water use practices are maintained, and then, we can induce urban organizations to adopt water-saving technologies including water recycling and reuse.

So, these are the two key words like recycling and reuse. Then demand management programs like promotion and distribution or sale of water-saving devices. Then the waste management benefits, say like the benefits will be for local citizen's protection of environment, protection of public health, protection of water resources, then water supply like that.

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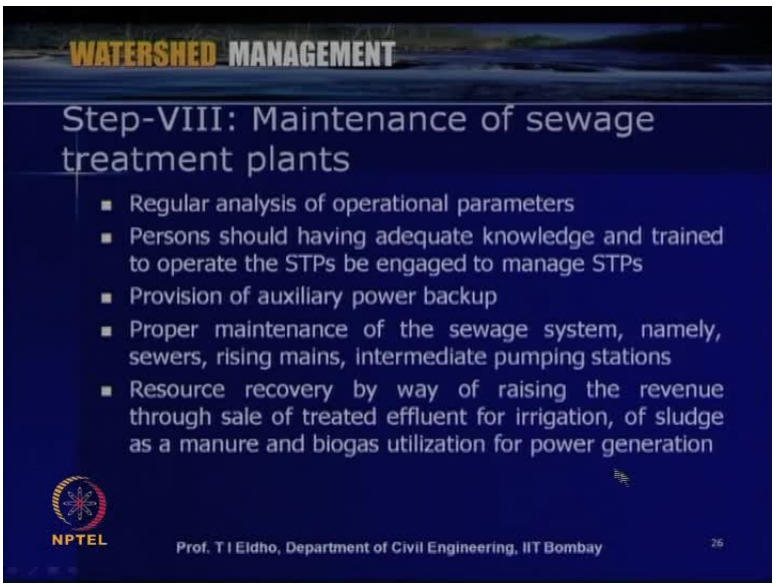

Then step number eight - maintenance of sewage treatment and plans. So, we have to see that regular analysis of operation parameters are done so that, the, we keep the strict maintenance of the treatment plants. Then persons should have adequate knowledge and we have to train to operate the sewage treatment plans, and then, there should be provision of auxiliary power backup; then proper maintenance of the sewage system namely: sewers, rising mains, intermediate pumping stations.

Then resource recovery by way of raising the revenue through sale of treated effluent for irrigation. So, like that we can see that we have to maintain the sewage treatment plants appropriately.

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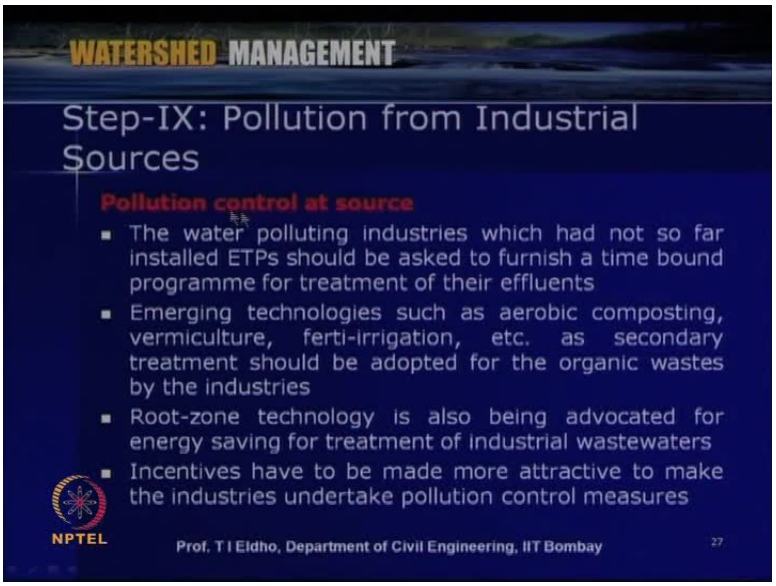

So, that is about the step number 8 when we prepare the guidelines, and step number 9 is pollution from industrial sources. So, pollution, say generally industrial sources are concerned; we can control the pollution at source itself through a various treatment procedure.

So, the water polluting industries which had not so far installed environmental, effluent treatment plants should be effluent treatment plants should be asked to furnish. A time bound program for treatment of their effluents.

So, this we have to put it in the guidelines, and then, strictly implement. Then emerging technology, such as, aerobic composting, vermiculture, ferti irrigation, etcetera, and then, secondary treatment or the secondary treatment like using the waste water for irrigation purpose or vermiculture should be adopted for the organic wastes. Then root-zone technology is also being advocated for energy saving for treatment of industrial waste water, and then, incentives we have to give for a the industry which go for appropriate pollution control measures.

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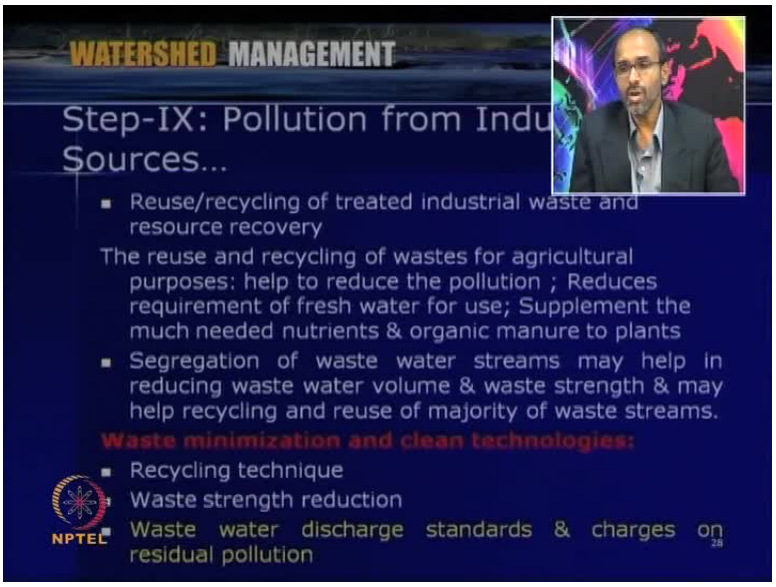

So, that is also important. Then re-use and recycling we have to now the main motto is 0 waste discharge. So, that is our, the, motto of most of the industries so that we can achieve through re-use and recycling of the industrial wastewaters. The reuse and recycling of waste for agricultural purposes help to reduce the pollution, reduced the requirement of fresh water for use, and supplement the much needed nutrients.

Then waste minimization and clean technologies like your recycling techniques, which this recycling and re-use will be discussing later in another module; somewhat more details will be discussed.

Then waste strength reductions, then waste water discharge standards and charges on residual pollution residual pollution, so, like that we can look into.

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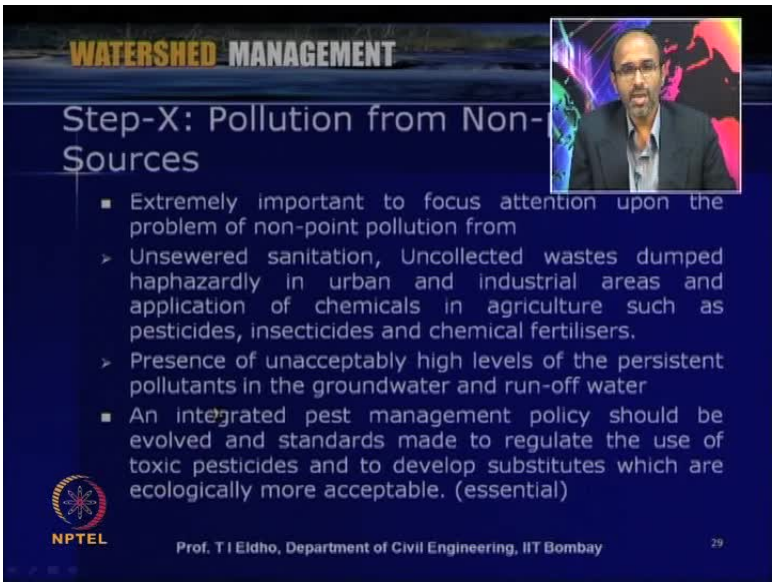

Then tenth step is pollution from non-point sources. So, another important source of pollution is non-point source. So, this is extremely important to focus attention upon the problem of non-point pollution from like unsewered sanitation, uncollected wastes dumped haphazardly in urban and industrial areas, and application of chemicals in agriculture, such as, pesticide insecticides and chemical fertilizers. Then presence of unacceptable high levels of the persistent pollutants in ground water or surface water.

Then the pest management is concerned, integrated pest management policy we can evolve so that, say we can use very less pesticides for the control of the pest.

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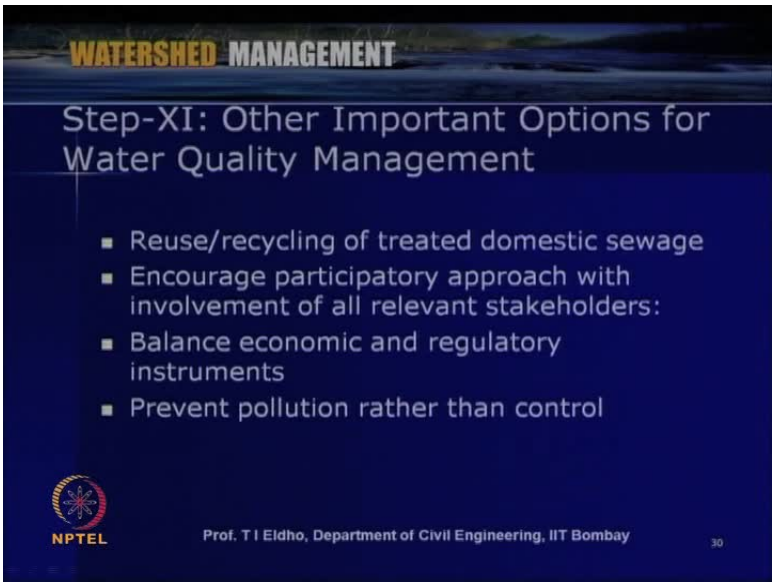

Then the last one is other important options for water quality management include, say as we discussed reuse and recycling of treats treated domestic sewage.

So, these issues we will be discussing later in a later module. Then encourage participatory approach with involvement of all relevant stakeholders. Then balance economic and regulatory instruments; then prevent pollution rather than control.

So, the main motto should be we have to reduce or we have to prevent the pollution or the, say when we deal with water quality management, our environmental guidelines or water quality guidelines. The main motto is prevent the pollution than the controlling.

So, once polluted to remediation or that is very difficult. So, first we have to prevent the pollution to the environment either to the land or to the aquatic systems or to the soil. Then, say we have to have very strict rules and regulations or guidelines we have to set up, and then, this environmental guidelines should be strictly implemented through various monitoring or say the body is like a central pollution control board or state pollution control board should take appropriate actions to implement this guidelines very strictly.

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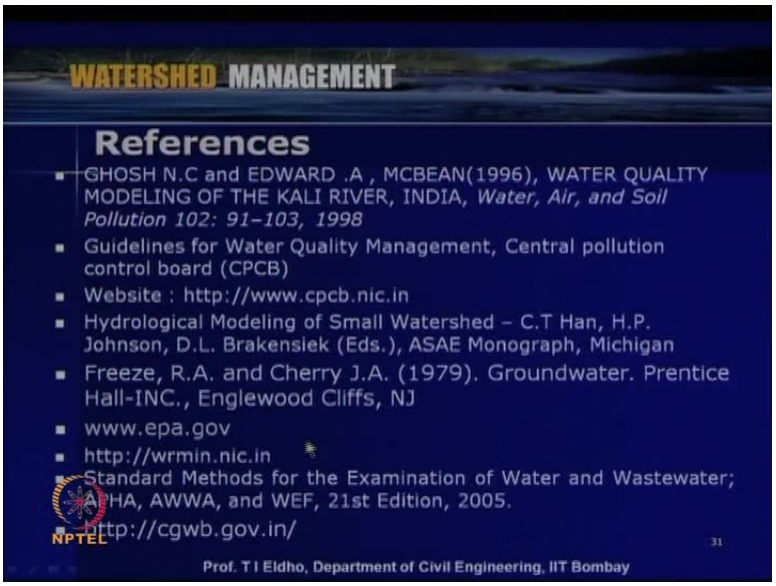

So, some of the references used for today's lecture mainly from central pollution control board websites, and then, epa websites.

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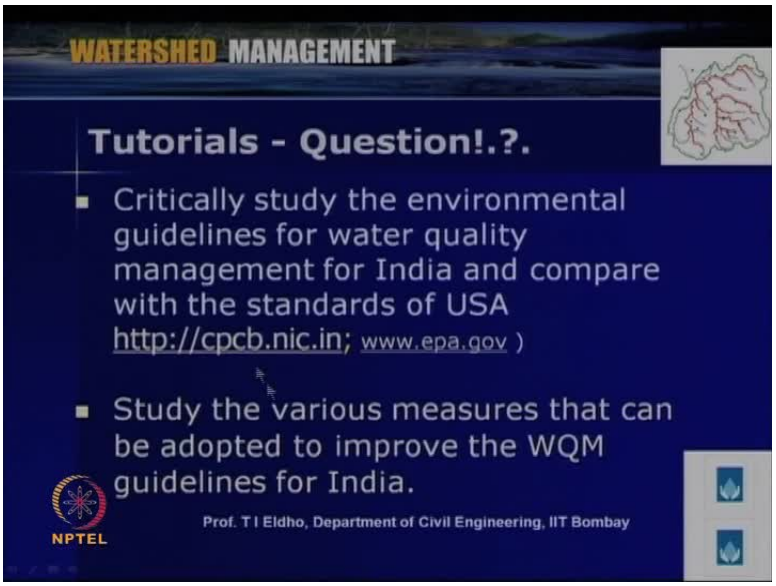

Then few questions, for tutorial questions - critically study the environmental guidelines for water quality management for India and compare with the standards of USA. So, these details are available in the website.

So, study this and compare the study of various measures that can be adopted to improve the water quality management guidelines, for example India. So, what is there, you study and then compare, and how we can improve, then few self-evaluations or assignment questions.

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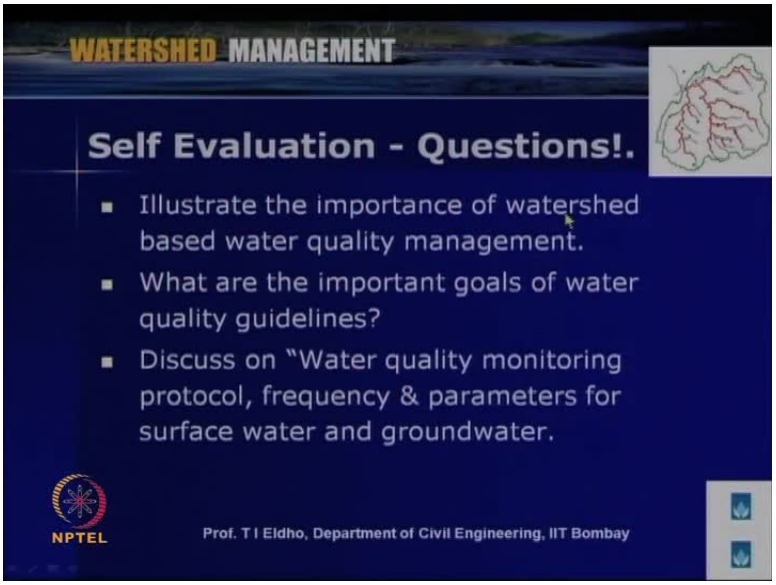

Illustrate the importance of watershed based water quality management. Then what are the important goals of water quality guideline. Discuss on water quality monitoring protocol frequency and parameters for surface water and ground water.

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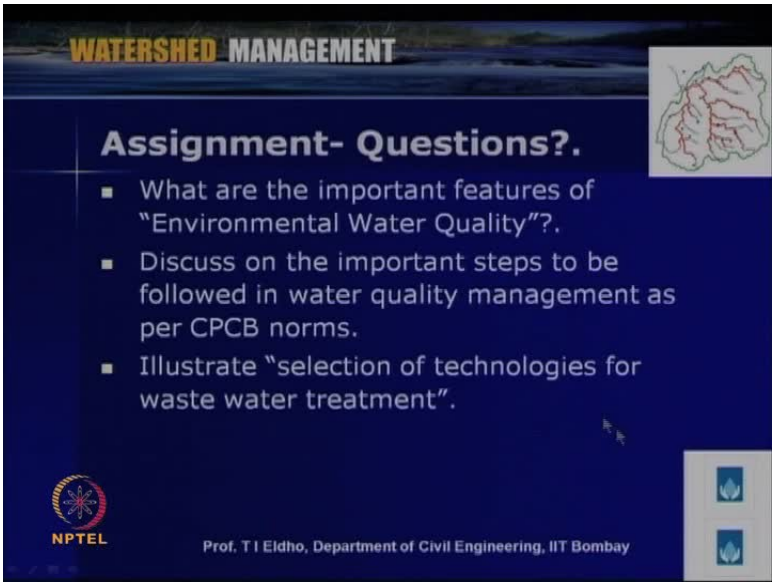

And then what are the important features of environmental water quality. Discuss on the important steps to be followed in water quality management as per central pollution control board norms. Illustrate the selection of technologies for waste water management.

So, all this details we can, you can get from today's lecture or through the various sources as I mentioned. So, with this, the module on water quality management is over. So, we discussed the issues related to water quality management in four lectures.

So, now, we will be going to the next module. So, thank you.