WATER QUALITY ANALYSIS FROM DIFFERENT SOURCES AND ESTIMATION OF WATER LOSS DUE TO TAP FIXTURE

Project Report submitted in partial fulfilment of the requirement for the degree of

Bachelor of Technology.

in

Civil Engineering

under the Supervision of

Prof. Dr. Veeresh Gali

By

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CERTIFICATE

This is to certify that project report entitled "Water quality analysis from different sources and estimation of water loss due to tap fixture", submitted by AYUSH SHRIVASTAVA (111707) and CHIRAG LODHA (111688) in partial fulfilment for the award of degree of Bachelor of Technology in Civil Engineering to Jaypee University of Information Technology, Waknaghat, Solan has been carried out under my supervision.

This work has not been submitted partially or fully to any other University or Institute for the award of this or any other degree or diploma.

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CONTENTS

LIST OF TABLES

Chapter 7

LIST OF FIGURES

Chapter 1
INTRODUCTION

The much do you really know about the water you drink every day? Where does it come from? Is it safe to drink? Is a home water treatment system necessary? How can drinking water be protected? Water is second to oxygen as being essential for life. People can survive days, weeks, or even longer without food, but only about four days without water. Urban growth and rapid increase in population have induced tremendous pressure on natural resources. On the other hand concern about the degradation of water quality is now widespread among the public as the water is of utmost physiological importance in the human body. About 80% of the diseases of the world population and more than one-third of the deaths in the developing countries are due to contamination of water Trace elements are essential for human health. However excess concentration of these elements cause health disorder. Man can control some undesirable chemical constituents in water before it enters the ground. But once the water enters the ground man’s control over the chemical quality of percolating water is very limited. Ground water composition in a region depends on the natural (such as wet and dry deposition of atmospheric salts, evaporation, soil-rock- water interactions) and anthropogenic processes, which can alter or modify the natural system of hydrological cycle has stated that the type and extent of chemical contamination of the ground water largely depend on the geochemistry of the soil, through which the water flows prior to reaching the aquifers.

There is no way to overstate the fresh water crises on the planet today.

The world is running out of fresh water, fresh water is a finite resource. The amount of fresh water supply provided by the hydrological cycle does not increase. Water everywhere on the planet is an integral part of the global hydrological cycle. Precipitation originates as evaporation from land and the oceans. Soil moisture is used by plants which returned more moisture to the atmosphere, which then returns to earth as rain and snow. Humans share the world with other creatures that also need water, water shortage is also crisis for wildlife. Out of 25 biodiversity hotspots designated by conservation international, 10 are located in water shortage region. Rivers are running dry. Many major rivers like Indus are so over-tapped that they now run dry for part of year. Water tables are falling in every continent. Aquifer depletion is a new problem. Water tables are falling down from the over-pumping of ground water in large portion of India. India has the highest volume of annual ground water overdraft of any nation in the world. Check your faucets -- do any of them drip? Well, maybe it's just a small drip -- how much water can a little drip waste? True, a single drip won't waste much water. But think about each faucet in your home dripping a

little bit all day long. What if every faucet in every home on your block ... in your town ... in your state also dripped? The drips would add up to a flood of water wasted down the drain.

1.1. Study area

Shimla, the capital of Himachal Pradesh, is a hilly town situated in the Himalayas. It is at an average altitude of 2434 m. It lies at latitude 30°6" N and longitude 77°11" E. Shimla district presents an intricate mosaic of high mountain ranges, hills and narrow deep valleys with altitude ranging from 1000 to 3000 m above MSL. In the areas underlain by high hill ranges of Himalayas, the valleys are narrow and deep with steep slopes trending in NW-SE direction. The terrain is moderately to highly dissected with steep slopes. The altitude is higher in north eastern parts and decreases towards south and west. Soil is generally sandy loam in valley areas of the district and in rest of the hilly and mountainous areas soil is skeletal, soil depth is generally shallow except in areas having good vegetative cover. It is generally dry, shallow and deficient in organic matter. Landslides are the common features in mountainous terrain. Soils are rich in nutrients and thus are fertile. Central Ground Water Board, NHR, Dharamshala, under exploration to know the aquifer system of the hard rock one deep tube well of 302 m bgl depth has been constructed at Ashwani Khad. The well has a discharge of about 1173 lpm with drawdown of 24.62 lpm/m and transmissivity of 70.39 m2 /day. The depth of water tables changes with monsoons going down to 4-6 m during premonsoon and rises to 0-3m during monsoon and post monsoon period.

1.2. Climate

Shimla is in the humid sub-temperate zone. The town remains cool and pleasant mostly except for the winter months when the temperature drops to about 6°C. The city receives snowfall in December and January. The town experiences monsoon from June to September.

The average annual rainfall is 1000 mm. Shimla is a tourist place and summer is the main tourist season because of its cool climate.

1.3. Water supply

Shimla district is drained by streams/rivers forming part of the drainage basins of the Sutluj, the Yamuna, the Pabbar and Tons rivers. major part of the district is drained by tributaries of Sutluj river. There are seven surface water sources, which supply raw water to four water treatment plants. Cherot nallah, Kufri nallah and springs are the raw water sources for Dhalli WTP. Ashwani Khad is the source of raw water for Ashwani WTP. Chairh nallah is the raw water source for chairh WTP. Nauti Khad and Kalyan nallah are the raw water sources for Gumma WTP. All the sources are well protected. It was reported that 80% of the population is served by these water supplies. However, to meet the present and future requirement, new raw water sources are to be tapped with augmentation of treatment plants capacity.

Chapter 2

Literature review

2.1. A CASE STUDY OF SHIMLA WATER CATCHMENT SANCTUARY, HIMACHAL PRADESH

Shimla -the state capital and a major tourist destination attracts both national and international tourists, with a permanent population of nearly 0.4 million people and at any point of time houses more than 15,000 floating population. The influx of tourists visiting Shimla increases drastically particularly during summer season thereby, leading to an increased water demand. The city population has grown tremendously in recent years hence, putting an additional pressure on the existing infra-structure of the city. The city requires 42 Million Lts water in a day (MLD) whereas, it generate/ receives only 30 MLD of water thereby leading to acute water shortage each year especially during summers. Owing to the heavy slope here, water harvesting is certainly a difficult task and accordingly, unlike other urban cities in India, Shimla largely depends on the surface sources like spring or streams for its adequate and safe water demand. The local distribution system of Shimla is more than 100 years old and the leakage losses are quite high due to damaged old pipes and leaking joints. Moreover, there is also considerable loss arising out of illegal tapping of water. A study conducted by National Environmental Engineering Research Institute (NEERI) had pegged the leakage losses at more than 45%. The cost of water supply is very high as water is generally sourced from the valleys and pumped up to the residential areas. With the increase in demand, the supply continued to be augmented several times. The system of earlier water supply in Shimla city comprised of tapping of spring water, old baoris and stream sources, treating it and pumping the same to the storage tanks, which was linked with the pipe network and carried to the consumer end. In view of all this, there is an urgent need to study the water management framework of Shimla city to address the problem and implement some measures or techniques that could be used to deal with the present and future demand of water to a great extent. Present water supply and demand of Shimla city is given in **Table 2.1.**

Table 2.1: Present Water Supply and Demand of Shimla City

S.NO.	Description	Amount of water
1.	Total water demand as per city agency (Shimla MC)	42 MLD
2.	Per capita water demand as per city agency (Shimla MC)	135 lpcd
3.	Total available water	30+15=45 MLD
4.	Per capita supply	135 lpcd
5.	15% Leakage loss or unaccounted water	15% of 45 MLD= 6.75 MLD
6.	Total available water after leakage loss	45-6.75=38.25 MLD
7.	Actual supply (after deducting leakage losses)	123 lpcd

Table 2.2: Projected Water Demand by the Year 2039

S.NO.	Description	Total Population	Per Capita supply (ltrs/day)	Water requirement (ltrs/day)
1.	Permanent population	4, 23,884	135	5,72,24,340
2.	Floating population	16, 7111	135	22,55,985
3.	Average water available from existing resources			30 MLD
4.	15% Transportation & Distribution losses			4.5 MLD
5.	Total available water			25.5 MLD
6.	Balance water requirement for year 2039 36 MLD			36 MLD

FIGURE 2.1: Water reservoir in shimla: Water catchment Sanctuary

Chapter 3.

EXPERIMENTAL INVESTIGATION

Detailed descriptions about the materials used, specimens tested and testing methods are essentials for an experimental investigation. Hence they are described in detail in the following sections.

Table 3.1: Apparatus used

S.NO.	**Experiment performed**	**Apparatus used**
1.	Turbidity	Nephelometric turbidity meter, test tubes
2.	pH	colorimetric paper
3.	Alkalinity	Stand, buretle, funnel, conical flask, beaker
4.	Conductivity	Conductivity Meter, Beakers, Thermometer
5.	Total dissolved solids	Beaker,Measuring Cylinder, Filter paper, Balance
6.	Acidity	Burette, Burette stand, pipette, standard flask, wash bottle, beakers
7.	Dissolved oxygen	Burette, Burette stand, pipette, standard flask, wash bottle, beakers, measuring, conical flask
8.	BOD	BOD incubator, burette, burette stand, wash bottle, 300ml glass stopper BOD bottle
9.	Chloride content	Burette, pipette, beakers, wash bottle

3.1. DETERMINE pH VALUE OF GIVEN WATER SAMPLE

3.1.1 Materials required

pH paper, dropper

3.1.2. Procedure

1. Still holding the dropper, move it from the beaker over to the pH strip and release it.
2. To find the pH value of the solution, select the colour from the menu on the left by clicking and dragging it to the pH strip and comparing it.
3. The colour that matches with the spot on the pH strip indicates the pH value of the solution.

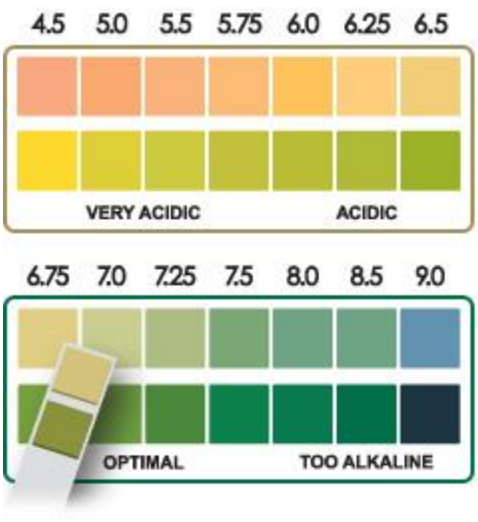

Figure 3.1: pH paper

3.2. TO DETERMINE THE AMOUNT OF DISSOLVED OXYGEN PRESENT IN GIVEN SAMPLE

3.2.1. Apparatus Required

Burette with stand, pipette, conical flask, measuring jar.

3.2.2. Chemicals Required

Sodium Hydroxide, Manganous Sulphate, Potassium iodide, Sodium Thiosuiphate, Conc.H2SO4, Starch.

3.2.3. Reagent Preparation

1. Manganous Sulphate: 12 gms of Manganous Sulphate is dissolved in 25m1 of distilled water.
2. Alkaline —Iodide Solution 9 gms of Sodium Hydroxide and 2.5gms of Potassium iodide are dissolved in 25m1 of distilled water.
3. Sodium thiosulphate Solution (O.O1N) 2.48gms of Sodium thiosulphate is dissolved in 1 litre of water.
4. Starch Solution: Take 1 gm of starch. Prepare paste with distilled water. Make 100 ml with water and boil by stirring and cool it.
5. PipetteSolution: 2m1 of Manganous Sulphate solution and 2ml of alkaline Iodide Solution is added to 250m1 of the sample taken in a reagent bottle. The bottle is stoppered and shaken thoroughly when the precipitate formed is settled, 2ml of Cone. HCL or Conc. H2S04 is added and shaken thoroughly until the precipitate gets dissolved completely.

3.2.4. Procedure

1. Take 50ml of clear pipette solution in a conical flask.
2. Add to it one or two drops of starch indicator until the colour becomes blue.
3. Titrate against Standard Sodium Thiosulphate solution until the disappearance of colour.
4. Repeat the titration for concordant values.

3.2.5. Sanitary Significance

In liquid wastes Dissolved Oxygen is the most important factor in determining whether aerobic or anaerobic organisms carryout biological changes. If sufficient D.O is available aerobic organisms oxidize the wastes to stable products. If D.O is deficient anaerobic bacteria take part in the conversion and reduce the waste often to obnoxious and nuisance conditions are usually resulted.

3.3. TO FIND OUT THE TURBIDITY OF GIVEN WATER SAMPLE

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3.3.1. Principle

When light in passed through a sample having Suspended particles, some of the light in Scattered by the particles. The scattering to the light is generally proportional to the turbidity. The turbidity of sample is thus measured from the amount of light scattered by the sample, taking a reference with standard turbidity suspension.

3.3.2. Apparatus Required

Nephelometers turbidimeter, Sample tubes

3.3.3. Reagents Preparation

1. Dissolve 1.0gm Hydrazine sulphate and dilute to 100m

2. Dissolve 10gm Hexa methylene Tetra min& and dilute in l00ml

3. 5ml of each of the above solution (1 and 2) in a l00ml volumetric flask and allow to stand for 24 hrs at 25±3°C and dilute to l000ml. This solution has a turbidity of 40NTU.

3.3.4. Procedure

1. The Nephelometer turbidimeter in switched on and waited for few minutes till it warms up.

2. The instrument is set up with a 4ONTU standard suspension

3. The sample is thoroughly shaked and kept it for sometimes so the air bubbles are eliminated

4. The sample is taken in Nephelometer sample tube and the sample is put in Sample chamber and the reading is noted directly.

5. The sample is diluted with turbidity free water and again the turbidity is read.

3.4. DETERMINATION OF TOTAL SOLIDS

3.4.1. Apparatus Required

Crucible, Chemical balance, hot air oven, muffle furnace, desicator

3.4.2. Procedure

1. Take the empty crucible. Clean it thoroughly and make it perfectly dry. Take the weight of empty crucible.

2. Add to the crucible 20m1 of liquid sample.

3. Heat the crucible in water bath at 100°C till the entire liquid in a crucible evaporates and dry residue remains at the bottom then place the crucible in oven at 103°C for I hour.

4. Take the weight of the crucible with residue after cooling it in a desicator for 20 minutes. Let us weight be W2 gm.

5. Take the sample crucible and keep it in a muffle furnace at a temperature of 650oC for 30mm

6. The volatile and organic matter in the solids evaporated and the crucible contains only fixed solids.

7. Cool the crucible in a desicator and weight it with the fixed solids residue. Let the weight be W3gm

Environmental Engineering Significance:

The water which contains of high volatile solids is not suitable for drinking purposes. The result of high volatile solids indicates that the water may have been pollutes by domestic waste or other organic waste. In general, ground water is free from volatile solids unless they have been polluted by waste seepages. But, well water may have high volatile solids due to lack of proper protection around well to prevent seepage of used water. Surface water may also have high volatile solids due to disposal of domestic and other wastes.

3.5. TO DETERMINE AMOUNT OF CHLORIDE IN SAMPLE

3.5.1. Apparatus required

Burette with stand, pipette, conical flask measuring jar etc.,

3.5.2. Chemicals Required

Sodium Chloride, Silver nitrate, Potassium Chromate

3.5.3. Procedure

1. Pipette 20 ml of sodium chloride solution in to the conical flask.

2. Add one or two drops of potassium chromate solution.

3. Titrate against Silver Nitrate solution until the appearance of reddish brown colour

4. Repeat the titration for concordant values.

3.5.4. Environmental Significance of Chlorides

Chloride associated with sodium exerts salty taste, when its concentration is more than 250 mg/1 .There is no known evidence that chloride constitute any human health hazard. For this reason, chlorides are generally limited to 250 mg/L in supplies intended for public use. In many areas of world where water supplies are scarce, sources containing as much as 2000mg/L are used for domestic purposes without the development of adverse effect once the human system becomes adapted to the water.

3.6. TO DETERMINE ALKALINITY

3.6.1. Apparatus required

Burette, pipette, conical flask, beakers, funnel, and dropper

3.6.2. Chemical Required

N/10 HCl, phenolphthalein and methyl orange indicators, Sample water

3.6.3. Procedure

1. Pipette out 20 ml of water sample into a conical flask. Add 1-2 drops of Phenolphthalein indicator.

2. Rinse and fill the burette with N/10 HCl.

3. Titrate the water sample in conical flask with N/10 HCl till the pink colour just disappears.

4. Note down the reading and repeat to get concordant readings.

5. Again take 20 ml of water sample in conical flask and add methyl orange indicator to it.

6. Titrate the water sample in conical flask with N/10 HCl till the yellow orange colour changes to orange red.

7. Note down the reading and repeat to get concordant readings.

Chapter 4

WATER QUALITY INDEX PROTOCOL

In an effort to develop a system to compare water quality in various parts of the country, over 100 water quality experts were called upon to help create a standard Water Quality Index (WQI). The index is basically a mathematical means of calculating a single value from multiple test results. The index result represents the level of water quality in a given water basin, such as a lake, river, or stream.

It is important to monitor water quality over a period of time in order to detect changes in the water's ecosystem. The Water Quality Index, which was developed in the early 1970s, can give an indication of the health of the watershed at various points and can be used to keep track of and analyze changes over time. The WQI can be used to monitor water quality changes in a particular water supply over time, or it can be used to compare a water supply's quality with other water supplies in the region or from around the world.

4.1. Determination of water quality index

To determine the WQI, the following nine water quality parameters are measured:

4.1.1. Biochemical Oxygen Demand

The Biochemical Oxygen Demand (or BOD) is a measure of the amount of food for bacteria that is found in water. Bacteria utilize organic matter in their respiration and remove oxygen from the water. The BOD test provides a rough idea of how much biodegradable waste is present in the water. (Biodegradable waste is usually composed of organic wastes, including leaves, grass clippings, and manure).

4.1.2. Dissolved Oxygen

The dissolved oxygen test measures the amount of life-sustaining oxygen dissolved in the water. This is the oxygen that is available to fish, invertebrates, and all other animals living in the water. Most aquatic plants and animals need oxygen to survive; in fact, fish will drown in water when the dissolved oxygen levels get too low. Low levels of dissolved oxygen in water are a sign of possible pollution.

4.1.3 Fecal Coliform

Fecal coliform is a form of bacteria found in human and animal waste.

4.1.4. Nitrates

Nitrates are a measure of the oxidized form of nitrogen and are an essential macronutrient in aquatic environments. Nitrates can be harmful to humans, because our intestines can break nitrates down into nitrites, which affects the ability of red blood cells to carry oxygen. Nitrites can also cause serious illnesses in fish.

4.1.5. pH

The pH level is a measure of the acid content of the water. Most forms of aquatic life tend to be very sensitive to pH. Water containing a great deal of organic pollution will normally tend to be somewhat a cidic. Water with a pH of 7 is considered neutral. If the pH is below 7, it is classified as acidic, while water with a pH greater than 7 is said to be alkaline. The pH of tap water in the U.S. is usually between 6.5 and 8.5.

4.1.6. Temperature Change

The water temperature of a river is very important, as many of the physical, biological, and chemical characteristics of a river are directly affected by temperature. Most waterborne animal and plant life survives within a certain range of water temperatures, and few of them can tolerate extreme changes in this parameter. Using the same thermometer, the water temperature should be checked at the test site and at a similar site one mile upstream. Care should be taken when taking the temperature upstream to ensure that the amount of sunlight and the depth of the river are similar to the original test site.

4.1.7. Total Dissolved Solids

This is a measure of the solid materials dissolved in the river water. This includes salts, some organic materials, and a wide range of other things from nutrients to toxic materials. A constant level of minerals in the water is necessary for aquatic life. Concentrations of total dissolved solids that are too high or too low may limit growth and lead to the death of many aquatic life forms.

4.1.8. Total Phosphate

Phosphates are chemical compounds made from the elements phosphorous and oxygen; they are necessary for plant and animal growth. Phosphates can be present in water in many forms, so total phosphate gives an estimate of the total amount of phosphate potentially available in a given water supply.

4.1.9 Turbidity

Turbidity is a measure of the dispersion of light in a column of water due to suspended matter. The higher the turbidity, the cloudier the water appears. If water becomes too turbid, it loses the ability to support a wide variety of plants and other aquatic organisms.

After the nine water quality tests are completed and the results recorded, a "Q" value is calculated for each parameter, and the overall WQI for the sampling site is then calculated.

4.2. Calculating the overall water quality index

After the nine water quality tests are completed and the results recorded, you can calculate the Water Quality Index (WQI) for the sampling area you tested.

To calculate the overall WQI, you must first compute what are known as Q-values for the results you obtained for each of the nine tests and record them on the WQI worksheet. This section outlines the procedures for computing these values:

1. Locate and print the chart for the appropriate test parameter, using the links below).

2. Locate and mark your test result on the bottom, or horizontal axis, of the chart.

3. Beginning at your mark, draw a vertical line up until it intersects the curve on the chart.

4. From the point where your line intersected with the curve, draw a horizontal line to the left until you reach the vertical axis of the chart.

5. Record the value where this horizontal line intersects the vertical axis of the chart on the form. This would be the Q-value for the test.

6. Repeat each of these steps to find the Q-value for each of the remaining tests results.

4.2.1. Completing the WQI Calculation

The Q-value for each test should then be multiplied by the weighting factor shown on the Worksheet for each test, and the answer should be recorded in the "Total" column. The weighting factor indicates the importance of each test to overall water quality. For example, the weighting factor for fecal coliform is 0.16, so it is considered more important in evaluating the overall water quality than nitrates, which only has a 0.10 weighting factor. Finally, add the numbers shown in the Total column to determine the overall Water Quality Index (WQI) for the water source tested. Compare your Index result to the scale shown in Table 1 to determine the water quality rating for the water supply tested.

TABLE 4.1: WATER QUALITY INDEX SCALE

91-100	Excellent water quality
71-90	Good water quality
51-70	Medium or average water quality
26-50	Fair water quality
0-25	Poor water quality

Water supplies with ratings falling in the good or excellent range would able to support a high diversity of aquatic life. In addition, the water would also be suitable for all forms of recreation, including those involving direct contact with the water. Water supplies achieving only an average rating generally have less diversity of aquatic organisms and frequently have increased algae growth.

Water supplies falling into the fair range are only able to support a low diversity of aquatic life and are probably experiencing problems with pollution. Water supplies that fall into the poor category may only be able to support a limited number of aquatic life forms, and it is expected that these waters have abundant quality problems. A water supply with a poor quality rating would not normally be considered acceptable for activities involving direct contact with the water, such as swimming.

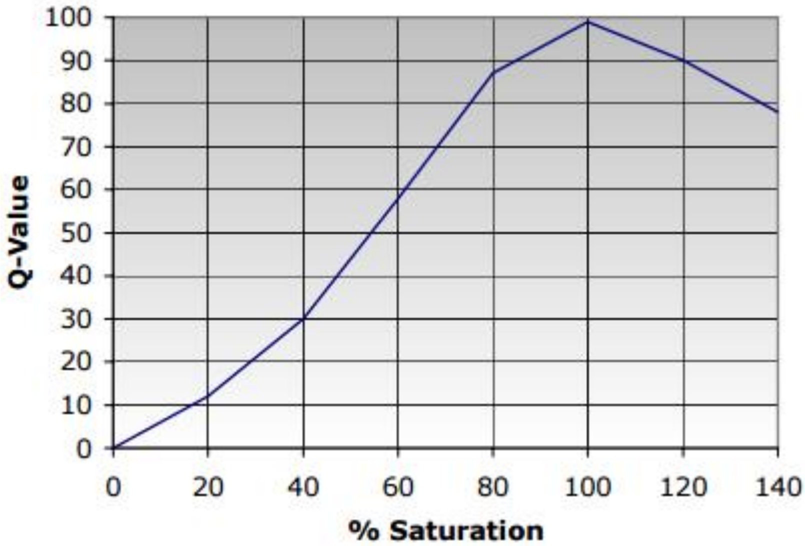

FIGURE 4.1: Q-VALUE CHART FOR DISSOLVED OXYGEN

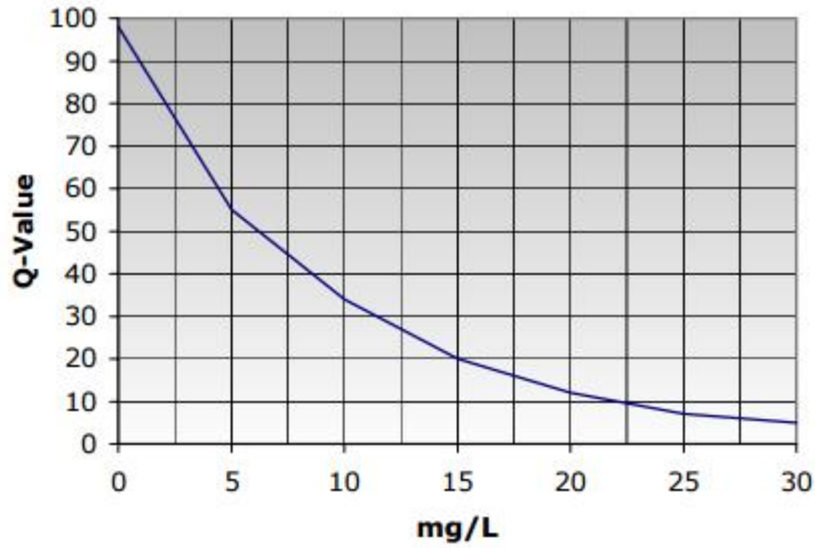

FIGURE 4.2: Q-VALUE CHART FOR BOD

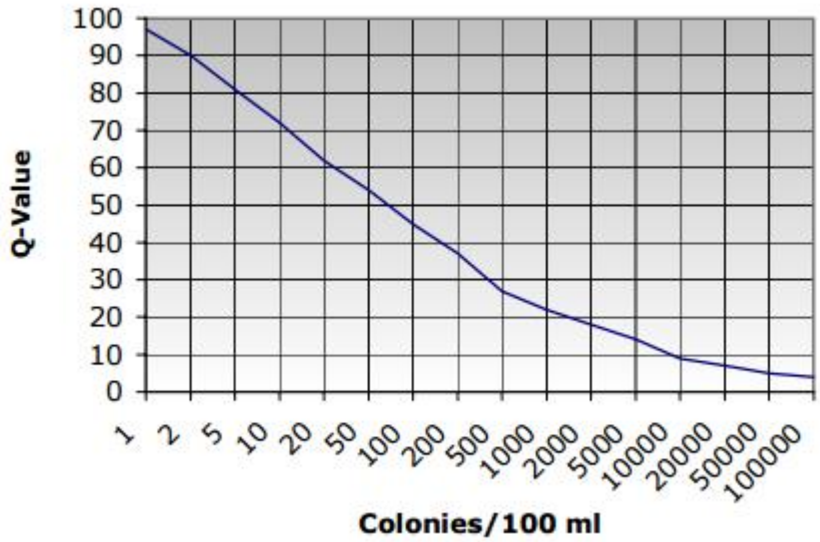

FIGURE 4.3: Q-VALUE CHART FOR FECAL COLIFORM

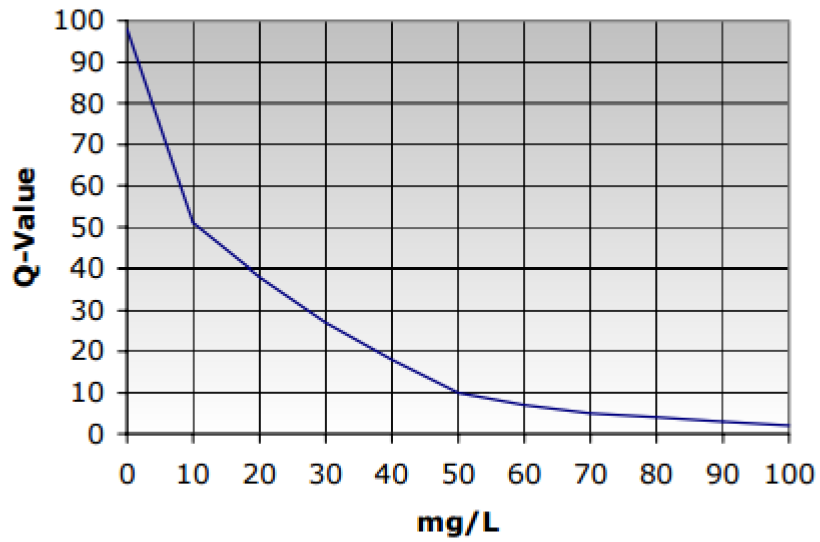

FIGURE 4.4: Q-VALUE CHART FOR NITRATES

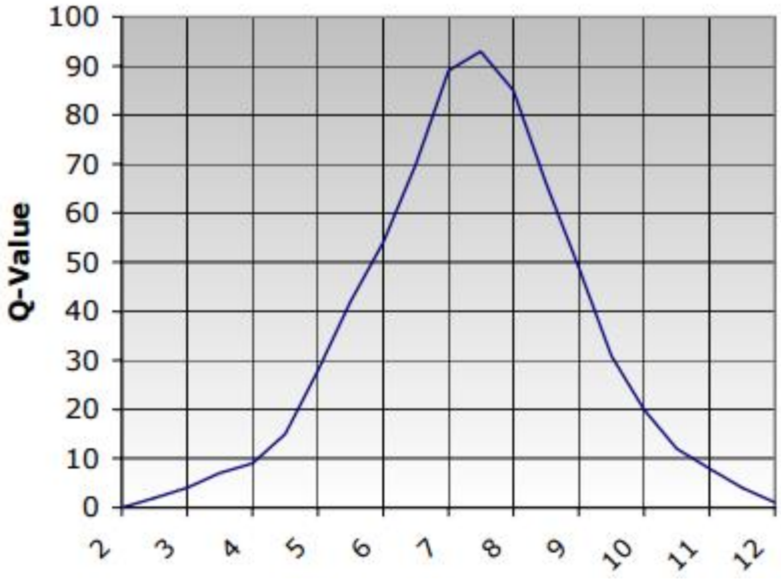

FIGURE 4.5: Q-VALUE CHART FOR PH

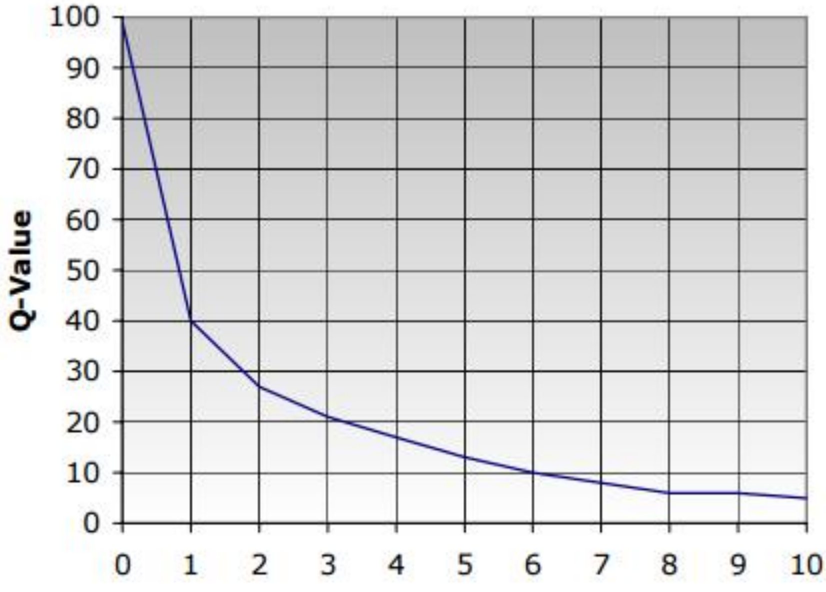

FIGURE 4.6: Q-VALUE CHART FOR PHOSPHATE

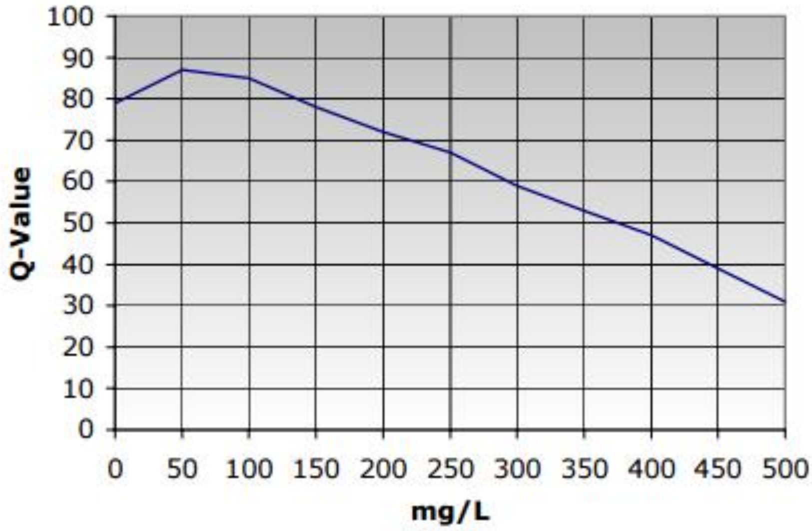

FIGURE 4.7: Q-VALUE CHART FOR TOTAL DISSOLVED SOLIDS

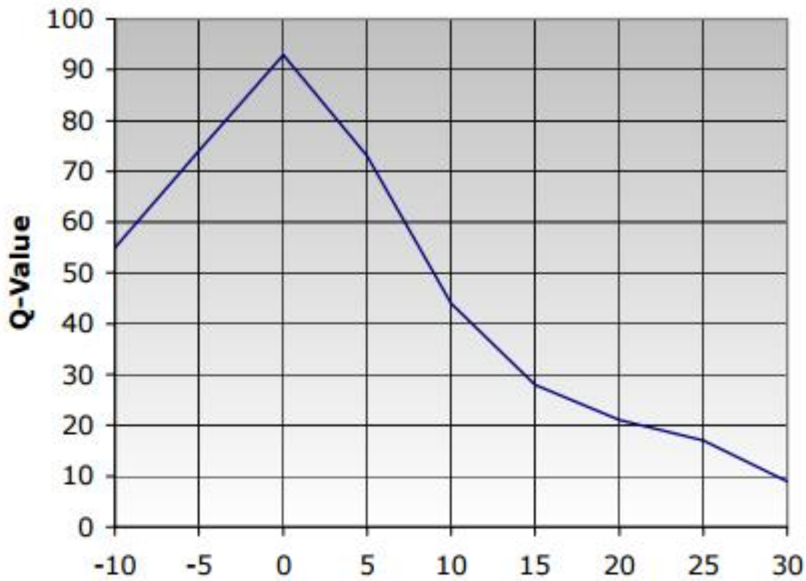

FIGURE 4.8: Q-VALUE CHART FOR TEMPERATURE

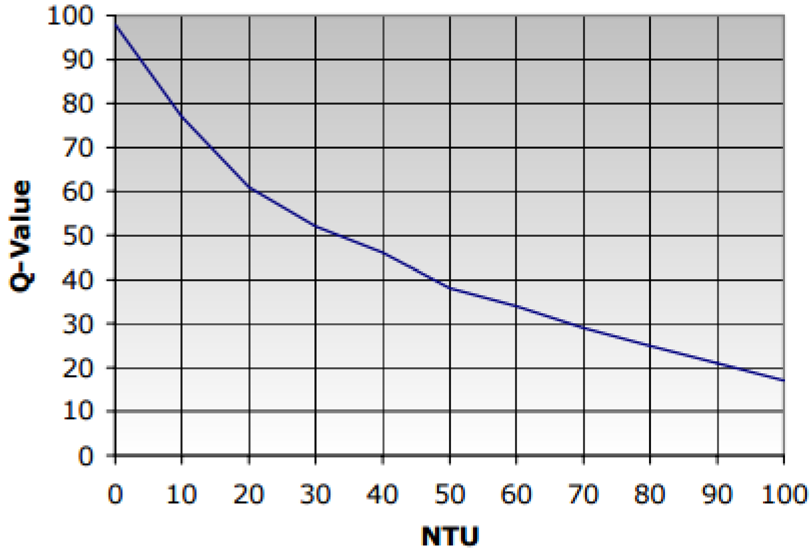

FIGURE 4.9: Q-VALUE CHART FOR TURBIDITY

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TABLE 4.2: WATER QUALITY FACTORS AND WEIGHT

Factor	Weight
Dissolved oxygen	0.17
Fecal coliform	0.16
Ph	0.11
Biochemical oxygen demand	0.11
Temperature change	0.10
Total phosphate	0.10
Nitrates	0.10
Turbidity	0.08
Total solids	0.07

TABLE 4.3: WATER QUALITY INDEX WORKHEET

Location Sampled:

Test Parameter	Test Results	Q- Value	Weighing Factor	Total
BOD	(mg/L)		0.11	
Dissolved Oxygen	(% saturation)		0.17	
Fecal Coliform	(colonies/100 mL)		0.16	
Nitrates	(mg/L)		0.10	
PH	(Units)		0.11	
Temperature			0.10	
Total Dissolved Solids	(mg/L)		0.07	
Total Phosphate	(mg/L)		0.10	
Turbidity	(NTU)		0.08	

Overall Water Quality Index ________________

Chapter 5

Calculation of Tap Water Loss

The world is running out of fresh water, fresh water is a finite resource. The amount of fresh water supply provided by the hydrological cycle does not increase. Water everywhere on the planet is an integral part of the global hydrological cycle. Precipitation originates as evaporation from land and the oceans. Soil moisture is used by plants which returned more moisture to the atmosphere, which then returns to earth as rain and snow. Humans share the world with other creatures that also need water, water shortage is also crisis for wildlife.

5.1. Steps for calculation of tap water loss

For calculation of the tap water losses of JUIT, measuring cylinder is thrice used to get the water loss for 5 minutes within the period of 30 minutes. This is done separately for the normal hours of the day and peak hours (when usage is maximum).

1. Such is done three times at the interval of 12 days and the average value is noted for both peak hour and normal hour.
2. For calculation of water loss per hour, the average value of loss per 5 minutes obtained is multiplied by 12.
3. For calculation of water loss per day, the average value of loss per hour obtained is multiplied by 24.
4. Water loss per hour = (avg. water loss per 5 min. * 12)
5. Water loss per day = (avg. water loss per hour * 24)

Chapter 6

RESULTS AND CONCLUSION

We have calculated parameters like pH, alkalinity, acidity, turbidity, conductivity, chloride content, total dissolved solids, dissolved oxygen, BOD, temperature. Values of parameters like fecal coliform, nitrates, total phosphate has been assumed according to permissible limits.

6.1. Water quality analysis

Water quality parameters have been calculated from different sources near Shimla. On the basis of result, conclusion about the quality of water is observed.

TABLE 6.1: WATER QUALITY PARAMETERS RESULLT

Source: Waknaghat

S.NO.	Test parameter	Result
1.	Taste	Tasteless
2.	Odour	Odourless
3.	Colour	Colourless
4.	Ph	6.8
5.	Alkalinity	150 mg/l
6.	Acidity	62.5 mg/l
7.	Turbidity	1 NTU
8.	Conductivity	0.24 mhos/cm
9.	Chloride content	35 mg/l
10.	Total dissolved solids	800 mg/l
11.	Fecal coliform	0 colonies/100 mL
12.	Nitrates	45 mg/l
13.	Total phosphate	0.5 mg/l
14.	Dissolved oxygen	7.6 mg/l
15.	Biochemical oxygen demand	0 mg/l

6.1.1 Determination of water quality index

Water quality index parameters :

1. BOD

2. Dissolved oxygen

3. Fecal coliform

4. Nitrates

5. pH

6. Temperature

7. Total dissolved solids

8. Total phosphate

9. Turbidity

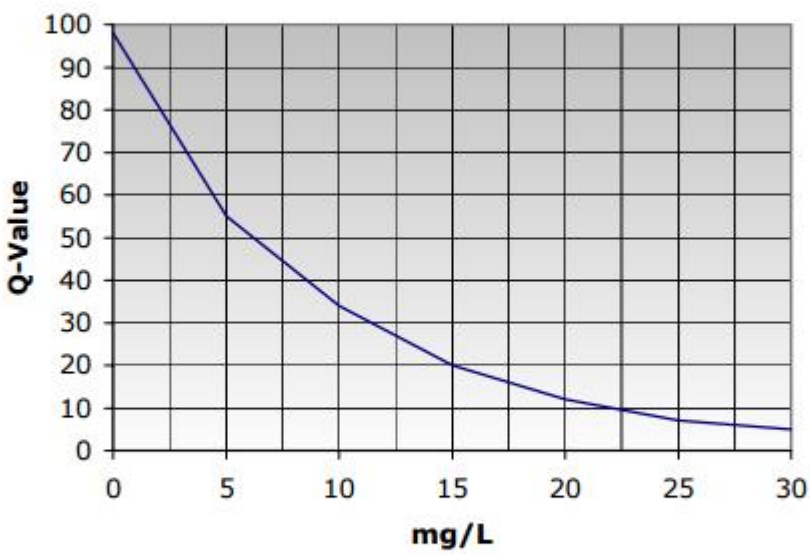

FIGURE 6.1: Q-VALUE CHART FOR BOD

Q-value for BOD from Q-value chart is 98.

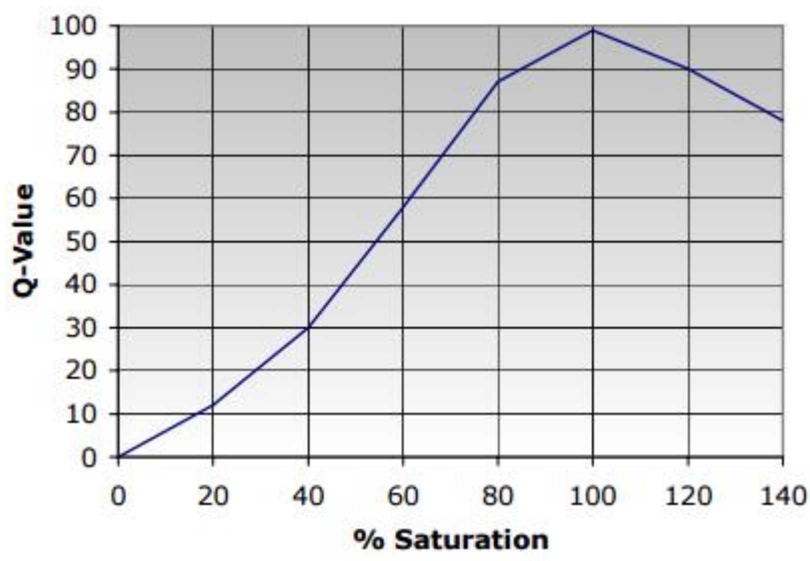

FIGURE 6.2: Q-VALUE CHART FOR DISSOLVED OXYGEN

Q-value for DO from Q-value chart is 70.

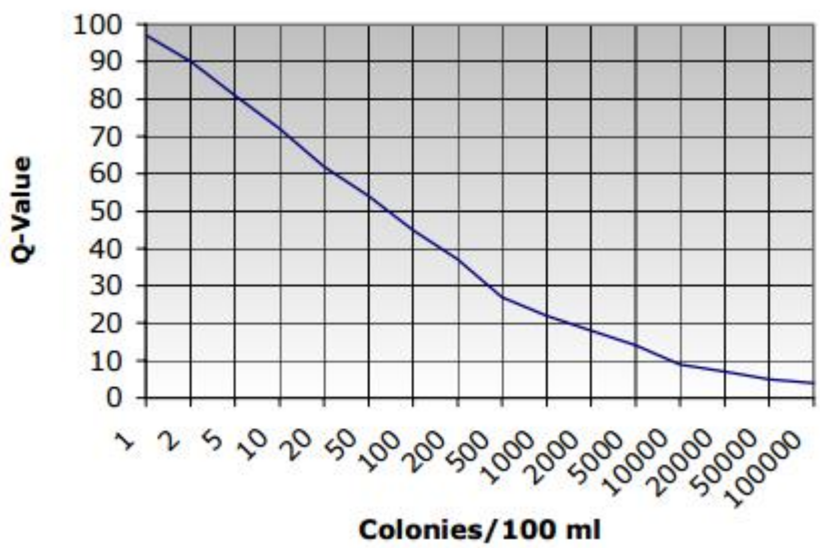

FIGURE 6.3: Q-VALUE CHART FOR FECAL COLIFORM

Q-value for Fecal coliform from Q-value chart is 98.

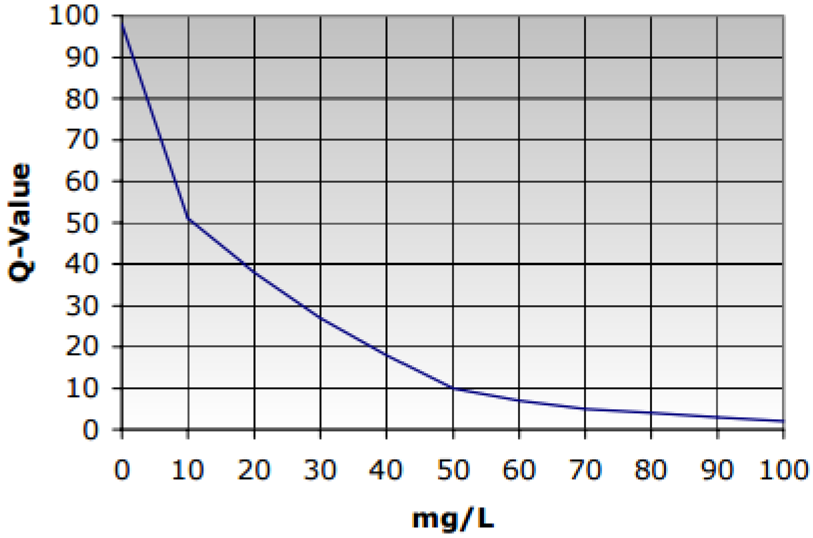

FIGURE 6.4: Q-VALUE CHART FOR NITRATES

Q-value for nitrates from Q-value chart is 15.

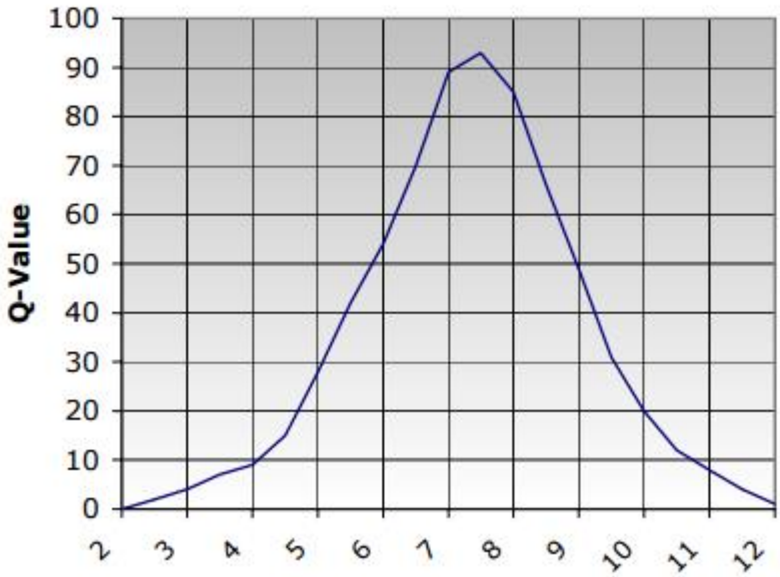

FIGURE 6.5: Q-VALUE CHART FOR pH

Q-value for PH from Q-value chart is 85.

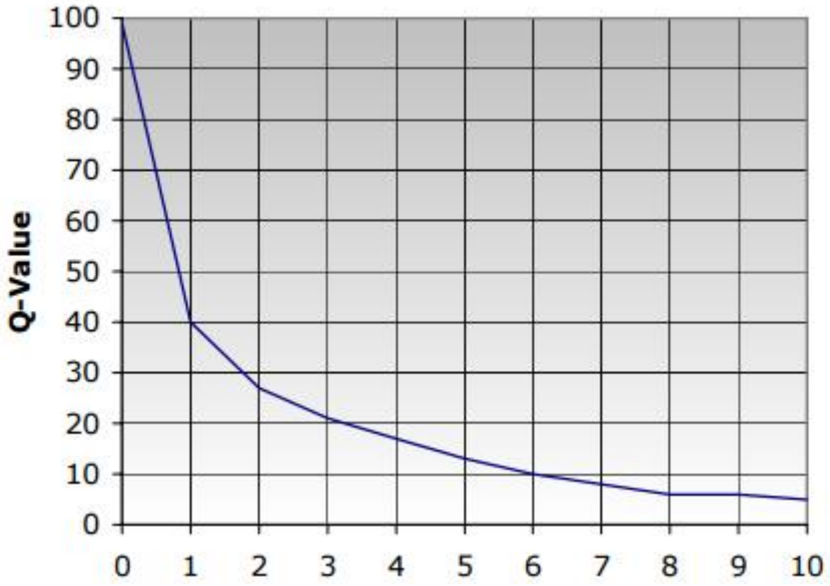

FIGURE 6.6: Q-VALUE CHART FOR PHOSPHATE

Q-value for phosphate from Q-value chart is 85.

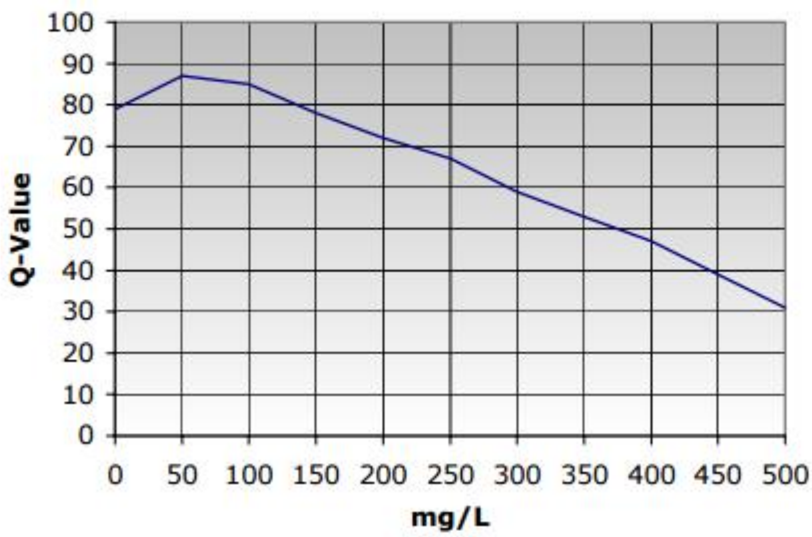

FIGURE 6.7: Q-VALUE CHART FOR TDS

Q-value for TDS from Q-value chart is 20. (Note: If TDS level > 500, Q=20)

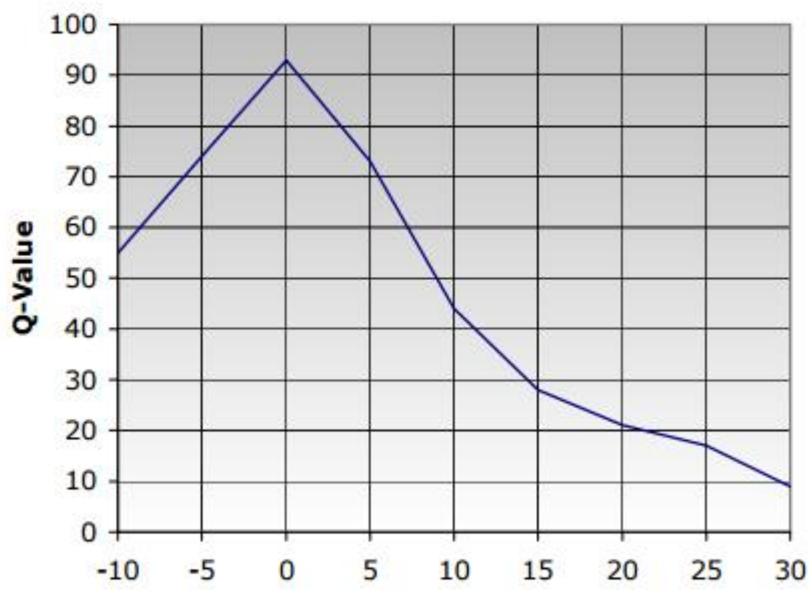

FIGURE 6.8: Q-VALUE CHART FOR TEMPERATURE

Q-value for temperature from Q-value chart is 28.

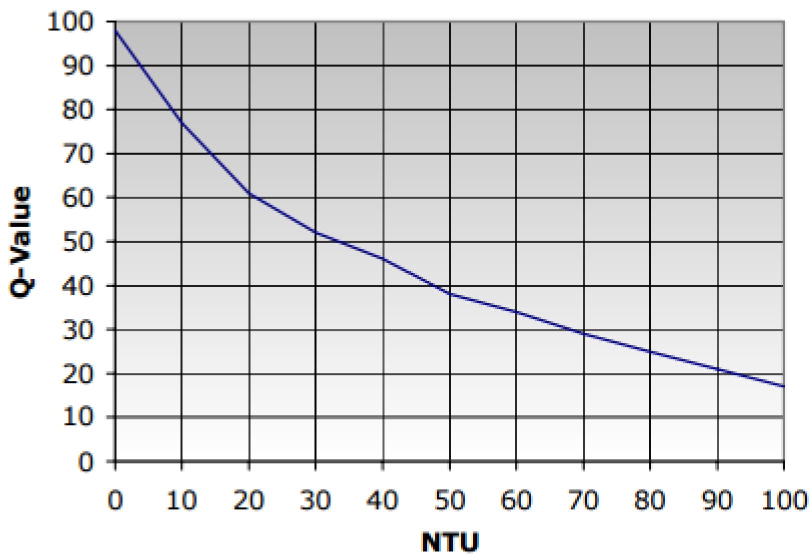

FIGURE 6.9: Q-VALUE CHART FOR TURBIDITY

Q-value for turbidity from Q-value chart is 96.

TABLE 6.2: WATER QUALITY INDEX WORKHEET

Location sampled – Waknaghat

Test Parameter	Test Results	Q- Value	Weighing Factor	Total
BOD	O (mg/L)	98	0.11	10.78
Dissolved Oxygen	70 (% saturation)	70	0.17	11.9
Fecal Coliform	0 (colonies/100 mL)	98	0.16	15.68
Nitrates	45 (mg/L)	15	0.10	1.5
PH	6.8 (Units)	85	0.11	9.35
Temperature	18 (degree celcius)	28	0.10	2.8
Total Dissolved Solids	800 (mg/L)	20	0.07	1.4
Total Phosphate	0 (mg/L)	85	0.10	8.5
Turbidity	1 (NTU)	96	0.08	7.68

Overall Water Quality Index is 69.59.

6.1.2 CONCLUSION

1. No objectionable color or odor was found in the sample, hence the sample passes the standards of the BIS.
2. All parameters are within permissible limit.
3. Water can be used for drinking purpose.
4. Overall water quality index is 69.59 so it comes under medium or average water quality.

TABLE 6.3: WATER QUALITY PARAMETERS RESULLT

Source: Dumehar

S.NO.	Test parameter	Result
1.	Taste	Tasteless
2.	Odour	Odourless
3.	Colour	Colourless
4.	pH	6.7
5.	Alkalinity	150 mg/l
6.	Acidity	26.7 mg/l
7.	Turbidity	0 NTU
8.	Conductivity	0.22 mhos/cm
9.	Chloride content	30.6 mg/l
10.	Total dissolved solids	219 mg/l
11.	Fecal coliform	0 colonies/100 mL
12.	Nitrates	45 mg/l
13.	Total phosphate	0.5 mg/l
14.	Dissolved oxygen	7.8 mg/l
15.	Biochemical oxygen demand	0 mg/l

6.2 Determination of water quality index

6.2.1 Water quality index parameters

1. BOD
2. Dissolved oxygen
3. Fecal coliform
4. Nitrates
5. pH
6. Temperature
7. Total dissolved solids
8. Total phosphate
9. Turbidity

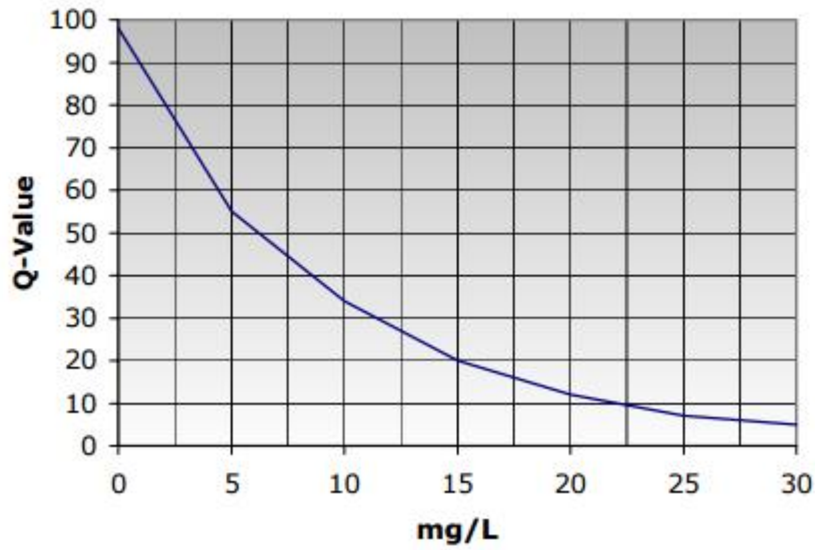

FIGURE 6.10: Q-VALUE CHART FOR BOD

Q-value for BOD from Q-value chart is 98.

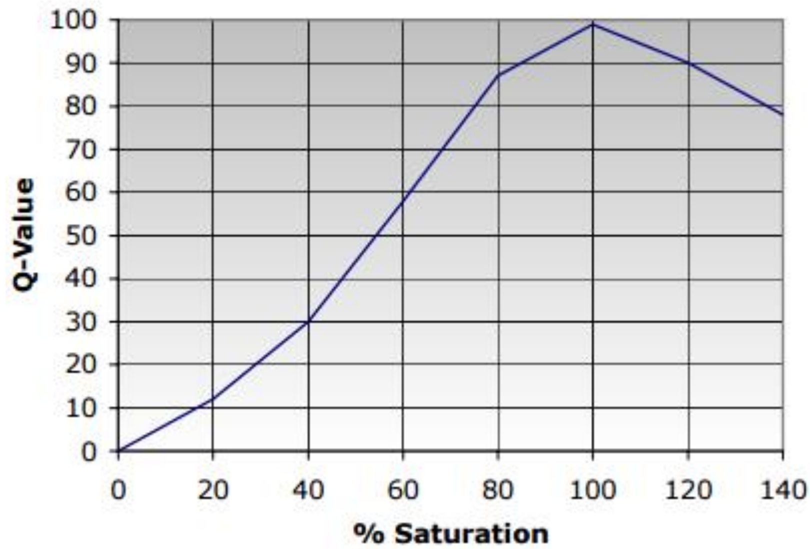

FIGURE 6.11: Q-VALUE CHART FOR DISSOLVED OXYGEN

Q-value for DO from Q-value chart is 88.

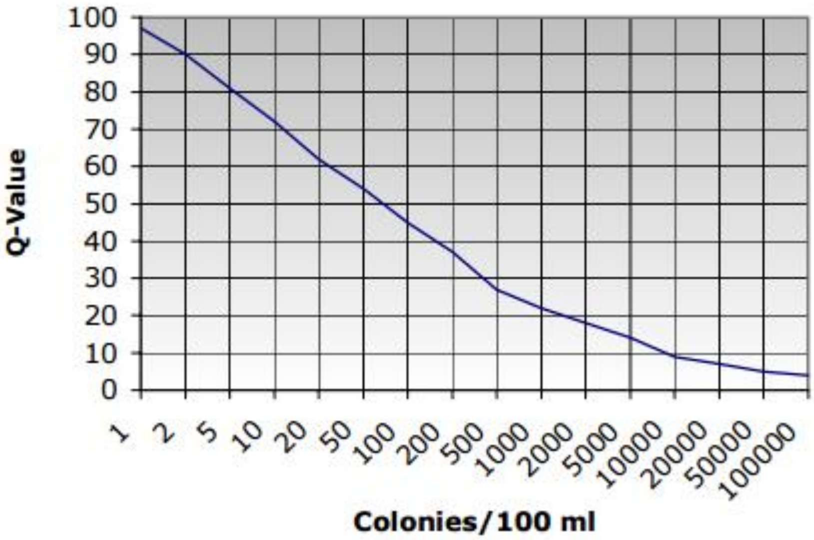

FIGURE 6.12: Q-VALUE CHART FOR FECAL COLIFORM

Q-value for Fecal coliform from Q-value chart is 98.

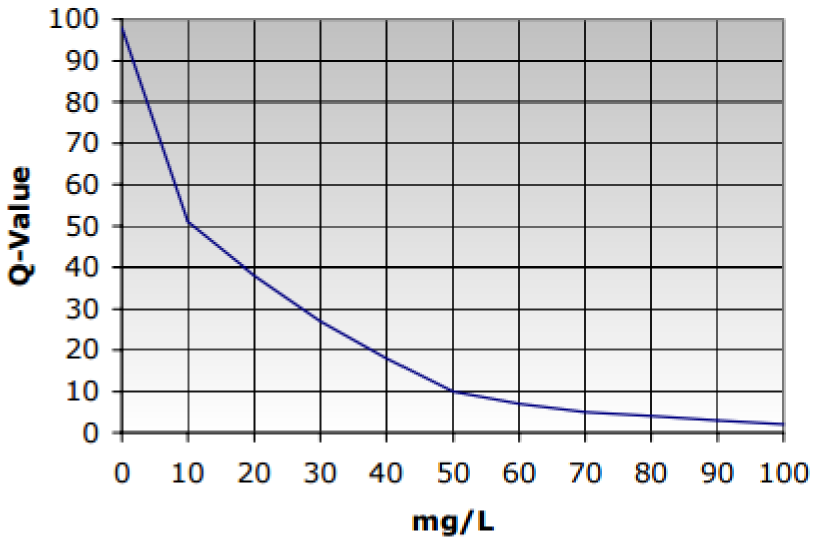

FIGURE 6.13: Q-VALUE CHART FOR NITRATES

Q-value for Nitrates from Q-value chart is 15.

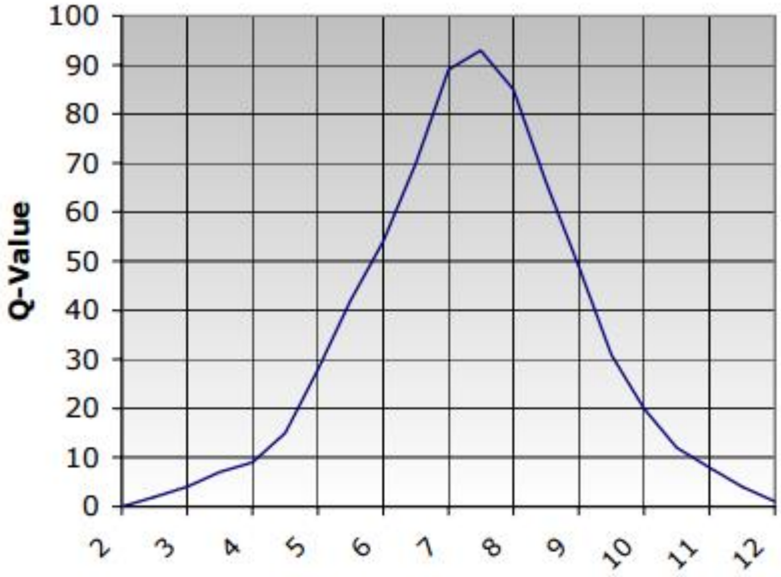

FIGURE 6.14: Q-VALUE CHART FOR pH

Q-vaue for PH from Q-value chart is 70.

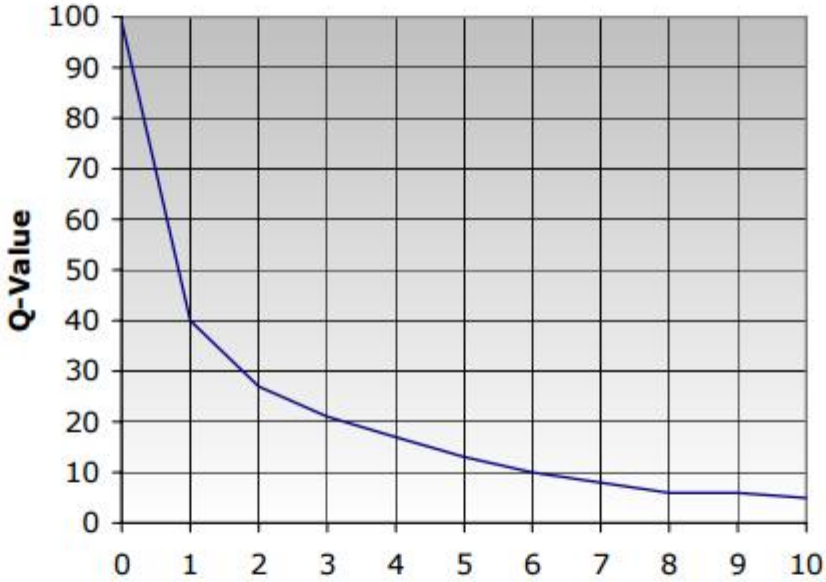

FIGURE 6.15: Q-VALUE CHART FOR PHOSPHATE

Q-value for Temperature from Q-value chart is 28.

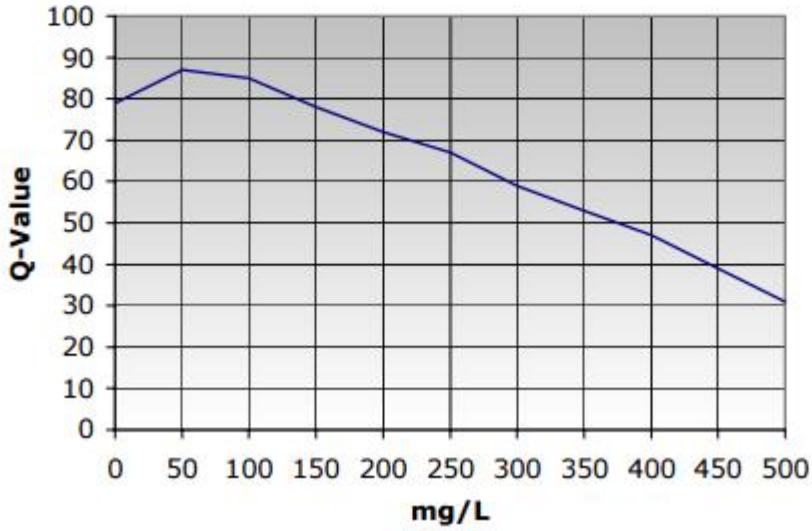

FIGURE 6.16: Q-VALUE CHART FOR TDS

Q-value for TDS from Q-value chart is 70.

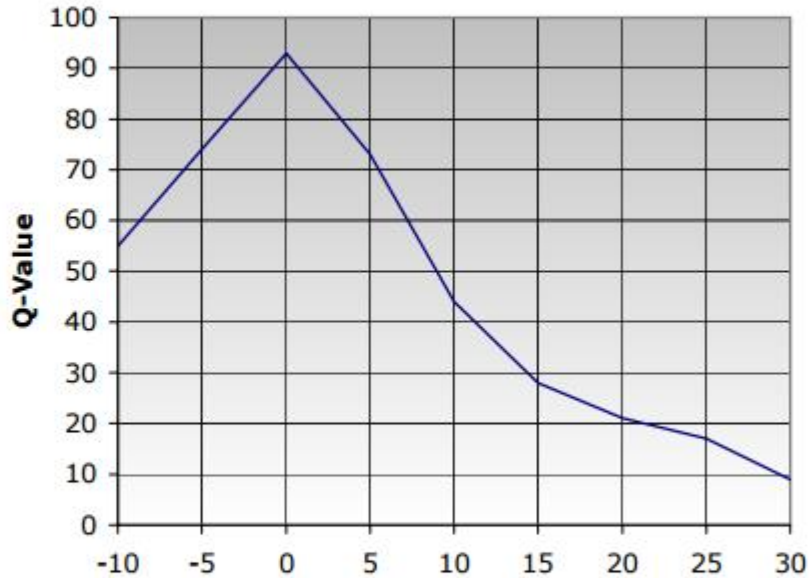

FIGURE 6.17: Q-VALUE CHART FOR TEMPERATURE

Q-value for Phosphate from Q-value chart is 85.

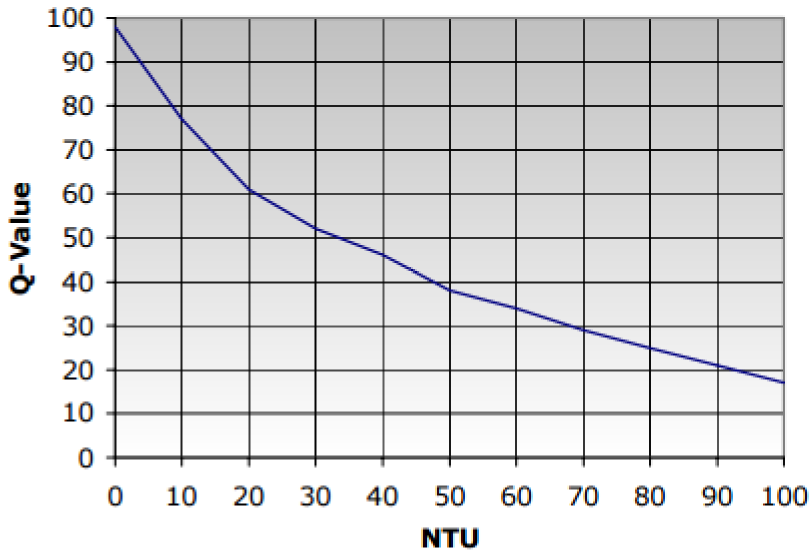

FIGURE 6.18: Q-VALUE CHART FOR TURBIDITY

Q-value for Turbidity from Q-value chart is 98.

TABLE 6.4: WATER QUALITY INDEX WORKSHEET

Location sampled – Dumehar

Test Parameter	Test Results	Q- Value	Weighing Factor	Total
BOD	0 (mg/L)	98	0.11	10.78
Dissolved Oxygen	80 (% saturation)	88	0.17	14.96
Fecal Coliform	0 (colonies/100 mL)	98	0.16	15.68
Nitrates	45 (mg/L)	15	0.10	1.5
PH	6.7 (Units)	70	0.11	7.7
Temperature	15 degree Celsius	28	0.10	2.8
Total Dissolved Solids	219 (mg/L)	70	0.07	4.9
Total Phosphate	0.5 (mg/L)	85	0.10	8.5
Turbidity	0 (NTU)	98	0.08	7.84

Overall Water Quality Index is 74.66.

6.2.2 Conclusion

1. No objectionable color or odor was found in the sample, hence the sample passes the standards of the BIS.
2. All parameters are within permissible limit.
3. Water can be used for drinking purpose.
4. Overall water quality index is 74.66.
5. Result reflects good water quality according to WQI quality scale.

TABLE 6.5: WATER QUALITY PARAMETERS RESULLT

Source: Shimla

S.NO.	Test parameter	Result
1.	Taste	Tasteless
2.	Odour	Odourless
3.	Colour	Colourless
4.	Ph	8.2
5.	Alkalinity	186 mg/l
6.	Acidity	75 mg/l
7.	Turbidity	0 NTU
8.	Conductivity	0.26 mhos/cm
9.	Chloride content	3.46 mg/l
10.	Total dissolved solids	500 mg/l
11.	Fecal coliform	0 colonies/100 mL
12.	Nitrates	45 mg/l
13.	Total phosphate	0.5 mg/l
14.	Dissolved oxygen	5 mg/l
15.	Biochemical oxygen demand	0 mg/l
16.	Temperature	16 degree celcius

6.3 Determination of water quality index

6.3.1 Water quality index parameters

1. BOD

2. Dissolved oxygen

3. Fecal coliform

4. Nitrates

5. pH

6. Temperature

7. Total dissolved solids

8. Total phosphate

9. Turbidity

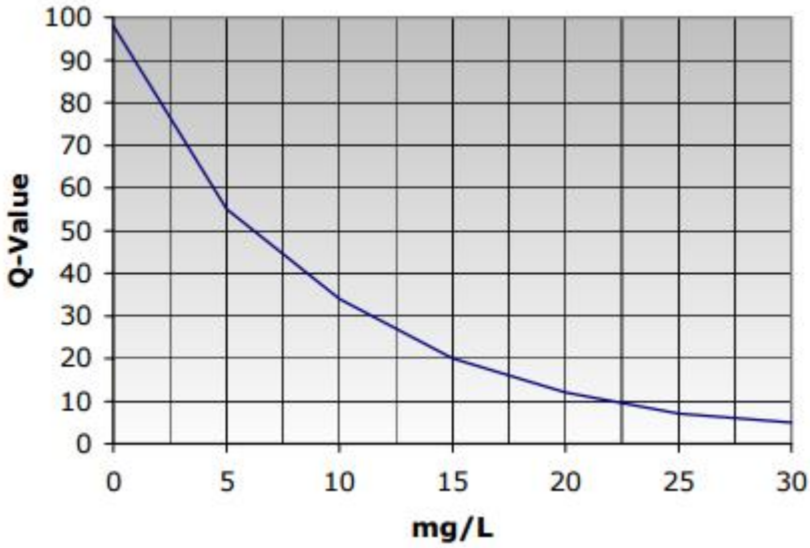

FIGURE 6.19: Q-VALUE CHART FOR BOD

Q-value for BOD from Q-value chart is 98.

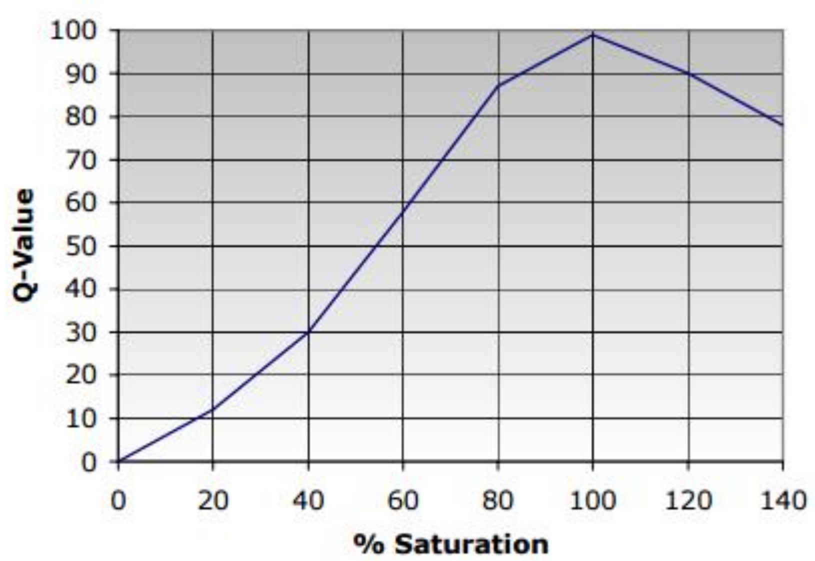

FIGURE 6.20: Q-VALUE CHART FOR DISSOLVED OXYGEN

Q-value for DO from Q-value chart is 50.

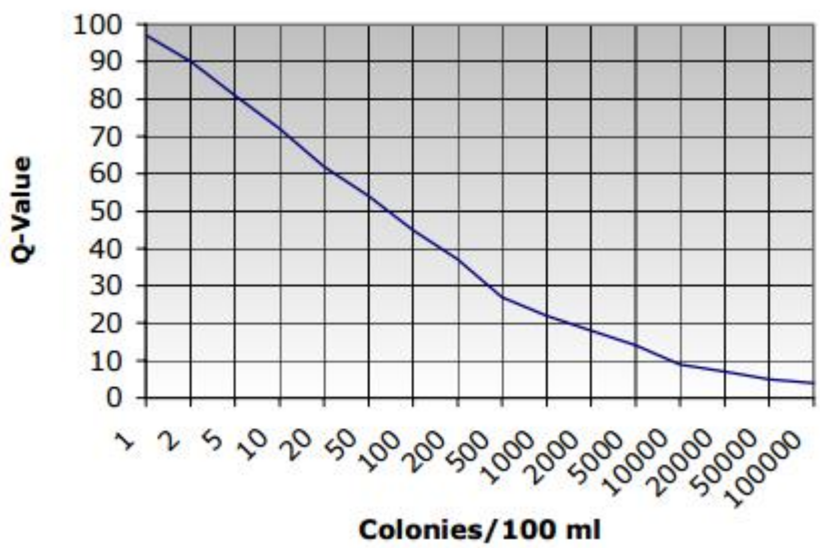

FIGURE 6.21: Q-VALUE CHART FOR FECAL COLIFORM

Q-value for Fecal coliform from Q-value chart is 98.

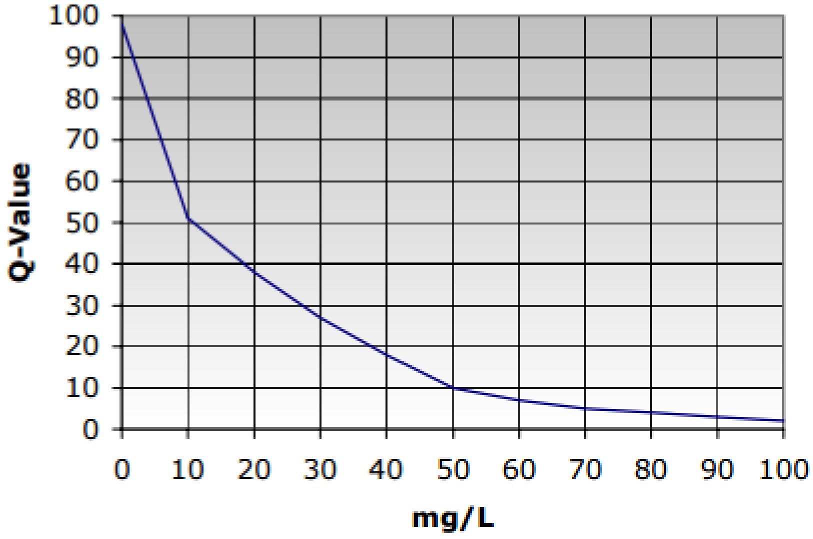

FIGURE 6.22: Q-VALUE CHART FOR NITRATES

Q-value for Nitrates from Q-value chart is 15.

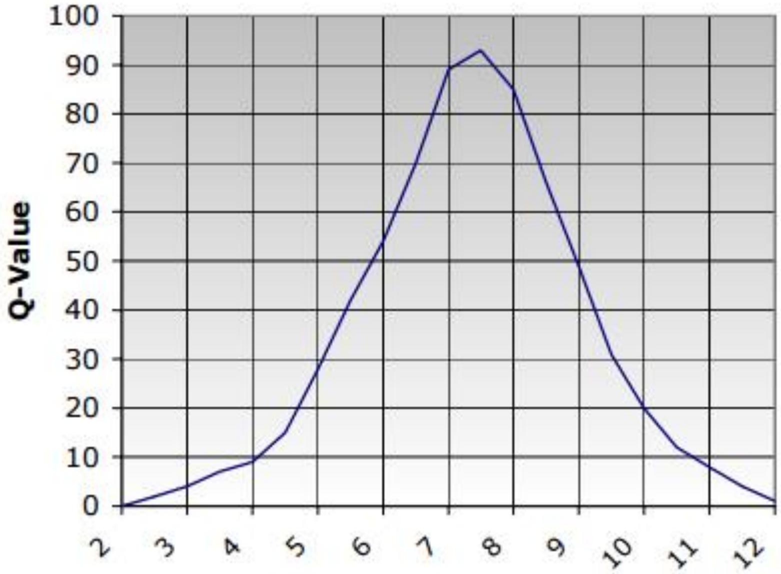

FIGURE 6.23: Q-VALUE CHART FOR pH

Q-value for PH from Q-value chart is 80.

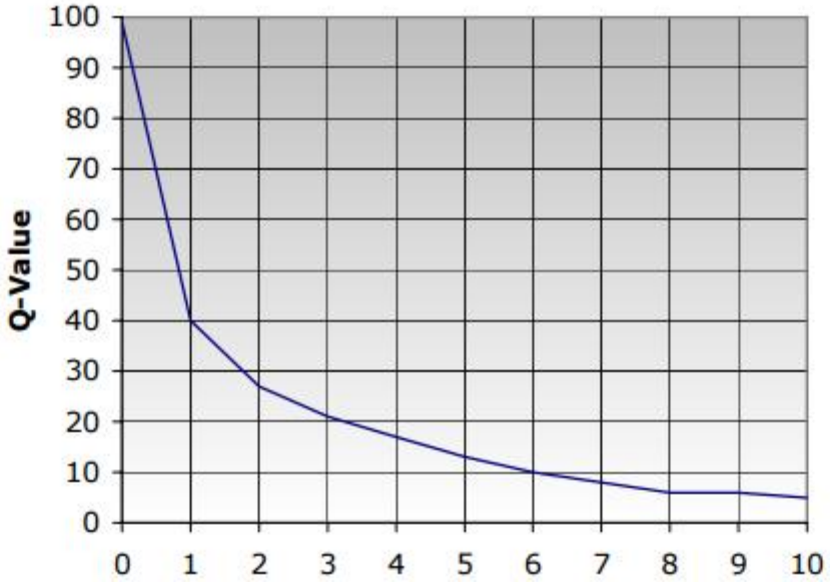

FIGURE 6.24: Q-VALUE CHART FOR PHOSPHATE

Q-value for Phosphate from Q-value chart is 70.

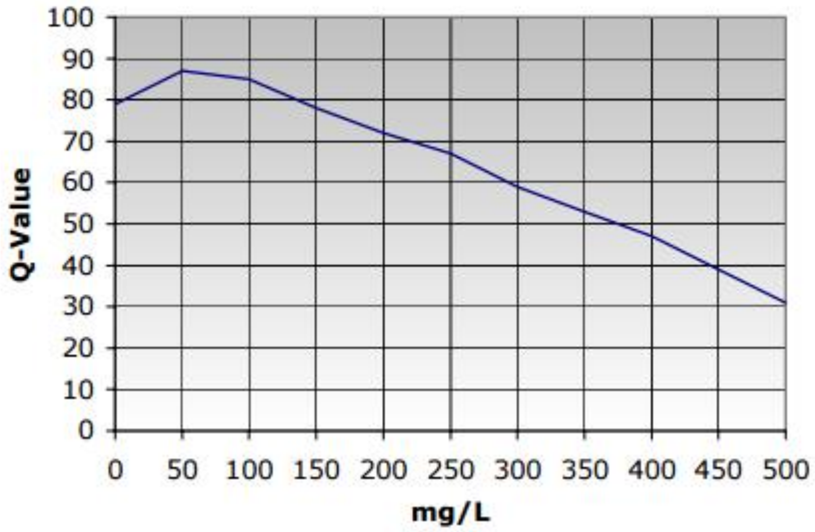

FIGURE 6.25: Q-VALUE CHART FOR TDS

Q-value for TDS from Q-value chart is 30.

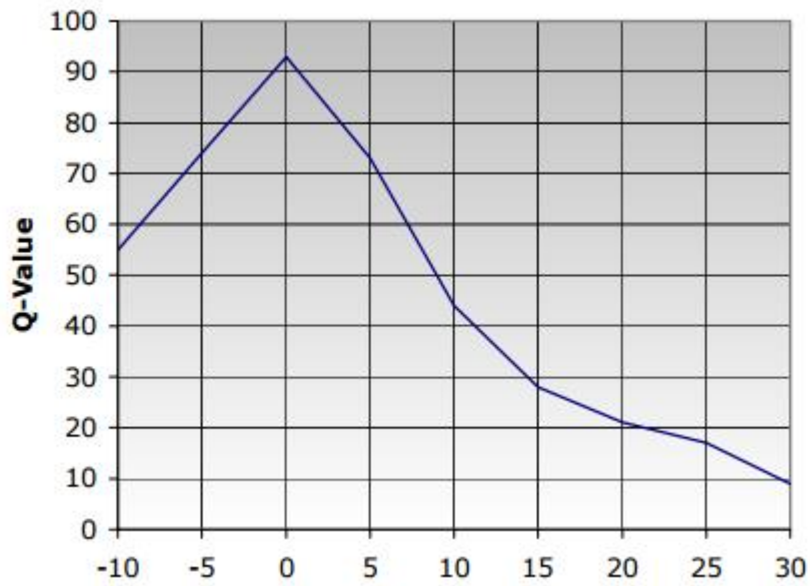

FIGURE 6.26: Q-VALUE CHART FOR TEMPERATURE

Q-value for Temperature from Q-value chart is 40.

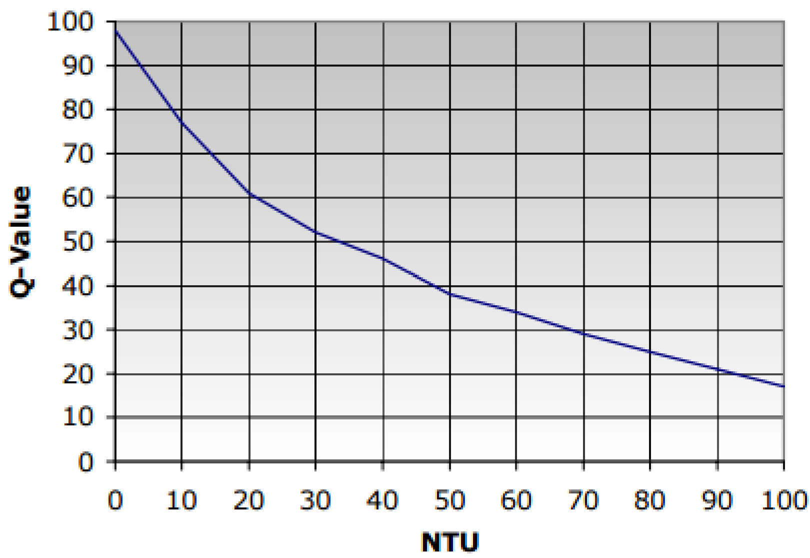

FIGURE 6.27: Q-VALUE CHART FOR TURBIDITY

Q-value for turbidity from Q-value chart is 98.

TABLE 6.6: WATER QUALITY INDEX WORKSHEET

Location sampled – Shimla

Test Parameter	Test Results	Q- Value	Weighing Factor	Total
BOD	0 (mg/L)	98	0.11	10.78
Dissolved Oxygen	50 (% saturation)	50	0.17	8.5
Fecal Coliform	0 (colonies/100 mL)	98	0.16	15.68
Nitrates	45 (mg/L)	15	0.10	1.5
PH	8.2 (Units)	80	0.11	8.8
Temperature	16 degree celcius	98	0.10	9.8
Total Dissolved Solids	500 (mg/L)	30	0.07	2.1
Total Phosphate	0.5 (mg/L)	70	0.10	7
Turbidity	0 (NTU)	98	0.08	7.84

Overall Water Quality Index is 72.

6.3.2 Conclusion

1. No objectionable color or odor was found in the sample, hence the sample passes the standards of the BIS.
2. All parameters are within permissible limit.
3. Water can be used for drinking purpose.
4. Overall water quality index is 72.
5. WQI reflects that water is of good quality according to WQI scale.

TABLE 6.7: WATER QUALITY PARAMETERS RESULLT

Source: JUIT

S.NO.	Test parameter	Result
1.	Taste	Tasteless
2.	Odour	Odourless
3.	Colour	Colourless
4.	pH	7.4
5.	Alkalinity	148 mg/l
6.	Acidity	67.5 mg/l
7.	Turbidity	0 NTU
8.	Conductivity	0.20 mhos/cm
9.	Chloride content	38.6 mg/l
10.	Total dissolved solids	1000 mg/l
11.	Fecal coliform	0 colonies/100 mL
12.	Nitrates	45 mg/l
13.	Total phosphate	0.5 mg/l
14.	Dissolved oxygen	6.7 mg/l
15.	Biochemical oxygen demand	0 mg/l

6.4 Determination of water quality index

6.4.1 Water quality index parameters

1. BOD

2. Dissolved oxygen

3. Fecal coliform

4. Nitrates

5. pH

6. Temperature

7. Total dissolved solids

8. Total phosphate

9. Turbidity

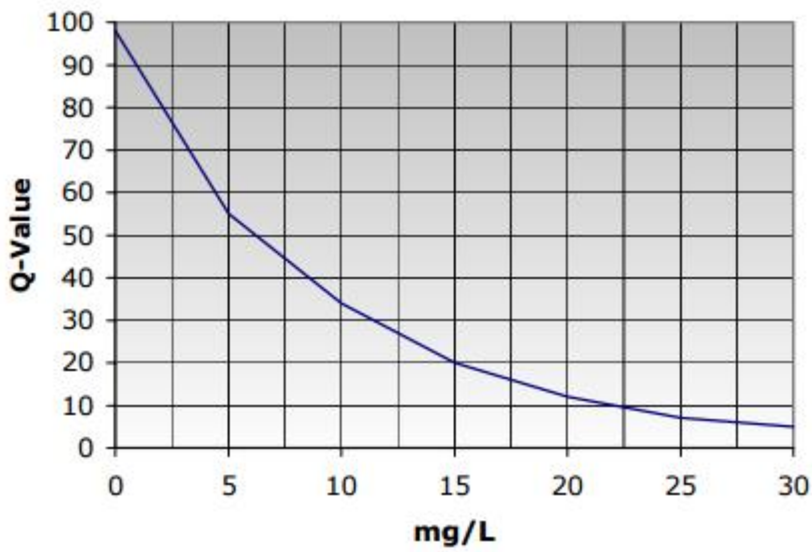

FIGURE 6.28: Q-VALUE CHART FOR BOD

Q-value for BOD from Q-value chart is 98.

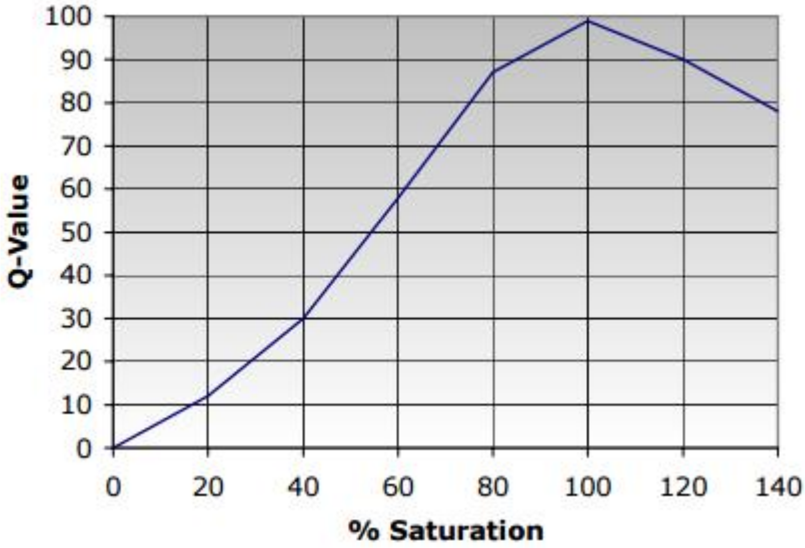

FIGURE 6.29: Q-VALUE CHART FOR DISSOLVED OXYGEN

Q-value for DO from Q-value chart is 70.

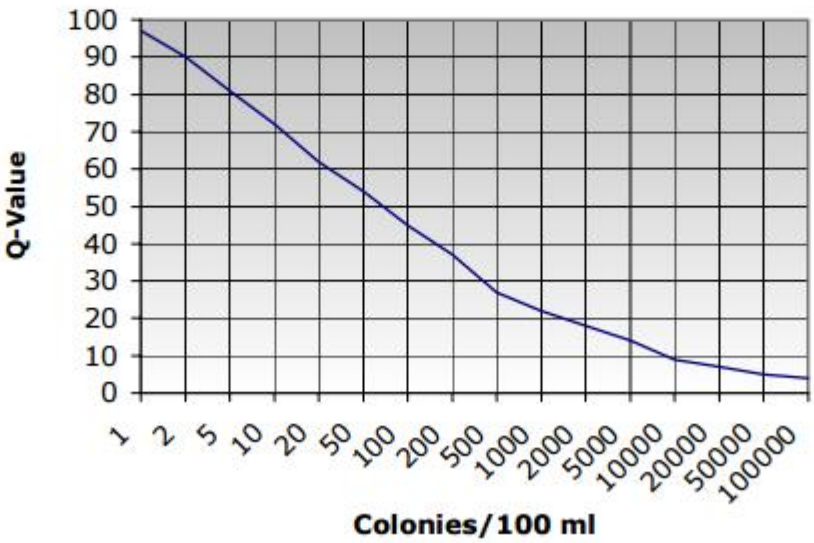

FIGURE 6.30: Q-VALUE CHART FOR FECAL COLIFORM

Q-value for Fecal coliform from Q-value chart is 98.

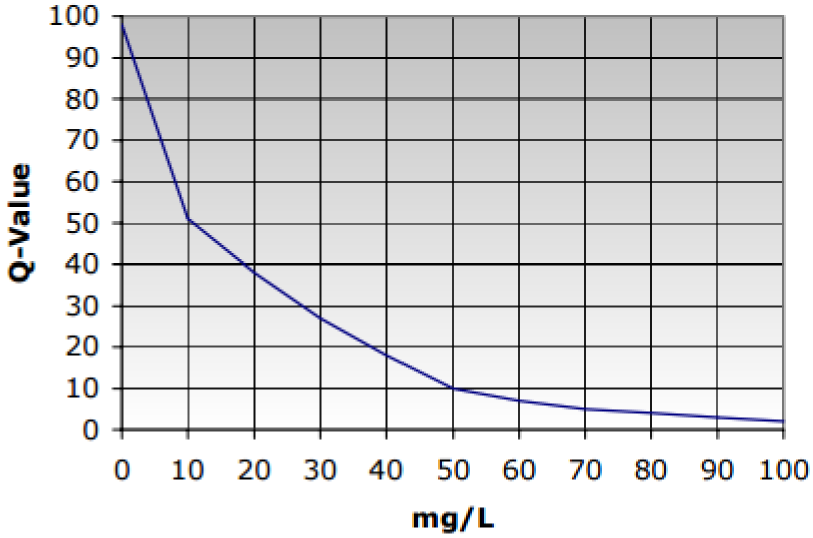

FIGURE 6.31: Q-VALUE CHART FOR NITRATES

Q-value for Nitrates from Q-value chart is 98.

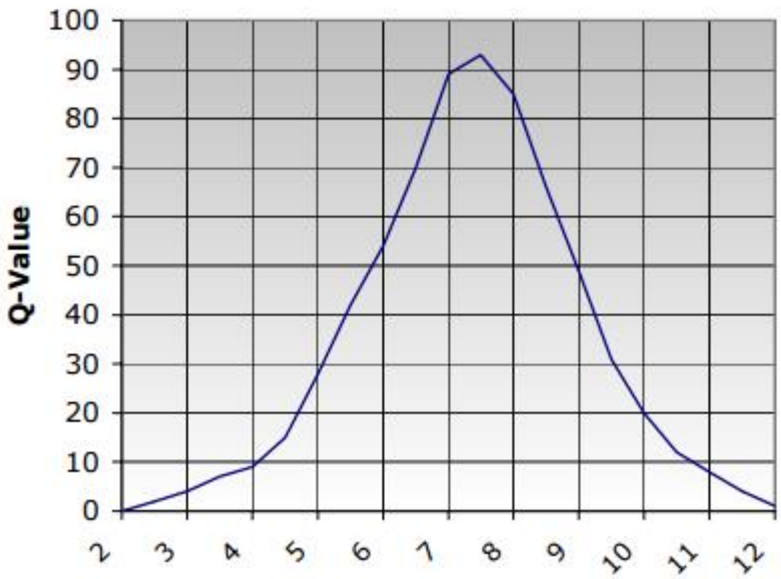

FIGURE 6.32: Q-VALUE CHART FOR pH

Q-value for PH from Q-value chart is 92.

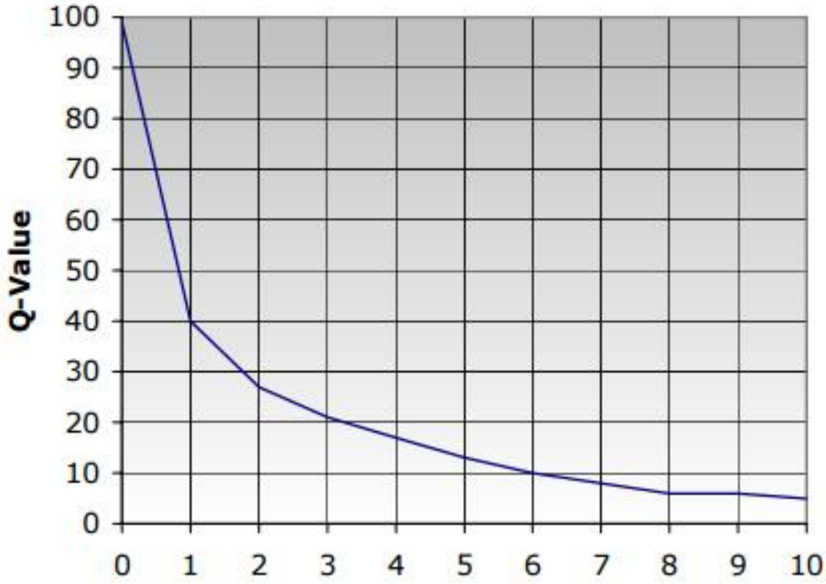

FIGURE 6.33: Q-VALUE CHART FOR PHOSPHATE

Q-value for Phosphate from Q-value chart is 70.

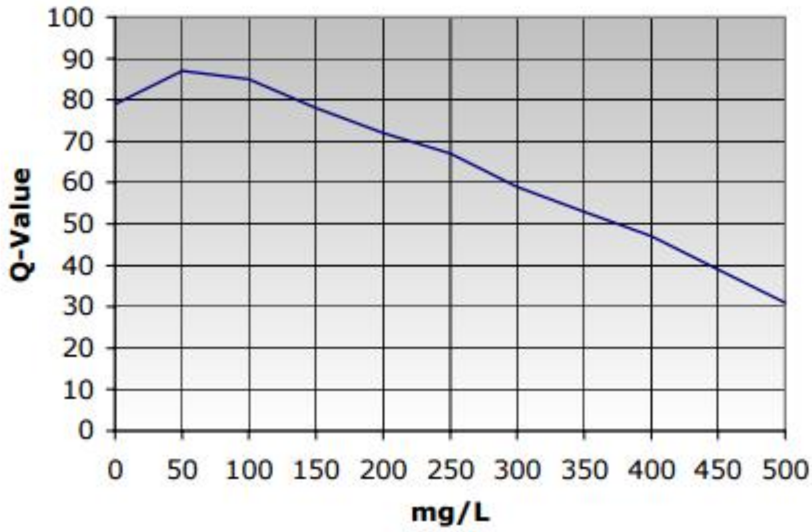

FIGURE 6.34: Q-VALUE CHART FOR TDS

Q-value for TDS from Q-value chart is 20. (Note: If TDS level > 500, Q=20)

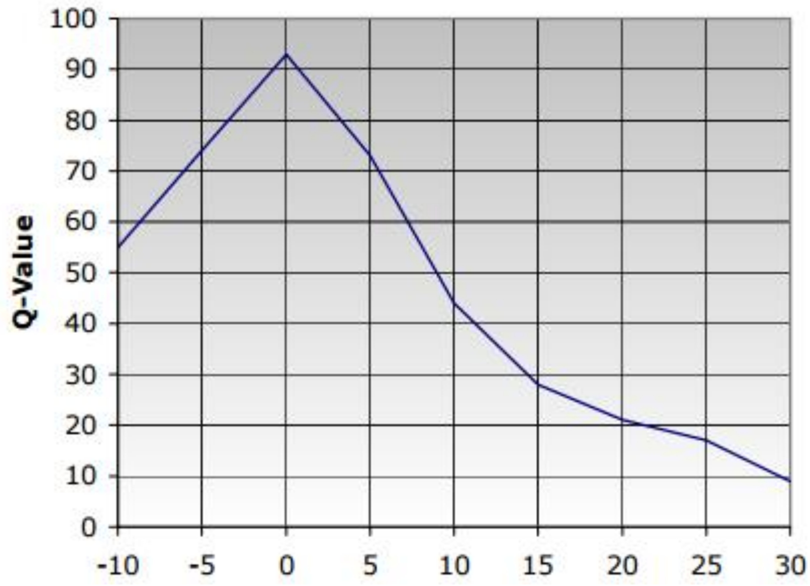

FIGURE 6.35: Q-VALUE CHART FOR TEMPERATURE

Q-value for Temperature from Q-value chart is 30.

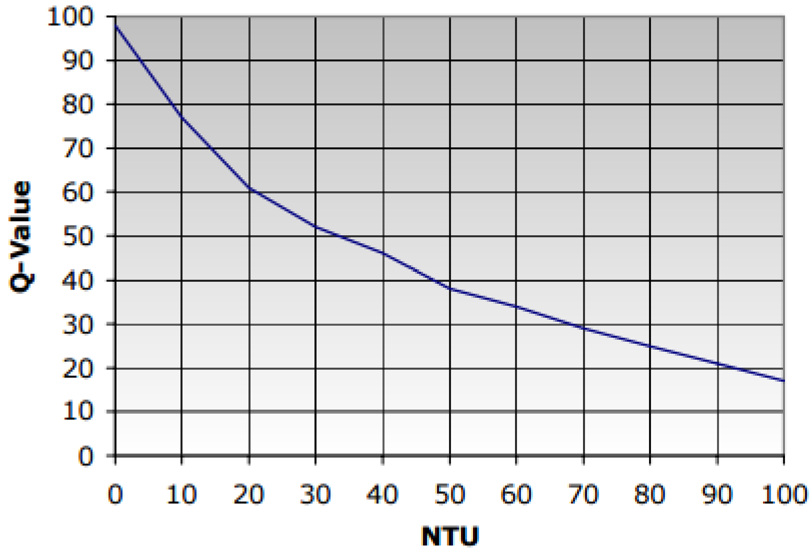

FIGURE 6.36: Q-VALUE CHART FOR TURBIDITY

Q-value for Turbidity from Q-value chart is 98.

TABLE 6.8: WATER QUALITY INDEX WORKSHEET

Location sampled – JUIT

Test Parameter	Test Results	Q- Value	Weighing Factor	Total
BOD	0 (mg/L)	98	0.11	10.78
Dissolved Oxygen	70 (% saturation)	70	0.17	11.9
Fecal Coliform	0 (colonies/100 mL)	98	0.16	15.68
Nitrates	45 (mg/L)	15	0.10	1.5
PH	7.4 (Units)	92	0.11	10.12
Temperature	15 degree celcius	40	0.10	4
Total Dissolved Solids	1000 (mg/L)	20	0.07	1.4
Total Phosphate	45 (mg/L)	70	0.10	7
Turbidity	0 (NTU)	98	0.08	7.84

Overall Water Quality Index s 70.22

6.4.2 Conclusion

1. No objectionable color or odor was found in the sample, hence the sample passes the standards of the BIS.
2. All parameters are within permissible limit.
3. Water can be used for drinking purpose.
4. Overall water quality index is
5. A high TDS does not necessarily mean that water is unsafe for consumption; it may just suggest that the water will have unpleasant aesthetic qualities in terms of colour, taste, smell, etc. If you are concerned about the safety of your drinking water, you should have your water professionally tested.
6. According to WQI scale it comes under good quality.

6.5 Tap Water Losses

The world is running out of fresh water, fresh water is a finite resource. The amount of fresh water supply provided by the hydrological cycle does not increase. Water everywhere on the planet is an integral part of the global hydrological cycle. Precipitation originates as evaporation from land and the oceans. Soil moisture is used by plants which returned more moisture to the atmosphere, which then returns to earth as rain and snow. Humans share the world with other creatures that also need water, water shortage is also crisis for wildlife.

6.5.1 HOSTEL H-11

TABLE 6.9: TAP WATER LOSSES

Normal Hours (1st Observation)

Floor	Reading 1 (ml)	Reading 2 (ml)	Reading 3 (ml)	Average (ml)
+2	61	60	52.5	57.8
+1	72	68	65.5	68.5
0	0	0	0	0
-1	150	145	141	145.3
-2	20	25.5	16	20.5
-3	42	41	42	41.05
Total				333.6

TABLE 6.10: TAP WATER LOSSES

Normal Hours (2nd Observation)

Floor	Reading 1 (ml)	Reading 2 (ml)	Reading 3 (ml)	Average (ml)
+2	45	44	42.5	45.8
+1	61	59.5	58.2	59.5
0	82	81.2	81.4	81.5
-1	42	41.5	40.2	48.83
-2	64	66	63	65.3
-3	0	0	0	0
Total				300.93

TABLE 6.11: TAP WATER LOSSES

Peak Hours (1st Observation)

Floor	Reading 1 (ml)	Reading 2 (ml)	Reading 3 (ml)	Average (ml)
+2	72	70.5	65	69.16
+1	0	0	0	0
0	45	43	41.5	43.16
-1	108	106.5	98.5	104.3
-2	31	29.5	27.4	29.3
-3	0	0	0	0
Total				245.96

TABLE 6.12: TAP WATER LOSSES

Peak Hours (2nd Observation)

Floor	Reading 1 (ml)	Reading 2 (ml)	Reading 3 (ml)	Average (ml)
+2	65	64	62.5	63.16
+1	61	62	61.5	61.5
0	0	0	0	0
-1	60	57	56.5	57.83
-2	45	41.3	40	42.1
-3	0	0	0	0
Total				224.59

6.5.2 HOSTEL H-4

TABLE 6.13: TAP WATER LOSSES

Normal Hours (1st Observation)

Floor	Reading 1 (ml)	Reading 2 (ml)	Reading 3 (ml)	Average (ml)
-1	60	59	57.2	58.7
-2	230	233.2	234	232.4
-3	60	58	57.5	58.5
-4	72	65	69	68.6
-5	180	175	182	179
-6	0	0	0	0
Total				597.2

TABLE 6.14: TAP WATER LOSSES

Normal Hours (2nd Observation)

Floor	Reading 1 (ml)	Reading 2 (ml)	Reading 3 (ml)	Average (ml)
-1	24	22.5	21.5	22.6
-2	152	150	151.5	151.16
-3	0	0	0	0
-4	32	34	36	34
-5	125	125	126	125.33
-6	0	0	0	0
Total				333.09

TABLE 6.15: TAP WATER LOSSES

Peak Hours (1st Observation)

Floor	Reading 1 (ml)	Reading 2 (ml)	Reading 3 (ml)	Average (ml)
-1	71.5	65	62.5	66.33
-2	260	257.5	256	264.5
-3	0	0	0	0
-4	24	22.5	21.5	22.56
-5	290	281.5	265.5	279
-6	0	0	0	0
Total				632.39

TABLE 6.16: TAP WATER LOSSES

Peak Hours (2nd Observation)

Floor	Reading 1 (ml)	Reading 2 (ml)	Reading 3 (ml)	Average (ml)
-1	0	0	0	0
-2	172	165.5	161	166.1
-3	0	0	0	0
-4	62	58.5	57.5	59.3
-5	240	229.5	216.5	228.6
-6	0	0	0	0
Total				454

Chapter 7

CONCLUSIONS AND RECOMMENDATIONS

1. The water losses calculated for Hostel H-4 is 123.16 lt/day (normal hours) and 156.43 lt/day (peak hour).

2. The water losses calculated for Hostel H-11 is 182.7 lt/day (normal hours) and 135.5 lt/day (peak hour).

3. On the basis of the results obtained, we conclude that there is a huge amount of water loss in the institution (JUIT) due to ill-functioning of taps or faulty valves in the washrooms.

4. So we recommend regular check up on the functioning of taps to ensure minimum tap water losses.

5. Water is safe for consumption and can be used for drinking purposes.

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