## 4.1 Procurement of relevant soil quality

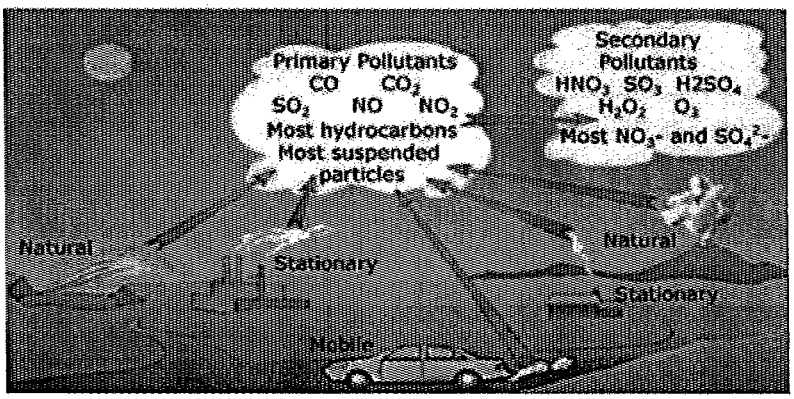
Description of the following components of environment must be included in the EIA study.

1. Air Environment
2. Water Environment
3. Noise Environment
4. Meteorology and Climate Data
5. Vegetation found in the Study Area

### 4.1.1. Air Environment

* Existing air quality
* Wind Speed
* Wind Direction
* Humidity
* Pollutants in Air

[Particulate matter (PM10 & PM2), Ozone (O3), Nitrogen dioxide (NO2), Carbon monoxide (CO), Sulphar dioxide (SO2)]



### 4.1.2. Water Environment

* Existing water resources

  [Ground water, tube wells, dig wells, hand pumps, aquifers].

* Surface water resources

  [Tanks, rivers, reservoirs, lakes, ponds, and coastal waters]

* Quality of water

* Quantity of water

* Impact of proposed construction activity on water resources

**Water pollution load in different states.**

| States | Pollution load | States | Pollution load |
|---|---|---|---|
| Bihar | 32194 | Tamil Nadu | 84384 |
| Madhya Pradesh | 243125 | Gujrat | 78354 |
| Maharashtra | 234360 | Kamataka | 58705 |
| Orissa | 204240 | Haryana | 36939 |
| Andhra Pradesh | 131536 | Rajasthan | 23530 |
| West Bengal | 130444 | Delhi | 12387 |
| Uttar Pradesh | 103205 | Pondicherry | 9655 |
| Punjab | 96050 | Chandigarh | 9294 |
| | | Assam | 7861 |

* Around half of all ocean pollution is caused by sewage and waste water.

* Each year, the world generates 400 billion tons of industrial waste, much of which is pumped untreated into rivers, oceans.

### 4.1.3. Noise Environment

* Noise levels of study area.

* Predicted noise levels during construction activity.

* Actions needed to reduce the noise levels.

* Sound intensity : 40-60db

* Sound < 80db, safe for ear

| Event | Noise levels(dB) |
|---|---|
| Volcano eruption | 190 |
| Thunder | 120 |
| Jet plane | 120 |
| Factory boiler | 110 |
| Trains | 110 |
| Cars and bikes | 90(approx) |
| Barking of a dog | 70 |
| Loud conversation | 70 |
| Typewriting | 50 |
| Whispering | 15 |
| Breathing | 10 |

### 4.1.4. Meteorology and Climate data

The following meteorology and climate data collected before and after project activity for EIA study.

* Temperature
* Air pressure
* Water vapour
* Humidity
* Precipitation
* Wind movement

### 4.1.5. Vegetation Data

The proponent of planned construction activity should include a description of all types of vegetation.

- Vegetation ecotypes

  [Forested, agricultural, wetland, riparian]

- Old growth forests
- Rare plants
- Medical plants
- Non-native species

## 4.2. Environmental Status of Ground Water

### 1. Chemical Composition of Ground Water

- Chemical composition of ground water depends on several factors such as
  - ✓ Frequency of precipitation
  - ✓ Quantity of salts leached
  - ✓ Duration of rainwater in the root zone
  - ✓ Presence of organic matter in soil

### 2. Description of Ground water

- The description should include the type of aquifer present in the study area
  - ✓ Whether it is confined or unconfined
  - ✓ The levels of pollution in the ground water resources

### 3. Description of underground drainage System

- Description of underground drainage system includes the
  - ✓ The rain water infiltrates rapidly through sink holes.
  - ✓ Fractures in the karst landscapes

[The karst landscapes are very fragile and vulnerable to various anthropogenic activities.]

### 4. Description of multiple aquifer systems

- ✓ Wherein two or more aquifers are interconnected.
- ✓ The quantity of groundwater flow between two different aquifers.
- ✓ The quality of groundwater flow between two different aquifers.
- ✓ Multiple aquifers are possibly separated by the aquitard at the project sites.

**5.** Quantitative data on the extractable groundwater resources.

**6.** Information related to uses of groundwater within the study area for many industrial processes, agricultural and municipal use, or public services.

**7.** Understand the factors influencing the likelihood of ground water contamination.

**8.** Information of the depth of usable quality ground water.

9. Description of the unsaturated zone where the pore spaces are not filled with ground water.

10. Description of ground water quality characteristics.

11. Emphasis on ground water problems in study area.

- ✓ Leaks and spills at factories and commercial facilities.
- ✓ Improper hazardous waste disposal.
- ✓ Disposal of pesticides.
- ✓ Animal wastes.
- ✓ Pipe line breaks leading to pollution from sewerage.
- ✓ Petroleum products.

## 4.3. Environmental Status of the Soil

- The assessment of current state of in-situ soil by laboratory analysis was done before & after project activity.
- The soil at the proposed construction site should be given maximum importance of EIA because,
  - ❑ Any developmental activity causes disturbance to the soil.
  - ❑ The agricultural land may be disturbed or loss due to project activity.
  - ❑ Contamination of land is likely to occur.
- The Condition of soil at the project site can be assessed by three ways.
- **1) Desk Study**
- Collection information by literature review related to the soil characteristics and geological information at the proposed construction.
- **2) Field Work**
- Observation of the color and texture of soil at the proposed project site.
- **3) Laboratory Tests**
- The physical and chemical properties of soil such as moisture content, density, pH, minerals, heavy metals, soil productivity, hydrological function (infiltration and permeability).

## 4.4. Impact Prediction

* The role of impact prediction of a project activity is to understand the consequences of the proposed development.
* The extent of changes that can affect the environment, so it will help the decision makers to identify the most important issues.
* Impact prediction involves the scientific characterization of the cause and effect of impacts on the environment and the local community.
* While predicting an impact, the physical, biological, socio-economic aspects, anthological data and techniques are taken into consideration.
* When a toxic liquid effluent is discharged irresponsibly into the environment, the potential impacts with regard to surface water hydrology include the following.
    * Reduced water quality parameters of the receiving streams.
    * Change in the ecology of banks of the water bodies.
    * Loss of land resources and livelihood due to allied developments.
    * Effects on the economy of the fishing community.
    * Socio-cultural effects as indigenous people, living in and around the proposed project areas are rendered homeless due to invasion by land speculators.
    * The Potential earnings from ecotourism market may suffer.

### 4.4.1 Impact Prediction Method

Impact prediction methods are broadly classified into two methods.

1) Box – Model Approach for prediction
2) Mass Balance Approach

**1) Box - Model Approach for prediction**

i. Box model is the simplest approach commonly used for prediction of various environmental impacts for engineering projects in a city.

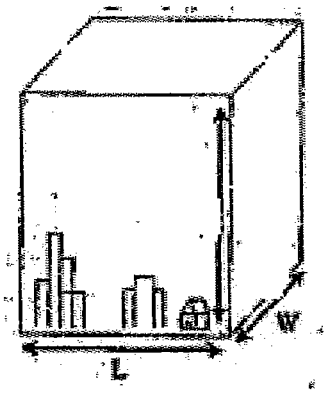
ii. The following assumptions were made in this model.

a. It assumes that the city under study is in the shape of a rectangular box with dimensions such as width W), Length (L), and Height (H).

b. The direction of wind flow is parallel to one side of the box.

c. The air pollutants are dispersed homogeneously inside the box.

d. The instability in the atmosphere produced must not cross above the height of the box.




iii. The dispersed pollutants have uniform concentration in the whole volume of air and do not change with time.

iv. The wind blows at constant velocity in the direction of the length or width of the box.

v. The concentration of the pollutant must be constant anywhere within the box and should not leave the box from any side.

vi. The average concentration of the gas or particular matter dispersed in the box is given by the following equation.

vii.

$$C = \frac{R \times T}{L \times W \times H}$$

Where

**C** = Avg. Concentration of the gas/particulate matter
**R** = Release role of pollutant (µg/sec)
**T** = Time period needed for uniform distribution of pollutant (sec)
**L** = along wind side / Length of the box (m)
**W** = Cross-wind dimension / Width of the box (m)
**H** = Vertical dimension of the box (m)

**2) Mass Balance Approach**

- The mass balance model (Material balance) for prediction of environmental impacts of engineering projects is a technique for assessing the potential risks on the environment owing to a developmental activity.
- It needs detailed knowledge of the inputs and outputs of several components during the construction and operation phases of the project activity.
- It helps to evaluate the situation and identify the options according to the principle of conservation of mass.

- The mass of the body remains the same throughout a process or an operation.
- The same principle is applicable to the mass balance concept.
- The rate of change of mass is given by the formula proposed by McKay, Peterson

$$\frac{dt}{dM} = (I+D+F+J) \div (X+R+T)$$

Where

I = Rate of mass inflow into the compartment
D= Rate of discharge into the compartment
F = Rate of mass formation due to activity
J = Rate of transfer from other compartments.
X = Rate of outflow from the compartment
R = Rate of the degrading reaction.
T = Rate of transfer to other compartments

## 4.5. Assessment of Impact Significance

A widely used environmental Evaluation system developed by a research team at the Battle Columbus Laboratories in the United States in 1972 called the Battelle Environmental Evaluation System (BEES) is used for the computation of environmental impacts. It consists of seventy-eight environmental factors (Parameters) arranged into Seventeen compounds and four categories.

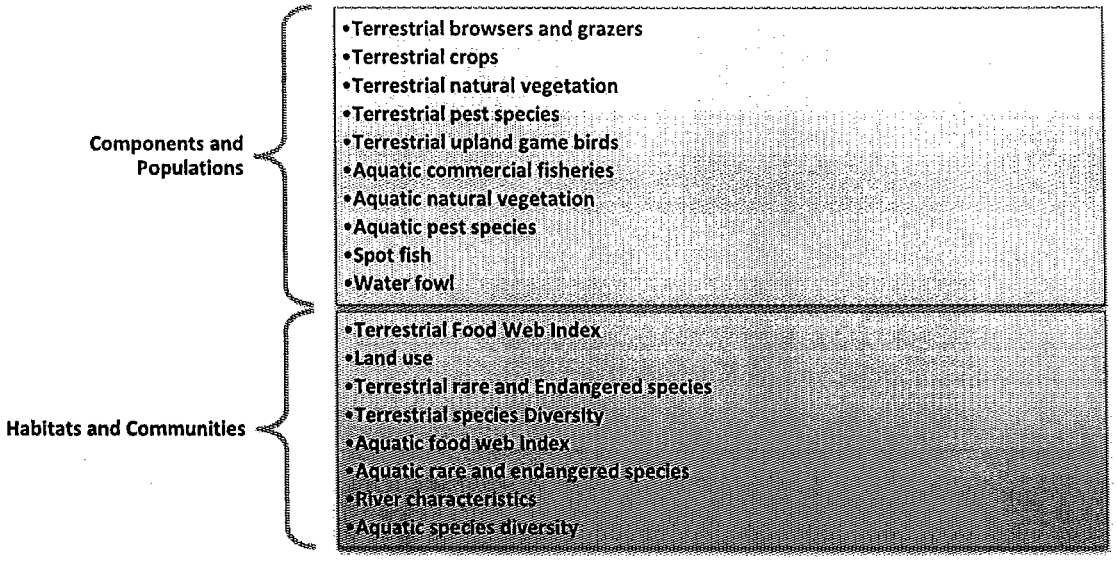
The four main categories of environmental impacts are,

1. Ecology
2. Physical/Chemical
3. Aesthetics
4. Human interest and social

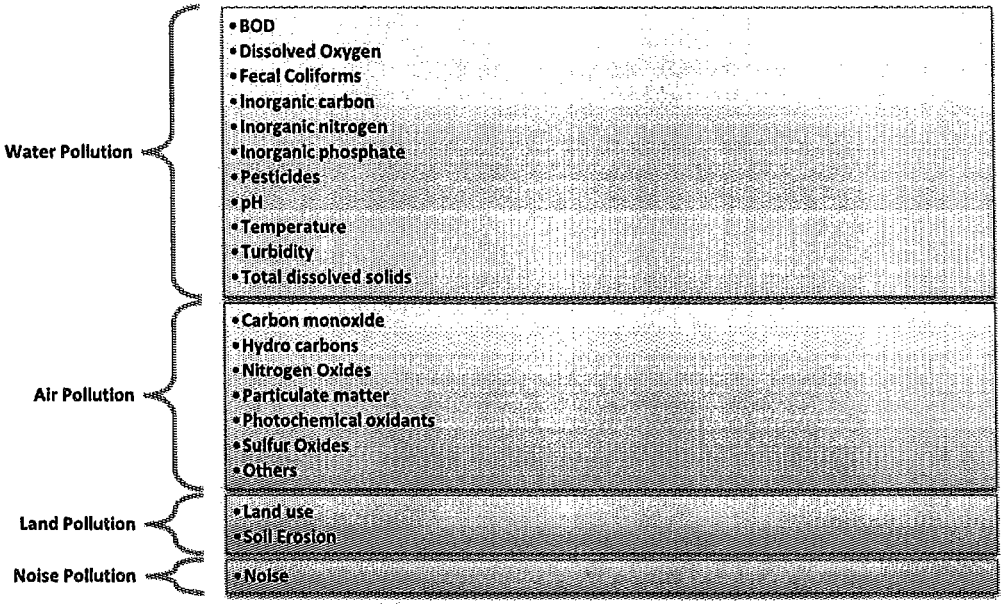
Each category is further subdivided into many environmental components and each environmental component is braked down into several parameters. Each environmental quality is given value in a scale ranging from 0 to 1.

The frame work for the BEES is given below.

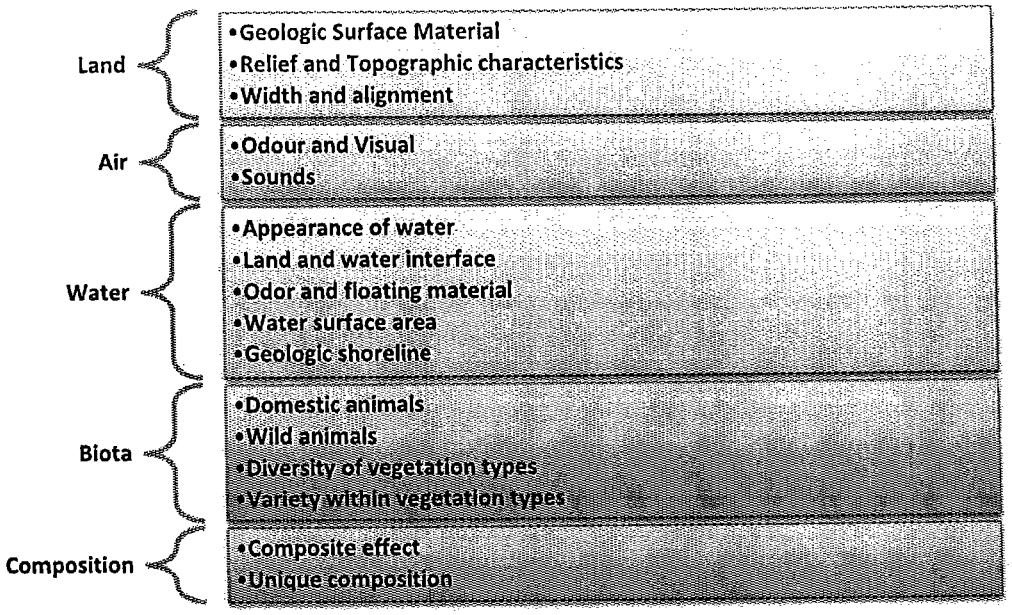
### 1. Ecology (Category – 1 : Ecology)



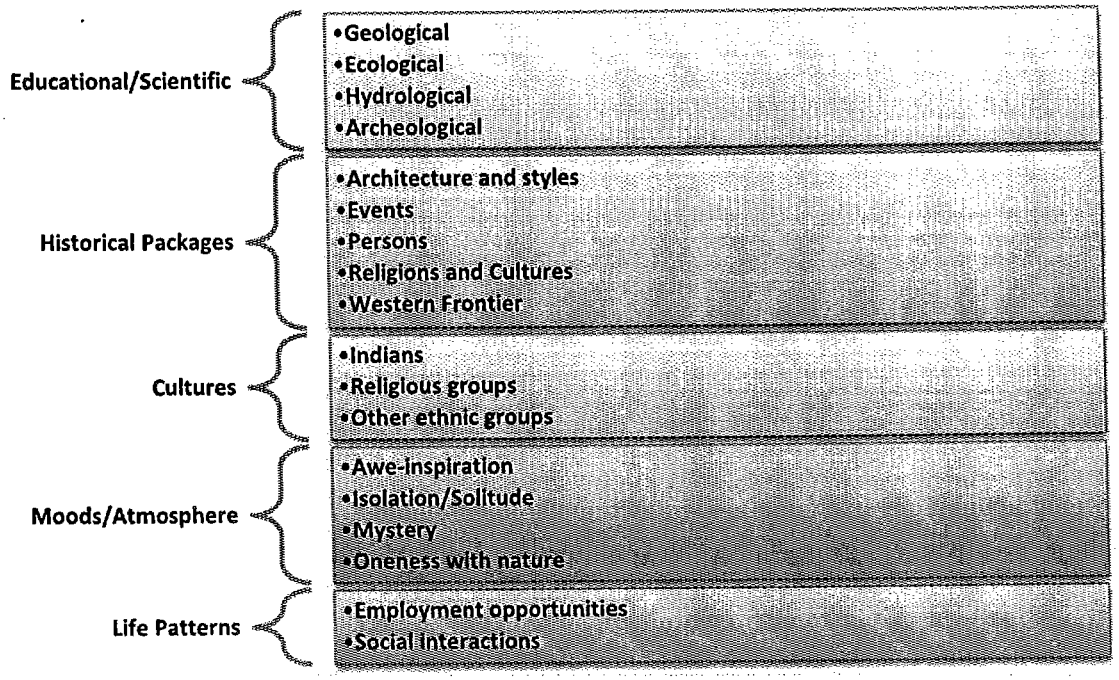

### 2. Environmental pollutants (Category – II : Environmental pollutants)



## 3. Aesthetics ( Category – III : Aesthetics )




## 4. Human Interest ( Category – IV : Human Interest )



## 4.6. Identification and Incorporation of Mitigation Measures

Different mitigation measures that can be employed for different adverse conditions that can affect the environment based on the type of developmental project activity.

### 4.6.1 Mitigation measures to counteract the adverse effects of a natural calamity

The different types of measures that can be employed for mitigation of adverse environment are,

1. Loss and damage to soils from erosion, compaction and pollutions can be mitigated by good practice techniques. Erosion of soil by various agents can be reduced by minimizing the amount of soil bared through reduced vegetation, by retaining the stubble of the crops in the soil, by promoting the growth of macroscopic and microscopic soil organisms, by promoting the use of anthropogenic chemicals in the soil, by encouraging extensive plantation of trees.
2. Restrictions on the cutting of plantation at the site.
3. Development of green belt on the surrounding periphery of project site.
4. Watering the ground before the excavation process begins.
5. Soil contamination from oil and material spills by adopting spill control procedures.
6. Restoring the vegetation on barren lands by landscaping with fast growing grass cover, plants, flowers, bushes and trees.
7. Implementing appropriate water conservation measures to meet the increased demand for electricity.
8. Implementing appropriate energy conservation measures to meet the increased demand for electricity.
9. Use of safety procedures and personal protective equipment to prevent adverse human health from dust and noise.
10. Prevent the entry of construction material into surface water to prevent the adverse impacts on drinking water supplies, irrigation systems and river ecology.
11. Prevent the entry of sediment into surface waters by implementing runoff control measures, mechanical sediment control measures, grassed filter strips, and soil bioengineering practices.
12. Regulation on the open building of solid waste/garbage.
13. Use of air pollution control techniques such as electrostatic precipitation, cyclone scrubbers, thermal oxidation, bio filtration, adsorption, wet scrubbing, condensation, and chemical treatment for reducing pollutant levels from point sources.
14. Modification in the project with changes in the design patterns.

### 4.6.2. Mitigation measures of adverse environmental impacts during operational phase of Engineering Project

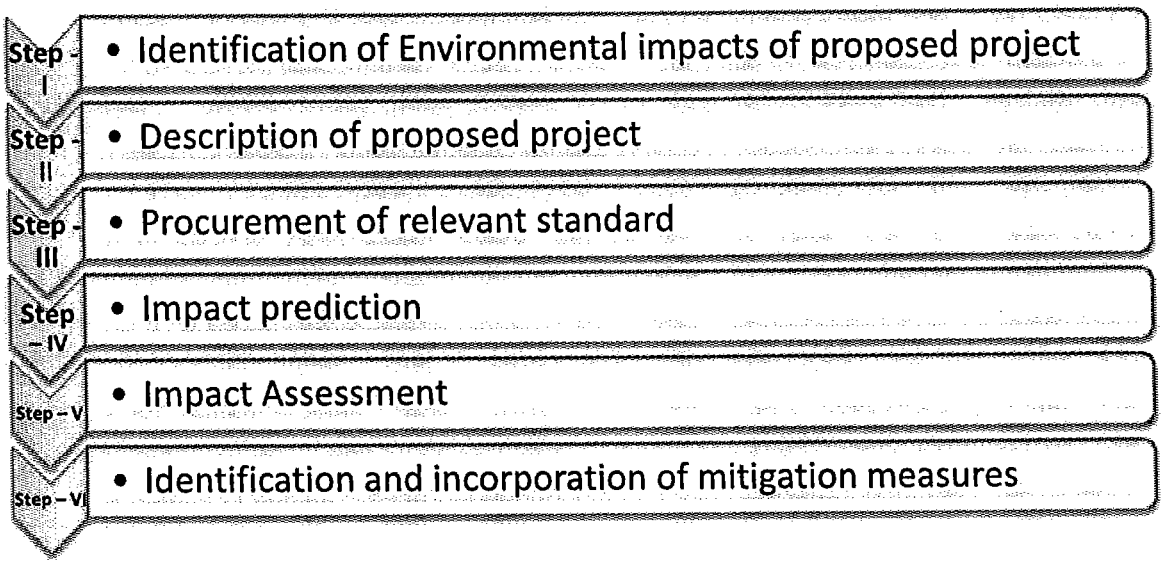
The measures to be taken for mitigation of adverse environmental impacts during operational phases of an engineering project are,

1. Decrease in the height at which the construction material is loaded or unloaded.

2. Influencing the ground vehicles to reduce emissions.
3. Use of silencers on construction equipment for noise abetment.
4. Use of noise barriers to prevent the noise emanating from the construction equipment from the sensitive receivers.
5. Energy management systems to monitor and reduce overall energy use includes,
    a. Use of renewable energy sources such as solar photovoltaic panels or wind turbines.
    b. Burning of municipal solid waste to produce electricity.
    c. Encourage the use of low-emission rental cars, taxis, shuttles.
6. Implement water conservation measures such as installation of automatic shut off and low-flow plumbing fixtures, water reuse programs.
7. Preventing soil compaction caused by the weight of vehicles and machinery by restricting the vehicular movement to defined tracts and avoid its use outside the construction zone.
8. Preventing the entry of construction material into surface water to prevent the adverse impacts on drinking water supplies, irrigation systems, river ecology, etc.
9. Prevent the entry of sediments into surface waters by implementing runoff control measures, mechanical sediment control measures, grassed filter strips, and soil bioengineering practices.

## 4.7. EIA with reference to Surface Water

A schematic diagram for a conceptual approach to the study focused on environment impacts is depicted below:



### 4.7.1. EIA study with respect to Surface water

The steps involved in the evaluation of impacts of various developmental activities on surface water environment are as mentioned below.

1. Identification of Surface Water Quantity or Quality Impacts of proposed Projects.
2. Analysis of the Potential impacts of the development project on the surface-water conditions.
3. Collections of Significant Information Related to Quantity and Quality of Surface Water.
4. Evaluation and Prediction of Impact on Surface Water.
5. Analysis of Impact Significance.
6. Mitigation Measures.

***STEP - 1*: *Identification of Surface Water Quantity or Quality Impacts of proposed Projects***

* The physical parameters of water include the temperature, color, conductivity, turbidity, total suspended solids, total dissolved solids, oil and grease, etc. The chemical parameters of water are broadly categorized into

a) Organic content of water

- ✓ It includes the biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Oxygen Demand (TOD).

b) Inorganic content of water

- ✓ It includes the salinity, hardness, acidity, alkalinity, pH, cations such as Ag, Al, As, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, Hg, k, Mg, Mo, Na, Ni, P, Pb, Sb, Se, Si, Sr, Th, T, V, U, Anions such as CI,F, SO4, CN.

c) Biological Components of Water

- ✓ They include total coliform count and fecal coliform count. Source of pollutant in water are categorized as

1. **Non-Point Sources**
   Pollutants come from many different sources, for example: Urban runoff, poor, irrigation practices, poorly managed construction sites, abandoned mines.
2. **Point Sources**
   The Pollutants come from one source, for example: Factory/ industrial plants, direct dumping of toxic waste into water. The water quality parameters are intrinsically linked to water quantity due to the fact that changes in water quantity are likely to affect the dilution of pollutants.

* The potential water quality impacts due to construction phase include.
  (a) Runoff general construction activities related to the project at the site.
  (b) Construction runoff and drainage.
  (c) Production of sewage effluents from the on-site construction work force.
  (d) Increased load of suspended solids and contaminants from site surface and drainage channels.
  (e) Pollutants such as fuel, oil, diesel, lubricants and solvents generated from vehicles and equipment used for construction activities, can enter the surrounding water bodies.

***STEP – 2:* Analysis of potential impacts of the development project on the surface-water conditions**

This step is accomplished by the use of several mathematical models to determine the changes in water quantity, quality and flow patterns.

a) Some mathematical models commonly used in EIA are mentioned below Fundamental runoff formula for predicting surface water runoff.

b) Rational formula — this is used to compute the peak discharge flow rate.

c) Naiver-Stokes equation -This is used to determine the water-flow patterns.

d) Streeter-Phelps equation :-( also known as the "dissolved oxygen sag" equation). This is used for evaluating dissolved oxygen in water.

e) Advective transport formulation

f) Dispersive transport formulation

g) Surface heat budget formulation

h) Dissolved oxygen saturation formulation

i) Hydrological transport model.

***STEP - 3:*** *Collection of significant information related to Quantity & Quality of surface water*

* The Bureau of Indian Standards Specifications ISO: 10500-1991 governs the quality of drinking water supplies in India.
* This is based on international standards for drinking water quality issued by the WHO.
* A number of government agencies are responsible to foresee the availability of drinking water of adequate quantity and potable quality.
* The government agencies include the ministry of water resources, the ministry of Urban Development and poverty Alleviation, the Ministry of Rural Development, the Ministry of Environment and forests, the Ministry of Health.
* The water quality standards in India recommended by the Bureau of Indian Standards

| S.No. | Characteristics | Permissible limit |
|---|---|---|
| 1 | Color | 5-25 Hazen units |
| 2 | Odour | No objectionable odour |
| 3 | Taste | No objectionable taste |
| 4 | Turbidity | 5-10 NTU |
| 5 | pH Value | 6.5-8.5 |
| 6 | Total Hardness | 300-600 mg/l |
| 7 | Iron | 0.3-1.0 mg/l |
| 8 | Chlorides | 250-1000 mg/l |
| 9 | Residual free cholrine | 0.2 mg/l |
| 10 | Calicum | 75-200 mg/l |
| 11 | Magnesium | 30-75 mg/l |
| 12 | Copper | 0.05-1.5 mg/l |
| 13 | Manganese | 0.1-0.3 mg/l |
| 14 | Sulphate | 200-400 mg/l |
| 15 | Nitrate | 45-100mg/l |

| | | |
|---|---|---|
| 16 | Fluoride | 1-1.5 mg/l |
| 17 | Phenolic compounds | 0.001-0.002 mg/l |
| 18 | Mercury | 0.001 mg/l |
| 19 | Cadmium | 0.01 mg/l |

***STEP – 4: Evaluation and prediction of impact on surface water***

* The potential surface water impacts that are likely to occurs as a result of the proposed developmental activity depends on several factors

**(a) Direction of the Impact**

- ✓ The types of impacts may have positive, negative or neutral effect on the environment.

**(b) Magnitude of the impact**

- ✓ The magnitude of impact may be categorized as none/negligible, low moderate or high.

**(c) Duration of Environmental Impact**

- ✓ The duration of the environmental impact may be transient, short term, medium term, long term or permanent.

**(d) Geographical Extent**

- ✓ It refers to extent to which the proposed activity is likely to affect-whether it is local, regional, national or international.

**(e) Probability of Impact Occurrence**

It refers to the chances of occurrence of impact. It can be of the following types,

i. Least probable / impropable (<5% chance)

ii. Low probability (5% to40% chance)

iii. Medium probability (40% to 60% chance)

iv. High probability (60% to 90% chance)

v. Definite ( Impact will occur definitely)

- ✓ The potential impact during the construction and operation phase of proposed project with regard to surface water hydrology includes the following.
  1. Increase in the erosion and sedimentation due to stripping of vegetation in and around the proposed construction site.
  2. The construction of river crossings would alter the ecology of river bank and river beds.
  3. Increase in erosion and sedimentation due to the construction of diversions channels for directing the river water in another direction.
  4. Increase in polluted discharges affect the water quality of the receiving streams.

***STEP – 5: Analysis of Impact Significance***

* Depending on the types and extent of the proposed development project, the type of resources affected can be ascertained.
* The information thus obtained can be used to make informed decisions on whether to proceed with the project or not.
* It may also be used for the identification and evaluation of alternatives if the proposed project has a significant impact on the community.

***STEP – 6: Mitigation Measures***

Some general mitigation measure should be practiced/ followed,

a) Re-Vegetation and tree plantations near the proposed construction site.

b) Preventing the entry of construction material into surface water to prevent the adverse impacts o drinking water supplies, irrigation systems and liver ecology.

c) Prevent entry of sediments into surface water by implementing runoff control measures, mechanical sediment control measures, grassed filter strips, mulching and soil bioengineering practices.

d) Increasing water infiltration into soil.

e) Controlling excessive storm runoff.

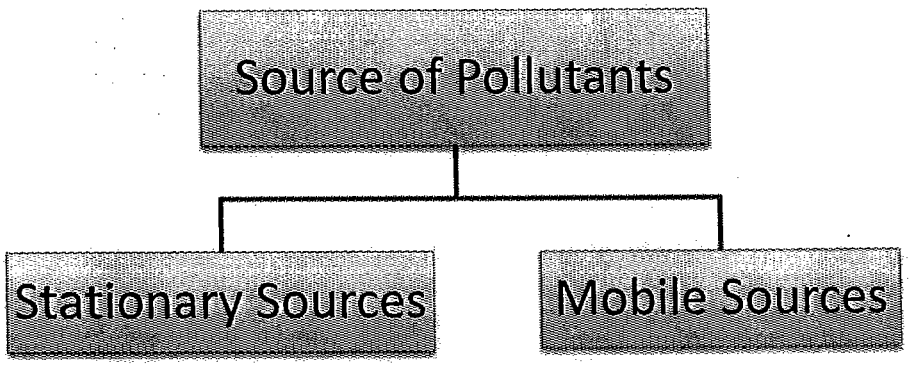
f) Controlling soil erosion.

## 4.8. The evaluation of impacts on environment by any project activity

The evaluation of impacts on environment by any project activity can be structured in the following steps,

***STEP - 1:*** ***Examination of Types of Pollutants, Quantities and sources Generated during the Construction and operation phase of Proposed Activity***

The first step for evaluating a proposed project activity is to consider the type of air pollutants released during the construction and operation phase of the proposed activity and their expected quantities. The air pollutants are added to the atmosphere from various sources, as mentioned below.




**Examples:**

- Electric power plants
- Fuel combustion facility stacks
- Domestic heating and cooking
- Dry cleaners
- Paint shops
- Phosphate processing plants
- Pulp and paper mills
- Solid waste disposal
- Municipal incinerators

**Examples:**

Vehicle emission from road transport
Railway inland navigation
shipping, Aviation.
Dust emission from stock piles Gas stations
Industrial plants airports
Dock yards
Rail Yard

***STEP – 2:*** ***Evaluation of project site for the Ambient Air Quality, Emission Inventory and Metrological data***

The ambient air quality at the proposed project site is established through intensive of ambient air quality with the help of automatic techniques such as TEMO (TAPERING ELEMENT OSCILLATING MICROBALANCE) beta gauge instruments, light scattering systems and manual techniques such as filter paper samples and impinges.

The pollutants in air are analyzed by the following methods,

(i) Gravimetric analysis
(ii) Volumetric analysis
(iii) Spectrophotometric analysis
(iv) Turbidimetry, Nephelometry
(v) Flurometry , Atomic absorption Spectrometry
(vi) Infrared spectroscopy, HPLC, Electro chemical techniques.

The information in this section should include the following

(a) Types and concentration of hazardous gaseous chemical emissions.
(b) Concentration of particulate matter.
(c) Offensive odors.
(d) Various climatic conditions. The data on meteorological variables to be included are - rainfall, temperature, air pressure, wind speed, direction of wind, relative humidity.
(e) It should also contain a summary of the pollutants in the vicinity of the proposed project site.

***STEP - 3:*** ***Examination of Air Quality Standards criteria, polices of the local, state and central government agencies***

This section has the documentation of existing air quality at the regional, sub regional and local level, the desirable air quality must be in compliance with the prevlling government regulatory standards, guidelines, codes of practices and permit conditions.

***STEP - 4:*** ***Impact*** **prediction** ***of new project on ambient air quality***

The most popular approach for impact prediction is,

(i) The Mass -Balance Approach The mass balance approach is for the total air pollutant emission during the construction and operation phase of proposed project activity.

(ii) Use of arithmetical models

(a) Box model

(b) Dispersion or craussian model

(c) Computer simulation model

***STEP – 5: Assessment of impact significance***

In this stage, the beneficial and detrimental impacts of the proposed development are assesed.This is accomplished by conducting public meetings and / or public participation programmers. If no significance impacts are likely to occur, then the agencies involved in environmental impact assessment study issues a finding of no significant impact.

***STEP – 6:** Mitigation Measures*

Some of the many mitigation measures during the constructional phase of the project include,

1. Decrease in the height at which the construction material is loaded or unloaded.

2. The excavated material at the construction site should be enclosed, covered or dampened, especially during the dry and windy conditions.

3. The construction areas should be dampened using appropriate water sprays.

4. The vehicles carrying the construction material should travel controlled speed to reduce traffic included dust dispersion.

5. The vehicles carrying the construction should carry properly.

6. Implementation of technology to the fuel efficiency of automobiles.

7. Reduction in the tail pipe emissions by adopting technology to control the emission of evaporative exhaust gases.

8. Manufacture of vehicles with alternative fuel options.

9. Use of air pollution control techniques such as electrostatic precipitators, clone scrubbers, mist filtration, thermal oxidation, catalytic oxidation etc.....

10. Regulation on the open burning of solid waste.