CHAPTER 6

EFFECTIVE MANAGEMENT OF GROUNDWATER

6.1. Augmentation of groundwater recharge potential

Dependence on groundwater has increased in areas where surface water resources are limited and polluted due to industrial and mining activities. Groundwater is extracted for various purposes in such areas, which causes the rapid decline in groundwater table.

The objective of this management is to improve in groundwater level by using Rainwater harvesting system and artificial recharge structure. There are many conservation measures that can be suggested in order to increase groundwater recharge potential in study regions are discussed below.

6.1.1 Afforestation and Plantations

The coal extraction process drastically alters the physical and biological nature of a mining area. Opencast mining activity, commonly practiced to recover coal reserves, destroys vegetation, causes extensive soil damage, compaction and reduced water infiltration capacity.

To improve the environment and greenery in the study area, NCL should be take up plantation on larger scale. The improvement in vegetation cover has a direct bearing on the augmentation of groundwater recharge. This greenery not only controls air pollution but also contains soil erosion and increase groundwater recharge.

6.1.2 Rainwater Harvesting and Artificial Recharge Structure

Rainwater harvesting is a technology used to collect, convey and store rain water for later use from relatively clean surfaces such as a roof, land surface or rock catchment. Rainwater harvesting is the technique of collecting water from roof, Filtering and storing for further uses.

The main objective of rainwater harvesting system is to make water available for future use and groundwater recharge structure has to be used to improve the groundwater level

of the study region. The 3D-Model of Rainwater harvesting system was designed by using AutoCAD Software are show in Figure 6.2.

Components of Rainwater Harvesting System and Artificial Recharge Structure:

A Rainwater harvesting system and Artificial recharge structure includes many components such as pipe, Filtration Unit, Storage Tank, overflow connection, Stop valve, and French Drain and infiltration tanks. The details of each component are shown in Fig.6.2.

Filtration Unit/ Chamber: A proportionate layer of Sand + Coarse Aggregate + Pebbles, are used as filter.

Storage Tank: Storage tank for the harvested rain water and it is usable in domestic, animal and for gardening purpose. The sketch of storage tank is shown in Fig. 6.1.For designing the optimum capacity of the tank following aspect have to be considered: (a) Average Annual rainfall, (b) Size of the catchment and (c) Drinking water requirements.

Over flow Connection: There should be an overflow connection for avoiding overflow condition during excess/heavy rainfall. Overflow connection should be opened on a canal or in a sloppy region of the particular area.

Stop valve: The stop valve is a flow switching and flows control device.

French Drains: A French drain is a trench filled with a perforated pipe and gravel that allows water to drain naturally from your yard. Water travels freely through the pipe, which empties a safe distance from the house. The trench bottom should be sloped about 1 inch for every 8 feet in the direction you want the water to flow. Cover the pipe with about 3-inches of gravel or crushed stone and Fill the trench with topsoil and compact to completely cover the entire French drain system. The water has to be collected into infiltration tanks for groundwater recharge.

Infiltration Tanks: The infiltration tanks are to collect rainwater for groundwater recharging purposes. There are five infiltration tanks of capacity 1000 liter have installed at different locations connected with storage tank through French drain pipe. Many holes of 1 cm diameter have been made in each infiltration tanks. Storm water has collected in infiltration tanks through the French drain system. The Infiltration tank that has worked as a Groundwater Recharge Structure. The basic purpose of GWR structure has to improve the groundwater level of the study area.

Estimation of Roof Rain Water Harvesting:

We shall first calculate the maximum quantity of rainfall that can be harvested from roof top.

Consider a building with a flat terrace area = 112 m^2.

The storage capacity and dimension of the storage tank is 100000 litres and 5m × 4m × 5m (l×b×h).

Volume of storage tank = 100 m^3

The average annual rainfall in Singrauli = 1100 mm (44 inches).

In simple terms, this means if the terrace floor is assumed impermeable, and all the rain that falls on it is retained without evaporation, then, in one year.

Area of the roof top = 112 m^2

Height of annual rainfall = 1.1 m (1100 mm or 44 inches)

Volume of rainfall over the plot = Area of plot X Height of rainfall

= 112 x 1.1 = 123.2 m^3 (1, 23,200 liters)

Assuming that only 60 percent of the total rainfall is effectively harvested,

Volume of water harvested = 73,920 litres

The tank capacity has to be designed for dry period i.e. the period between two consecutive rainy seasons.

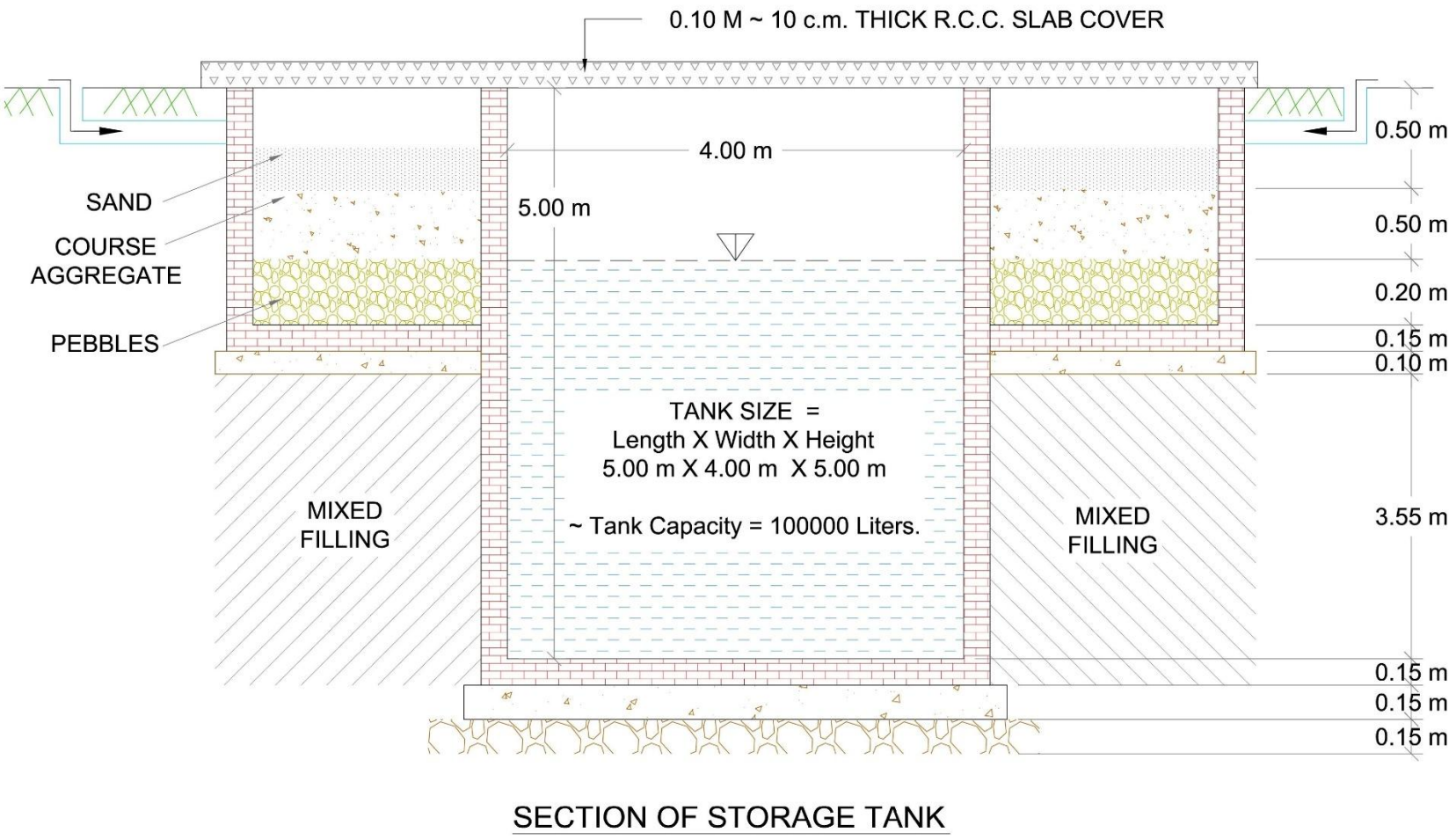
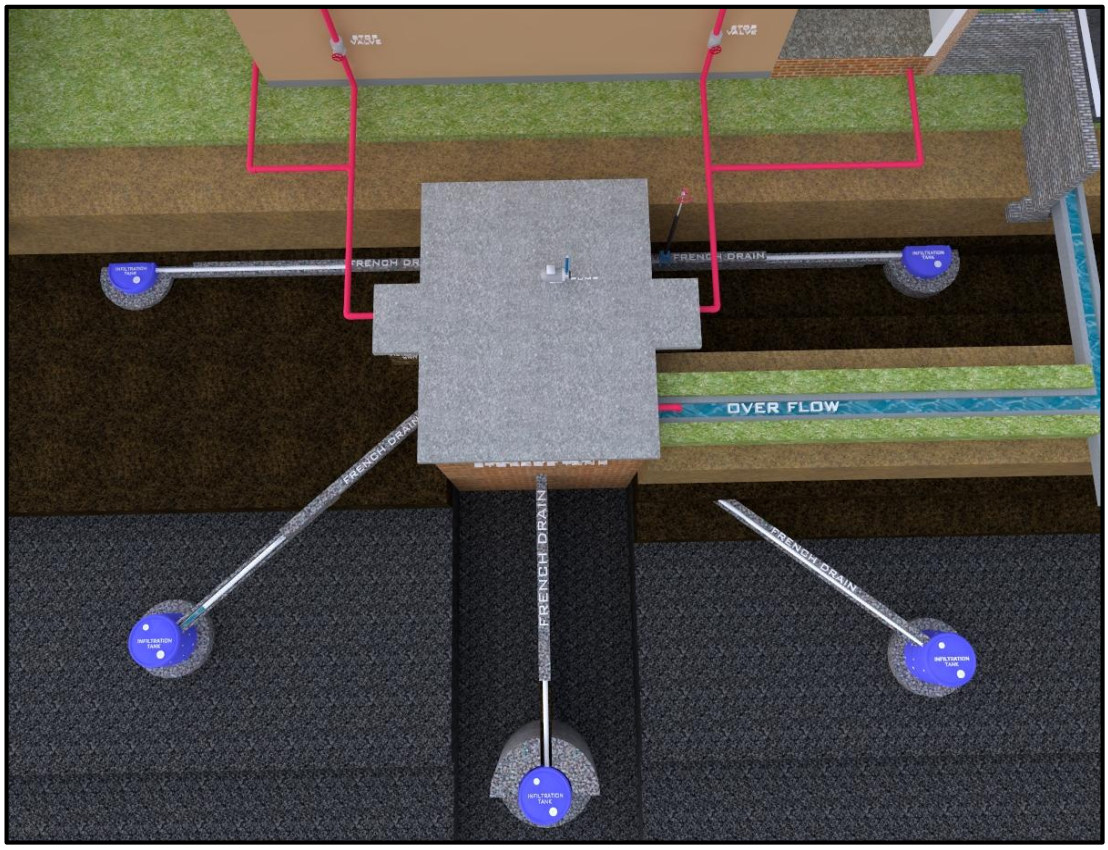
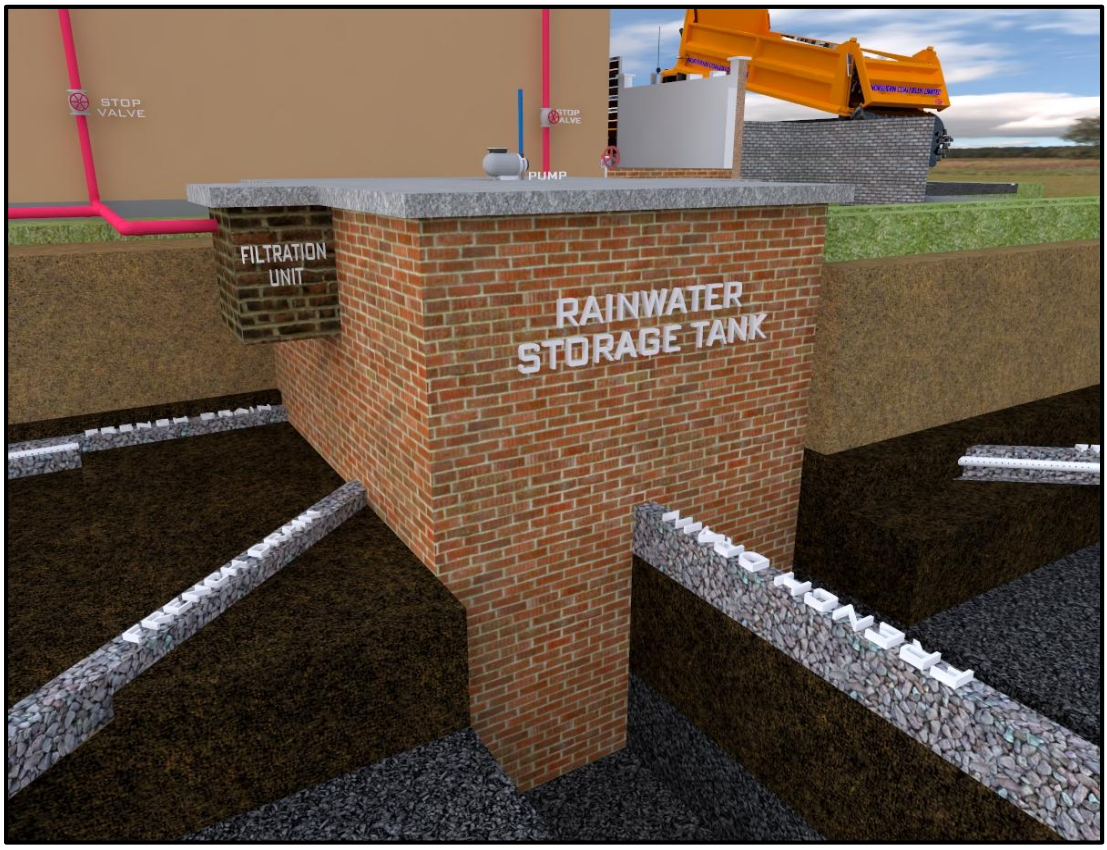
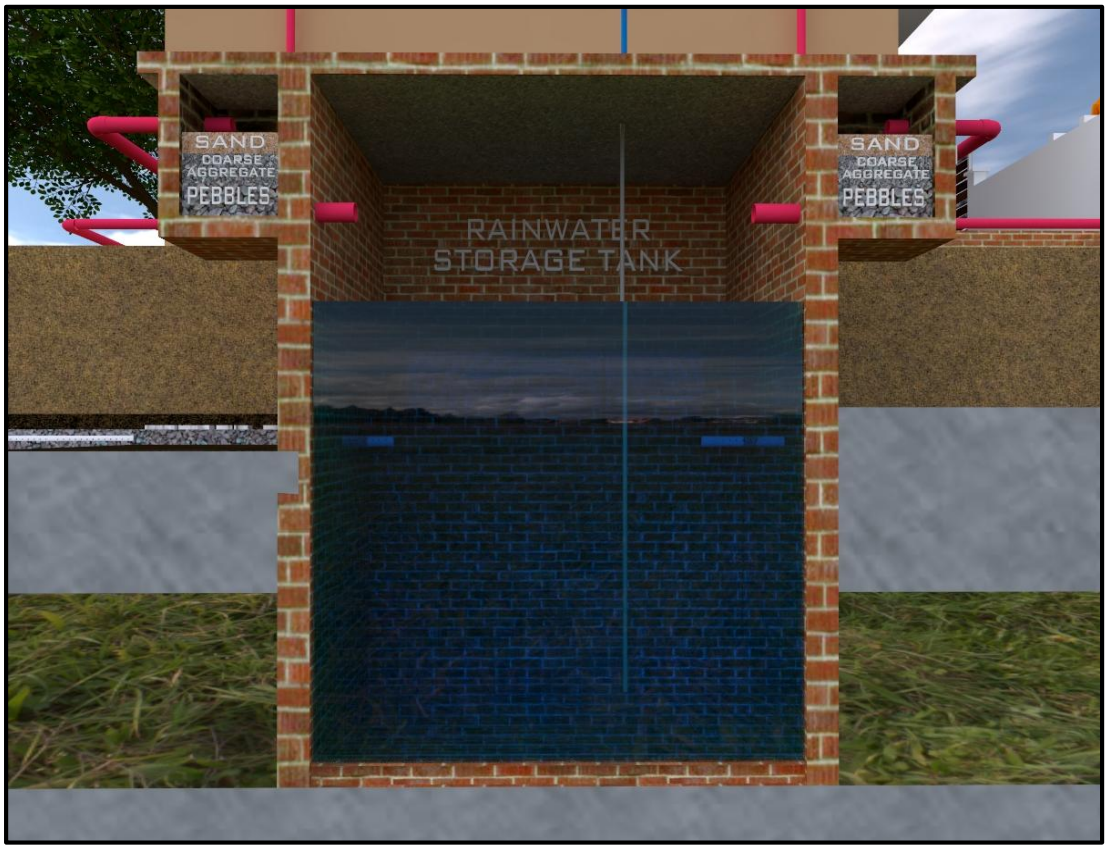


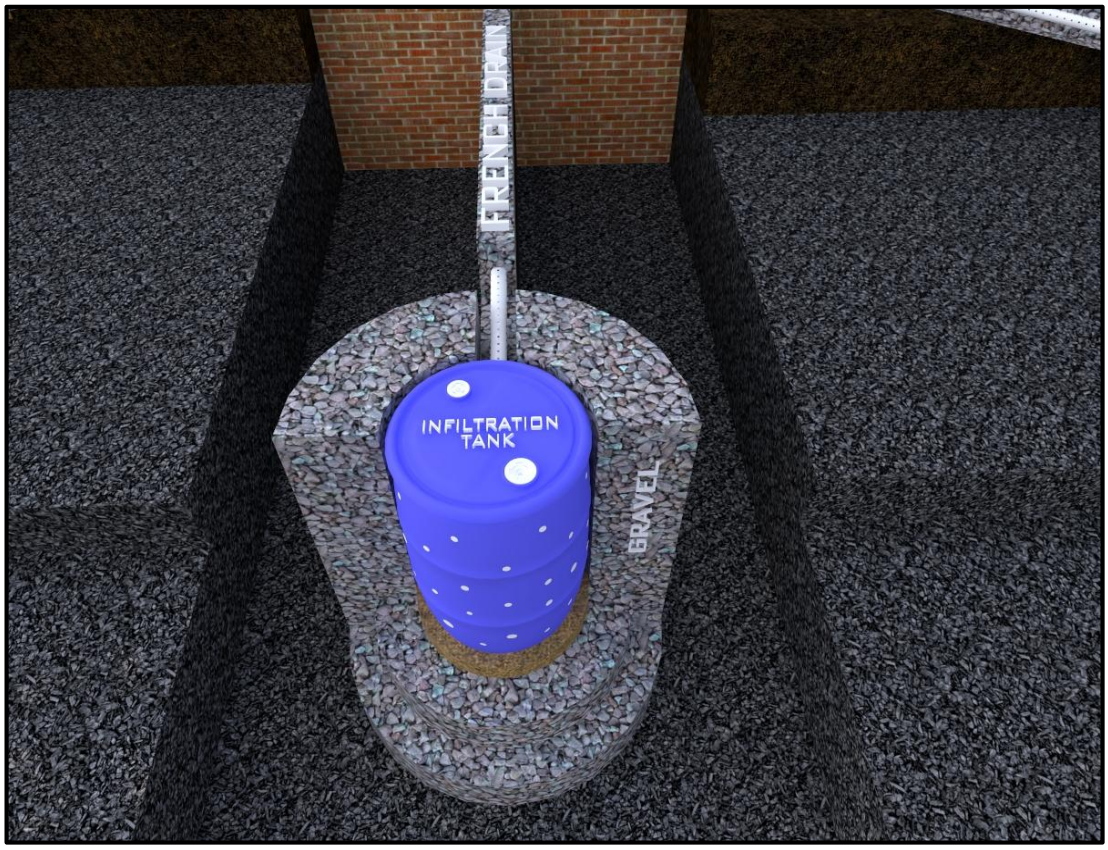
Figure 6.1 Diagram showing cross-section of the Storage tank


OVER FLOW
FRENCH DRAIN
FRENCH DRAIN
FRENCH DRAIN
FRENCH DRAIN


NCL , SINGRAULI
<-- RAIN WATER DRAIN PIPE -->
RAINWATER
STORAGE TANK
GRAVEL


STOP VALVE
PUMP
FILTRATION UNIT
RAINWATER STORAGE TANK


SAND
COARSE AGGREGATE
PEBBLES
RAINWATER STORAGE TANK
SAND
COARSE AGGREGATE
PEBBLES


FRENCH DRAIN
INFILTRATION TANK
GRAVEL

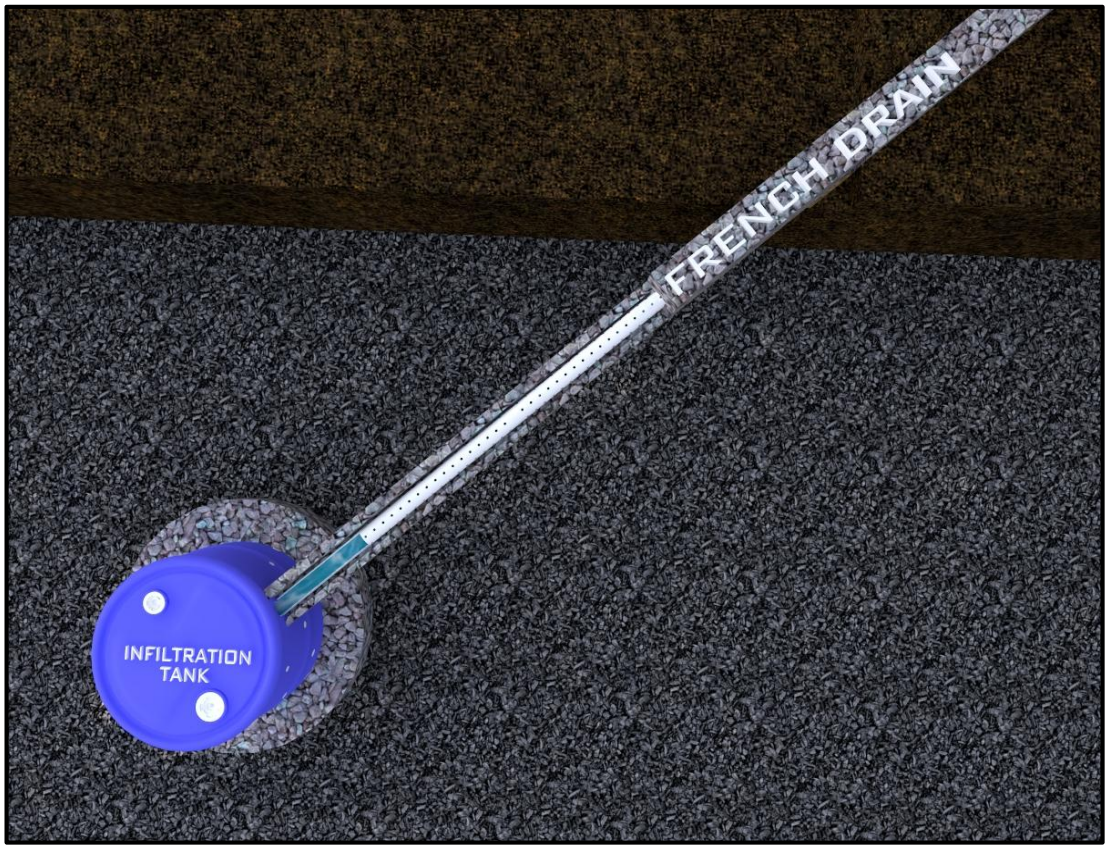

FRENCH DRAIN
INFILTRATION TANK

Figure 6.2 Components of rainwater harvesting and artificial recharge structure

Identification of the location:

The identification of the location of the rainwater harvesting system was done by overlapping groundwater potential map and groundwater fluctuation map, after overlapping the site was identified. Some of the possible sites for water conservation structure are shown in Figure 6.3.

The artificial recharge of ground water is normally taken in the following areas:

- Areas where groundwater levels are declining on regular basis.
- Areas where due to rapid urbanization infiltration of rainwater into subsoil has decreased drastically.
- Area where groundwater level is very high (>20 mbgl).
- The area where groundwater level fluctuation and groundwater recharge potential is very low.

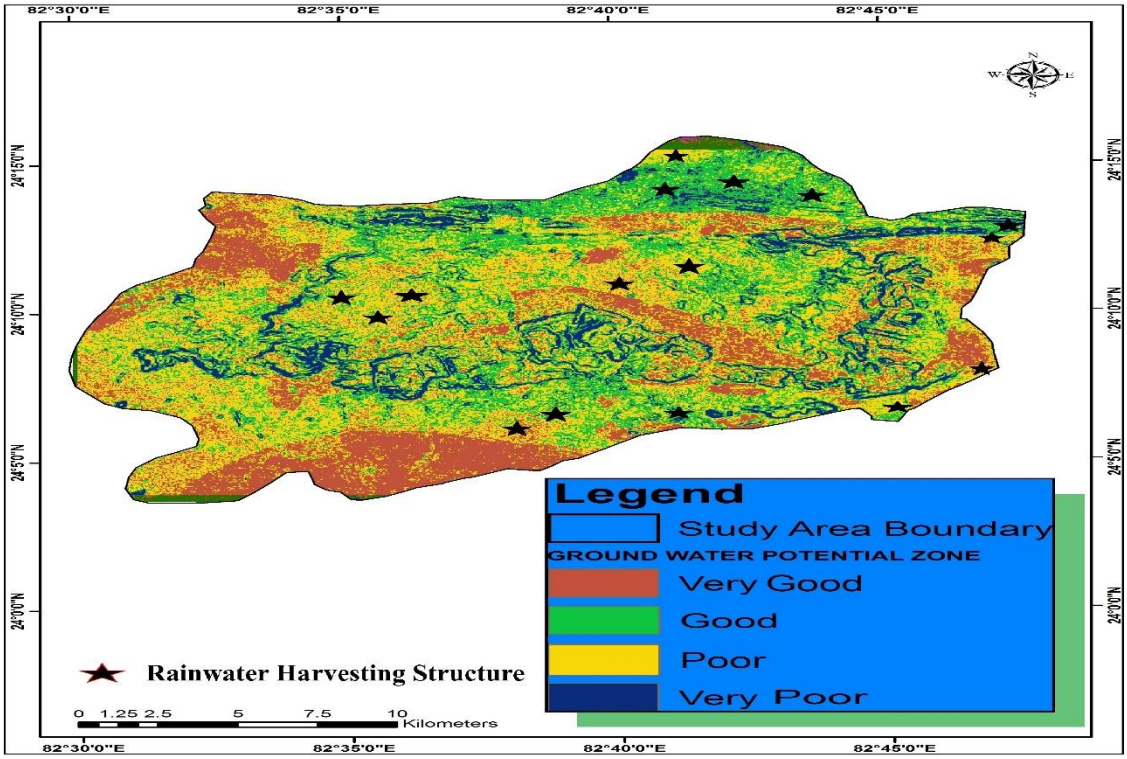


Figure 6.3 Map shows the suggested locations of the rainwater harvesting structure

6.2. Water treatment Technology

Minimizing the influence of coal mining activities on local water resources should be the top priority of the mining industry. Numerous approaches are being used for the treatment of mine waters, industrial water, and surface water with the treatment solution depend on the water contamination. The water quality management as adopted in coal mine is shown in the as flowchart Fig. 6.4.

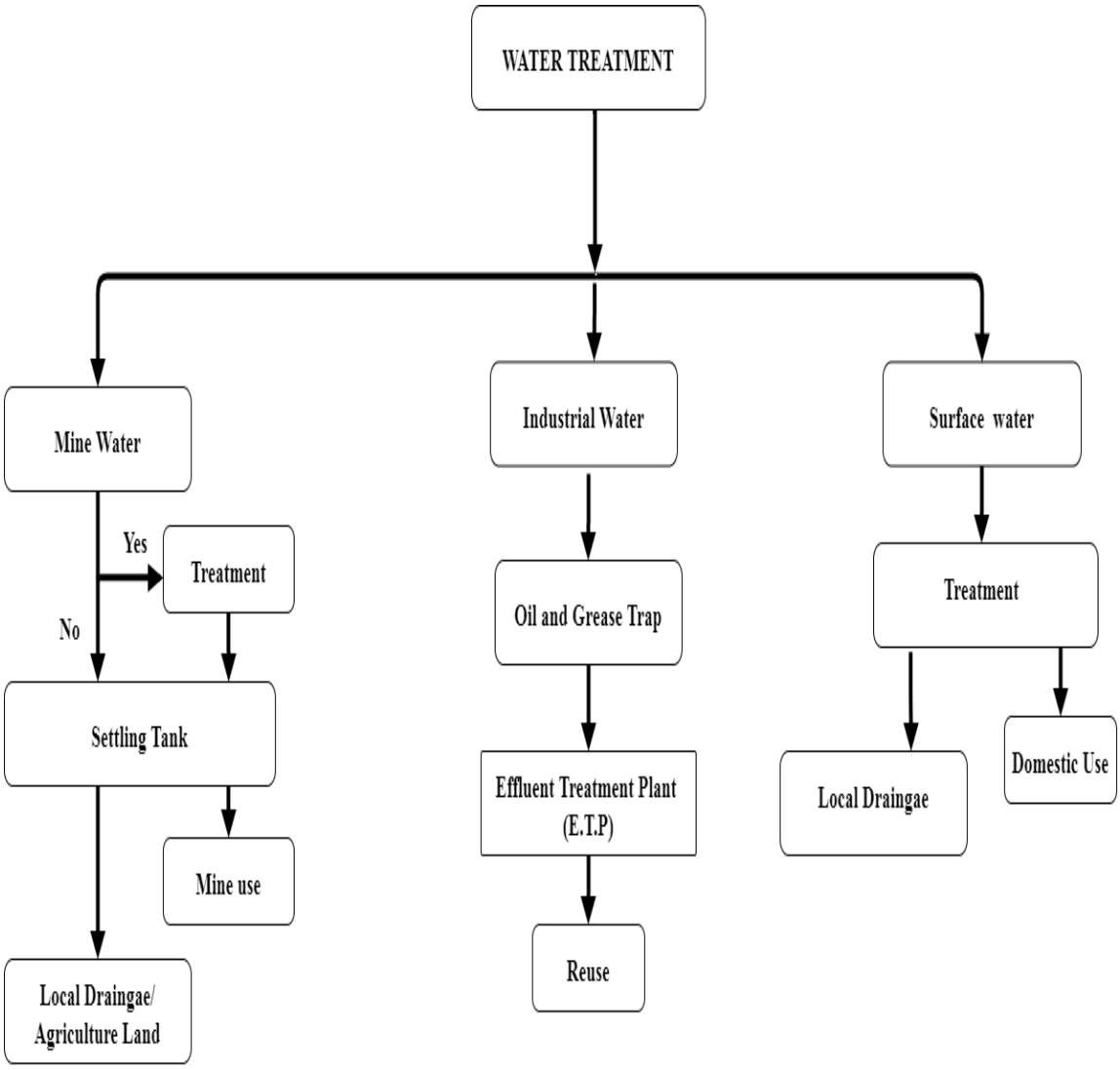


Figure 6.4 Flow chart of water quality management in coal mine

6.3. Other Strategy

- Creation of awareness among mine workers and local people, about water conservation, rainwater harvesting and artificial recharge.
- To assess the impact on local water levels, in time and space coordinated, monitoring of water levels in dug wells should be continued under routine monitoring.
- To create the water source and to increase ground water recharge, tanks/ponds should be maintained, under community development, in the nearby villages.
- Monitoring of water quality of mine water discharge, local river/nalas and groundwater (dug well/hand pump) should be continued under routine monitoring.