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Title of the Thesis : Analysis of Aquifer System and Design of Rainwater Harvesting for Dwarka Sub City, Delhi

Abstract

FINDINGS

Failure of the public supply system to meet the growing water demand of the residents of Dwarka Sub-City, has led to the abstraction of the Ground Water by private means, which has resulted in decline of the Ground Water table & depletion of the fresh water layer, restricting its use for the domestic purpose. The Research aims to formulate the remedial strategies in the form of Rainwater Harvesting for ground water restoration in the area. To achieve the objective of the research extensive Field survey, Literature Review, in-depth study of the Master Plan, interaction with concerned public/private agencies & residents, Field Investigations, Water Balance study, Impact Assessment Study was conducted.

Based on the Aquifer test (at constant discharge), the Transmissivity of the area was found to be generally varying between 1.63 to 7.28 m²/hr (which indicated that the well yield in the area varies from average to High) and Storativity between 0.1×10^{-5} to 2.32×10^{-5} (Indicating the aquifer system to be semi-confined to confined in nature). The Study of Tube-well Strata charts & interpretation of the Geophysical investigations results, showed a thick pile of alluvium overlying the basement rock, consisting of alternate layer of silt, clay, sand & kankar and the aquifer system in Dwarka Sub-city as Unconfined to Semi-confined to Confined in nature. Weathered formation constitutes the aquifer material. The top soil in the area is mostly non-calcareous in nature and comprises of silt clay and sandy loam soils with largely single grained structures. These soils are moderately to well drained. By and large near the Najafgarh drain, the soil is of coarse sandy loam nature and in the remaining area it is generally silty clay loam. The Ground water Level in Dwarka Sub-city was recorded to have acquired a declining trend and the natural recharge in major parts was not able to compensate for the Ground Water withdrawal rate. The study of Hydro-chemistry indicated the Ground Water to be Saline and moderately alkaline in nature in major part of Dwarka Sub-city and except Nitrate Sulphate & Coliform all other assessed parameters namely: Electrical Conductivity, TDS, Total Hardness, Magnesium, Calcium and Chloride were recorded to be exceeding the desirable limits in major part of the area. The Annual Rainfall for the area was determined to be 600 mm and the pH of the rainwater was observed to be varying between 6-6.5 ie moderately acidic in nature, while other

constituents namely TDS, Total Hardness, Magnesium, Calcium, Chloride & Nitrate were found to be in negligent quantity. The study of Ground water Potential (determined based on Specific Yield Method) & Rainwater Potential of Dwarka Sub-city indicated that except for few areas Roof Top Rainwater Potential & Total Rainwater Potential is generally more than the Gross Recharge & Recoverable Recharge Potential. Water Balance Study established the over-exploitation of Ground Water reservoir in area i.e. Stage of Ground Water Development(SGWD) >100%, hence, any future Ground Water Development in the area be linked with water conservation measures. However, it was observed that Post Harvesting considering Total & Roof Top Rainwater Harvesting Potential, the SGWD of the Area was brought down to 107 % & 167 % respectively from 608%.

The Impact Assessment study carried out based on the mathematical calculations indicated a considerable enhancement in Qualitative & Quantitative Potential of Ground water on Recharge through artificial means. The same is detailed below:

- Impact on Salinity & other constituents (% decrease) varies as :- (a) Roof Top Harvesting: 14.14 to 91.64 % (b) Road Area Harvesting: 11.95 to 91.86 % (c) Open Area Harvesting: 25.71 to 79.45 % (d) Total Rainwater Harvesting: 43.36 to 95.08%
- Impact on pH :- By and large close to '7' post harvesting .
- Impact on Ground Water Potential (% increase) varies as:- (a) Roof Top Harvesting: 16.47 to 1095.6 % (b) Road Area Harvesting: 13.57 to 1127.82 % (c) Open Area Harvesting: 34.62 to 386.68 % (d) Total Rainwater Harvesting: 49.45 to 2142 %

The study established that major part of the area fall under 'Very Critical' category requiring immediate implementation of Ground Water restoration strategies and recommends Rainwater Harvesting Methodology as (a) Total Rainwater Harvesting (b) Roof Top Harvesting only (in case it is not feasible to tap Road area & Open Area potential) (c) Roof Top + Road Area harvesting or Roof Top +Open Area Harvesting, in case Total Rainwater Harvesting is not feasible due to ground conditions (d) Road Area + Open Area Harvesting. The study further recommends Recharge Shaft Model, Recharge Trench Model, Injection well Model and Recharge Pit Model for Dwarka Sub-city depending upon the Aquifer Geometry and land use pattern in the area. The recommended number of Recharge Structures for the each Sector & for major Land use categories, their designs & locations is detailed at pages 304-313 of the thesis