

**GROUND WATER INFORMATION BOOKLET
KOLKATA MUNICIPAL CORPORATION, WEST BENGAL**

DISTRICT AT A GLANCE

Sl. No.	Items	Statistics
	GENERAL INFORMATION	
1.	i) Geographical Area (Sq. km.)	187.33 sq.km
	ii) Administrative Division (as on 2001)	
	No. Wards	141
	iii) Population (as on 2001 Census) (with density of population)	45, 80,544 (24451.74 per sq.km.)
	iv) Normal Annual Rainfall (mm)	1647
	GEOMORPHOLOGY	
2.	Major Physiographic Units	Lower deltaic plains of the Ganga- Bhagirathi river system
	Major Drainages	Hugli river along its western boundary. Several canals like Bagjola Khal in the north and Beleighata and Circular Khal in the central part and Adi-Ganga (a paleo channel), and Talli nala in the southern part cover a large area of the city.
3.	LAND USE (Sq.km.) (as on 2004-05)	Urban area (Kolkata Municipal Corporation).
4.	MAJOR SOIL TYPES	Younger alluvial soils mainly silty clay to clay.
5.	NUMBERS OF GROUND WATER MONITORING WELLS OF CGWB (As on 31.03.07) No. of Piezometers/ Tube wells	21 (Tubewells-12, Piezometers-9)
8.	PREDOMINANT GEOLOGICAL FORMATIONS	Recent alluvium.
9.	HYDROGEOLOGY	
	Major Water bearing formation	Quaternary alluvium

	Pre-monsoon depth to water level during 2006	12.09 to 19.59 mbgl.
	Post-monsoon depth to water level during 2006	10.72 to 15.42 mbgl
	Long term water level trend in 10 years (1997-2006) in m/yr	There is fall of 7 to 11m in ground water level in last 45 years from 1958 to 2003. Declining trend of water level to the tune of 0.33m/yr at the core of the trough and 0.11 m/yr at the periphery.
10.	GROUND WATER EXPLORATION BY CGWB (As on 31.03.07)	
	No. of wells drilled	10
	Depth Range (m)	54.00-245.00 mbgl.
	Discharge (lps)	7.22-19.50
	Storativity (S)	$33 \times 10^{-3} - 20 \times 10^{-5}$
	Transmissivity (m^2/day)	2064.5 -2276
11.	GROUND WATER QUALITY	
	Presence of Chemical constituents more than permissible limit	Chloride and Arsenic in few places.
	Type of water	<ul style="list-style-type: none"> ➤ Ca-Mg-HCO₃ ➤ Na- HCO₃ ➤ Ca-Mg-Cl ➤ Na- Cl
12.	DYNAMIC GROUNDWATER RESOURCES	Due to semi confined to confined nature of aquifers estimation of ground water resource by water table fluctuation method could not be done. Depending upon the available data a total quantum of 204 million litre per day (45.3 million gallon per day) of ground water is entering into the central depressed zone.
	Gross Annual Ground water draft for domestic & industrial use	305.20 Million litres per day.
	Projected Demand for domestic and Industrial uses upto 20-25	320.43 Million litres per day.
13.	AWARENESS AND TRAINING ACTIVITY	
	Number of Mass Awareness programme organized, date & No of participants.	2 Nos on 06/02/2001 and 23/07/2003. No of participants were 150 in each program.
	Number of Water Management Training programme organised, date & No of participants.	1 No from 28/07/2003 to 30/07/2003. No of participants were 18.

	EFFORTS OF ARTIFICIAL RECHARGE AND RAIN WATER HARVESTING	
14.	Projects Completed by CGWB (No. and amount spent)	Artificial recharge scheme has been taken under Central Sector Scheme at All India Soil & land Use Survey Building having roof area of 676 sq.m. Two nos of gravity head recharge tube wells of 119.38 mbgl depth have been constructed in a recharge trench (11.57m X 1.65m X 3m) filled with filter materials. Zone tapped 102.61-114.77mbgl. A quantity of 890m ³ of rainwater has been recharged annually to ground water. The water level shows a rising trend after the artificial recharge. Project cost was Rs 10.65 lakhs.
	Projects under technical guidance of CGWB (nos)	<ul style="list-style-type: none"> ➤ Artificial recharge scheme has been taken at Raj Bhawan Building having roof area of 1400 sq.m. ➤ Technical guidance has been rendered to various organizations for rainwater harvesting.
15.	GROUND WATER CONTROL AND REGULATION	Ground Water Regulation Act has been enacted from September 2005 in the State by Govt of West Bengal. KMC area has not yet been notified.
16.	MAJOR GROUND WATER PROBLEMS AND ISSUES	<ul style="list-style-type: none"> ➤ Declining trend of ground water level. Ground water level has been lowered to a large extent over the years. ➤ Saline ground water in shallow aquifers within 120m bgl in western part and in deeper aquifers below 120m bgl in the eastern part. ➤ KMC has reported sporadic occurrence of Arsenic beyond permissible limit (0.05mg/l) in ground water in a few places. ➤ Ground water tapped by open wells in the marshy/ swampy lands is hydraulically connected to the surface water bodies and is biogenecally polluted.

1.1. Administrative details:

Kolkata Municipal Corporation area is bounded by river Hugli in the Northwest, South 24 Parganas district in the south and southwest, Salt Lake City in the east and North 24 Parganas district in the north. The area falls between north latitudes of $22^{\circ}28'00''$ and $22^{\circ}37'30''$ and east longitudes $88^{\circ}17'30''$ and $88^{\circ}25'00''$. KMC covers an area of 187.33 sq.km. and is divided into 141 wards (Fig-1) and 15 nos of borough (Fig-2). Initially the city covered an area of 104 sq.km with 100 nos of wards, which subsequently extended to the present area after including 44 nos of more wards from the municipalities of South Suburban, Garden Reach and Jadavpur in 1983.

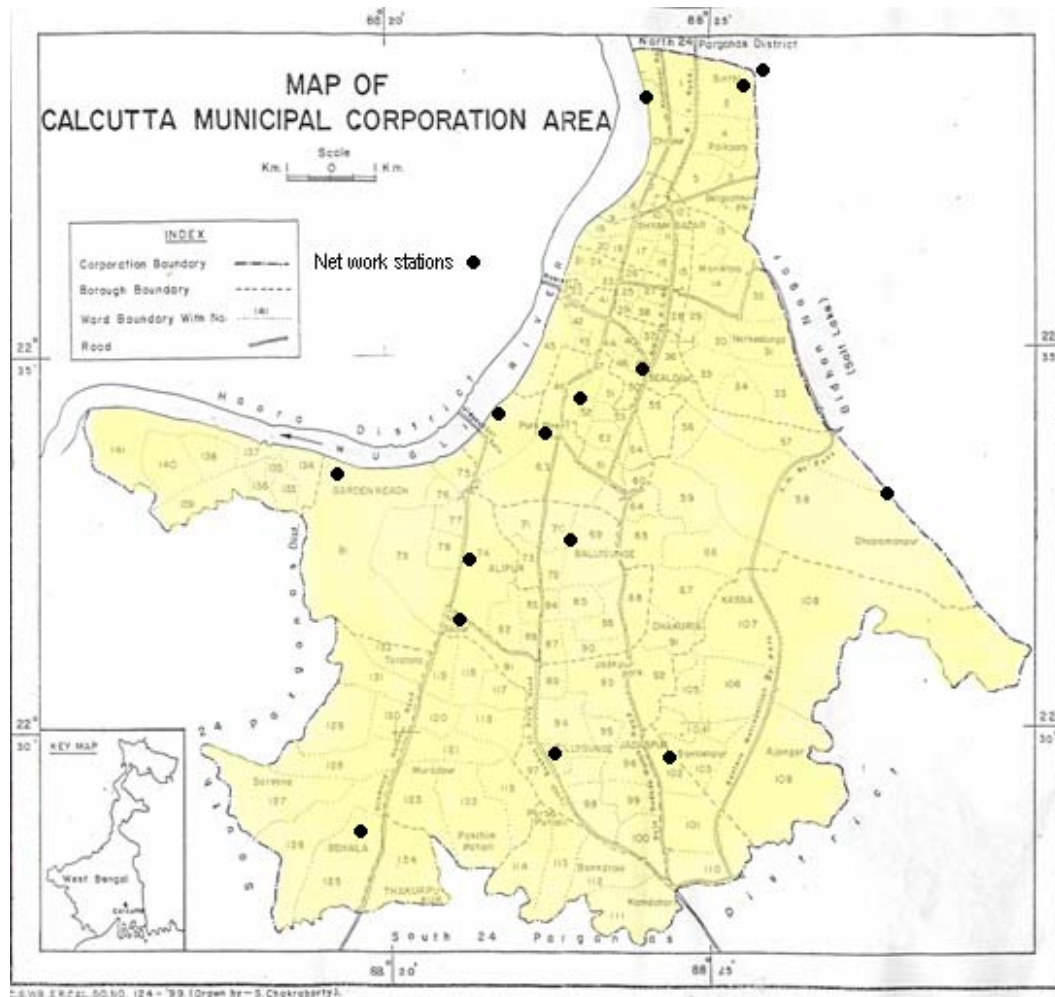


Fig-1

BOROUGH MAP OF KOLKATA MUNICIPAL CORPORATION AREA

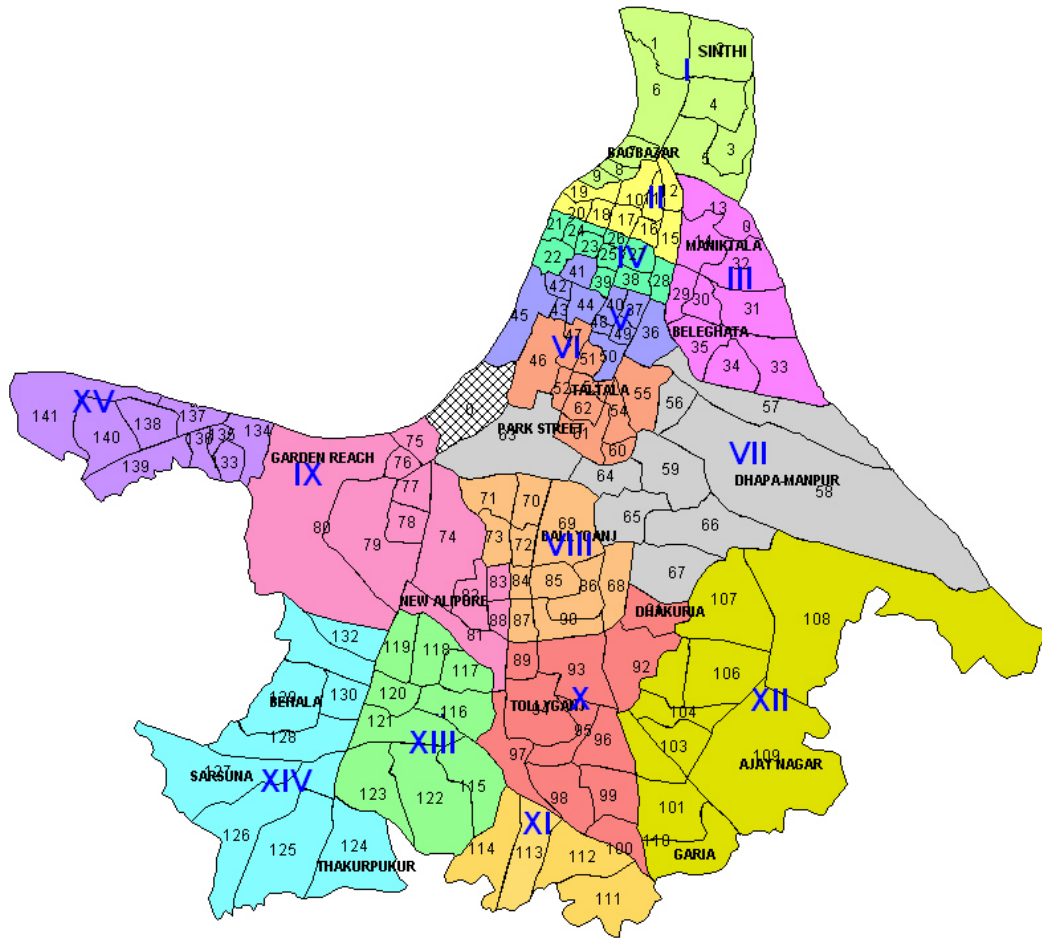


Fig-2

1.2. Basin:

KMC is located in the lower part of the Ganga basin.

1.3. Drianage:

The area is drained by major Hugli river along its Northwestern boundary and by several canals like Bagjola Khal in the north and Beleiaghata and Circular Khal in the central part and Adi-Ganga (a paleo channel), and Talli nala in the southern part, which flows in the NNW-SSE direction. These khals and nalas cover a large area of the city. At present all the khals and nalas have been silted. They need proper desiltation as they are the main surface water sources inside the city and they can be used for inland water transport.

2.0. Rainfall & Climate:

The normal annual rainfall is 1647mm. Monthwise normal rainfall (mm) is given in fig-3. Kolkata experiences the following four distinct climatological features eg. i) Mild Winter, ii) Brief Spring, iii) Summer with occasional Norwesters and iv) Prolong Monsoon. The mean temp in winter is 22.5°C , which goes down to a minimum of 10°C in the months of December-January. The mean temp in summer is 29.25°C and goes up to a maximum of 40°C in the month of April. The climate during monsoon months is warm and humid.

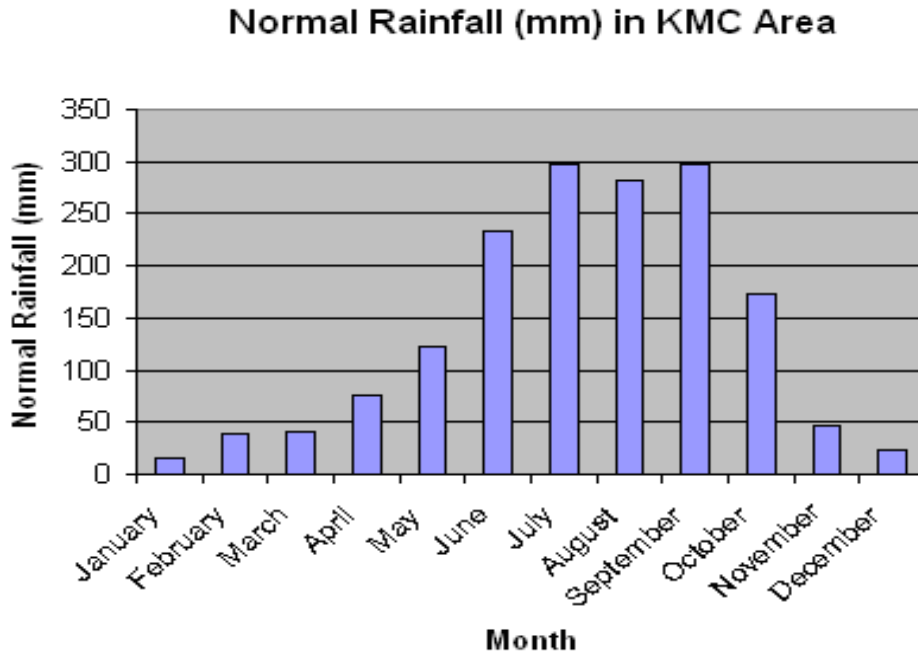


Fig-3

3.0. Geomorphology & Soil Types

Kolkata forms a part of the lower deltaic plains of the Ganga- Bhagirathi river system. It is a typical deltaic flat land with surface elevation ranging between 3.5 to 6m above mean seal level. Several low lying depressions in the form of marshes, shallow lakes or jills occur within the city and most of these represent river scars of the post river channels of Bhagirathi. The master slope of the land is towards south. Younger levee, deltaic plain, interdistributory marsh, paleo channels and younger levee adjacent to river Hugli and older levee on both sides of the old Adi Ganga are the important geomorphological units present in the area (Fig-4). The area is covered with younger alluvial soil mainly of silty & clayey loams.

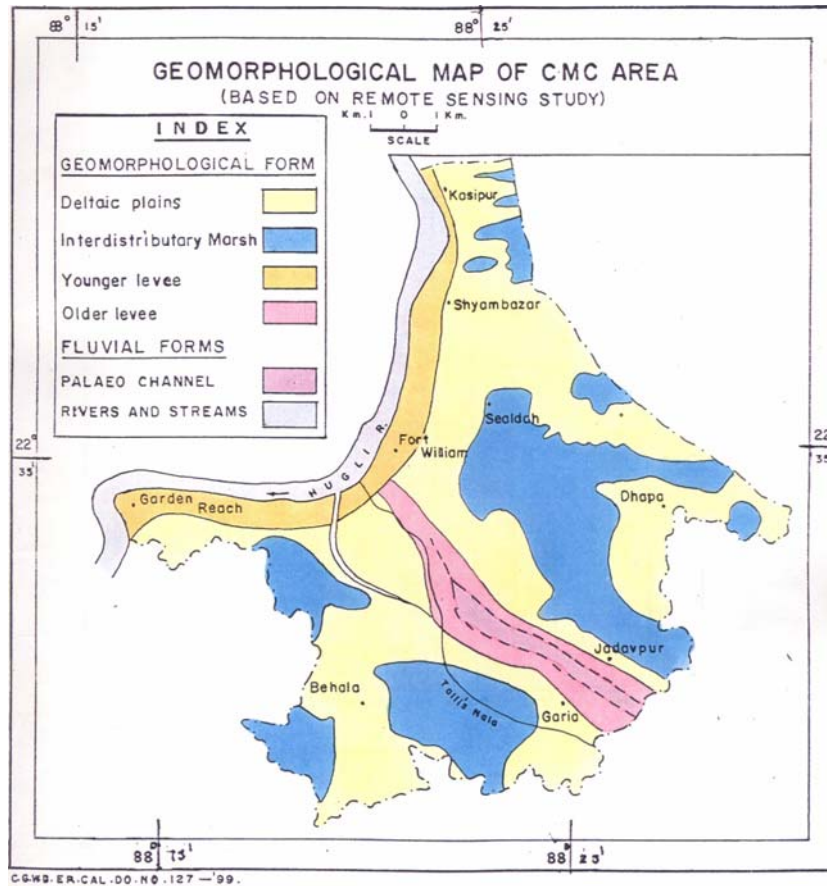


Fig-4

4.0. Ground Water Scenario

4.1. Hydrogeology:

4.1.1. Water bearing formation

The area is underlain by 762m thick unconsolidated alluvium, which overlies a huge pile of unconsolidated to semi-consolidated sediments deposited on the basement. The structure and lithology of the sediments indicates number of pulses of sedimentation, marine transgression and regression and tectonic uplift from Cretaceous to Pleistocene times. The study of the lithological logs of borehole data indicates that the upper 300m of sediments are of Quaternary age but the exact boundary between the Quaternary and Tertiary sediments could not be established due paucity of data. The Quaternary alluvium comprising several cycles of sand, silt and clay and shows facies variation in both vertical as well as in horizontal sections.

The panel diagram (Fig-5) prepared on the basis of the lithological logs of the tube wells indicates that there are two regionally extensive clay beds throughout KMC area within the depth of 400mbgl. The depth of occurrence of the basal clay bed varies from place to place but in general it occurs from 300 to 450m bgl and the depth gradually decreases southward. The top clay bed of 10 to more than 60m thick occurs above the entire alluvium sequence from the ground surface in KMC area. The thickness of this clay bed varies from place to place. Both top and bottom clays are dark grey in colour, sticky, plastic and often found to contain strings of silt and fine sand. The upper clay bed often contains peaty matter within the depth of 10m bgl indicating earlier land

subsidence in recent past. Sands of various grades with occasional gravel occur between these two clay beds form the main aquifer system in KMC area. Presence of several clay layers and lenses at various depths at different places divides the above mentioned sand zones into several layers.

Thin lenses of very fine grained sand and silt in the silt clay layer also occur above the top clay layer at some places around Ballyganj, Tollyganj, Tijola, Dhakuria, Kasba, Santoshpur, Garia, Behala, Barish and Thakurpur in the marshy/swampy lands. The thickness of these sand and silt layers varies from place to place. In the levee deposits along the bank of river Hugli lenses of sand of fine to coarse grained are also present above the top clay bed at some places. The thickness of this sand bed also varies from place to place.

SUB-SURFACE DISPOSITION OF AQUIFERS IN KOLKATA MUNICIPAL CORPORATION AREA

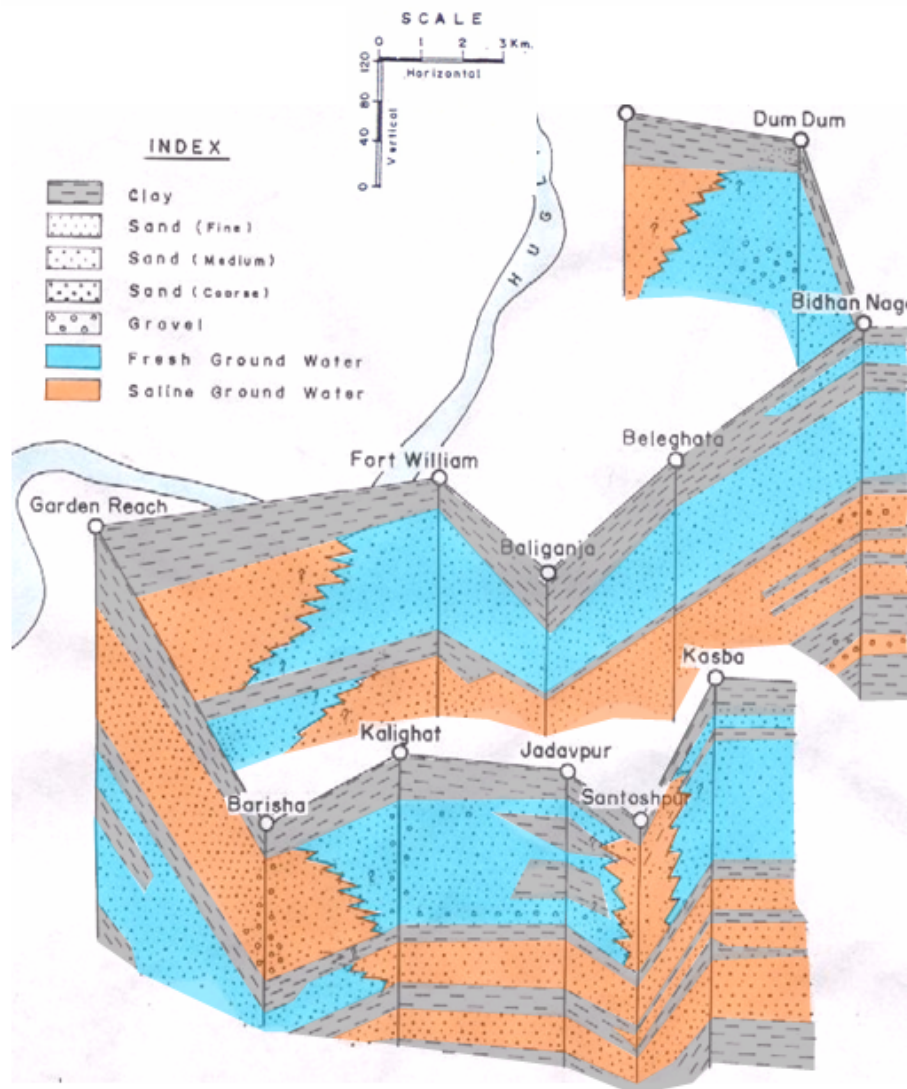


Fig-5

4.1.2. Occurrence of ground water:

In general ground water in KMC area occurs under confined to semi confined condition. A typical hydrochemical situation exists in KMC area. In the major part of KMC area fresh ground water overlies the brackish ground water except in the western part starting from Fort William in the central part on the bank of river Hugli and Kalighat in the south and in a localized body around Kasipur, west of Dumdum in the north, where brackish ground water overlies the fresh ground water (Fig-5&6). In the levee deposit on the bank of Hugli river thin lens of shallow aquifer occur within 12m bgl, where ground water occurs under water table condition. Ground water also occurs under unconfined condition within 17m below ground level in the marshy/swampy lands around Ballyganj, Tollyganj, Tiljola, Dhakuria, Kasba, Santoshpur, Garia, Behala, Barish and Thakurpur.

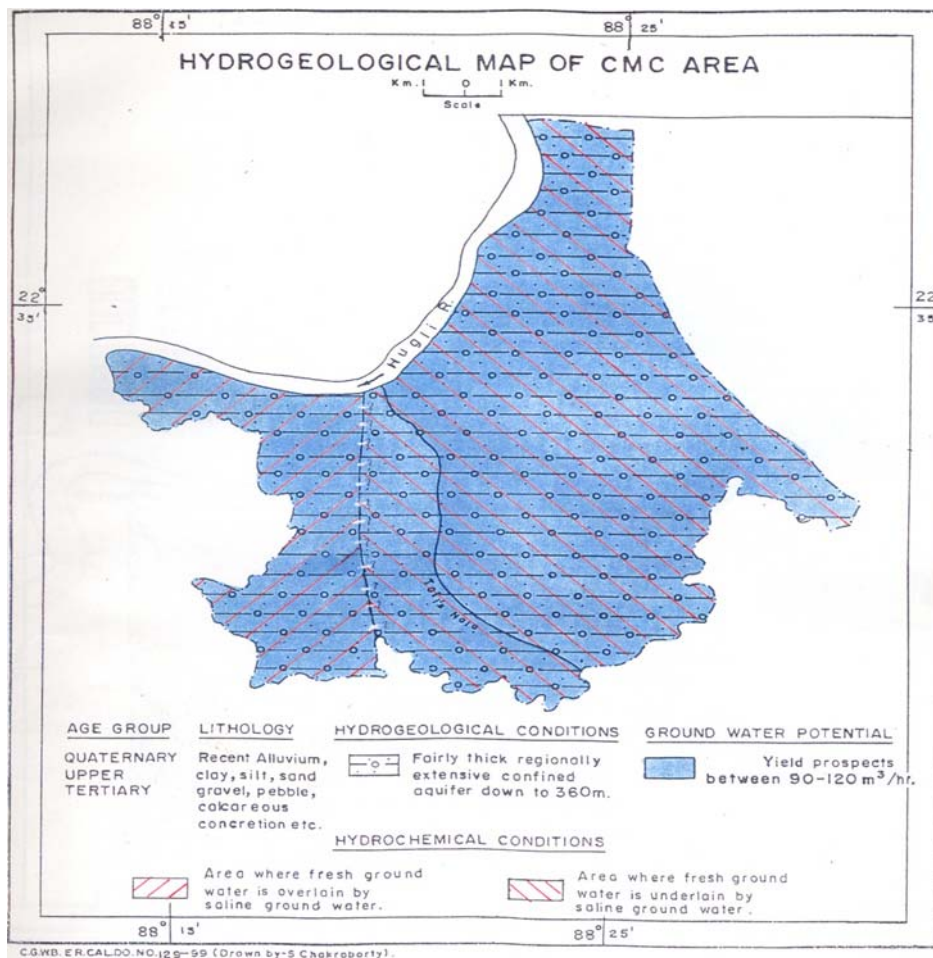


Fig-6

4.1.3. Nature and depth of aquifer system:

The sub-surface disposition of the aquifers (Fig-5) indicates that the blanket of clay (10 to 60m thick) at the top of the sedimentary sequence imparts confined to semi confined nature to the groundwater occurring in the aquifers below this clay blanket. The aquifers below this clay bed consist of fine to coarse sand, which are occasionally mixed with gravel. The sediments show facies variation at a few places, which is

characteristic of typical deltaic deposition and the top clay bed shows a transition from aquiclude to aquitard. The thickness of the individual aquifer varies from place to place with the frequent occurrence of clay lens within them. The principal productive fresh water aquifer occurs within the depth span of 60-180m below ground level in the major part of the area except in the western part as discussed above. In the western part in Garden Reach-Barisha Sector and around Kashipur, west of Dumdum brackish water aquifers occur down to depth of 160m bgl and 200 m bgl respectively from the surface. These brackish water aquifers are underlain by fresh water aquifers. In Santoshpur area in the extreme south all the aquifers within 300 m bgl are brackish.

4.1.4. Depth to ground water level:

Pre-monsoon 2006: Depth to ground water level in confined aquifer in use varies from 12.09 to 19.59 mbgl (Fig- 7).

PRE-MONSOON DEPTH TO GROUND WATER LEVEL (mbgl) 2006

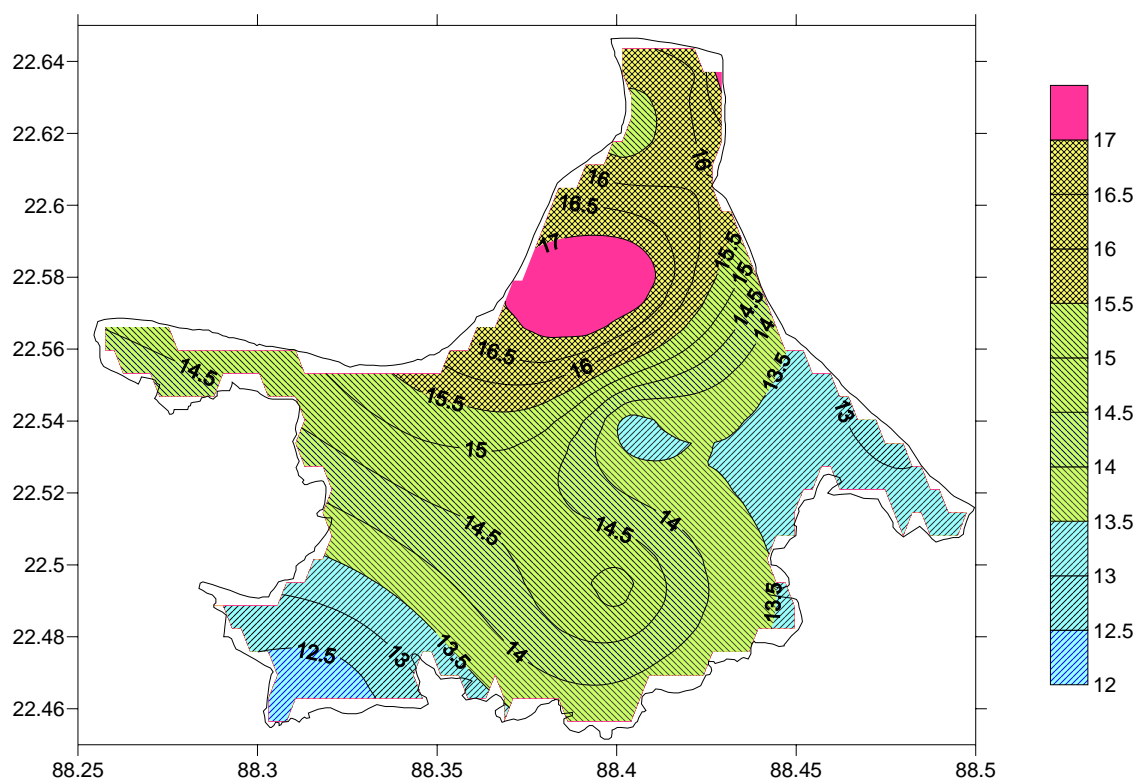


Fig-7

Post-monsoon 2006: Depth to ground water level in confined aquifer in use varies from 10.72 to 15.42 mbgl (Fig- 8).

POST MONSOON DEPTH TO GROUND WATER LEVEL (mbgl) 2006

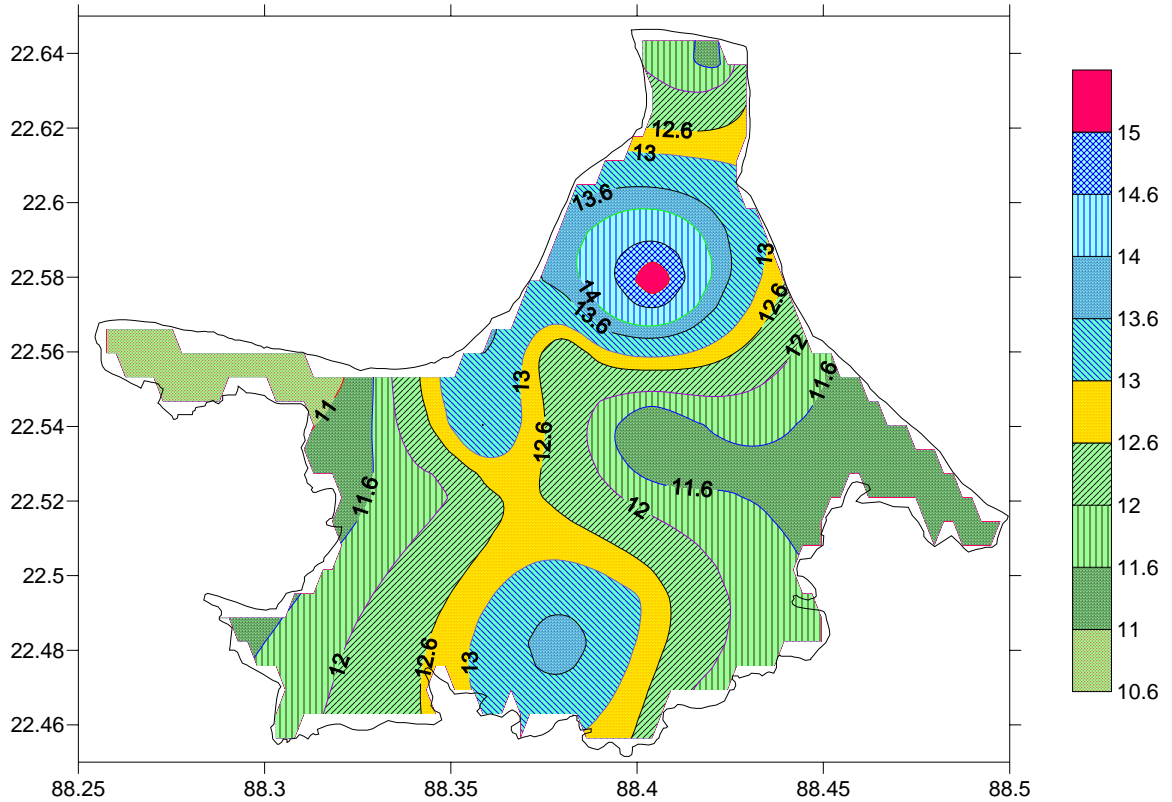


Fig-8

Long term water level trend (1996-2006).

The long term trend of water level for the monitoring stations (Fig-9) situated in KMC area indicates a falling trend in both pre and post monsoon period for most of the wells. The rate of declining of water level has been noticed to the tune of 0.33m/vr at the core of the trough and 0.11 m/vr at the periphery.

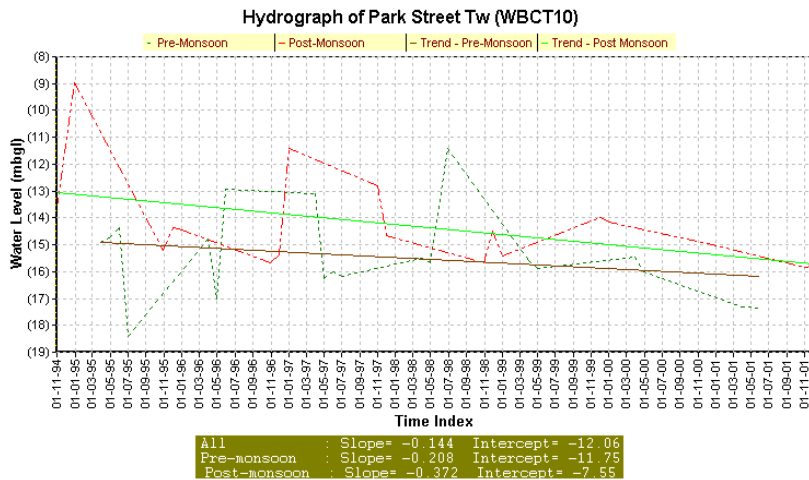


Fig-9

4.2. Ground Water Resources:

Due to semi confined to confined nature of aquifers estimation of ground water resource by water table fluctuation method could not be done. Depending upon the available data a total quantum of 204 million litres per day of ground water is entering into the central depressed zone. Ground water in the localized water table aquifers in Ballyganj, Tollyganj, Tiljola, Dhakuria, Kasba, Santoshpur, Garia, Behala, Barish and Thakurpur area and in the levee deposits along the bank of Hugli river has got limited yield prospects but estimation of ground water resources is not possible due to paucity of data as the aerial extension of the aquifer can not be determined due to cover by urban agglomeration.

4.3. Ground Water Quality:

A typical hydrochemical situation exists in KMC area. Ground water in KMC area may be classified under two principal types viz. a) Bicarbonate type and b) Chloride type. The anionic types may further be subdivided into two types on the basis of predominance of cation concentration. These are i) Calcium- Magnesium bicarbonate, ii) Sodium bicarbonate and iii) Calcium- Magnesium chloride and iv) Sodium chloride. Ground water in the area west of a line connecting BBD Bag, Park Street and Jadavpur is of Bicarbonate type whereas in the area east of this line ground water is of Chloride type (Fig-10).

❖ Bicarbonate type

➤ Ca-Mg-HCO₃

Ground water in the entire Western and South-Central part of the city, south of Taltala-Kasba-Santoshpur tract in the NNW-SSE direction is of Ca-Mg-HCO₃ type. Concentration of chloride is low.

➤ Na- HCO₃

Ground water in the southern part of the city and particularly Behala, Tallygunj, Jadavpur and Putiari is of Na- HCO₃ type and ground water is soft with total hardness less than 150 mg/l. Ground water in the HCO₃ dominated area is neutral with pH value 7.0.

❖ Chloride type

➤ Ca-Mg-Cl:

Ground water in the entire Northern and eastern part of the city, north of Taltala-Kasba-Santoshpur tract in the NNW-SSE direction is of Ca-Mg-Cl type. Concentration of chloride is high (280-620 mg/l) having more than 1000 mg/l TDS. Ground water is hard with total hardness 460-775 mg/l. Sodium rarely exceeds 40%.

➤ Na- Cl

Ground water rarely contains high chloride in combination with sodium in the depth range of less than 125m bgl. At a few places in Dhakuria, Jadavpur, Garfa, Ranikuti ground water contains 55-69% sodium and 50-80% chloride. Occurrence of relatively high sodium –chloride ground water in some localized pockets (Fig-6) is most likely due to entrapped condition preventing further dilution.

The quality of ground water, although being utilized for domestic, commercial and industrial uses, is considered by the users as problematic particularly in Bidhannagar in the east to Baghajatin in the south, where mineralisation increases depthwise. Ground water in the southwestern part is fresh and is suitable for all purposes. The

mineralisation is due to relict salinity of deltaic alluvium formed at the time of deposition and simultaneous dilution/ flushing of the seawater.

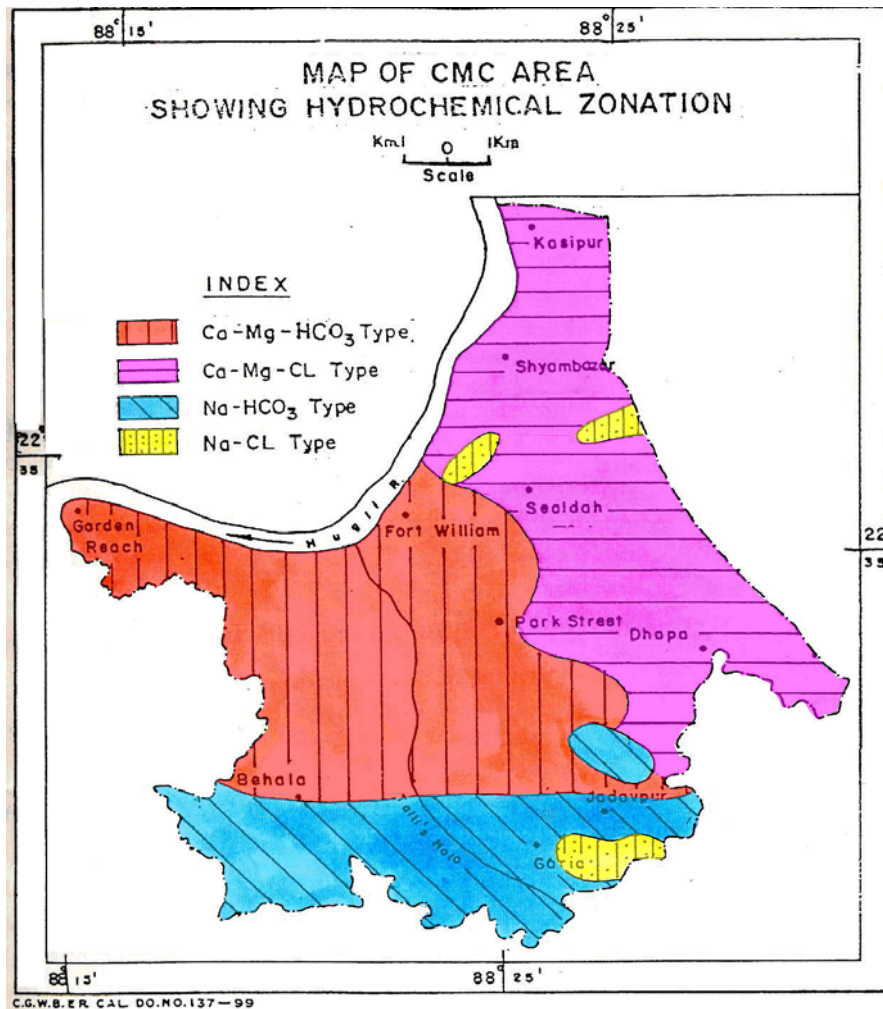


Fig-10

4.3. Status of Ground Water Development

City water supply is dependent on both surface water source from the river Hugli and ground water sources.

4.3.1. Surface water sources

Initially surface water supply was made from Palta pumping station (27mld in 1869). A quantity of 1161mld (258mgd) (2006) of treated surface water from river Hugli is being supplied in KMC area through four pumping stations at Palta, Garden Reach, Jorabagan and Watganj.

4.3.2. Ground water sources

As on December 2006 Kolkata Municipal Corporation owned 264nos large dia (300mm) tube wells fitted with 20 Horse Power submersible pump with a discharge of 0.486 million litres per day and 10,000 nos small dia (40mm) tube wells fitted with hand pump with a discharge of 0.0016 million litres per day, which are operating in Kolkata Municipal Corporation area. Besides Kolkata Municipal Corporation owned tube wells, there are 5840nos of Private owned small dia (40-200mm) tube wells fitted with 1 to 12 Horse Power pump with discharge varying from 0.0189 to 0.27 million litres per day in Kolkata Municipal Corporation area. Withdrawal from Private owned tube wells and hand pump fitted tube wells works out to be 160.9 million litres per day and 16 million litres per day respectively. As per Kolkata Municipal Corporation withdrawal from Kolkata Municipal Corporation owned large dia tube wells is 128.30 million litres per day during 2006. Thus a total of 305.20 million litres per day of ground water is being withdrawn in Kolkata Municipal Corporation area. The withdrawal of ground water by Kolkata Municipal Corporation owned tube wells from 1986 to 2006 is as follows (Table-1).

Table-1

YEAR	NO OF GROUND WATER STRUCTURES (KMC owned)		TOTAL GROUND WATER WITHDRAWN (million litres per day)
	Deep Tube Well	Shallow Tube Well (Hand pump fitted)	
1986	232	5000	121.50
1991	285	10500	184.95
1993	308	11877	202.72
1998	325	12000	209.70
2006	264	10000	144.30

Withdrawal of ground water in Kolkata Municipal Corporation area by Kolkata Municipal Corporation increased progressively from 121.5 million litres per day in 1986 to 209.7 million litres per day in 1998 and it continued upto 2004. From 2005 Kolkata Municipal Corporation started replacing gradually the ground water supply by surface water supply. As a result there is a reduction in the quantum of ground water withdrawal from 2005. In 2006 ground water withdrawal by Kolkata Municipal Corporation owned tube wells comes down to 144.30 million litre per day million litres per day.

Source: Kolkata Municipal Corporation.

4.3.3. Borough wise Ground Water Potential (Table-2)

Table-2

Borough No	Depth of fresh ground water aquifer.	Ground Water quality.	Depth to ground water level.		Trend of ground water level.	Scope for ground water development.
			Pre-monsoon 2006	Post monsoon 2006		
I	Within 170 mbgl except at Kasipur where ground water within 200mbgl is brackish	Ca-Mg-Chloride type	15 to 17 mbgl	11 to 13 mbgl	Declining trend @ 0.11m/yr.	
II	Within 160 mbgl	Ca-Mg-Chloride type	16 to 16.5m bgl	13 to 13.5 mbgl.	Declining trend @ 0.11 to 0.12 m/yr.	
III	Within 160 mbgl	Ca-Mg-Chloride type	14-16.5 mbgl	12-14.5mbgl	Declining trend @ 0.11 to 0.15 m/yr.	
IV	Within 160 mbgl	Ca-Mg-Chloride type	16.5 to >17mbgl.	13.5- >15 mbgl	Declining trend @ 0.11 to 0.15 m/yr.	
V	Within 160 mbgl	Ca-Mg-Chloride type	16.5 to >17mbgl.	14->15 mbgl	Declining trend @ 0.11 to 0.15 m/yr.	
VI	Within 160 mbgl	Ca-Mg-Chloride type	16 to >17mbgl.	12-13.75 mbgl	Declining trend @ 0.13 to 0.18 m/yr.	
VII	Within 160 mbgl	Ca-Mg-Chloride type	13-16.8 mbgl	11-13.5 mbgl	Declining trend @ >0.30 m/yr.	
VIII	Within 160 mbgl	Ca-Mg-Chloride type	14.5-15mbgl	12-13mbgl	Declining trend @ 0.20 m/yr.	
IX	Below 160mbgl and within 160mbgl in the eastern part near Fort William.	Ca-Mg-HCO ₃ type	14-15.5mbgl	11-12.5mbgl	Declining trend @ 0.13-0.16 m/yr.	
X	Within 160 mbgl	Na-HCO ₃ type	14.5-15mbgl	12.5-14mbgl	Declining trend @ 0.13-0.16 m/yr.	
XI	Within 150 mbgl	Ca-Mg-HCO ₃ type	13.5-14.5mbgl	12.5-14 mbgl	Declining trend @ 0.11-0.13 m/yr.	
XII	Within 150 mbgl	Ca-Mg-Chloride type	13-14 m bgl	11-12mbgl	Declining trend @ 0.11-0.13	

		in the east, Ca-Mg-HCO ₃ type in the west and Na-HCO ₃ type in the south with patches of Na-Cl type in the south-east except in Santoshpur area where all the aquifers within 300mbgl are brackish.			m/yr.	
XIII	Below 160mbgl	Ca-Mg-HCO ₃ type	13.5-14.5 mbgl	12-13mbgl	Declining trend @ 0.11-0.13 m/yr.	
XIV	Below 160mbgl	Ca-Mg-HCO ₃ type	12.5-13.5mbgl	11.5-12mbgl	Declining trend @ 0.11 m/yr.	
XV	Below 150mbgl	Ca-Mg-HCO ₃ type	14.5-15mbgl	10.5-11mbgl	Declining trend @ 0.11 m/yr.	

5.0. Groundwater Management Strategy:

5.1. Groundwater Development

Withdrawal of ground water in KMC area by KMC owned tube wells increased progressively from 121.5 mld in 1986 to 209.7mld in 1998 and it continued upto 2004. As a result the piezometric surface becomes deepest around Park Street forming a trough in Central Kolkata around Park Street, Rajabazar, Fort William etc due to excessive withdrawal of ground water as well as due to interference effect of closely spaced tube wells running simultaneously. The long term trend of ground water level in this part indicates a falling trend in both pre and post monsoon period. There is fall of 7 to 11m in ground water level in last 45 years from 1958 to 2003 (Fig- 11). From 2005 KMC started replacing gradually the ground water supply by surface water supply. As a result there is a reduction in the quantum of ground water withdrawal by KMC tube wells from 2005. The impact is very positive on ground water regime, as the area of the ground water trough started reducing.

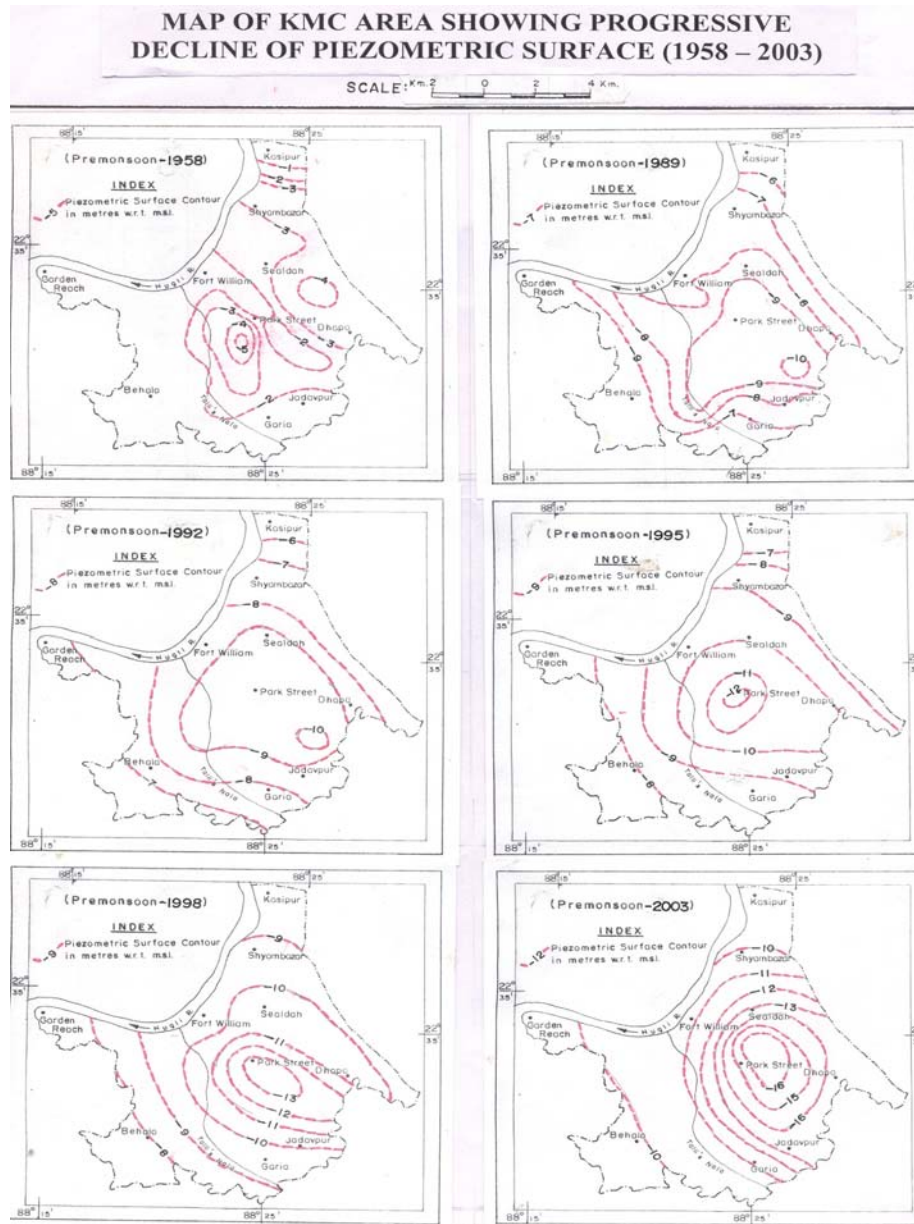


Fig-11

5.2. Water Conservation & Artificial Recharge:

Considering the hydrogeological condition in KMC area vis -a -vis the withdrawal of ground water, it is very much necessary to reduce the stress on ground water resources. Net rainwater available annually in KMC area is 247mil m³. Artificial recharge scheme has been taken under Central Sector Scheme at All India Soil & land Use Survey Building having roof area of 676 sq.m by CGWB, ER, Kolkata. Two nos of gravity head recharge tube wells of 119.38 mbgl depth have been constructed in a recharge trench (11.57m X 1.65m X 3m) filled with filter materials (Fig-12).



Recharge Pit

Fig-12

Zone tapped 102.61-114.77mbgl. A quantity of 890m³ of rainwater has been recharged annually to ground water. The water level shows a rising trend after the artificial recharge (Fig-13).

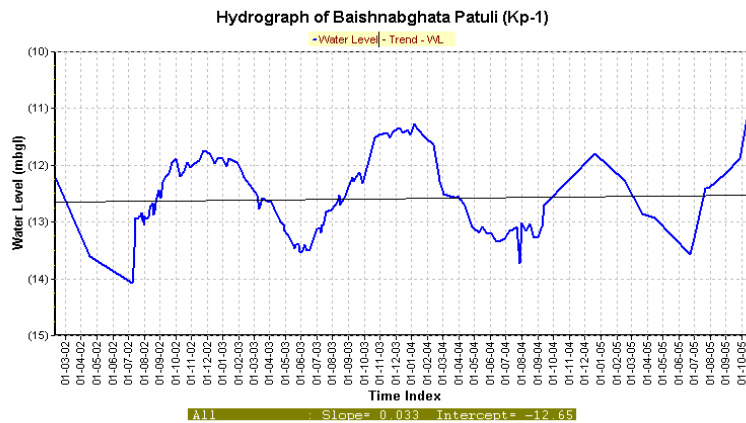
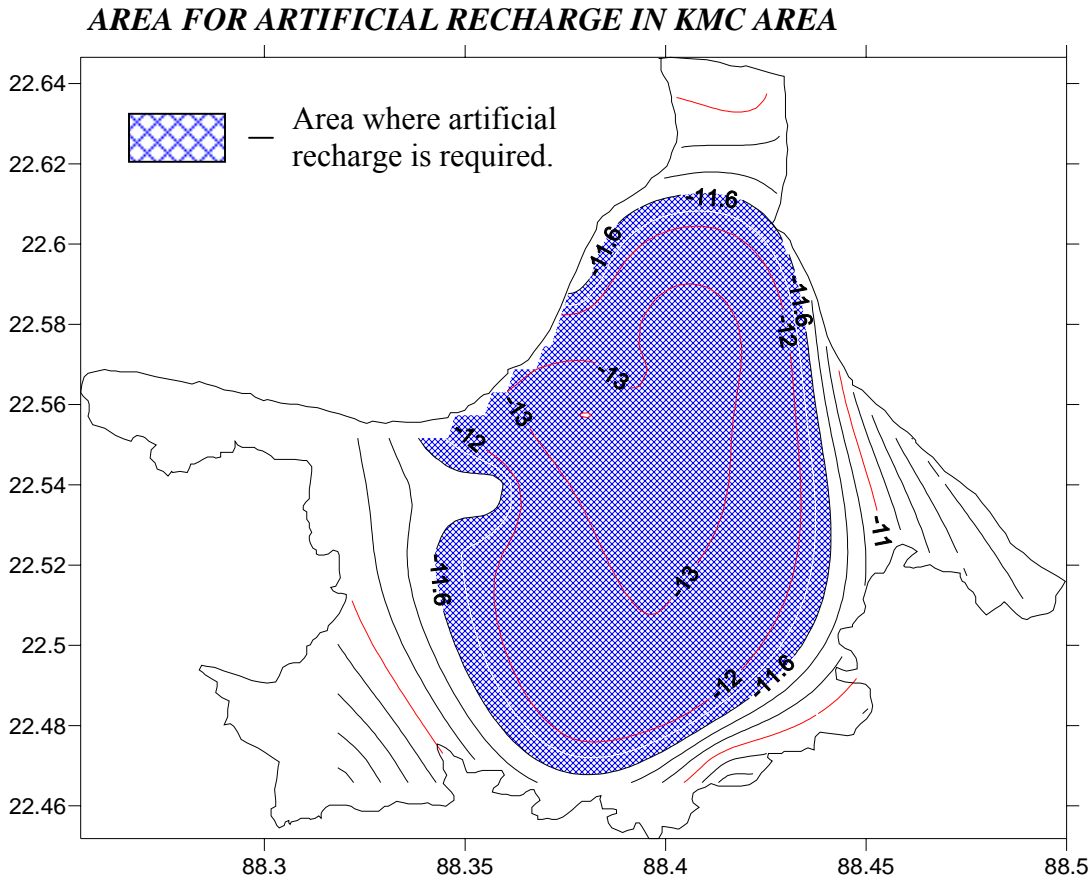


Fig-13

In Kolkata Municipal Corporation area the presence of a thick clay layer at the top of the sedimentary sequence and the metalled and concrete pavement in the surface restrict the rainfall recharge to ground water in the area. Considering hydrogeological set up of KMC area gravity head recharge tube well using the roof top rainwater is the only recharge structure feasible. The exact depth, dimension of the tube well and position of slots will be decided on the basis of the depth of aquifer to be recharged and the quantum of roof top rainwater available.

5.2.1. Area for Artificial Recharge

In Kolkata Municipal Corporation area gravity head recharge tube well may be used where a huge ground water trough has been formed in central Kolkata around Park street, Camac street, Fort William, Kalighat, Ballygangj etc and has been demarcated in Fig-14.



In Kolkata Municipal Corporation area the following precautions are to be taken in artificial recharged schemes.

- ❖ The borehole needs to be electrically logged to ascertain the exact position of the fresh water zone because of the typical hydrochemical situation in Kolkata Municipal Corporation area.
- ❖ In KMC area the occurrence of both fresh water and brackish/saline water aquifers are not following a particular pattern. At some places the brackish/saline aquifer overlies the fresh water aquifer and at other places it underlies the freshwater aquifer. In addition to this brackish / saline water occurs laterally in the same fresh water aquifer. For artificial recharge only fresh water aquifer is to be selected.
- ❖ The upper part of the recharge tube well is to be properly sealed with cement against the clay zone to avoid any contamination from the top.
- ❖ In the area where upper zone is brackish/saline the lower fresh water zone is to be separated with proper cement sealing.

- ❖ Proper monitoring of water level is to be carried out to study the effect of recharge.
- ❖ Combination of conservation and artificial recharge will also be very successful.
- ❖ Blending of arsenic contaminated or saline ground water with conserved rainwater will reduce the concentration of arsenic or salinity and makes this blended water fit for use.

6.0 Groundwater related issues and problems

- The principal productive fresh water aquifer occurs within the depth span of 60-180m bgl in the major part of the area except in the western part. In the western part in Garden Reach-Barisha Sector and around Kashipur, west of Dum Dum brackish water aquifers occur down to depth of 160m bgl and 200 m bgl respectively. These brackish water aquifers are underlain by fresh water aquifers. In Santoshpur area in the extreme south all the aquifers within 300 m bgl are brackish.
- Piezometric surface indicates that water level is deepest around Park Street forming a trough in Central Kolkata around Park Street, Rajabazar, Fort William etc due to excessive withdrawal of ground water as well as due to interference effect of closely spaced tube wells running simultaneously. The long term trend of ground water level in this part indicates a falling trend in both pre and post monsoon period. There is fall of 7 to 11m in ground water level in last 45 years from 1958 to 2003.
- Ground water in KMC area may be classified under two principal types viz. Bicarbonate type and Chloride type. Ground water in the area west of a line connecting BBD Bag, Park Street and Jadavpur is of Bicarbonate type whereas in the area east of this line ground water is of Chloride type. Ground water in the entire western and south-central part of the city, south of Taltala- Kasba-Santoshpur tract in the NNW-SSE direction is of Ca-Mg-HCO₃ type. Concentration of chloride is low. Ground water in the entire northern and eastern part of the city, north of Taltala-Kasba-Santoshpur tract in the NNW-SSE direction is of Ca-Mg-Cl type. Concentration of chloride is high (280-620 mg/l) having more than 1000 mg/l TDS.
- In the eastern part of KMC area near Tangra- Topsia- Tiljala toxic trace elements like Cr, Co are found in excess of 0.01mg/l in the shallow aquifers within 20m bgl, which is under semi-confined condition. Leather industries are present in these areas. Industrial effluents from Tanneries cause serious environmental hazards due to pollution in the Bheries, Wetlands and Agricultural fields. Kolkata Municipal Corporation has reported sporadic occurrence of Arsenic in ground water in excess of permissible limit in some places. The concentration of arsenic varies from 0.054mg/l to 0.71 mg/l. The sporadic distribution of arsenic is very common in other parts of West Bengal and is of geogenic origin.
- Ground water tapped by open wells in Ballyganj, Tollyganj, Tijola, Dhakuria, Kasba, Santoshpur, Garia, Behala, Barish and Thakurpur area in the marshy/ swampy lands is hydraulically connected to the surface water bodies like ponds, unlined drains etc is biogenecally polluted.

7.0. Awareness & Training Activity

7.1.1. Mass Awareness Program (MAP):

A total 2 nos. of mass awareness program was conducted in this city. The details are given below (Table-3).

Table-3

Date	Place	No of participants
06/02/2001	CGWB, ER, Salt Lake, Kolkata	150
23/07/2003	All India Soil and Land Use Survey , Baishnabghata Patuli, Kolkata	150

7.1.2. Ground Water Management Training Programme (WMTP) with special reference to Roof Top Rainwater Harvesting for Artificial Recharge:

1 No WMTP was conducted in this city. The details are given below (Table-4).

Table-4

Date	Place	No of participants
28/07/2003 – 30/07/2003	CGWB, ER, Salt Lake, Kolkata	18

8.0. Recommendations

- There is a good scope for rainwater harvesting in KMC area. A net quantum of 247 mil m³ of available rainwater may be utilized by both conservation and artificial recharge.
- Due to critical ground water condition in KMC area indiscriminate withdrawal of ground water is to be restricted. If necessary, the area is to be notified by legal means. Emphasis is to be given to lower the stress on ground water development by covering more and more area under pipe water supply (treated surface water).
- Regular monitoring of both ground water level and quality of ground water is to be done. This will help to understand the change in piezometric surface consequent to withdrawal of ground water and the change in quality of ground water and to identify the tube wells affected by arsenic or any other chemical and/ or biogenic contamination. The tube wells affected by any sort of pollution should be discarded.
- Ground water from open wells wherever present may be used for domestic purposes after proper treatment.