BANGLADESH WATER DEVELOPMENT BOARD

Ground Water Table Hydrograph of 38 districts for the year 2008 to 2018

June 2020

GROUND WATER PROCESSING BRANCH

PROCESSING AND FLOOD FORCASTING CIRCLE

BWDB, 72 Green Road, Dhaka

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Prepared & Published by:

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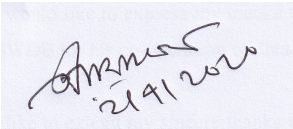
Foreword

BWDB's Hydrology has now operational network of Hydro-Geological Stations covering Ground Water, Surface Water and River Morphology station all over the Bangladesh. All these activities are organized by three Circles and one Directorate under Chief Engineer, Hydrology, BWDB, Dhaka. Processing and Flood Forecasting Circle, BWDB, Dhaka is one of those three circles. This circle has five divisions headed by one Deputy Director and four Executive Engineers.

Ground Water Processing Branch is one of the branch/division under Processing and Flood Forecasting Circle which is receiving Ground Water related data from two field Ground water hydrology division. After getting ground water related data (Ground Water Table weekly data, Ground Water Table daily data, Ground Water Quality data, Aquifer Pump Test data & etc) from two field divisions, this branch is responsible to send the above data to the data base server of BWDB.

Quality control, consistency checking, validation and archiving these data are additional secondary information for different user groups are vital responsibility of the Processing Branch of Hydrology. Due to the shortage of manpower last 4 to 5 years no analysis and reporting work are done from this office. As such the Ground Water Processing Branch has taken initiative in this context which will continue in future.

This report "*Ground Water Table Hydrograph of 38 districts of Ground Water Hydrology Division-I From 2008 to 2018*" is an attempt to find out the overall level of ground water trend of eastern part of Bangladesh for the last 11 years.



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Acknowledgement

I express my heartfelt gratitude to Almighty Allah Who has given me the opportunity to complete this report.

I express my honor and gratitude to Muhammad Amirul Haq Bhuiya, Superitending Engineer, Processing and Flood Forecasting Circle, BWDB, Dhaka for his support and guidance, which helped a lot to prepare this report.

I gratefully acknowledge to Md. Nurul Amin, Chief Engineer, Hydrology, BWDB, Dhaka, for his kind strong support.

I would like to express my satisfaction to perform the interesting assignment regarding checking of quality and consistency and changes of ground water table in eastern part of Bangladesh. I am thankful to Mr. B. M. Abdul Momin, Deputy Director (Add.Charge), Ground Water Processing Branch, BWDB, Dhaka for the overall guidance and continuous suggestion to prepare this report in time.

I also express my deep gratitude to Dr. Anwar Zahid, Director, Ground Water Hydrology, BWDB, Dhaka for his continuous guidance and encouragement for successful completion of this report.

I would like to express my thanks to Mr. Md. Mushfiqur Rahman, System Analysis, PFFC, BWDB, Dhaka to support of ground water table data from BWDB archive.

I would like to express my thanks to my colleague Mr. Bellal Hossain, Geologist, GWPB of BWDB for his co-operation of data analysis and draw maps.

I like to extend my sincere thanks to my colleagues and staffs of GWPB, BWDB all of them for their untiring service and co-operation during preparation of this report. Finally all are requested to come up with valuable suggestions for further improvement.

02.07.2020

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Abstract

Over populated country like Bangladesh it became a challenge to fulfilling the demand of fresh water. Ground water is the key source of fresh water in most of the areas of the country for decades and we are immensely dependent on ground water for irrigation, drinking, industrial and many other purposes. Bangladesh Water Development Board (BWDB) has a rich network of 1253 ground water observation well (piezometric well) under Ground Water Hydrology Circle throughout the country. This network encompasses almost all the upazilas and districts to collect and monitor ground water table data on a weekly basis throughout the year. To observe the whole condition of GWT at a glance hydrograph is the best way. Hydrographs are drawn from 211 observation well data of 11 years 2008 to 2018 one in each upazilla of eastern Bangladesh is to analyze the trend of GWT. Most of the wells of study area show regular trend with certain seasonal fluctuations which means GWT of those areas are in a stable and good condition. But in some wells GWT shows declining trend or some abnormal characteristics. Most of these types of wells are identified in urban areas or in the central areas of the upazillas or it can be said in other words where ground water uses are comparatively higher such as irrigation, household or industrial purposes. From the study it is also found that GWT recharge dependent on many aspects such as type of recharge or type of catchment, land use, soil characteristics, surface water availability and connectivity with ground water, interconnectivity between aquifers and flood conditions of that area. Large scale and sustainable action plan for example aquifer management system, artificial recharge etc is immediately needed to improve the ground water condition where situation getting worse day by day and also in the stable state areas to maintain that level.

Acronyms

BWDB	Bangladesh Water Development Board
PFFC	Processing and Flood Forecasting Circle
GWPB	Ground Water Processing Branch
GWT	GWT
m	Meter

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1. Introduction

Bangladesh, a small country of 147,570 km^2 with a huge population of around 162 million *(7)* has a developing ground water system. The Geology of Bangladesh is affected by the country's location, as Bangladesh is mainly a riverine country. It is the eastern two-thirds of the Ganges and Brahmaputra river delta plain stretching to the north from the Bay of Bengal which played the main role for developing the ground water of this country ***(8)***. Worldwide, groundwater provides over 97% of accessible freshwater, half of the drinking water, and approximately half of the irrigation water for agriculture (*Jakeman, et al. 2016).* In Bangladesh, scarcity of surface water has made groundwater an essential source to improvement dry season water demand to meet urban, industrial, and irrigation requirements *(Michael, et al. 2009 & Alam et al. 2003)*. Groundwater abstraction has tremendously increased in Bangladesh since the 1980s. Currently, it supplies 79% of the water demand for irrigation, livestock, household, and industrial usages *(BBS, 2017)*. It is emphasized that more than 90% of the groundwater withdrawn is used for irrigation purpose and less than 10% is used for drinking purpose. Storage of groundwater is depleted by its abstraction and is replenished by recharge. In Bangladesh large volume of groundwater abstraction occurs by the large number of hand, shallow and deep tube wells for irrigation, public water supply and domestic uses. Groundwater plays a key role in the successful development of irrigated agriculture in a major part of Bangladesh. The development of groundwater for irrigation of dry season crops has seen a tremendous growth in all the regions of Bangladesh. New water management strategies are very much needed to assure a secured and sustained water supply as well as sustainable development for future generations of Bangladesh.

2. Objective

The main objective of this report is to observe annual fluctuations of ground water table in the eastern districts of Bangladesh during the period 2008-2018. This report will help planner and policy makers to study the overall changes of ground water table through last eleven years and take necessary steps to ensure sustained water supply for all.

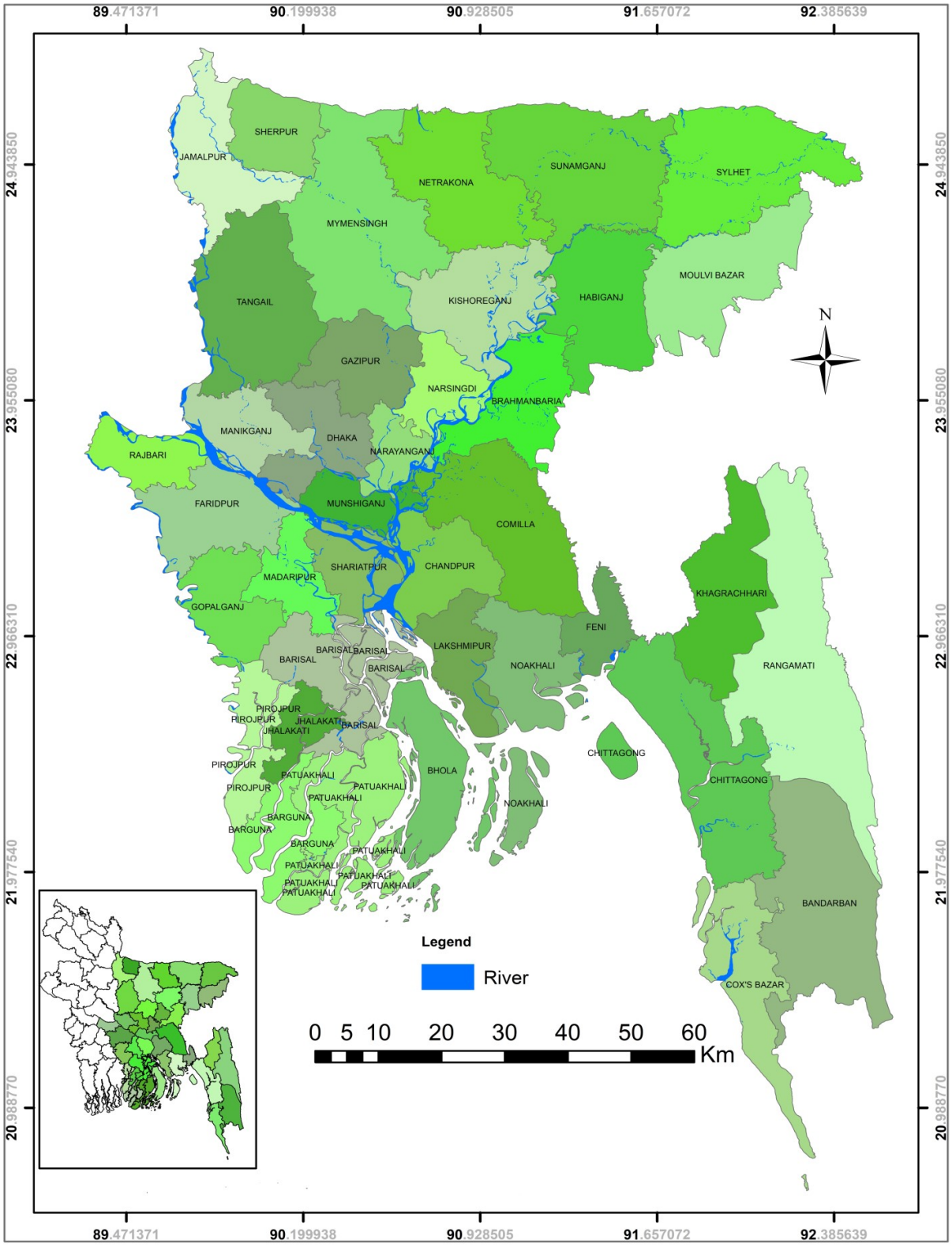

Figure-2.1: Location of the Study Area

3. Study Area

The study area covers the entire eastern part of Bangladesh and also the districts shown on Figure-2.1. The boundary of the study area was marked by major rivers. The boundary from north to south is lined by the eastern side Jamuna, Padma and Meghna river. This area covers the Brahmaputra-Jamuna floodplain, Old Brahmaputra floodplain, Madhupur tract, Sylhet depression, Meghna floodplain, Tippera surface, Chittagong Hill tarcts and some parts of Ganges delta plain (Figure-3.1). During the Pleistocene and Holocene time large volume of sediments were laid down in the Ganges-Brahmaputra-Meghna (GBM) delta complex by these rivers that built up the delta and aquifer systems of this country. In Bangladesh a thick layer of semi-consolidated to unconsolidated fluvio-deltaic sediments of Miocene to the present have many aquifers. But apart from the Dupi Tila Sandstone Formation of the Plio-Pleistocene age, other formations are too deep to consider for ground water extraction except in the Hilly Region of the country (18% area of Bangladesh). This formation is the main water-bearing zone and occurs at depths ranging from less than 5m in the northwest to more than 75 m in the south and most areas of the country. Presently, groundwater is drawn mainly from this aquifer zone. In Bangladesh the principal sources of groundwater recharge includes the rainwater that infiltrate and percolate through the unsaturated zone, flood water which overflows the river and stream banks infiltrated into the groundwater, water from the permanent water bodies (river, canals, haors, beels, jheels, ponds, irrigated fields etc.) that lie above the water table also percolate to the groundwater. Peripheral rivers act as sources of recharge as the Dupi Tila sands are exposed along the riverbeds. Other sources of recharge are vertical percolation of rain and flood water, leakage from water mains and the sewer system and seepage from standing water bodies within the area *(GWTF Report, 2001)*.

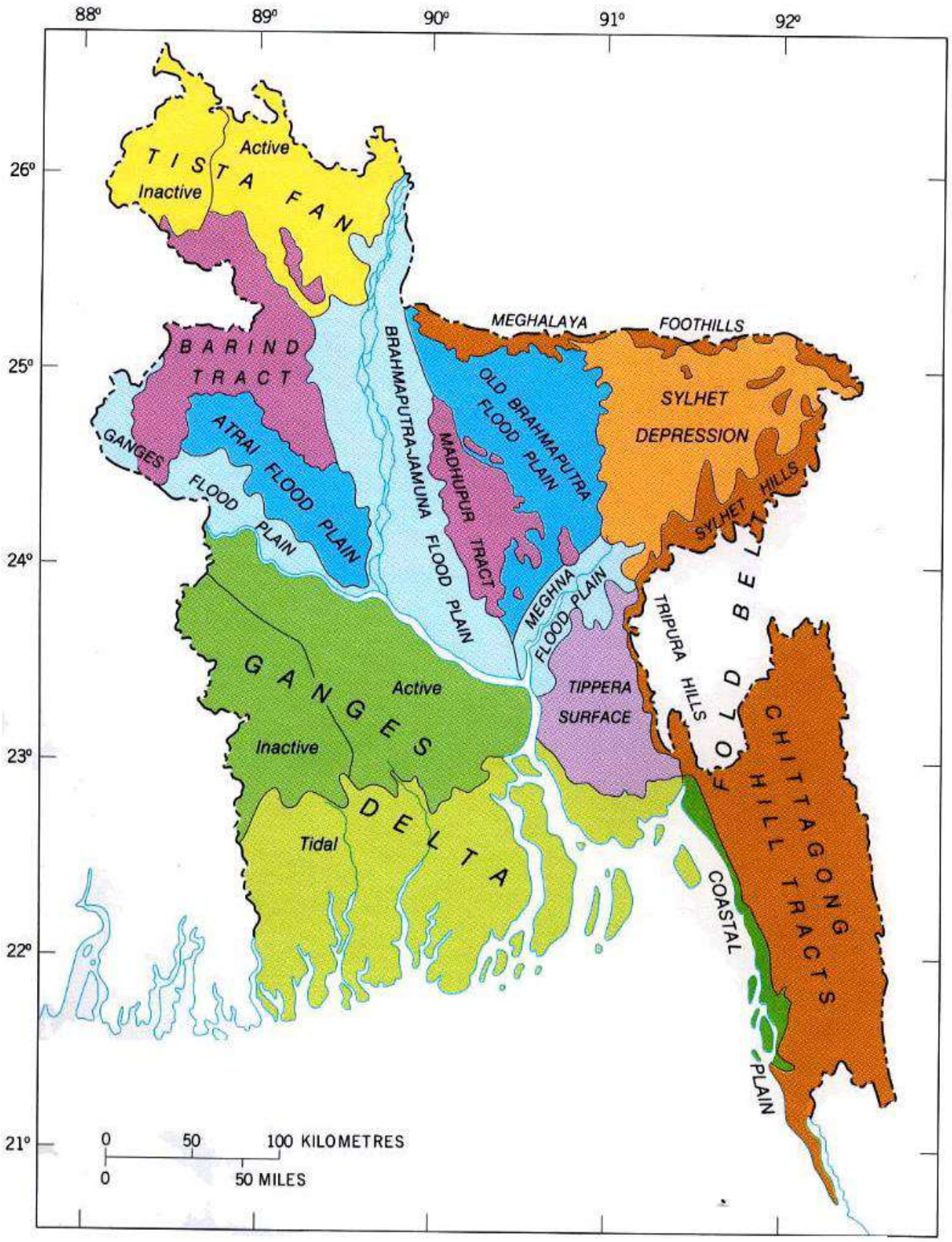

Figure-3.1: Physiographic Map of Bangladesh *(Alam, et al. 1991)*

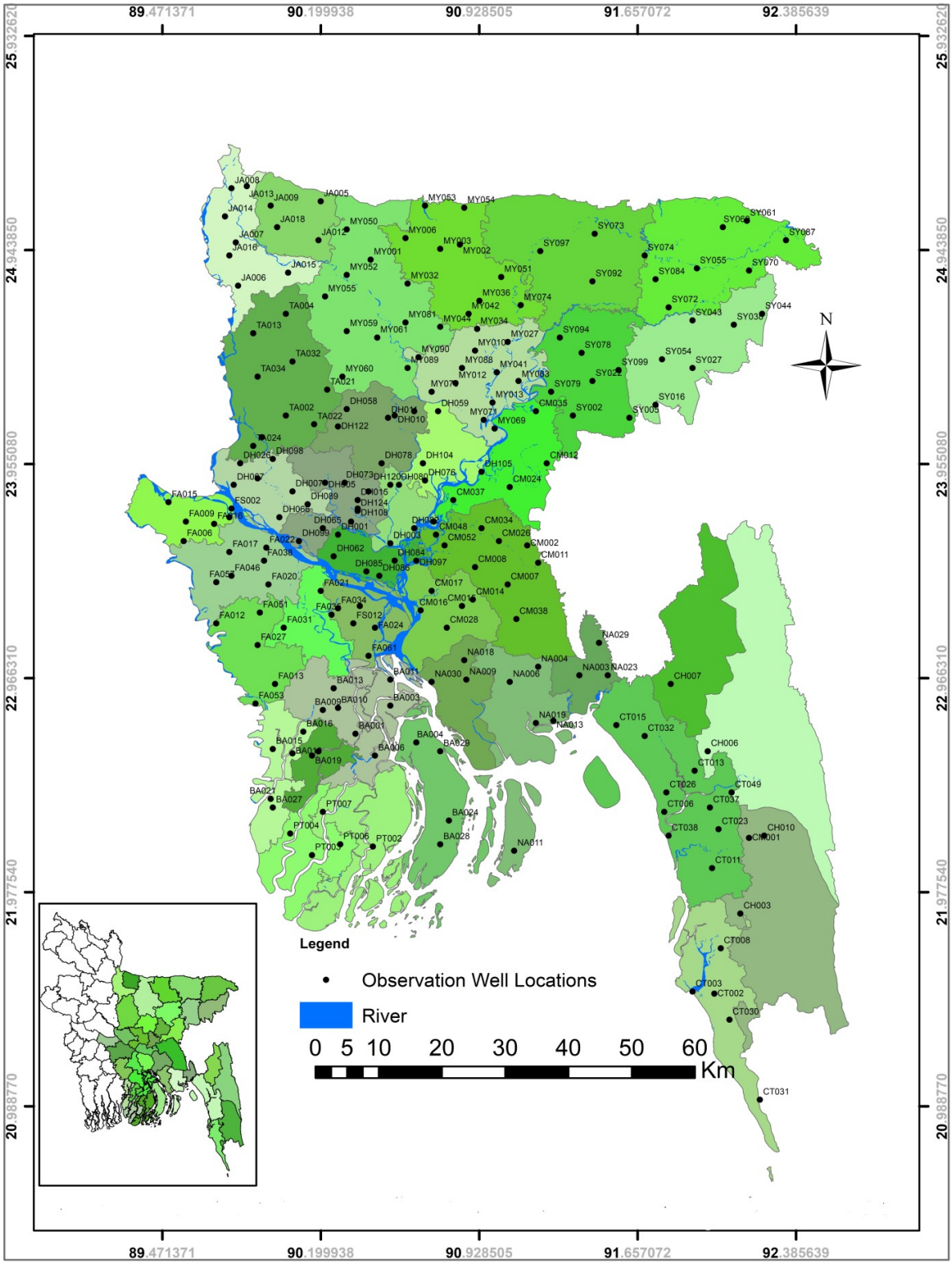

Figure-3.2: Locations of the Observation Well Water Hydrology Division-I

4. Groundwater Hydrograph Data

The groundwater table data were obtained from the database of Processing and Flood Forecasting Circle, Dhaka. Two divisions, Ground Water Hydrology Division-I, Dhaka and Ground Water Hydrology Division-II, Dhaka under the Ground Water Hydrology Circle, Dhaka observe and collect ground water data through field investigation. Ground Water Processing Branch, Dhaka under the Processing and Flood Forecasting Circle do the storage, accuracy checking, processing and analytical works of these data. There are 630 observation wells under BWDB located in Ground Water Hydrology Division-I. Here 211 wells were randomly selected as one well from each upazillas of 38 districts. Groundwater table data are being collected from each of the observation well in weekly basis. A manual gauge indicating 'meter' unit is used to measure the groundwater table. This ground water table data is recorded in the field and send to Processing and Flood Forecasting Circle at the end of month to store and process data. The database thus generated forms the basis for planning the ground water development and management program. This data is used for assessment of ground water resources and changes in the ground water regime as well as this data can be used for various development and management activities.

The sduty includes:

• The location of 211 groundwater observation wells;

• Depth of 211 groundwater observation wells;

• Groundwater Table data for 211 groundwater observation wells and others necessary.

It is expected that such an extensive database would have errors, given that the data have been collected more than fifty years which were manually measured and manually entered into the database.

Based on the following points groundwater table data is checked for accuracy:

- Rapid rise in water table
- Rapid decline in water table
- Gaps in hydrograph due to unavailability of data

5. Groundwater Hydrograph

Making of ground water hydrograph is one of the most important features in ground water analysis. It is possible to understand the consistency of data by analyzing the hydrograph of a location at a glance. Careful analysis of hydrographs can reveal much useful information regarding aquifer system geometry, hydrogeological characteristics, irrigation practice and recharge. The impact of increasing groundwater development can often be clearly observed from hydrographs (*National Water Management Plan Project; Draft Development Strategy; Annex C Appendix 6; Estimation of Groundwater Resources; August 2000*). Here each year has been divided into four time period pre-monsoon period (March-May), monsoon period (June-August), post monsoon period (September-November) and dry period (December-February) for the convenience of hydrograph interpretation. Some breaks are noticeable in the hydrographs due to insufficient data. Ground water hydrograph of 211 wells in Ground Water Division-I during the year 2008 to 2018 have drawn district wise and listed sub-division wise,

5.1. Ground Water Sub-division Dhaka includes 12 districts; Dhaka, Gazipur, Manikganj, Munshiganj, Narayanganj, Narsingdi, Mymensingh, Netrokona, Kishoreganj, Jamalpur, Sherpur, Tangail.

5.2. Ground Water Sub-division Kumilla includes 15 districts; Kumilla, Brahmanbaria, Chandpur, Noakhali, Lakshmipur, Feni, Chattogram, Cox's Bazar, Bandarban, Khagrachhari, Rangamati, Sylhet, Sunamganj, Moulvi Bazar, Habiganj.

5.3. Ground Water Sub-division Faridpur includes 11 districts; Faridpur, Gopalganj, Madaripur, Rajbari, Shariatpur, Barisal, Bhola, Jhalokathi, Pirojpur, Barguna, Patuakhali.

These are shown in figure 5.1.1 to 5.3.11 and the findings from the hydrographs are given below:

5.1.1. Dhaka

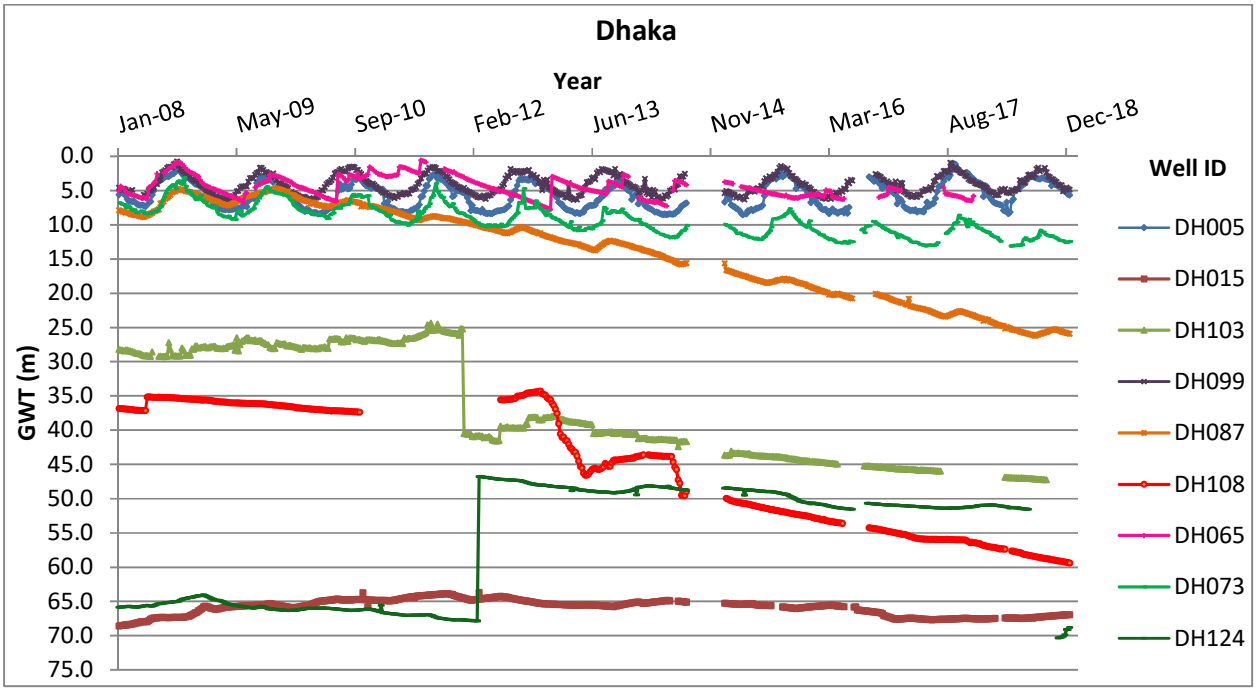

Figure 5.1.1: Hydrographs of GWT of Dhaka District

In this district GWT shows quite different and abnormal trend. This is because of extreme demand on ground water for various purposes. There 9 wells DH005, DH103, DH099, DH087, DH015, DH108, DH065, DH073 and DH124 were selected which located in Dhamrai, Cantonment, Dohar, Keraniganj, Mirpur, Mahammadpur, Nawabganj, Savar and Tejgaon both city corporation and out side of it. In well DH103 and DH124 there was an abrupt change of 15.3m and 21.10m water table difference which is due to re-sinking of well and change in well depth. From hydrographs of DH005, DH015, DH065 and DH099 it is evident that GWT shows normal trend in these areas. Except well DH015 other wells are situated outside the city corporation area. In these areas GWT can recharge during monsoon so that it can uphold its static level. In other wells GWT decreases in a very alarming rate. The declination rates of GWT in well DH103, DH087, DH108, DH073 and DH124 from 2008 to 2018 are around 0.46m, 2.04m, 2.40m, 0.74m and 0.74m respectively.

5.1.2. Gazipur

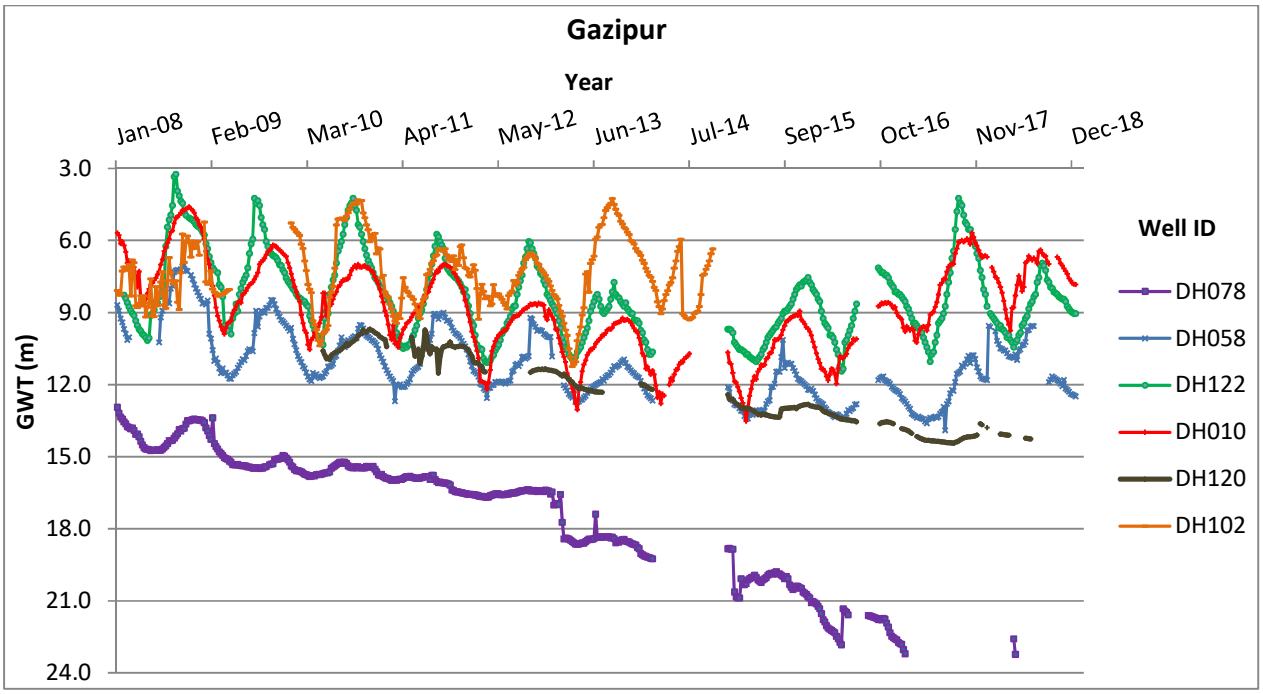

Figure 5.1.2: Hydrographs of GWT of Gazipur District

Among 6 wells the overall trends of hydrographs are almost similar in 4 wells namely DH058, DH122, DH010 and DH102 which situated in Kaliakair, Kaliakair, Sreepur and Kapasia upazillas in that order. The hydrographs show decreasing trend in dry period (December-February) and these show lowest level in pre-monsoon period (March-May) followed by a rapid increasing trend in the monsoon period (June-August) and over again a gradual decrease in post monsoon period (September-November). In well DH120 and DH078 which sited in Kaliganj and Gazipur Sadar GWT gradually decreases at the rate of around 0.45m and 0.86m per year. These declinations may be due to excessive extraction of ground water and the recharge don't reach that level.

5.1.3. Manikganj

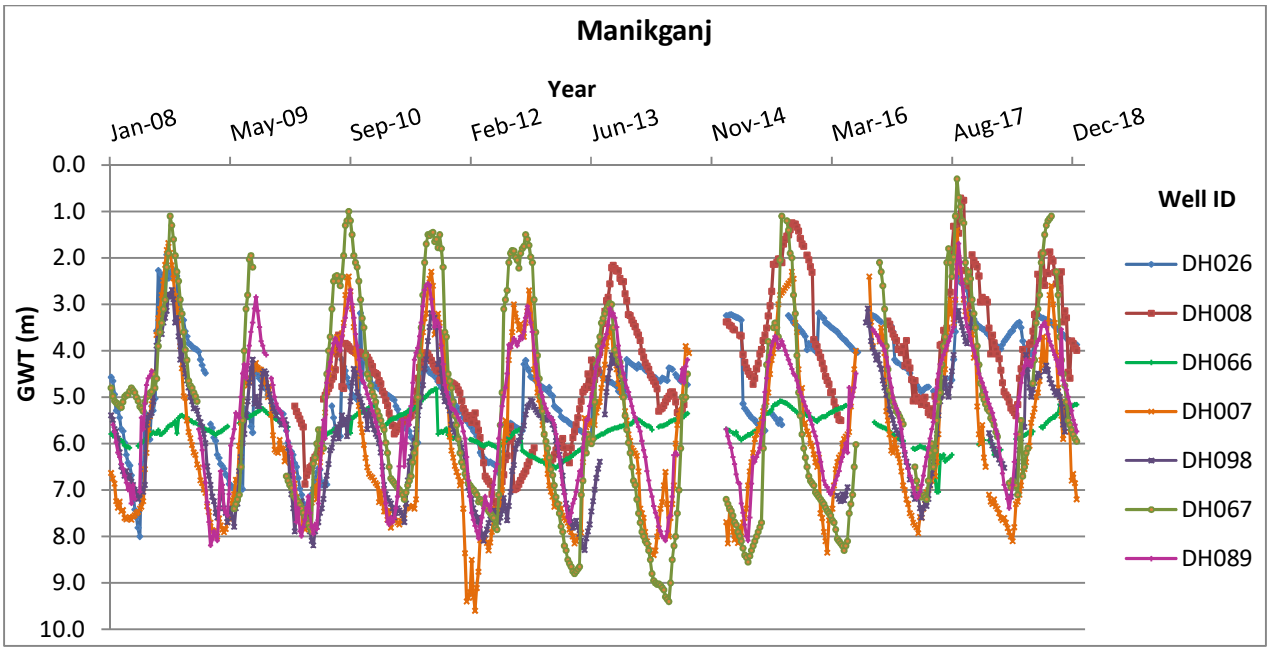

Figure 5.1.3: Hydrographs of GWT of Manikganj District

In this district 7 wells were selected for hydrograph DH026, DH008, DH066, DH007, DH098 and DH067 from 7 upazillas Daulatpur, Ghior, Harirampur, Manikganj Sadar, Saturia and Shivalaya correspondingly. The overall trends of these hydrographs are typical. The hydrographs show decreasing trend in dry period (December-February) and these show lowest level in pre-monsoon period (March-May) followed by a rapid increasing trend in the monsoon period (June-August) and over again a gradual decrease in post monsoon period (September-November). In 5 wells GWT fluctuations are almost similar excluding DH026 and DH066. In these two wells seasonal fluctuation ranges in the region of 0.50m to 2.50m.

5.1.4. Munshiganj

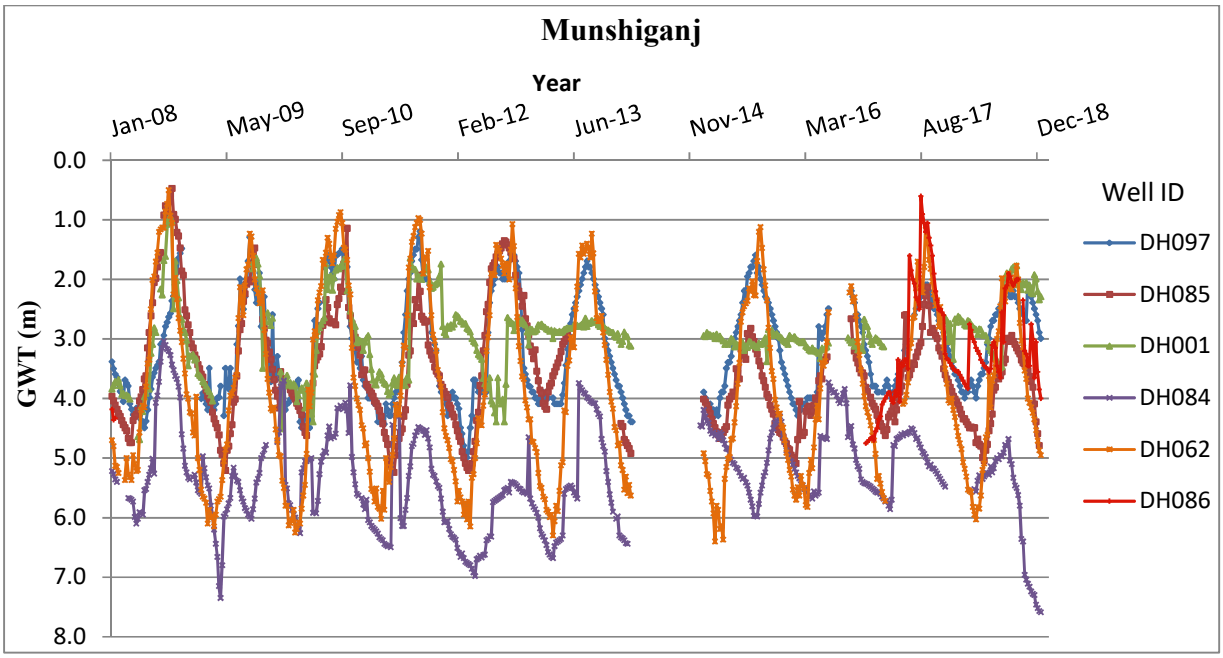

Figure 5.1.4: Hydrographs of GWT of Munshiganj District

The overall trends of all hydrographs are normal. In this district 6 wells DH097, DH085, DH084, DH001, DH062 and DH086 were selected from Gazaria, Lohajang, Munshiganj Sadar, Sirajdikhan, Sreenagar and Tongibari upazillas. Among these wells, in DH085 and DH084 which sited in Lohajang and Munshiganj Sadar GWT gradually decreases at the rate of around 0.22m and 0.15m per year. These declinations may be due to excessive extraction of ground water and the recharge don't reach that static level.

5.1.5. Narayanganj

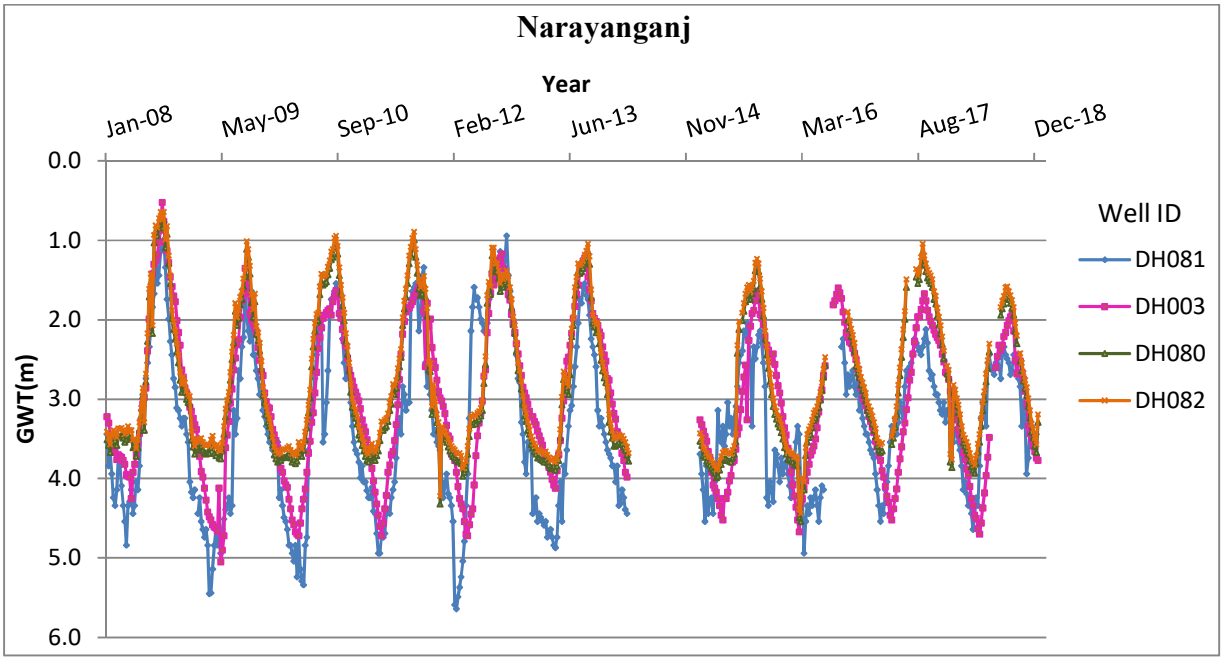

Figure 5.1.5: Hydrographs of GWT of Narayanganj District

The overall trends of hydrographs are almost similar and show similar seasonal fluctuations. The hydrographs of groundwater table show decreasing trend in dry period (December-February) and these show lowest level in pre-monsoon period (March-May) followed by a rapid increasing trend in the monsoon period (June-August) and over again a gradual decrease in post monsoon period (September-November). Seasonal fluctuation trends during the time period of 2008 to 2018 are almost similar in all 4 wells DH081, DH003, DH080 and DH082 which located in Araihazar, Narayanganj Sadar, Rupganj and Sonargaon upazillas respectively. In these wells GWT fluctuated between 0.52m to around 5.64m.

5.1.6. Narsingdi

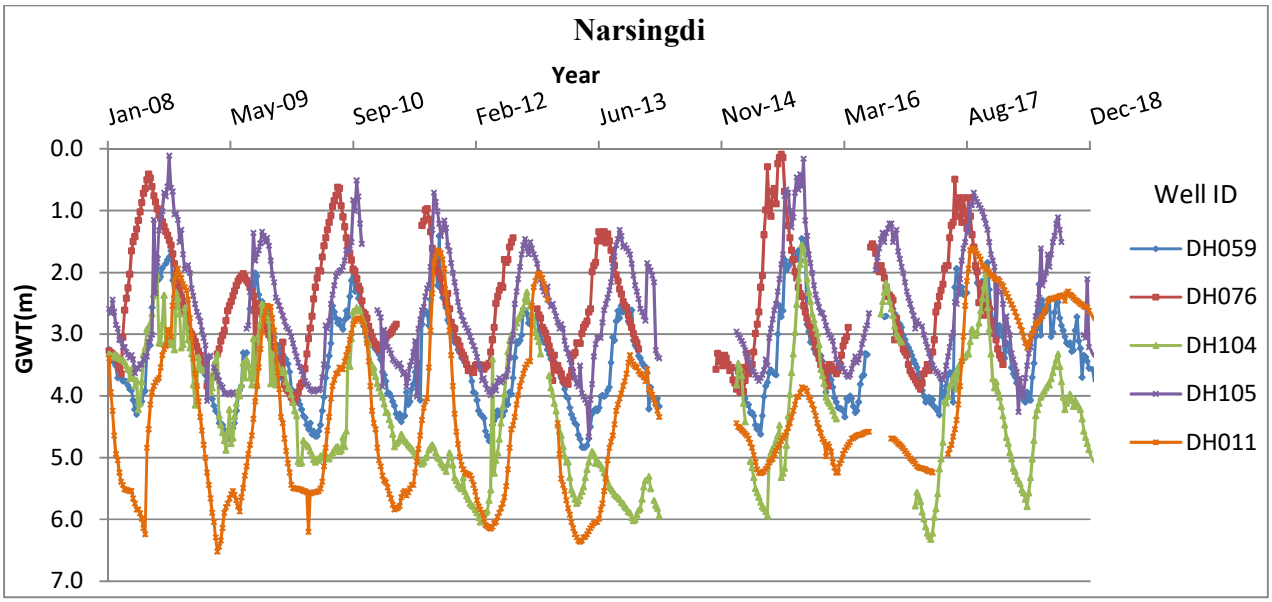

Figure 5.1.6: Hydrographs of GWT of Narsingdi District

All the hydrographs were showing typical and similar trends in all wells DH059, DH076, DH104, DH105 and DH011 which is located in Manohardi, Narsingdi Sadar, Palash, Raipur and Shibpur in the same way. In these wells GWT fluctuated roughly 1.15m to 4.50m. Sometimes the graphs show abrupt fluctuations in a very short period. This may be due to heavy rainfall or excessive extraction in a short time.

5.1.7. Mymensingh

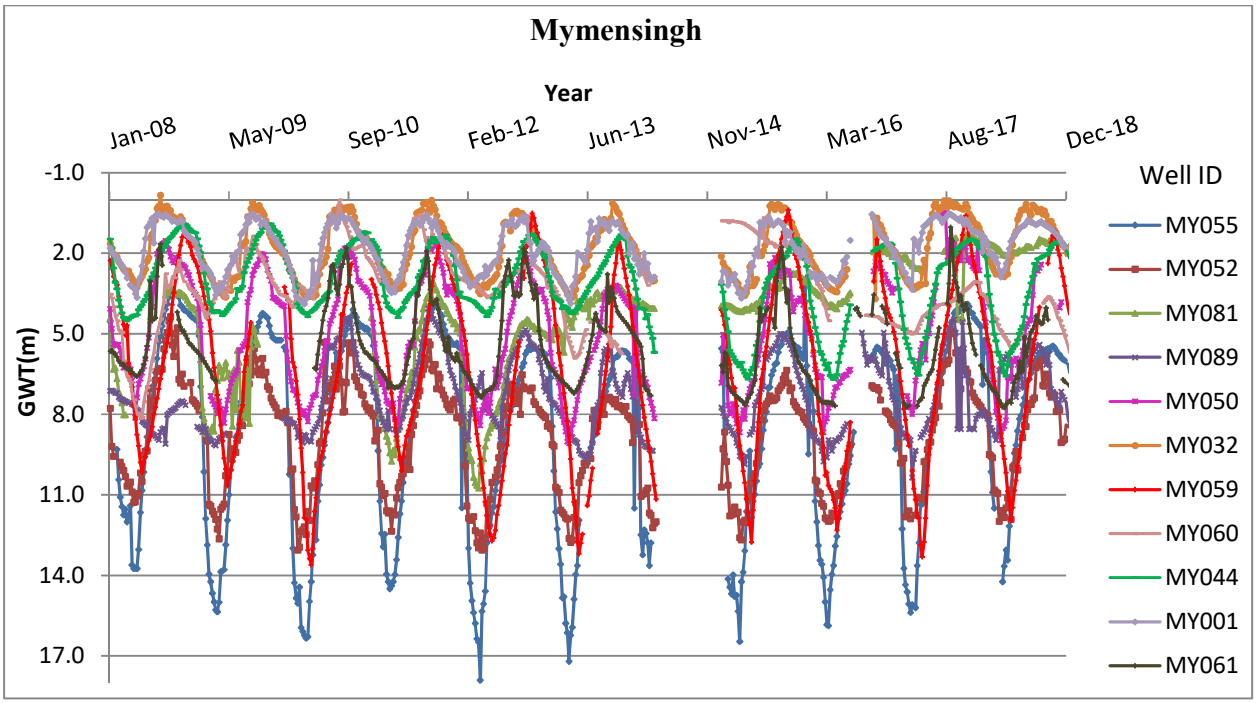

Figure 5.1.7: Hydrographs of GWT of Mymensingh District

The general trends of all hydrographs are regular and similar in all wells MY055, MY052, MY081, MY089, MY050, MY032, MY059, MY060, MY044, MY001 and MY061 which is located in Muktagachha, Mymensingh Sadar, Ishwarganj, Gaffargaon, Haluaghat, Gauripur, Fulbaria, Bhaluka, Nandail, Phulpur and Trishal correspondingly. The hydrographs show decreasing trend in dry period (December-February) and these show lowest level in pre-monsoon period (March-May) followed by a rapid increasing trend in the monsoon period (June-August) and over again a gradual decrease in post monsoon period (September-November). In few well seasonal fluctuation ranges from roughly 2.5m to 4m whereas in some well the range is around 10m to 14m.

5.1.8. Netrokona

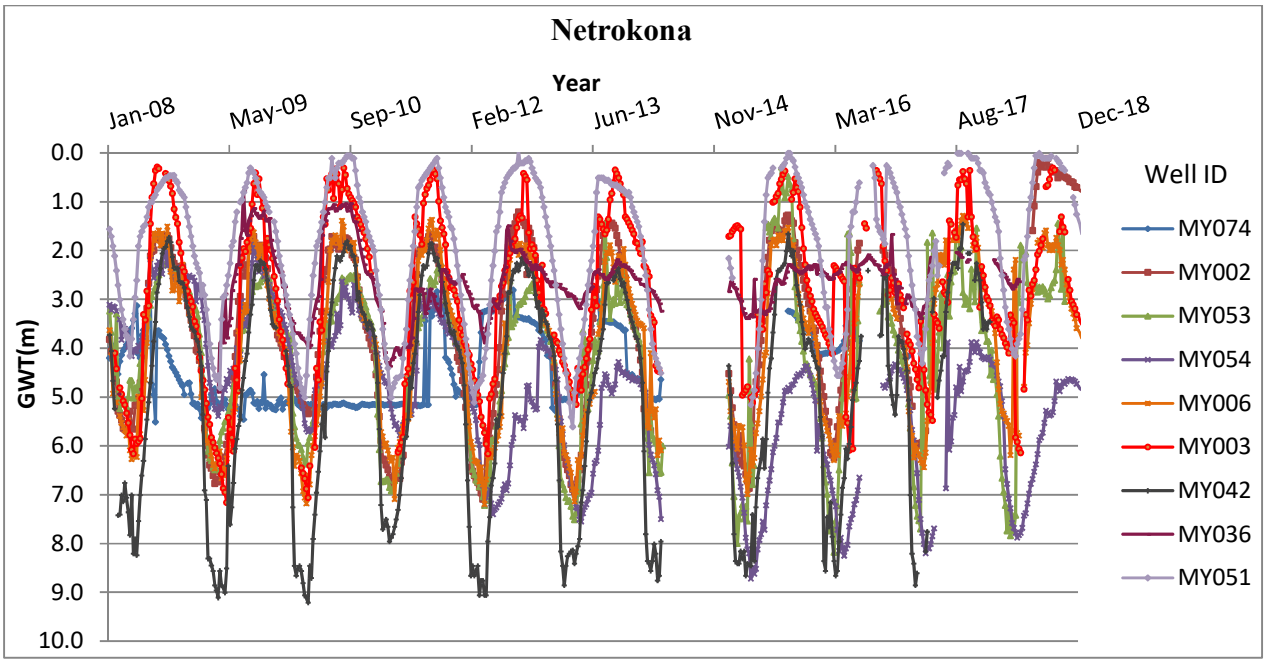

Figure 5.1.8: Hydrographs of GWT of Netrokona District

The trends of hydrographs are usual and similar in all wells MY074, MY002, MY053, MY054, MY042, MY036, MY003, MY006 and MY051 which is located in Khaliajuri, Barhatta, Durgapur, Kalmakanda, Kendua, Madan, Netrokona Sadar, Purbadhala and Mohanganj in the same way. The hydrographs show decreasing trend in dry period (December-February) and these show lowest level in pre-monsoon period (March-May) followed by a rapid increasing trend in the monsoon period (June-August) and over again a gradual decrease in post monsoon period (September-November). In few well seasonal fluctuation ranges from around 6m to 7m whereas in some well the range is around 1m to 2m.

5.1.9. Kishoreganj

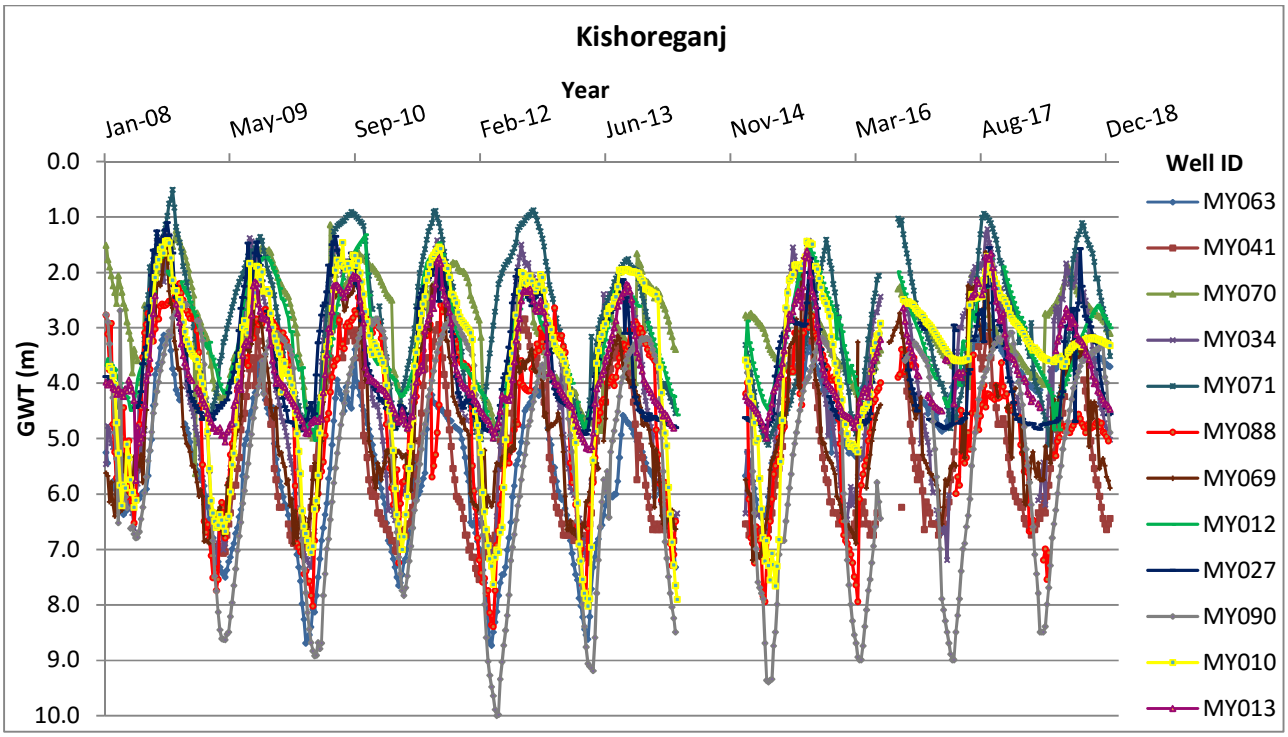

Figure 5.1.9: Hydrographs of GWT of Kishoreganj District

The overall trends of hydrographs are normal and similar in all wells MY063, MY041, MY070, MY013, MY034, MY071, MY088, MY069, MY012, MY010, MY090 and MY027 which located in Astagram, Nikli, Pakundia, Bajitpur, Tarail, Kuliar Char, Kishoreganj Sadar, Bhairab, Katiadi, Karimganj, Hossainpur and Itna correspondingly. The hydrographs show decreasing trend in dry period (December-February) and these show lowest level in pre-monsoon period (March-May) followed by a rapid increasing trend in the monsoon period (June-August) and over again a gradual decrease in post monsoon period (September-November). In few well seasonal fluctuation ranges from around 7m to 9m whereas in some well the range is around 3m to 4m.

5.1.10. Jamalpur

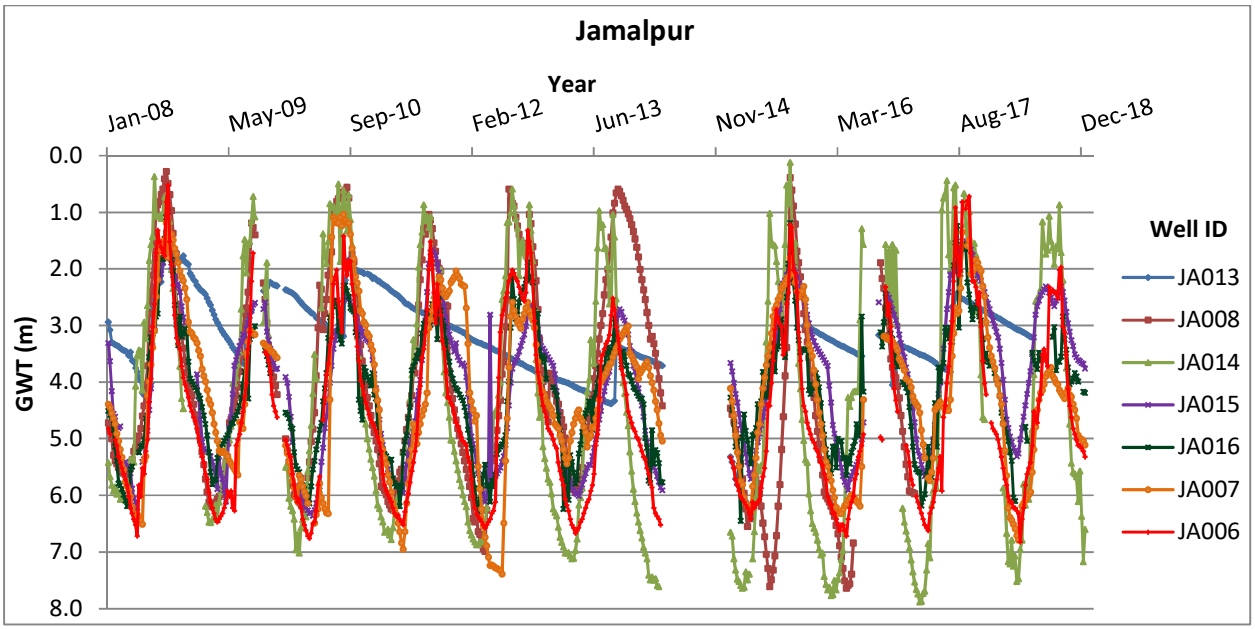

Figure 5.1.10: Hydrographs of GWT of Jamalpur District

The seasonal fluctuations are almost similar in all wells JA008, JA014, JA015, JA016, JA007 and JA006 which sited in Dewanganj, Islampur, Jamalpur Sadar, Madarganj Melandaha and Sarishabari upazillas respectively except well JA013 which sited in Baksiganj upazilla among 7 wells in this district. In these wells GWT fluctuated between 0.12m to around 7.87m from surface level of those areas. In well JA013 the water table fluctuated from 1.67m to 6.41m but it didn't match with the seasonal fluctuations.

5.1.11. Sherpur

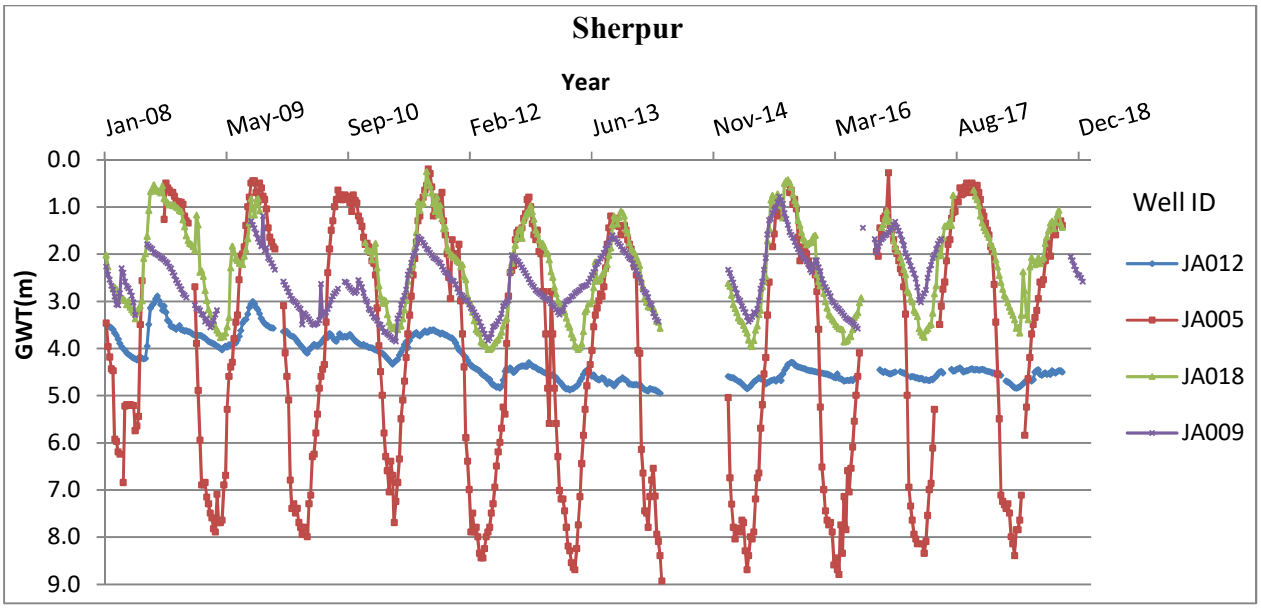

Figure 5.1.11: Hydrographs of GWT of Sherpur District

In this district 4 wells were selected for hydrograph JA012, JA005, JA018 and JA009 from 4 upazillas Nakla, Nalitabari, Sherpur Sadar and Sreebardi respectively. Among these JA018 and JA009 show almost same seasonal fluctuation trends and fluctuations lie between 0.25m to 3.98m. In well JA005 GWT shows normal trend with fluctuation between 0.19m to 8.93m. In well JA012 GWT shows a decreasing trend with a declination of around 0.17m per year. It is indicate that theis well unable to recharge in the monsoon period.

5.1.12. Tangail

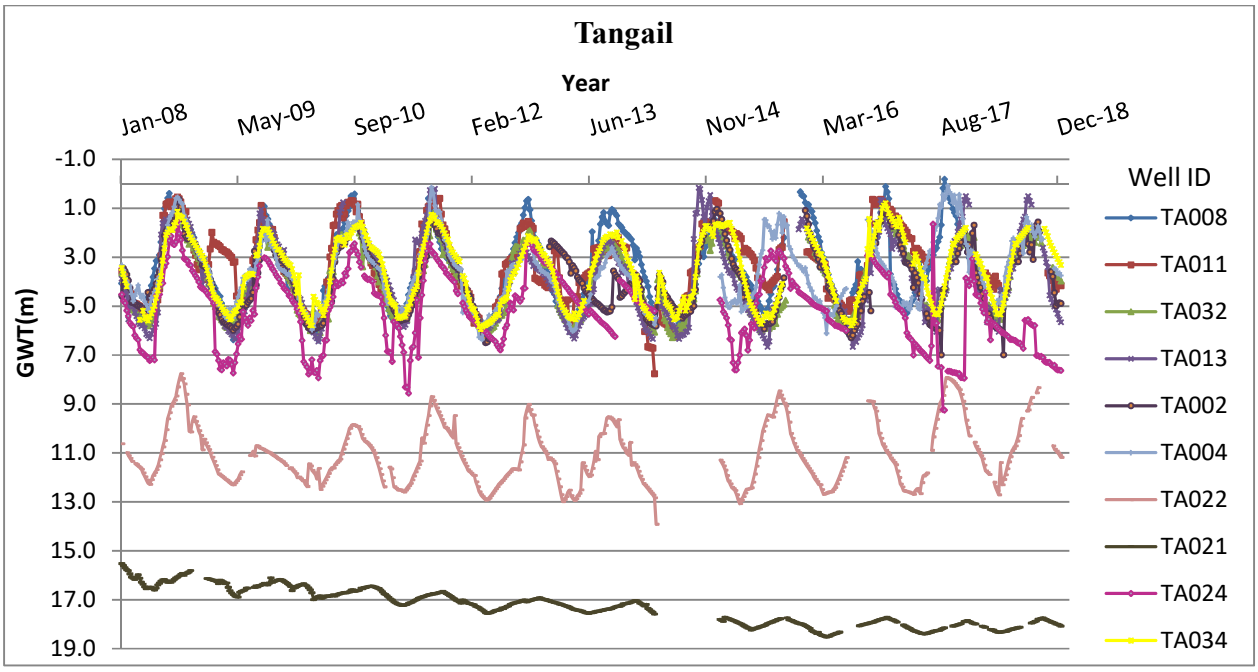

Figure 5.1.12: Hydrographs of GWT of Tangail District

All the hydrographs of Tangail district show regular trend except well TA021. Here 10 wells were selected TA011, TA008, TA002, TA032, TA013, TA034, TA021, TA024, TA022 and TA004 from Bhoapur, Delduar, Basail, Ghatail, Gopalpur, Kalihati, Sakhipur, Nagarpur, Mirzapur and Madhupur upazillas correspondingly. In well TA021 GWT gradually declining at the rate of around 0.20m per year from monsoon of 2008 to monsoon of 2018. This declination happening may be due to excessive extraction of ground water and the recharge don't reach the static level.

5.2.1. Kumilla

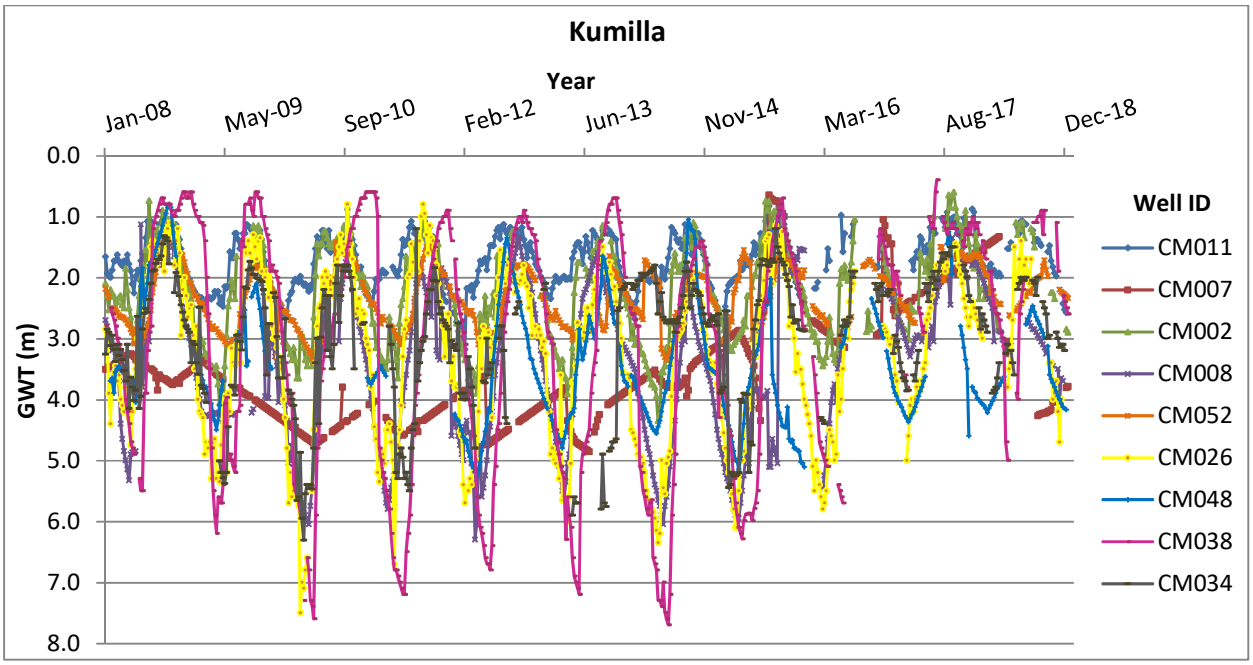

Figure 5.2.1: Hydrographs of GWT of Kumilla District

The overall trends of hydrographs are normal. The hydrographs of groundwater table show decreasing trend in dry period (December-February) and these show lowest level in pre-monsoon period (March-May) followed by a rapid increasing trend in the monsoon period (June-August) and over again a gradual decrease in post monsoon period (September-November).Seasonal fluctuations are almost similar in 8 wells CM002, CM008, CM011, CM052, CM026, CM048, CM038 and CM034 which situated in Burichang, Chandina, Kumilla Sadar, Daudkandi, Debidwar, Homna, Laksam and Muradnagar upazillas respectively. In these wells GWT fluctuated between 0.59m to around 7.69m from surface level of those areas. In well CM007 the water table was around 3.50m depth during monsoons of 2008 but it didn't reach the static level during the monsoons of 2009 to 2013. Again in 2014 the GWT of well CM007 gradually increases and it reaches around 2m depth during the monsoon of 2017. Well CM007 installed in the central area of Barura upazilla. This declination may be due to excessive extraction of ground water and the recharge didn't reach that level in that period.

5.2.2. Brahmanbaria

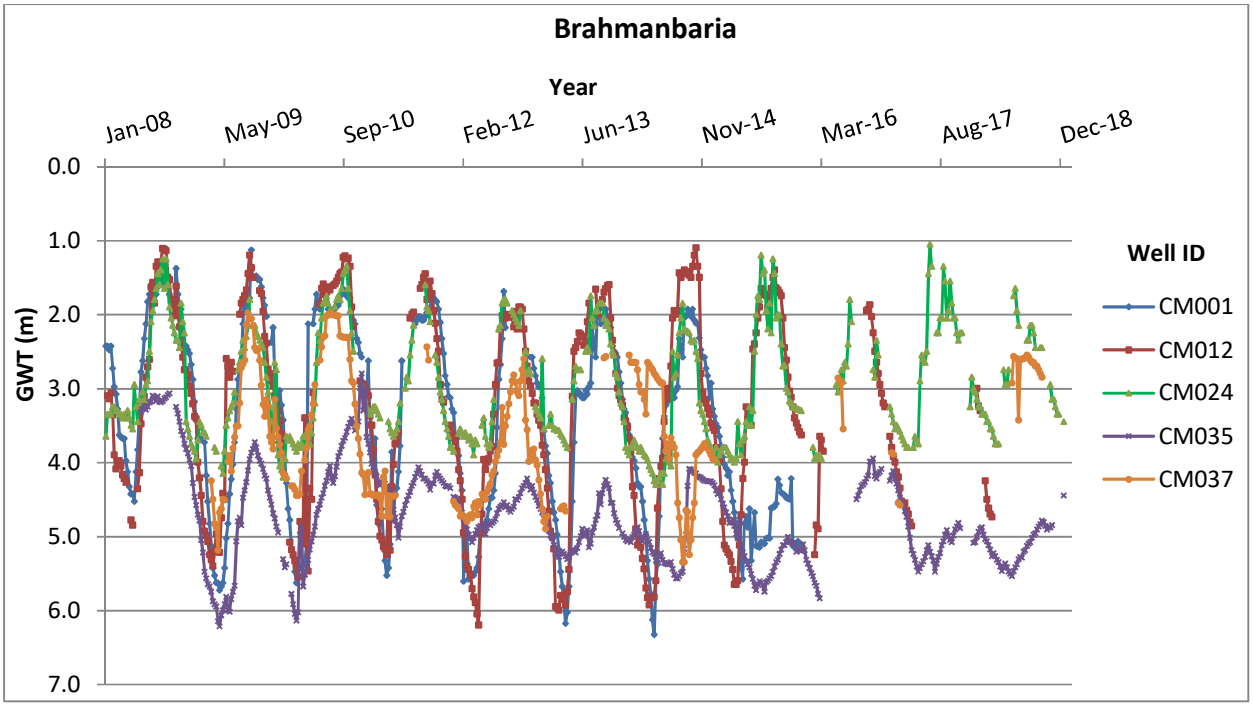

Figure 5.2.2: Hydrographs of GWT of Brahmanbaria District

The overall trends of hydrographs are normal. The hydrographs of groundwater table show decreasing trend in dry period (December-February) and these show lowest level in pre-monsoon period (March-May) followed by a rapid increasing trend in the monsoon period (June-August) and over again a gradual decrease in post monsoon period (September-November).Seasonal fluctuations are almost same in 4 wells CM001, CM012, CM037 and CM024 which situated in Kasba, Brahmanbaria Sadar, Banchharampur and Nabinagar upazillas respectively. In these wells GWT fluctuated between 1m to around 6m from surface level of those areas. In well CM035 the water table was 3m depth during monsoon, 2008 but it didn't reach the static level during the monsoon of 2009. In hydrograph it evident that water table of well CM035 gradually decreases from 3m to around 4.7m during the monsoons of 2010 to 2018. Well CM035 situated in the central area of Nasirnagar upazilla. This declination of GWT may be due to excessive extraction of ground water and the recharge don't reach that level.

5.2.3. Chandpur

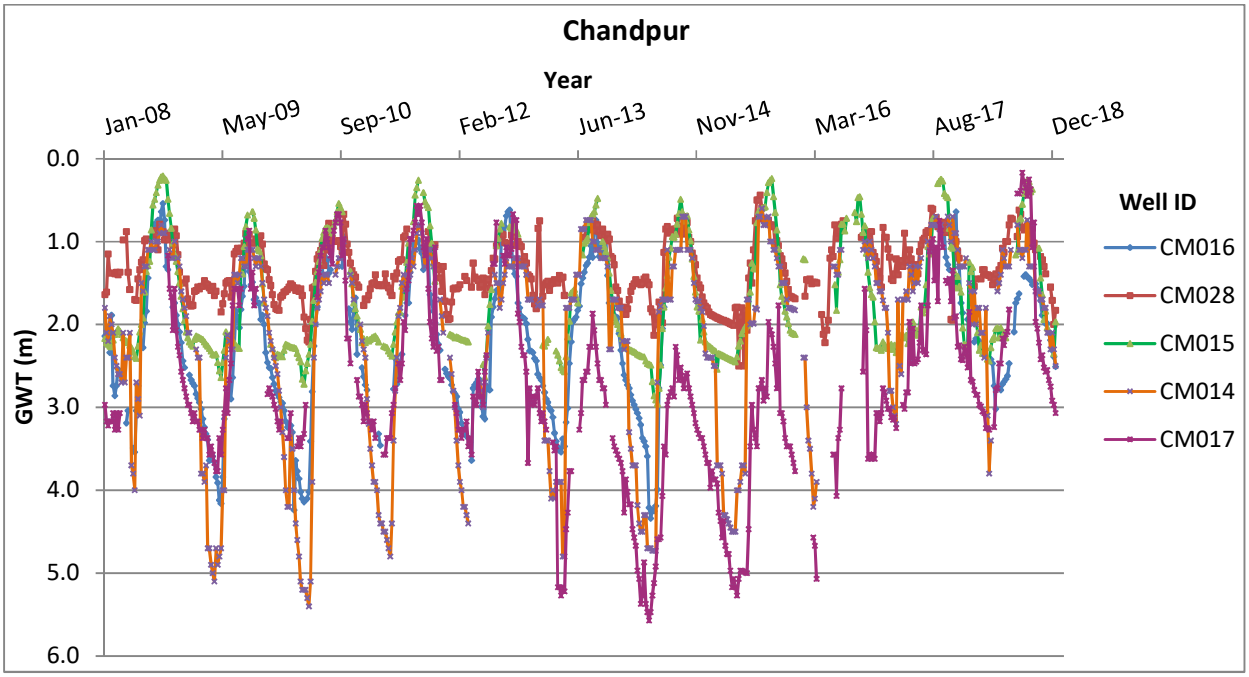

Figure 5.2.3: Hydrographs of GWT of Chandpur District

The overall trends of hydrographs are normal. The hydrographs of groundwater table show decreasing trend in dry period (December-February) and these show lowest level in pre-monsoon period (March-May) followed by a rapid increasing trend in the monsoon period (June-August) and over again a gradual decrease in post monsoon period (September-November). Seasonal fluctuation trends during the time period of 2008 to 2018 are almost similar in all 5 wells CM016, CM028, CM015, CM014 and CM017 which situated in Chandpur Sadar, Faridganj, Hajiganj, Kachua and Matlab upazillas respectively. In well CM028 and CM015 GWT fluctuated between 0.3m to around 3m whereas in well CM016, CM014 and CM017 GWT fluctuated between 0.5m to around 5.5m from surface level of those areas. In well CM017 the water table was around 0.5m depth during monsoons of 2008 to 2012 but it didn't reach the statistic level during the monsoons of 2013 to 2016. Again in 2017 the GWT of well CM017 gradually increases and it reaches around 0.2m depth during the monsoon of 2018. Well CM017 installed in a market area of Matlab upazilla. This declination may be due to excessive extraction of ground water and the recharge didn't reach that level in that period.

5.2.4. Noakhali

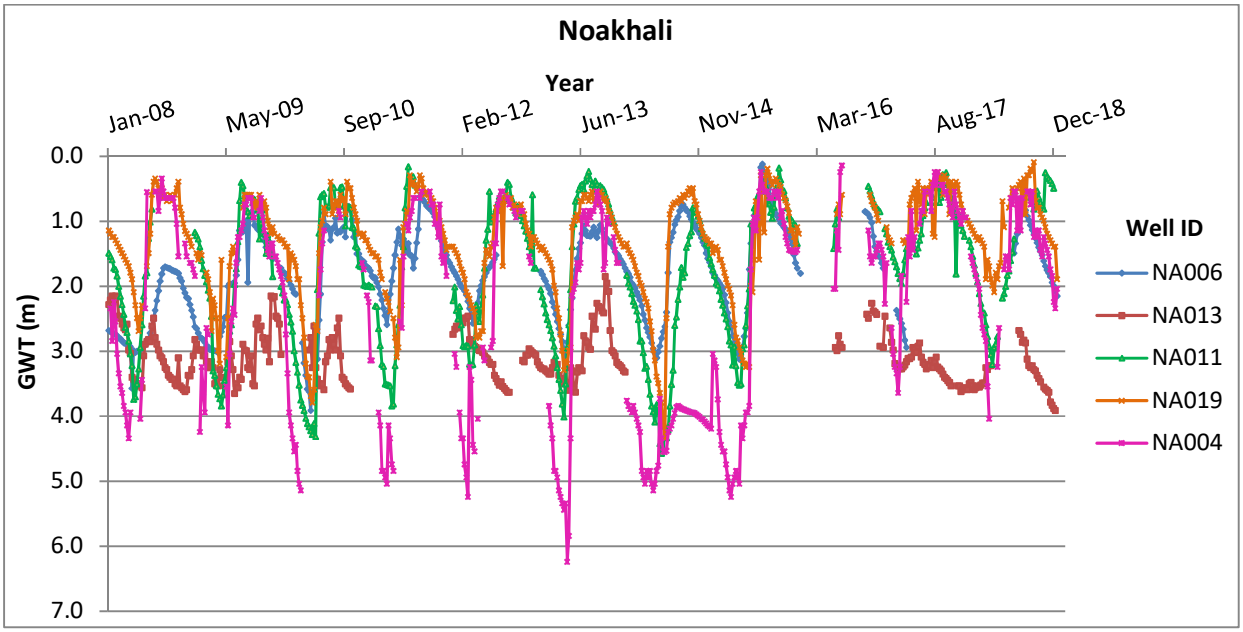

Figure 5.2.4: Hydrographs of GWT of Noakhali District

Among 5 wells the overall trends of hydrographs are almost similar in 4 wells NA006, NA011, NA019 and NA004 which situated in Begumganj, Hatiya, Noakhali Sadar and Senbagh upazillas in that order. The hydrographs show decreasing trend in dry period (December-February) and these show lowest level in pre-monsoon period (March-May) followed by a rapid increasing trend in the monsoon period (June-August) and over again a gradual decrease in post monsoon period (September-November). In these wells GWT fluctuated between 0.09m to 6.24m and reaches the static level from surface level of those areas during monsoon. In well NA013 the water table fluctuated in an abnormal way in relation to seasonal fluctuation.

5.2.5. Lakshmipur

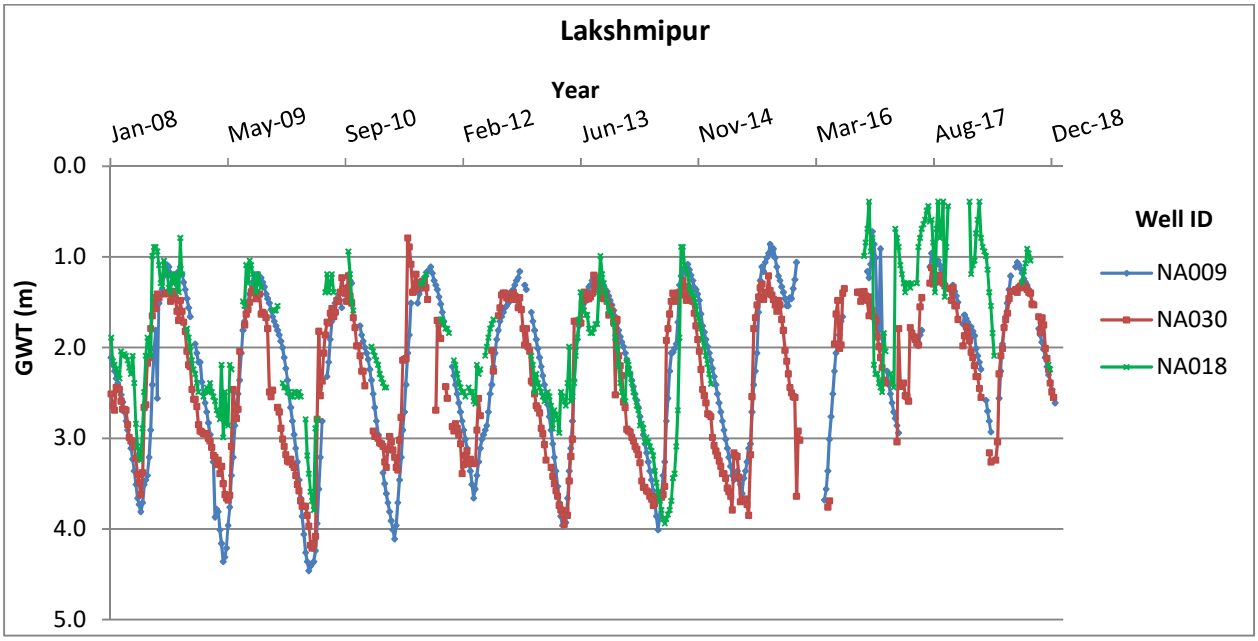

Figure 5.2.5: Hydrographs of GWT of Lakshmipur District

The overall trends of hydrographs are normal. The hydrographs of groundwater table show decreasing trend in dry period (December-February) and these show lowest level in pre-monsoon period (March-May) followed by a rapid increasing trend in the monsoon period (June-August) and over again a gradual decrease in post monsoon period (September-November). Seasonal fluctuation trends during the time period of 2008 to 2018 are almost similar in all 3 wells NA009, NA030 and NA018 which situated in Lakshmipur Sadar, Raipur and Ramganj upazillas respectively. In these wells GWT fluctuated between 0.39m to around 4.38m.

5.2.6. Feni

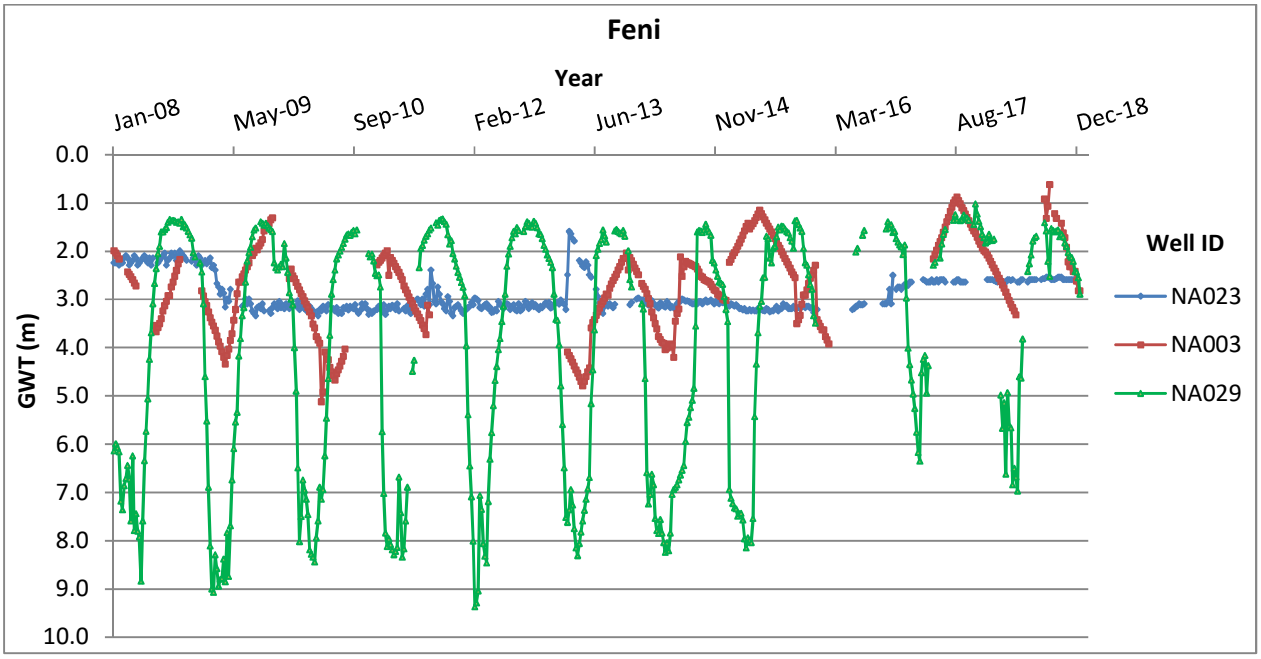

Figure 5.2.6: Hydrographs of GWT of Feni District

In this district 3 wells were selected for hydrograph NA023, NA003 and NA029 which are in Chhagalnaiya, Feni Sadar and Parshuram respectively. Among these well NA029 has the normal trend. Seasonal fluctuation in this well is within 1m to 9.32m from surface and it reaches the static level during monsoon period. In well NA023 the water table was fluctuated between 1.64m to 3.34m depth during this 11 year time. Well NA003 shows abnormal trend which doesn't match with seasonal fluctuations. This well situated in the central area of Feni Sadar upazilla.

5.2.7. Chattogram

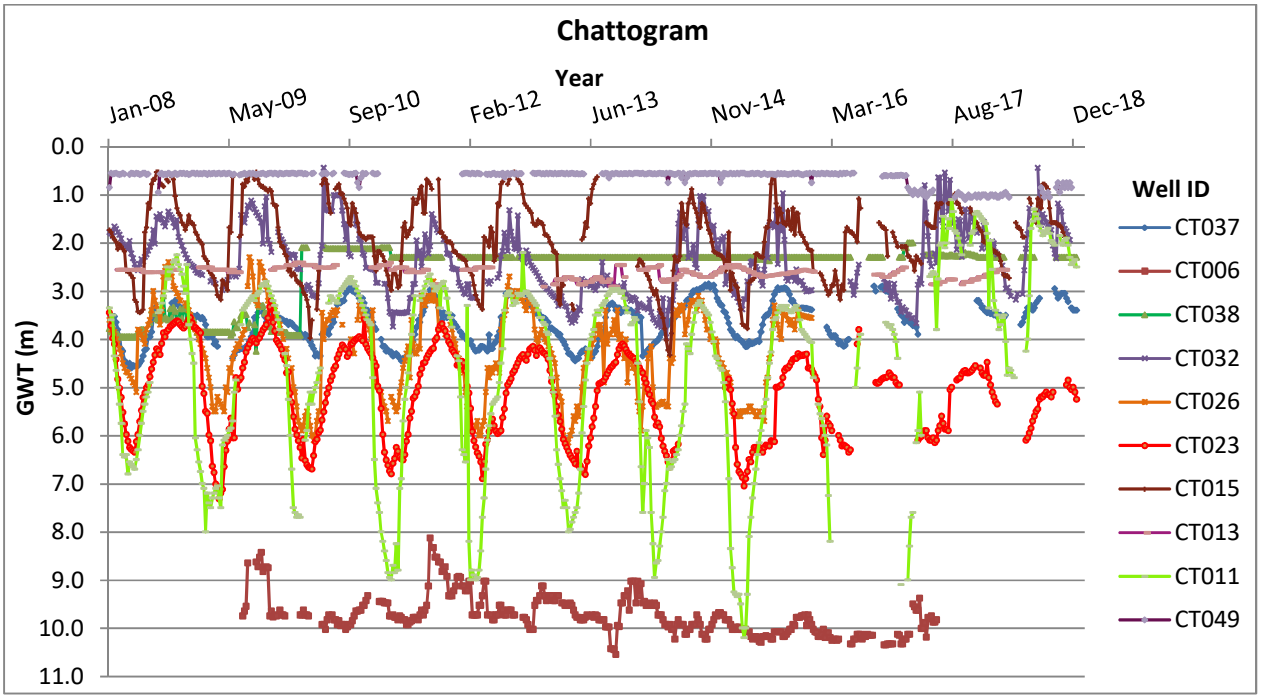

Figure 5.2.7: Hydrographs of GWT of Chattogram District

Seasonal fluctuation trends during the time period of 2008 to 2018 are almost similar in wells CT037, CT032, CT026, CT015, CT023 and CT011 which situated in Boalkhali, Fatikchhari, Hathazari, Mirsharai, Patiya and Satkania upazillas respectively whereas in well CT049, CT006, CT038 and CT013 which situated in Rangunia, Chattogram Sadar, Double Mooring and Raozan show abnormal characteristics. The hydrograph of well CT013 shows very little seasonal fluctuations of groundwater table ranges from 2.40 m to 2.90 m within a year but it doesn't show any significant trend of water level. In well CT006 the water table was 8.12m depth during monsoon, 2008 but it didn't reach the statistic level during the monsoon of 2009. In hydrograph it evident that water table of well CT006 gradually decreases from 8.12m to 10.17m during the monsoon of 2016. Well CT006 situated in the central area of Chattogram Sadar upazilla. This declination of GWT may due to excessive extraction of ground water and the recharge don't reach that level. In well CT038 and CT049 there is no seasonal fluctuation. The hydrographs are almost straight line which is absolutely abnormal.

5.2.8. Cox's Bazar

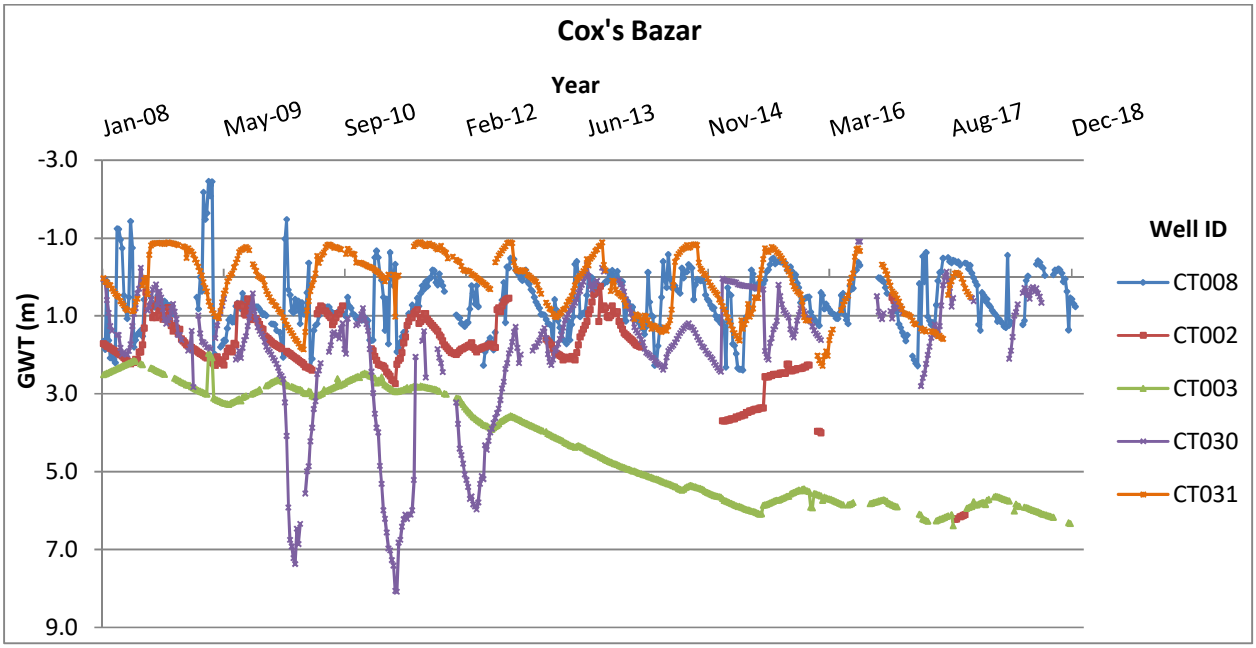

Figure 5.2.8: Hydrographs of GWT of Cox's Bazar District

Among 5 wells the overall trends of hydrographs are almost similar in 4 wells CT008, CT002, CT030 and CT031 which situated in Chakaria, Cox's Bazar Sadar, Ramu and Teknaf upazillas in that order. In these wells GWT remains above the surface level most of the time of the year. From the trends it can say that these wells are artesian type wells. In well CT003 of Maheshkhali upazilla the water table was around 2.37m depth during monsoon, 2008 whereas it was 6.05m depth during monsoon, 2018. That means GWT in well CT003 gradually decreases at a rate of around 0.37m per year. This declination may be due to excessive extraction of ground water and the recharge don't reach that level.

5.2.9. Bandarban

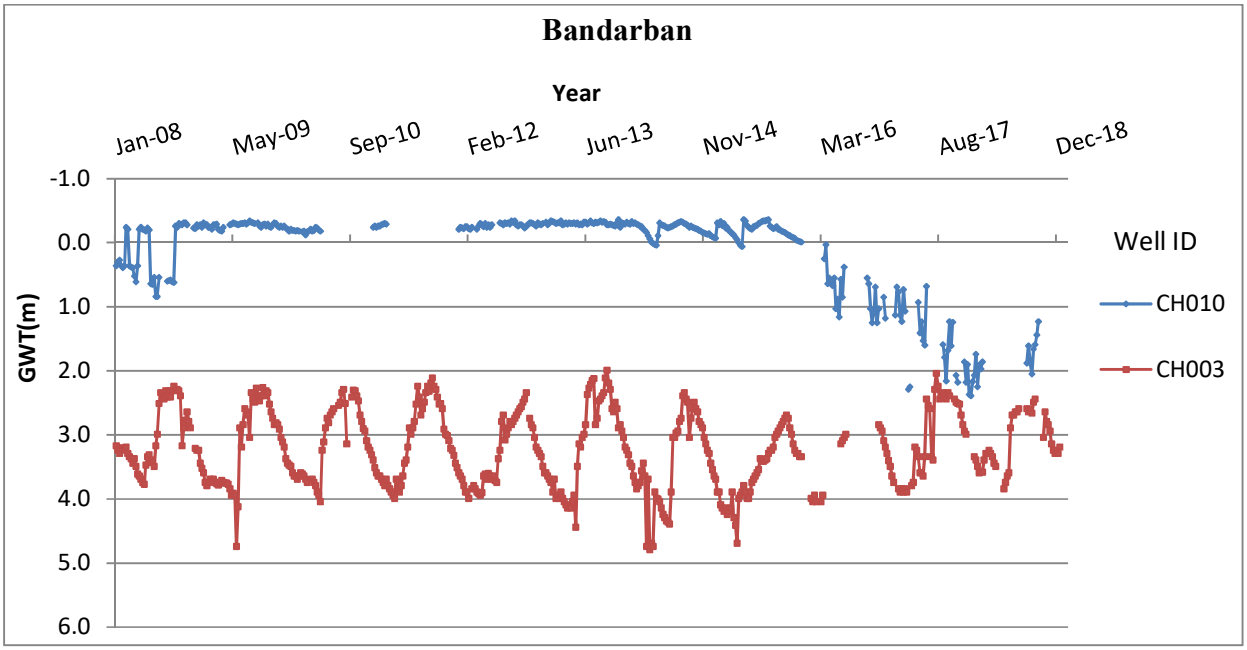

Figure 5.2.9: Hydrographs of GWT of Bandarban District

In this district two wells data were available for hydrographs CH010 and CH003 in two upazillas Bandarban Sadar and Lama. In well CH010 GWT was above surface level till monsoon of 2015 and acted as an artesian well. Then water level was continuously decreasing at an alarming rate around 0.74m per year and going ahead. In well CH003 seasonal fluctuation of GWT was typical.

5.2.10. Khagrachhari

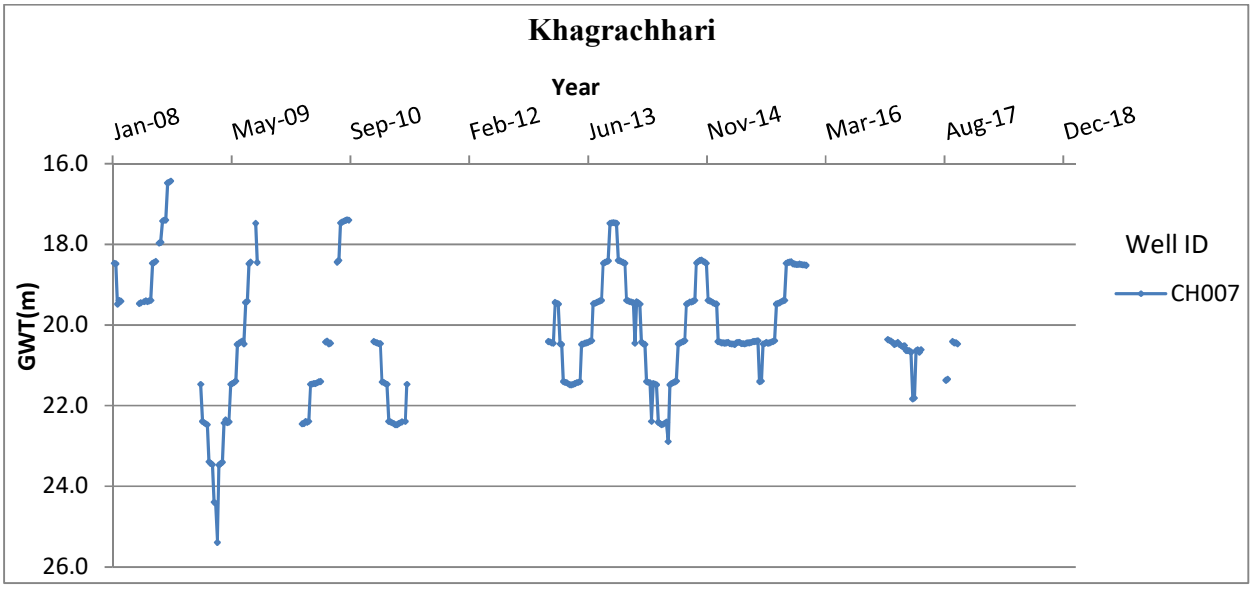

Figure 5.2.10: Hydrographs of GWT of Khagrachhari District

In this district only one well data were available for hydrograph CH007 in Ramgarh. In this well, from available data it was seen that seasonal fluctuations of GWT were as usual. The hydrographs show decreasing trend in dry period (December-February) and these show lowest level in pre-monsoon period (March-May) followed by a rapid increasing trend in the monsoon period (June-August) and over again a gradual decrease in post monsoon period (September-November). But there are many breaks in the graph due to lacking of data. It could be more understandable if the graph was continued and completed.

5.2.11. Rangamati

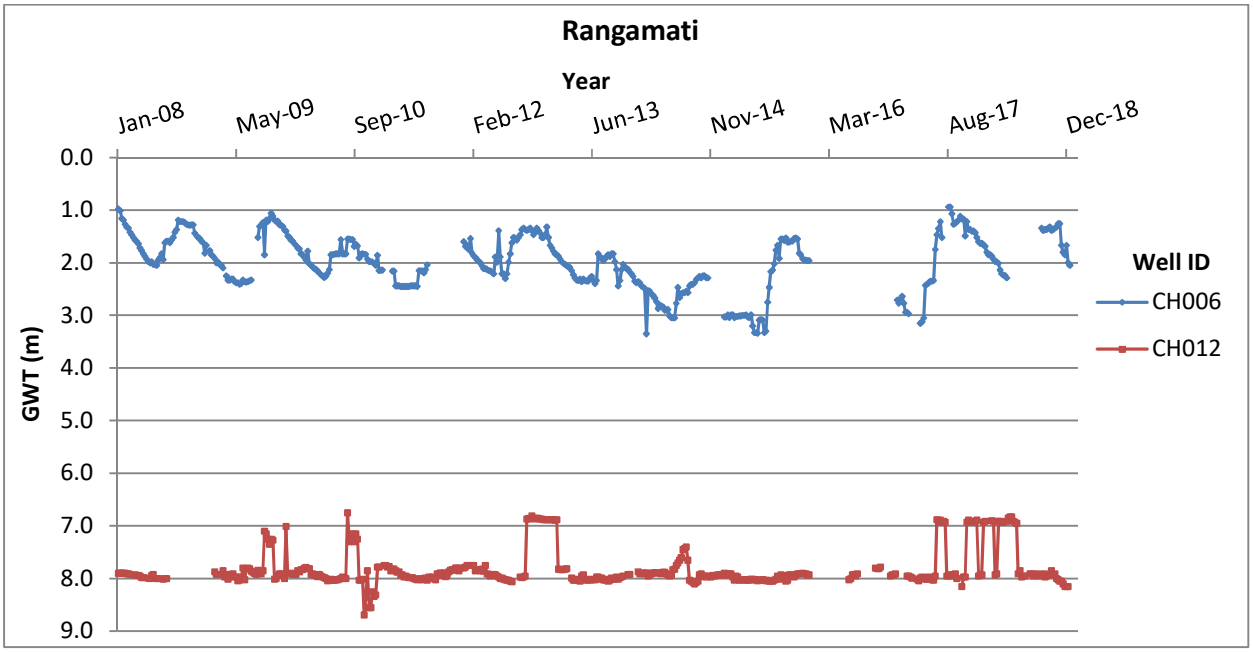

Figure 5.2.11: Hydrographs of GWT of Rangamati District

The overall trends of hydrographs are normal. Both the wells are in Kawkhali/ Betbunia upazilla but trends of hydrographs are totally different. In well CH006 seasonal fluctuation is from 0.94m to around 3.35m. In well CH012 GWT shows very little fluctuations throughout the 11 year time. Sometimes the graphs show abrupt fluctuations in a very short period. This may be due to heavy rainfall or excessive extraction in a short time.

5.2.12. Sylhet

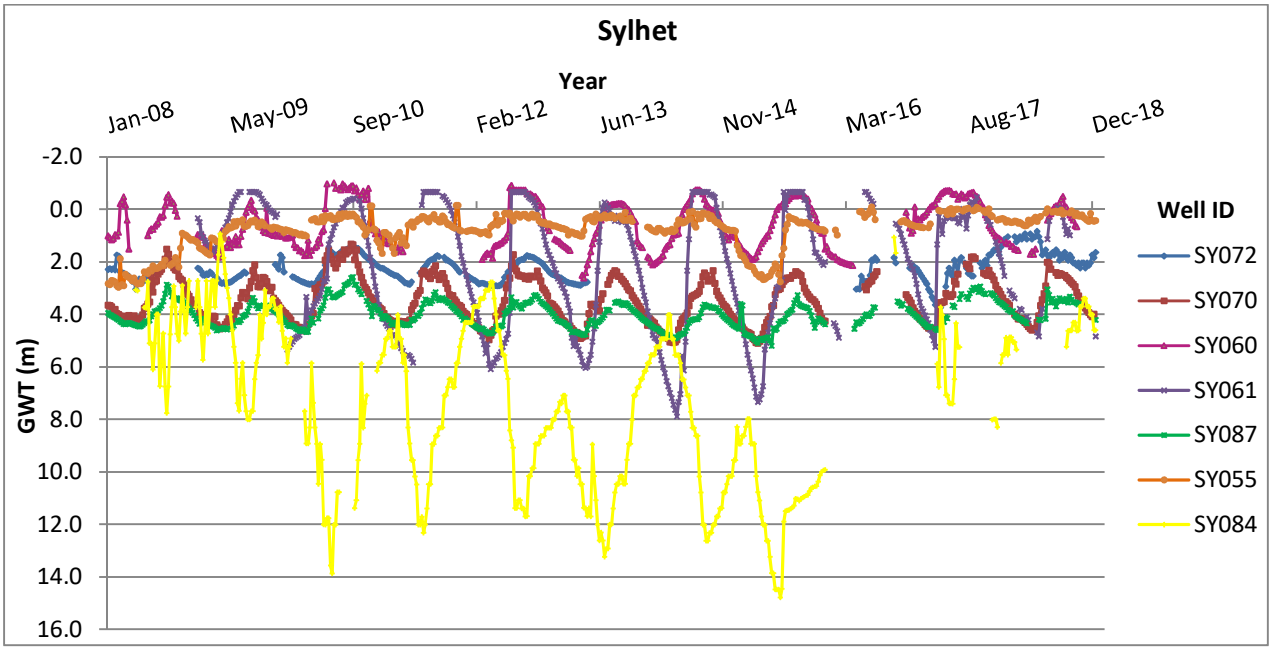

Figure 5.2.12: Hydrographs of GWT of Sylhet District

In this district 7 wells were selected for hydrograph SY072, SY070, SY060, SY061, SY087, SY055 and SY084 from 7 upazillas Balaganj, Beanibazar, Gowainghat, Jaintapur, Kanairghat, Sylhet Sadar and Bishwhanath correspondingly. Among these SY072, SY070, SY060, SY061 and SY087 show almost similar seasonal fluctuation trends. In other two wells SY055 and SY084 GWT fluctuated differently from other wells of the district.

5.2.13. Sunamganj

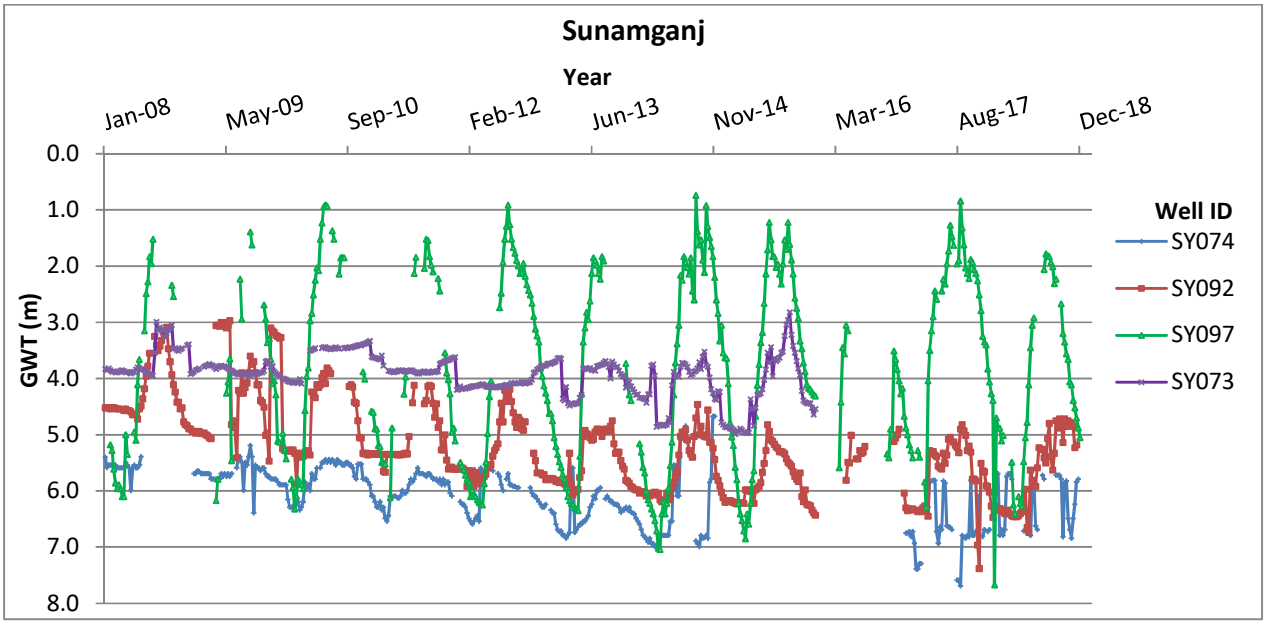

Figure 5.2.13: Hydrographs of GWT of Sunamganj District

In this district 4 wells were selected for hydrograph SY074, SY092, SY097 and SY073 from 4 upazillas Chhatak, Derai, Jamalganj and Sunamganj Sadar respectively. The overall trends of these hydrographs are normal. The hydrographs show decreasing trend in dry period (December-February) and these show lowest level in pre-monsoon period (March-May) followed by a rapid increasing trend in the monsoon period (June-August) and over again a gradual decrease in post monsoon period (September-November). In well SY092 the water table was around 3.50m depth during monsoon, 2008 whereas it was 5.26m depth during monsoon, 2018. That means GWT in well SY092 gradually decreases at a rate of around 0.18m per year. This declination may be due to excessive extraction of ground water and the recharge don't reach that static level.

5.2.14. Moulvi Bazar

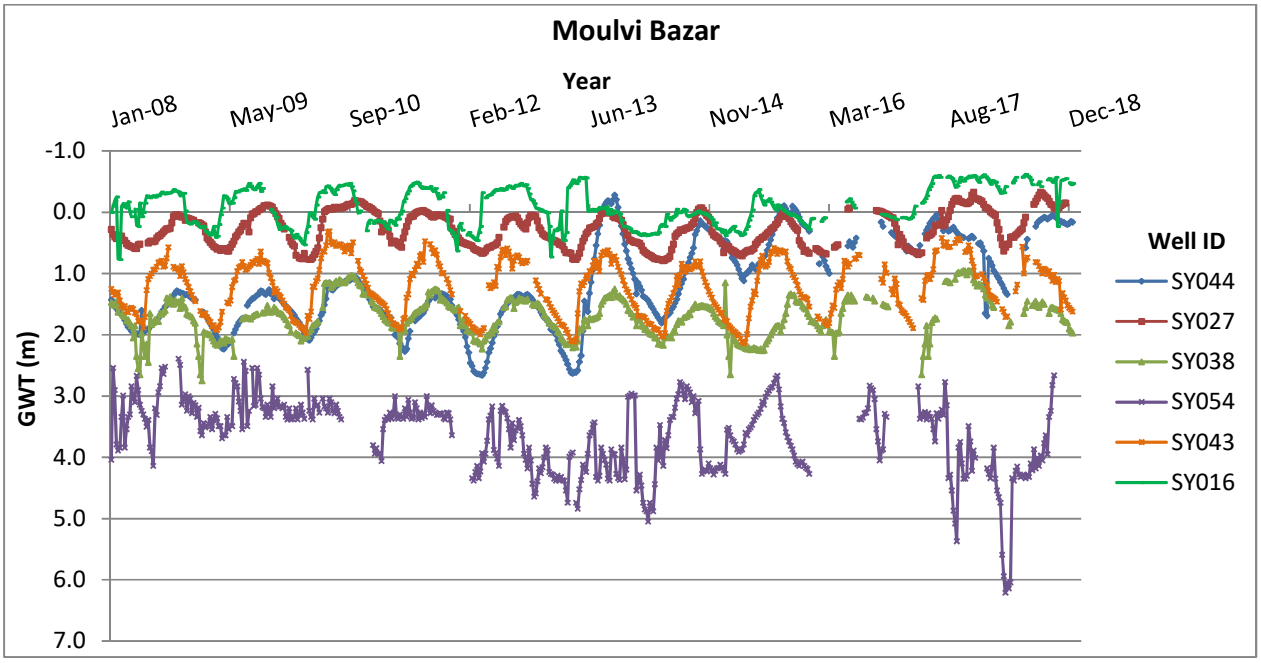

Figure 5.2.14: Hydrographs of GWT of Moulvi Bazar District

Among 6 wells the overall trends of hydrographs are almost similar in 5 wells SY044, SY027, SY038, SY043 and SY016 which situated in Barlekha, Kamalgani, Kulaura, Rajnagar and Sreemangal upazillas respectively. In these wells GWT reaches the static level from surface level of those areas during monsoon. In well SY016 the water table fluctuated from -0.56m to 0.77m and remains above the surface level most of the time of the year. From the trend of hydrograph it can say that well SY016 is an artesian type well. In well SY054 the GWT doesn't show any definite pattern or trend. This well is in the central area of Moulvi Bazar Sadar upazilla and for which reason the GWT fluctuated in an abnormal way in relation to seasonal fluctuation.

5.2.15. Habiganj

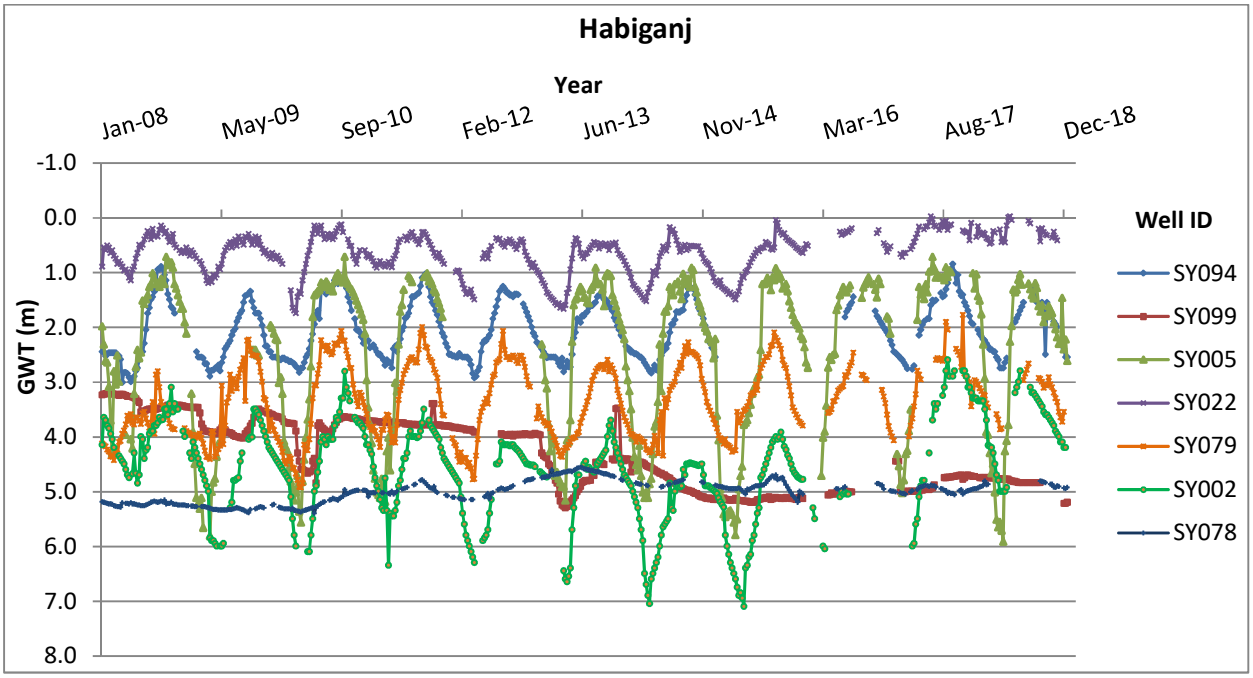

Figure 5.2.15: Hydrographs of GWT of Habiganj District

In general the trends of hydrographs are almost similar in 5 wells SY094, SY005, SY022, SY079 and SY002 which situated in Ajmirganj, Chunarughat, Habiganj Sadar, Lakhai and Madhabpur upazillas respectively. In these wells GWT reaches the static level from surface level of those areas during monsoon. In well SY099 the water table was around 3.30m depth during monsoon, 2008 whereas it was 4.83m depth during monsoon, 2018. That means GWT in Bahubal central area gradually decreases at a rate of around 0.15m per year. This declination may be due to excessive extraction of ground water and the recharge don't reach that level. Well SY078 which situated in Baniachong upazilla has very little fluctuation between 4.55m to 5.31m depth during this 11 year time.

5.3.1. Faridpur

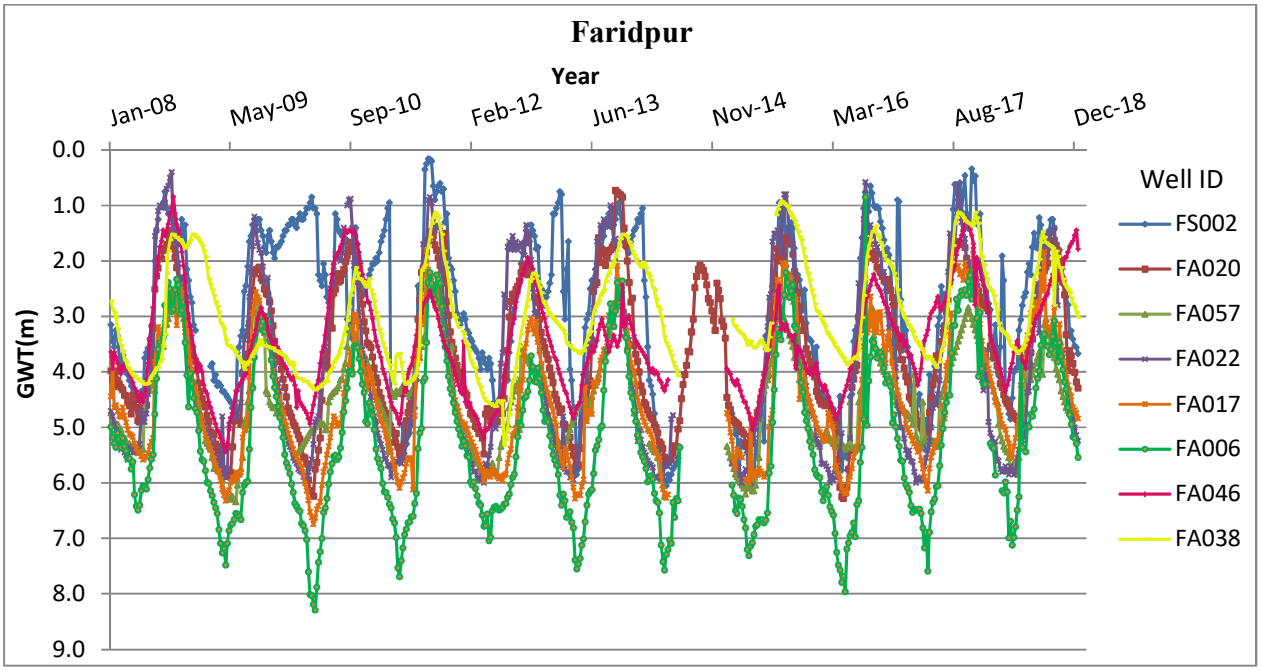

Figure 5.3.1: Hydrographs of GWT of Faridpur District

The overall trends of hydrographs are normal and show almost similar seasonal fluctuations. Here 8 wells were selected FS002, FA020, FA057, FA022, FA017, FA006, FA046 and FA038 from 8 different upazillas Alfadanga, Bhanga, Boalmari, Char Bhadrasan, Faridpur Sadar, Madhukhali, Nagarkanda and Sadarpur. Seasonal fluctuation of GWT in this district varies from around 2m to 5m during this 11 year period.

5.3.2. Gopalganj

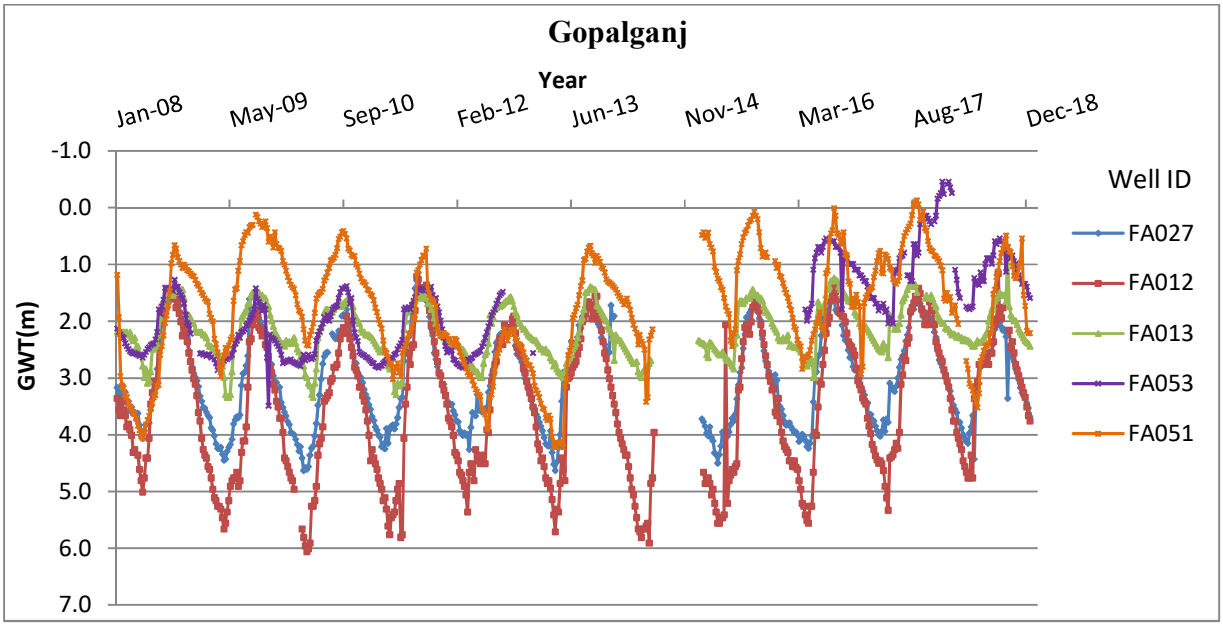

Figure 5.3.2: Hydrographs of GWT of Gopalganj District

All the hydrographs of Gopalganj district show normal trend and almost similar seasonal fluctuations. In this district 5 wells were selected FA027, FA012, FA013, FA051and FA053 from 5 different upazillas Gopalganj Sadar, Kashiani, Kotalipara, Muksudpur and Tungipara respectively. Seasonal fluctuation of GWT in this district varies from around 1.1m to 4.1m during this 11 year period.

5.3.3. Madaripur

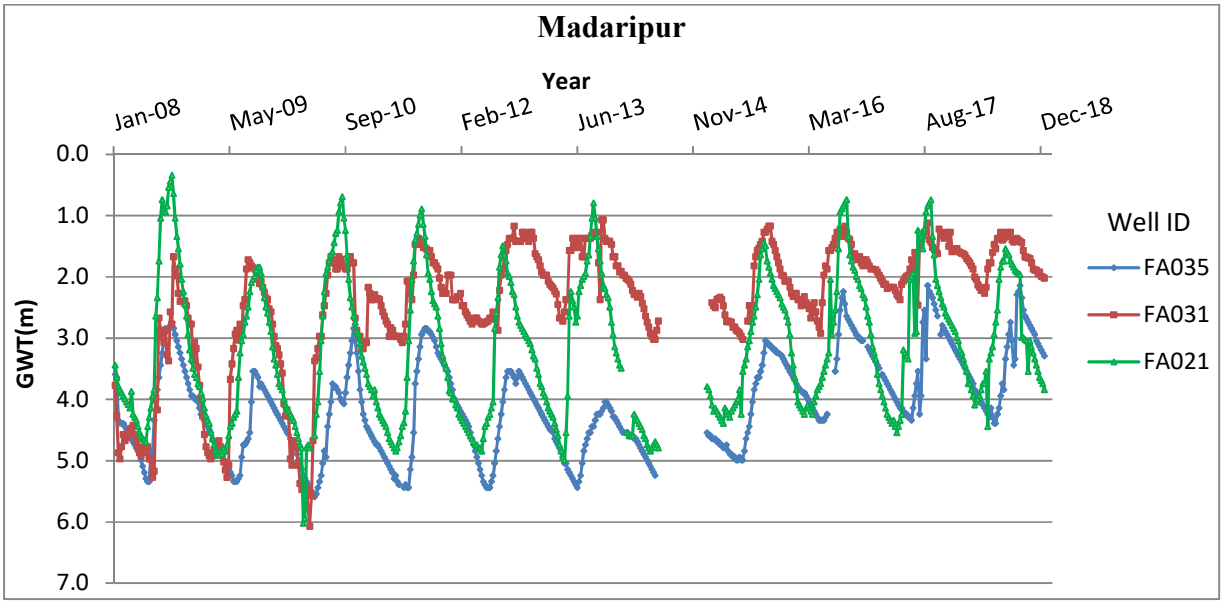

Figure 5.3.3: Hydrographs of GWT of Madaripur District

The overall trends of hydrographs are normal and show almost similar seasonal fluctuations. Here 3 wells were selected FA035, FA031and FA021 from 3 different upazillas Madaripur Sadar, Rajoir and Shibchar. Seasonal fluctuation of GWT in this district varies from around 0.90m to 4.30m during this 11 year period.

5.3.4. Rajbari

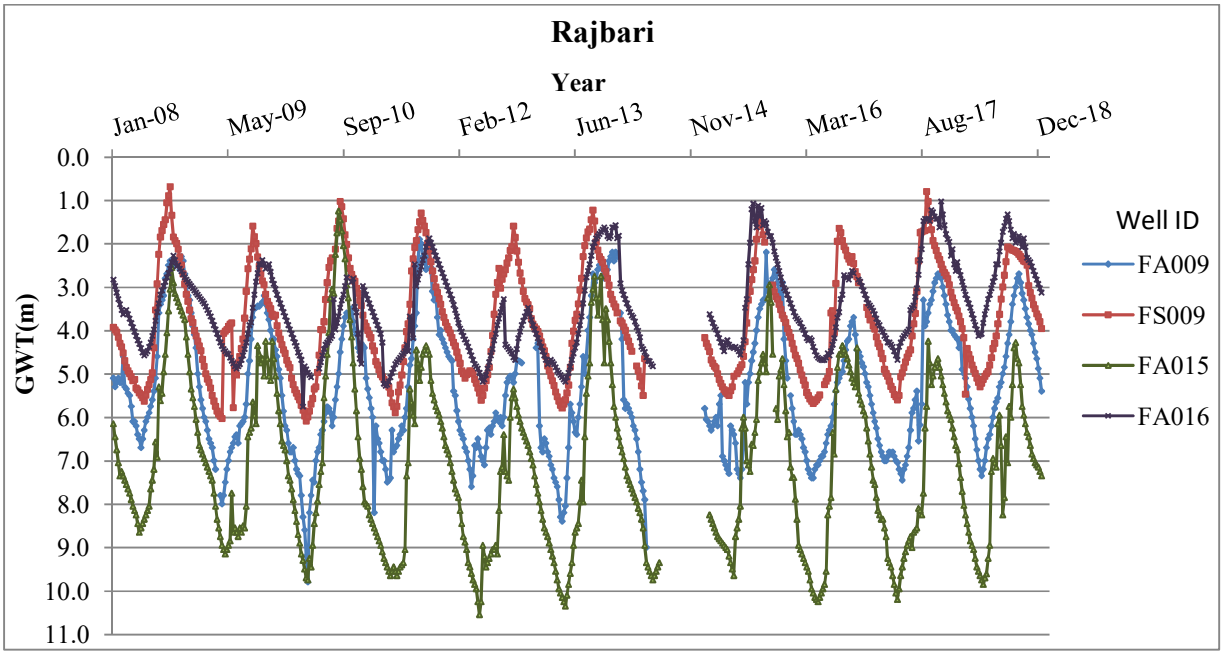

Figure 5.3.4: Hydrographs of GWT of Rajbari District

The general trends of hydrographs are normal and show almost similar seasonal fluctuations. In this district 4 wells were selected FA009, FS009, FA015 and FA016 from 4 different upazillas Baliakandi, Goalandaghat, Pangsha and Rajbari Sadar respectively. Seasonal fluctuation of GWT in this district varies from around 2m to 7.60m during this 11 year period.

5.3.5. Shariatpur

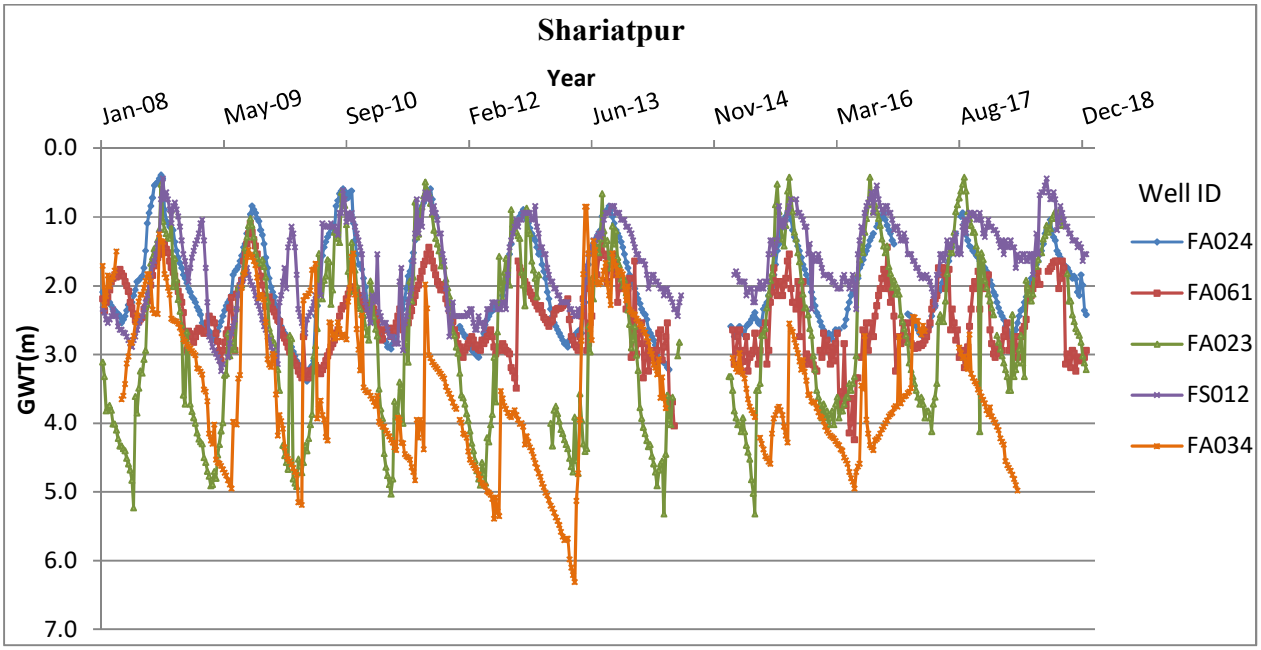

Figure 5.3.5: Hydrographs of GWT of Shariatpur District

The overall trends of hydrographs are normal and show almost similar seasonal fluctuations. The hydrographs of groundwater table show decreasing trend in dry period (December-February) and these show lowest level in pre-monsoon period (March-May) followed by a rapid increasing trend in the monsoon period (June-August) and over again a gradual decrease in post monsoon period (September-November). Here 5 wells were selected FA024, FA061, FA023, FS012 and FA034 from 5 different upazillas Bhedarganj, Gosairhat, Naria, Shariatpur Sadar and Zanjira correspondingly. Seasonal fluctuation of GWT in this district varies from around 1.20m to 5.45m during this 11 year period.

5.3.6. Barisal

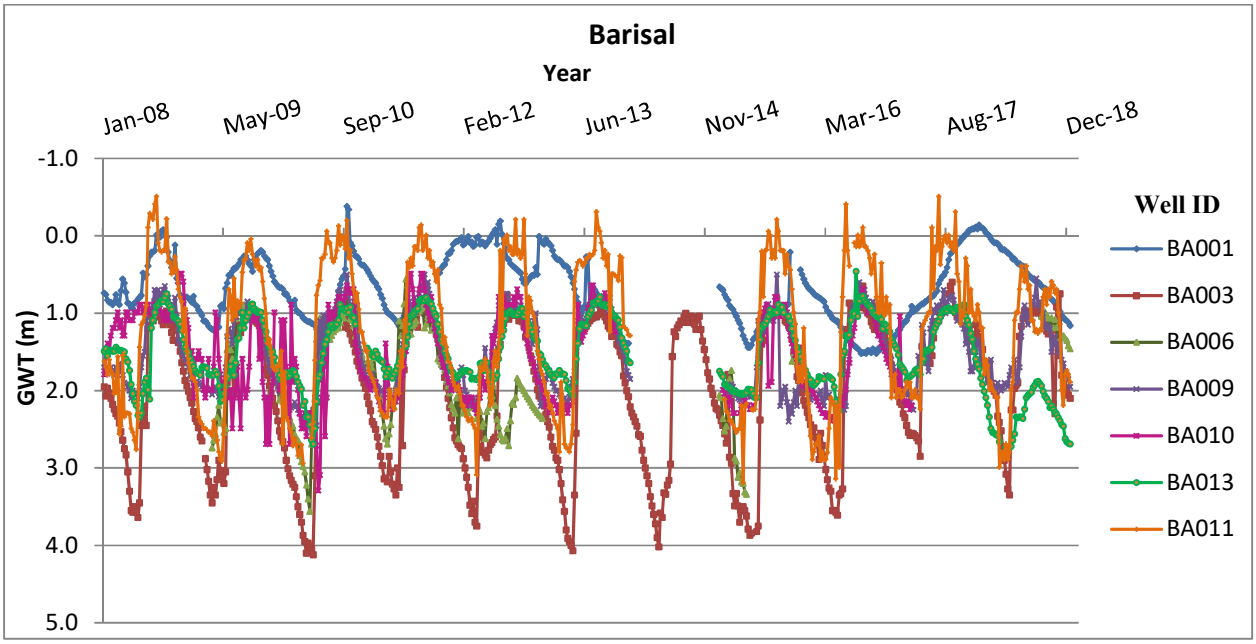

Figure 5.3.6: Hydrographs of GWT of Barisal District

All the hydrographs of Barisal district show normal trend. Here 7 wells were selected BA001, BA003, BA006, BA009, BA010, BA013 and BA011 from Barisal Sadar, Mehendiganj, Bakerganj, Banaripara, Babuganj, Gaurnadi and Hizla upazillas correspondingly. In this district GWT fluctuated from -0.51m to 4.12m. In well BA011 from Hizla GWT overflows the surface level during monsoon which is a characteristic of artesian well.

5.3.7. Bhola

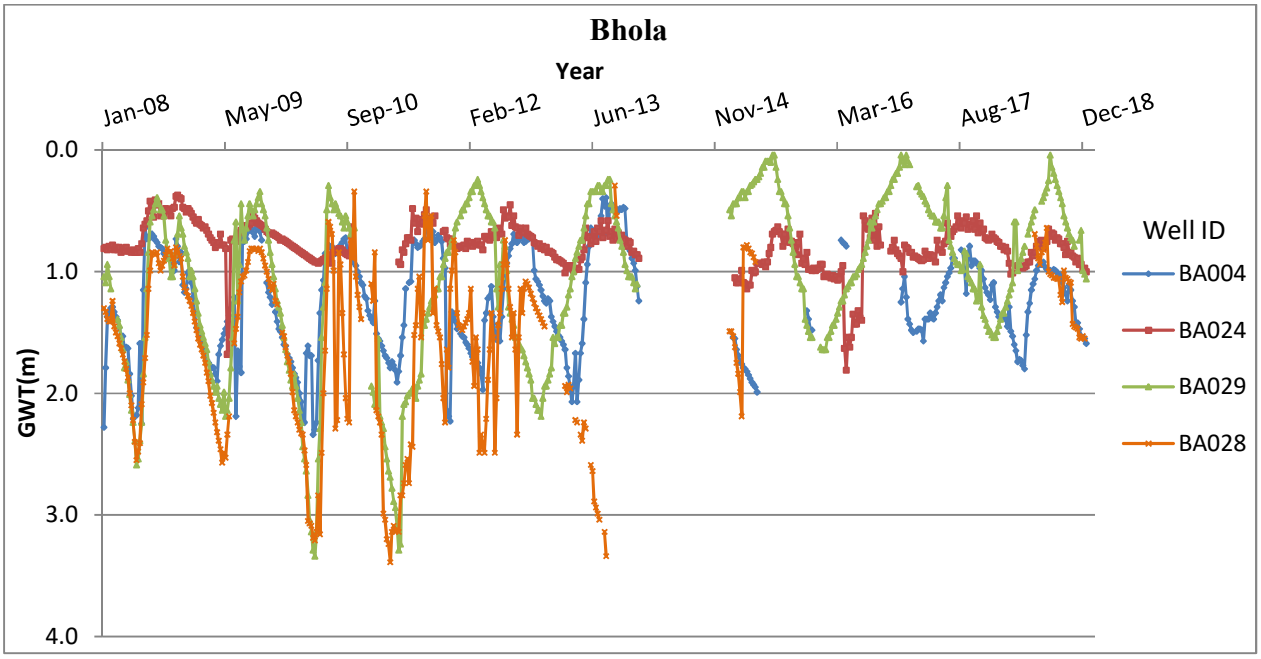

Figure 5.3.7: Hydrographs of GWT of Bhola District

In this district GWT shows normal trend in all 3 wells BA004, BA029 and BA024 from Bhola Sadar, Daulatkhan and Lalmohan except in well BA028 from Char Fasson upazilla. Due to lacking of data and with many rapid ups and downs the GWT in this well during year 2010 to 2018 didn't follow any definite trend or shape.

5.3.8. Jhalokathi

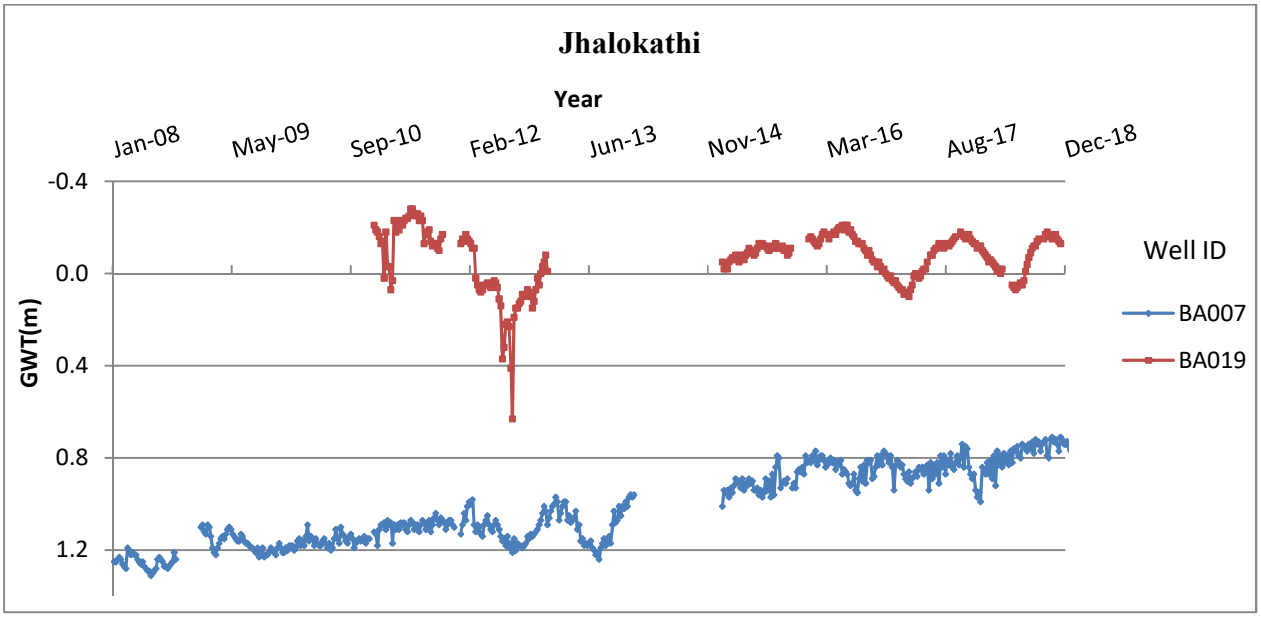

Figure 5.3.8: Hydrographs of GWT of Jhalokathi District

In this district 2 wells had selected BA007 and BA019 which installed in 2 upazillas Jhalokathi Sadar and Rajapur. From above hydrographs it is evident that overall trend of GWT is normal but quite different in 2 upazillas. In well BA007 GWT gradually increases at a very minute rate 0.05m per year, whereas in well BA019 GWT remains at a static level. Sometimes, the graph shows abrupt fluctuations in a very short period. This may be due to heavy rainfall or excessive extraction in a short time.

5.3.9. Pirojpur

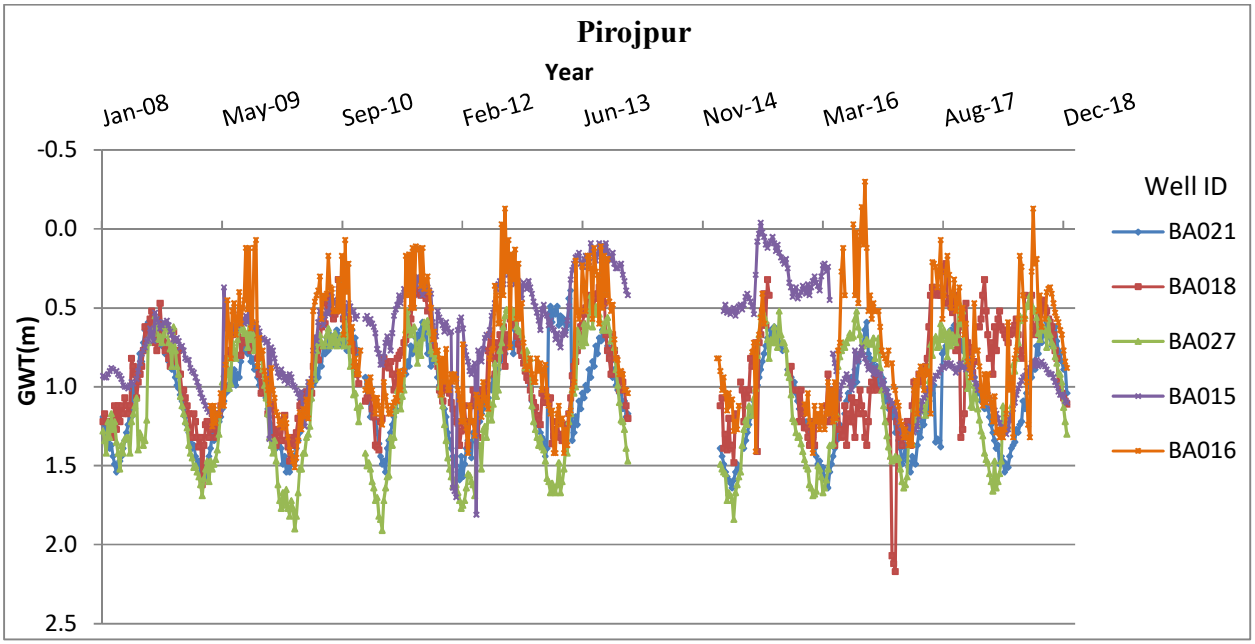

Figure 5.3.9: Hydrographs of GWT of Pirojpur District

In general the trends of hydrographs are normal and show almost similar seasonal fluctuations. The hydrographs of groundwater table show decreasing trend in dry period (December-February) and these show lowest level in pre-monsoon period (March-May) followed by a rapid increasing trend in the monsoon period (June-August) and over again a gradual decrease in post monsoon period (September-November). Here 5 wells were selected BA021, BA018, BA027, BA015 and BA016 from 5 different upazillas Bhandaria, Kawkhali, Mathbaria, Pirojpur Sadar and Nesarabad (Swarupkathi) respectively. Seasonal fluctuation of GWT in this district varies from around 0.50m to 2m during this 11 year period.

5.3.10. Barguna

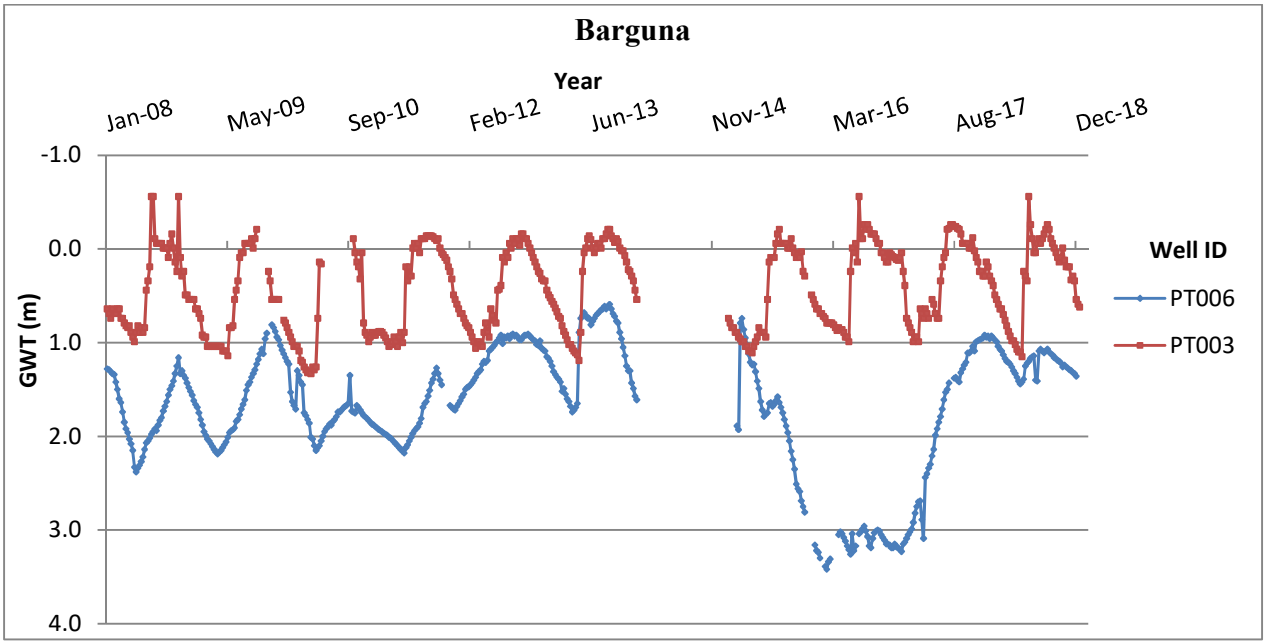

Figure 5.3.10: Hydrographs of GWT of Barguna District

The overall trends of hydrographs are normal. Among 2 wells PT003 is located in Barguna Sadar and PT006 in Amtali. The trends of hydrographs are normal and quite similar. In well PT003 seasonal fluctuation is from -0.56m to around 1.26m. From the trend of hydrograph it can say that well PT003 is an artesian type well. In well PT006 GWT decreased rapidly after pre-monsoon period of 2014 and during monsoon of 2017 it gradually increased and reached the previous level. This declination may be due to excessive extraction of ground water and the recharge don't reach the static level.

5.3.11. Patuakhali

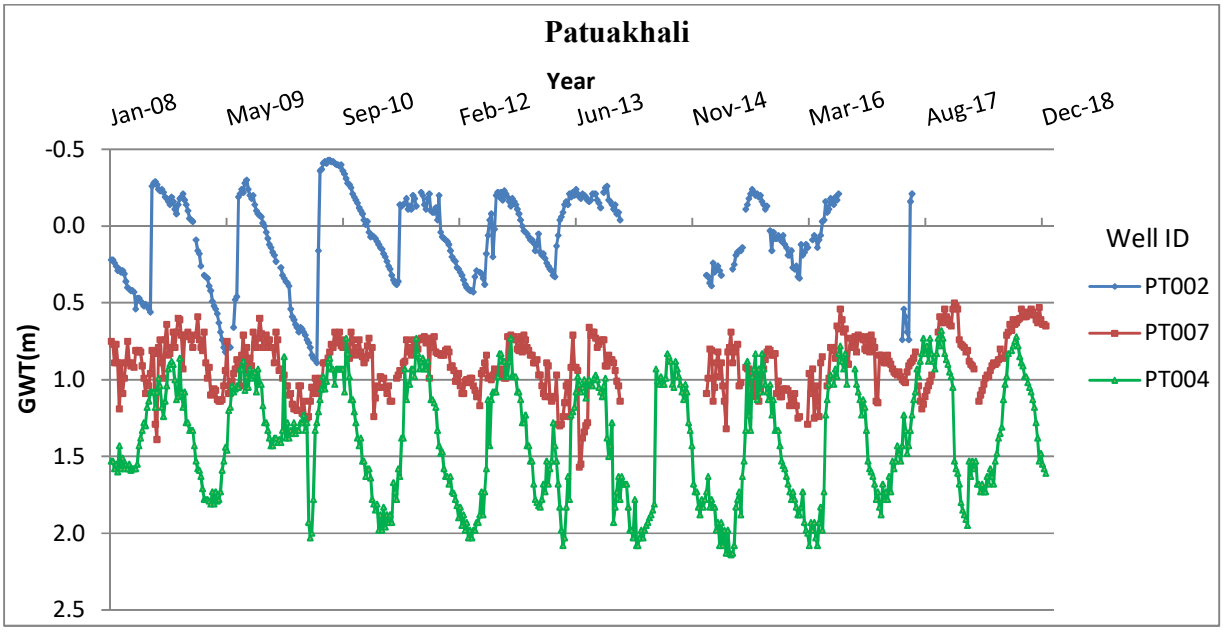

Figure 5.3.11: Hydrographs of GWT of Patuakhali District

Among 3 wells the overall trends of hydrographs are almost similar in 2 wells PT002 and PT004 which situated in Galachipa and Patuakhali Sadar respectively. In these wells GWT reaches the static level from surface level of those areas during monsoon. In well PT007 which located in Mirzaganj the hydrograph shows many spikes or abrupt fluctuations in a very short period. This may be due to heavy rainfall or excessive extraction in a short time. In well PT002 the water table fluctuated from -0.41m to 0.89m and remains above the surface level most of the time of the year. From the trend it can say that well PT002 is an artesian type well.

5.4. Monthly Changes of GWT of Selected Wells

In Section 5.1, 5.2 and 5.3 changes of GWT were analyzed for the period of 11 years in a single graph of each well. As it is a long period monthly changes of GWT are not clearly understood. For this monthly trends of GWT of some randomly selected wells are drawn. 12 hydrographs are drawn with one year GWT data of each well are presented below.

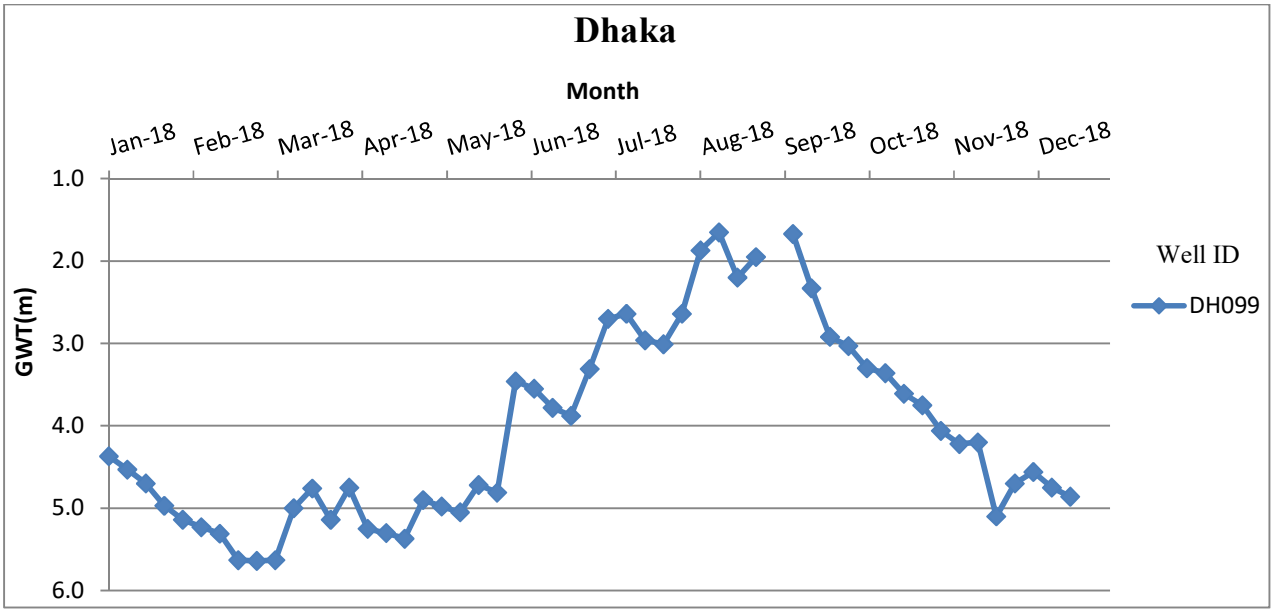

Figure 5.4.1: Monthly Hydrograph of GWT of Dhaka District

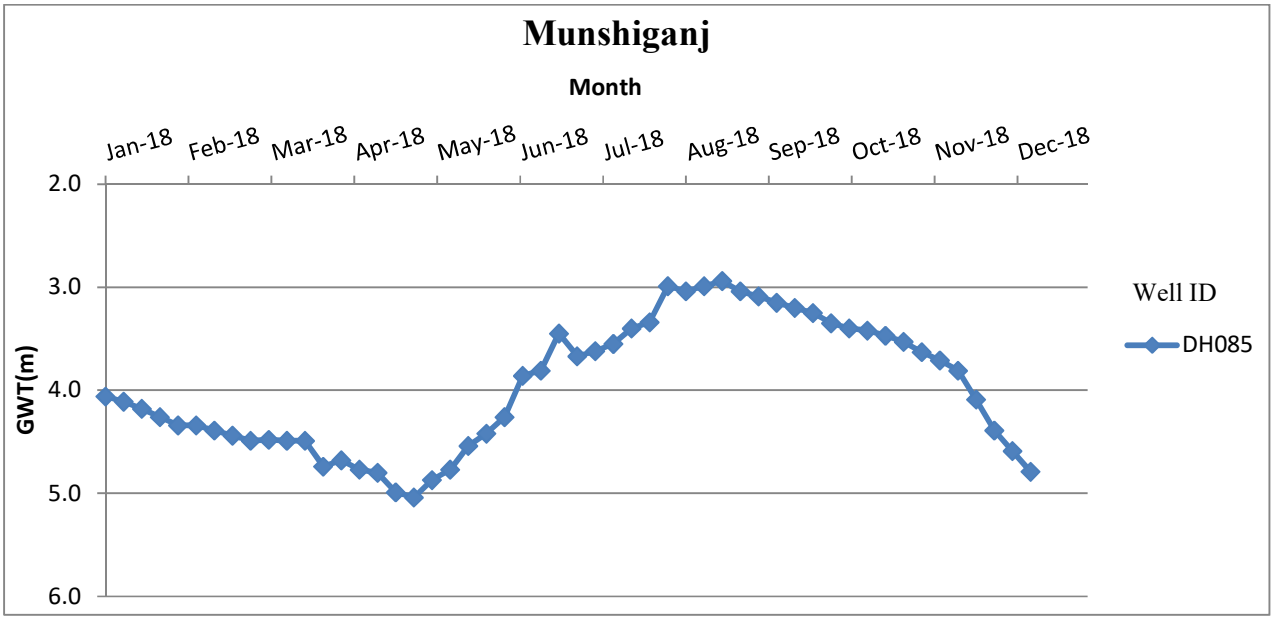

Figure 5.4.2: Monthly Hydrographs of GWT of Munshiganj District

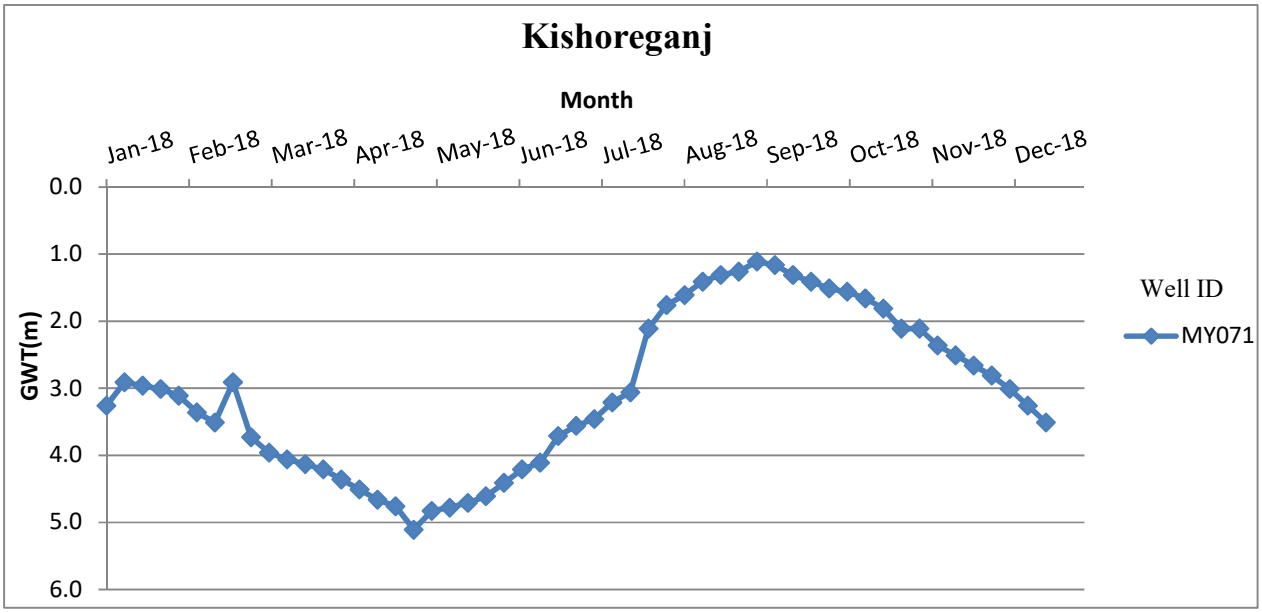

Figure 5.4.3: Monthly Hydrographs of GWT of Kishoreganj District

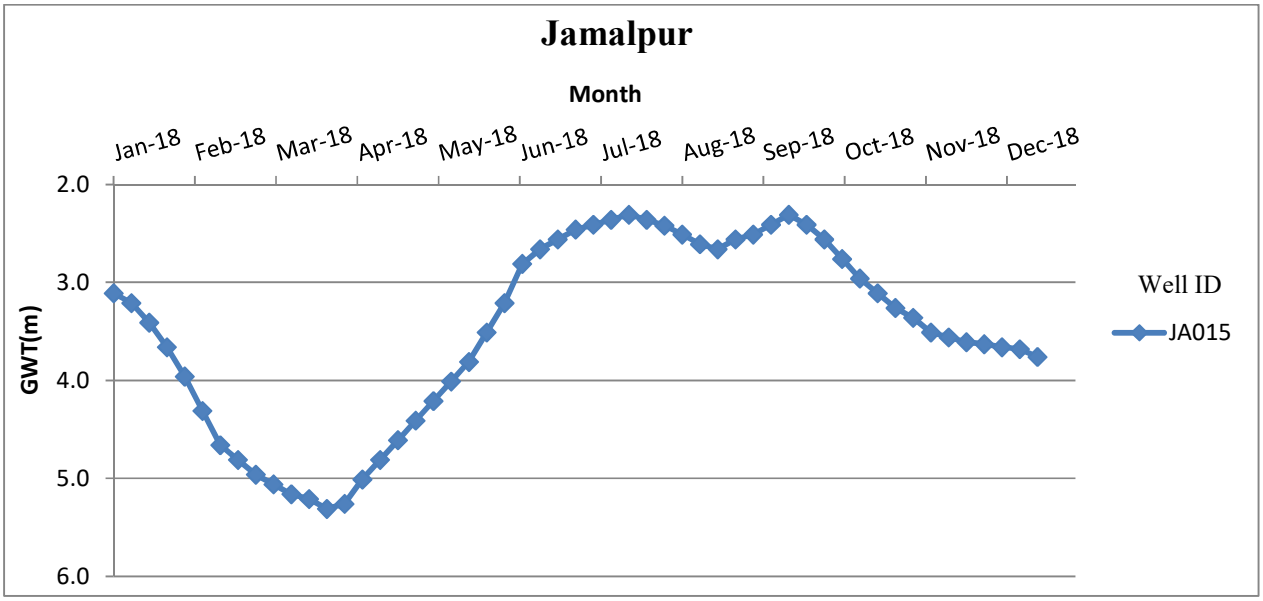

Figure 5.4.4: Monthly Hydrographs of GWT of Jamalpur District

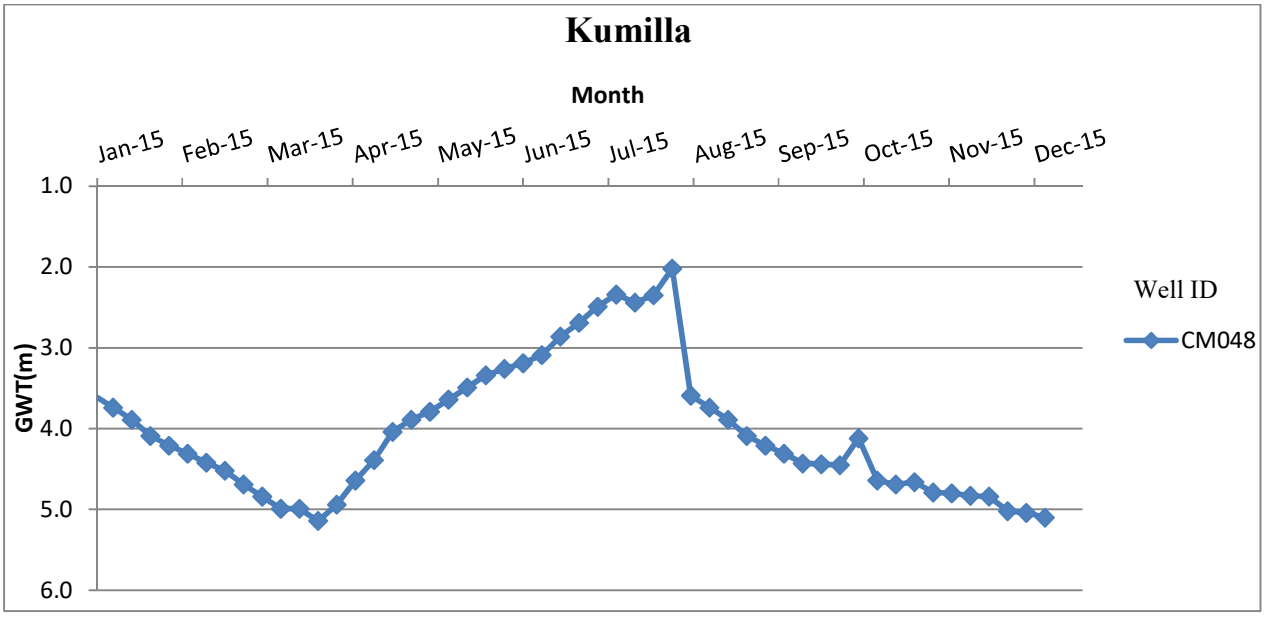

Figure 5.4.5: Monthly Hydrographs of GWT of Kumilla District

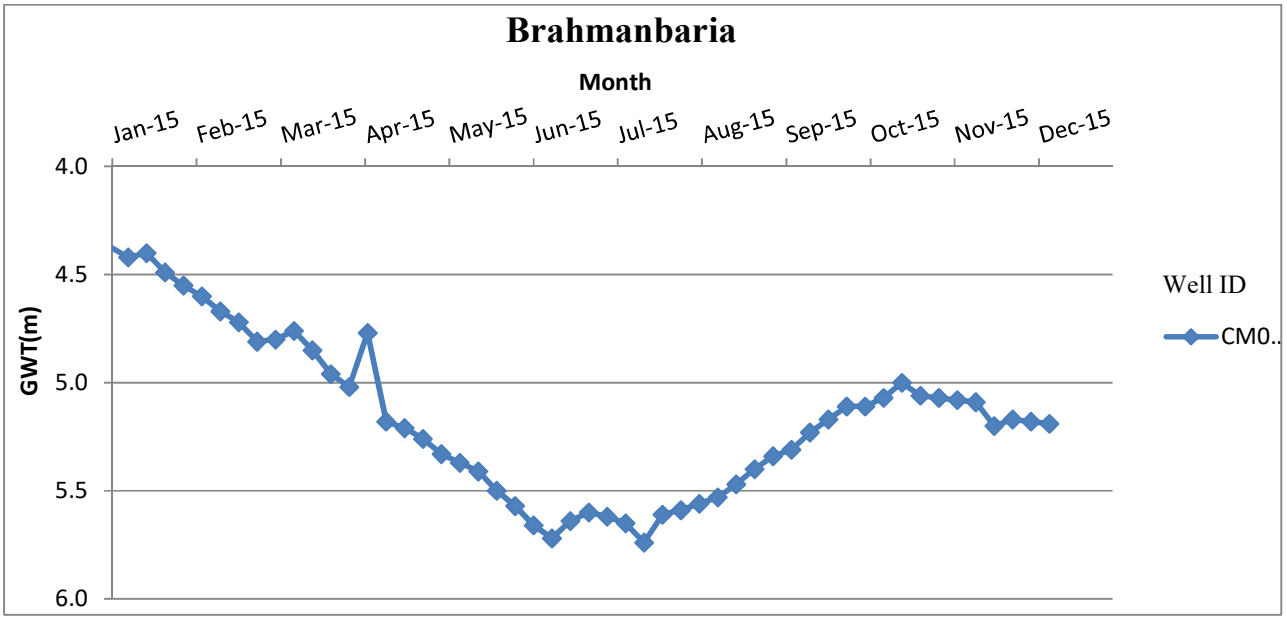

Figure 5.4.6: Monthly Hydrographs of GWT of Brahmanbaria District

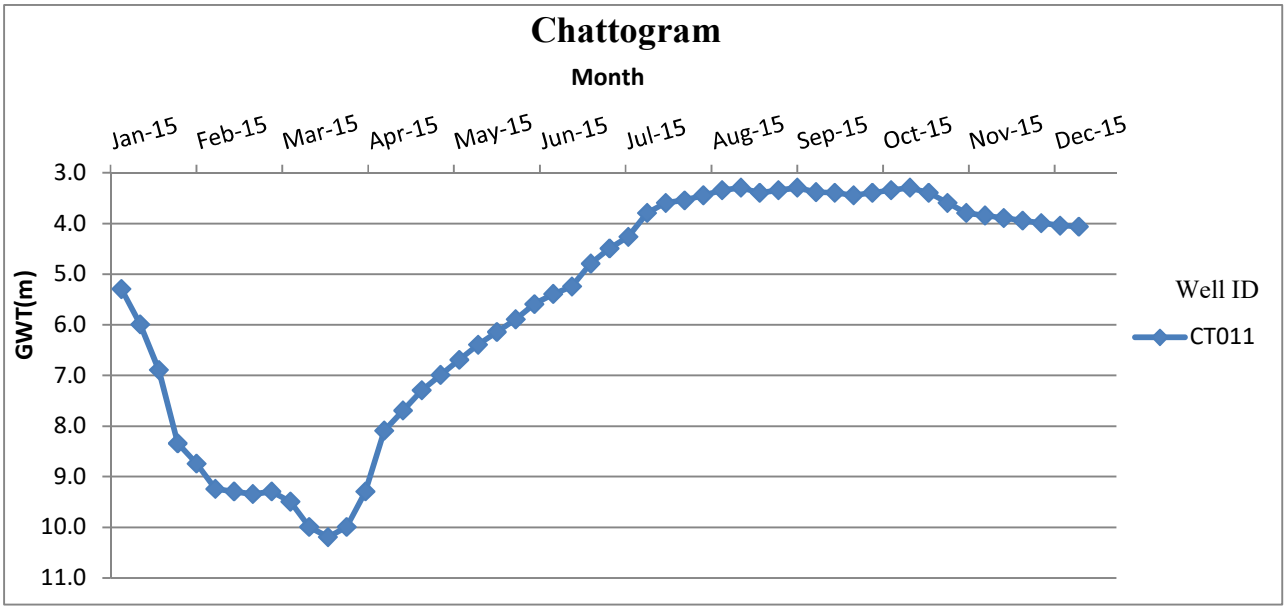

Figure 5.4.7: Monthly Hydrographs of GWT of Chattogram District

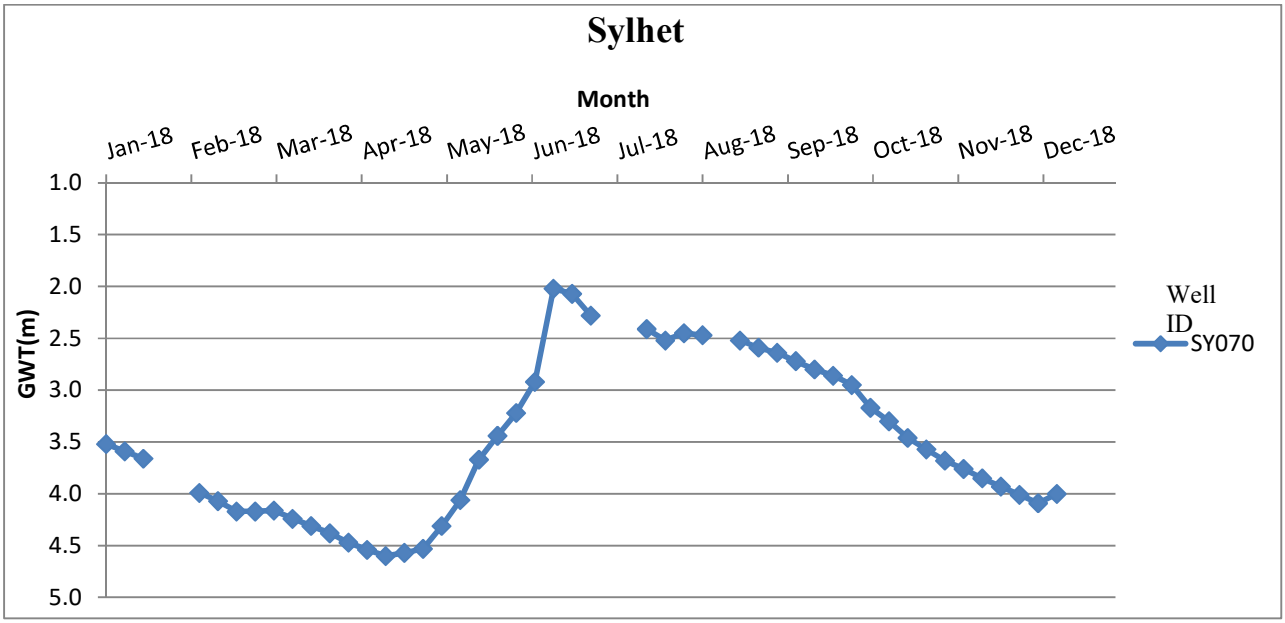

Figure 5.4.8: Monthly Hydrographs of GWT of Sylhet District

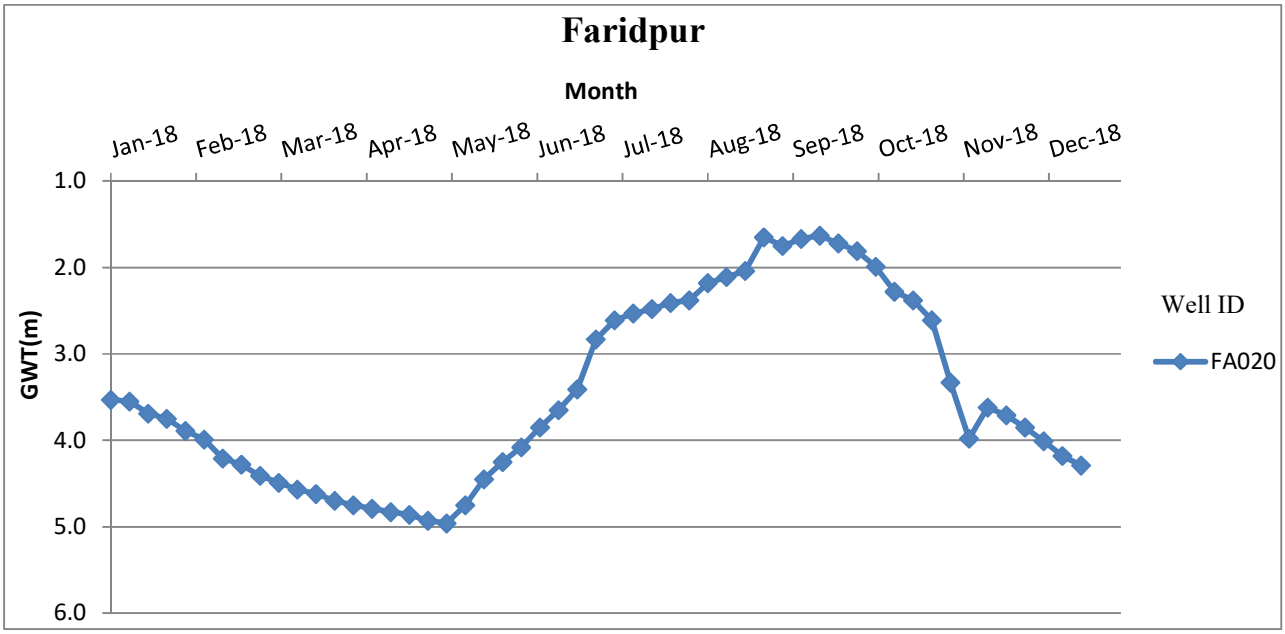

Figure 5.4.9: Monthly Hydrographs of GWT of Patuakhali District

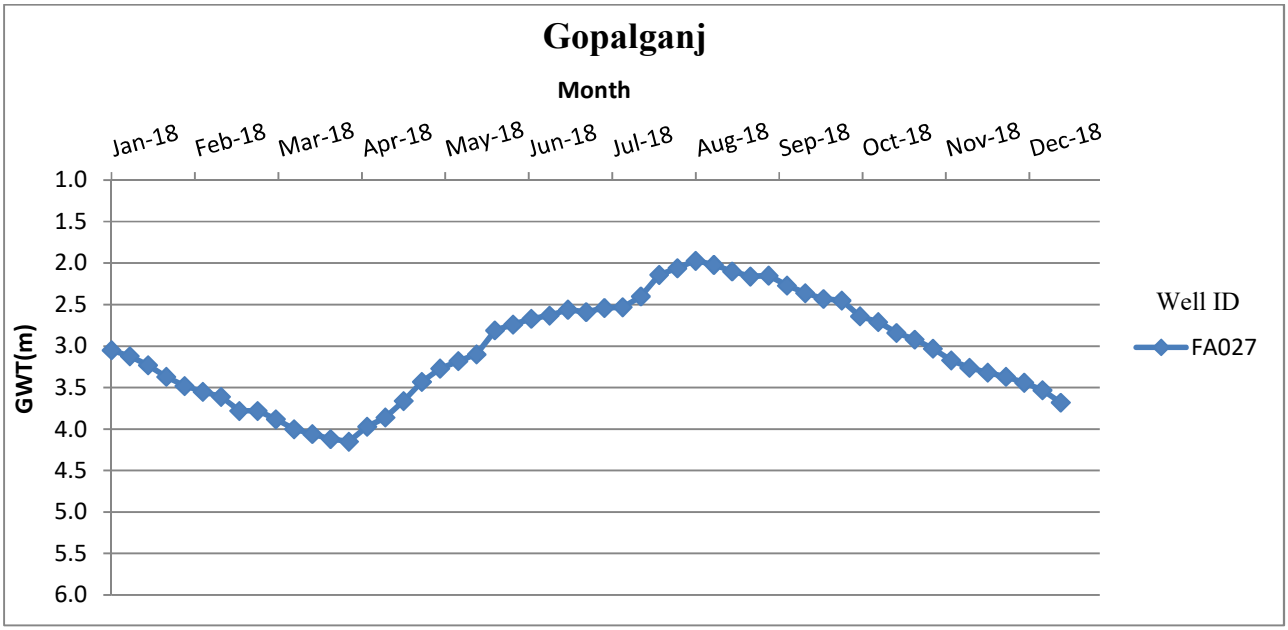

Figure 5.4.10: Monthly Hydrographs of GWT of Patuakhali District

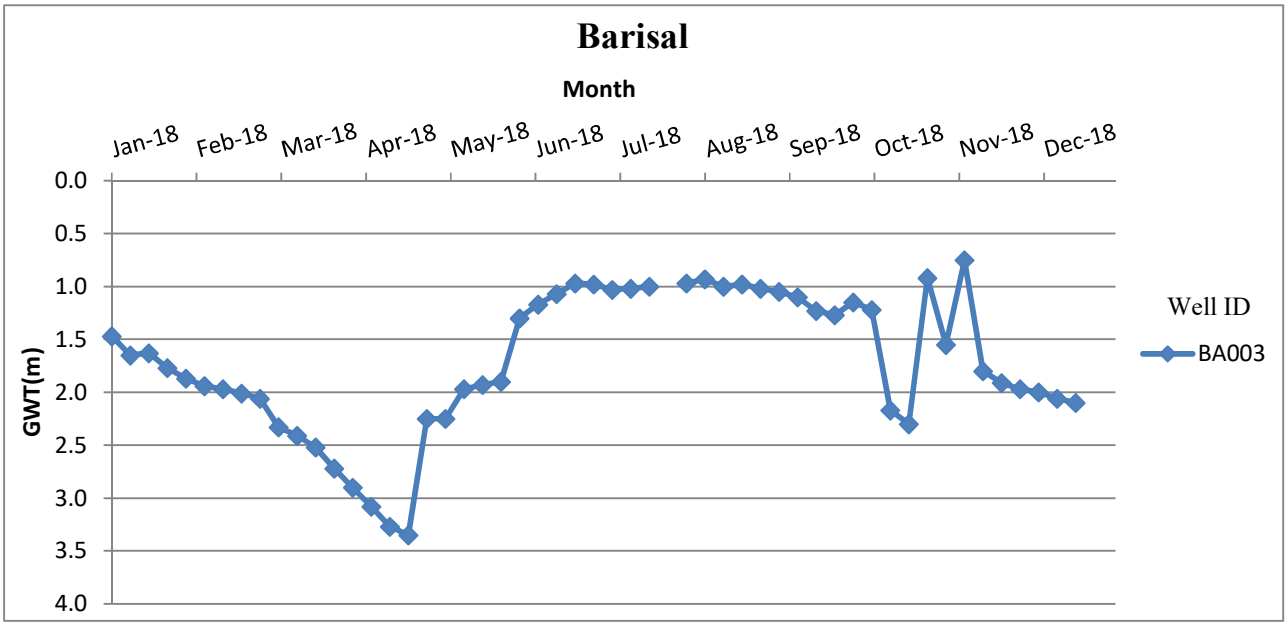

Figure 5.4.11: Monthly Hydrographs of GWT of Barisal District

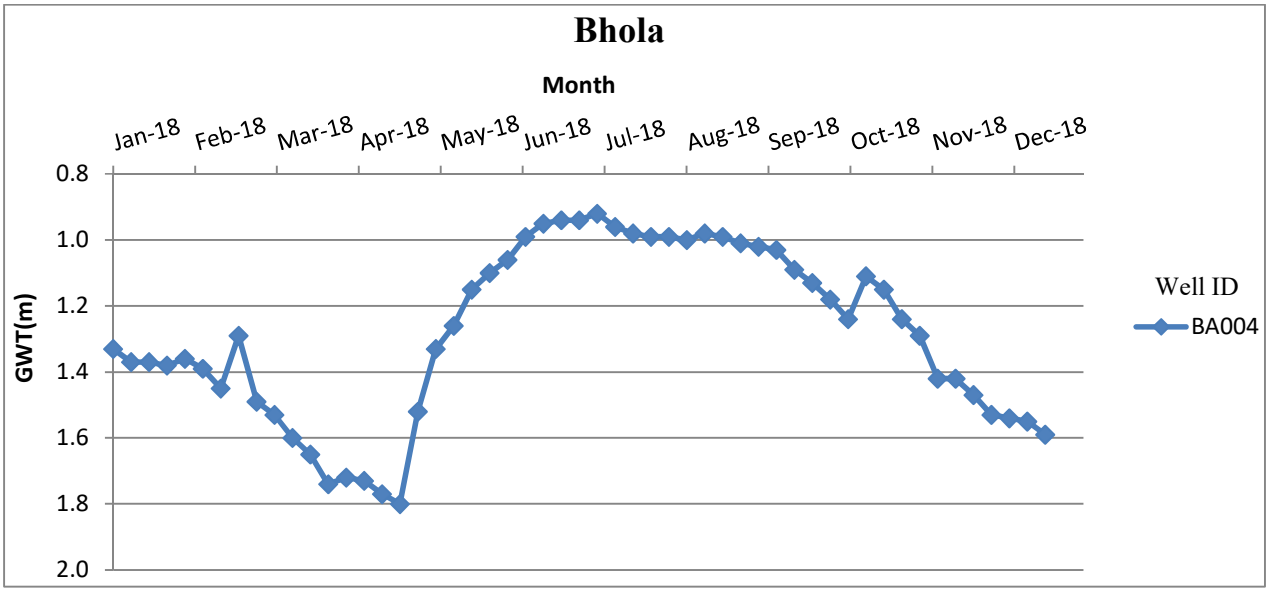

Figure 5.4.12: Monthly Hydrographs of GWT of Bhola District

6. Trend Analysis of Hydrographs

The hydrographs in figure 5.1.1 to 5.3.11, which are got from well data of last 11 years (2008 to 2018) of different upazillas of 38 districts under Ground Water Hydrology Division-I. Ground water table shows different trends in different wells. From all the hydrographs few types of trends can be identified such as some hydrographs showed normal trend, some showed declining trend, some showed flat line that is no seasonal fluctuations, some wells showed artesian well characteristics and a very few showed rising trend (well BA007, Jhalokathi) at a very minute rate. Trends of hydrographs change with the changing of form of ground water use in that area, demands and availability of ground water and the rate of recharge of aquifer and all these reasons are manmade. All the wells show declining trend hydrograph are located in the urban or industrial or central areas of upazilla, or in the areas where no other source of water available. In these areas demand of ground water is very high for many purposes like household uses, drinking, irrigation, industrial uses etc. Few areas like Dhaka, GWT is continuously declining at an alarming rate. We all know about the population density of this city which has a huge demand of water and ground water fulfilling the 90% of this demand. The only reason of this declining trend is the over exploitation for decades and very negligible recharge mainly in city area. As a

result ground water level is permanently declining and the recharge rate is nearly zero. Moreover, this circumstance also affecting its surrounding areas like Manikganj, Gazipur, Narayanganj, Munshiganj etc and creating a ground water flow towards the declining zone. Artesian type wells were found mainly in the coastal belts like Barisal, Patuakhali, Jhalokathi, Barguna, Cox's Bazar districts and in hilly regions like Sylhet, Moulvi Bazar, Bandarban districts and Chattogram which has both hilly regions and coastal areas.

Key indicators include the following:

•Sometimes the graphs show abrupt fluctuations in a very short period. This may due to heavy rainfall or excessive extraction in a short time.

• Rapid rise in groundwater table during the early monsoon period is a sign of rapid recharge.

• When GWT shows a relatively constant level for a session during the monsoon indicates 'aquifer full' conditions, with groundwater table largely controlled by flood water levels.

• GWT declination in monsoon doesn't only mean that the aquifer in that area is excessively abstracted. It may also indicate that water flowing to surrounding areas where groundwater development is nearing its maximum potential.

• A sudden change in the rate of declination during dry period is an indication of the start of the irrigation season.

• Sudden and significant recovery of declination during and at the end of the irrigation season, and the sudden rise in groundwater table occurs during rainy season when abstraction is stopped or reduced, and also at the end of the irrigation season when abstraction ends.

• Groundwater declines more during the dry season and the rise is often delayed. When abstraction is immense, groundwater table may fall towards a permanent new equilibrium state. If the abstraction continuing to increase or expand laterally, groundwater table continues to drop permanently (such as is the case in Dhaka city).

The rise in groundwater levels is controlled by a number of influences. These include the rate of recharge, the rise in flood levels and the specific yield values. It is obviously difficult to separate these influences, when available information is limited.

7. Conclusion

Here we analyze 211 wells of 38 districts of eastern part of Bangladesh. GWT changes its character with different physiographic units and shows different trend which influenced by the aquifer type and depth, the upper confining layer, the quality and quantity of aquifer recharge and besides these natural causes many manmade reasons such as the type and extent of ground water uses and its management. Most of the areas of Ground Water Hydrology Division-I trend of GWT showed fine potentiality except few areas like Dhaka and some restricted areas of different districts where GWT showed declining trend and some abnormal characteristics. This continuous declination of water table in these areas with little or even no fluctuation is distinctive for overexploited aquifers. Other abnormality may be due to error in data or some other reasons. These trend analyses can be more accurate and reliable if the data were more consistence and regular. For a sustainable ground water development some steps should be taken. For this at first detail knowledge of the aquifers is essential for a better management and utilization of groundwater. Dependency on groundwater abstracted from different layers of aquifers need to be reduced by providing alternate sources of water supply. The abstraction rate of the safe aquifers needs to be determined to assess the potential for sustainable future water supplies from this resource. Saving of open land surface, natural water bodies like river, lake, ponds and dredging of peripheral rivers is needed to remove obstruction from river beds to allow more fresh water percolation to aquifers. Large scale extraction of ground water in the coastal areas has not been encouraged due to possibility of sea-water intrusion or leakage from the upper aquifer. Groundwater aquifer can be secured by reducing the rate of water consumption and waste and for this appropriate action plan is required.

References

1. Alam. M.K., Hasan, A.K.M.S., Khan, M.R., and Whitney, J.W., 1991. Geological map of Bangladesh. Geological Survey of Bangladesh, Dhaka.

2. Alam, M.; Alam, M.M.; Curray, J.R.; Chowdhury, M.L.R.; Gani, M.R. An overview of the sedimentary geology of the Bengal Basin in relation to the regional tectonic framework and basin-fill history. Sediment. Geol. 2003, 155, 179–208

3. BBS (Bangladesh Bureau of Statistics). Statistics and Informatics Division (SID). Ministry of Planning; Government of the People's Republic of Bangladesh: Dhaka, Bengal, 2017.

4. Jakeman, A.; Barreteau, O.; Hunt, R.J.; Rinaudo, J.D.; Ross, A. Integrated Groundwater Management; Springer: Berlin, Germany, 2016.

5. Md. Munir Hussain and S.K.M. Abdullah, Ground Water Task Force, October, 2001, Geological Setting Of The Areas of Arsenic Safe Aquifers, Ministry of Local Government, Rural Development & Cooperatives, Local Government Division, Ground Water Task Force

6. Michael, H.A.; Voss, C.I. Estimation of regional-scale groundwater flow properties in the Bengal Basin of India and Bangladesh. Hydrogeol. J. 2009, 17, 1329–1346

7. https://en.wikipedia.org/wiki/Bangladesh

8. https://en.wikipedia.org/wiki/Geology_of_Bangladesh

Appendix

An **aquifer** is an underground layer of water-bearing permeable rock, rock fractures or unconsolidated materials (gravel, sand, or silt). Groundwater can be extracted using water well.

Water table, also called **groundwater table**, upper level of an underground surface in which the soil or rocks are permanently saturated with water.

A **river delta** is a landform created by deposition of sediment that is carried by a river as the flow leaves its mouth and enters slower-moving or stagnant water. This occurs where a river enters an ocean, sea, estuary, lake, reservoir, or (more rarely) another river that cannot carry away the supplied sediment.

DupiTila Formation a Pliocene-Pleistocene mappable body of rock in the Bengal Basin, named after the DupiTila hills in the Hari (Shari) river (25°06'N; 92°08'E) valley of Sylhet district.

The **Pleistocene** Epoch is typically defined as the time period that began about 2.6 million years ago and lasted until about 11,700 years ago. It was followed by the current stage, called the **Holocene** Epoch.

The **Miocene** is the first geological epoch of the Neogene Period and extends from about 23.03 to 5.333 million years ago.

Specific yield is defined as the ratio of the volume of water that a saturated rock or soil will yield by gravity to the total volume of the rock or soil. **Specific yield** is usually expressed as a percentage.

Table 1: Groundwater observation wells

Well No.	Well	Long	Lat	Upazilla	District	Sub-Division
1	CM007	91.06	23.40	Barura	Kumilla	Kumilla
2	CM002	91.15	23.58	Burichang		
3	CM008	90.91	23.48	Chandina		
4	CM011	91.20	23.50	Kumilla Sadar		
5	CM052	90.77	23.58	Daudkandi		
6	CM026	91.02	23.60	Debidwar		
7	CM048	90.73	23.63	Homna		
8	CM038	91.10	23.24	Laksam		
9	CM034	90.94	23.66	Muradnagar		
10	CM037	90.81	23.79	Banchharampur	Brahmanbaria	
11	CM012	91.24	23.96	Brahmanbaria Sadar		
12	CM001	92.17	22.23	Kasba		
13	CM024	91.07	23.85	Nabinagar		
14	CM035	91.19	24.20	Nasirnagar		
15	CM016	90.66	23.28	Chandpur Sadar	Chandpur	
16	CM028	90.78	23.20	Faridganj		
17	CM015	90.85	23.30	Hajiganj		
18	CM014	90.90	23.33	Kachua		
19	CM017	90.71	23.37	Matlab		
20	CT037	91.99	22.37	Boalkhali	Chattogram	
21	CT006	91.78	22.35	Chittagong Sadar		
22	CT038	91.80	22.24	Double Mooring		
23	CT032	91.69	22.70	Fatikchhari		
24	CT026	91.79	22.44	Hathazari		
25	CT015	91.56	22.75	Mirsharai		
26	CT023	92.03	22.27	Patiya		
27	CT049	92.09	22.44	Rangunia		
28	CT013	91.92	22.54	Raozan		
29	CT011	92.00	22.09	Satkania		
30	NA023	91.52	22.98	Chhagalnaiya	Feni	
31	NA003	91.39	22.98	Feni Sadar		
32	NA029	91.48	23.13	Parshuram		
33	SY094	91.30	24.54	Ajmirganj	Habiganj	
34	SY099	91.57	24.39	Bahubal		
35	SY078	91.40	24.47	Baniachong		

Well No.	Well	Long	Lat	Upazilla	District	Sub-Division
36	SY005	91.62	24.17	Chunarughat		
37	SY022	91.45	24.34	Habiganj Sadar		
38	SY079	91.26	24.29	Lakhai		
39	SY002	91.36	24.18	Madhabpur		
40	NA009	90.87	22.96	Lakshmipur Sadar	Lakshmipur	
41	NA030	90.71	22.95	Raipur		
42	NA018	90.86	23.05	Ramganj		
43	SY044	92.23	24.65	Barlekha	Moulvi Bazar	
44	SY027	91.91	24.40	Kamalgani		
45	SY038	92.10	24.60	Kulaura		
46	SY054	91.77	24.44	Moulvi Bazar Sadar		
47	SY043	91.91	24.62	Rajnagar		
48	SY016	91.74	24.23	Sreemangal		
49	NA006	91.07	22.95	Begumganj	Noakhali	
50	NA013	91.27	22.77	Companiganj		
51	NA011	91.09	22.17	Hatiya		
52	NA019	91.19	22.76	Noakhali Sadar		
53	NA004	91.20	23.02	Senbagh		
54	SY072	91.80	24.68	Balaganj	Sylhet	
55	SY070	92.17	24.85	Beanibazar		
56	SY060	92.05	25.05	Gowainghat		
57	SY061	92.16	25.08	Jaintapur		
58	SY087	92.34	24.99	Kanairghat		
59	SY055	91.93	24.86	Sylhet Sadar		
60	SY084	91.74	24.81	Bishwhanath		
61	CT008	92.04	21.72	Chakaria	Cox's Bazar	
62	CT002	92.01	21.51	Cox's Bazar Sadar		
63	CT003	91.91	21.52	Maheshkhali		
64	CT030	92.08	21.39	Ramu		
65	CT031	92.22	21.02	Teknaf		
66	CH010	92.24	22.24	Bandarban Sadar	Bandarban	
67	CH003	92.13	21.88	Lama		
68	CH006	91.98	22.63	Kawkhali Betbunia	Rangamati	
69	CH012			Kawkhali Betbunia		
70	SY074	91.69	24.92	Chhatak	Sunamganj	
71	SY092	91.45	24.80	Derai/ Dharampasha		
72	SY097	91.21	24.94	Jamalganj		
73	SY073	91.46	25.02	Sunamganj Sadar		

Well No.	Well	Long	Lat	Upazilla	District	Sub-Division
74	DH005	90.22	23.87	Dhamrai	Dhaka	Dhaka
75	DH103	90.42	23.83	Cantonment		
76	DH099	90.10	23.60	Dohar		
77	DH087	90.34	23.69	Keraniganj		
78	DH015	90.37	23.79	Mirpur		
79	DH108	90.37	23.75	Mahammadpur		
80	DH065	90.21	23.66	Nawabganj		
81	DH073	90.31	23.87	Savar		
82	DH124	90.37	23.74	Tejgaon		
83	DH078	90.48	23.96	Gazipur Sadar	Gazipur	
84	DH058	90.32	24.21	Kaliakair		
85	DH122	90.28	24.13	Kaliakair		
86	DH102	90.63	24.20	Kapasia		
87	DH010	90.54	24.18	Sreepur		
88	DH120	90.52	23.86	Kaliganj		
89	JA013	89.86	25.24	Baksiganj	Jamalpur	
90	JA008	89.79	25.23	Dewanganj		
91	JA014	89.76	25.10	Islampur		
92	JA015	90.05	24.84	Jamalpur Sadar		
93	JA016	89.78	24.92	Madarganj		
94	JA007	89.81	24.98	Melandaha		
95	JA006	89.82	24.78	Sarishabari		
96	MY063	91.11	24.34	Astagram	Kishoreganj	
97	MY041	91.01	24.38	Nikli		
98	MY070	90.71	24.29	Pakundia		
99	MY013	90.99	24.24	Bajitpur		
100	MY034	90.92	24.58	Tarail		
101	MY071	90.95	24.16	Kuliar Char		
102	MY088	90.85	24.40	Kishoreganj Sadar		
103	MY069	91.00	24.12	Bhairab		
104	MY012	90.82	24.33	Katiadi		
105	MY010	90.91	24.48	Karimganj		
106	MY090	90.65	24.45	Hossainpur		
107	MY027	91.06	24.52	Itna		
108	DH026	89.83	23.96	Daulatpur	Manikganj	
109	DH008	89.91	23.89	Ghior		
110	DH066	90.01	23.71	Harirampur		
111	DH007	90.07	23.83	Manikganj Sadar		

Well No.	Well	Long	Lat	Upazilla	District	Sub-Division
112	DH098	89.98	23.98	Saturia		
113	DH067	89.80	23.86	Shivalaya		
114	DH089	90.14	23.77	Singair		
115	DH097	90.64	23.51	Gazaria	Munshiganj	
116	DH085	90.41	23.46	Lohajang		
117	DH084	90.54	23.51	Munshiganj Sadar		
118	DH001	90.28	23.63	Sirajdikhan		
119	DH062	90.26	23.53	Sreenagar		
120	DH086	90.47	23.44	Tongibari		
121	TA011	89.85	24.21	Bhoapur	Tangail	
122	TA008	89.93	24.08	Delduar		
123	TA002	90.04	24.18	Basail		
124	TA032	90.07	24.43	Ghatail		
125	TA013	89.89	24.56	Gopalpur		
126	TA034	89.91	24.36	Kalihati		
127	TA021	90.23	24.30	Sakhipur		
128	TA024	89.89	24.04	Nagarpur		
129	TA022	90.17	24.14	Mirzapur		
130	TA004	90.04	24.65	Madhupur		
131	MY074	91.12	24.69	Khaliajuri	Netrokona	
132	MY002	90.84	24.97	Barhatta		
133	MY053	90.68	25.15	Durgapur		
134	MY054	90.86	25.14	Kalmakanda		
135	MY042	90.88	24.65	Kendua		
136	MY036	90.93	24.71	Madan		
137	MY003	90.75	24.95	Netrokona Sadar		
138	MY006	90.59	25.00	Purbadhala		
139	MY051	91.03	24.82	Mohanganj		
140	DH059	90.74	24.20	Manohardi	Narsingdi	
141	DH076	90.68	23.88	Narsingdi Sadar		
142	DH104	90.67	23.96	Palash		
143	DH105	90.94	23.92	Raipur		
144	DH011	90.51	24.17	Shibpur		
145	MY055	90.22	24.73	Muktagachha	Mymensingh	
146	MY052	90.32	24.83	Mymensingh Sadar		
147	MY081	90.59	24.61	Ishwarganj		
148	MY089	90.60	24.40	Gaffargaon		
149	MY050	90.32	25.04	Haluaghat		

Well No.	Well	Long	Lat	Upazilla	District	Sub-Division
150	MY032	90.60	24.79	Gauripur		
151	MY059	90.32	24.57	Fulbaria		
152	MY060	90.30	24.36	Bhaluka		
153	MY044	90.75	24.59	Nandail		
154	MY001	90.43	24.90	Phulpur		
155	MY061	90.46	24.54	Trishal		
156	DH081	90.72	23.69	Araihazar	Narayanganj	
157	DH003	90.52	23.59	Narayanganj Sadar		
158	DH080	90.56	23.86	Rupganj		
159	DH082	90.63	23.66	Sonargaon		
160	JA012	90.19	24.99	Nakla	Sherpur	
161	JA005	90.20	25.17	Nalitabari		
162	JA018	90.00	25.05	Sherpur Sadar		
163	JA009	89.97	25.15	Sreebardi		
164	PT003	90.16	22.15	Barguna Sadar	Barguna	Faridpur
165	PT006	90.29	22.20	Amtali		
166	BA001	90.36	22.71	Barisal Sadar	Barisal	
167	BA003	90.52	22.84	Mehendiganj		
168	BA006	90.45	22.61	Bakerganj		
169	BA009	90.21	22.82	Banaripara		
170	BA010	90.28	22.83	Babuganj		
171	BA013	90.26	22.92	Gaurnadi		
172	BA011	90.52	22.96	Hizla		
173	BA004	90.64	22.67	Bhola Sadar	Bhola	
174	BA028	90.75	22.20	Char Fasson		
175	BA029	90.75	22.63	Daulatkhan		
176	BA024	90.79	22.31	Lalmohan		
177	FS002	89.79	23.75	Alfadanga	Faridpur	
178	FA020	89.96	23.40	Bhanga		
179	FA057	89.72	23.41	Boalmari		
180	FA022	89.95	23.57	Char Bhadrasan		
181	FA017	89.78	23.55	Faridpur Sadar		
182	FA006	89.57	23.60	Madhukhali		
183	FA046	89.79	23.44	Nagarkanda		
184	FA038	89.94	23.51	Sadarpur		
185	FA027	89.91	23.12	Gopalganj Sadar	Gopalganj	
186	FA012	89.72	23.22	Kashiani		
187	FA013	89.99	22.94	Kotalipara		

Well No.	Well	Long	Lat	Upazilla	District	Sub-Division
188	FA051	89.92	23.27	Muksudpur		
189	FA053	89.90	22.85	Tungipara		
190	BA007	90.19	22.63	Jhalokathi Sadar	Jhalokathi	
191	BA019	90.16	22.61	Rajapur		
192	FA035	90.25	23.26	Madaripur Sadar	Madaripur	
193	FA031	90.03	23.20	Rajoir		
194	FA021	90.20	23.37	Shibchar		
195	PT002	90.44	22.19	Galachipa	Patuakhali	
196	PT007	90.21	22.35	Mirzaganj		
197	PT004	90.06	22.25	Patuakhali Sadar		
198	BA021	89.97	22.41	Bhandaria	Pirojpur	
199	BA018	90.07	22.62	Kawkhali		
200	BA027	89.98	22.37	Mathbaria		
201	BA015	89.98	22.64	Pirojpur Sadar		
202	BA016	90.12	22.72	Nesarabad(Swarupkathi)		
203	FA009	89.58	23.69	Baliakandi	Rajbari	
204	FS009	89.78	23.71	Goalandaghat		
205	FA015	89.50	23.78	Pangsha		
206	FA016	89.71	23.68	Rajbari Sadar		
207	FA024	90.45	23.20	Bhedarganj	Shariatpur	
208	FA061	90.42	23.07	Gosairhat		
209	FA023	90.38	23.30	Naria		
210	FS012	90.35	23.22	Shariatpur Sadar		
211	FA034	90.28	23.29	Zanjira		