# CHAPTER VI

## CONCLUDING REMARKS

The detailed examination of subsurface data from groundwater wells in Bangkok Metropolis covering an area of approximately 1,500 squre kilometers primarily aims at determining of sedimentary facies and the reconstruction of depositional environments. In this regard, 33 primary reference wells with information on electrical logs and lithological logs, over 100 primary wells and numerous secondary wells are employed in this investigation. Almost all the wells have been penetrated to the approximate depth of 250 meters of unconsolidated sedimentary sequence in the area.

The uppermost layer of sediments appears as a thin veneer of fluvial mud deposited in the Chao Phraya floodplain during the Holocene Epoch. Underlying this fluvial mud facies is the shelf mud facies with approximately 10-20 meters thick. The facies is characterized by the salty marine mud with rather homogeneous lithology. This facies is believed to be deposited during the Holocene Epoch.

Below the Holocene shelf mud facies is the deltaic plain facies of upper delta cycle with approximately 50-130 meters thick. The facies is characterized by the interbedding of sands and clays with

diagnostic fining upward nature. The correlation of sediments underlying Bangkok Metropolis with the sedimentary sequence in the Gulf of Thailand reveals that the deltaic plain facies of upper delta cycle and underlying sediments are believed to be deposited during the Pleistocene Epoch. Sediments beneath the deltaic plain facies are the delta front facies of upper delta cycle with approximately 40-160 meters thick. The facies is characterized by the presence of sand body overlying the distal sands and silts interbeds. It is remarkable to note that sediments underlying the delta front facies of upper delta cycle are the deltaic plain facies of the lower delta cycle with unknown thickness. The lithological characteristics of this facies is fairly similar to that of the deltaic plain facies of upper delta cycle previously described. It is concluded from the cyclic deltaic sedimentation that there must be a break of sedimentation between the two delta cycles. However, all deltaic sediments which are present from 20 meters to approximately 250 meters depth were all deposited during the Pleistocene Epoch. The conclusion being drawn here regarding the deltaic sedimentation on the northern part could be well fitted with the broader sedimentation pattern. That is during the same geological time span, Pleistocene, sedimentation in the area on the southern part of the study area or to the seaward direction was the inner neritic facies presently found in the Gulf of Thailand.

The sand bodies in the deltaic plain facies of upper delta cycle are essentially channel sands which are grouped together to be the Bangkok aquifer, the uppermost aquifer in the study area. This aquifer is

found within the depth range of 20-90 meters below the ground surface having thickness less than 1 meter to 80 meters.

The second aquifer is the sheet sand bodies of distributary mouth bars in the delta front facies of the upper delta cycle. This aquifer, Phra Pradaeng aquifer, is found within the depth range of 60-150 meters below the ground surface having thickness of less than 15 to 80 meters.

The third and the fourth aquifers are the channel sand bodies of deltaic plain facies of the lower delta cycle. They are called Nakhon Luang aquifer and Nonthaburi aquifer irrespect to the increassing in depth. Nakhon Luang aquifer is found at the depth range of 110-190 meters below the ground surface having thickness of less than 15 to 75 meters. The upper surface of Nonthabure aquifer is found at the depth range of 180-200 meters, and the thickness can not be identified in this study due to the limitation of data available.

It is interesting to note that evidences from the subsurface geological map and sections of the study area reveal the partial interconnection of sand bodies of Bangkok aquifer, Phra Pradaeng aquifer and Nakhon Luang aquifer. Evidences within the study area do not show any direct-interconnection of Nonthaburi aquifer with others, but the information on the hydraulic characters and hydrochemical facies indicates that the interconnection of Nonthaburi aquifer with others is not impossible.

The determinations of groundwater potentials using the data and information available from 1975 to 1978 have been primarily focussed upon the potential of acceptable limits for potable water and their hydraulic characteristics. The findings regard this matter for each aquifer are concluded here.

In Bangkok aquifer, the groundwater quality falls mainly within the hydrochemical facies 2 and 4 which means that the calcium and magnesium content is less than 50 per cent. whereas chloride and sulphate content varies considerably from less than 50 per cent to more than 50 per cent. The ranges of concentration of total dissolved solid, total hardness, chloride and total iron are 240-2,000, 88-1,160, 5-1,160 and 0-4.8 respectively. Generally the groundwater quality on the eastern bank of Chao Phraya River is relatively better than on the western bank according to the drinking standard of W.H.O.. The water level in this aquifer declines at the approximate rate of 2.03 meters per year.

In Phra Pradaeng aquifer, the groundwater quality falls mainly within the hydrochemical facies 2 which means that the calcium and magnesium content is less than 50 per cent while the chloride and sulphate content is less than 50 per cent. The ranges of concentration of total dissolved solid, total hardness, chloride and total iron are 215-4,400, 79-1,700, 5-2,340 and 0-3.92 respectively. Generally the groundwater quality on the eastern bank of Chao Phraya River is relatively better than on the western bank according to the drinking standard

of W.H.O.. The water level in this aquifer declines at the approximate rate of 3.06 meters per year.

In Nakhon Luang aquifer, the groundwater quality falls mainly within the hydrochemical facies 2 which means that the calcium and magnesium content is less than 50 per cent while the chloride and sulphate content is less than 50 per cent. The ranges of concentration of total dissolved solid, total hardness, chloride and total iron are 94-14,400, 40-4,980, 2-8,850 and 0-4.8 respectively. Generally the groundwater quality on the eastern bank of Chao Phraya River is relatively better than on the western bank according to the drinking standard of W.H.O.. The water level in this aquifer declines at the approximate rate of 3.67 meters per year.

In Nonthaburi aquifer, the groundwater quality falls mainly within the hydrochemical facies 2 which means that the calcium and magnesium content is less than 50 per cent while the chloride and sulphate content is less than 50 per cent. The ranges of concentration of total dissolved solid, total hardness, chloride and total iron are 235-6,600, 56-4,500, 1-4,100 and 0-2.97 respectively. Generally the groundwater quality on the eastern bank of Chao Phraya River is relatively better than on the western bank according to the drinking standard of W.H.O.. The water level in this aquifer declines at the approximate rate of 3.40 meters per year.

It is apparent that Phra Pradaeng, Nakhon Luang and Nonthaburi aquifers have better groundwater potential both in terms of water quantity and quality as compared with Bangkok aquifer. However, considering the groundwater quality potential, the Nonthaburi aquifer appears to be the best one for consumption.

The exceptionally growth of population in Bangkok Metropolis area and expanding industrialization have put and increasing demand for water. Groundwater development projects have been accordingly accelerated to supplement the limited surface water resources. Groundwater has been essentially used for household water supply and industries. As a consequence of unplanned groundwater development and malmanagement, a number of serious environmental problems have arisen, namely, salt water encroachment, land subsidence, depletion of groundwater resource, etc.. The magnitude and intensity of these problems have been ever increasing and some of them proved to produce adverse environmental effect in Bangkok Metropolitan area and other areas on the Upper Gulf of Thailand.

The full understanding on the nature and characteristic of water-bearing sedimentary sequence, groundwater potential, geotechnical aspect of the subsurface materials, etc., in a more systematic and scientific manner might help to minimize the problems. Besides, it is against scientific base-line information that proper management and development can be formulated and implemented.

It is therefore endeavour that the contribution from this study is not only for scientific purpose, but also to serve as a base-line information for future planning and assisting in the formulation of any preventive and remedial measures of the problems concerned.