CHAPTER III

METHOD OF INVESTIGATION

3.1 Gathering Data

All wells logging and cuttings data are collected from many sources. They can be divided into 2 types as follows:

3.1.1 Primary Wells Data

These data are mainly used in this study and they are divided into 2 groups:

3.1.1.1 Primary Reference Wells Data

The primary wells are cuttings sample throughout borehole and electrical logging motifs wells. There are 5 lithological primary reference wells. These data obtained from Groundwater Division, Department of Mineral Resources, DMR.

3.1.1.2 Primary Wells Data

The primary wells Data are those collected from the DMR, Department of Public Work, Metropolitan Water Work Authority and the Consultant Private Company. The data collected are as follow:

A. Lithologic Logging Wells. These wells data are, mainly from the DMR, composed of only the cuttings. As those boreholes were drilled since 1994, only 7 wells data that can be used in the study.

B. The Pumping Test Wells. The wells data are obtained from the production wells. Information regarding the field data of pumping test; the well yield is pumping capacity and the drawdown. There are 17 wells pumping test data that

used for calculation of the transmissivity and hydraulic conductivity whereas 184 wells are used for the specific capacity.

C. The Observation Wells. These data are received from the 94 observation wells of the DMR composing of the water quality, the potentiometric surface and the land subsidence. **The water quality data** are obtained from two categories, namely; the formal and informal analysis. The formal data analyses were collected from 1991 to 1995. The data display the parameters concerning water quality including, Calcium (Ca^{2+}), Magnesium (Mg^{2+}), Sodium (Na^{+}), Potassium (K^{+}), Total Iron (Fe), Sulfate (SO_4^{2-}), Chloride (Cl^{-}), Bicarbonate (HCO_3^{-}), Nitrate (NO_3^{-}), Fluoride (F^{-}), Total Dissolved Solids, Total Hardness as CaCO3, Manganese (Mn^{+}), Power of Hydrogen ion (pH), and Specific Electrical Conductance (EC)**. The potentiometric surface data** were collected from 1997-2000. **The land subsidence data** can be subdivided into 2 types. The first one is the 72 Reference points at the depth of the NL aquifer started from 1992-2000 while the second one is 169 Benchmarks at the depth of one meter started from 1998-2000.

3.1.2 Secondary Wells Data.

The secondary wells data are those data, which complied and systematically identified from the DMR, regarding the lithologic and electric loggings from 117 **groundwater monitoring wells stations.**

The data, from both primary and secondary wells data, are used to constructing the Hydrogeologic Cross section so as to characterize the Nakhon Luang aquifer.

3.2 Preparation of Location Maps

The location maps are prepared with reference to the military grid system of 1: 900,000 scale map series for the hydrogeologic characteristics maps and 1:300,000 scale map series for the hydrogeologic cross section analysis.

Primary reference wells, primary wells and secondary wells are located on the map according to their grid references.

3.3 Sedimentary Facies Analysis

3.3.1 Identification of Physical Properties of the aquifer from Cuttings

Physical properties of cuttings are identified under the binocular microscope. The cuttings, 14 boreholes being used, are selected only within the Nakhon Luang aquifer interval to correlating with the adjacent well. The grain size, sorting, roundness and mineral composition of the cuttings are examined.

It would be remarked here that only coarse grained sediment are available in the cuttings due to the fact that the cuttings were collecting under the wash boring technique.

3.3.2 Interpretation of Depositional Environment

The interpretation of depositional environment of the Nakhon Luang aquifer within the studied area is carried out on the basis of the SP curves, which playing a great role on interpretation of the sedimentary facies. Furthermore, data obtained from the cuttings, regarding the sedimentary properties, are used to supplement this interpretation as well.

Generally, the sedimentary facies, can be depicted the depositional environment, is deduced by means of the correlation method with appropriate vertical grain size profile and the SP curve models.

3.4 Groundwater Potential Analysis

3.4.1 Water Quality

The water quality of 94 groundwater samples were analyzed and concentrated for only 15 parameters, physical and chemical variables. They are Calcium (Ca^{2+}), Magnesium (Mg^{2+}), Sodium (Na^{+}), Potassium (K^{+}), Total Iron (Fe), Sulfate (SO_4^{2-}), Chloride (Cl^{-}), Bicarbonate (HCO_3^{-}), Nitrate (NO_3^{-}), Fluoride (F^{-}), Total Dissolved Solids, Total Hardness as CaCO3, Manganese (Mn^{+}), Power of Hydrogen ion (pH), and Specific Electrical Conductance (EC). Most of the groundwater quality data are obtained from the observation wells. The water sample, analyzed in the laboratory, were the residual water which collected in the well casing under the condition that the stagnant water are not pumping out. Thus, those data might not be representative of the actual aquifer water quality.

Water analyses plotted on Piper (trilinear) diagram. Cation percentages in equivalent per liter are plotted on three axes on left triangle, while anions are also plotted in same way on right triangle. Classification of hydrochemical facies employed the Piper plot. Facies names is included the combination of cation and anion types.

3.4.2 Hydraulic Properties

The 17 pumping test wells data, available from the DMR, Department of Public Works, and the private Consultants Co., are analyzed in order to point out the important hydraulic characteristics of aquifer and calculated the transmissivity, hydraulic conductivity and specific capacity. The storativity cannot be calculated from the production well. It needs more data from the observation wells, particularly on the effective radius and the drawdown of the pumping well. All of the hydraulic

parameters are calculated by means of equations that have been reviewed in the Chapter II.

3.4.3 The Flow Nets Analysis

The potentiometric surface of the 94 groundwater-monitoring wells in the year 2000 is used to pursue the flow nets. The equipotential lines are drawn via a computer whereas the flow lines are drawn via manual. The equipotential line is 5 m interval, ranging from 5 to 55 m. The 12 flow lines are drawn perpendicular to the equipotential lines, thus, 12 flow channels are established. Then, the groundwater yield is calculated.