







the occurrence, distribution and flow of groundwater. Typically, hydrogeology characteristics are classified into two main types: unconsolidated rocks and consolidated rocks, and then classified into sub-hydrogeologic units, depending on the hydrogeological properties in terms of storage and discharge properties. After processing all geophysical survey points completely, the hydrogeological cross-section was constructed with the help of lithologic log data, electric log data, measured static water levels, and well screen depths.

## 2. RESULTS AND DISCUSSION

### 2.1 Vertical Electrical Sounding results

Results of the VES survey were displayed on the log-log graph between electrode spacing and apparent resistivity values that can be used to identify soil and rock layers. Shape and slope of VES data on graph represents changes among layers having different resistivity values (Telford et al. 1990). All 22 VES data showed the H type curve (see Figure 3) (Telford et al. 1990). This implied that there were three layers in the subsurface that consist of resistivity:  $\rho_1 > \rho_2 < \rho_3$  ( $\rho_1$ = resistivity of upper layer,  $\rho_2$ = resistivity of intermediate layer and  $\rho_3$ = resistivity of bottom layer) (Song et al., 2006) and consistent with characteristics of geology and hydrogeology of study area. The top layer represents the unsaturated sediment, the middle layer was saturated sediments and the bottom layer is as a base rock.

There were 16 VES data used to create a pseudo cross-sections B-B', which was perpendicular to the coastal line, starting from the western to eastern areas (see Figure 4). Total distance of this line is approx. 8,450 meters. Sixteen VES points are follows: St11, St12, St13, St14, St15, St16, St17, St18, St19, St20, St21, St22, St23, 42-126 and 42-125 (see Figure 3). From Figure 4, it was found that the surface layer (0-10 meters) has resistivity anomalies between 10 to 400  $\Omega\text{m}$ , representing unsaturated zone of aquifer. The next layer showed resistivity

values ranged from 2 to 20  $\Omega\text{m}$ . It could be interpreted as sediment layer saturated with groundwater. Near the coastal line, there is low resistivity zone (0-10  $\Omega\text{m}$ ) in Qfd that extends approx. 2 kilometers inland. It seems to represent the influences of seawater intrusion. Low resistivity values (0-10  $\Omega\text{m}$ ) is consistent with a study of Nowroozi et al. (1999), Cimino (2008) and Kouzana et al. (2010). They found that the area where low resistivity in range 0 to 10  $\Omega\text{m}$  is influenced by seawater intrusion. For the western side of profile at the depth of 20-200 meters, it showed the zone of resistivity ranging from 60 to 250  $\Omega\text{m}$ , representing bedrock layer.

The geological cross-section (see Figure 5), of west-east direction, was established by combining the data from the VES data with lithologic log data and electric log data of boreholes in the area (see Figure 6). It showed that the maximum depth of aquifer is approx. 200 meters. The cross-section clearly showed the boundaries of each aquifer. The top layer is Qfd aquifer consisting of sand (well sorted and high sphere), from 0 to 20 meters thick. The next layer is Qcl aquifer, consisting of clayey gravel (poorly sorted and angular to sub-angular) and interbedded with sand in some areas with an average thickness of 50 to 60 meters, but it may be up to 100 meters in the area near the coastal line. The bottom layer is Granite (Gr) aquifer that represents the base rock in this area, and plays the barrier role against the seawater intrusion.

### 2.2 Hydrogeological characteristics

The study area is underlain with both unconsolidated and consolidated aquifers. Unconsolidated aquifers in study area are quaternary sediments, that can be classified by the depositional environment into 3 aquifers as follows: 1) Quaternary Beach-Sand Deposits (Qbs), 2) Quaternary Floodplain Deposits (Qfd) and 3) Quaternary Colluvial Deposits (Qcl). In Amphoe Cham, Qbs consisting of







