CHAPTER 2

HYDROGEOLOGICAL SETTING

2.1 Geology of area

The geology of Chiang Mai basin is composed of a wide range of litho logical rocks, consolidated rocks and unconsolidated rocks of the Precambrian - Quaternary age. The Chiang Mai basin is mostly oriented in the North- south direction with host and graben faulted in the east/west direction. In the central area is the plain of Chiang Mai basin, which lies in between this high mountain of granite and metamorphic rocks.

2.1.1 Metamorphic rocks of the Precambrian age (PE) are composed of high grade metamorphic rocks, gneiss, and schist, which are found in Mae Taeng district, Mae Rim district in the north extending to the Mae Chaem district, and Hod district. Fault contact between older and younger rock is commonly found.

2.1.2 Carbonate rocks of Ordovician age (O) are comprised of limestone and micaceous shale, which are found in western side of the basin; as well as in Mae Taeng district, Hang Dong district, Chom Tong district, and Hod district.

2.1.3 Low-grade metamorphic rocks of Silurian Devonian age (SD) consist of quartzite, phyllite, and chert, which scattered from the east to the west of the basin.

2.1.4 Sedimentary rocks of Carboniferous age (C) are composed of sandstone shale conglomerate limestone and volcanic rocks. They are found on both sides of the basin from the north in Fang district,and Chai Prakarn district, and to the south in San Sai district and San Kamphaeng district.

2.1.5 Limestone of Permian age (Pc) is comprised of limestone and shale; in some areas it is interbedded with shale and sandstone.

2.1.6 Sedimentary rocks of Triassic and Jurassic age; sandstone, siltstone, shale and conglomerate are found cropping out west of Doi Lo district and Om Koi district.

2.1.7 Unconsolidated rocks of Tertiary age (T), clay stone and oil shale of Tertiary rocks are concealed with sand, gravel, silt and clay of Quaternary rocks.

2.1.8 Unconsolidated rocks of Quaternary age (Q), consist of gravel, sand, silt and clay of the Ping River flood plain, high terrace, low terrace and colluviums.

2.2 Hydrogeology of area

The geological map of Chiang Mai basin was modified into a hydro geological map according to groundwater yielding properties and groundwater quality (Figures 2.1 and 2.2). The basin is comprised of various kinds of groundwater baring rocks; and aquifers of different ages. These have been classified according to hydrogeological characteristics, unconsolidated aquifers of Quaternary age, semi-consolidated aquifers of Tertiary age and consolidated aquifers of Mesozoic to Paleozoic age (DGR, 2002).

2.2.1 Unconsolidated aquifers

Unconsolidated aquifers consist of loosely cemented gravel, sand, silt and clay. Groundwater in these aquifers is obtained from inter-granular voids. Groundwater yields depend on hydrogeological properties, such as porosity, grain size, aquifer thickness, and pore's continuity. The unconsolidated aquifers in the Chiang Mai basin are divided into three units (Figures 2.3 and 2.4).

Quaternary alluvial aquifers (Qcp) are composed of gravel, sand, silt and clay. These aquifers occur within the flood plains of the meandering Ping and Wang rivers. These aquifers yield from 20 to 50 cubic meters per hour and their depths range from 20 to 60 meters. Water quality is generally good.

Quaternary terraces (Qcr) are composed of gravel, sand, silt, and clay next to alluvial flood plain aquifers. The groundwater yield is a meager 20 cubic meters per hour and the aquifer depths vary from 30 to 100 meters.

Older Quaternary terraces (Qcm) aquifers are made up of gravel, sand, silt and clay underlying the terrace aquifers. These older aquifers typically are within high and rolling terrain and yield 2 to 20 cubic meters per hour. The aquifer depths are generally 50 to 250 meters, though as deep as 300 meters in some areas.

2.2.2 Semi-consolidated aquifers

Semi-consolidated aquifers (Tsc) consist of Tertiary sedimentary rocks, oil shale, shale, and lignite. Groundwater is obtained from fractures, along bedding planes, and within fault zones. Wells in these aquifers yield 2 to 10 cubic meters per hour from depths of 60 to100 meters.

2.2.3 Consolidated aquifers

Most groundwater from consolidated aquifers is obtained from fractures, joints, fault zones, and cavities within sedimentary, metamorphic, igneous, carbonate and volcanic rocks. Litho logic units and hydrogeological units of consolidated rocks are described in Table 2.1. Groundwater quantity from these diverse aquifers depends on the size and continuity of the fractures, joints, fault zones, and cavities. Yields range from meager to 50 cubic meters per hour. Aquifer depths are about 50 meters, though in some areas depths are 70 to100 meters.

Table 2.1 Summary of hydro geological units in Chiang Mai basin

Lithologic unit	Hydrogeological unit	Description
Unconsolidated rocks	Qfd (Qcp)	Floodplain deposits aquifer
	Qyt (Qcr)	Young terrace deposits aquifer
	Qot (Qcm)	Old terrace deposits aquifer
Semiconsolidated rocks	Tsc (ss)	Semiconsolidated aquifer
Metasedimentary rocks	PCms (ms)	Permian to Carboniferous Metasediments aquifer
	Cms (ms)	Carboniferous sediments Aquifer
Sedimentary rocks	Jmk (ss)	Middle Khorat Aquifer
	TRJlk (ss)	Lower Khorat Aquifer
Metamorphic rocks	PEmm (mm)	Precambrian Metamorphic Aquifer
	DEmm (mm)	Cambrian-Devonian Metamorphic Aquifer
	Emm (mm)	Cambrian Metamorphic Aquifer
Granitic rocks	Gr (Gr)	Granitic Aquifer
Carbornate rocks	Ols (Lst)	Ordovician Limestone Aquifer
	Pc (Lst)	Permian Carbonate Aquifer
Volcanic rocks	Vc (Vc)	Volcanic Aquifer

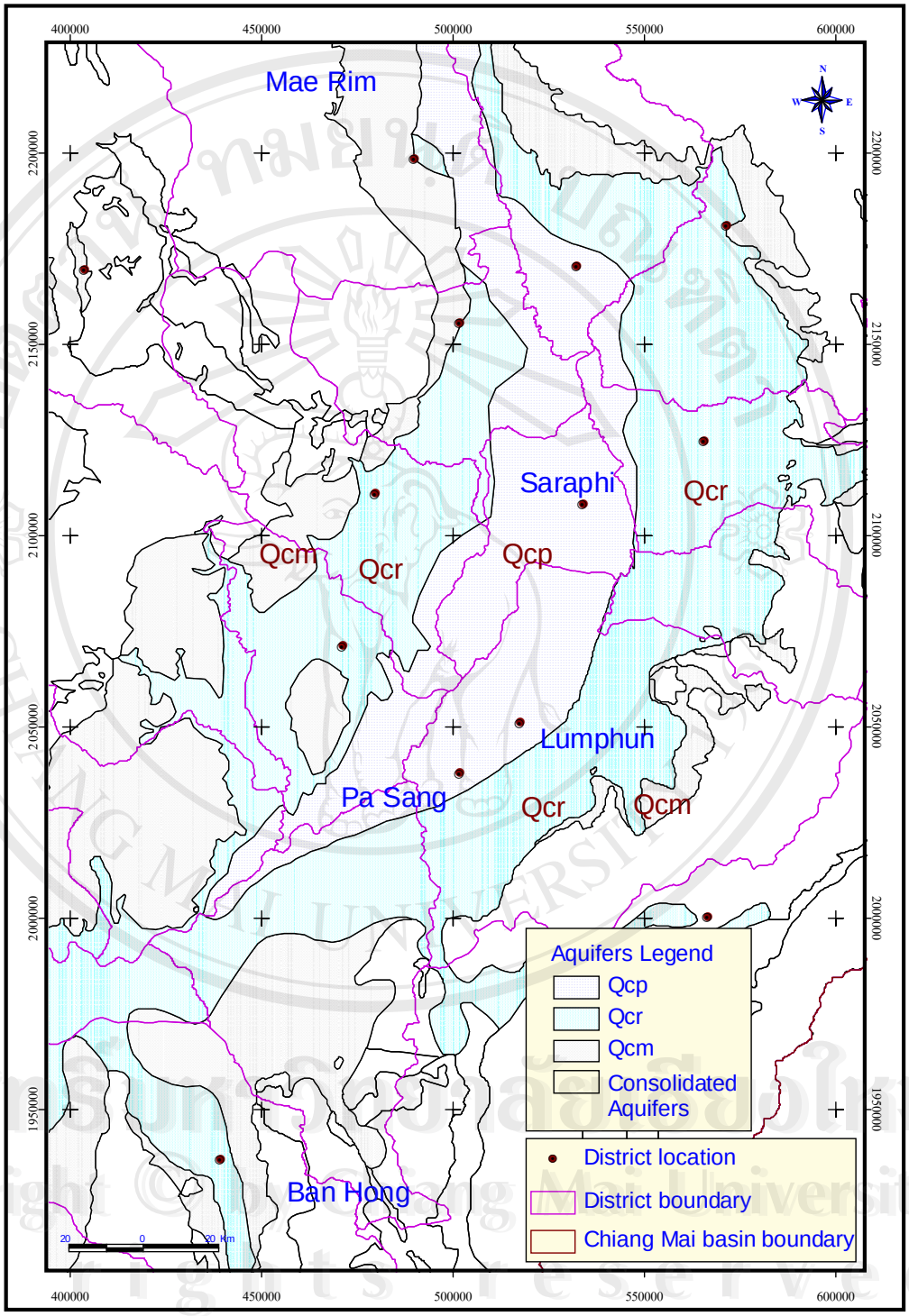

Figure 2.1 Hydrogeological map of Chiang Mai basin (modified from aquifers map of Chiang Mai and Lumphun Province, DMR, 1996)

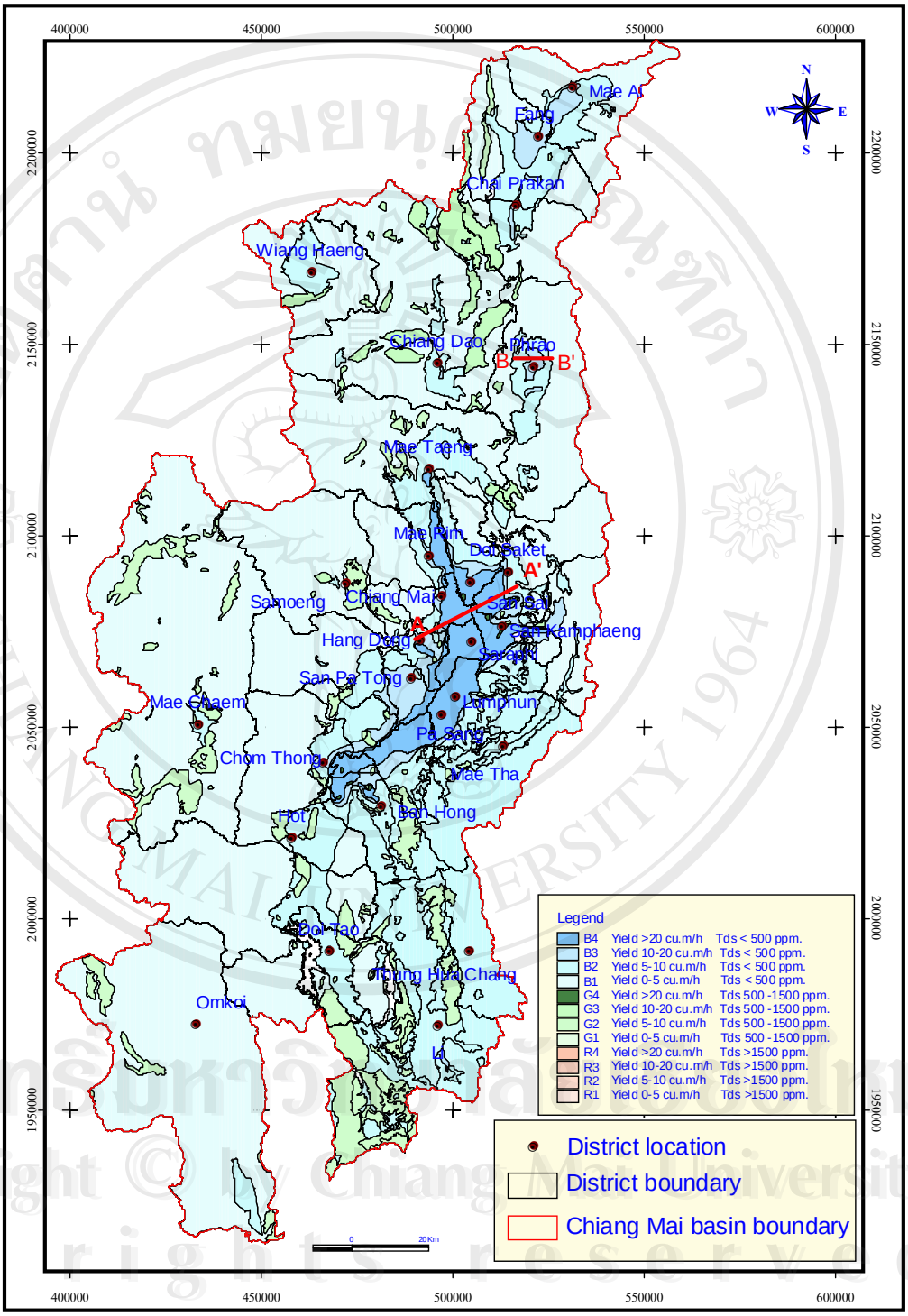

Figure 2.2 Provincial groundwater availability map (DGR, 2002).

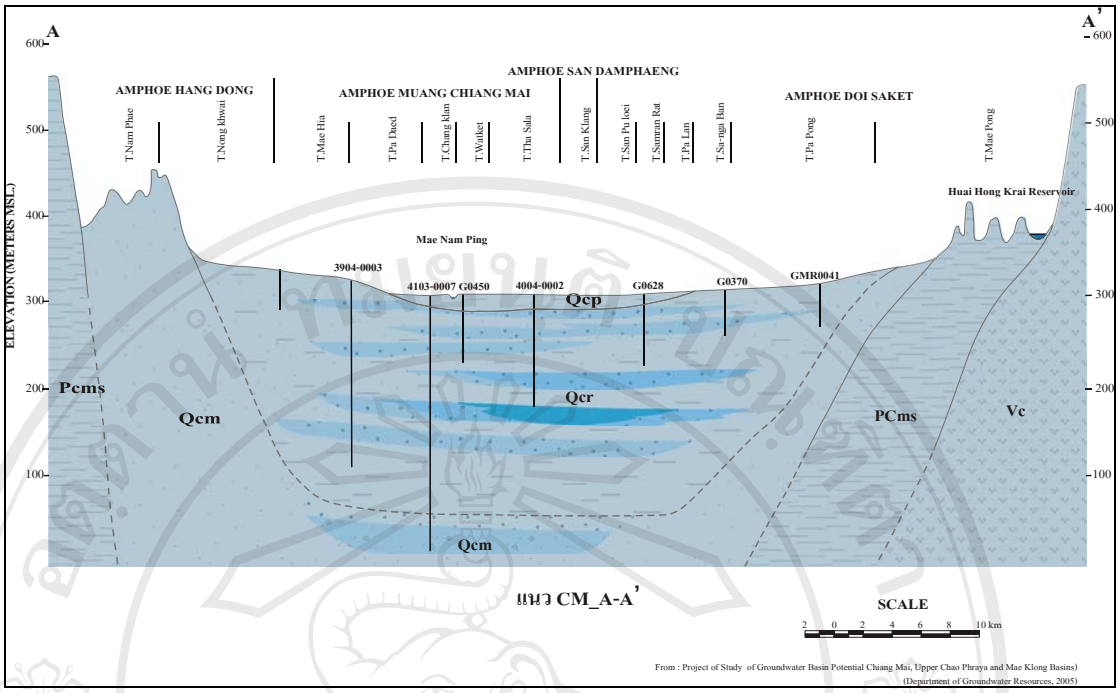

Figure 2.3 Hydrogeological cross section along lines A-A'.

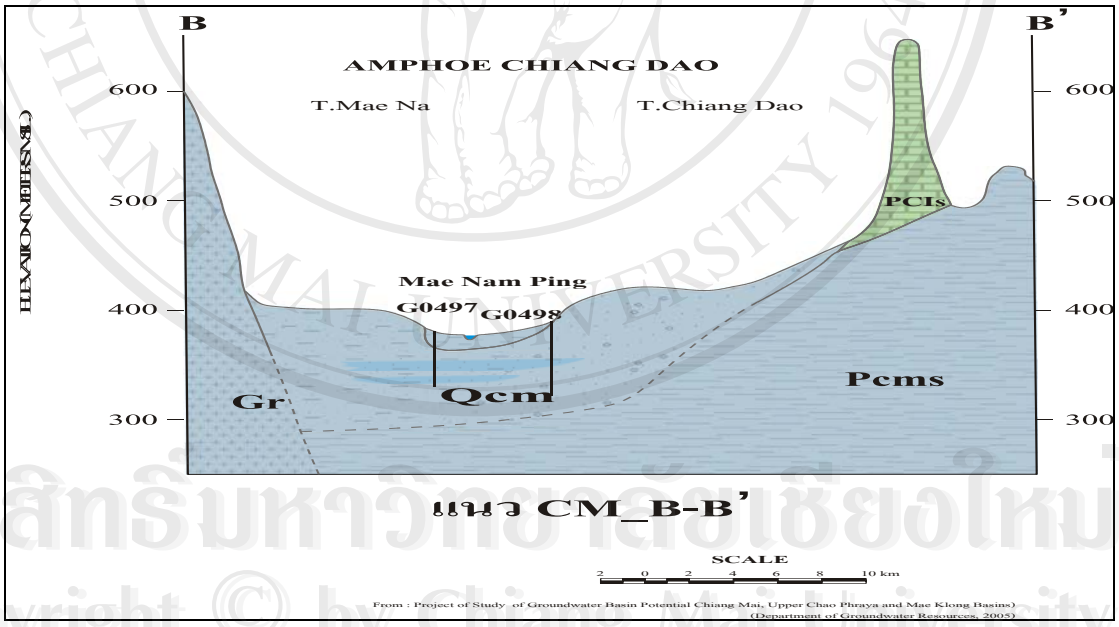

Figure 2.4 Hydrogeological cross section along line B-B'.

2.3 Hydrogeological cross section map.

According to the master plan project of DGR, 2005, Khon Khaen University and a consulting company have evaluated Chiang Mai basin. Hydro geological cross sections were conducted to illustrate aquifer thickness and distribution, and the cross section shows clearly that Chiang Mai basin is formed by host and graben structures. The western part of Chiang Mai basin is controlled by north-south direction faults (Figures 2.5 to 2.10).

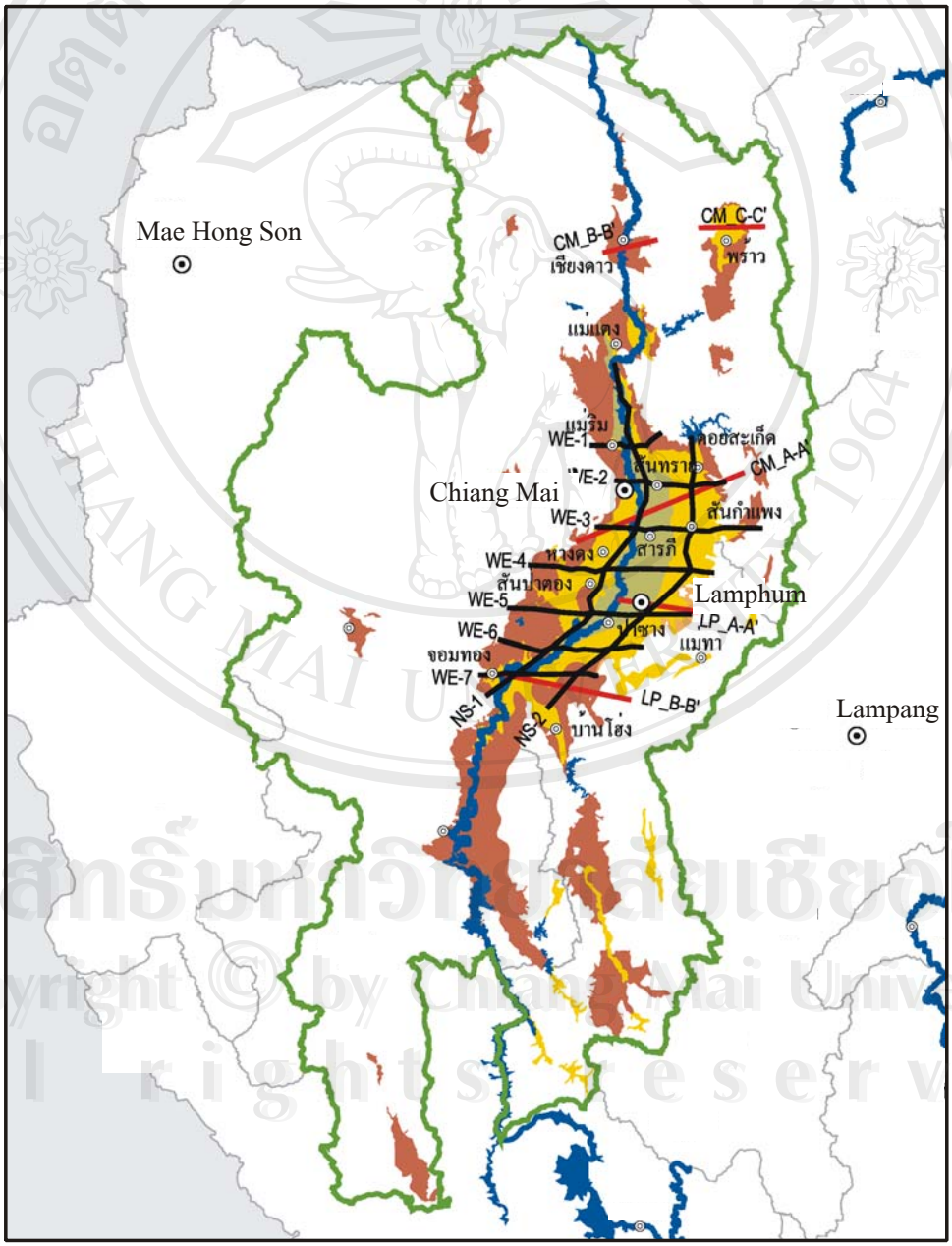

Figure 2.5 Line of cross sections of Chiang Mai basin (DGR, 2005)

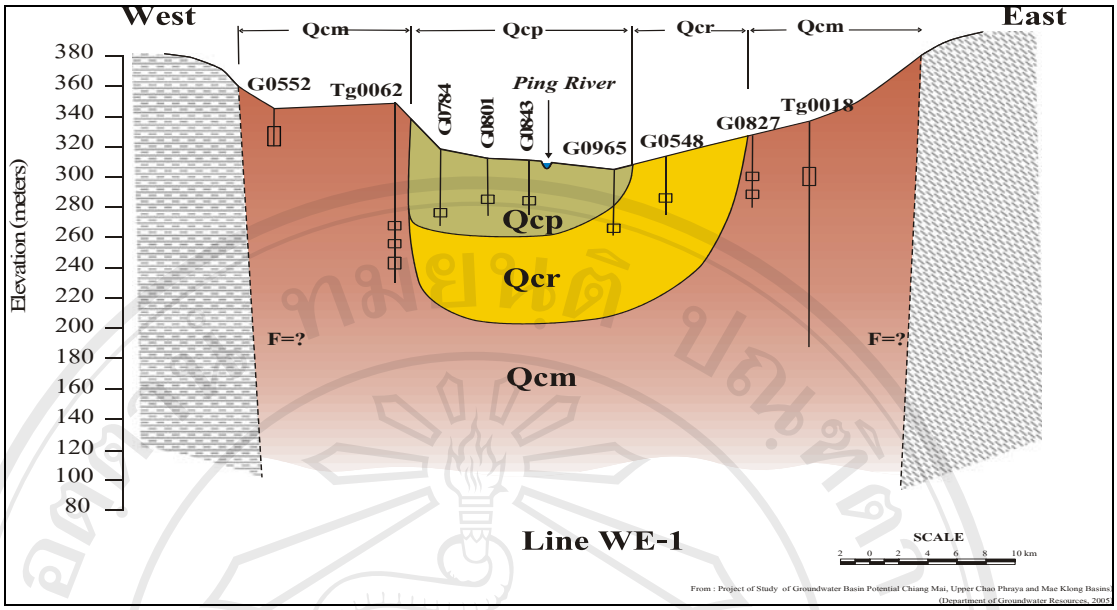

Figure 2.6 Hydrogeological cross section along line WE-1.

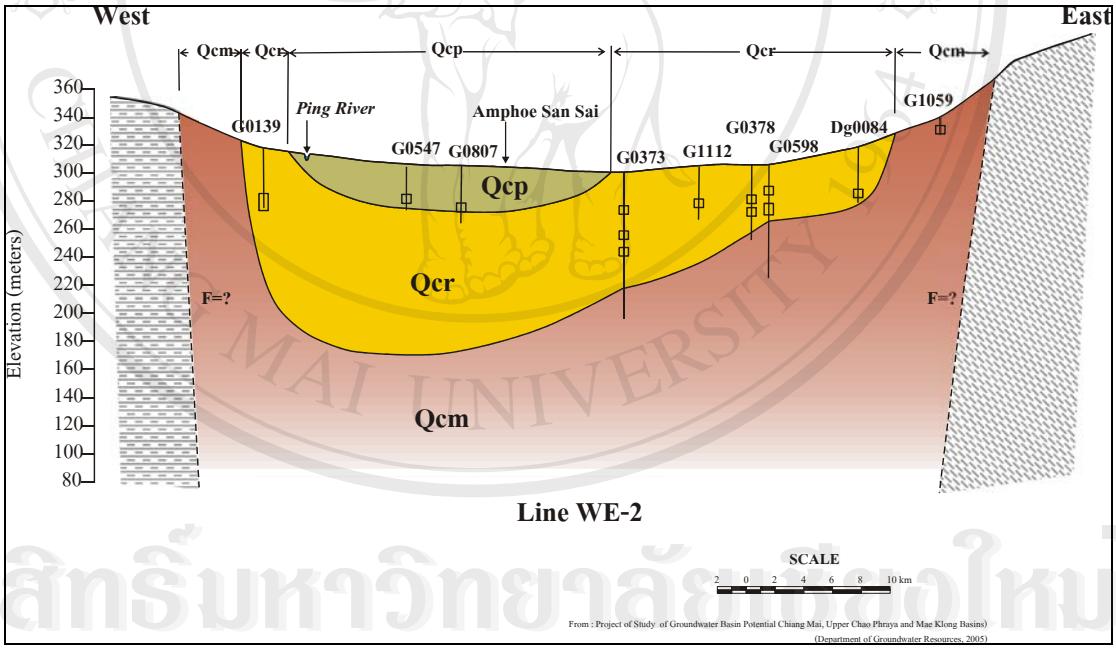

Figure 2.7 Hydrogeological cross section along line WE-2.

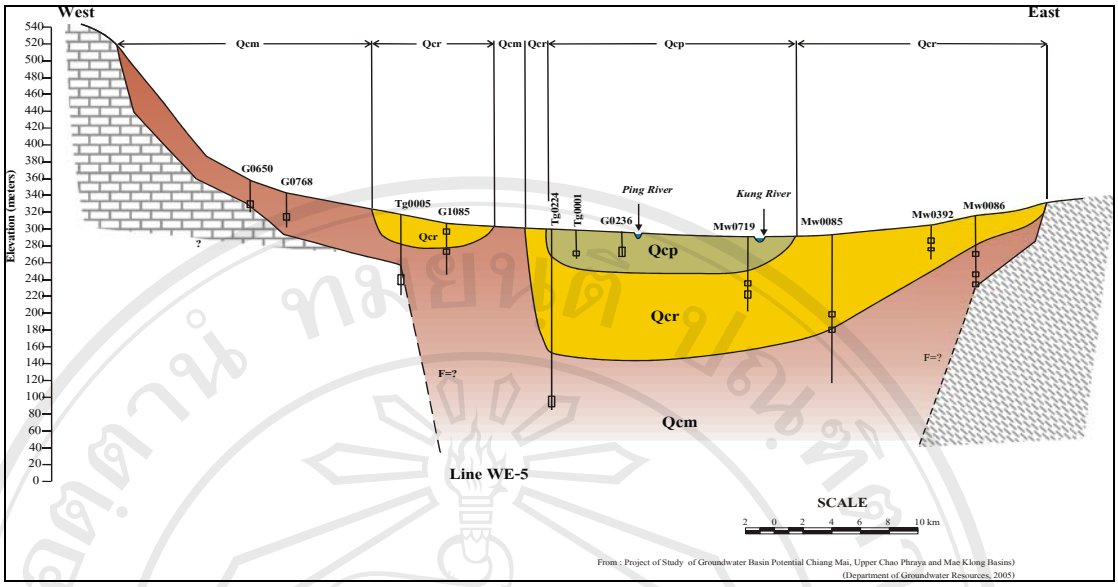

Figure 2.8 Hydrogeological cross section along line WE-5.

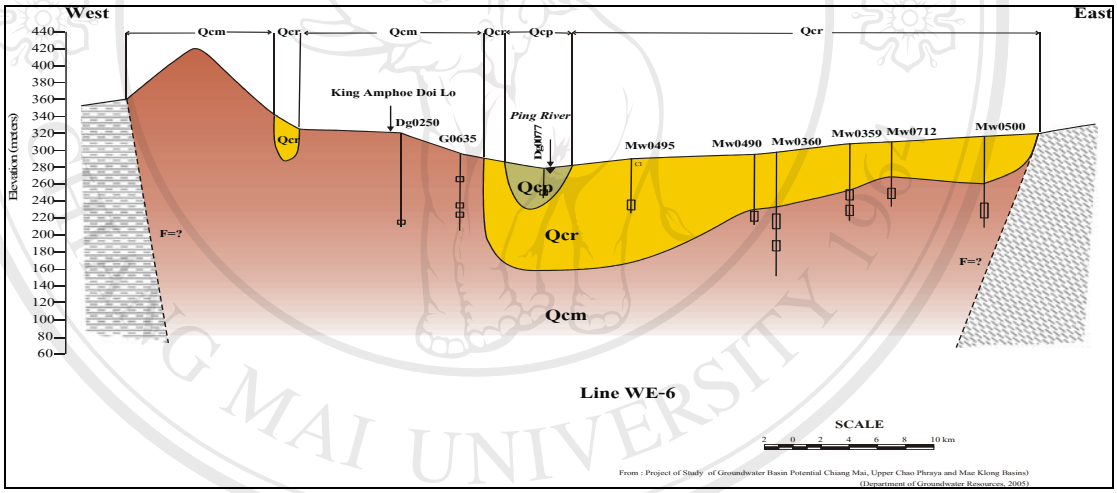

Figure 2.9 Hydrogeological cross section along line WE-6.

Figure 2.10 Legend used in cross sections