CHAPTER I

INTRODUCTION

1.1 Background

Changwat Saraburi is situated in the central part of Thailand. In the National Economic and Social Development Plan numbers 6 and 7 choose Saraburi as a center of development for industrial and transportation junction between the central part, the north, the northeast and the eastern parts especially to Eastern Seaboard Industrial Area.

Saraburi has plenty of raw materials for cement and ceramic, industry ,such as,limestone and shale for cement industry and dickite or pyrophyllite for ceramic industry. Moreover, there are the existing natural gas pipeline, electricity power transmission line and good transportation network pass through Saraburi to Bangkok that is the greatest consumer in the country. Besides, the industrial development will also increase through the agricultural land use and pollution. Therefore,determination of the resources for optimum utilization of agricultural land and minimum the effect of development should be realized.

A term "environmental geology" is widely used among geologists. The term was initiated by Hackett (1967) to identify a new orientation for the study and use of geology in coordinated and integrated manner. It was applied to project and conducted by The Illinois Geological Survey in 1962 (Betz, 1975).

Environment may be considered as the total set of circumstances that surround an individual or a community. It may be defined into two parts : first, physical conditions such as air, water, landforms, etc. which affect the growth and development of an individual or a community ; and second, social and cultural aspects such as ethics, economics, aesthetics etc. which affect the behavior of an individual or a community.

Environmental geology is the application of geological information to human problems encountered in the physical environment. It includes evaluation of natural hazards to minimize loss of human life and properties damage ; evaluation of the landscape for site selection, land-use planning, and evaluation of earth materials to determine their potential use as resources or waste disposal sites and the effect on human health, and to assess the need for conservation practices (Keller, 1979).

1.2 Objectives of the study

The aims of this study are to (i) compile an existing information of socio-economic, geology and resources, (ii) analyze and interpret those informations in term of limitation and advantage, (iii) recommend the area for industrial area and sanitary landfell waste disposal site.

1.3 Location of the Study Area

Saraburi province is situated in the northeast of Bangkok metropolitan and covers area about 3,576 square kilometers or 2,235,000 rais. It lies between latitude $14^{o}\ 13'$ N to $15^{o}\ 5'$ N and the longitude $100^{o}\ 35'$ E to $101^{o}\ 37'$ E (Figure 1.1). It is about 108 kilometers from Bangkok via the National Highway No.1, about 113 kilometers by railway and about 165 kilometers along the Chao Phraya River and the Pasak River. It is bounded in the north by Lop Buri Province, the east by Nakhon Ratchasima and Nakhon Nayok Provinces, the west by Phra Nakhon Si Ayutthaya Province and the south by Phranakhon Si Ayutthaya, Pathum Thani and Nakhon Nayok Provinces (Figure 1.2).

1.4 Previous Investigation

Many workers studied in this area for many different objectives. Brown et al. (1951) studied the Upper Palaeozoic limestone unit covering the studied area and vicinity. He designated its as the Ratburi limestone after the type locality in Changwat Ratburi. Moreaux et al. (1959), Kobayashi (1960), Klompe (1962) and Toriyama and Sugi (1955) studied fossils in limestone and other rock types covering the studied area and vicinity. Borax and Stewart (1966) correlated the Palaeozoic stratigraphy of the Northeastern Thailand including the northeastern part of the studied area. Kaset Pitakpaivan et al. (1969) reported the Permian fossils from the limestone in Changwat Saraburi. The Department of Geology, Chulalongkorn University selected Saraburi area for fourth year

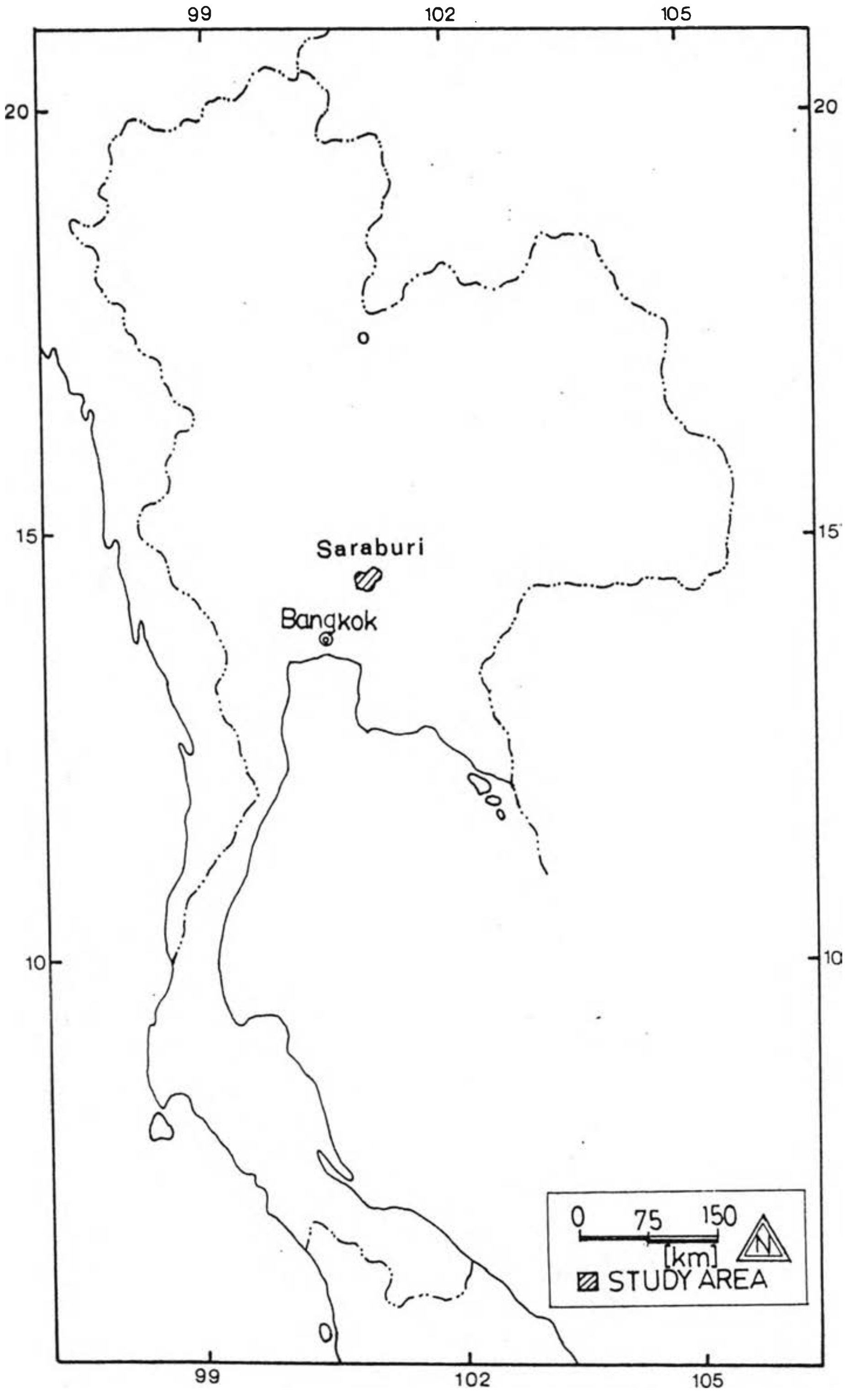

Figure 1.1 Index Map of The Study Area

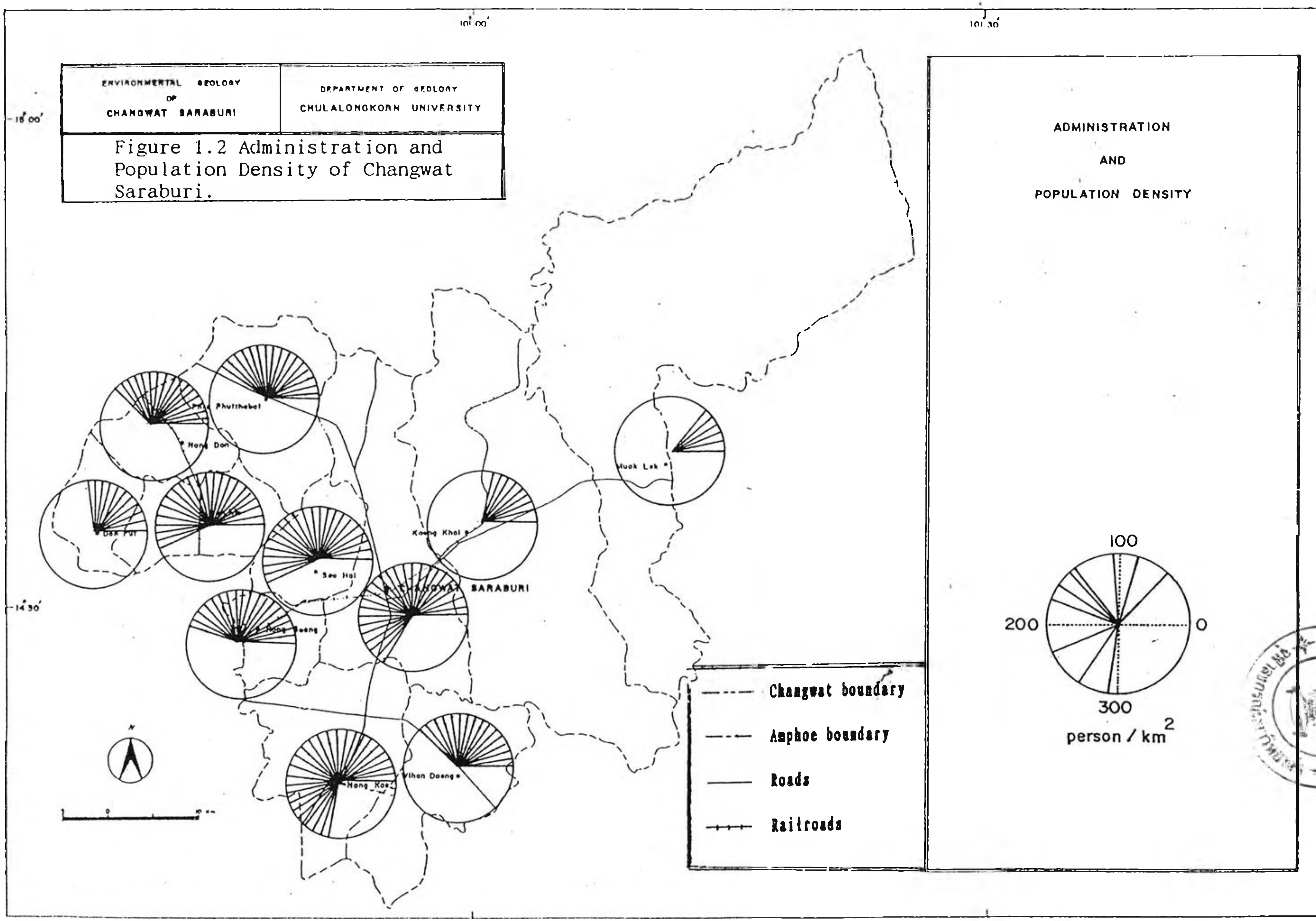

Figure 1.2 Administration and Population Density of Changwat Saraburi.

student field work in summer season for several academic year (i.e. 1963, 1970, 1971, 1972 and 1985). In 1992, a fourth year student of this department, Montri Choowong performed the senior project on the preliminary environmental geological assessment for regional planning in Changwat Saraburi. Dawson (1978) reported the study on stratigraphy along highway no.21 (Phu Khae-Lom Sak) between kilometer 6-14. Chaiyan Hintong (1976 and 1981) compiled the geological map scale 1:250,000 (ND 47-8) Changwat Phra Nakhon si Ayutthaya which covered most of the studied area. The work described on the lithology, stratigraphy, general structure and economic minerals. Prasong Phothong (1986) studied geology and structural geology of Permian Ratburi group in Changwat Saraburi.

Quaternary Geology and Geomorphology : In 1967, Alekseev and Takaya attempted to establish the Upper Cenozoic stratigraphy of the Central Plain based mainly on the morphology of the deposits, lithology and a few fossils. Takaya (1968, 1971 and 1972) reported his study on Quaternary outcrops in Central Plain in more detail. Takaya and Narong Thiramongkol (1982) studied Chao Phraya Delta of Thailand and divided into in blocks based on physical environment for rice growing. Narong Thiramongkol (1982) continued his works on geomorphology of the Lower Central Plain, Thailand.

Water resources : Sahat Buenchuen (1978) studied rainfall and stream run-off of Pasak Basin. Sabur (1982) analyzed and compared methods of flood-frequency analysis in many river basins in Thailand. Charoen Piancharoen et al. (1962) produced the hydrogeological map of Central Plain and Eastern Part of Thailand in scale 1:500,000.

Somkid Buapeng (1988) studied some groundwater chemistry from many wells in Changwat Saraburi. Royal Irrigation Department (RID) has published annual run-off of river basins in Thailand.

Mineral Resource : Jumpon Kuentag (1979) studied on marl deposits at Ban Mo. Vivat Paijitprapaporn et al. (1984) studied on limestones, marble and dolomite in map sheet Changwat Phra Nakhon Si Ayutthaya scale 1:250,000. Vuttiganta Suksoem (1988) reported his study on limestones and dolomite covering the studied area and vicinity.

Construction materials : Thapanit Aimasiri (1990) presented some engineering properties of laterite/lateritic soils, sand and limestones which used in construction of Rang Sit - Saraburi Highway. Somwang Changsuwan (1991) compiled and analyzed some engineering properties of limestones in Changwat Saraburi and vicinity.

Soils : Charoem Wongvisitrangsri et al. (1981) reported their study on soils map of Changwat Saraburi scale 1:100,000. Pranom Kaosuta et al. (1986) reported their work on land use planning for agriculture of Changwat Saraburi.

Hazards : Prinya Nutalaya et al. (1985) compiled the seismic source and maximum earthquake intensity map of Thailand and adjacent areas. Ohkura et al. (1989) studied LANDSAT images of dry and rainy seasons and analyzed the flood-inundate area of Central Plains, Thailand.

General : Chutamas Nielsen (1988) studied tourism development planning in Saraburi and Lop Buri provinces. Preecha Tosai (1990) studied development planning quideline of Saraburi Province. Saraburi Provincial Office (1991) reported socio-economic of Changwat Saraburi. Japan International Cooperation Agency (JICA, 1990) proposed the strategies of tri-sector balance economy (agriculture, industry and service) of the Upper Central Region (UCR), including Saraburi area.

1.5 Human Interaction with The Environment

Human activities can cause or accelerate permanent change in natural systems. The impact of humans on the global environment is broadly proportional to the size of the population as well as to the level of technological development achieved. The increase in population causes the evolutionary of urban areas from the farm to the small town, to the city and to the large metropolitan area. If the growth is properly planned and directed, urban areas should be able to maintain at least a rough balance between acceptable environment degradation and constructive use of environment (Keller, 1979).

1.5.1 Hydrology and Human Use

Water is a fundamental resource for people, industry and irrigation. Severe water problems arise because it is often not suitably distributed for human use. If there is too much water it will create floods and it too little will cause droughts, or if the quality is polluted it will cause disease and ruin crops. When we understand and use it in a right way water can be a true and worthy servant of mankind, but when we neglected and abused, it can be fiendish tyrant and destroyer (Coates, 1985).

1.5.1.1 Hydrological cycle

The world's resources are locked into the hydrological cycle whereby evaporation of ocean water becomes entrained into the atmosphere. Precipitation from the sky provides water to lakes, streams and wet lands. In addition, some water may sink below the land surface and become part of the groundwater. Ultimately, all these continental waters flow back to the ocean and become recycle once again (Caates, 1985).

1.5.1.2 Ground Water Mining and Land Subsidence

A condition known as ground water overpumping is produced when excessive pumping rate contributes to a lowering of the water table. Thus, discharge exceeds recharge, and earth materials are dewatered. Such a condition can lead to a tighter packing arrangement of sediments with resulting subsidence and fissuring of the land surface (Coates, 1985).

ESCAP (1985) concluded that Bangkok was situated over 1,000 meters of soft sediments, mostly sand and clay. The total rate of ground water pumpage in Bangkok metropolitan area in 1985 including both private and public sector was about 1.3 million cubic meters per day. The intensive of pumpage of groundwater from interconnected sand aquifers in eastern Bangkok has resulted in the lowering of the ground surface and the development of a major subsidence bowl.

Another result of dewatering of the sand aquifers in Bangkok is highly saline connate water begin leaking out of marine clays sandwiched in the section between the sands or sea water has been introduced into the sands where the clay at the surface is missing.

1.5.1.3 Pollution

Sources of pollution may be subdivided into point sources and non-point sources. Point sources are sources from which pollutants are released at one readily spot such as a sewer outlet, a steel mill, a septic tank and so far. Non-point sources are more diffuse including fertilizer run-off from farmland, acid drainage from abandoned step mine. The point sources are often easier to identify as potential pollution problems. They are also easier to monitor systematically (Montgomery, 1989).

1.5.2 Mineral Resources and Environment

There are two classes of solid mineral resources. The first has value that is critically dependent upon its location. For example, sand, gravel and cement rock are of low unit value and transportation accounts for one-half or more of the costs. The second class of mineral resources has sufficient value to justify local concentration and long distance shipment. Copper, iron, gold and silver are members of this group. Actually, most mineral resources are intermediate types with the ratio of bulk to value determining the economic feasibility of shipping to distant markets (Howard and Remson, 1978).

1.5.2.1 Geology and Mineral Resources

The geology of economic mineral and rock materials is as diversified and complex as the processes responsible for their formation or accumulation in natural environment.

The genesis of mineral resources with commercial value can be subdivided into 4 categories : first, igneous processes, including crystal settling and late magmatic and hydrothermal activities ; second, metamorphic processes such as contact metamorphism ; third, sedimentary processes, including accumulation in oceanic, lake, stream, wind and glacial environments ; and fourth, weathering processes such as soil formations and insides (in-place) concentration of insoluble minerals in weathered rock debris (Keller, 1979).

1.5.2.2 Environmental Impact of Mineral Development

The impact of mineral exploitation on the environment varies with the stage of development of the resources. The exploration and testing stage involve considerably less impact than the mining and processing stages which may have a considerable impact on the land, water, air and biologic resources. However, minimizing environmental degradation caused by mining may be very difficult considering that demand for minerals is continuing to grow while the volume of highly concentrated minerals deposits diminish (Keller, 1979).

1.5.3 Natural Hazards

1.5.3.1 Seismic Hazards

Earthquakes are the detectable shaking of the earth's surface resulting form seismic wave generated by a sudden release of energy from within the earth. Surface effects include damage to or destruction of structures ; faults and crustal warping, subsidence, liquefaction and slope failures offshore or onshore ; and tsunamis and seishes in water bodies (Hunt, 1984).

To delineate earthquake effect, seismic zoning map is prepared in relation to some earthquake parameters such as magnitude, intensity, acceleration, active fault, probability of occurrence and others (Santoso, 1982).

1.5.3.2 Flooding Frequency

Sabur (1982) concluded that by using probability analysis of Gumbel's theory and others for rivers in Thailand is suitable and simple.

1.5.3.3 Flood Inundated Area

Ohkura (1982) using LANDSAT images in dry and rainy season for several years combined with geomorphology of Central Plain to construct flood inundated area.

1.5.4 Waste Disposal

Waste is produced at home, by industry, by agriculture and by storm run-off. Waste could be solid, liquid or gaseous. For solid waste there are many methods of disposal, eg. open dump, land fill, disposal at sea, incineration, composting, bating & shredding, animal feed, resources and energy recovery (Fleming, 1974).

The California Department of Water Resources classifies solid waste disposal site on the basis of potential for impairing the quality of surface and ground water. The classification is based on the fact that the physical characteristics of a disposal site control the type of wastes that can be safely disposed off without resulting in water pollution.

Three general classes of disposal sites have been established:

Class I : Disposal sites are located on non water bearing rocks or on rock containing isolated bodies of unusable groundwater. Sites are locate more than 150 meters (500 feet) from adjacent surface water, and facilities are provided to divert stream around the site. Except for radioactive materials, there is no limitation on the type of material, liquid or solid that may be dumped.

Class II : Disposal sites may be underlain by usable, confined or free groundwater where the lowest elevation of the disposal site is at least 2 feet above the highest anticipated ground water level. The exact distance separating the bottom of the fill and the highest ground water level is determined by drilling and evaluated on a case-by-case basis.

Adjacent surface water must be excluded from the site as in the Class I disposal site and discharge to surface water is prohibilted.

The materials that can be disposed of the these sites include decomposable organic wastes as well as other solid wastes. Specific examples include garbage, dead animals ; plant wastes from agriculture.

Class III Disposal sites afford little or no protection to underlying or adjacent waters. Debris control must be practiced. Only non water soluble, non decomposable inert solids may be disposed of the site. Examples are natural earth, rock, sand and gravel, concrete and construction materials.

Any material that can be disposed off in a Class II site can also be disposed off in a Class i site. Similarly, anything that can be disposed off in a Class III site is acceptable in either a Class I or Class II site (Howard & Renson, 1978).