INSTITUT PENYELIDIKAN HIDRAULIK KEBANGSAAN MALAYSIA

NATIONAL HYDRAULIC RESEARCH INSTITUTE OF MALAYSIA

9th MALAYSIAN PLAN

PENYELIDIKAN PENGURUSAN AIR TANAH

PROJECT CODE: P2317000 014 0001

STUDY ON GROUNDWATER OPTIMISATION IN JENDERAM HILIR, DENGKIL, SELANGOR

REPORT NO: NAHRIM/PKG/2/2011

KEMENTERIAN SUMBER ASLI DAN ALAM SEKITAR

MINISTRY OF NATURAL RESOURCES AND ENVIRONMENT

This report can be obtained from:

National Hydraulic Research Institute of Malaysia (NAHRIM),
Lot 5377, Jalan Putra Permai,
43300 Seri Kembangan,
Selangor Darul Ehsan,
MALAYSIA

www.nahrim.gov.my
Telephone: +603-89483033
Fax: +603-89483044

STUDY ON GROUNDWATER OPTIMISATION IN JENDERAM HILIR, DENGKIL, SELANGOR

MOHD KHAIRUL NIZAR BIN SHAMSUDDIN

AND

SAIM SURATMAN

REPORT NO: NAHRIM/PKG/2/2011

STUDY ON GROUNDWATER OPTIMISATION IN JENDERAM HILIR, DENGKIL, SELANGOR

TABLE OF CONTENTS

TABLE OF CONTENTS i
LIST OF FIGURE iii
LIST OF TABLE iv
LIST OF ABBREVIATIONS v
LIST OF APPENDICES vii
ABSTRACT viii
1.0 INTRODUCTION 1
1.1 Introduction 1
1.2 Objective 4
1.3 Scope of Study 4
1.4 Methodology 4
1.5 Description of the Study Area 5
1.6 Literature Review 6
1.6.1 Hydrogeology 6
1.6.2 Bank Infiltration 8
2.0 PHYSIOGRAPHY 16
2.1 Topography 16
2.2 Drainage 18
2.3 Landuse 18
2.4 Temperature 19
2.5 Rainfall 20
2.6 Evaporation 21
3.0 GEOLOGY 22
4.0 HYDROGEOLOGY 24
4.1 Geophysical Investigation 24

4.2 Subsurface Exploration 32
4.3 Aquifer System 33
4.4 Surface Water and Groundwater Interaction 36
4.5 Aquifer Test 42
4.6 Bank Infiltration 49
4.6.1 Sieve Analysis For Aquifer Material 49
4.6.2 Utilisation of Bank Infiltration for Water Treatment In Malaysia 51
4.6.3 Bank Infiltration in the Study Area 56
5.0 WATER QUALITY 64
5.1 Groundwater and Surface Water Sampling 64
5.1.1 pH 67
5.1.2 Electrical Conductivity (EC) 67
5.1.3 Total dissolved solids (TDS) 67
5.1.4 Turbidity 68
5.1.5 Sulphate (SO_4) 68
5.1.6 Nitrate (NO_3) 68
5.1.7 Heavy Metals 69
5.1.8 Ferum (Fe) 69
5.1.9 Magnesium (Mg) 69
5.1.10 Calcium (Ca) 70
5.1.11 Sodium (Na) 70
5.1.12 Potassium (K) 70
5.1.13 Bicarbonate (HCO_3) 70
5.2 Microoganism Counting 71
5.2.1 Cryptosporidium and Giardia 71
5.2.2 Total Coliform and *Escherichia coli (E.coli)* 72
5.3 Water Classification 73
6.0 CONCLUSION 89
7.0 REFERENCE 90

LIST OF FIGURE

Figure 1.1: Location of study area 6
Figure 1.2: Sketch of factors influencing bank infiltration (modified after Nogeitzig,2005) 10
Figure 1.3: Schematic view of an aquifer system showing redox reactions and zonations at a variety of spatial scales (POC = particulate organic carbon, DOC = dissolved organic carbon) (after Hunter et al.,1998) 12
Figure 2.1: Schematic flow of lake water displacement (WT1) in the Jenderam Hilir area (source: Konsotium ABASS Sdn Bhd.)..... 17
Figure 2.2: Landuse Map (after Department of Agriculture, 2006) 19
Figure 2.3: Yearly temperature at KLIA station for 2003 to 2010 20
Figure 2.4: Monthly rainfall in Dengkil and KLIA station for Jan 2010 to Jun 2011 21
Figure 2.5: Yearly evaporation at KLIA station for 2003 to 2010 21
Figure 3.1: General geology of the Langat Basin 23
Figure 4.1: Location of the 2D resistivity survey line in Jenderam Hilir, Selangor 25
Figure 4.2: Resistivity profile line A-A' in Jenderam Hilir, Dengkil Selangor. 26
Figure 4.3: Resistivity profile line B-B' in Jenderam Hilir, Dengkil, Selangor..... 27
Figure 4.4: Resistivity profile line C-C' in Jenderam Hilir, Dengkil, Selangor..... 28
Figure 4.5: Resistivity profile line D-D' in Jenderam Hilir, Dengkil, Selangor 29
Figure 4.6: Resistivity profile line E-E' in Jenderam Hilir, Dengkil, Selangor 30
Figure 4.7: 2D Resistivity profile line F-F' in Jenderam Hilir, Dengkil, Selangor..... 30
Figure 4.8: 2D Resistivity profile line G-G' in Jenderam Hilir, Dengkil, Selangor 31
Figure 4.9: Location of 25 monitoring wells (MW),Test Wells (DW) and JMG Monitoring well (BKLEH) in Jenderam Hilir, Selangor 34
Figure 4.10: Lithological log and well design DW1 in study area 37
Figure 4.11: Lithological log and well design DW2 in study area 38
Figure 4.12: The schematic hydrogeological cross section A-A', B-B’ and C-C’ illustrating the aquifer system in Jenderam Hilir..... 39
Figure 4.13: Schematic diagram of bank infiltration project in Jenderam Hilir, Dengkil 40
Figure 4.14: Groundwater level and Sungai Langat water level for the year 2010 41

Figure 4.15: Step-drawdown test curve showing drawdown versus time for DW1 44
Figure 4.16: Step drawdown test curve showing drawdown versus time value for DW2 44
Figure 4.17: A schematic diagram of the conventional raw water treatment in Malaysia (sources: Konsortium Abass Sdn Bhd.) 54
Figure 4.18: Schematic plan for process scheme development of river water treatment in Malaysia utilising Bank Infiltration 55
Figure 4.19: Cross-sections of D-D' across the test well DW 2 58
Figure 4.20: Concentration of ions and dissolved solids in water samples from Jenderam Hilir, Dengkil 62
Figure 4.21: Change in sulphate and nitrate concentration in Sungai Langat and its BI water from well DW2 at 30 minutes, 24 hours, 48 hours and 72 hours at a distance of 17.4 m from the riverbank. 63
Figure 5.1: Piper trilinear diagram for the data obtained from chemical analysis of groundwater sample from Jenderam Hilir 77

LIST OF TABLE

Table 1.1: Example of riverbank or bank infiltration in some countries in the world (after Lee, I. S. and Lee, S.S., 2008) 3
Table 1.2: Important clogging effects on infiltration sediments (after Nogeitzig, 2005) . 10
Table 1.3 Sequence of microbially driven redox reactions or terminal electron accepting processes (TEAPs) and corresponding standard state changes of free energy (in kJ/mol CH_2O) (CH_2O = unidentified organic matter with zero-valent carbon) (after Berner, 1981) 11
Table 1.4: Water supply systems analysed for Bank infiltration in Malawi (Sharma & Amy, 2009) 14
Table 3.1: Stratigraphic position on the underlying rocks in relation to the regional geology 23
Table 4.1: Summary of 25 monitoring wells (MW) and test wells (DW) in Jenderam Hilir 35
Table 4.2: Results of step drawdown test wells for DW1 44
Table 4.3: Results of step drawdown test well for DW2 45

Table 4.4: Result of pumping test analyses for value of Transmissivity (T) and Hydraulic Conductivity (K) based on Thesis equation 48
Table 4.5: Summary results of soil particle and values of hydraulic conductivity calculated using Hazen methods for DW2 50
Table 4.6: Selangor growth in population and domestic Demand, Selangor 1960-2006 (GOM, 2000) 53
Table 4.7: Statistic of water consumption in Malaysia from 2008 until 2009 (after Malaysia Water Association, 2010) 57
Table 4.8: Groundwater and surface water quality of the study area in Jenderam Hilir .. 59
Table 4.9: Water quality in Jenderam Hilir sample during the pumping test, for period of 30 minutes, 24 hours, 48 hours and 72 hours 61
Table 5.1: List of parameters analysed for groundwater and surface water 65
Table 5.2: Results of groundwater and surface water analysis from the Jenderam Hilir . 66
Table 5.3: Occurrence of Cryptosporidium and Giardia in river water and groundwater sample in Jenderam Hilir, Dengkil, Selangor 75
Table 5.4: Occurrence of total coliform and *E. coli* in river water and groundwater samples in Jenderam Hilir, Dengkil taken in May 2010 76
Table 5.5: Occurrence of total coliform and *E.coli* in river water and groundwater samples in Jenderam Hilir, Dengkil collected in October 2010 76

LIST OF ABBREVIATIONS

a.g.l.	-	Above ground level
a.m.s.l.	-	Above mean sea level
BI	-	Bank Infiltration
DBPs	-	Disinfection by-product
DW	-	Test well
E. coli	-	Escherichia Coli
ERL	-	Express Rail Link
HAA	-	Haloacetic acid

JMG	-	Department of Minerals and Geoscience of Malaysia
JPS	-	Department of Irrigation and Drainage
K	-	Hydraulic Conductivity
KLIA	-	Kuala Lumpur International Airport
km	-	Kilometers
LUAS	-	Lembaga Urus Air Selangor
m	-	meters
MAR	-	Managed Aquifer Recharge
mg/l	-	milligrams per liter
MLD	-	Million liters per day
mm	-	milimeters
MMD	-	Malaysia Meteorological Department
MOH	-	Ministry of Health Malaysia
MPN	-	most-probable number
msl	-	mean sea level
MW	-	Monitoring well
NAHRIM	-	National Hydraulic Research Institute of Malaysia
pH	-	Acidity/Alkalinity
PIW	-	Paya Indah Wetlands
PLUS	-	North-South Highways
Q	-	Discharge/low flow
R&D	-	Research and development
Sungai	-	River
S_w	-	drawdown
T	-	Transmissivity
THM	-	Trihalomethane
TOC	-	Top of casing
W_e	-	Well efficiency
WHO	-	World Health Organisation

LIST OF APPENDICES

Appendix A: Borehole log and well design
Appendix B: Pumping test records and analysis
Appendix C: Sieve analysis results
Appendix D: Results of groundwater analysis
Appendix E: Result of microorganism counting
Appendix F: Photo of the study area

STUDY ON GROUNDWATER OPTIMISATION IN JENDERAM HILIR, DENGKIL, SELANGOR

ABSTRACT

It is known that most surface water sources in Malaysia are polluted to a certain extent by various pollutants coming from point sources such as landfills and industrial waste and non-point sources of agricultural related activities. The water operator incurred higher cost of water treatment particularly when using conventional sedimentation treatment in which the high concentration of pollutants requires higher volumes of chemicals. At the same time, the disinfection by-product (DBP) is also increasing. Hence, the R&D work is being carried out on Bank Infiltration (BI) or also known as Riverbank Filtration (RBF) method as a form of natural treatment in increasing the quality of water sourced for public water supply system. BI refers to the process of surface water seeping from the bank or bed of a river or lake to the production wells. During the water's passage through the ground, its quality changes due to microbial, chemical and physical processes, and due to mixing with groundwater.

The BI study in Jenderam Hilir, Selangor is a pilot project which the objective to develop a better and sustainable source of water, and provide a good platform to introduce this method in Malaysia which has been successfully implemented in many Asian and European countries. This site was chosen due to the high water demand in the area and groundwater is seen as one of the sources with very high potential to be developed as supplementary to meet need. Twenty five (25) monitoring wells and 2 test wells were constructed at the study site and pumping tests have been carried on these two test wells. The pumping tests indicated that DW1 and DW2 were able to produced more than 15.9 m^3/hr (0.3816 MLD) and 128 m^3/hr (3.072 MLD) respectively during the duration of 72 hours pumping tests with drawdown for DW1 was 4.17 m and DW2 was 2.63 m. The distance between the surface water sources and the test well is more than 18 m and the shortest travel time is 10 days. The study was carried out to determine the effectiveness of BI in reducing selected water quality parameters and improving the quality of river

water which is filtered through a 16 m thick silty sand for DW1 and 13 m thick gravelly sand for DW2. Both wells are located in confined aquifer adjacent to Sungai Langat. The pumping tests were undertaken to determine the effective rate of water extraction between two different lithologies of the study area.

Water quality analyses were carried out for water from the Sungai Langat and groundwater from the study site and the results showed decrease in turbidity, nitrate, aluminium and sulphate in groundwater which were very high in the Sungai Langat. Microorganism counting (E. coli, Total coliform, *Cryptosporidium* and *Giardia*) was also carried out. Results of sampling from the 2 test wells confirmed that the microorganism count were significantly reduced during the passage in BI and capable to achieve more than 99.9% removal of E. coli, total coliform and *Giardia*. The construction of BI method is a proactive effort of NAHRIM to improve the surface water quality as a source for domestic water of a modern urbanised area.

STUDY ON GROUNDWATER OPTIMISATION IN JENDERAM HILIR, DENGKIL, SELANGOR

1.0 INTRODUCTION

1.1 Introduction

In Malaysia, surface water is used as the main source of public water supply. Selangor is one of the most important states and the fastest developing among 14 states in Malaysia. In recent years, rapid development in Selangor has increased demand for water supply significantly. In addition, the impact of climate change such as long dry season or drought and pollution of rivers have reduced the availability of source of clean surface water.

Pollution of rivers have made river water unsuitable as source of raw water for treatment and in certain cases costs of treatment have risen unexpectedly. In order to supply safe drinking water and avoid supply disruption due to pollution, bank infiltration (BI) is one of the best method to provide water from both river and groundwater. Existing dams can no longer cope with such high demand whereas building new dams will increase the government expenditure and damage the natural ecology and upset the balance in nature. Thus, there is a need to use groundwater as a second source of water supply to guarantee clean and permanent water supply in Selangor. BI effectively remove microorganism and pollutant when surface water flows through aquifer materials.

It is known that most surface water sources in Malaysia are polluted to a certain extent by various pollutants coming from point sources such as landfills and industrial wastes, and non-point sources of agricultural related activities and there is a safety risk for human consumption unless they are extensively treated. The water operator incurred higher costs of water treatment particularly when using conventional sedimentation treatment in which higher concentrations of pollutants requires higher volumes of chemicals. At the same time, the volume of disinfection by-product (DBPs) is also high. Hence, R&D work

is being carried out on BI method as a form of natural treatment to increase the quality of water sourced for public water supply.

BI refers to the process of surface water seeping from the bank or bed of a river or lake to the production wells of a water treatment plant. During the water's passage through the ground (aquifer), its quality changes due to microbial, chemical and physical processes, and due to mixing with groundwater. BI can be accomplished through natural seepage into receiving ponds, shallow vertical or horizontal wells placed in alluvial sand and gravel deposits adjacent to surface waters, and infiltration galleries. Hence, the proper use of an alluvial aquifer could benefit water usage and water management.

The BI study in Jenderam Hilir, Selangor is a part of studying the potential of Managed Aquifer Recharge (MAR) technique. This is a pilot project to develop a better quality and sustainable source of water, and provide a good platform to introduce this method in Malaysia. BI has been successfully implemented in many Asian and European countries, thus, BI is a low-cost and efficient treatment method for potable water applications. BI does not require chemical additives, simple to operate and requires minimal maintenance. BI can reduce concentrations of many pollutants including disinfection by-products (DBPs) through a combination of natural processes including filtration, biodegradation and dilution. Other advantages of BI include its ability to attenuate contaminant shock loads and reduce water temperature fluctuation.

Since the last 100 years, the BI has been introduced along the Rhine, Elbe and Danube rivers to produce high quality drinking water. In the European countries, the BI has been successful in achieving effective removal of particulate matter, man made or natural organic compounds, some common bacteria, algae, disinfectant by-product precursors and a large number of chemical and other micropollutants (Verstraeten et al. 2002; Kühn and Müller, 2000; Grischek et al., 1998). Fifty percent (50%) of potable supplies in the Slovak Republic, 45% in Hungary, 16% in Germany and 5% in the Netherlands use BI method, i.e conjuntive use of surface water and groundwater. The sources of groundwater

come from infiltrating river. In Asian countries, namely South Korea and India are using BI as a way of obtaining drinking water supplies (Table 1.1).

Other than availability of flowing river, the hydrogeological characteristic are the most important aspects when evaluating potential BI sites. The detailed profiling of alluvial aquifers is crucial in selecting suitable well sites and well design. The key factors in selecting and developing suitable BI sites are the extent of alluvial aquifer and thickness of the aquifer. Hydraulic conductivity of the aquifer and available drawdown in the well are major hydrogeological conditions to be taken into consideration when evaluating potential of pumping significant volume of water from well.

Table 1.1: Example of riverbank or bank infiltration in some countries in the world (after Lee, I. S. and Lee, S.S., 2008)

River	**Location**	**Description***	**Capacity (m^3/d)**
Rhine	Düsseldorf (Germany)	70 V, 18 RC	357,600
Llobregat	Cornellá (Spain)	26 V, 7 R	62,000
Limmat	Hardhof (Swiss)	9 V, 4 RC	15,000
Donau	Lobau (Austria)	8 RC	136,000
Donau	Csepel (Hungary)	256 V, 30 RC	150,000
Great Miami	Cincinnati, OH (USA)	10 V	61,000
Kansas	Kansas City, KS (USA)	1 RC	151,200
Ohio	Louisville, KY (USA)	2 RC	75,600
Nakdong	Changwon (Korea)	50 V, 1 RC	80,000
**Remarks: V: vertical wells, RC: radial collector well, R: recharge well*			

1.2 Objective

The main objectives of the study are:

i. To identify the feasibility of Managed Aquifer Recharge (MAR) technique(s) to improve the groundwater quality and increase the quantity to fulfill water demand, and
ii. To identify the potential and suitability of Bank Infiltration method in the study area

1.3 Scope of Study

The present study was conducted to demonstrate the applicability and potential benefits of BI technique. The purpose of the evaluation was to determine whether BI is a feasible means of obtaining water from well in the Sungai Langat. The approach would take advantage of both the large volume of water in the river and the ability of the geologic materials underlying the river to filter suspended solids out of the water and reduce microorganism, thus simplifying the water treatment processes. The scope of the evaluation include ways of implementing BI and determine if the study area is a suitable location for such approach.

1.4 Methodology

The methodology followed in this study comprised the following steps:

i. Carry out desktop study to locate the best possible site for R&D in BI along Sungai Langat,
ii. Conduct geophysical survey to indentify location of piezometers and borehole at the chosen site,
iii. Drill at 25 locations to ascertain the subsurface geology of the area and surrounding areas complete with soil sampling and analysis,

iv. Construct 25 piezometers (monitoring wells) to monitor groundwater levels at the drilled locations
v. Construct 2 vertical test wells,
vi. Carry out a number of pumping tests – constant tests of 168 hours (7 days) and 72 hours (3 days), and step test (5 Steps) to determine the aquifer characteristics such as of transmissivity, permeability, storage coefficient and well efficiency,
vii. Carry out coliform count (Total Coliform and *E. coli*) and
viii. Carry out microorganism count (Cryptosporidium and Giardia), and
ix. Carry out water quality analysis.

1.5 Description of the Study Area

Jenderam Hilir is located in the southwest state of Selangor within the Langat Basin. It extends between latitude 2^0 53' 28.56" N and 2^0 53' 39.75" N and longitude 101^0 42' 03.78" E and 101^0 44' 14.58"E, covering an area of 10 km^2. The study area is located of downstream of confluence of Sungai Langat and Sungai Semenyih. This area is a former tin mining area. There are many areas of the lakes is this old mining site and used as water reservoirs. Dengkil is nearest town to the study area (Figure 1.1). It is a small town in the Sepang district of Selangor that lies between Cyberjaya to the north and Salak Tinggi to the south. In recent years, Dengkil has benefited from the growth of Putrajaya (the administrative capital of Malaysia) and Kuala Lumpur International Airport (KLIA) which are located nearby.

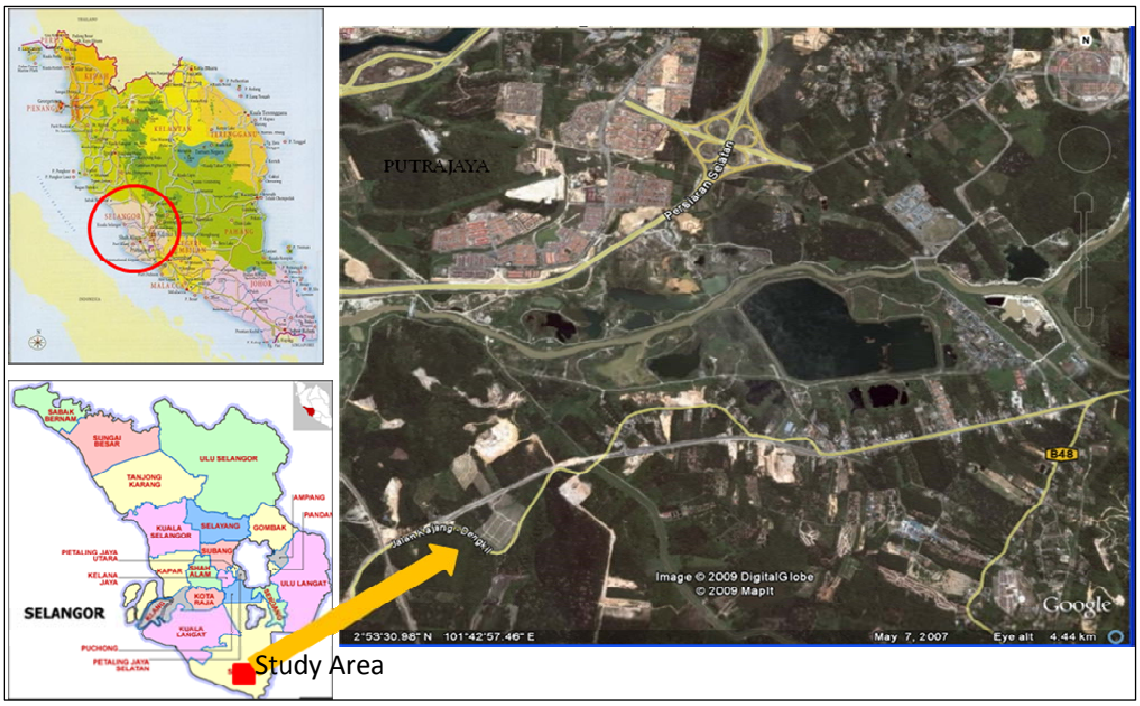


Figure 1.1: Location of study area

1.6 Literature Review

1.6.1 Hydrogeology

Langat Basin hydrogeological potential has prompted Japan International Cooperation Agency (JICA, 2002) to undertake detailed study in study area. Selangor is one of the states that is utilising groundwater quite significantly especially for industrial use. Lembaga Urus Air Selangor (LUAS) indicated that there are more than 350 active wells in Selangor. Based on the hydrogeological setting, three aquifer systems are present in the Langat Basin. They are Granite and Meta-Sedimentary Bedrock Aquifer (Kenny Hill/Kajang and Hawthornden Formation), River Alluvial Aquifer and Alluvial Plain Aquifer. Among the three aquifers, the Alluvial Plain Aquifer offers significant contribution of groundwater to the water needs of the Basin and the aquifer is bounded in the north and east by hills.

One of the earliest groundwater resources investigation was carried out by Doll Said (1988), covering coastal alluvial areas in the Langat Basin. A total of 48 drilling holes using water jetting technique, with depth ranges from 10-50 m were drilled in villages around the Sungai Langat estuary. This investigation revealed that there are 2 layers of aquifer in which saline water was encountered at depth of 15-30 m.

Other work on the western parts of the Jenderam Hilir include that of Abdul Rashid Bachik and Mohamed Hatta Abdul Karim (1998) who carried out hydrogeological explorations in Telok Datok area. They have identified two different layers of aquifer within the catchments area which are known as shallow and deep aquifers within the Quaternary alluvium which consists of gravel, sand, silt and clay. Another hydrogeological investigation to the north of study area was carried out in 1999 by Abdul Rashid Bachik (2000). The study covered about 400 km^2 extending from Kuala Selangor-Batang Berjuntai to part of Tanjong Karang areas in Kuala Selangor District.

JICA (2002) made an assessment on the sustainable groundwater resources and Environmental Management for the Langat Basin. The study covered the entire Langat and neighbouring southern basins covering an area of 2750.2 km^2. The study found that physical development in the Basin could threaten the quality of the groundwater through the introduction of contaminants into the groundwater regimes.

Ismail Yusoff et al. (2004) carried out a study on the groundwater component in the form of base flow in Sungai Chua and Sungai Bisa sub-catchment within Putrajaya Wetlands near the study area during low flow period. The study concluded that the flow of Sungai Chua is strongly supported by groundwater base flow. The hydraulic conductivity of the sediment in Sungai Chua is five time greater than the alluvium in the Sungai Bisa due to high composition of sand and gravel.

One area which was recently studied and very close to the study area is Paya Indah Wetlands (PIW). The study was carried out by Bahaa-eldin et al. (2009). The study found that there are significant interaction between surface water and groundwater in lakes in

PIW. Numerical modelling was carried out using MIKE SHE software to simulate the fluctuations of surface water levels and groundwater levels in PIW during dry and wet seasons. The simulation suggested that both surface water level and groundwater head provide good visual description of the hydrodynamic interaction between them in PIW.

1.6.2 Bank Infiltration

Bank infiltration (BI) is a process of abstracting water, using vertical or horizontal collector wells adjacent to rivers or lakes. The wells induce a hydraulic gradient which causes infiltration of surface water into the aquifer. During the underground passage, mechanical as well as biogeochemical reactions proceed, substantially improving the water quality in term of suspended solids, algae, pathogens and other bacteria, algal toxins, dissolved organic carbon, nitrate, organic pollutants and pharmaceutical residues. These constituents are eliminated or significantly reduced, peak concentrations of the surface water are mitigated. It is an effective and cost-efficient pretreatment, applied in many parts of the world, mainly for drinking water production. The term BI is used in two ways:

i. With respect to water supply, it denotes the total amount of water which is produced by a waterworks which is affected by bank filtration.
ii. At the scale of a well only the part which infiltrated by surface water is called bank filtrate, in contrast to inland water recharged by precipitation.

BI is predominantly applied in Europe. Usually vertical collector wells are located about 30-300 m from surface waters. Large plants exist in the following countries, the percentage denotes the ratio of nationwide consumed water: Netherlands (7%), Hungary (40%), Finland (48%), France (50%), Switzerland (80%) and Germany (16%). In Germany big plants exist in Düsseldorf, Dortmund, Dresden and Berlin. In the USA it is rarely applied, big plants are located at the Plate River, Nebraska. In contrast to Europe, in the USA wells are located much closer to the rivers, often horizontal collector wells are located directly beneath the river bed. Distances between 3-30 m are usual with

higher water abstraction rates, as a consequence abstracted amounts are higher, travel times are shorter and purification capacity is lower (Schubert, 2002).

The induced infiltration of surface water to aquifers is also defined as bank filtration or artificial groundwater recharge. The factors influencing BI processes depend on site-specific conditions (Grischek et al., 2002), as it is illustrated in Figure 1.2. The sediment properties such as grain size distribution, permeability and porosity, as well as the pumping regime, control the infiltration velocity. The spatial and seasonal distribution of organic and suspended matter in the surface water strongly influences the hydraulic conductivity by clogging of the sediment surface (Rittmann 1993; Greskowiak et al., 2005). Clogging by fine grained particles affects the hydraulic conductivity of the sediment (Schuh, 1990). The mechanism changing the sediment's properties are multiple and the most important clogging effects are listed in Table 1.2.

Biological clogging can have positive effects on the purification capacity of the filtering aquifer (Okubo and Matsumoto, 1983). Microorganisms are able to break down the influent organic compounds to a certain extent because the detention time increases with the development of biological clogging.

Within the first decimetres up to metres of the infiltration flow path, the most significant processes are reported to affect the filtration water in relation to microbial degradation of organic matter (Jacobs et al. 1988). Driven by the consumption of dissolved or sedimentary organic matter and characterised by the reduction of electron acceptors, redox sequences are observed in a large number of aquifer systems (Massmann et al. 2004). In most cases, microbial populations in subsurface environments derive their energy from the oxidative decomposition of organic substrates (Hunter et al. 1998). The reasons for the specific order of a typical redox sequence, starting with the consumption of oxygen and proceeding further, are of both thermodynamic and kinetic/microbial nature (Appello & Postma 1999).

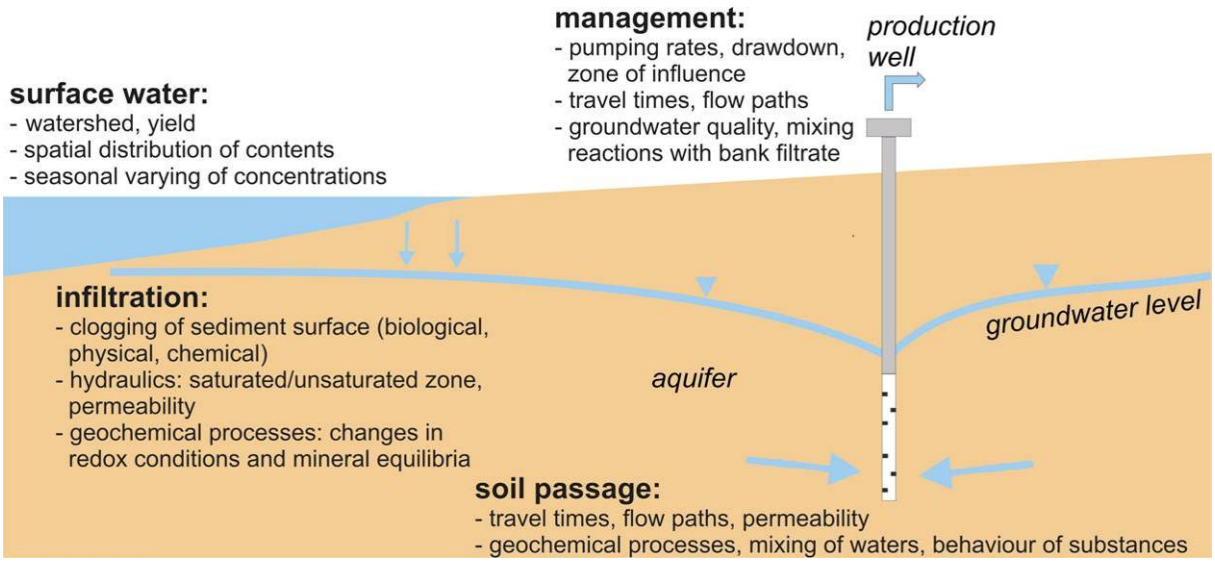


Figure 1.2: Sketch of factors influencing bank infiltration (modified after Nogeitzig,2005)

Table 1.2: Important clogging effects on infiltration sediments (after Nogeitzig, 2005)

Clogging effect	Causes of clogging
Physical clogging	Filtration of suspended particles or compaction of the sediment structure
Biological clogging	Bacterial colonisation and growth, polysaccharide fermentation
Chemical clogging	Precipitation of minerals (redox conditions, equilibriums)
Mechanical clogging	In situ degassing or intrusion of air (unsaturated zone below water body)

The reactions generally proceed from the highest energy yield downwards, the principle pathways are aerobic respiration, denitrification, manganese reduction, iron reduction, sulphate reduction and fermentation (Hunter et al. 1998). The significant reactions are the final electron transfers to an electron acceptor, as it is listed in Table 1.3.

Table 1.3 Sequence of microbially driven redox reactions or terminal electron accepting processes (TEAPs) and corresponding standard state changes of free energy (in kJ/mol CH_2O) (CH_2O = unidentified organic matter with zero-valent carbon) (after Berner, 1981)

Process	Reactions	Energy (in kJ/mol CH_2O)
Aerobic respiration	$CH_2O + O^2 \geq CO^2 + H_2O$	–475
Denitrification	$5CH_2O + 4NO^3 \geq 2N_2 + 4HCO^{3-} + CO^2 + 3H_2O$	–448
Manganese (IV) reduction	$CH_2O + 2MnO^2 + 3CO^2 + H_2O \geq 2Mn^{2+} + 4HCO^{3-}$	–349
Iron (III) reduction	$CH_2O + 4Fe(OH)^3 + 8H^+ \geq 4Fe^{2+} + 8HCO^{3-} + 3H_2O$	–114
Sulphate reduction	$2CH_2O + SO_4^{2-} + H^+ \geq H_2S + 2HCO^{3-}$	–77
Methane fermentation	$2CH_2O \geq CH_4 + CO^2$	–58

In some cases the disappearance is monitored of a reactant (O^2, NO^{3-}, SO_4^{2-}), while in other cases the appearance is registered of a reaction product (Mn^{2+}, Fe^{2+}, HS^-, CH^4). It has been proposed (Berner, 1981) to classify redox environments in terms of the presence or absence of indicative redox species. The dominating factors governing the extent of redox zonal environments are the availability (Banwart, 1999) and reactivity (Hartog et al., 2005) of organic matter, the fluxes of electron acceptors (Andersen et al., 2001) as well as the stored amounts of redox species in the sediment (Keating & Bahr, 1998). This is strongly dependant on the diffusive or advective kind of the predominant transport mechanism and therefore also dependant on the flow velocity (Jakobsen & Postma, 1999).

Permeability changes occur on a variety of scales (Figure 1.3). From large-scale permeability contrasts between aquifer and aquitard units to small-scale differences between flow channels and the porous matrix. Slow transport in aquitards and in narrow pore space limits the supply of electron acceptors, such as O^2 or SO_4^{2-} to the pore solution (Hunter et al., 1998). Furthermore, impermeable, fine-grained sediments

frequently have significant amounts of sedimentary organic matter associated with them (Lovley & Chapelle, 1995), creating conditions favourable for fermentation to occur within aquitards. As an example, in a groundwater flow system, the zone of Fe(III) reduction may be located upstream from the zone of sulphate reduction. Among various authors, Sinke et al. (1998) have shown that distinct redox zoning can develop within only a few centimetres thickness, while in other cases, redox sequences are stretching over several kilometres away from the infiltration place (Massmann et al. 2004). Field site-specific conditions, as fluctuating flow regimes may also lead to partly reversible redox processes in the aquifer (Sinke et al., 1998).

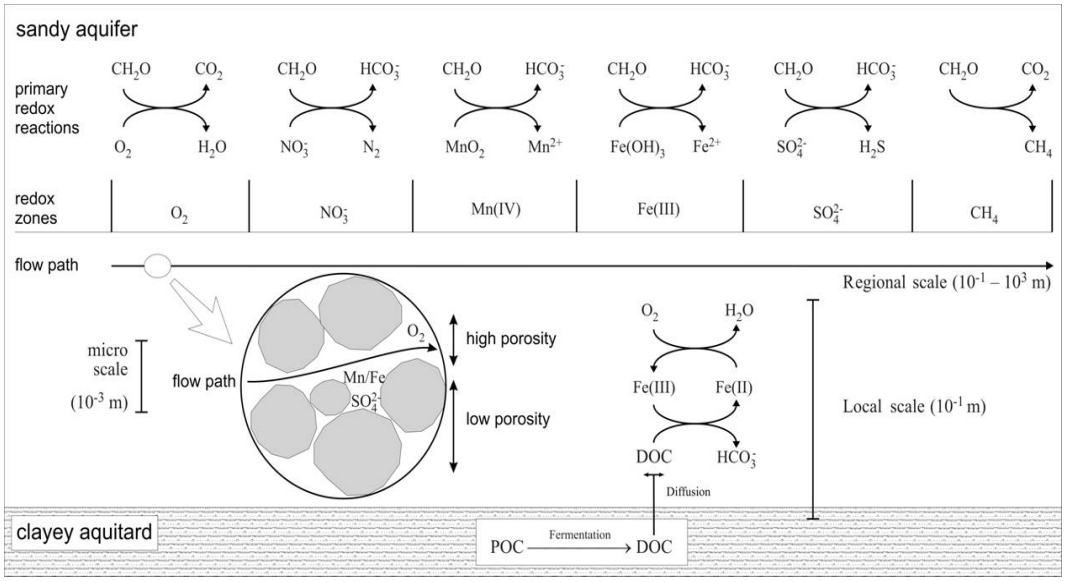


Figure 1.3: Schematic view of an aquifer system showing redox reactions and zonations at a variety of spatial scales (POC = particulate organic carbon, DOC = dissolved organic carbon) (after Hunter et al.,1998)

Active microbial populations modify the chemical composition of their surrounding, which in turn affects the microbial ecology and rate of production of biomass; metabolic reactions also influence groundwater pH and alkalinity. By modifying the redox conditions, the pH and the alkalinity, microbial reactions take over control on inorganic processes such as ion exchange, adsorption reactions and mineral precipitation and dissolution (Hunter et al., 1998). Furthermore, Postma & Jakobsen (1996) and other

authors found that a segregation of TEAPs (terminal electron accepting processes) into distinct redox zones is strongly affected by the spectrum of oxidisable matter present in the sediment. The greater the variance of, for example iron oxides, in stability, the more diffuse will be the zones of Fe(III) and sulphate reduction.

BI with its effective natural attenuation processes evidently has the following striking advantages:

- Elimination of suspended particles, biodegradable compounds, bacteria, viruses
- Part elimination of absorbable compounds
- Equilibration of temperature changes and concentrations of dissolved constituents, and
- Vicinity to surface waters ensure high recharge and pumping rates.

Detention times of BI in the aquifer range from 5 days to more than 10 years (Grischek et al., 2002). In Germany, a travel time minimum of 50 days is proposed because an old rule determines this period of time being sufficient to obtain the water free of pathogens. However, recent findings underline that the flow path length, river bed or lake bed properties and redox conditions play an important role for the removal of surface water-borne pathogens (Heberer, 2002). Several pharmaceutically active compounds that are discharged almost unchanged from municipal sewage water treatment plants are not eliminated during recharge through the subsurface. Further undesirable effects of BI on water quality can include increases in hardness, ammonium and dissolved iron and manganese concentrations, and the formation of malodorous sulfur compounds as a result of changing redox conditions (Hiscock & Grischek, 2002).

Five cities in Africa; three cities in Malawi; Blantyre, Lilongwe, and Mzuzu; and two cities in Kenya; Eldoret and Nakuru are using BI method. In most of these water supply systems, surface water (river) is the main source of water and conventional surface water treatment (sedimentation, chemical coagulation/flocculation, clarification and chlorination) are applied. For groundwater treatment in Nakuru, chlorination is the only

treatment applied. Furthermore, excessive chemical sludge production and difficulty in water treatment plant operation due to variation in the turbidity of the surface water are common in water supply systems of these cities (Sharma & Amy, 2009). Details salient features of the water supply systems analysed and cost calculations are presented in Table 1.4.

Table 1.4: Water supply systems analysed for Bank infiltration in Malawi (Sharma & Amy, 2009)

	Blantyre	**Lilongwe**	**Mzuzu**	**Eldoret**	**Nakuru**
Population	700,000	670,000	135,000	217,000	285,000
Water sources	Surface water (Shire river, Mudi dam)	Surface water (Lilongwe river)	Surface water (Lunyangwa river)	Surfeace water (Ellegirini, Endoroto and Moiben rivers	Surface water (31%; Groundwater (69%)
Existing water treatment plant capacity (m^3/day)	110,000	75,000	15,000	22,000	35,950
Operational cost of existing treatment (USDollar/m^3)	0.120	0.030	0.009	0.043	0.029
Estimated operational costs of BI system (USDollar/m^3)	0.098	0.014	0.009	0.036	0.020

In the United States, BI effectiveness for removing pathogen surrogates, particles, turbidity, natural organic matter, disinfection by-product precursors and pesticides too have been monitored. The BI system studied achieved up to 2.4 logs of particle removal, whereas in a comparative study, the conventional treatment process achieved only up to 1.5 logs of particle reduction. Total organic carbon (TOC) of 60% in river water was removed by BI. Conventional treatment processes, however, achieved about 25% TOC removal efficiency (Wang et al., 1995). The results obtained from the field study by Wang et al. (1995) indicated that the removal efficiency increased with the filtration depth, with most of the removal occurring within the first meter of the filtration. Analysis of data for total coliform, total aerobic spores and microscopic particulates suggests that more than 2.5 log removal was due to BI. Weiss et al. (2003, 2005) reported BI treatment removal for E. coli C bacteriophage was between 2.6-3.3 logs and for E. coli F-amp bacteriophage was between 1.9-2.3 logs at three different sites. Trihalomethane (THM) formation potential and haloacetic acid (HAA) formation potential were also reduced by 50-80%; whereas, reductions in haloacetonitriles, haloketones, chloral hydrate and chloropicrin precursors ranged from 30-100%. Bacterial transport in soil and other unconsolidated or consolidated materials depends strongly on material properties. Temperature, humidity, pH, amounts of organic matter in soil and aquifer material, rainfall, sunlight, and competitive microorganisms will all affect pathogenic survival in aquatic and soil environments as well as in other unconsolidated material, and even within aquifer matrices (Gerba & Bitton, 1984; Crook, 1985). During artificial sand filtration, removal of coliforms and heterotrophic bacteria decreases as temperature decreases (Bellamy et al., 1985); water salinity may also have an effect (Gannon et al. 1991). In fine sand, the migration of bacteria is limited and most bacteria are removed at the beginning of infiltration many even within the first 0.5 m (Bellamy et al. 1985; Preuss, 1996; Albrechtsen et al. 1998). In sandy gravel, Pang et al. (1998) reported the detection of Bacillus subtilis endospores after transport of 90 m from an injection well. In a gravel aquifer, Sinton et al. (1997) reported that E. coli J6-2 was recovered 401 m from an injection well. These data suggest that some coarse-grained aquifers may provide high water yields, but may have low efficiency in removing bacteria by BI when fine-grained river bed sediments are absent. Under steady-state conditions, BI with an average

residence time of 2 weeks showed 5 log removal efficiency for pathogenic microorganism surrogates, bacteria and bacteriophage. There may be variations of ±1 log removal efficiency, depending on the microorganism (Medema et al., 2000). Schijven et al. (2002) concluded that BI is an efficient system for the removal of microbial contaminants. Given sufficient flow path length and time, microbial contaminants will be removed or inactivated to levels that will safeguard public health. The field experiments by Schijven et al. (1998, 1999, and 2000) serve as a benchmark for field removal under relatively homogenous and steady-state conditions in a saturated sand aquifer. Under optimal conditions (canal infiltration into dune sand), BI can achieve up to 8 log virus removal over a distance of 30 m within 25 days.

Besides the gratifying opportunity of potable water production, BI at suitable sites also contributes to better preservation of groundwater resources and makes high pumping rates possible. Nevertheless, management of bank infiltration schemes should be implemented into wide catchment planning in order to limit potentially polluting activities in the watershed and also to balance infiltration losses with the ecological needs of the water body.

2.0 PHYSIOGRAPHY

2.1 Topography

The study area is part of Langat Basin area. The topography of the Langat Basin can broadly be divided into three regions, namely the mountainous areas located in the northeastern part of the basin, the hilly areas which are characterised by rolling hills with gentle slopes and predominate over a large part of the middle section of the basin, and the lowlands located in the southwest part of the Basin bounded by the hilly areas in the north and east, and by the sea in the southwest. At the top end of the mountainous terrain, the land elevation is around 1000 m above mean sea level (msl). However, most of the mountainous areas are below 500 m (msl). The change from mountainous to hilly land is gradual and the change is at around 150 m (msl). The hilly areas are characterised by

rolling hills with gentle slopes and predominate over a large part of the middle section of the basin. The elevation ranges from 50 – 150 m (msl).

The study area which is a former mining areas is occupied by a member of lakes. Three of the lakes are used as reservoirs and managed by Konsortium ABASS Sdn Bhd (the short name from Aliran Bekalan Air Selangor Selatan), and named as Pond A, Pond B and Pond C. These the ponds are interconnected with each others. (Figure 2.1) and functioned to increase the capacity of raw water intake and reduce the release of water from the Semenyih dam, and could be pumped into the nearby water intake.



Figure 2.1: Schematic flow of lake water displacement (WT1) in the Jenderam Hilir area (source: Konsotium ABASS Sdn Bhd.)

2.2 Drainage

Study area is located at the confluence of two major rivers namely Sungai Semenyih, Sungai Langat and one smaller river, Sungai Jenderam Hilir in the state of Selangor. The two rivers are the major source of raw water in Selangor where there are many water intakes located along the Sungai Langat and Sungai Semenyih. In the study area, Sungai Semenyih water intake is built a few hundred metres upstream from the confluence of the two rivers. This water intake serves Putrajaya mainly.

2.3 Landuse

Area surrounding the study area is rapidly developing as a result of the spill over on the development of Putrajaya, Cyberjaya and Kuala Lumpur International Airport (KLIA). Availability of road networks such as the ELITE highway, North-South highway (PLUS), Nilai-KLIA highway and main road connecting Dengkil and Kajang, and Putrajaya including rail service i.e. Express Rail Link (ERL), has become the source of connection that led to increase of landuse activities around the study area. Physical development including housing is active in Dengkil, Putrajaya and Bandar Baru Salak Tinggi. Agricultural activities, especially oil palm and rubber plantations dominated these areas. There are also green areas that still remained, near the area such as Kuala Langat North Forest Reserve located on the west and Universiti Kebangsaan Malaysia (UKM) reserves are located northeast of the study area. Figure 2.2 shows the landuse map of the study and surrounding areas. Over 70% of the study area is a former mining area and not developed.

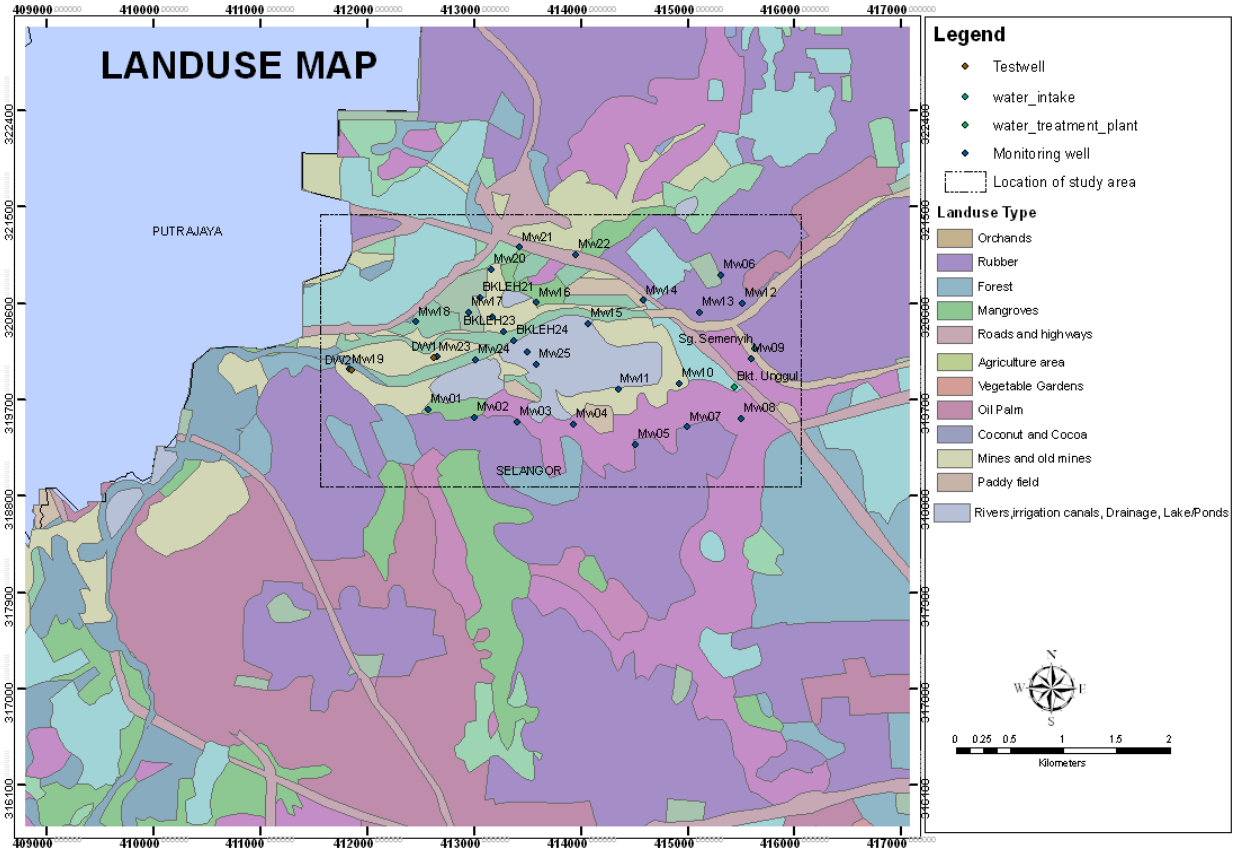


Figure 2.2: Landuse Map (after Department of Agriculture, 2006)

2.4 Temperature

Dengkil is always hot and humid with daily temperatures between 27-30^{0}C. The nearest weather stations is located at Dengkil town and KLIA, Sepang. The monthly temperature recorded at KLIA, Sepang from 2003-2010 remains relatively stable throughout the year with average monthly variations not exceeding 3.0^{0}C. The lowest and highest 24 hour mean temperature were 26.4^{0}C (2009) and 29.5^{0}C (2005) respectively (Figure 2.3).

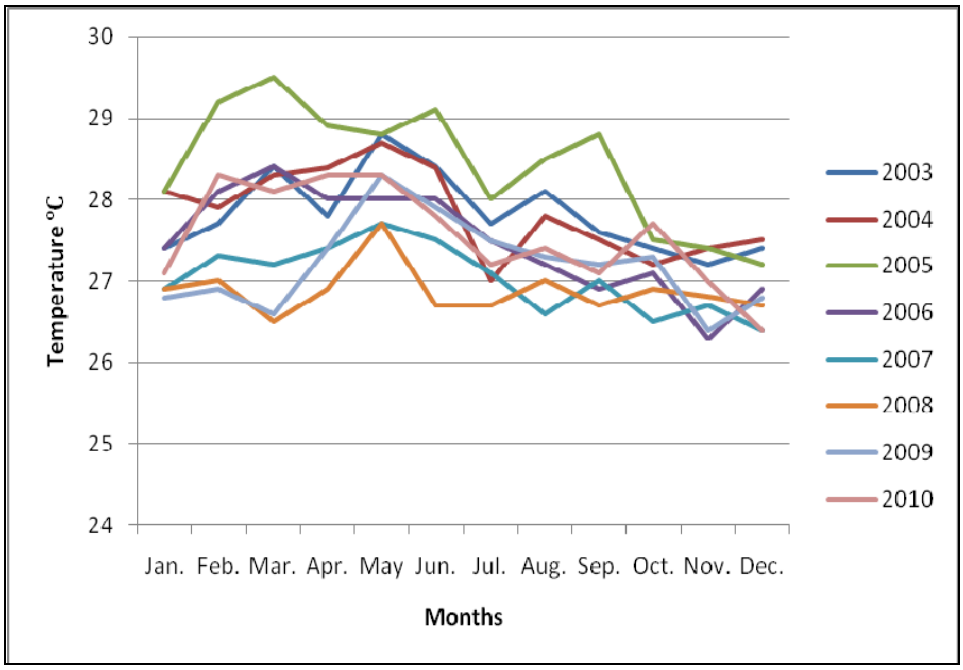


Figure 2.3: Yearly temperature at KLIA station for 2003 to 2010

2.5 Rainfall

The two monsoon periods, northeast monsoon from October to January and the Southwest monsoon from May to September are well defined. The rainfall is concentrated between January and March. The annual mean precipitation was 1288.6 mm for 2010. The rainfall data recorded at KLIA, Sepang and at Dengkil station recorded by Department of Irrigation and Drainage Malaysia (JPS) from the January 2010–Jun 2011 shows a fluctuating distribution pattern with March 2010 having the heaviest rainfall (i.e. 265.4 mm daily total rainfall in Dengkil Station) and August 2010 at KLIA station (i.e. 173 mm) while the February 2010 and May 2011 was the driest months with 12.2 mm and 8.0 mm daily total rainfall at KLIA station. Based on the monthly rainfall for the year 2010 as shown in Figure 2.4, it is indicated that the heaviest rainfall occur in January and March. The total annual rainfall for 2010 was 1288.6 mm.

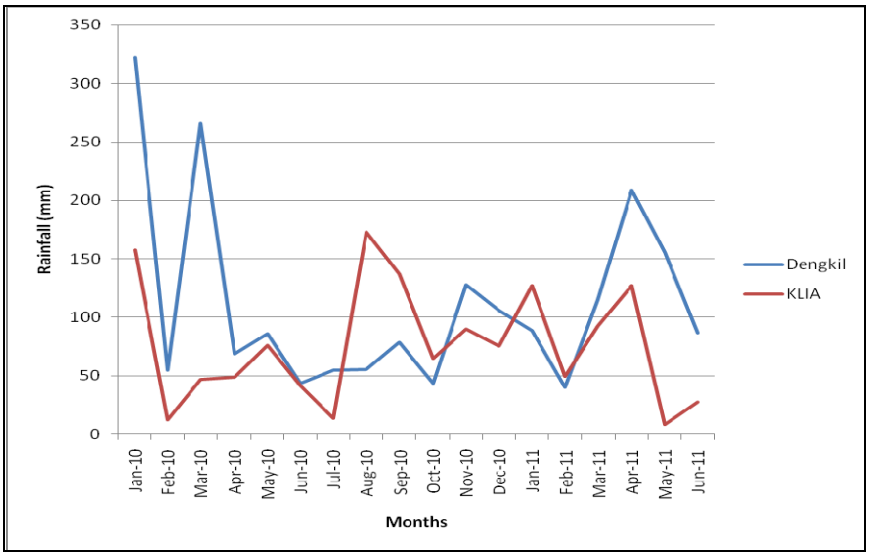


Figure 2.4: Monthly rainfall in Dengkil and KLIA station for Jan 2010 to Jun 2011

2.6 Evaporation

Daily evaporation data recorded at KLIA from the year 2003-2010 were analysed. The highest mean daily evaporation was in the year of 2010 with 4.3 mm while the lowest mean daily evaporation was in the 2003, 2004 and 2008 with 3.9 mm (Figure 2.5).

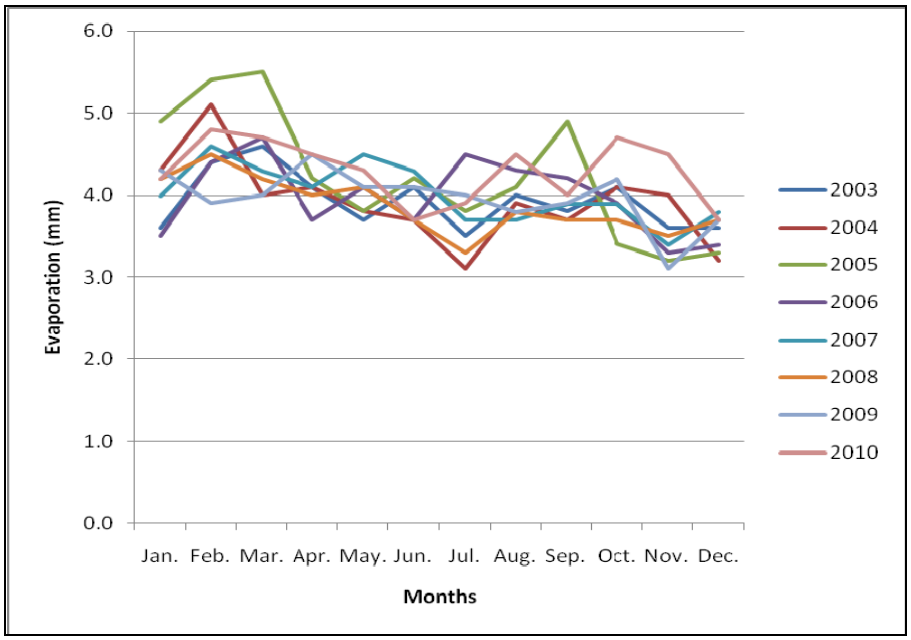


Figure 2.5: Yearly evaporation at KLIA station for 2003 to 2010

3.0 GEOLOGY

3.1 Regional Geology

The Langat Basin has an area of about 2,100 km^2, comprising about 1,155 km^2 of hilly and mountainous terrain, and 945 km^2 of coastal plain. Figure 3.1 shows the general geological map of the Langat Basin. Bedrock in the mountainous area includes Permian igneous rocks, and Pre-Devonian schist and phyllite of the Hawthornden Schist. Hawthornden Formation rocks are highly deformed and have undergone two phases of deformation (Gobbett and Hutchison 1973). The predominant rock in the foothills is Permo-Carboniferous meta-sandstone, quartzite, slates, phyllites and quartz schist of Kenny Hill Formation. These strata are comparatively less deformed than rocks of the Hawthornden Formation. On the coastal plain, Quaternary deposits consisting of Palaeocene through Holocene unconsolidated gravel, sand, silt and clay of Simpang, Kempadang, Gula and Beruas Formations unconformably overlay eroded bedrock, and grow progressively younger and thicker toward the coast (Gobbett and Hutchison, 1973). In general, these sediments grade downward from clay to gravel and were deposited in fluvial and shallow marine environments. Coarse to very-coarse sandy gravel of the Simpang Formation (Palaeocene to Pliocene) at the base of the Quaternary strata is considered the main aquifer of the Langat Basin. The aquifer is typically several metres thick near the foothills and varies from about 50 m to more than 100 m further toward the coast (JICA 2002).

Geology of Sepang and Kuala Langat District is made up Kenny Hill Formation, Hawthornden Schist, granite and alluvium (Abdullah Sani, 1985). Majority of the area is covered by alluvium, which is characterised by gently sloping and flat terrain. Kenny Hill Formations and Hawthornden Schist characterised the low and semi-rolling hills. Granite shows higher topography and located in the west of study area (Figure 3.1). Granite is part of the main range and Kuala Lumpur Granite Pluton (Cobbing and Mallick, 1987). There are a series of faults in the Kenny Hill Formation, Hawthornden Schist and granite. Folding can be found in the quartzite and phyllite of the Kenny Hill Formation. The

stratigraphic position of the underlying rocks in relation to the regional geology is as shown in Table 3.1.

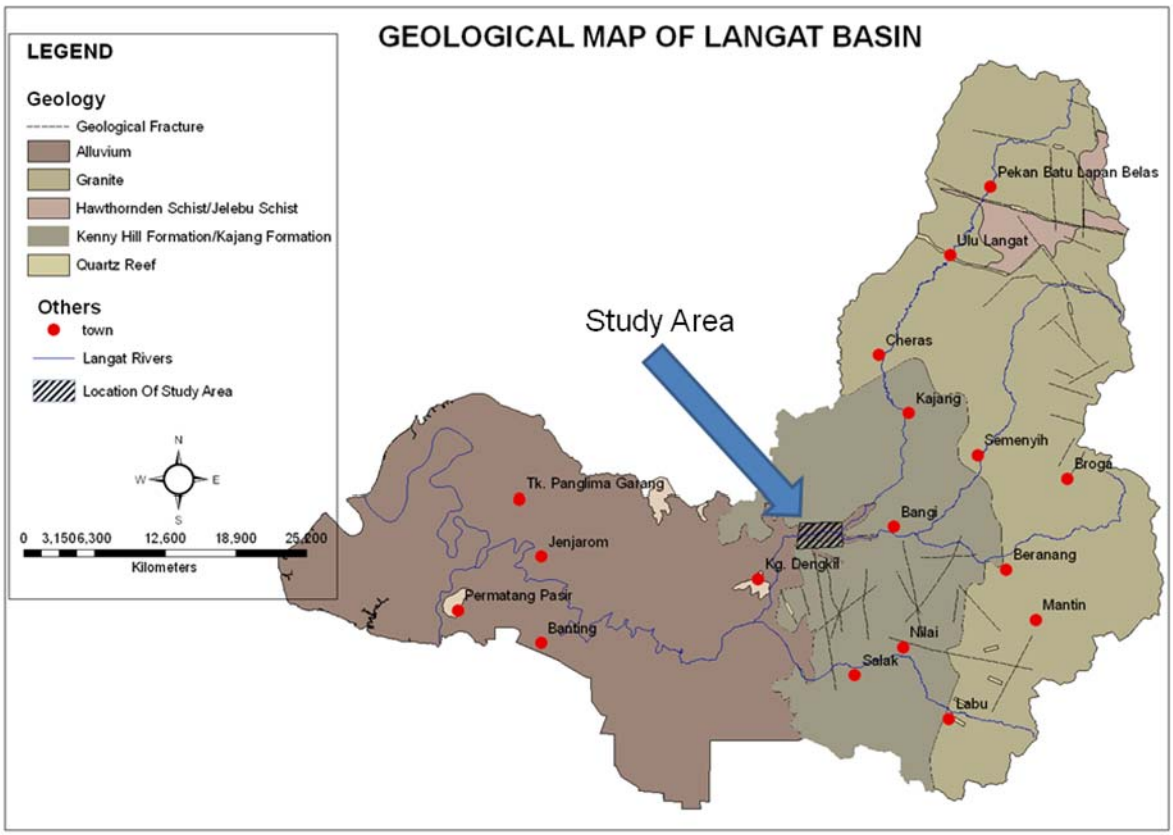


Figure 3.1: General geology of the Langat Basin

Table 3.1: Stratigraphic position on the underlying rocks in relation to the regional geology

Age	**Rock Formation**
Quaternary	Alluvium
Mesozoic	Quartz reef and the associated sericite, Granite
Permian-Carboniferous	Kenny Hill Formation/Kajang Formation
Middle-Upper Silurian	Hawthornden Formation

3.1 Geology of the Study Area

The geology of the study area consists of alternating phyllite, schists, slate and sandstone layers of the Kenny Hill Formation with some conglomerates, overlain by alluvium consisting of sand, gravel, clay and silt. Ong (1979) stated that the bedrock geology of the study area consists of metasediments such as mudstone, sandstone and shale of the folded Kenny Hill Formation. The Kenny Hill Formations overlies the Hawthornden Schists, contradicting with Abdullah Sani (1985) which stated that in general, almost all areas of Dengkil is overlain by Hawthornden Schists.

The drilling logs of the boreholes drilled in the study area and final standpipe design in Jenderam Hilir are shown in Appendix A. The area is covered with alluvium consisting of gravel, sand, silt and clay which is underlain by weathered Hawthornden Schist. Alluvium in Jenderam Hilir is thicker than 20 m. Most of the soil in the study area is disturbed by to mining activities in the past, but some borehole logs show that in the study area, original soil or bedrock geology could still be intercepted.

4.0 HYDROGEOLOGY

4.1 Geophysical Investigation

Geophysical method was used to investigate the subsurface geology of the study area to determine the depth of the potential aquifer in Jenderam Hilir, Selangor. Figure 4.1 shows the location of the 2D resistivity survey line at the site. The principle geophysical technique used was multi-electrode resistivity profiling using the Lund Imaging System ES464 with an ABEM TSAS4000 Terrameter. Eight resistivity lines ranges for 400-1200 m were carried out by using Schlumberger electrode arrangement. The total length of all the line is 6,040 m employing a 10 m electrode spacing. Observation from the study area then were transferred to a computer and converted into a format that could be read by processing software S4Kwin RES2DINV version 3:23. Graphic profiles resulted from the processing using RES2DINV were exported to DESIGNER graphics software for presentation of the profile.

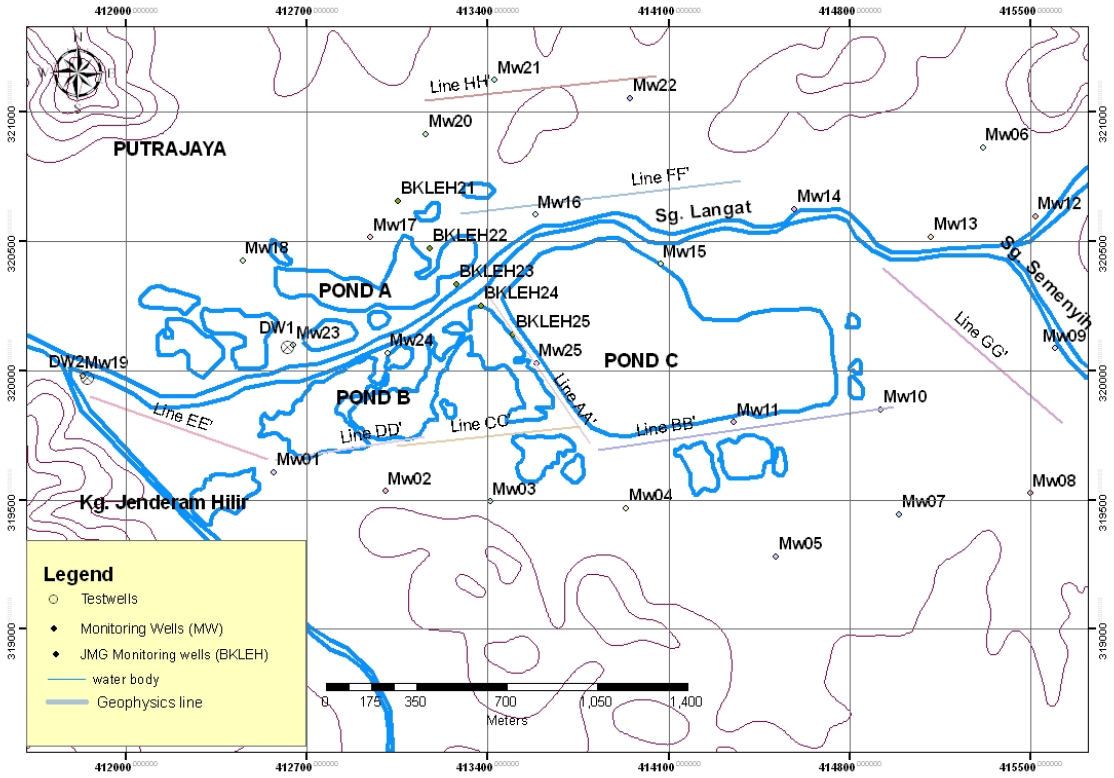


Figure 4.1: Location of the 2D resistivity survey line in Jenderam Hilir, Selangor

Figure 4.2 to 4.9 show the results of 2D resistivity profile line A-A', B-B', C-C', D-D', E-E', F-F', G-G 'and H-H'. Electrode spacing of a maximum of 10 m in 800 m long survey line was to allow for the penetration profile of up to 130 m.

2D resistivity profile for cross section line A-A' shown in Figure 4.2 is located in between two ponds (Pond C and Pond B) measuring 800 m long. LP1 layer is interpreted as layer of sand. The thickness of sand layer is about 25 m. This was followed by schist (S1) which has a higher resistivity value (150 Ωm) compared with S2 schist (60 Ωm). S2 schist is interpreted as weathered schist. SP1 is a boundary or a fault that divides between the two types of schist. Anomalies A1 and A2 which have sharp boundries have very low resistivity values and are interpreted as the effect of high conductivity of the underground water pipes which can be observed at those locations.

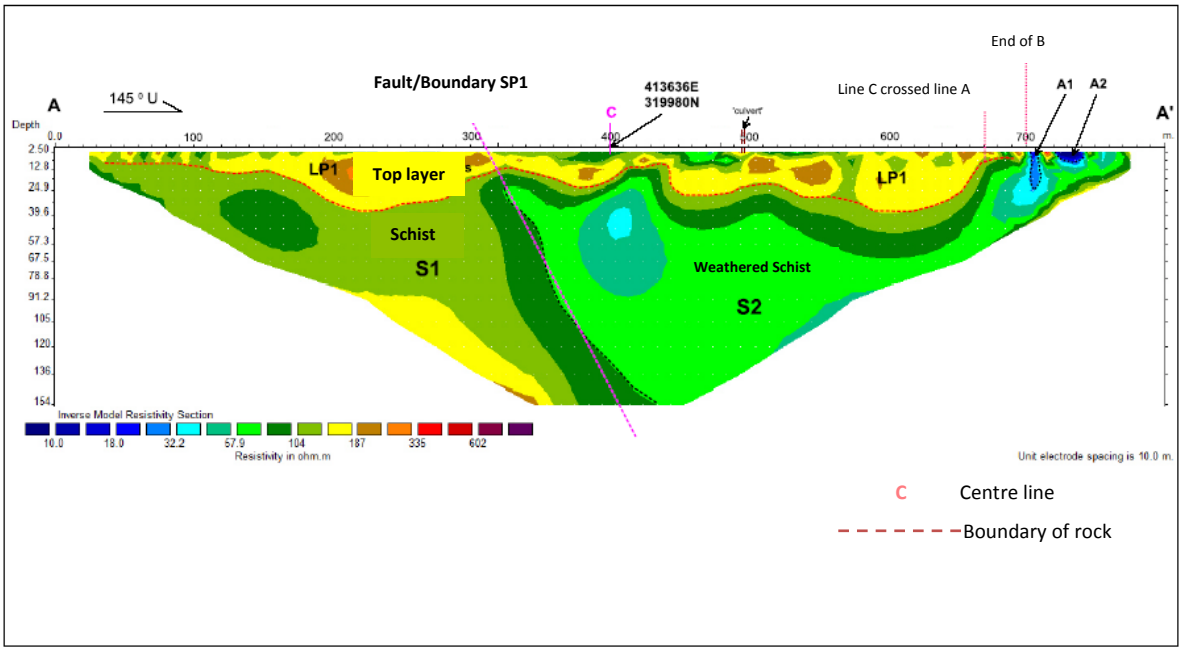


Figure 4.2: Resistivity profile line A-A' in Jenderam Hilir, Dengkil Selangor.

Figure 4.3 shows the 2D resistivity profiles cross the line B-B' of which is 1200 m long. LP2 layer has an average thickness of 15 m, and be interpreted as a layer of sand. Survey results also showed that the resistivity of the bedrock is not similar to as the line A-A' as this zone has very low resistivity value of between 10-30 Ωm. These zones known area are SG1, SG2 and S3 which consist of graphitic schist interpreted as showing high conductivity values. S3 (schist) was detected in the middle of this profile, while BTP1 interpreted as mudstone or sandstone based on very high resistivity of 200-600 Ωm.

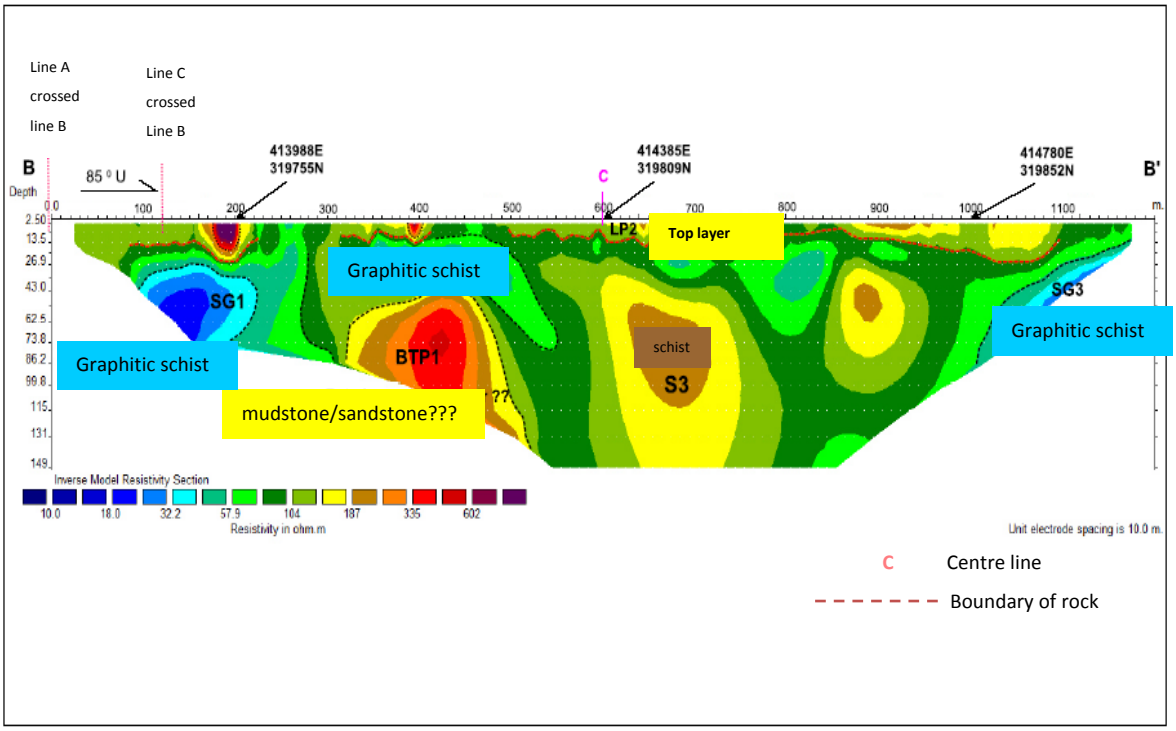


Figure 4.3: Resistivity profile line B-B' in Jenderam Hilir, Dengkil, Selangor.

Resistivity profile across the line C-C' which is 800 m long (Figure 4.4) showed two of the most significant lithology. The first is to the left of the profile where most of the bedrock consists of graphitic schist (SG4 and SG5) of highly conductive with resistivity of 10-30 Ωm. The graphitic schist is the dominant bedrock in the area. However, the two are separated by a lithologic boundary or fault known as SP2. Thus it can be concluded that the survey area in the east, shown by profiles A-A' and B-B' is dominated by schist bedrock or weathered schist and graphitic schist, while on the west of the survey line is dominated by graphitic schist. Zones BTP2 and BTP3 which has a high resistivity value (200-600 Ωm) are interpreted as mudstone or sandstone. Mudstone or sandstone at BTP2 looks thinning to the surface and widened at the base as shown by the profile C-C'. Conductive anomalies A3 is interpreted as the effect of water pipe that runs parallel to the line C-C', in the position of 350-430 m from the position of the electrodes.

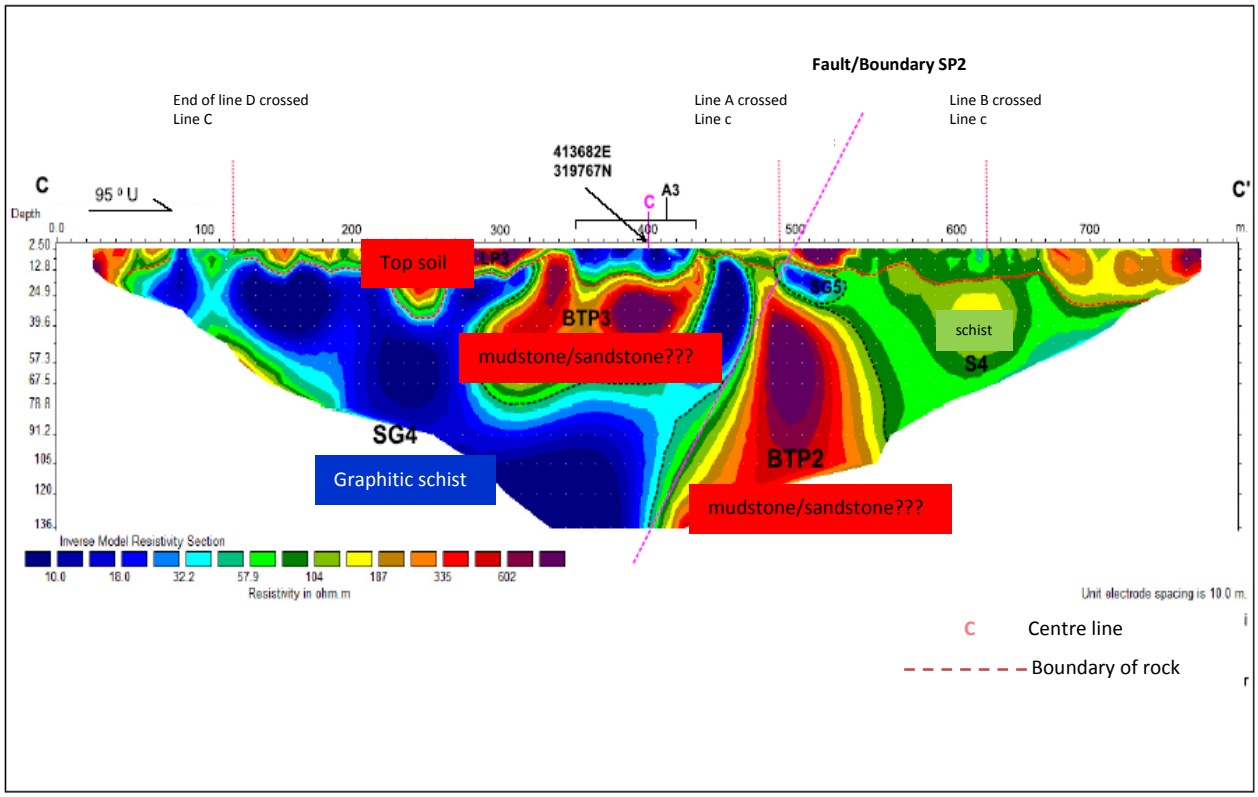


Figure 4.4: Resistivity profile line C-C' in Jenderam Hilir, Dengkil, Selangor

Figure 4.5 shows the profile of resistivity 2D line D-D' of which the length is 800 m. Results showed that most of the bedrock consists of graphitic schist. Zone SG6, SG7 and SG8 consist of graphitic schist. BTP4 zone is interpreted as mudstone/sandstone. High conductive anomalies in A4 was detected and interpreted as a water pipe to the treatment plant perpendicular to the profile.

Figure 4.6 is a 2D resistivity profiles line E-E' of measuring 640 m long. Survey results found that graphitic schist SG9, SG10 and SG11 dominated the bedrock underlying the layer of LP5 which consists of sand. These three zones of graphitic schist overlies BTP5 of mudstone/sandstone, which is located in the middle of the profile of this survey line. The very conductive A5 anomaly is of water pipe.

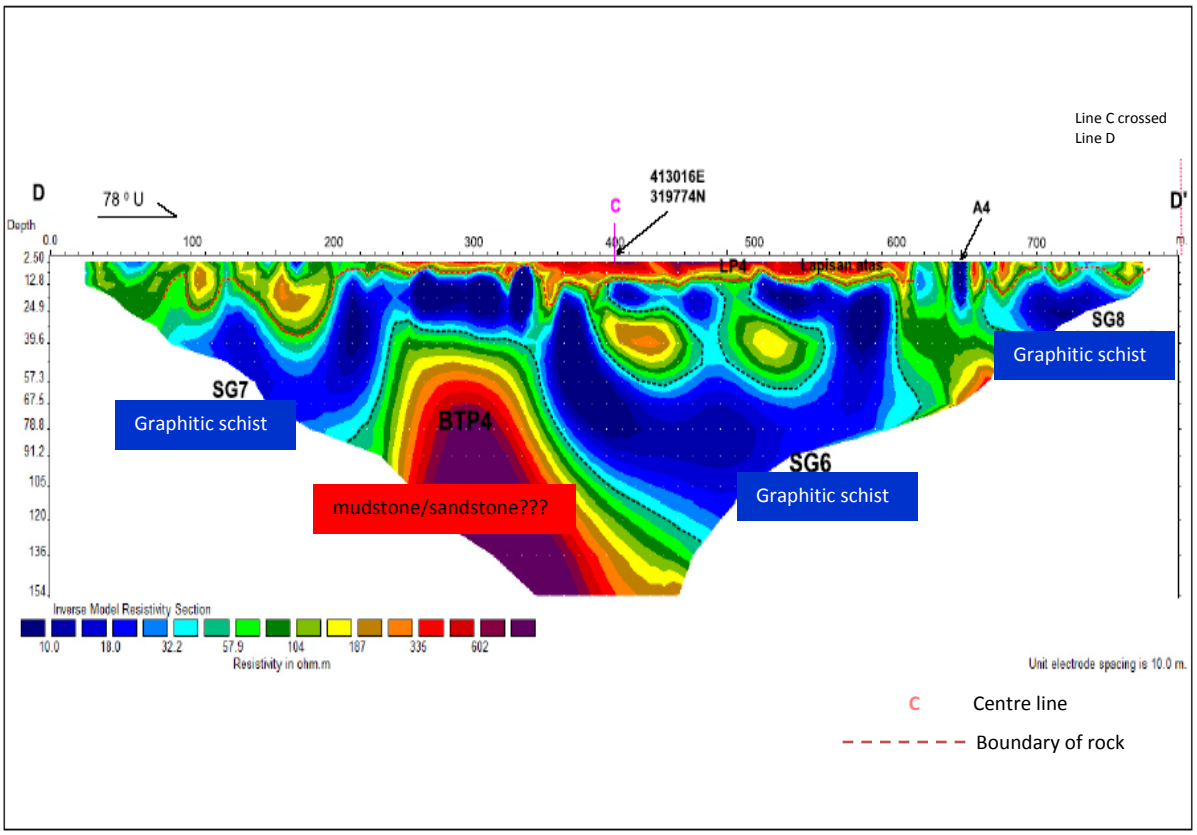


Figure 4.5: Resistivity profile line D-D' in Jenderam Hilir, Dengkil, Selangor

Resistivity profile line F-F' with length of about 600 m is shown in Figure 4.7. The bedrock is very shallow where the mudstone or sandstone BTP7 is found near the surface. This may be due to the survey lines are traversing shallow bedrock where there is no deposition of sediment in this area in the past. Mudstone or sandstone is massive and could be seen from the results of a very high resistivity of 400 Ωm. Under the BTP7, graphitic schist of SG12 and SG13 are dominant. The mudstone/sandstone of BTP6 is visible under the layers of graphitic schist of SG12 and SG13. The mudstone/sandstone could have been forming the inner part of folded SG12 and SG13.

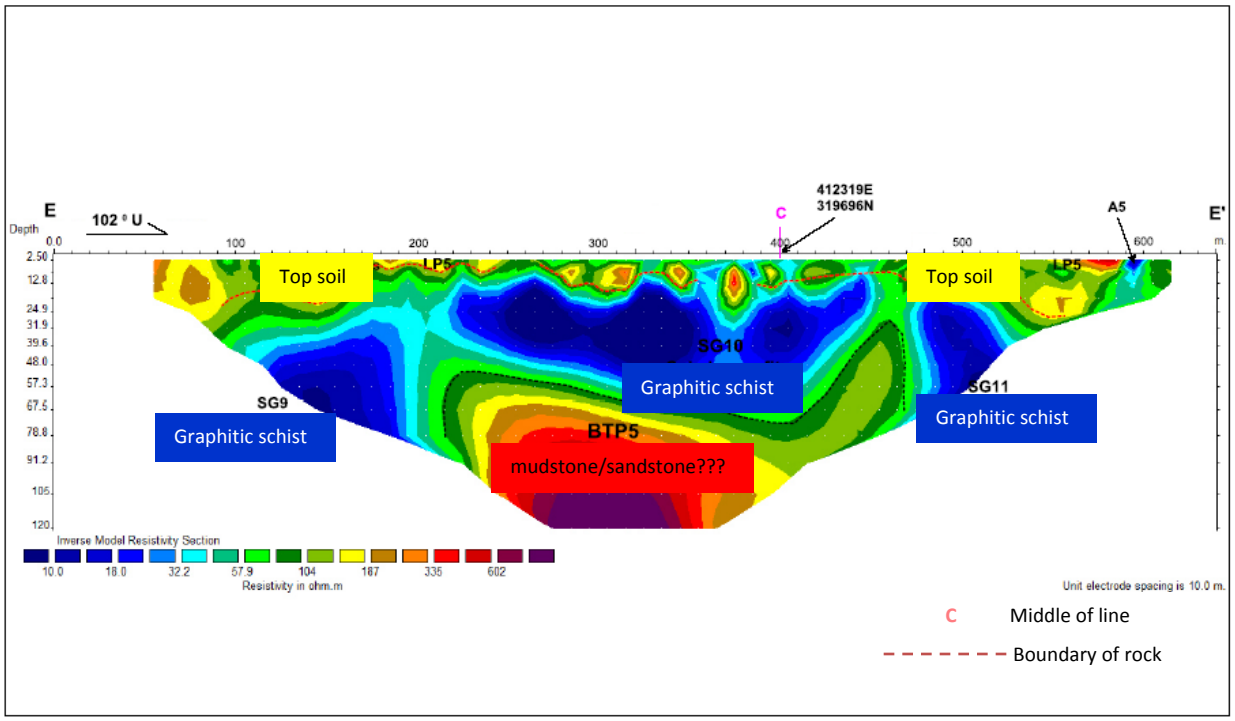


Figure 4.6: Resistivity profile line E-E' in Jenderam Hilir, Dengkil, Selangor

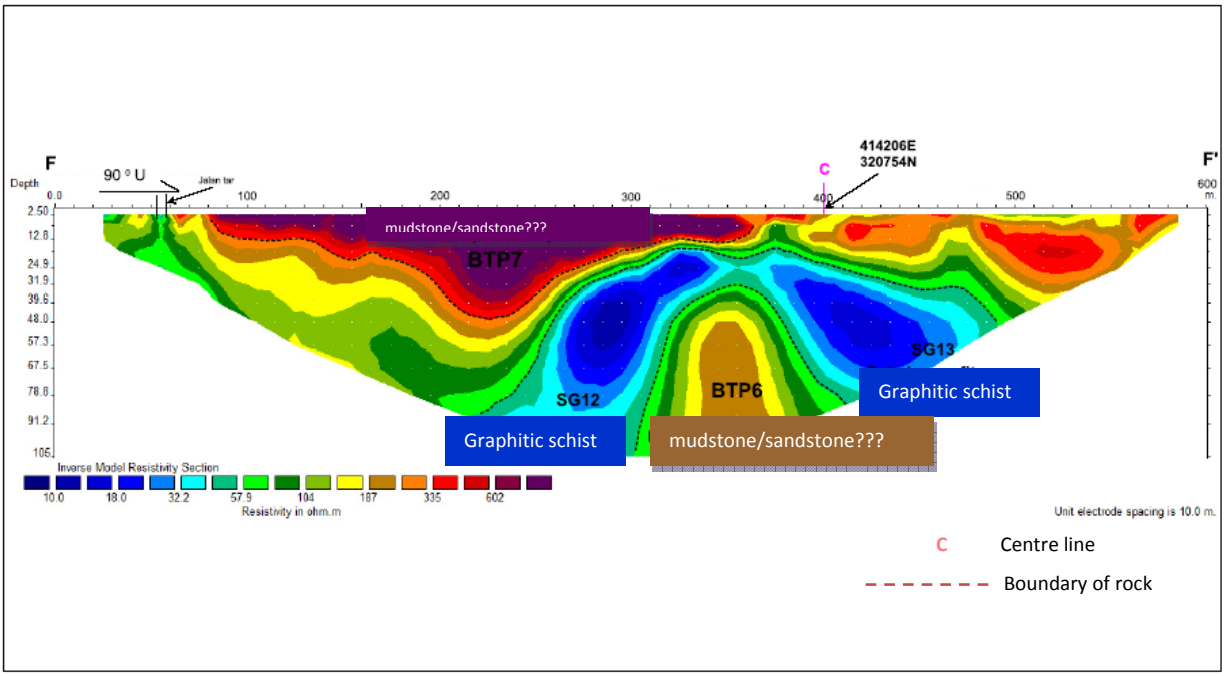


Figure 4.7: 2D Resistivity profile line F-F' in Jenderam Hilir, Dengkil, Selangor

Figure 4.8 shows the 2D resistivity profile line G-G' with a length of 800 m. Results show that LP6 with high resistivity values is on top with an average thickness of 15 m. The LP6 is interpreted as layer of gravel which provides high resistivity values. Below this gravel layer consist of graphitic schist SG14, SG15, SG16 and SG17. The graphitic schist of SG16 and SG17 are indicated by very low resistivity values.

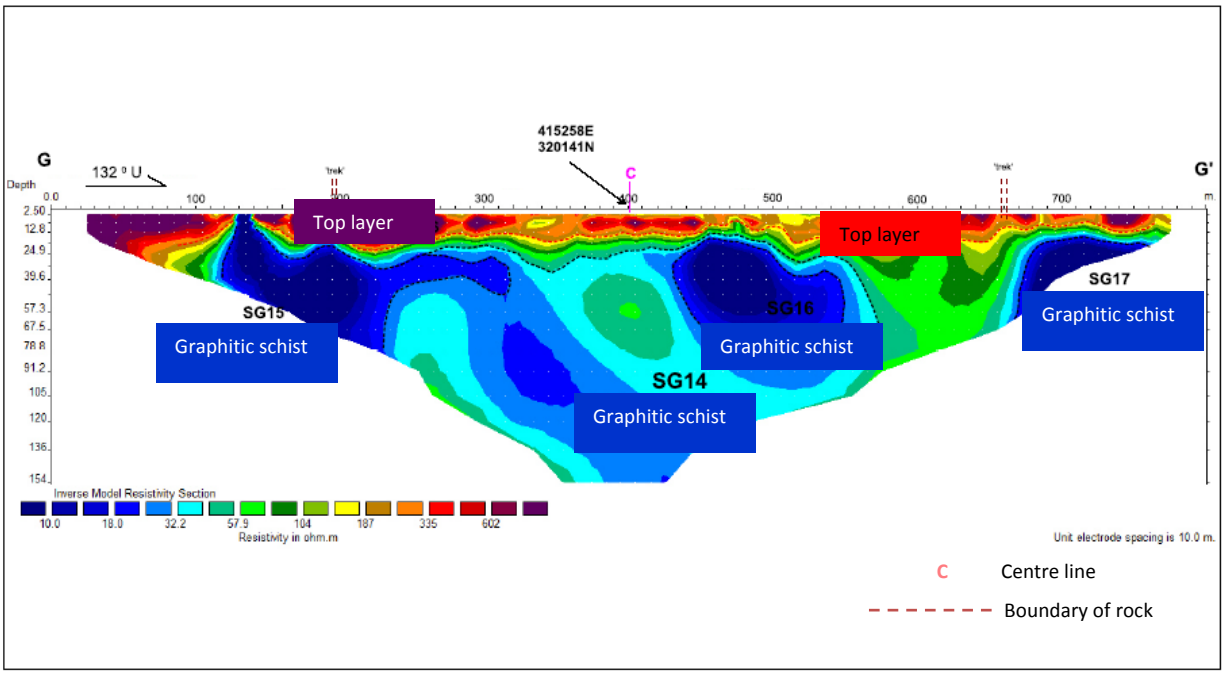


Figure 4.8: 2D Resistivity profile line G-G' in Jenderam Hilir, Dengkil, Selangor

The 2D resistivity survey found that:

1. The thickness of the sand layer is about 15-25 m which indicated that the area has a good layer of aquifer with high potential for groundwater development. However, for the successful groundwater development, this layer did not show continuity, most likely due to the mining activities in the past.
2. The resistivity profiling could be used to identify the presence of sand layer which is crucial in the study.
3. Bedrock in the study area consists of mainly of graphitic schist of the Hawthornden schist with low groundwater development.

4.2 Subsurface Exploration

The main objective of this exploration works is to obtaining detailed information on the lithology of the site and the physical properties of the aquifer in the study area. The exploration is required to in ascertain the suitability to carry out BI at the site.

Eight (8) wells were drilled using YBM rotary drilling machine employing wash boring method to bedrock and 17 hole were drilled using a motorised auger to a depth of 2-3 m below the existing water table. The drilling work was conducted in May 2009 to establish the subsurface geology and the depth of the water table in selected locations around the Jenderam Hilir and a total of 25 monitoring wells (MW) have been constructed (Figure 4.9), that focused to the area downstream of the confluence of Sungai Semenyih and Sungai Langat. The wells were constructed using PVC pipe of 50 mm diameter or 75 mm diameter complete with slotted screen. The summary of the monitoring wells and test wells is shown in Table 4.1.

Based on the exploration and geological information gathered in the study area, as well as the availability of R&D funds, two test wells i.e. DW1 and DW2 with diameter of 255 mm, at a depth of 19.0 and 18.40 m respectively were constructed to determine the hydraulic parameters of the wells and aquifer. The test wells have been drilled using with semi-mechanised bangka percussion drill. For the DW2, the drilling of the 305 mm diameter exploration borehole encountered light grey to dark purplish clay from the top to a depth of 3.0 m, followed by light greyish brown clayey silt up to 5.0 m. This was followed by light greyish gravelly sand with some decaying wood fragments up to a depth of 18.4 m. The construction of the test wells consists of installation of 255 mm diameter slotted PVC screen from 11.4-17.4 m, followed by 1 m blank PVC pipes of the same diameter at the bottom of the screen to act as a sand-trap. The bottom of the sand-trap was installed with an end-cap. While, the test wells of DW1 consist of light brownish to dark purplish grey clay from 0-3.0 m, followed by light greyish clayey silt with some decaying wood from 3.0-7.7 m and silty sand and gravel up to 19.0 m when reaching bedrock. Screen were installed from 12-18 m (below ground level). Boreholes geological

log and the detailed designs of the two test wells are shown in Figure 4.10 and Figure 4.11. the geological log and well design for all other wells are in Appendix A.

4.3 Aquifer System

The aquifer system in the study area consist of alluvial deposits of sand, silt and gravel which form shallow aquifer. The unsaturated zone sits on the aquifer consists of clay. The thickness of this clay layer is about 1-3 m. The aquifer is mostly of fine to coarse grained sand with mixture of gravel. The thickness of aquifer layer ranging from 5-20 m. It can be locally heterogeneous due to the presence of beds of fine to coarse-grained sand. Based on drilling information, gravelly sand or sandy gravel aquifer layer are overlain by layer of clay, while some areas are overlain by a layer of low permeability fine sand or silt which make the aquifer confined or semi confined depending on locations. Bedrock in the study area is located at depths of 20 m. Recharge to the aquifer is from rainwater and river water that infiltrates through the aquifer resulting in the interdependence between groundwater and river water. Due to the presence of sandy gravel which has high porosity and transmissivity, and connections to the river, during high river flow, water from the river discharged into the aquifer. During the river low flow, depending on location of the study area, groundwater recharge to the river. The schematic hydrogeological cross section A-A', B-B' and C-C' (Figure 4.12) is illustrating the aquifer system in Jenderam Hilir based on 25 piezometers and 2 test wells borehole logs. The schematic diagram of the bank infiltration project in Jenderam Hilir, Selangor is shown in Figure 4.13.

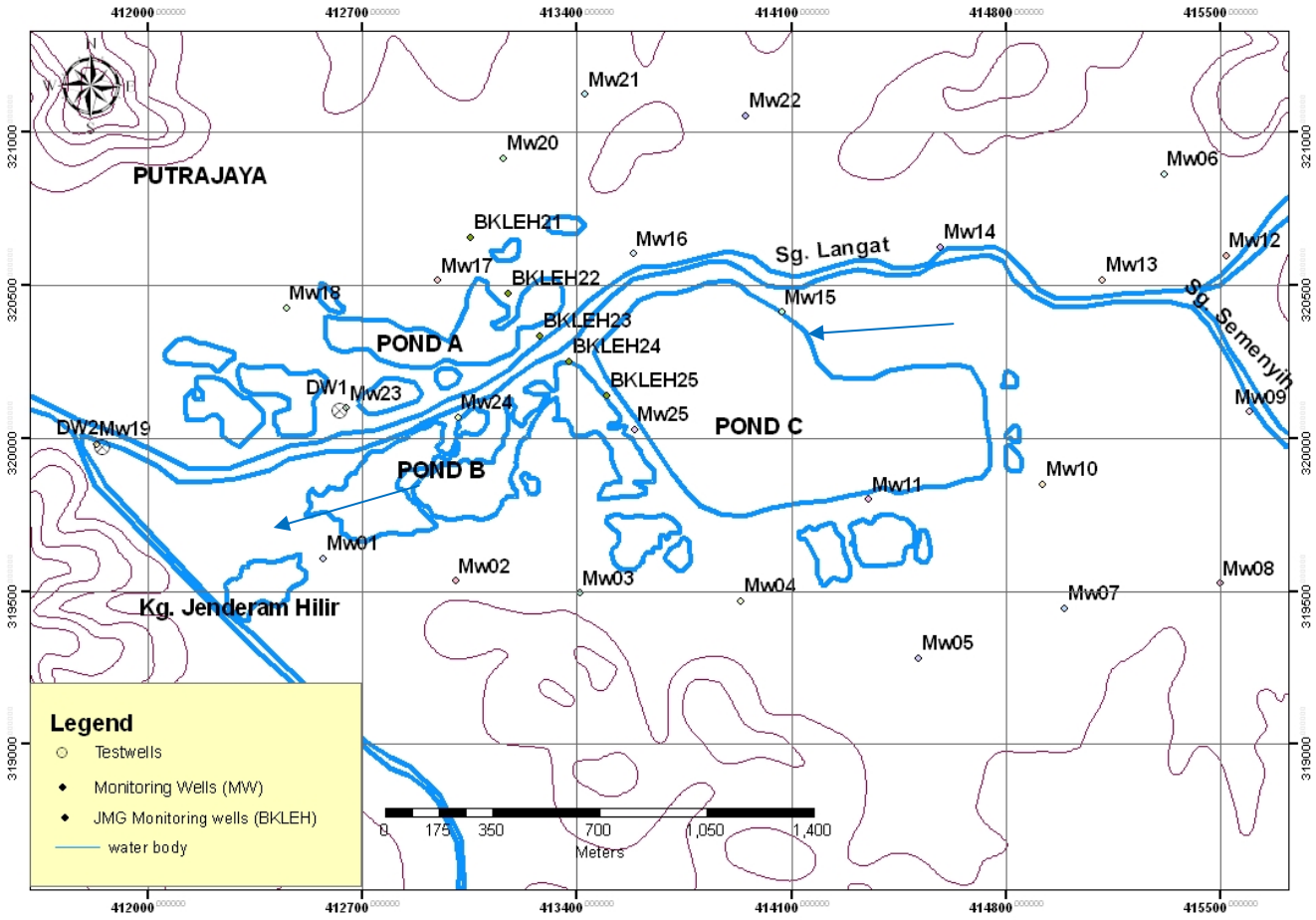


Figure 4.9: Location of 25 monitoring wells (MW),Test Wells (DW) and JMG Monitoring well (BKLEH) in Jenderam Hilir, Selangor

Table 4.1: Summary of 25 monitoring wells (MW) and test wells (DW) in Jenderam Hilir

No. Well	Well Diameter (mm)	Groundwater water level m.b.g.l	Screen Length (m)	Depth of well (m)
MW01	75.00	3.95	1.50	6.00
MW02	50.00	2.49	2.00	13.50
MW03	75.00	1.30	1.50	5.00
MW04	75.00	2.30	1.50	5.60
MW05	75.00	0.82	1.50	4.32
MW06	75.00	2.02	1.50	5.92
MW07	75.00	1.69	1.50	5.20
MW08	75.00	1.13	1.50	5.10
MW09	75.00	4.70	2.00	11.20
MW10	50.00	3.70	1.50	5.90
MW11	50.00	3.80	2.00	14.00
MW12	75.00	4.01	1.50	7.25
MW13	50.00	5.70	2.00	12.50
MW14	75.00	5.10	1.50	7.30
MW15	75.00	2.50	1.50	7.30
MW16	50.00	4.20	2.00	14.10
MW17	50.00	0.90	2.00	4.50
MW18	50.00	5.02	2.00	6.60
MW19	50.00	3.70	2.00	15.09
MW20	75.00	1.60	2.00	5.80
MW21	50.00	2.10	2.00	5.10
MW22	50.00	0.60	2.00	4.12
MW23	75.00	5.21	2.00	15.50
MW24	75.00	2.37	1.50	6.00
MW25	50.00	4.70	2.00	14.70
DW1	255.00	5.00	6.00	19.00
DW2	255.00	1.50	6.00	18.40

4.4 Surface Water and Groundwater Interaction

The surface water system and groundwater system interact with one another. Surface water can enter the groundwater system by percolating down through the soil. This process is called infiltration. Depending on the season and location, streams can be what are called gaining streams or losing streams. Whether a stream is gaining or losing can be affected by the pumping of a nearby well. Pumping from a well can cause a dip in the water table (potentiometric surface). This drawdown, or cone of depression, represents a negative head gradient and can cause water from a nearby stream to enter the groundwater system. This process is called induced infiltration (Fetter, 2001).

At the Jenderam Hilir site, the minimum and maximum groundwater levels of the various boreholes are used to identify the interaction between the groundwater and river. The water levels of the test wells (DW) and monitoring wells (MW) and the Sungai Langat were plotted on Figure 4.14. The water tables show the variations during the observation period in 2010. The water tables are normally high in January and started to drop in February. Based on the observations of the water levels, the fluctuation of the DW and MW are affected by precipitation, and the increase of the water level in Sungai Langat would also increase the groundwater levels in the well. This situations clearly indicates the strong relationship between the groundwater and surface water. Higher groundwater levels in comparison to the river level indicated that the groundwater contributed to the surface water.

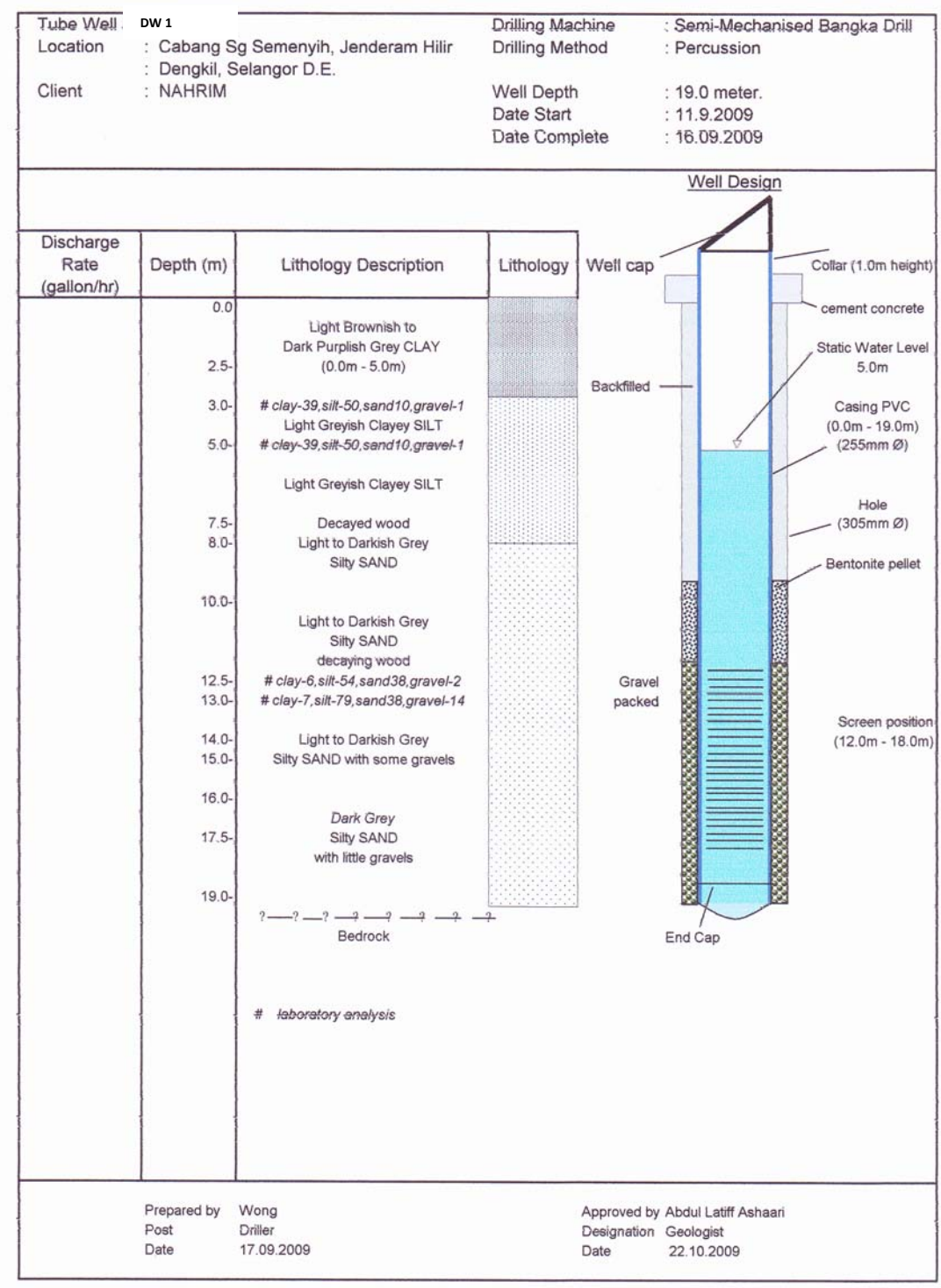


Figure 4.10: Lithological log and well design DW1 in study area

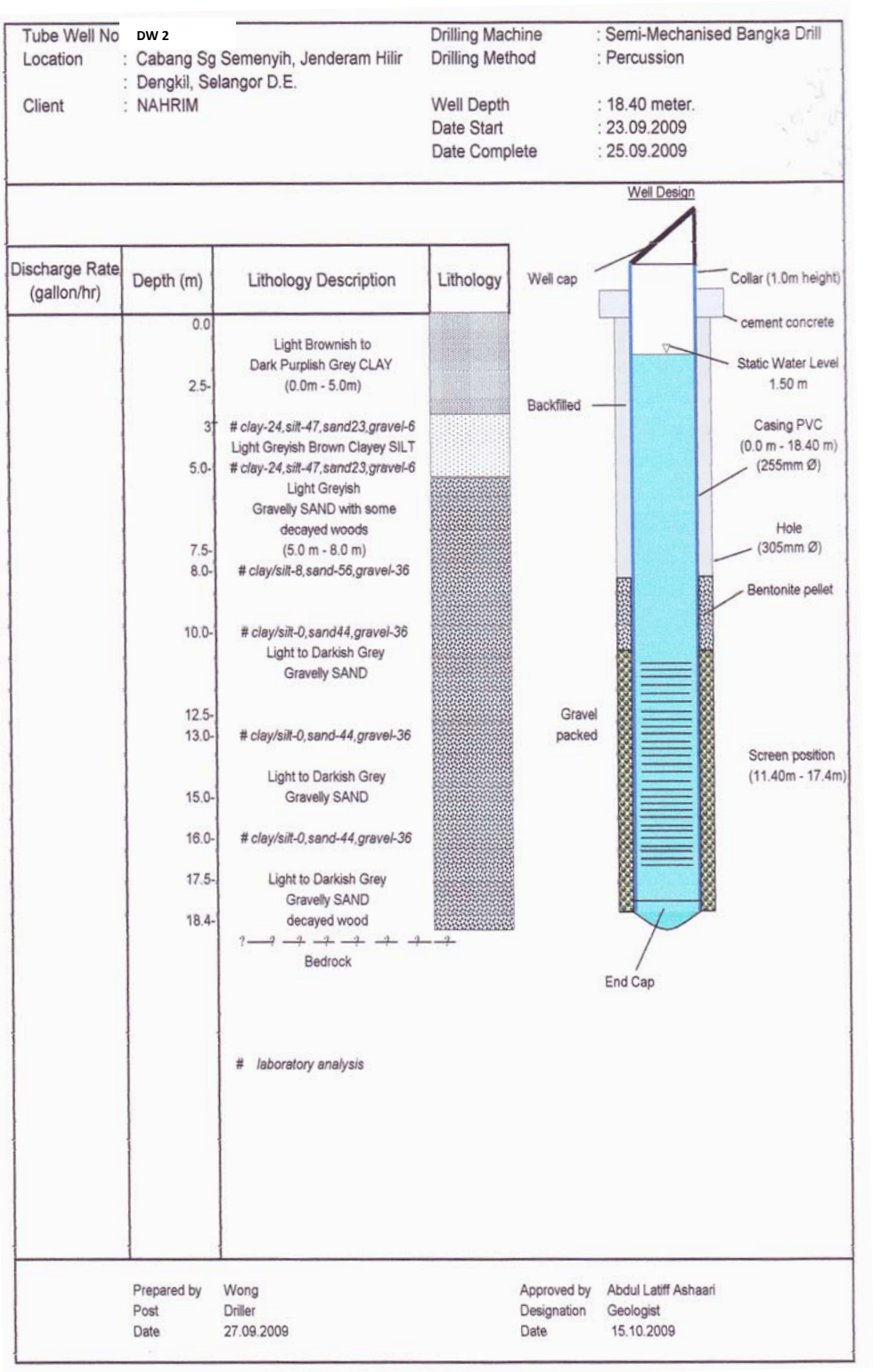


Figure 4.11: Lithological log and well design DW2 in study area

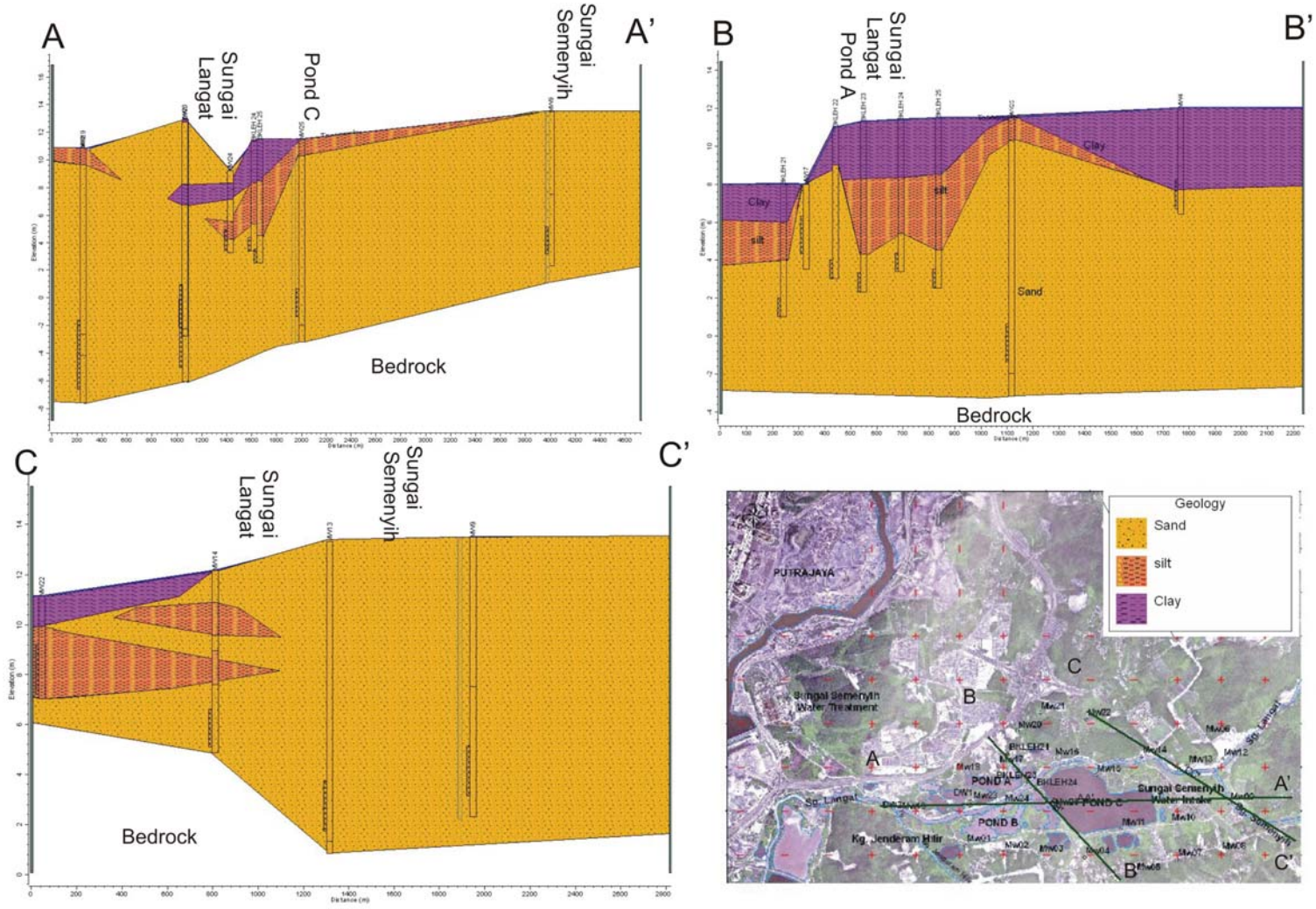


Figure 4.12: The schematic hydrogeological cross section A-A', B-B’ and C-C’ illustrating the aquifer system in Jenderam Hilir

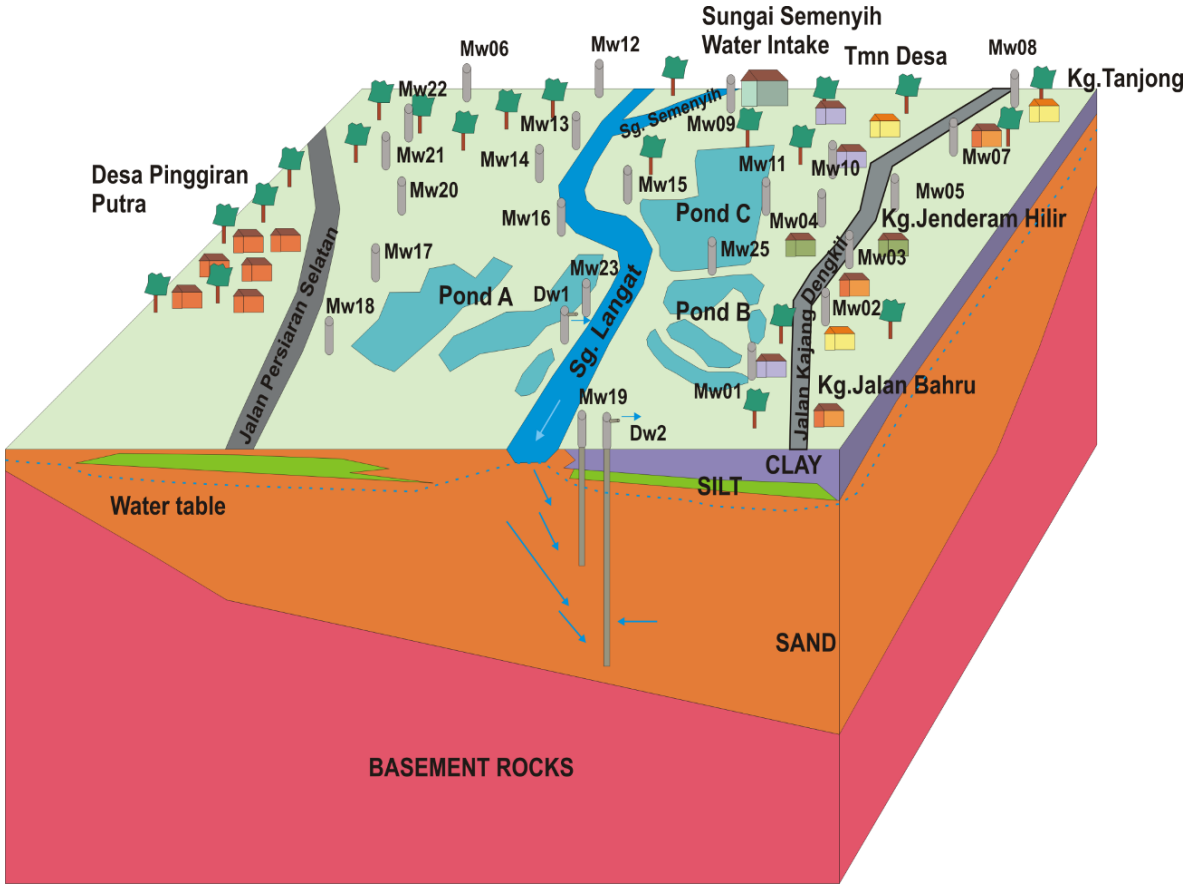


Figure 4.13: Schematic diagram of bank infiltration project in Jenderam Hilir, Dengkil

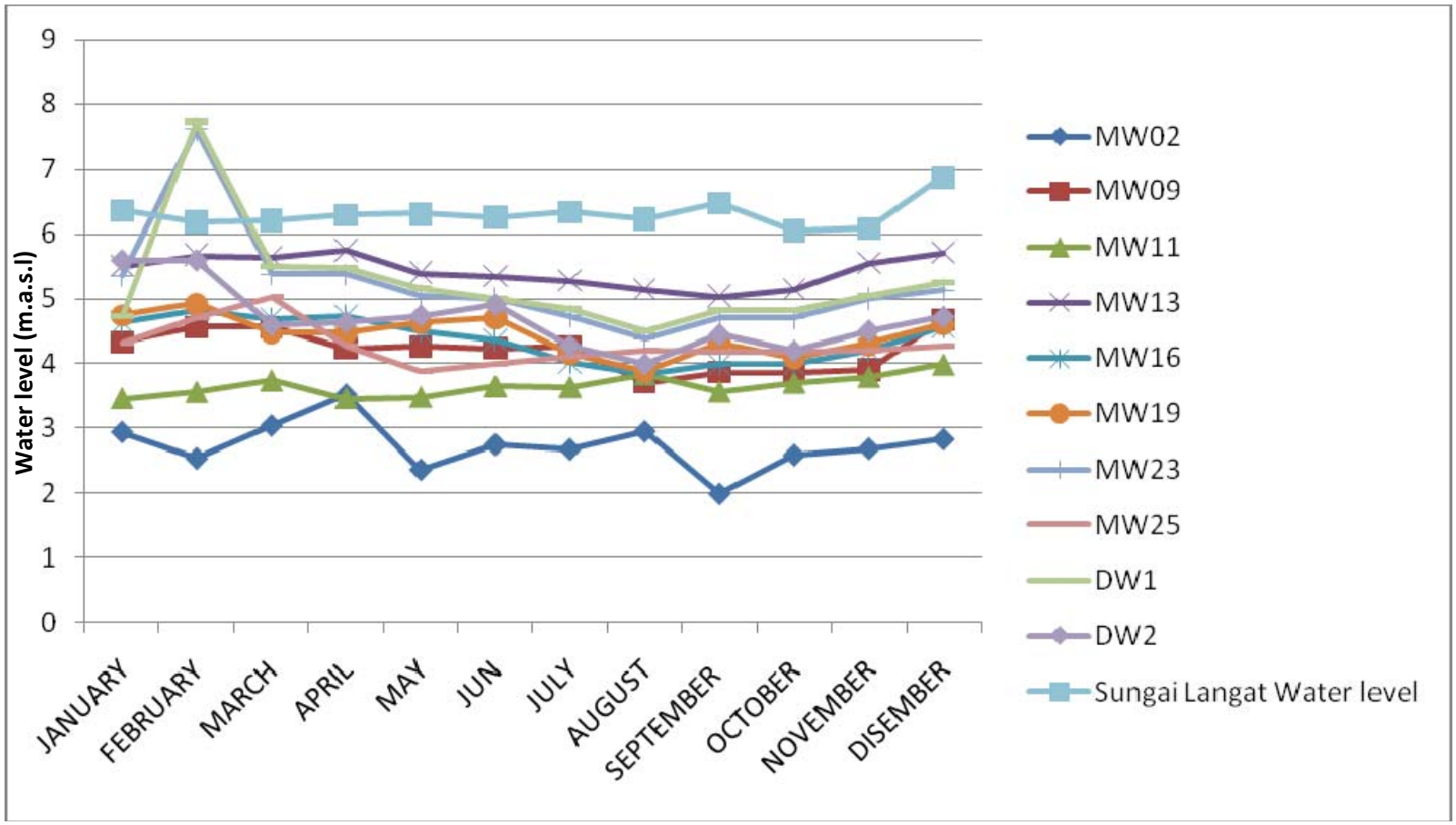


Figure 4.14: Groundwater level and Sungai Langat water level for the year 2010

4.5 Aquifer Test

One of the fundamental aspects of groundwater resources investigation is the determination of aquifer characteristics such as transmissivity, permeability and storage coefficient. These characteristics are important in determining the natural flow of water through an aquifer and its response to groundwater abstraction. Normally, the determination of transmissivity, permeability and storage coefficient are made on the basis of data obtained from test-pumping wells. Although such tests are not run exclusively for the determination of aquifer characteristics, it is essential that test programmes be designed so that they can be clearly and reliably assessed.

A pumping test program will allow determination of some or all of the following:

i. the yield characteristics and potential of the well,
ii. the efficiency of the well performance as an indication of its hydraulic conditions,
iii. confirmation of the hydrogeological nature of the aquifer,
iv. determination of the hydraulic properties of the aquifer, and
v. prediction of the effect(s) of present and/or future abstraction from the well on groundwater condition in the aquifer.

A pumping test programme for test well DW1 and DW2 was carried out in 2009. A Step-Drawdown test (five steps) and a 72 hours Constant Discharge test, and recovery test were done on the 22nd October 2009 for DW1 and 5th December 2009 for DW2 using a Groundfos 45-7 submersible pump.

During the pumping tests, pumping rate was measured using V-notch weir. The measurement of groundwater levels was performed using automatic data logger placed in the test wells. Besides automatic measurements, manual measurements using water level recorder were performed at prescribed intervals. The measurement collected during

pumping and recovery test were kept in a database. All measurements are documented in graphical form in linear and semi-logarithmic scale in Appendix B.

Step-drawdown test have been introduced by Jacob (1947) to study how the discharge Q affects the drawdown S_w of a well drilled in confined aquifers. He proposed the following equation:

$$s_w = BQ + CQ^2 \qquad (1)$$

where

s_w = drawdown in the well;

B = head loss coefficient due to laminar flow, usually assumed to be caused by the aquifer;

C = head loss coefficient for turbulent flow, usually caused by flow into the borehole and screen;

Q = discharge of the well

The time drawdown graph shown in Figure 4.15 is used to assess the efficiency of the wells. The well efficiency is defined by Walton (1962) as the rate of loss of total water level drawdown. Loss coefficient of the aquifer (B), and the coefficient of loss of wells (C), can be determined from the graph. From the Figure 4.15, it can be concluded that well DW1 is not that efficient as the efficiency is less than 48% (Table 4.2). Low efficiency is affected by the finer composition of the aquifer materials which consist of 54% silt and 38% sand. At the step 5, the drawdown increased to the 4.2 m from initial static during step 1. In comparison, the results of pumping test of DW2 show that the drawdown is only 0.15 m (Figure 4.16) and the efficiency of the well is very high (Table 4.3). The low drawdown in DW2, may suggest that the river is significantly contributing water to the well.

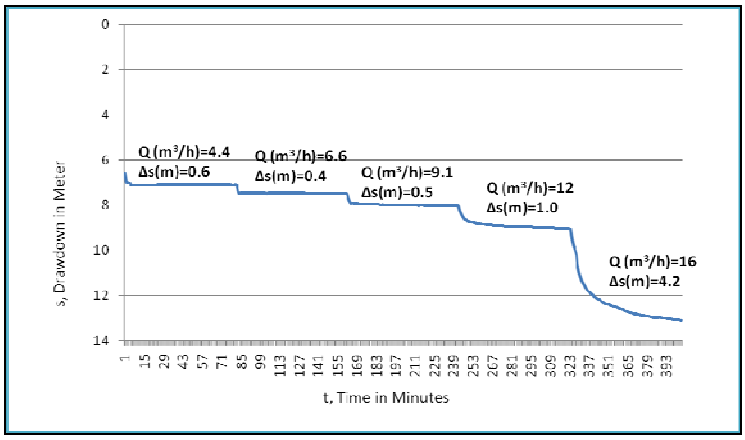


Figure 4.15: Step-drawdown test curve showing drawdown versus time for DW1

Table 4.2: Results of step drawdown test wells for DW1

STEP	Q (m^3/h)	Δs(m)	S_w(m)	S_w/Q	W_e
1	4.4	0.60	0.60	0.136	48.2%
2	6.6	0.39	0.99	0.15	38.28%
3	9.1	0.53	1.50	0.165	31.03%
4	12.2	1.02	2.52	0.207	25.13%
5	15.9	4.17	6.69	0.421	20.48%

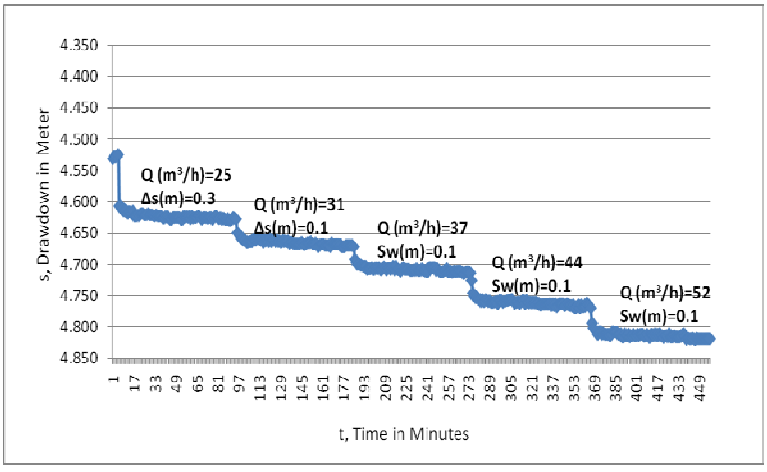


Figure 4.16: Step drawdown test curve showing drawdown versus time value for DW2

Table 4.3: Results of step drawdown test well for DW2

STEP	Q (m^3/h)	Δs(m)	S_w(m)	S_w/Q	W_e
1	25.1	0.29	0.29	0.01155	99.85%
2	30.7	0.08	0.37	0.01205	86.34%
3	36.9	0.09	0.46	0.01246	84.02%
4	43.9	0.1	0.56	0.01276	81.55%
5	51.6	0.12	0.68	0.01318	78.99%

The step test was followed by a constant rate test to provide an estimate of aquifer hydraulic properties and to evaluate potential long-term well yield. Discharge rates for the constant test were selected based on the step test results. Aquifer recovery was measured after the test pumping to provide a second estimate of aquifer hydraulic parameters.

On the 22nd October 2009 at 10.10 pm, based on drawdowns obtained during the step tests, the discharge rate for the constant rate test of test wells DW1 was set at 12.2 m^3/hours. Starting from a water level of 6.32 m below ground level, the drawdown at 4320 minutes (72 hours) was 4.16 m (10.48 m below ground level). Water-level data measured during the pumping test are given in Appendix B. Drawdown and recovery data were analysed using the Theis equation. The calculated values of transmissivity (T) and hydraulic conductivity (K) resulting from Theis and Theis recovery analyses and the analysis plots are shown in Appendix B.

The Theis, (1935) recovery method was used to analyse the water level recovery data. This method consists of plotting the residual drawdown in the well versus the ratio of *t/t'*, where *t* is the elapsed time since pumping began, and *t'* is the elapsed time since pumping ceased. The residual drawdown is plotted on an arithmetic y axis, and the ratio of *t/t'* is plotted on a logarithmic x axis. A straight line is then fit through the plotted water level recovery data, and the slope of the line is measured to estimate aquifer transmissivity. Transmissivity is defined as the amount of water that can be transmitted horizontally through a unit width by the full saturated thickness of the aquifer under a hydraulic

gradient of one, and has units of length/time. Similarly, hydraulic conductivity is defined as the ability of aquifer materials to transmit water, but does not consider aquifer thickness. As a result, hydraulic conductivity is expressed in units of length per unit time (e.g. meters per day), or velocity. The Theis recovery method of analysis is valid for the late-time water level recovery data from confined, unconfined and leaky confined aquifers (Theis, 1935).

Transmissivity estimates for the wells were calculated from the Theis recovery method according to the following equation:

$$T = \underline{Q}/4\pi\Delta s$$

where:

T = transmissivity;

Q = pumping rate; and

Δs = change in residual drawdown over one log cycle of t/t'.

Based on the calculated values for transmissivity, the hydraulic conductivity (K) is then estimated according to:

$$K = \mathrm{T}/b$$

where:

b = aquifer thickness in meters.

After the pumping test was terminated, recovery measurements were collected in DW1 for a period of approximately 720 minutes. The water level in DW1 recovered from a final pumping water level of 3.99 m to 0.11 m within 720 minutes is shown in Appendix B.

On the 5th December, 2009 at 10:10 pm, the pumping test was started at DW2 at a rate of 51.6 m^3/hour. The static water level just before pumping was 4.19 m below top of casing

(TOC) and the pump was set at a depth of 9 m from TOC. The flow rate was constant throughout the test at 51.6 m^3/hour. The total drawdown at the end of the one day pumping test was 4.94 m. Water levels measured during the pumping test of DW2 are given in Appendix B. The calculated values of transmissivity (T) and hydraulic conductivity (K) resulting from Theis and Theis recovery analyses are shown in Table 4.4 and the analysis plots are shown in Appendix B.

Because of the high yield potential and low drawdown for DW2, another pumping test was conducted to study the aquifer characteristics. This test well has shown tremendous potential to be developed for BI technique. The constant discharge was conducted on the 22nd April 2010 for 168 hours (7 days) followed by a recovery test. The long duration of constant rate pumping test was to ascertation the impact of pumping on the surrounding area especially the lakes nearby. Groundfos SP 60-7 submersible pump was used for the pumping test. The static water level was 4.36 m and the final water level was 6.30 m i.e. the drawdown was only 2.02 m. The transmissivity (T) and hydraulic conductivity (K) value was 31.48 m^2/hour and 2.35 m/hour (56.4 m/day) respectively.

Recovery test was carried out immediately after the constants discharge test ends. The residual drawdown was 0.29 m. The transmissivity and hydraulic conductivity value of 47.22 m^2/hour and 3.52 m/hour (78 m/day) were obtained respectively. Summary of analyses of the drawdown and recovery data DW2 is shown in Table 4.4. For the DW2, another 72 hours constant discharge test and recovery test was carried out on the 9th October 2010 to ascertain the capacity of the well. No step-drawdown test was carried out. The pumping test was carried out using a DT 95-10 Dynatech submersible pump. The submersible pump was installed to a depth of 9.5 m below ground level with 125 mm diameter galvanised (GI) riser pipe connected to the submersible pump. A 125 mm diameter gate-valve was connected to the riser pipe to regulate the flow rate. A flow meter was installed at the riser pipe to measure the flow rate. The riser pipe was then directed to a tank complete with 90^0 V-Notch weir to also measure the flow rate. After the installation of the pump and all other necessary set-up was completed, a calibration test was carried out for 2 hours to determine the capacity of the test well. The constant discharge test was carried out with a pumping rate of 128 m^3/hour. The static water level was 4.05 m and the final water level was 6.68 m below ground level. The drawdown was

only 2.63 m. The transmissivity and hydraulic conductivity value was 52.05 m^2/hour and 3.88 m/hour (93.12 m/day) respectively.

The recovery test was then carried out immediately after the constant discharge test was completed. The recovery was completed in 4 hours, and the residual drawdown was 0.50 m. The recovery after 4 hours was 80.99%, with a transmissivity and hydraulic conductivity value of 117.12 m^2/hour and 8.74 m/hour (209.76 m/day) respectively. The pumping test data is shown in Appendix B. The drawdown of DW2 was very low, this show that the well is capable of producing much higher amount of water. According to this aquifer test, the range of travel time from river water to recharge the aquifer is average on 3 to 11 days. The travel time was estimated by dividing hydraulic conductivity (K) in m/day with distance measured from the river to the well. The test well, DW2 has successfully shown that well constructed along river bank is capable of yielding significant volume of water with very much higher quality.

Table 4.4: Result of pumping test analyses for value of Transmissivity (T) and Hydraulic Conductivity (K) based on Thesis equation

Date	Pumping Hours	No. Well	Pumping Rate Q (m^3/h)	Drawdown (m)	Transmissivity (T) m^2/h Constant discharge	Transmissivity (T) m^2/h Recovery	Hydraulic Conductivity (K) m/h Constant discharge	Hydraulic Conductivity (K) m/h Recovery
22/9/2009	72	DW 1	12. 20	4.16	3.18	27.90	0.29	2.54
7/12/2009	72	DW 2	51.60	0.75	33.73	94.43	2.52	7.05
22/04/2010	168	DW 2	90.20	2.02	55.02	82.50	4.11	6.16
10/10/2010	72	DW 2	128.00	2.63	52.50	117.12	3.92	8.74

4.6 Bank Infiltration

4.6.1 Sieve Analysis For Aquifer Material

Grain size analysis (British Soil Classifications BS 1377 Part 2, 1990) from the aquifer materials was carried out up to the depths of 15 m at the sites for all the 27 boreholes in study area. Grain size distribution was determined using wet-sieving techniques and mesh sizes of 5.0, 4.0, 2.83, 2.0, 1.180, 0.60, 0.425, 0.30, 0.212, 0.150 and 0.063 mm. Sediments were characterised in terms of percent gravel (%G), sand (%S), silt (%Si) and clay (%C), $d_{10,}$ median grain size (d_{50}), d_{60} and the uniformity coefficient, C_u (Hazen, 1911). The effective grain size, d_{10}, is the size corresponding to the 10% line on the grain-size distribution curve and represents passing of 10% finer (by weight) of the sample during the sieve analysis. The grain size analysis indicates that the surface soil up to the depth of 15 m has higher percentage of gravel, coarse sand and medium sand. Gravel, however, is found to a depth of 20 m. Therefore, the efficient aquifer can be assumed up to 20 m. The required soil parameters for estimating hydraulic conductivity were determined from the sieve analysis for DW2 in Appendix C. Values of hydraulics conductivity (K), a necessary parameter to estimate travel time at different depths (Table 4.5) was estimated using Hazen methods (Hazen, 1911). The travel time between the screens of the test wells and the river bank is an important parameter for bacteria and turbidity removal. A 60-day travel time was assumed to be adequate to inactivate pathogenic bacteria to the degree that no health risk exists (Schijven and Majid Hassanizadeh, 2000). In Germany, a travel time of 50 days is commonly recommended for the elimination of bacteria and to design a water protection zone where no microbial pollution should occur. The study of bank infiltration in Nainital, India, groundwater tubewells, which are very close to the lake bank, were found to be 1-2 days and for tubewell which is around 84 m away from the lake, the travel time was estimated the most 11-19 days. To reach 4-5 log removal of colifrom during BI, travel time between 10-20 days is needed in India (Dash et al., 2008).

Grain-size distribution curves can be used to estimate the hydraulic conductivity of sands where the effective grain size is between approximately 0.1 to 3.0 mm (Fetter, 2001) by applying the Hazen method. Those values from the generated grain-size distribution curves were applied to the Hazen approximation for hydraulic conductivity as follows:

$$K = C \times (d_{10})^2$$

where:

K = hydraulic conductivity (cm/s)

d_{10} = effective grain size (cm/s)

C = coefficient based on grain size (Fetter, 2001)

Depth profiles of particle size distribution and the saturated hydraulic conductivity are shown in Table 4.5. The samples from 1.2 to 15 m deep were predominately medium-grained sand (90%), gravelly sand (36-56%), and sandy gravel (44-56%). Samples from greater depths of DW2 were generally coarser and predominantly coarser sand or gravelly sand. The estimated hydraulic conductivity for all the samples were between 0.233-397 m/d by the Hazen method. The values increased from approximately 0.233 m/d at the surface to 26.5 m/d at a depth of 8 m and increased to 26.5 to 397 m/d at a depth of 13 m in DW2. The results show that there is an increase in heterogeneity with depth as sampled in DW2.

Table 4.5: Summary results of soil particle and values of hydraulic conductivity calculated using Hazen methods for DW2

Depth	**Clay**	**Silt**	**Sand**	**Gravel**	**d_{10}**	**d_{50}**	**d_{60}**	**K (Hazen,1911)**	
m	%	%	%	%	(mm)	(mm)	(mm)	m/day	m/sec
1.2-6	4	6	90	0	0.015	0.49	0.6	0.233	0.0000027
8-10	4	4	56	36	0.16	1.3	1.8	26.5	0.0003072
13-15	0	0	44	56	0.6	2.3	3	397	0.0046

4.6.2 Utilisation of Bank Infiltration for Water Treatment In Malaysia

Malaysia has traditionally sought its supply of water from sources referred to as surface water which include rivers and dams. Currently, surface water accounts for more than 98% of the national public water supply and the high level of dependence on surface water needs to be diluted due to the impending climate change.

BI is a water treatment process that make use of surface water that naturally sinks into the ground via the river bed or bank and is recovered via a pumping well. Compared with an ordinary water treatment system, which takes water directly from the river. BI is a traditionally efficient and well accepted method of surface water treatment in Europe. As BI systems are simple to operate and robust, they have a high potential for application in developing countries such as Malaysia.

Due to the nature of the system, which also take groundwater from the ground as opposed to directly from the river, the system is able to continue its supply of water even in the event of water pollution or unexpected disaster. With this system, the shutting down of water treatment plants due to pollution can be prevented. It is noted that for Kuala Lumpur, the Cheras 11th Mile water treatment plant in Hulu Langat is periodically closed due to high ammonia levels in Sungai Langat which serves as the plant's raw water intake point.

Several mechanisms are responsible for improvement of water quality during BI. During infiltration and travel through the soil and aquifer sediments, surface water is subjected to a combination of physical, chemical and biological processes such as (Sharma & Amy, 2009);

i. filtration,
ii. solution-precipitation.
iii. ion-exchange,
iv. sorption-desorption,
v. complexation,

vi. redox reactions,
vii. microbial biodegradation and
viii. dilution that significantly improve water quality.

River water exhibiting a wide range of spatio-temporal variations is treated by a series of process to provide safe water for human consumption. The degree of treatment depends on the nature of the river water. The conventional raw water treatment depends on the scheme. In Malaysia, Ministry of Health (MOH) is responsible for monitoring the raw water quality at the intake points of the treatment plants. State Water Authorities or private companies then supply piped drinking water from the treatment plants to the population. In the year 2000, 98% of the urban population in Malaysia were already served through reticulated systems from water treatment plants using all or some of the conventional treatment processes of aeration, coagulation and flocculation, sedimentation, filtration and chlorination. However, the effectiveness of some smaller treatment plants where only chlorination was used, are now under threat because of development. A schematic diagram of the conventional raw water treatment processes is presented in Figure 4.17.

In case of polluted rivers, raw water is generally pre-chlorinated and then subjected to a treatment sequence in Figure 14.17. Chlorination of water polluted with organics is a potential sources for the formation of disinfection by-products (DBPs). Removal of organics to minimise formation of DBPs is a regulatory requirement in developed countries.

Increasing chemical pollution, especially in areas with significant human activities, which may result in high concentrations of ammonia, organic compounds and micropollutants in the river water, necessitated introduction of supplementary pre- and post-treatment steps to build up a multiple-barrier system. A variety of technologies may be applied to treat BI and treatment strategies may be quite different depending on the river water quality. Aeration or ozone may be used to oxidise iron and manganese that are picked up in anaerobic aquifers and activated carbon can be used for adsorption and protection against

more persistent contaminants. Today nearly all water utilities situated along large rivers use granular activated carbon filters, often combined with ozonation and filtration. Proposal for process scheme development of BI water treatment in Malaysia show in Figure 4.18.

Due to the rising demand for drinking water, BI is one of the best options to provide source of drinking water. Surface water, streams, rivers and local water catchments are part of many great water systems in Selangor. But with the growth in population and development, freshwater resources have become scarce. Once plentiful, water resources in the Klang Valley have become contaminated as a result of excessive disposal of animal wastes, industrial farms and other wastes in leaching harmful pollutants into water supplies. Not only in Klang Valley but in Peninsular Malaysia. Mains water demand in this country is projected to increase 27% from 11,806 MLD in 2005 to 16,271 MLD in 2010. In Selangor (Table 4.6), domestic demand grew at an average compounded rate of 5.9% from 1960 to 2006. During this years, water demand was divided between the domestic and non-domestic sectors by a ratio of 61 to 39. The projected domestic and industrial demand for Peninsular Malaysia up to 2050 based on study by Economic Planning Unit, reported in National Water Resources Study (GOM, 2000) predicts Langat Basin's water demand in 2012 to be about 1,200 MLD, its present water supply caters for only 1000 MLD and projected to reach 24,485 MLD by the year 2020.

Table 4.6: Selangor growth in population and domestic Demand, Selangor 1960-2006 (GOM, 2000).

	1960	1970	1980	1990	2000	2006
Domestic Water demand (MLD)	105	177	295	493	1,117	1,459
Population (Million)	1.12	1.18	2.41	3.28	5.25	6.47

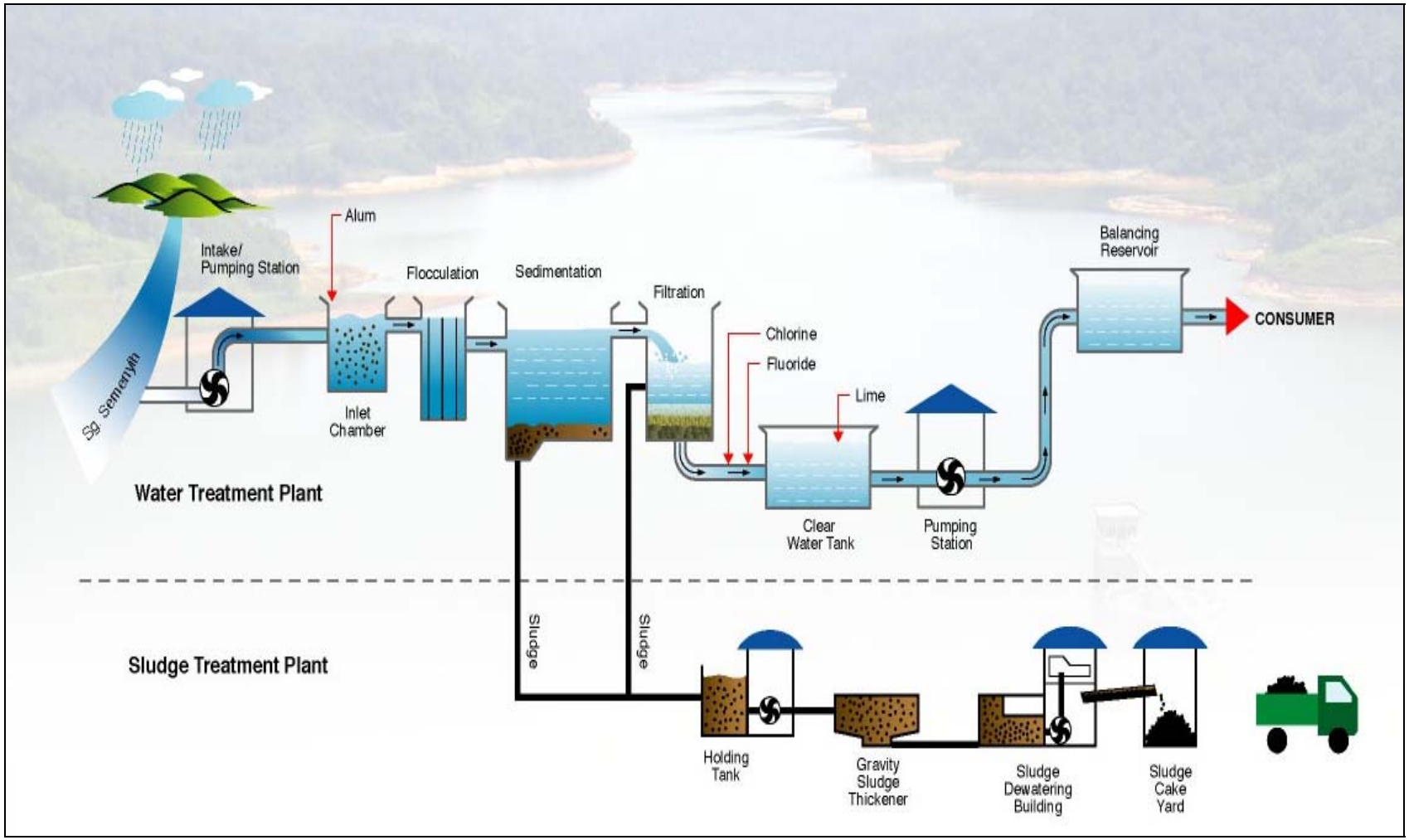


Figure 4.17: A schematic diagram of the conventional raw water treatment in Malaysia (sources: Konsortium Abass Sdn Bhd.)

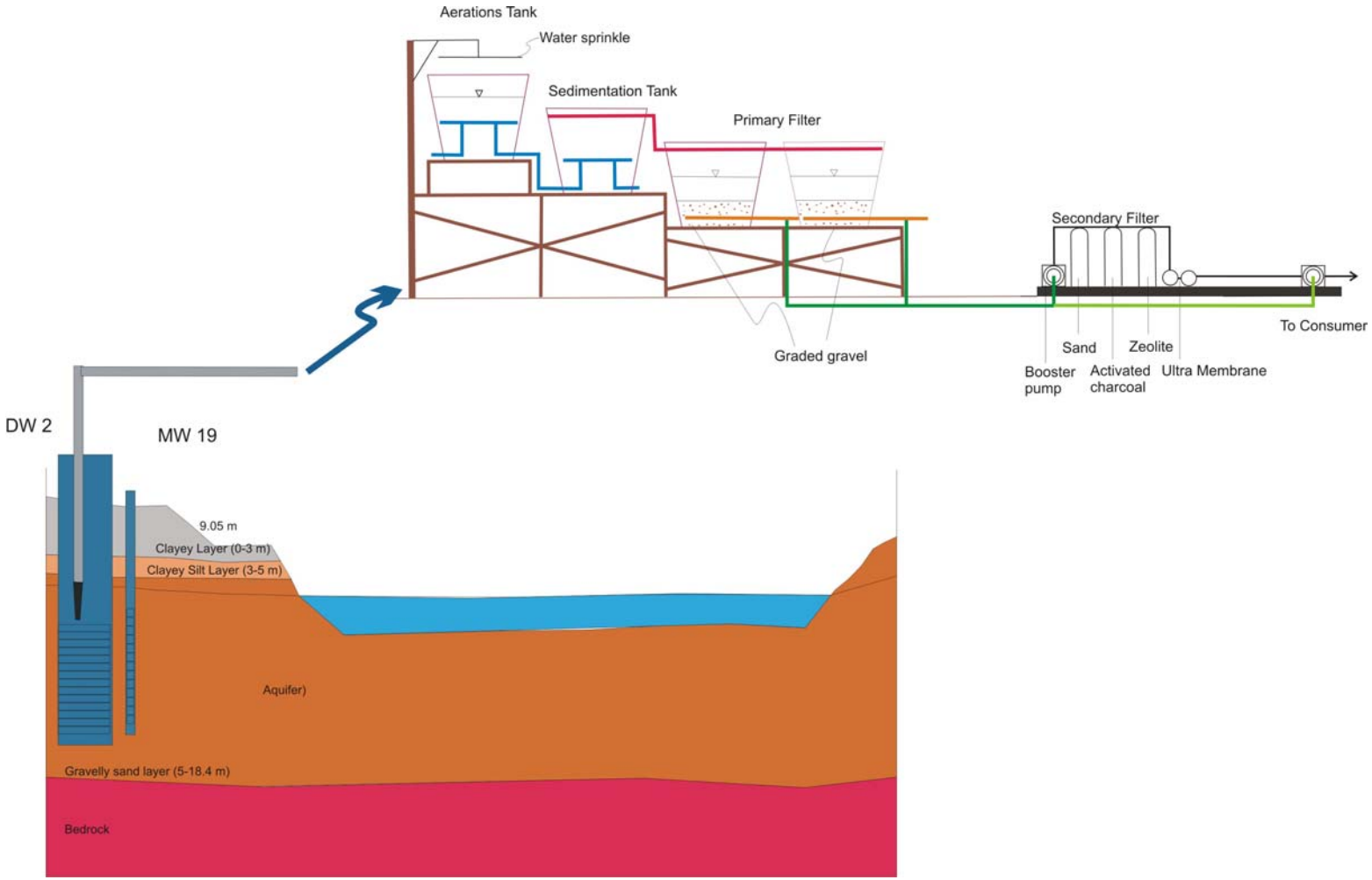


Figure 4.18: Schematic plan for process scheme development of river water treatment in Malaysia utilising Bank Infiltration

From the statistic of water consumption in Malaysia from 2008 to 2009, that there are about 12,418 intake in 2008, taking water directly from rivers in the water supply needs of the states in Malaysia. The number of intakes and has risen to 12,583 in the year 2009 due to increased demand for water (Table 4.7). What was feared would be closure of water intakes due to pollution as the dependency on the surface water is very high. Therefore, the BI method is needed to prevent the repetitive occurrence of closure of water intake.

4.6.3 Bank Infiltration in the Study Area

In Selangor, the drinking water is supplied solely by surface water. However, the quality of the source of drinking water is more and more difficult to maintain due to an increase source of contamination. The quality of the raw water is much worse in downstream areas than in upstream areas. The BI method should be considered by water operators in order to obtain clean raw water for public water supply and lower the cost of water treatment. Jenderam Hilir which is situated down stream on the Langat River Basin, where condition of implementing BI is very conducive, hence pumping the source of municipal water from the Sungai Langat is potentially viable through this method of water treatment. Two wells, DW1 and DW2 which were developed by NAHRIM was used for the BI study. The 254 mm diameter DW1 and DW2 pumping well are located 60 m and 18 m respectively from the riverbank (Figure 4.19). This relatively short distance to the pumping well was chosen so that smaller groundwater withdrawal occurs from the surrounding aquifer, and to guarantee the larger amounts of pumped water derived from the river which will minimise the effects of mixing of groundwater and surface water and maximise BI. The withdrawal rate at DW2 are 3 MLD and could be increased futher using higher capacity pump.

A study conducted by NAHRIM in 2008, climate change projection study in Peninsular Malaysia up to 2050 will bring about significant changes to water availability (NAHRIM, 2008). Selangor can expect 5% less rainfall, a decrease in mean monthly rainfall and significantly lower minimum monthly flows. Droughts are forecasted for the years 2028, 2029, 2034, 2042 and 2044. Higher maximum and lower minimum rainfall, and more

extreme hydrological conditions are expected in the future in many sub regions. Based on this study, the raw water availability in Malaysia will impact the industrial and domestic water supply needs. There are 25 monitoring wells located at the site and recently, monitoring well MW 19 were bored 1 m to DW2 at a depth of 15.09 m. The aquifer comprises of alluvial deposit to a depth 20 m ranging from sand to gravelly sand. The deposit is underlain by the Hawthornden Schist. The aquifer could be described as a single layer systems with direct hydraulics connection to the river. The Sungai Langat in the study area is 39.16 m wide and on the average is 1.71 m deep. The water table during monsoon normally fluctuates from elevation 5.59-6.75 m.

Table 4.7: Statistic of water consumption in Malaysia from 2008 until 2009 (after Malaysia Water Association, 2010)

Water Supply Entities	**2008**				**2009**			
	Direct Extraction From River	Storage Dam (Direct)	Groundwater	Total	Direct Extraction From River	Storage Dam (Direct)	Groundwater	Total
	Million litre per day (MLD)							
Johor	1,039	398		1,437	1,265	334		1,599
Kedah	1,226	17		1,243	1,246	16		1,262
Kelantan	207		135	342	200		148	348
Labuan	41	10		51	40	11	1	52
Melaka	342	145		487	289	216		505
N.Sembilan	703	368		1,071	509	420		929
P.Pinang	860	78		938	895	96		991
Pahang	971		6	977	1,090		4	1,094
Perak	1,134	127		1,261	1,021	319		1,340
Perlis	47	53	9	109	50	53	8	111
Sabah	596	241	45	882	599	243	45	887
Sarawak	858	100		958	892	100		992
Selangor	3,843	145		3,988	3,914	153		4,067
Terengganu	551		0	551	571		0	571
MALAYSIA	12,418	1,682	195	14,295	12,583	1,961	206	14,750

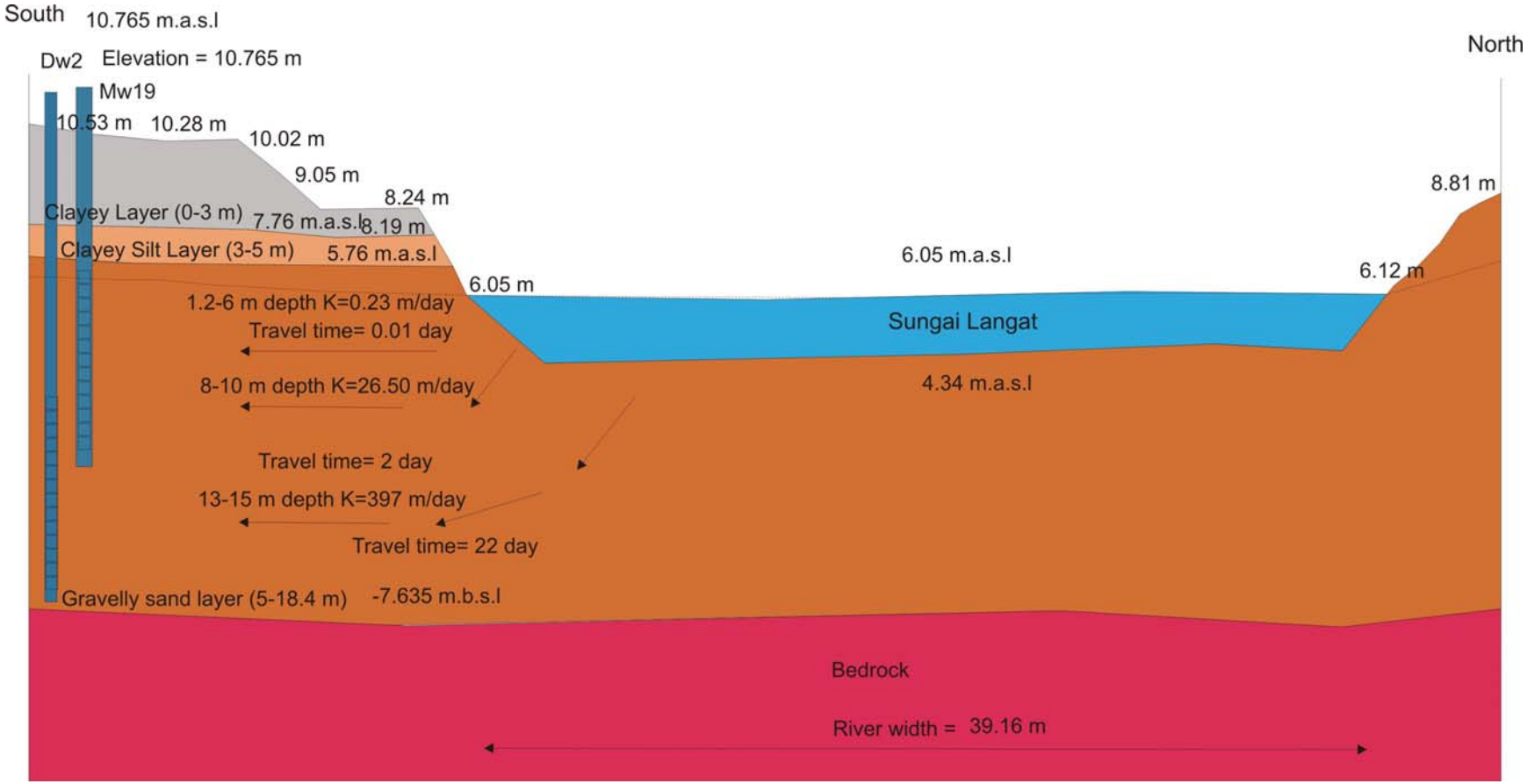


Figure 4.19: Cross-sections of D-D' across the test well DW 2

The range of values of water quality of 6 samples collected from DW2 during the pumping tests are presented in Table 4.8. Water samples from the river shows high turbidity. The table shows that turbidity is reduced from 328 NTU to 14.0 NTU, that proved BI has been able to reduce the turbidity of the river water in the study area very significantly. Total solid was reduced significantly. This technique was also are able to remove completely the total coliform and E. coli. The river routinely has NO_3 levels greater than the 5 mg/l. The NO_3 concentration in Sungai Langat was 9.1-16 mg/l and reduced to 1.0 mg/l in the groundwater. The study conducted by NAHRIM revealed that nitrate levels were 4 to 6 times lower in wells adjacent to the river. Natural filtration was able to remove contaminants and provide water to their customers without extensive treatment. The comparative values of various parameters of samples taken in the study area are shown in Figure 4.20.

Table 4.8: Groundwater and surface water quality of the study area in Jenderam Hilir

Parameter	**Sungai Langat**	**Groundwater/DW2**
pH	6.7	7.1
Turbidity (NTU)	328.0	14.0
Total Solid, mg/l	370	140
Conductivity µS/cm	211	94
$S0_4$, mg/l	15	6
Cl, mg/l	7	11
$N0_3$, mg/l	9.1-16	1.0
Ca, mg/l	11	32
Total Coliform MPN/100ml	2420	<1
E. coli MPN/100ml	488	<1

BI has been shown to be effective in removing many of the contaminants present in surface water such as removal of turbidity (Dash et al. 2008; Dillon et al. 2002; Wang et al. 1995), natural organic matter, pesticides, and pharmaceuticals (Massmann et al. 2003; Ray et al. 2002; Verstraeten et al. 2002; Wang 2002; Kühn and Müller 2000; Miettinen et al. 1994), salinity (Dillon et al. 2002); as well as taste- and odour-causing compounds, which may not be removed from the surface water by conventional treatment methods (Worch et al. 2002). The potential of BI or BI systems to provide a significant barrier to microorganisms has also been observed (Weiss et al. 2003; Gollnitz et al. 2003; Wang 2002; Medema et al. 2000) and it has been proven to significantly reduce the presence of Giardia and Cryptosporidium for drinking-water applications when flow path length and filtration times are sufficient (Gollnitz et al, 2003; Berger 2002; Schijven et al. 2002). For more than 100 years, BI systems have been used along the Rhine, Elbe and Danube rivers to produce drinking water. The Europeans have been successful in achieving effective removal of particulate matter, man made or natural organic compounds, some common bacteria, algae, disinfectant by-product precursors and a large number of chemical and other micropollutants (Verstraeten et al. 2002; Kühn and Müller 2000; Grischek et al. 1998). In a hydrogeological summary conducted by Grischek et al, (2002) on a number of BI sites in the United States and Europe, most sites were found to be located in alluvial sand and gravel aquifers having hydraulic conductivities well over 1×10^{-4} m/s (>9 m/day). The thickness of exploited aquifers ranges from 5-120 m. At most sites in Europe, the distances between river bank and production wells are more than 50 m with travel times exceeding 50 days.

Some data on water quality changes during infiltration into aquifer are given in Table 4.9, for period of 30 minutes, 24 hours, 48 hours and 72 hours during a pumping test. Water quality change in Jenderam Hilir depend mainly on the redox reactions. These reactions were involving oxidised inorganic species such as Fe(III) and nitrate, and reduced organic carbon (Figure 4.20) can strongly influence the levels of both organics and of Fe(II) in groundwater (Grischek et al., 1998).

Table 4.9: Water quality in Jenderam Hilir sample during the pumping test, for period of 30 minutes, 24 hours, 48 hours and 72 hours

Parameter	unit	Sungai Langat upstream	Sungai Langat Downstream	DW2 (30 minutes)	DW2 (24 hours)	DW2 (48 hours)	DW2 (72 hours)
pH		6.3	6.7	7.1	5.26	5.26	5.27
Colour	H.U.	5	5	5	3.5	5.6	8
Turbidity	N.T.U	52.0	328.0	14.0	57	61	60
Conductivity	µS/cm	161	94	211	141	135	130
silica (SiO_2)	mg/l	7.7	22.0	6.2	14.2	14.9	13.8
Tot. Solid	mg/l	206	370	140	92	99	84
Diss. Solid	mg/l	88	54	120	90	86	83
CO_3	mg/l	<1	<1	<1	<1	<1	<1
HCO_3	mg/l	41	23	99	38	39	39
Cl	mg/l	11	7	7	1.6	1.5	0.8
SO_4	mg/l	15	10	6	2.61	1.89	3.8
NO_2	mg/l	0.01	0.011	0.015	1.12	0.46	0.75
NO_3	mg/l	16.0	9.1	1.0	0.007	0.009	0.009
F	mg/l	<0.5	<0.5	<0.5	0.2	0.2	0.15
P	mg/l	0.79	0.81	0.76	0.05	0.04	0.05
NH_4	mg/l	<0.5	<0.5	<0.5	0.71	0.86	0.86
Ag	mg/l	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Al	mg/l	2.5	11.0	<0.1	0.63	0.65	0.78
As	mg/l	0.03	0.01	0.06	0.016	0.012	0.018
Ba	mg/l	<0.1	0.1	0.2	<0.05	<0.05	<0.05
Ca	mg/l	24.0	11.00	32.0	11.3	11.9	12.63
Cd	mg/l	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001
Co	mg/l	<0.05	<0.05	<0.05	<0.01	<0.01	<0.01
Cr	mg/l	<0.01	<1	<0.01	<0.03	<0.03	<0.03
Cu	mg/l	<0.1	<0.1	<0.1	<0.01	<0.01	<0.01
Fe	mg/l	3.4	7.9	15.0	7.93	8.93	8.74
Hg	mg/l	<1	<1	<1	<0.001	<0.001	<0.001
K	mg/l	4.6	4.8	8.3	3.37	3.48	3.68
Mg	mg/l	1.4	1.5	3.0	3.1	3.11	3.3
Mn	mg/l	<0.1	0.2	0.8	0.59	0.62	0.65
Na	mg/l	9.5	5.4	3.8	2.88	2.94	3.12
Ni	mg/l	<0.1	<0.1	<0.1	<0.01	<0.01	<0.01
Pb	mg/l	<0.01	0.05	<0.01	<0.01	<0.01	<0.01
Se	mg/l	<0.01	<0.01	<0.01	<0.01	<0.001	<0.001
Sr	mg/l	0.03	0.03	0.03	0.03	0.03	0.03
Zn	mg/l	<0.1	<0.1	<0.1	0.06	0.07	0.04
Carbonate Hardness	mg/l	66	34	92	39	42.4	44

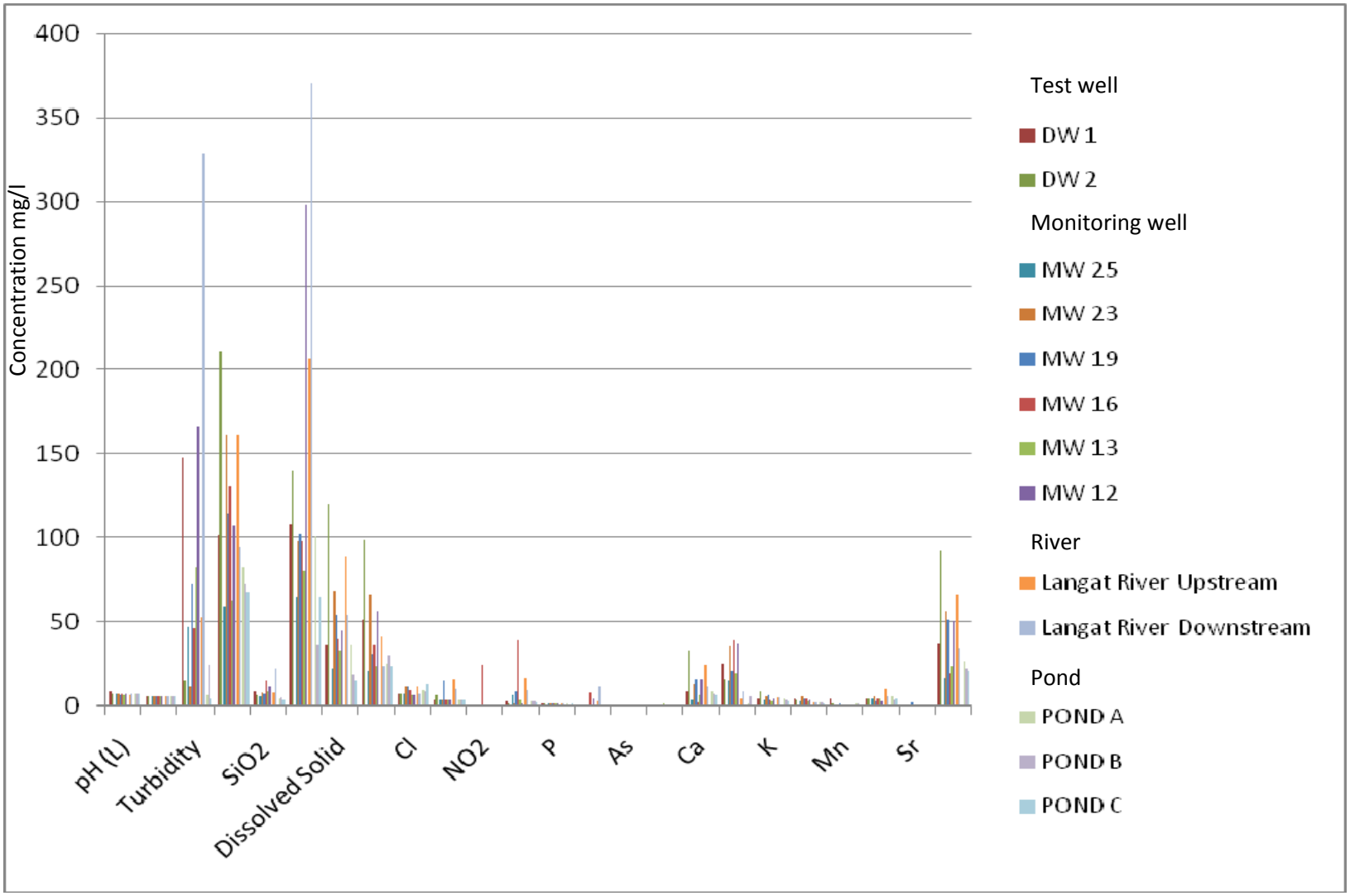
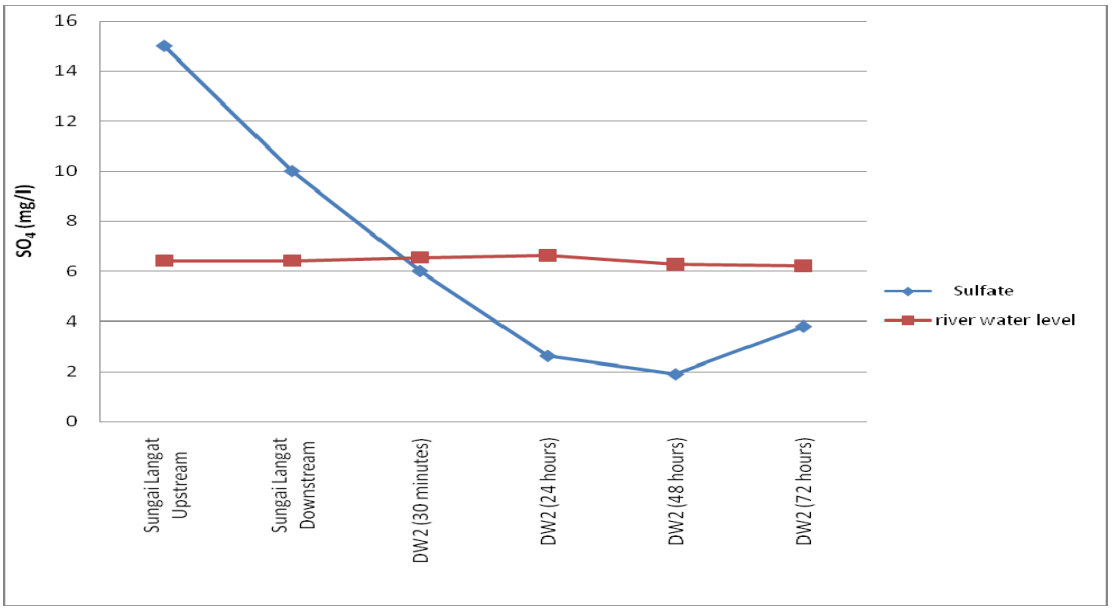


Figure 4.20: Concentration of ions and dissolved solids in water samples from Jenderam Hilir, Dengkil



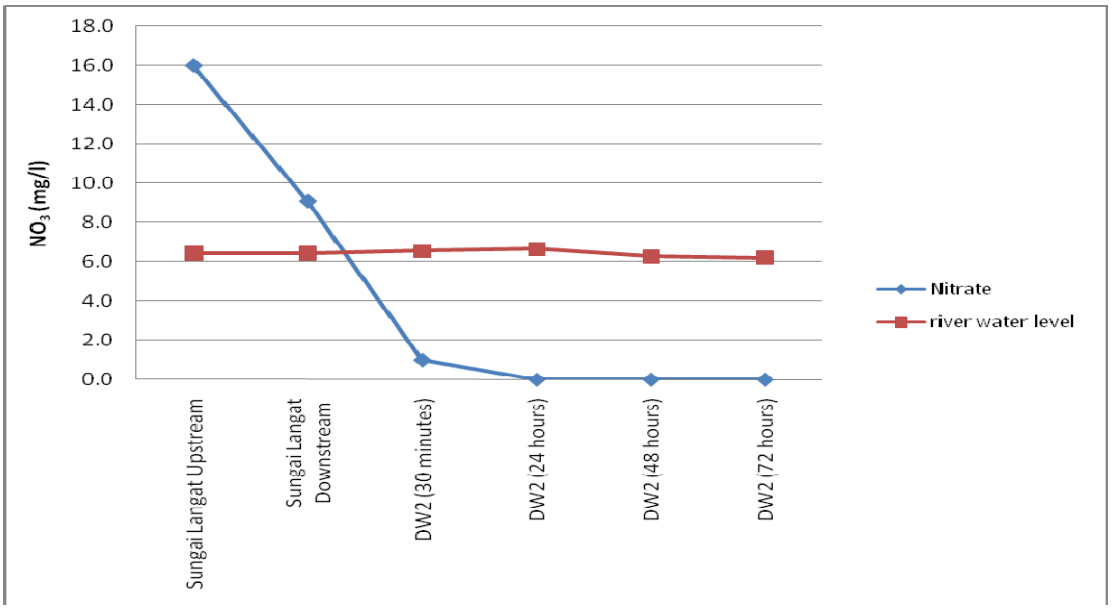


Figure 4.21: Change in sulphate and nitrate concentration in Sungai Langat and its BI water from well DW2 at 30 minutes, 24 hours, 48 hours and 72 hours at a distance of 17.4 m from the riverbank.

5.0 WATER QUALITY

5.1 Groundwater and Surface Water Sampling

Apart from the sampling during the pumping test, a sampling programme for the study of groundwater and surface water quality was carried out. Eight groundwater samples (DW1, DW2, MW12, MW13, MW16, MW19, MW23, and MW25), 5 surface water samples (upstream and downstream Sungai Langat) and pond water samples (A, B and C) were collected on Mac 2010 from the study area. For the groundwater sampling, the wells were pumped for more than 30 minute before sampling. The list of parameters analysed in the laboratory is shown in Table 5.1. Method of collection and analysis of water samples followed APHA (1985). All samples from surface and groundwater were collected in 2 l capacity polyethylene bottles of raw water samples and 1 l of the sample were acidified with 50% strength nitric acid (HNO_3) to a pH of less than 2 so as to keep the iron and manganese in solution, and were filtered and split in different polyethylene bottle for subsequent analysis of cations and anions. All the analysis were performed in the Geochemical Laboratory, Technical Services Divison, Minerals and Geoscience Department (JMG), Ipoh.

During the constant discharge test for production well DW2, groundwater samples were collected at 24, 48 and 72 hours, and sent to the private laboratory for chemical and physical analysis. The results of the analysis are shown in Table 5.2 and details are in Appendix D. All concentrations are expressed in milligrams per liter (mg/l), except pH and EC.

Table 5.1: List of parameters analysed for groundwater and surface water

	Parameters Analysed
1	Turbidity
2	Colour
3	pH
4	Conductivity
5	Manganese (Mn)
6	Iron (Fe)
7	Nitrate Nitrogen (NO_3-N)
8	Nitrite Nitrogen (NO_2-N)
9	Total Dissolved Solids (TDS)
10	Total Solids (TS)
11	Chloride (Cl)
12	Ammonium (NH_4)
13	Fluoride (F)
14	Carbonate (CO_3)
15	Bicarbonate (HCO_3)
16	Total Hardness ($CaCO_3$)
17	Sodium (Na)
18	Calcium (Ca)
19	Potassium (K)
20	Aluminium (Al)
21	Magnesium (Mg)
22	Mercury (Hg)
23	Cadmium (Cd)
24	Selenium (Se)
25	Arsenic (As)
26	Lead (Pb)
27	Chromium (Cr)
28	Silver (Ag)
29	Copper (Cu)
30	Zinc (Zn)
31	Sulphate (SO_4)
32	Silica (SiO_2)
33	Cobalt (Co)
34	Barium (Ba)
35	Strontium (Sr)
36	Nickel (Ni)
37	Phosphorus (P)

Table 5.2: Results of groundwater and surface water analysis from the Jenderam Hilir

Well No.	unit	DW 1	DW 2	MW 25	MW 23	MW 19	MW 16	MW 13	MW 12	Langat River Upstream	Langat River Downstream	POND A	POND B	POND C
pH	-	8.1	7.1	6.9	6.9	6.3	6.7	6.3	6.8	6.3	6.7	6.8	6.8	6.7
Colour	H.U.	5	5	5	5	5	5	5	5	5	5	5	5.0	5
Turbidity.	N.T.U.	147.0	14.0	46.0	11.0	72.0	46.0	82.0	166.0	52.0	328.0	5.7	24.0	3.5
Conductivity	µS/cm	101	211	58	161	114	130	62	107	161	94	82	72.0	67
silica (SiO_2)	mg/l	8.1	6.2	5.4	7.2	6.6	14.0	8.2	11.0	7.7	22.0	3.4	4.6	3.1
Total Solid	mg/l	108	140	64	98	102	98	80	298	206	370	100	36.0	64
Dissolved. Solid	mg/l	36	120	22	68	54	40	32	44	88	54	36	18.0	14
CO_3	mg/l	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
HCO_3	mg/l	51	99	20	66	30	36	23	56	41	23	25	29.0	23
Cl	mg/l	7	7	7	11	11	9	6	6	11	7	9	8.0	13
SO_4	mg/l	3	6	3	3	14	3	3	3	15	10	3	3.0	3
NO_2	mg/l	0.005	0.015	0.007	0.008	0.005	24	0.005	0.005	0.01	0.011	0.01	0.0	0.01
NO_3	mg/l	2.1	1.0	5.7	0.6	8.3	39.0	3.0	0.6	16.0	9.1	2.2	2.2	1.8
F	mg/l	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
P	mg/l	0.88	0.76	0.77	0.81	0.75	0.80	0.80	0.78	0.79	0.81	0.80	0.0	0.79
NH_4	mg/l	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Ag	mg/l	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.1	0.05
Al	mg/l	0.1	0.1	0.1	0.1	0.1	7.7	0.1	4	2.5	11	0.2	0.2	0.1
As	mg/l	0.09	0.06	0.05	0.17	0.04	0.19	0.06	0.14	0.03	0.01	0.02	0.0	0.01
Ba	mg/l	0.1	0.2	0.1	0.2	0.2	0.1	0.8	0.1	0.1	0.1	0.1	0.1	0.1
Ca	mg/l	8.4	32.0	3.2	13.0	15.0	1.5	5.9	15.0	24.0	11.0	8.0	6.4	6.2
Cd	mg/l	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Co	mg/l	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.1	0.05
Cr	mg/l	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.0	0.01
Cu	mg/l	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Fe	mg/l	25.0	15.0	14.0	35.0	20.0	39.0	19.0	37.0	3.4	7.9	0.9	4.9	0.1
Hg	mg/l	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.2	1.00
K	mg/l	3.6	8.3	3.1	5.4	5.7	2.9	2.5	3.7	4.6	4.8	3.6	3.1	2.6
Mg	mg/l	4.0	3.0	1.9	5.6	3.4	3.8	2.0	3.0	1.4	1.5	1.4	1.5	1.1
Mn	mg/l	3.5	0.8	0.1	0.1	1.1	0.1	0.1	0.1	0.1	0.2	0.6	0.4	0.1
Na	mg/l	3.4	3.8	3.4	5.4	2.6	3.7	3.4	1.9	9.5	5.4	4.9	2.9	3.7
Ni	mg/l	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Pb	mg/l	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Se	mg/l	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.0	0.01
Sr	mg/l	0.02	0.03	0.03	<0.01	1.30	0.03	0.03	0.01	0.03	0.11	0.05	0.0	0.02
Zn	mg/l	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Carbonate Hardness	mg/l	37	92	16	56	51	19	23	50	66	34	26	22.0	20

5.1.1 pH

The pH of an aqueous solution is a measure of the number of hydrogen ions or protons present and measured with a pH meter. The pH of the analysed groundwater sample in the study varies from 6.30-8.10 which is within the permissible limit of drinking water standard of 5.5-9.0 (Department of Standard Malaysia, 2010). DW1 and DW2 show that groundwater are mildly alkaline (pH: 7.10-8.10) whereas for MW 12, MW 13, MW 16, MW23 and MW25 are mildly acidic (6.30-6.90). Samples from surface water S1, S2, PA, PB and PC collected from Jenderam Hilir, showed pH values ranging from 6.30-6.70. The mildly acidic surface water has significantly increased the pH values of the groundwater.

5.1.2 Electrical Conductivity (EC)

Electrical Conductivity (EC) depends upon temperature, ionic concentration and types of ions present in the water. Thus the EC gives a qualitative picture of the quality of groundwater. The groundwater with EC less then 1500 µS/cm is classified into fresh water. The EC for groundwater in the study area varies from about 62-166 µS/cm with the mean value of 118 µS/cm. In the Sungai Langat upstream and downstream of the study area, low conductivity was observed. The S1, S2, PA, PB and PC samples showed 67-161 µS/cm.

5.1.3 Total dissolved solids (TDS)

The permissible limit for TDS is 1,500 mg/l (Department of Standard Malaysia, 2010) and TDS value of <1000 mg/l is considered as fresh water. In the study area, the TDS value ranges from 22-120 mg/l for the groundwater and 14-88 mg/l for the surface water.

5.1.4 Turbidity

Turbidity, which makes water appear cloudy or muddy, is caused by the presence of suspended and dissolved matter, such as clay, silt, finely divided organic matter, plankton and other microscopic organisms, organic acids, and dyes. The colour of water, whether resulted from dissolved compounds or suspended particles, could affect the turbidity measurement. High turbidity value for surface water in the study area ranges between 328-699 NTU. The groundwater samples show low turbidity. This shows that bank infiltration in Jenderam Hilir could significantly reduced the turbidity value. Turbidity is not a major health concern, but high turbidity can interfere the with disinfection process and provides a medium for microbial growth. It may also indicate the presence of microbes.

5.1.5 Sulphate (SO_4)

Mineral springs or mining wastes are among the major sources of sulphate in groundwater. Industrial and domestic wastewater also sometimes causes detection of this ion. The sulphate concentration in groundwater and surface water samples in the study area is rather similar with groundwater 3.0-14.0 mg/l, with a mean of 4.75 mg/l, while all surface water show low sulphate concentration from 3.0-15.0 mg/l.

5.1.6 Nitrate (NO_3)

Nitrate in natural water is due to organic sources, or industrial and agricultural chemicals. While nitrogen is an essential constituent of protein in all living organisms, nitrate concentrations of greater than 50 mg/l can cause cyanosis or blue baby syndrome among infants (Young et al., 1976: Vigil et al., 1965) and development of cancer in adults (WHO, 2008). The permissible limit (DSM, 2010) for NO_3 in raw water is 10 mg/l (Department of Standard Malaysia, 2010). The concentration of NO_3 in groundwater and surface water in study area varies from 1.80 to 39.0 mg/l. High concentration of NO_3, which is 39.0 mg/l can be seen at MW16 for the groundwater and for the surface water

S1 is 16.0 mg/l are observed in Jenderam Hilir. High nitrate concentration could be resulted from sewage and septic tanks, industrial effluents and also coming from agricultural chemical as MW16 is near the oil palm estate.

5.1.7 Heavy Metals

Analysis were done for mercury (Hg), arsenic (As), lead (Pb), chromium (Cr), copper (Cu) and zinc (Zn). High concentration of arsenic could be observed, while mercury, copper, zinc, chromium and lead values did not exceed the drinking water standard in wells and surface water samples. There are 6 wells (MW12, MW13, MW16, MW19, MW23, MW25) that indicates arsenic values exceeding the standards of 0.01 mg/l. All samples from surface water also containing high concentrations of arsenic (0.01-0.03 mg/l). Most likely arsenic content came from pesticides and herbicides used in the study area.

5.1.8 Ferum (Fe)

All groundwater samples from 8 wells show concentration of iron higher than the drinking water standards i.e., 0.3 mg/l. The iron concentration of groundwater is from 14.0-39.0 mg/l. Iron is a common constituent of many primary minerals, such as biotite, pyroxenes and amphiboles. It is assumed that the geochemical conditions of the study area may result in predominant distribution of ferrous and ferric irons although it is not confirmed that these minerals clearly exist in the area.

5.1.9 Magnesium (Mg)

Magnesium is also one of the abundant elements in rocks. It causes hardness in water. High concentration of Mg leads to encephalitis. The Mg concentration in wells ranges from 1.90-5.60 mg/l and for surface water ranges from 1.10-1.50 mg/l. The permissible limit of magnesium is <30 mg/l (WHO, 2008) and in Malaysian drinking water standard (Department of Standard Malaysia, 2010) is 150 mg/l.

5.1.10 Calcium (Ca)

The calcium concentration ranges from the 1.50-32.0 mg/l. The concentrations of calcium appear to be low with most of the samples of groundwater and surface water show value <50 mg/l. The permissible limit of calcium concentration is 75 mg/l in drinking water standard (WHO, 2008).

5.1.11 Sodium (Na)

The primary source of sodium in natural water is from the release of the soluble products during weathering. Much of the sodium probably comes from rainwater and also from ion exchange. Other sources of sodium in groundwater could be clay and Na-plagioclase. The concentrations of the sodium in the wells and surface water range from 1.90-9.50 mg/l, which is well below the permissible limit of Malaysia Drinking Water Standard (Department of Standard Malaysia, 2010).

5.1.12 Potassium (K)

Ionic potassium occurs at fairly low concentrations in groundwater and major sources of potassium concentration in the study area could be from rainfall and rivers, potash feldspar and micaceous minerals. The concentration of potassium is in the range of 2.50-8.30 mg/l for both the groundwater and surface water. Most of the samples show low potassium concentrations not exceeding 10 mg/l.

5.1.13 Bicarbonate (HCO_3)

Bicarbonate concentration in groundwater collected from the DW2 is 99.0 mg/l. Most water samples recorded concentration of <66 mg/l. High concentrations of bicarbonate in groundwater is due to dissolution of CO_2 gas in recharge water principally within the soil

zone, dissolution of carbonate minerals and biochemical oxidation of organic material (Sprinkle, 1989). Dissolution of CO_2 gas occurs in the recharge area and the higher concentration occurs in the discharge area.

5.2 Microoganism Counting

5.2.1 Cryptosporidium and Giardia

Cryptosporidium parvum is an enteric and obligate protozoa, which infects the gastrointestinal tract of animals and humans, causing cryptosporidiosis. This protozoan parasite has a complex life cycle. However, the oocyst stage is the one of concern due to its resistance to conventional water treatment methods, its prolonged survival and its low infectious dose (as low as 1.0-10.0 oocysts per individual), and because it is the propagation phase commonly found in the environment and causes gastroenteritis, mostly to young and immune compromised adults. The most frequent route of transmission is the oral-faecal route, and human and animal faeces are the common source of contamination.

Farizawati et al. (2005) reported a study of Cryptosporidium and Giardia from cattle farms located near Sungai Langat and Sungai Semenyih showed that out of 24 samples of water taken from Sungai Semenyih, 4.2% was positive for Giardia cysts with a concentration of 1.3 cysts/l and 20.8% were positive with Cryptosporidium oocysts with a range of 0.7–2.7 oocysts/l. In Sungai Langat, from the 43 samples taken, 23.3% were positive for Giardia cysts with a range of 1.5–9.0 cysts/l whereas 11.6% were positive with Cryptosporidium oocysts with a range of 2.5–240.0 oocysts/l. This shows that wastewater was discharged into the river signifying contamination of (oo)cycts from the cattle farms into the river system.

For analysis of *Cryptosporidium* and *Giardia* concentrations in the Jenderam Hilir, Selangor, 3 samples were collected. One sample from upstream (SW1) and downstream (SW2) of Sungai Langat within the study area, and one samples was collected from the

tube well (DW2). USEPA method 1623 (USEPA, 2005) was used for testing purposes. An absolute porosity filter (*Whatman Cryptest*®) was used to collect debris from 10 l of water. If the water was too turbid to allow filtration of 10 l, a lesser volume was filtered. The filter was eluted through backflushing and the debris was collected and centrifuged to concentrate it. The concentrate was subjected to immunomagnetic separation (IMS) that specifically retains the *Cryptosporidium* oocysts and *Giardia* cysts, and allows the background debris to be removed. The IMS part of the sample was placed on a well slide and stained with fluorescein-tagged antibodies to *Cryptosporidium* and *Giardia* and a vital dye stain (DAPI) that specifically delineates the nuclei within the organisms. The slides were examined microscopically, and organisms that were identified as *Cryptosporidium* and *Giardia* were counted.

Analysis of water samples from Sungai Langat and test well DW2, showed that two samples from the Sungai Langat contained Giardia cyst in concentration of 0.1-2.9 cysts/l (Table 5.3). Whereas the well water concentration is 0.0 cycts/l. In Malaysia, river water polluted with Giardia cyst is common, cyst range from 0.7-12,780.0 cysts/l have been reported (Farizawati et al, 2005; Lim et al, 2008). Giardia cyst can be eliminated in temperature more than 65^{o}C. However, to date there is still no reported disease outbreak in Malaysia in relation to water borne giardiasis. On treatment for Giardia, conventional chlorine concentration that is used for water treatment could not kill Giardia cyst. Ozonation is effective but expensive. Therefore, it is important to make sure that Giardia cyst be reduced through filtration process.

.

5.2.2 Total Coliform and *Escherichia coli (E.coli)*

E. coli is a thermo-tolerant coliform bacterium that causes gastrointestinal infections. It has a low dose of infection (10-100 cells per individual) and has a good resistance to acidic conditions. Although its origin is human and animal faeces, it is a very cosmopolitan bacterium that can be found in insects, food, vegetables, and water. It can be easily transmitted via person-to-person contact (Campbell and Wallis, 2002). Its

consistently presence in warm-blooded animal faeces and its easy and quick detection, makes it one of the preferred indicators for faecal contamination.

Total coliform and *E. coli* concentrations were determined using the most-probable number (MPN) method from Colilert™ at NAHRIM's Laboratory. Colilert™ is a commercially available liquid medium (Idexx Corporation, Westbrook, Maine) that allows the simultaneous detection of total coliforms and *E. coli*. The MPN method is facilitated by the use of a specially designed disposable incubation tray called the Quantitray. To perform the analysis, two enzyme substrates are reacted in Colilert™-a chromogen that reacts with the enzyme found in total coliforms (galactosidase), and a fluorogen that reacts with an enzyme found in *E. coli* (glucuronidase). After 24 hours of incubation at 35°C, a total coliform-positive reaction turns the medium yellow, while an *E. coli*-positive reaction causes the medium to fluoresce under a long-wave ultraviolet light (366 nm).

Samples from Sungai Langat upstream and downstream of the study area and test well (DW2) were analysed for total coliform and *E. coli*. The water samples were collected on May and October 2010. The result of this study showed that samples in the water taken from Sungai Langat were positive for total coliform and *E. coli*. Total coliforms and *E. coli* were not detected in groundwater (DW2) samples (Table 5.4 and 5.5).Detailed results of microorganism counts are in Appendix E.

5.3 Water Classification

The Piper trilinear diagrams is one of the most useful graphical representation in groundwater quality studies and help in understanding the geochemistry of shallow groundwater by bringing out the chemical relationships in large sample group in more definite terms than with the other plotting methods (Walton,1970).

Figure 5.1 is the Piper trilinear diagram for the data obtained from chemical analysis of groundwater samples from the study area. This diagram consist of two lower triangles that show the percentage distribution, on the milliequivalent basis, of the major cations (Ca^{+}, Mg^{+}, Na^{+} and K^{+}) and the major anions (SO_4^{2-}, Cl^{-}, $C0_3^{2-}$ + HCO_3^{-}). The diamond shaped part above summarises the dominant cations and anions to indicate the final water type. This classification system shows the anion and cation facies in terms of major ion percentage.

In the confined aquifer in the study area, the Ca-HCO_3 water type prevails in all the groundwater and surface water samples. The major cations, which are dominant in that groundwater are both calcium and magnesium. In well MW16, the sodium and potasium ions are more dominant compared with other major cations. The groundwater is also of bicarbonate. This indicates that the water is fairly fresh and that it has not flow long distance within the aquifer. The water classification show that the surface water and groundwater in this study area are connected.

Table 5.3: Occurrence of Cryptosporidium and Giardia in river water and groundwater sample in Jenderam Hilir, Dengkil, Selangor

Station No	Sampling Site	Date collected	Sampled volume (litre)	Parasitological Analysis				
				Concentrated volume (ml)	No. of Giardia cysts counted on the slide	Giardia cycts/l	No of Cryptosporidium oocysts on the slide	Cryptosporidium oocysts/l
SW1	Sungai Langat	20/4/2010	10	10	29	2.9	0	0
SW2	Sungai Langat	20/4/2010	10	10	1	0.1	0	0
DW2	Testwell	20/4/2010	10	10	0	0	0	0

Table 5.4: Occurrence of total coliform and *E. coli* in river water and groundwater samples in Jenderam Hilir, Dengkil taken in May 2010

Samples	Bacteria Analysis-Analysis Quantitative	
	Total Coliform	*E. coli*
Sungai Langat	>2420 MPN/100 ml, 35.5± 0.5^{0}C/24 h	488 MPN/100 ml, 35.5± 0.5^{0}C/24 h
DW2	<1.0 MPN/100 ml, 35.5± 0.5^{0}C/24 h	<1.0 MPN/100 ml, 35.5± 0.5^{0}C/24 h

Table 5.5: Occurrence of total coliform and *E.coli* in river water and groundwater samples in Jenderam Hilir, Dengkil collected in October 2010

Samples	Bacteria Analysis-Analysis Quantitative	
	Total Coliform	*E. coli*
Sungai Langat	>2420 MPN/100 ml, 35.5± 0.5^{0}C/24 h	1414 MPN/100 ml, 35.5± 0.5^{0}C/24 h
DW2	<1.0 MPN/100 ml, 35.5± 0.5^{0}C/24 h	<1.0 MPN/100 ml, 35.5± 0.5^{0}C/24 h

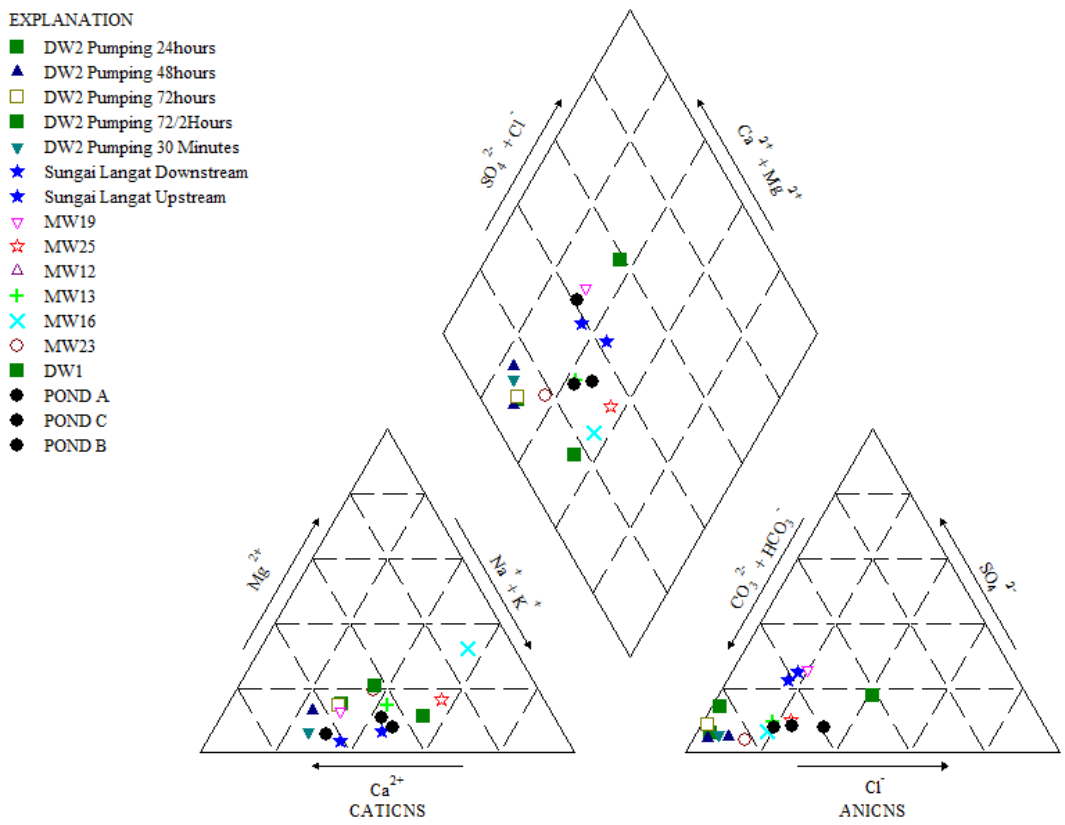


Figure 5.1: Piper trilinear diagram for the data obtained from chemical analysis of groundwater sample from Jenderam Hilir

6.0 CONCLUSION

i. BI method has been proven around the world to be a very effective and environmentally friendly technology that reduce accidents or incidents caused by waterborne diseases due to consumption of untreated surface water. BI is a natural water treatment facility used as an attractive alternative method in addition to conventional water treatment technologies that are applicable at present to reduce treatment operating costs and also reduce the reliance on chemicals in eliminating bacteria in water. It is well known that BI has the ability to improve the raw and drinking water quality, and makes drinking water safe and more acceptable to the consumer. Some microorganisms such as Cryptosporidium are very resistant to chlorine. Conventional surface water treatment method is largely dependent on the chemical in comparison to the BI method. BI reduces water treatment costs and avoid or minimise the problem of chemical sludge treatment and disposal as well.

ii. BI method depends very much on the hydrogeology (hydraulic conductivity, saturated depth, transmissivity, porosity, lithology, storage coefficient and travel time) of the area for natural water treatment to proceed. Natural filtration is a success factor in getting good water quality. In the case of Jenderam Hilir, the travel time of river water to the tube well water is more than 10 days, hence, the natural water treatment methods to reduce pollution of the river water that flow into the tube wells is considered sufficient in improving the water quality of the river water. The thickness of the aquifer in the study area which is more than 5 m and consist of more than 80% gravely sand help to remove more than 50% of turbidity and coliform bacteria.

iii. BI not only for water treatment but also increase the rate of well discharge. Based on constant pumping test, 254 mm diameter test well DW2 produced as much as 128 m^3/hr (3.072 MLD) with a drawdown of only 2.63 m. The high projected water demand in Selangor in 2020 is an opportunity for the introduction of the BI method to increase and fulfill water need in Selangor. It has been through this study that BI facilities in

Jenderam Hilir would secure sufficient, clean and safe drinking water be provided to the people living in Selangor.

iv. The study has shown that turbidity, total solid, conductivity, sulphate and nitrate were reduced significantly through the natural filtration systems of BI. There is great potential in developing BI technologies for water treatment in developing countries such in Malaysia. The use of BI will also lessen the over-dependence on surface water as the source of public water supply system as BI also taps groundwater at the same time.

7.0 REFERENCE

Abdul Rashid Bachik, (2000). Potensi sumber air bawah tanah di kawasan Kuala Selangor-Batang Berjuntai-Tanjong Karang, Selangor. Unpublished report. Geological Survey of Malaysia.

Abdul Rashid Bachik and Mohamed Hatta Abdul Karim (1998). Groundwater potential in Telok Datuk-Olak Lempit Area, Kuala langat, Selangor. Report No. 01/98, Unpublished report. Geological Survey of Malaysia.

Abdullah Sani, H.H. (1985). Laporan kemajuan Pemetaan geologi kawasan Teluk Datuk-Sepang. Syit 101-2, Selangor Malaysia. Annual Report Geological. Survey of Malaysia 1985: 1991-1955.

Albrechtsen, H.J., Boe-Hansen, R., Henze, M. and Mikkelsen, P.S. (1998). Microbial growth and clogging in sand column experiments simulating artificial recharge of ground water. In: Peters, J.H. et al. (eds), Artificial recharge of groundwater Balkema, Rotterdam, The Netherlands: 73–77.

Andersen, M.S. Larsen, F., and Postma, D. (2001). Pyrite oxidation in unsaturated aquifer sediments. Reaction stoichiometry and rate of oxidation. Environmental Science Technology, 35: 4074– 4079.

APHA (1985). Standards methods for the examination of water and wastewater. 16th ed., APHA, Washington D.C.,1-50.

Appello, C.A.J. and Postma, D. (1999). Geochemistry, groundwater and pollution. A.A. Balkema Publishers, Netherlands, 647p.

Bahaa-eldin, E.A.R., Yusoff, I., Jafri, A.M. and Othman. Z. (2009). Simulation of integrated surface-water/groundwater flow for freshwater wetland in Selangor State, Malaysia. Geological Society of Malaysia, Bulletin 55: 95-100.

Banwart, S.A. (1999). Reduction of iron (III) minerals by natural organic matter in groundwater; Geochimica et Cosmochimica Acta, 63(19/20): 2919–2928.

Bellamy, W.D., Silvennan, G.P. Hendricks, D.W. and Logsdon, G.S.(1985): Removing Giardia Cysts with Slow Sand Filtration. Journal American Water Works Association, 77(2):52-60.

Berger, P. (2002): Removal of Cryptosporidium using bank filtration. In: Proceedings of the NATO Advanced Research Workshop on Riverbank Filtration: understanding contaminant biogeochemistry and pathogen removal, Tihany, Hungary, September 2001, 85–121.

Berner, R.A. (1981). A new geochemical classification of sedimentary environments. Journal of Sedimentology and Petrology,51(2): 35–365.

British Soil Classification 1990. British Standards Methods of test for soils for civil Engineering Purposes: Part 2: Classification Test. London BS 1377.

Campbell, A.T. and Wallis, P. (2002). The effect of UV irradiation on human-derived Giardia lambia cysts. Water Resources, 36(4): 963-969.

Cobbing, E.J. and Mallick, D.I.J. (1987). Southeast Asia granite project: Field report for Peninsular Malaysia. British Geological Survey, 129p.

Crook, J. (1985). Water reuse in California. Journal of America Water Works Association, 77(7): 60–71.

Dash, R.R., Mehrotra, I., Kumar, P. and Grischek, T. (2008). Lake bank filtration at Nainital, India: water quality evaluation. Hydrogeology Journal, 16(6):1089–1099.

Department of Agriculture, (2006). Land Use Map. Department of Agriculture Malaysia.

Department of Standards Malaysia, (2010). Malaysian Standard: Drinking water-quality requirements (MS 2320:2010). Department of Standard Malaysia, 19p.

Dillon, P.J., Miller, M., Fallowfield, H. and Hutson, J. (2002). The potential of river bank filtration for drinking water supplies in relation to microcystin removal in brackish aquifers. Journal Hydrology, 266(3): 209–221.

Doll Said Ngah (1988). Penyiasatan menentukan sumber air tanah untuk kegunaan pam tangan di luar bandar, daerah Kuala Langat. No. Laporan GPH 1/1988, Jabatan Penyiasatan Kajibumi.

Farizawati, S., Lim, Y.A., Ahmad, R.A., Fatimah, C.T. and Siti Nor., Y., (2005). Contribution of cattle farms towards river contamination with Giardia cysts and Cryptosporidium oocysts in Sungai Langat Basin. Tropical Biomedicine, 22(2): 89-98.

Fetter, C.W. (2001). Applied Hydrogeology. Prentice Hall, New Jersey: 598p.

Gannon, J., Tan, Y., Baveye, P., Alexander, M. (1991). Effects of sodium chloride on transport of bacteria in saturated aquifer material. Journal of Applied Environmental Microbiology, 57(9): 2497–2501.

Gerba, C.P. and Bitton, G. (1984). Microbial pollutants: their survival and transport pattern in groundwater. In: Bitton, G. and Gerba C.P. (eds). Groundwater pollution microbiology.Wiley, New York, 66–88.

Gobbett, D.J. and Hutchison, C.S. (1973). Geology of the Malay Peninsula – West Malaysia and Singapore. Regional Geology Series. Wiley, New York: 438p.

Government of Malaysia (2000). The National Water Resources Study 2000-2050, Vol 1 (Study undertaken by SMHB, Ranhill and JPZ).

Gollnitz, W.D., Clancy, J.L., Whitteberry, B.L. and Vogt, J.A, (2003). RBFBI as a microbial treatment process. Journal of the American Water Works Association, 95(12): 56–66.

Greskowiak, J., Prommer, H., Massmann, G., Johnston, C.D., Nützmann, G. and Pekdeğer, A. (2005). The impact of variably saturated conditions on hydrogeochemical changes during artificial recharge of groundwater. Applied Geochemistry, 20: 1409–1426.

Grischek, T., Hiscock, K.M., Metschies, T.T., Debbis, P.F. and Nestler, W. (1998). Factors affecting denitrification during infiltration of river water into a sand and gravel aquifer in Saxony, Germany. Water Resource, 32(2): 450-460.

Grischek, T., Schoenheinz, D., and Ray, C. (2002). Siting and design issues for river bank filtration schemes. In: Ray, C. et al (eds), Riverbank filtration: improving source water quality. Kluwer, Dordrecht, The Netherlands: 291–302.

Hazen, A. (1911). Discussion of Dam on sand foundations. Transactions, American Society of Civil.Engineers, 73; 199-200

Heberer, T. (2002). Tracking persistent pharmaceutical residues from municipal sewage water to drinking water. Journal of Hydrology, 266: 175–189.

Hiscock, K.M. and Grischek, T. (2002). Attenuation of groundwater pollution by bank filtration. Journal of Hydrology, 266:139–144.

Hunter, K.S., Wang, Y. and Van Cappellen, P. (1998). Kinectic Modelling of microbially driven chemistry of subsurface environments: Coupling transport, microbial metabolism and geochemistry. Journal of Hydrology, 209: 53-80.

Ismail Yusoff, Abd. Hadi Abd. Rahman, Ahmad Farid Abu Bakar and Mohd Azamie Wan Abd Ghani (2004). Annual Geological Conference 2004. Geological Society of Malaysia, Bulletin 49, April 2006: 13-18.

Jacob, C.E. (1947). Drawdown test to determine effective radius of artesian well. Transactions of the American Society of Civil Engineers, 112 (2321): 1047-1064.

Jacobs, L.A., Von Gunten, H.R., Keil, R. and Kuslys, M. (1988). Geochemical Changes Along a River-Groundwater Infiltration Flow Path Glattfelden, Switzerland. Geochimica et Cosmochimica Acta, 5: 2693–2706.

Jakobsen, R. and Postma, D. (1999). Redox zoning, rates of sulfate reduction and interactions with Fe-reduction and methanogenesis in a shallow sandy aquifer, Rømø, Denmark. Geochimica et Cosmochimica Acta, 63(1): 137-151.

JICA (2002). The study on the sustainable groundwater resources and environmental management for the Langat Basin in Malaysia. Volume 1, Executive Summary, Japan International Cooperation Agency (JICA) and Department of Minerals and Geoscience Malaysia.

Keating, E.H. and Bahr, J.M. (1998). Reactive transport modelling of redox geochemistry: Approaches to chemical disequilibrium and reaction rate estimation at a site in northern Wisconsin. Water Resources Research, 34(12): 3573–3584.

Kühn, W. and Müller U. (2000). Riverbank filtration: an overview. Journal of the American Water Works Association, 92(12): 60–69.

Lee, I. S. and Lee, S.S. (2008). Site suitability analysis for riverbank filtration in the Han River, Korea. Proceedings of 16th IAHR-APD Congress and 3rd Symposium of IAHR-ISHS, Hohai University, Nanjing, China, October 20-23.

Lim, Y.A.L., Ahmad, R.A. and Smith, H.V. (2008). Current status and future trends in Cryptosporidium and Giardia epidemiology in Malaysia. Journal of Water and Health, 6(2).

Lovley, D.R. and Chapelle, F.H. (1995). Deep subsurface microbial processes. Reviews of Geophysics, 333(3): 365-382.

Malaysia Water Associaton (2010). Malaysia Water Industry Guide 2010. The Malaysian Water Association.

Massmann, G., Tichomirowa, M., Merz, C. and Pekdeger, A. (2003). Sulfide oxidation and sulfate reduction in a shallow groundwater system (Oderbruch aquifer, Germany). Journal . of Hydrology, 278(1-4): 231-243

Massmann, G., Pekdeğer, A. and Merz, C. (2004). Redox processes in the Oderbruch polder groundwater flow system in Germany. Applied Geochemistry, 19: 863 – 886.

Medema, G.J., Juhasz-Holterman, M.H.A. and Luijten, J.A. (2000). Removal of microorganisms by bank filtration in a gravel-sand soil. In Jülich, W. and Schubert, J. (eds) Proceedings International Riverbank Filtration Conference International Association of the Rhine Waterworks (IAWR), Amsterdam. 16-161

Miettinen, I.T., Martikainen, .P.J. and Vartiainen, T. (1994). Humus transformation at the bank filtration water plant. Water Science Technology, 30(10): 179–187.

NAHRIM (2008). Climate Change adaptation and integrated water resources Management (IWRM). Proceedings of the Seminar on Vulnerability and Adaptation Requirement to Climate Change Impact on Water Resources, 4 November 2008. National Hydraulic Research Institute of Malaysia, Malaysia.

Nogeitzig, A. (2005). Processes During Infiltration at the Water-Sediment Interface. Published Thesis., University of Berlin, Germany.

Okubo, T. and Matsumoto, J. (1983). Biological clogging of sand and changes of organic constituents during artificial recharge. Water Resources, 17(7): 813–821.

Ong, W.S. (1979). Geology of bedrock and late cainozoic stanniferous aluvium (with associated artifacts) of Dengkil Area, Selangor. Unpublished thesis, Universiti Of Malaya, Malaysia.

Pang, L., Close, M. and Noonan, M. (1998). Rhodamine WT and Bacillus Subtilis Transport Through An Alluvial Gravel Aquifer. Groundwater, 36(1): 112–122.

Preuss, G. (1996). Succession of microbial communities during bank filtration and artificial groundwater recharge. In: Proceedings International Symposium on

Artificial Recharge of Groundwater, Finnish Environment Institute, Helsinki, June 1996, 215–221

Postma, D. and Jakobsen, R. (1996). Redox zonation: Equilibrium const raints on the Fe(III)/SO_4^{-2} reduction interface; reduction interface; Geochimica et Cosmochimica Acta, 60(17): 3169–3175.

Ray, C., Grischek, T., Schubert, J., Wang, Z., and Speth, T.F. (2002). A perspective of riverbank filtration. Journal of the American Water Works Association, 94(4):149–160.

Ritmann, B.E. (1993). The significance of biofilms in porous media. Water Resources Research, 29(7): 2195–2202.

Schijven, J.F., Hoogenboezem, W., Nobel, P.J., Medema, G. and Stakelbeek, A. (1998). Reduction of FRNA-bacteriophages and faecal indicator bacteria by dune infiltration and estimation of sticking efficiencies, Water Science Technology, 38(12), 127–131.

Schijven, J.F., Hoogenboezem, W., Hassanizadeh, S.M. and Peters, J.H. (1999). Modelling removal of bacteriophages MS2 and PRD1 by dune infiltration at Castricum, the Netherlands. Water Resources Research, 35, 1101–1111.

Schijven, J.F. and Majid Hassanizadeh, S. (2000). Removal of viruses by soil passage: Overview of modeling, processes and parameters. Critical reviews in Environmental Science and Technology, 30(1): 49-127.

Schijven, J.F., Berger, P. and Miettinen, I. (2002). Removal of pathogens, surrogates, indicators, and toxins using riverbank filtration. In: Ray C et al (eds) Riverbank filtration: Improving source water quality. Kluwer, Dordrecht, The Netherlands, pp 73–116.

Schubert, J. (2002). Hydraulic aspect of river bank filtration-field studies. Journal of Hydrology, 266: 145–161.

Schuh, W.M. (1990). Seasonal variation of clogging of an artificial recharge basin in a northern climate. Journal of Hydrology, 121: 193–215.

Sharma, S.K. and Amy, G. (2009). Bank Filtration: A sustainable water treatment technology for developing countries. 34th WEDC International conference, Addis Ababa, Ethiopia.

Sinke, A.J.C., Dury, O. and Zobrist, J. (1998). Effects of a fluctuating water table: Column study on redox dynamics and fate of some organic pollutants. Journal of Contaminant Hydrology, 33: 231–246.

Sinton, L.W., Finlay, R.K., Pang, L. and Scott, D.M. (1997). Transport of bacteria and bacteriophages in irrigated effluent into and through an alluvial gravel aquifer. Water, Air Soil Pollution, 98(1–2): 17–42.

Sprinkle, C.R. (1989). Geochemistry of the Floridan aquifer system in Florida and in parts of Georgia, South Carolina, and Alabama. United State Geological Survey Professional paper 1403-I. 105p.

Theis, C.V. (1935). The relation between the lowering of the peizometric surface and the rate duration of discharge of a well using groundwater storage. Transactions of the American Society of Geophysics Union, 16: 519-524.

USEPA (2005). Method 1623: Cryptosporidium and Giardia in Water by Filtration/IMS/FA. EPA 821-R-OI-025, Office of Water, Washington.

Verstraeten, I.M., Thurman, E.M., Lindsey, M.E., Lee, E.C. and Smith, R.D. (2002). Changes in concentrations of triazine and acetamide herbicides by bank filtration,

ozonation, and chlorination in a public water supply. Hydrogeology Journal, 266(3–4): 190–208.

Vigil, J., Warburton, S., Haynes, W. and Kaiser, L.R. (1965). Nitrates in municipal water supply causing Methemoglobinia in infants. Public Health report. 80(12), 119-1121.

Wang, J., Smith, J. and Dooley, L. (1995). Evaluation of riverbank infiltration as a process for removing particles and DBP precursors. In: Proceedings Water Quality Technology Conference, American Water Works Association., Denver, CO.

Wang, J., (2002). In: Riverbank Filtration: Improving source-water quality, Ray, C., Melin, G., and Linsky, R. (eds). Kluwer Academic Publisher, Netherlands, 117-145.

Walton, W.C. (1962). Selected analytical methods for well and aquifer evaluation. Illinois State Water Survey, Bulletin No.49.

Walton, W.C. (1970). Ground water resources evolution.McGraw Hill: New York, 300p.

WHO, (2008). Guidelines for drinking-water quality [electronic resource]: incorporating 1st and 2nd addenda, Vol.1, Recommendations – 3rd ed. World Health Organization, Geneva, Switzerland, 515p.

Weiss, W.J., Bouwer, E.J., Ball, W.P., O´Melia, C.R., Le Chevallier, M.W., Arora, H., Aboytes, R. and Speth, T.F. (2003). Study of water quality improvements during riverbank filtration at three midwestern united states drinking water utilities. Geophysical Research Abstracts, 5(04297).

Weiss, W.J., Bouwer, E.J.,Aboytes, R., LeChevallier, M.W., O'Melia, C.R., Le, B.T. and Schwab, K.J. (2005). Riverbank filtration for control of microorganisms: result from field monitoring. Water Research, 39(10): 1990-2001.

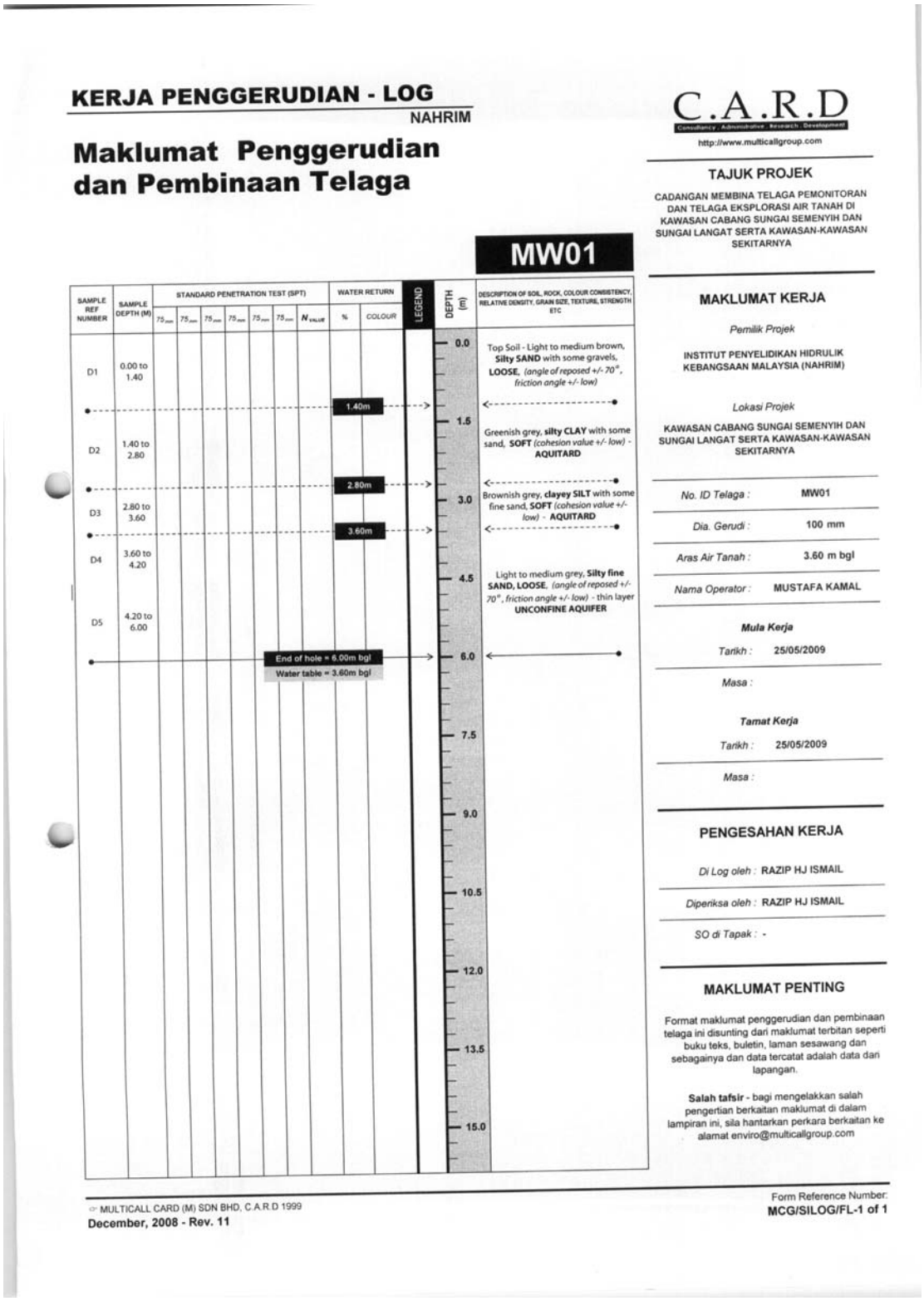
Worch , E., Grischek, T., Bornick, H. and Eppinger, P. (2002). Laboratorary test for simulating attenuation processes of aromatic amines in riverbank filtration. Hydrogeology Journal 266 (3-4): 259-268.

Young, C.P., Oakes, D.B. and Wilkinson, W.S. (1976). Prediction of future nitrate concentration in Groundwater. Groundwater, 4(6). 426-438.

APPENDIX A

BOREHOLE LOG AND WELL DESIGN IN JENDERAM HILIR

Borehole log and well design in Jenderam Hilir



KERJA PENGGERUDIAN - LOG

NAHRIM

Maklumat Penggerudian dan Pembinaan Telaga

C.A.R.D

Consultancy . Administrative . Research . Development

http://www.multicallgroup.com

MW01

SAMPLE REF NUMBER	SAMPLE DEPTH (M)	STANDARD PENETRATION TEST (SPT) 75mm 75mm 75mm 75mm 75mm 75mm N VALUE	WATER RETURN %	WATER RETURN COLOUR	LEGEND	DEPTH (m)	DESCRIPTION OF SOIL, ROCK, COLOUR CONSISTENCY, RELATIVE DENSITY, GRAIN SIZE, TEXTURE, STRENGTH ETC
D1	0.00 to 1.40					0.0	Top Soil - Light to medium brown, **Silty SAND** with some gravels, **LOOSE**, *(angle of reposed +/- 70°, friction angle +/- low)*
			1.40m			1.5	
D2	1.40 to 2.80						Greenish grey, **silty CLAY** with some sand, **SOFT** *(cohesion value +/- low)* - **AQUITARD**
			2.80m			3.0	Brownish grey, **clayey SILT** with some fine sand, **SOFT** *(cohesion value +/- low)* - **AQUITARD**
D3	2.80 to 3.60						
			3.60m			4.5	
D4	3.60 to 4.20						Light to medium grey, **Silty fine SAND, LOOSE**, *(angle of reposed +/- 70°, friction angle +/- low)* - thin layer **UNCONFINE AQUIFER**
D5	4.20 to 6.00						
			End of hole = 6.00m bgl Water table = 3.60m bgl			6.0	
						7.5	
						9.0	
						10.5	
						12.0	
						13.5	
						15.0	

TAJUK PROJEK

CADANGAN MEMBINA TELAGA PEMONITORAN DAN TELAGA EKSPLORASI AIR TANAH DI KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

MAKLUMAT KERJA

Pemilik Projek

INSTITUT PENYELIDIKAN HIDRULIK KEBANGSAAN MALAYSIA (NAHRIM)

Lokasi Projek

KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

No. ID Telaga :	MW01
Dia. Gerudi :	100 mm
Aras Air Tanah :	3.60 m bgl
Nama Operator :	MUSTAFA KAMAL

Mula Kerja

Tarikh : 25/05/2009

Masa :

Tamat Kerja

Tarikh : 25/05/2009

Masa :

PENGESAHAN KERJA

Di Log oleh : RAZIP HJ ISMAIL

Diperiksa oleh : RAZIP HJ ISMAIL

SO di Tapak : -

MAKLUMAT PENTING

Format maklumat penggerudian dan pembinaan telaga ini disunting dari maklumat terbitan seperti buku teks, buletin, laman sesawang dan sebagainya dan data tercatat adalah data dari lapangan.

Salah tafsir - bagi mengelakkan salah pengertian berkaitan maklumat di dalam lampiran ini, sila hantarkan perkara berkaitan ke alamat enviro@multicallgroup.com

© MULTICALL CARD (M) SDN BHD, C.A.R.D 1999

December, 2008 - Rev. 11

Form Reference Number:
MCG/SILOG/FL-1 of 1

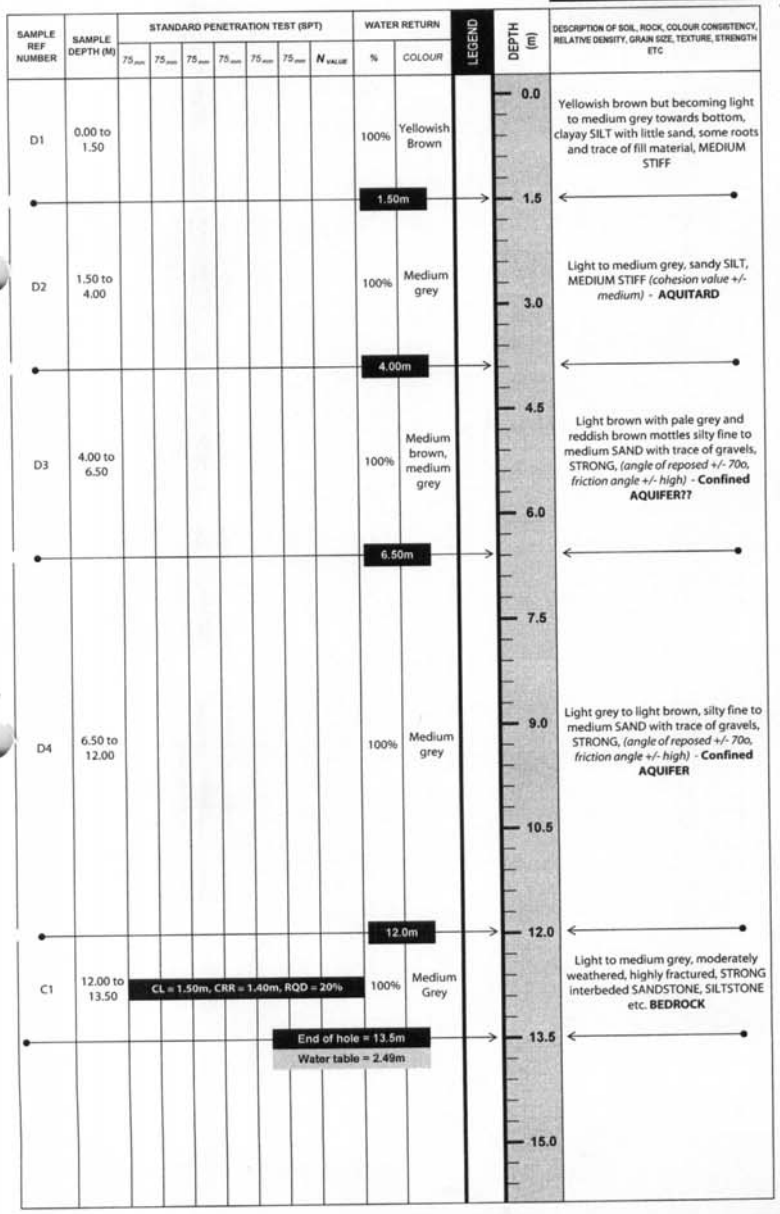
KERJA PENGGERUDIAN - LOG

NAHRIM

Maklumat Penggerudian dan Pembinaan Telaga

C.A.R.D
Consultancy . Administrative . Research . Development
http://www.multicallgroup.com

MW02



TAJUK PROJEK

CADANGAN MEMBINA TELAGA PEMONITORAN DAN TELAGA EKSPLORASI AIR TANAH DI KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

MAKLUMAT KERJA

Pemilik Projek

INSTITUT PENYELIDIKAN HIDRULIK KEBANGSAAN MALAYSIA (NAHRIM)

Lokasi Projek

KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

No. ID Telaga :	MW02
Dia. Gerudi :	100 mm
Aras Air Tanah :	2.49 m bgl
Nama Operator :	MUSTAFA KAMAL

Mula Kerja

Tarikh : 29/04/2009

Masa :

Tamat Kerja

Tarikh : 29/04/2009

Masa :

PENGESAHAN KERJA

Di Log oleh : RAZIP HJ ISMAIL

Diperiksa oleh : RAZIP HJ ISMAIL

SO di Tapak : -

MAKLUMAT PENTING

Format maklumat penggerudian dan pembinaan telaga ini disunting dari maklumat terbitan seperti buku teks, buletin, laman sesawang dan sebagainya dan data tercatat adalah data dari lapangan.

Salah tafsir - bagi mengelakkan salah pengertian berkaitan maklumat di dalam lampiran ini, sila hantarkan perkara berkaitan ke alamat enviro@multicallgroup.com

© MULTICALL CARD (M) SDN BHD, C.A.R.D 1999

December, 2008 - Rev. 11

Form Reference Number:
MCG/SILOG/FL-1 of 1

KERJA PENGGERUDIAN - LOG

NAHRIM

Maklumat Penggerudian dan Pembinaan Telaga

C.A.R.D
Consultancy - Administrative - Research - Development
http://www.multicallgroup.com

MW03

SAMPLE REF NUMBER	SAMPLE DEPTH (M)	STANDARD PENETRATION TEST (SPT) 75/mm	75/mm	75/mm	75/mm	75/mm	75/mm	N VALUE	WATER RETURN %	WATER RETURN COLOUR	LEGEND	DEPTH (m)	DESCRIPTION OF SOIL, ROCK, COLOUR CONSISTENCY, RELATIVE DENSITY, GRAIN SIZE, TEXTURE, STRENGTH ETC
D1	0.00 to 0.50											0.0	Dark brown **silty CLAY** with some sand, some roots and trace of fine gravel, **SOFT** *(cohesion value +/- low)* - **AQUITARD**
									0.50m				
D2	0.50 to 3.00											1.5	
												3.0	Brownish grey to yellowish brown **clayey SILT** with some fine sand and trace of gravel. **MEDIUM STIFF** *(cohesion value +/- medium)* - **AQUITARD**
D3	3.00 to 4.20											4.5	
D4	4.20 to 5.00												
									End of hole = 5.00m bgl Water table = 1.30m bgl			6.0	
												7.5	
												9.0	
												10.5	
												12.0	
												13.5	
												15.0	

TAJUK PROJEK

CADANGAN MEMBINA TELAGA PEMONITORAN DAN TELAGA EKSPLORASI AIR TANAH DI KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

MAKLUMAT KERJA

Pemilik Projek

INSTITUT PENYELIDIKAN HIDRULIK KEBANGSAAN MALAYSIA (NAHRIM)

Lokasi Projek

KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

No. ID Telaga :	MW03
Dia. Gerudi :	100 mm
Aras Air Tanah :	1.30 m bgl
Nama Operator :	MUSTAFA KAMAL

Mula Kerja

Tarikh : 04/06/2009

Masa :

Tamat Kerja

Tarikh : 04/06/2009

Masa :

PENGESAHAN KERJA

Di Log oleh : RAZIP HJ ISMAIL

Diperiksa oleh : RAZIP HJ ISMAIL

SO di Tapak : -

MAKLUMAT PENTING

Format maklumat penggerudian dan pembinaan telaga ini disunting dari maklumat terbitan seperti buku teks, buletin, laman sesawang dan sebagainya dan data tercatat adalah data dari lapangan.

Salah tafsir - bagi mengelakkan salah pengertian berkaitan maklumat di dalam lampiran ini, sila hantarkan perkara berkaitan ke alamat enviro@multicallgroup.com

© MULTICALL CARD (M) SDN BHD, C.A.R.D 1999

December, 2008 - Rev. 11

Form Reference Number:
MCG/SILOG/FL-1 of 1

KERJA PENGGERUDIAN - LOG

NAHRIM

Maklumat Penggerudian dan Pembinaan Telaga

C.A.R.D
Consultancy · Administrative · Research · Development
http://www.multicallgroup.com

MW04

SAMPLE REF NUMBER	SAMPLE DEPTH (M)	STANDARD PENETRATION TEST (SPT) 75mm 75mm 75mm 75mm 75mm 75mm N VALUE	WATER RETURN %	WATER RETURN COLOUR	LEGEND	DEPTH (m)	DESCRIPTION OF SOIL, ROCK, COLOUR CONSISTENCY, RELATIVE DENSITY, GRAIN SIZE, TEXTURE, STRENGTH ETC
D1	0.00 to 0.50		0.50m			0.0	Top soil - Dark brown **silty CLAY, VERY SOFT**, *(cohesion value +/- low)* - **AQUITARD**
D2	0.50 to 3.00					1.5	Light grey with reddish brown mottled **silty CLAY** with some fine sand. **SOFT** *(cohesion value +/- medium)* - **AQUITARD**
D3	3.00 to 4.30		4.30m			3.0	
D4	4.30 to 5.60					4.5	Light grey, **silty fine to medium SAND, LOOSE**, *(angle of reposed +/- 70°, friction angle +/- medium)* - **Confined AQUIFER**
			End of hole = 5.60m bgl Water table = 2.30m bgl			6.0	
						7.5	
						9.0	
						10.5	
						12.0	
						13.5	
						15.0	

TAJUK PROJEK

CADANGAN MEMBINA TELAGA PEMONITORAN DAN TELAGA EKSPLORASI AIR TANAH DI KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

MAKLUMAT KERJA

Pemilik Projek

INSTITUT PENYELIDIKAN HIDRULIK KEBANGSAAN MALAYSIA (NAHRIM)

Lokasi Projek

KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

No. ID Telaga :	MW04
Dia. Gerudi :	100 mm
Aras Air Tanah :	2.30 m bgl
Nama Operator :	MUSTAFA KAMAL

Mula Kerja

Tarikh : 1/06/2009

Masa :

Tamat Kerja

Tarikh : 1/06/2009

Masa :

PENGESAHAN KERJA

Di Log oleh : RAZIP HJ ISMAIL

Diperiksa oleh : RAZIP HJ ISMAIL

SO di Tapak : -

MAKLUMAT PENTING

Format maklumat penggerudian dan pembinaan telaga ini disunting dari maklumat terbitan seperti buku teks, buletin, laman sesawang dan sebagainya dan data tercatat adalah data dari lapangan.

Salah tafsir - bagi mengelakkan salah pengertian berkaitan maklumat di dalam lampiran ini, sila hantarkan perkara berkaitan ke alamat enviro@multicallgroup.com

© MULTICALL CARD (M) SDN BHD, C.A.R.D 1999

KERJA PENGGERUDIAN - LOG

NAHRIM

Maklumat Penggerudian dan Pembinaan Telaga

C.A.R.D
Consultancy · Administrative · Research · Development
http://www.multicallgroup.com

MW05

SAMPLE REF NUMBER	SAMPLE DEPTH (M)	STANDARD PENETRATION TEST (SPT) 75mm	75mm	75mm	75mm	75mm	75mm	N VALUE	WATER RETURN %	WATER RETURN COLOUR	LEGEND	DEPTH (m)	DESCRIPTION OF SOIL, ROCK, COLOUR CONSISTENCY, RELATIVE DENSITY, GRAIN SIZE, TEXTURE, STRENGTH ETC
D1	0.00 to 1.50											0.0	Top soil - Dark brown **sandy clayey SILT, VERY SOFT**, *(cohesion value +/- low)* - **AQUITARD**
									1.50m			1.5	
D2	1.50 to 3.00												Dark brown, **clayey silty find SAND, LOOSE**, *(angle of reposed +/- 70°, friction angle +/- medium)* - Thin **Unconfined AQUIFER**
									3.00m			3.0	
D3	3.00 to 3.60												Light grey, **clayey sandy SILT, SOFT**, *(cohesion value +/- medium)* - **AQUITARD**
D4	3.60 to 4.32												
									End of hole = 4.32m bgl			4.5	
									Water table = 0.82m bgl				
												6.0	
												7.5	
												9.0	
												10.5	
												12.0	
												13.5	
												15.0	

TAJUK PROJEK

CADANGAN MEMBINA TELAGA PEMONITORAN DAN TELAGA EKSPLORASI AIR TANAH DI KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

MAKLUMAT KERJA

Pemilik Projek

INSTITUT PENYELIDIKAN HIDRULIK KEBANGSAAN MALAYSIA (NAHRIM)

Lokasi Projek

KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

No. ID Telaga :	MW05
Dia. Gerudi :	100 mm
Aras Air Tanah :	0.82 m bgl
Nama Operator :	MUSTAFA KAMAL

Mula Kerja

Tarikh : 2/06/2009

Masa :

Tamat Kerja

Tarikh : 2/06/2009

Masa :

PENGESAHAN KERJA

Di Log oleh : RAZIP HJ ISMAIL

Diperiksa oleh : RAZIP HJ ISMAIL

SO di Tapak : -

MAKLUMAT PENTING

Format maklumat penggerudian dan pembinaan telaga ini disunting dari maklumat terbitan seperti buku teks, buletin, laman sesawang dan sebagainya dan data tercatat adalah data dari lapangan.

Salah tafsir - bagi mengelakkan salah pengertian berkaitan maklumat di dalam lampiran ini, sila hantarkan perkara berkaitan ke alamat enviro@multicallgroup.com

KERJA PENGGERUDIAN - LOG

NAHRIM

Maklumat Penggerudian dan Pembinaan Telaga

C.A.R.D
Consultancy · Administrative · Research · Development
http://www.multicallgroup.com

MW06

SAMPLE REF NUMBER	SAMPLE DEPTH (M)	STANDARD PENETRATION TEST (SPT) 75mm / 75mm / 75mm / 75mm / 75mm / 75mm / N VALUE	WATER RETURN %	WATER RETURN COLOUR	LEGEND	DEPTH (m)	DESCRIPTION OF SOIL, ROCK, COLOUR CONSISTENCY, RELATIVE DENSITY, GRAIN SIZE, TEXTURE, STRENGTH ETC
D1	0.00 to 1.00					0.0	Top soil - Reddish brown **clayey SILT** with some sand and lateritic gravels, **SOFT**, *(cohesion value +/- low)* - **AQUITARD**
			1.00m				
D2	1.00 to 2.70					1.5	Brownish grey to medium grey, **clayey SILT** with some fine sand, **SOFT**, *(cohesion value +/- medium)* - **SEMI-AQUITARD**
D3	2.70 to 4.00					3.0	
			4.00m				
D4	4.00 to 5.92					4.5	Medium grey, **silty fine SAND, LOOSE**, *(angle of reposed +/- 70°, friction angle +/- medium)* - **Thin layer Unconfined AQUIFER**
		End of hole = 5.92m bgl Water table = 2.02m bgl				6.0	
						7.5	
						9.0	
						10.5	
						12.0	
						13.5	
						15.0	

TAJUK PROJEK

CADANGAN MEMBINA TELAGA PEMONITORAN DAN TELAGA EKSPLORASI AIR TANAH DI KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

MAKLUMAT KERJA

Pemilik Projek

INSTITUT PENYELIDIKAN HIDRULIK KEBANGSAAN MALAYSIA (NAHRIM)

Lokasi Projek

KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

No. ID Telaga :	MW06
Dia. Gerudi :	100 mm
Aras Air Tanah :	2.02 m bgl
Nama Operator :	MUSTAFA KAMAL

Mula Kerja

Tarikh : 5/06/2009

Masa :

Tamat Kerja

Tarikh : 5/06/2009

Masa :

PENGESAHAN KERJA

Di Log oleh : **RAZIP HJ ISMAIL**

Diperiksa oleh : **RAZIP HJ ISMAIL**

SO di Tapak : -

MAKLUMAT PENTING

Format maklumat penggerudian dan pembinaan telaga ini disunting dari maklumat terbitan seperti buku teks, buletin, laman sesawang dan sebagainya dan data tercatat adalah data dari lapangan.

Salah tafsir - bagi mengelakkan salah pengertian berkaitan maklumat di dalam lampiran ini, sila hantarkan perkara berkaitan ke alamat enviro@multicallgroup.com

© MULTICALL CARD (M) SDN BHD, C.A.R.D 1999

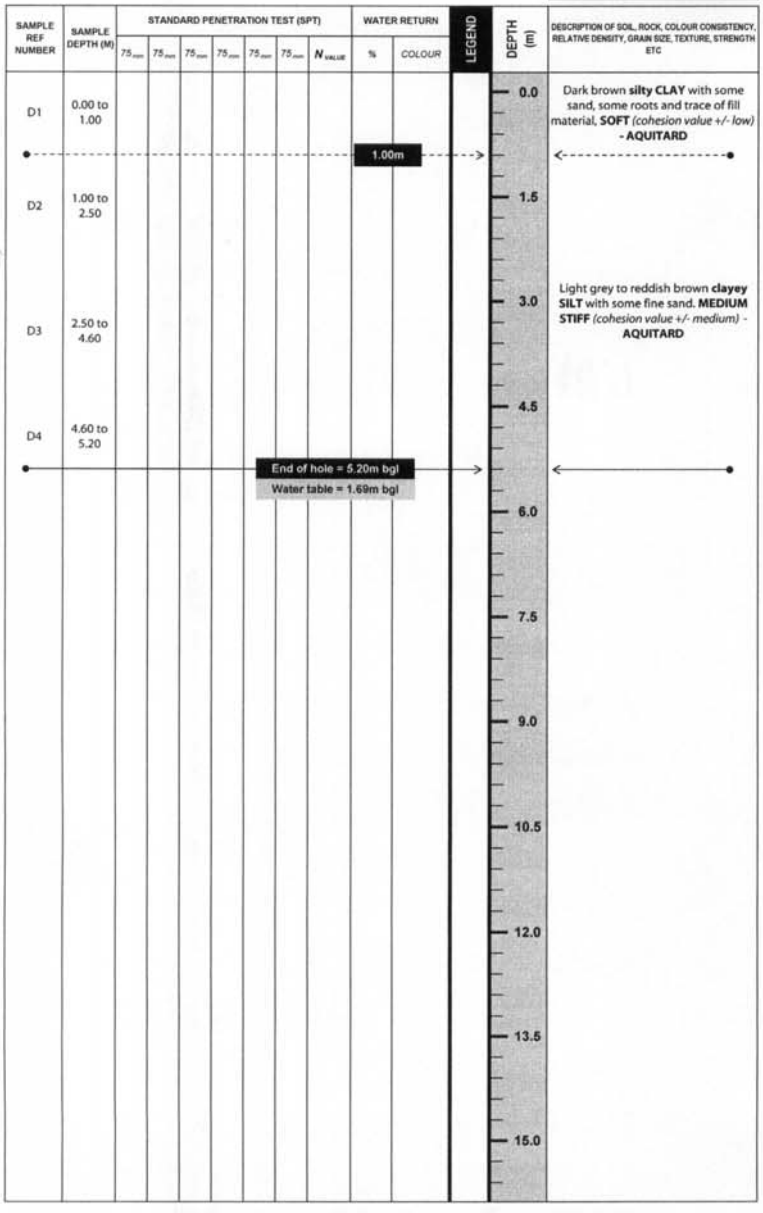
KERJA PENGGERUDIAN - LOG

NAHRIM

Maklumat Penggerudian dan Pembinaan Telaga

C.A.R.D
Consultancy · Administrative · Research · Development
http://www.multicallgroup.com

MW07



TAJUK PROJEK

CADANGAN MEMBINA TELAGA PEMONITORAN DAN TELAGA EKSPLORASI AIR TANAH DI KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

MAKLUMAT KERJA

Pemilik Projek

INSTITUT PENYELIDIKAN HIDRULIK KEBANGSAAN MALAYSIA (NAHRIM)

Lokasi Projek

KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

No. ID Telaga :	**MW07**
Dia. Gerudi :	**100 mm**
Aras Air Tanah :	**1.69 m bgl**
Nama Operator :	**MUSTAFA KAMAL**

Mula Kerja

Tarikh : **04/06/2009**

Masa :

Tamat Kerja

Tarikh : **04/06/2009**

Masa :

PENGESAHAN KERJA

Di Log oleh : **RAZIP HJ ISMAIL**

Diperiksa oleh : **RAZIP HJ ISMAIL**

SO di Tapak : -

MAKLUMAT PENTING

Format maklumat penggerudian dan pembinaan telaga ini disunting dari maklumat terbitan seperti buku teks, buletin, laman sesawang dan sebagainya dan data tercatat adalah data dari lapangan.

Salah tafsir - bagi mengelakkan salah pengertian berkaitan maklumat di dalam lampiran ini, sila hantarkan perkara berkaitan ke alamat enviro@multicallgroup.com

© MULTICALL CARD (M) SDN BHD, C.A.R.D 1999
December, 2008 - Rev. 11

Form Reference Number:
MCG/SILOG/FL-1 of 1

KERJA PENGGERUDIAN - LOG

NAHRIM

Maklumat Penggerudian dan Pembinaan Telaga

C.A.R.D
Consultancy · Administrative · Research · Development
http://www.multicallgroup.com

MW08

SAMPLE REF NUMBER	SAMPLE DEPTH (M)	STANDARD PENETRATION TEST (SPT) 75mm 75mm 75mm 75mm 75mm 75mm N VALUE	WATER RETURN %	WATER RETURN COLOUR	LEGEND	DEPTH (m)	DESCRIPTION OF SOIL, ROCK, COLOUR CONSISTENCY, RELATIVE DENSITY, GRAIN SIZE, TEXTURE, STRENGTH ETC
D1	0.00 to 0.50					0.0	Brownish grey, **clayey SILT** with some sand, **VERY SOFT**, *(cohesion value +/- low)* - **AQUITARD**
			0.50m				
D2	0.50 to 1.50					1.5	Brownish grey, **clayey SILT** with some sand, **SOFT TO MEDIUM STIFF** *(cohesion value +/- low)* - **AQUITARD**
D3	1.50 to 2.00						
			2.00m				
D4	2.00 to 3.30					3.0	Light to medium grey, **silty fine SAND, LOOSE**, *(angle of reposed +/- 70°, friction angle +/- medium)* - **Thin layer Unconfined AQUIFER**
D5	3.30 to 3.90						
			3.90m				
D6	3.90 to 5.10					4.5	Light grey, **clayey SILT** with some sand, **SOFT**, *(cohesion value +/- low)* - **AQUITARD**
		End of hole = 5.10m bgl Water table = 1.13m bgl				6.0	
						7.5	
						9.0	
						10.5	
						12.0	
						13.5	
						15.0	

TAJUK PROJEK

CADANGAN MEMBINA TELAGA PEMONITORAN DAN TELAGA EKSPLORASI AIR TANAH DI KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

MAKLUMAT KERJA

Pemilik Projek

INSTITUT PENYELIDIKAN HIDRULIK KEBANGSAAN MALAYSIA (NAHRIM)

Lokasi Projek

KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

No. ID Telaga :	MW08
Dia. Gerudi :	100 mm
Aras Air Tanah :	1.13 m bgl
Nama Operator :	MUSTAFA KAMAL

Mula Kerja

Tarikh : 3/06/2009

Masa :

Tamat Kerja

Tarikh : 3/06/2009

Masa :

PENGESAHAN KERJA

Di Log oleh : RAZIP HJ ISMAIL

Diperiksa oleh : RAZIP HJ ISMAIL

SO di Tapak : -

MAKLUMAT PENTING

Format maklumat penggerudian dan pembinaan telaga ini disunting dari maklumat terbitan seperti buku teks, buletin, laman sesawang dan sebagainya dan data tercatat adalah data dari lapangan.

Salah tafsir - bagi mengelakkan salah pengertian berkaitan maklumat di dalam lampiran ini, sila hantarkan perkara berkaitan ke alamat enviro@multicallgroup.com

© MULTICALL CARD (M) SDN BHD. C.A.R.D 1999

KERJA PENGGERUDIAN - LOG

NAHRIM

Maklumat Penggerudian dan Pembinaan Telaga

C.A.R.D
Consultancy . Administrative . Research . Development
http://www.multicallgroup.com

MW10

SAMPLE REF NUMBER	SAMPLE DEPTH (M)	STANDARD PENETRATION TEST (SPT) 75mm 75mm 75mm 75mm 75mm 75mm N VALUE	WATER RETURN %	WATER RETURN COLOUR	LEGEND	DEPTH (m)	DESCRIPTION OF SOIL, ROCK, COLOUR CONSISTENCY, RELATIVE DENSITY, GRAIN SIZE, TEXTURE, STRENGTH ETC
D1	0.00 to 0.50					0.0	Yellowish brown, **silty CLAY** with some sand and gravels. **SOFT TO MEDIUM STIFF** *(cohesion value +/- low)* - **AQUITARD**
D2	0.50 to 1.80						
			1.80m			1.5	
D3	1.80 to 2.50						Light grey, **silty medium SAND** with trace of gravels, **LOOSE TO MEDIUM DENSE** - very thin **Unconfined AQUIFER**
			2.50m				
D4	2.50 to 3.70					3.0	Light to medium grey, **silty CLAY** with trace of fine sand. **SOFT TO MEDIUM STIFF** *(cohesion value +/- low)* - **AQUITARD**
D5	3.70 to 4.00						
			4.00m			4.5	
D6	4.00 to 5.90						Light grey, **silty medium SAND, LOOSE TO MEDIUM DENSE**, *(angle of reposed +/- 60°, friction angle +/- medium)* - **Unconfined AQUIFER**
		End of hole = 5.90m bgl				6.0	
		Water table = 3.70m bgl					
						7.5	
						9.0	
						10.5	
						12.0	
						13.5	
						15.0	

TAJUK PROJEK

CADANGAN MEMBINA TELAGA PEMONITORAN DAN TELAGA EKSPLORASI AIR TANAH DI KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

MAKLUMAT KERJA

Pemilik Projek

INSTITUT PENYELIDIKAN HIDRULIK KEBANGSAAN MALAYSIA (NAHRIM)

Lokasi Projek

KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

No. ID Telaga :	MW10
Dia. Gerudi :	100 mm
Aras Air Tanah :	3.70 m bgl
Nama Operator :	MUSTAFA KAMAL

Mula Kerja

Tarikh : 10/06/2009

Masa :

Tamat Kerja

Tarikh : 10/06/2009

Masa :

PENGESAHAN KERJA

Di Log oleh : RAZIP HJ ISMAIL

Diperiksa oleh : RAZIP HJ ISMAIL

SO di Tapak : -

MAKLUMAT PENTING

Format maklumat penggerudian dan pembinaan telaga ini disunting dari maklumat terbitan seperti buku teks, buletin, laman sesawang dan sebagainya dan data tercatat adalah data dari lapangan.

Salah tafsir - bagi mengelakkan salah pengertian berkaitan maklumat di dalam lampiran ini, sila hantarkan perkara berkaitan ke alamat enviro@multicallgroup.com

☞ MULTICALL CARD (M) SDN BHD, C.A.R.D 1999

December, 2008 - Rev. 11

Form Reference Number:
MCG/SILOG/FL-1 of 1

KERJA PENGGERUDIAN - LOG

NAHRIM

Maklumat Penggerudian dan Pembinaan Telaga

C.A.R.D
Consultancy . Administrative . Research . Development
http://www.multicallgroup.com

MW11

SAMPLE REF NUMBER	SAMPLE DEPTH (M)	STANDARD PENETRATION TEST (SPT) 75mm 75mm 75mm 75mm 75mm 75mm N VALUE	WATER RETURN %	WATER RETURN COLOUR	LEGEND	DEPTH (m)	DESCRIPTION OF SOIL, ROCK, COLOUR CONSISTENCY, RELATIVE DENSITY, GRAIN SIZE, TEXTURE, STRENGTH ETC
D1	0.00 to 1.20		100%	Light grey		0.0	Light to medium grey , **clayay SILT** with little sand, some roots and trace of fill material, **MEDIUM STIFF**
			1.20m			1.5	
D2	1.20 to 6.00		70%	Medium Grey		3.0	Light to medium grey, **sandy SILT, MEDIUM STIFF** *(cohesion value +/- medium)* - **SEMI-AQUITARD**
						4.5	
			6.00m			6.0	
D3	6.00 to 11.00		100%	Light Grey		7.5	Light grey, **silty fine to medium SAND** with trace of gravels, **LOOSE TO MEDIUM DENSE**, *(angle of reposed +/- 70°, friction angle +/- high)* - **Confined AQUIFER**
						9.0	
			11.00m			10.5	
D4	11.00 to 13.50		100%	Brownish grey		12.0	Light grey to light brown, **silty fine to medium SAND** with trace of gravels, **LOOSE TO MEDIUM DENSE**, *(angle of reposed +/- 70°, friction angle +/- high)* **Confined AQUIFER**
			13.50m			13.5	
C2	13.50 to 14.00	CL = 0.50m, CRR = 0.50m, RQD = NIL	100%	Medium grey			Light brown to medium grey, moderately weathered, highly fractured, STRONG interbeded SANDSTONE, SILTSTONE etc. **BEDROCK**
		End of hole = 14.00m bgl					
		Water table = 3.80m bgl				15.0	

TAJUK PROJEK

CADANGAN MEMBINA TELAGA PEMONITORAN DAN TELAGA EKSPLORASI AIR TANAH DI KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

MAKLUMAT KERJA

Pemilik Projek

INSTITUT PENYELIDIKAN HIDRULIK KEBANGSAAN MALAYSIA (NAHRIM)

Lokasi Projek

KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

No. ID Telaga :	MW11
Dia. Gerudi :	100 mm
Aras Air Tanah :	3.80 m bgl
Nama Operator :	MUSTAFA KAMAL

Mula Kerja

Tarikh : 04/05/2009

Masa :

Tamat Kerja

Tarikh : 05/05/2009

Masa :

PENGESAHAN KERJA

Di Log oleh : RAZIP HJ ISMAIL

Diperiksa oleh : RAZIP HJ ISMAIL

SO di Tapak : -

MAKLUMAT PENTING

Format maklumat penggerudian dan pembinaan telaga ini disunting dari maklumat terbitan seperti buku teks, buletin, laman sesawang dan sebagainya dan data tercatat adalah data dari lapangan.

Salah tafsir - bagi mengelakkan salah pengertian berkaitan maklumat di dalam lampiran ini, sila hantarkan perkara berkaitan ke alamat enviro@multicallgroup.com

© MULTICALL CARD (M) SDN BHD, C.A.R.D 1999

KERJA PENGGERUDIAN - LOG

NAHRIM

Maklumat Penggerudian dan Pembinaan Telaga

C.A.R.D
Consultancy . Administrative . Research . Development
http://www.multicallgroup.com

MW12

SAMPLE REF NUMBER	SAMPLE DEPTH (M)	STANDARD PENETRATION TEST (SPT) 75mm 75mm 75mm 75mm 75mm 75mm N VALUE	WATER RETURN %	WATER RETURN COLOUR	LEGEND	DEPTH (m)	DESCRIPTION OF SOIL, ROCK, COLOUR CONSISTENCY, RELATIVE DENSITY, GRAIN SIZE, TEXTURE, STRENGTH ETC
D1	0.00 to 0.40					0.0	Top Soil - Brownish grey, **clayey silty CLAY, SOFT** *(cohesion value +/- low)* - **AQUITARD**
			0.40m				
D2	0.40 to 1.60					1.5	Greenish grey to light brownish grey, **fine sandy SILT. SOFT TO MEDIUM STIFF** *(cohesion value +/- low)* - **AQUITARD**
D3	1.60 to 3.00						
			3.00m			3.0	Light to medium grey, **medium to coarse SAND, LOOSE - Unconfined AQUIFER**
D4	3.00 to 3.60						
			3.60m			4.5	
D5	3.60 to 4.20						
D6	4.20 to 5.00						Light brown to light grey **silty SAND** with trace of gravels, **LOOSE,** *(angle of reposed +/- 70°, friction angle +/- medium)* - **Unconfined AQUIFER**
D7	5.00 to 7.20					6.0	
		End of hole = 7.25m bgl Water table = 4.01m bgl				7.5	
						9.0	
						10.5	
						12.0	
						13.5	
						15.0	

TAJUK PROJEK

CADANGAN MEMBINA TELAGA PEMONITORAN DAN TELAGA EKSPLORASI AIR TANAH DI KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

MAKLUMAT KERJA

Pemilik Projek

INSTITUT PENYELIDIKAN HIDRULIK KEBANGSAAN MALAYSIA (NAHRIM)

Lokasi Projek

KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

No. ID Telaga :	MW12
Dia. Gerudi :	100 mm
Aras Air Tanah :	4.01 m bgl
Nama Operator :	MUSTAFA KAMAL

Mula Kerja

Tarikh : 13/06/2009

Masa :

Tamat Kerja

Tarikh : 13/06/2009

Masa :

PENGESAHAN KERJA

Di Log oleh : RAZIP HJ ISMAIL

Diperiksa oleh : RAZIP HJ ISMAIL

SO di Tapak : -

MAKLUMAT PENTING

Format maklumat penggerudian dan pembinaan telaga ini disunting dari maklumat terbitan seperti buku teks, buletin, laman sesawang dan sebagainya dan data tercatat adalah data dari lapangan.

Salah tafsir - bagi mengelakkan salah pengertian berkaitan maklumat di dalam lampiran ini, sila hantarkan perkara berkaitan ke alamat enviro@multicallgroup.com

☞ MULTICALL CARD (M) SDN BHD, C.A.R.D 1999

December, 2008 - Rev. 11

Form Reference Number:
MCG/SILOG/FL-1 of 1

KERJA PENGGERUDIAN - LOG

NAHRIM

Maklumat Penggerudian dan Pembinaan Telaga

C.A.R.D
Consultancy · Administrative · Research · Development
http://www.multicallgroup.com

MW13

SAMPLE REF NUMBER	SAMPLE DEPTH (M)	STANDARD PENETRATION TEST (SPT) 75mm 75mm 75mm 75mm 75mm 75mm N VALUE	WATER RETURN %	WATER RETURN COLOUR	LEGEND	DEPTH (m)	DESCRIPTION OF SOIL, ROCK, COLOUR CONSISTENCY, RELATIVE DENSITY, GRAIN SIZE, TEXTURE, STRENGTH ETC
D1	0.00 to 0.30					0.0	
D2	0.30 to 3.00		100%	Brownish grey to Light grey		1.5	Light grey to brownish grey, **silty fine to medium SAND** with trace of gravels, **LOOSE**, *(angle of reposed +/- 70°, friction angle +/- medium)* - **Unconfined AQUIFER**
			3.00m			3.0	
D3	3.00 to 6.00		70%	Light Grey		4.5	Light grey, **silty medium to coarse SAND, LOOSE TO MEDIUM DENSE**, *(angle of reposed +/- 70°, friction angle +/- medium)* - **Unconfined AQUIFER**
			6.00m			6.0	
D3	6.00 to 9.00					7.5	
			100%	Brownish Grey		9.0	Brownish grey, **silty medium to coarse SAND, LOOSE TO MEDIUM DENSE**, *(angle of reposed +/- 70°, friction angle +/- medium)* - **Unconfined AQUIFER**
D4	9.00 to 12.00					10.5	
			12.00m			12.0	
C1	12.00 to 12.50	CL = 0.50m, CRR = 0.40m, RQD = NIL	100%	Brownish grey			Light brown, moderately weathered, highly fractured, STRONG interbeded SANDSTONE, SILTSTONE etc. **BEDROCK**
		End of hole = 12.50m bgl				13.5	
		Water table = 5.70m bgl				15.0	

TAJUK PROJEK

CADANGAN MEMBINA TELAGA PEMONITORAN DAN TELAGA EKSPLORASI AIR TANAH DI KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

MAKLUMAT KERJA

Pemilik Projek

INSTITUT PENYELIDIKAN HIDRULIK KEBANGSAAN MALAYSIA (NAHRIM)

Lokasi Projek

KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

No. ID Telaga :	MW13
Dia. Gerudi :	100 mm
Aras Air Tanah :	5.70 m bgl
Nama Operator :	MUSTAFA KAMAL

Mula Kerja

Tarikh : 09/05/2009

Masa :

Tamat Kerja

Tarikh : 09/05/2009

Masa :

PENGESAHAN KERJA

Di Log oleh : RAZIP HJ ISMAIL

Diperiksa oleh : RAZIP HJ ISMAIL

SO di Tapak : -

MAKLUMAT PENTING

Format maklumat penggerudian dan pembinaan telaga ini disunting dari maklumat terbitan seperti buku teks, buletin, laman sesawang dan sebagainya dan data tercatat adalah data dari lapangan.

Salah tafsir - bagi mengelakkan salah pengertian berkaitan maklumat di dalam lampiran ini, sila hantarkan perkara berkaitan ke alamat enviro@multicallgroup.com

© MULTICALL CARD (M) SDN BHD. C.A.R.D 1999

December, 2008 - Rev. 11

Form Reference Number:
MCG/SILOG/FL-1 of 1

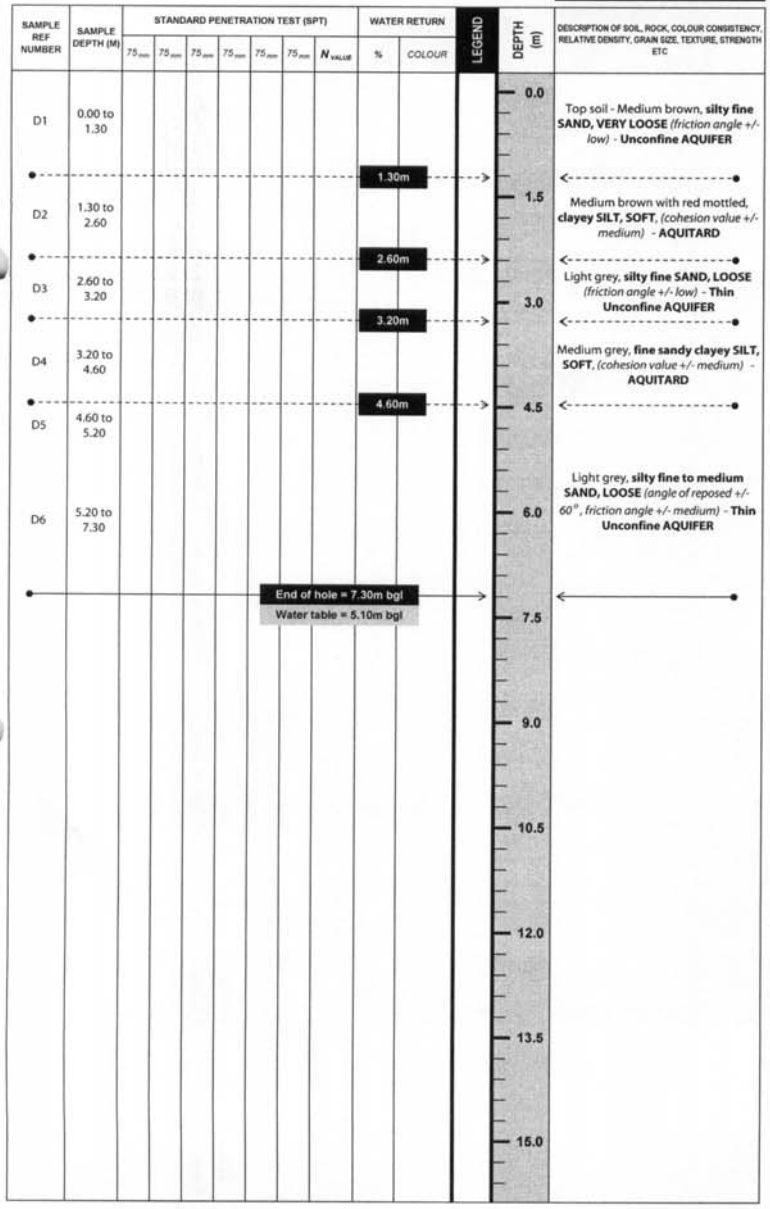
KERJA PENGGERUDIAN - LOG

NAHRIM

Maklumat Penggerudian dan Pembinaan Telaga

C.A.R.D
Consultancy . Administrative . Research . Development
http://www.multicallgroup.com

MW14



TAJUK PROJEK

CADANGAN MEMBINA TELAGA PEMONITORAN DAN TELAGA EKSPLORASI AIR TANAH DI KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

MAKLUMAT KERJA

Pemilik Projek

INSTITUT PENYELIDIKAN HIDRULIK KEBANGSAAN MALAYSIA (NAHRIM)

Lokasi Projek

KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

No. ID Telaga :	MW14
Dia. Gerudi :	100 mm
Aras Air Tanah :	5.10 m bgl
Nama Operator :	MUSTAFA KAMAL

Mula Kerja

Tarikh : 05/06/2009

Masa :

Tamat Kerja

Tarikh : 05/06/2009

Masa :

PENGESAHAN KERJA

Di Log oleh : RAZIP HJ ISMAIL

Diperiksa oleh : RAZIP HJ ISMAIL

SO di Tapak : -

MAKLUMAT PENTING

Format maklumat penggerudian dan pembinaan telaga ini disunting dari maklumat terbitan seperti buku teks, buletin, laman sesawang dan sebagainya dan data tercatat adalah data dari lapangan.

Salah tafsir - bagi mengelakkan salah pengertian berkaitan maklumat di dalam lampiran ini, sila hantarkan perkara berkaitan ke alamat enviro@multicallgroup.com

© MULTICALL CARD (M) SDN BHD, C.A.R.D 1999
December, 2008 - Rev. 11

Form Reference Number:
MCG/SILOG/FL-1 of 1

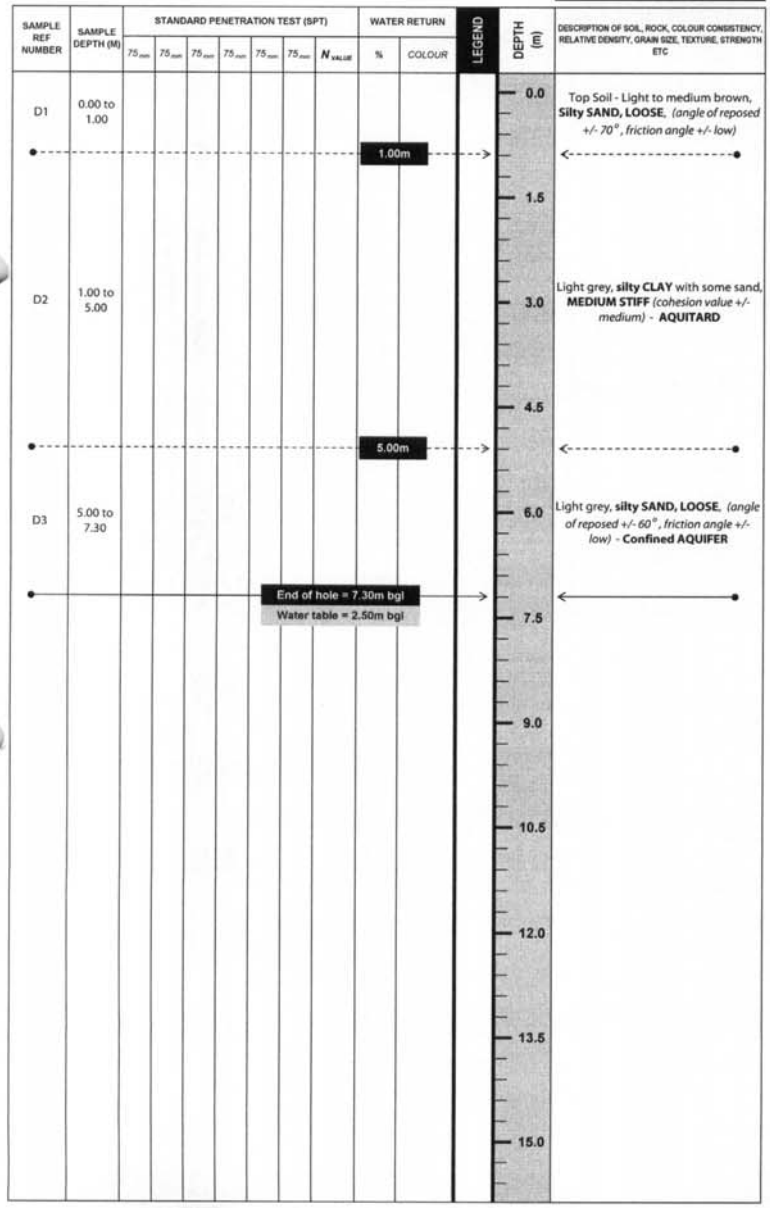
KERJA PENGGERUDIAN - LOG

NAHRIM

Maklumat Penggerudian dan Pembinaan Telaga

C.A.R.D
Consultancy · Administrative · Research · Development
http://www.multicallgroup.com

MW15



TAJUK PROJEK

CADANGAN MEMBINA TELAGA PEMONITORAN DAN TELAGA EKSPLORASI AIR TANAH DI KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

MAKLUMAT KERJA

Pemilik Projek

INSTITUT PENYELIDIKAN HIDRULIK KEBANGSAAN MALAYSIA (NAHRIM)

Lokasi Projek

KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

No. ID Telaga :	MW15
Dia. Gerudi :	100 mm
Aras Air Tanah :	2.50 m bgl
Nama Operator :	MUSTAFA KAMAL

Mula Kerja

Tarikh : 12/06/2009

Masa :

Tamat Kerja

Tarikh : 12/06/2009

Masa :

PENGESAHAN KERJA

Di Log oleh : RAZIP HJ ISMAIL

Diperiksa oleh : RAZIP HJ ISMAIL

SO di Tapak : -

MAKLUMAT PENTING

Format maklumat penggerudian dan pembinaan telaga ini disunting dari maklumat terbitan seperti buku teks, buletin, laman sesawang dan sebagainya dan data tercatat adalah data dari lapangan.

Salah tafsir - bagi mengelakkan salah pengertian berkaitan maklumat di dalam lampiran ini, sila hantarkan perkara berkaitan ke alamat enviro@multicallgroup.com

© MULTICALL CARD (M) SDN BHD, C.A.R.D 1999
December, 2008 - Rev. 11

Form Reference Number:
MCG/SILOG/FL-1 of 1

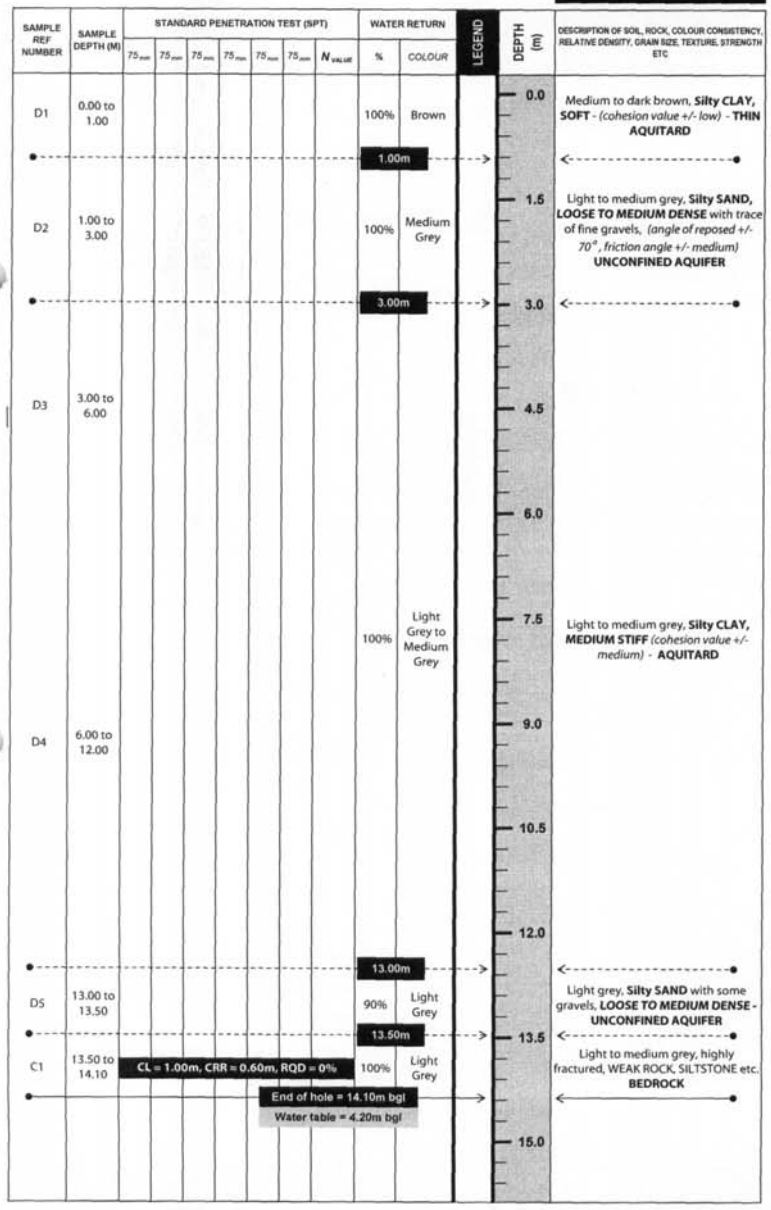
KERJA PENGGERUDIAN - LOG

NAHRIM

Maklumat Penggerudian dan Pembinaan Telaga

C.A.R.D
Consultancy . Administrative . Research . Development
http://www.multicallgroup.com

MW16



TAJUK PROJEK

CADANGAN MEMBINA TELAGA PEMONITORAN DAN TELAGA EKSPLORASI AIR TANAH DI KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

MAKLUMAT KERJA

Pemilik Projek

INSTITUT PENYELIDIKAN HIDRULIK KEBANGSAAN MALAYSIA (NAHRIM)

Lokasi Projek

KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

No. ID Telaga :	MW16
Dia. Gerudi :	100 mm
Aras Air Tanah :	4.20 m bgl
Nama Operator :	MUSTAFA KAMAL

Mula Kerja

Tarikh : 13/05/2009

Masa :

Tamat Kerja

Tarikh : 13/05/2009

Masa :

PENGESAHAN KERJA

Di Log oleh : RAZIP HJ ISMAIL

Diperiksa oleh : RAZIP HJ ISMAIL

SO di Tapak : -

MAKLUMAT PENTING

Format maklumat penggerudian dan pembinaan telaga ini disunting dari maklumat terbitan seperti buku teks, buletin, laman sesawang dan sebagainya dan data tercatat adalah data dari lapangan.

Salah tafsir - bagi mengelakkan salah pengertian berkaitan maklumat di dalam lampiran ini, sila hantarkan perkara berkaitan ke alamat enviro@multicallgroup.com

© MULTICALL CARD (M) SDN BHD, C.A.R.D 1999

December, 2008 - Rev. 11

Form Reference Number:
MCG/SILOG/FL-1 of 1

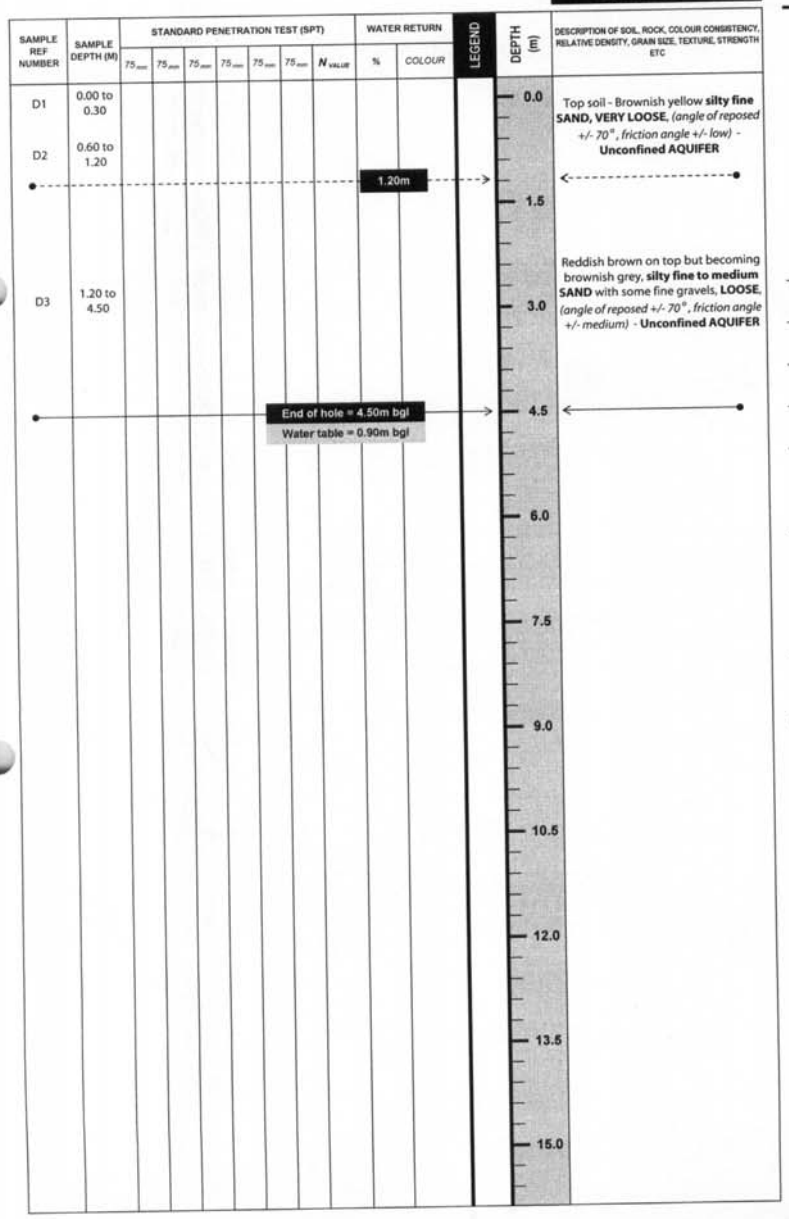
KERJA PENGGERUDIAN - LOG

NAHRIM

Maklumat Penggerudian dan Pembinaan Telaga

C.A.R.D
Consultancy . Administrative . Research . Development
http://www.multicallgroup.com

MW17



TAJUK PROJEK

CADANGAN MEMBINA TELAGA PEMONITORAN DAN TELAGA EKSPLORASI AIR TANAH DI KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

MAKLUMAT KERJA

Pemilik Projek

INSTITUT PENYELIDIKAN HIDRULIK KEBANGSAAN MALAYSIA (NAHRIM)

Lokasi Projek

KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

No. ID Telaga :	MW17
Dia. Gerudi :	100 mm
Aras Air Tanah :	0.90 m bgl
Nama Operator :	MUSTAFA KAMAL

Mula Kerja

Tarikh : 30/05/2009

Masa :

Tamat Kerja

Tarikh : 30/05/2009

Masa :

PENGESAHAN KERJA

Di Log oleh : RAZIP HJ ISMAIL

Diperiksa oleh : RAZIP HJ ISMAIL

SO di Tapak : -

MAKLUMAT PENTING

Format maklumat penggerudian dan pembinaan telaga ini disunting dari maklumat terbitan seperti buku teks, buletin, laman sesawang dan sebagainya dan data tercatat adalah data dari lapangan.

Salah tafsir - bagi mengelakkan salah pengertian berkaitan maklumat di dalam lampiran ini, sila hantarkan perkara berkaitan ke alamat enviro@multicallgroup.com

© MULTICALL CARD (M) SDN BHD, C.A.R.D 1999
December, 2008 - Rev. 11

Form Reference Number:
MCG/SILOG/FL-1 of 1

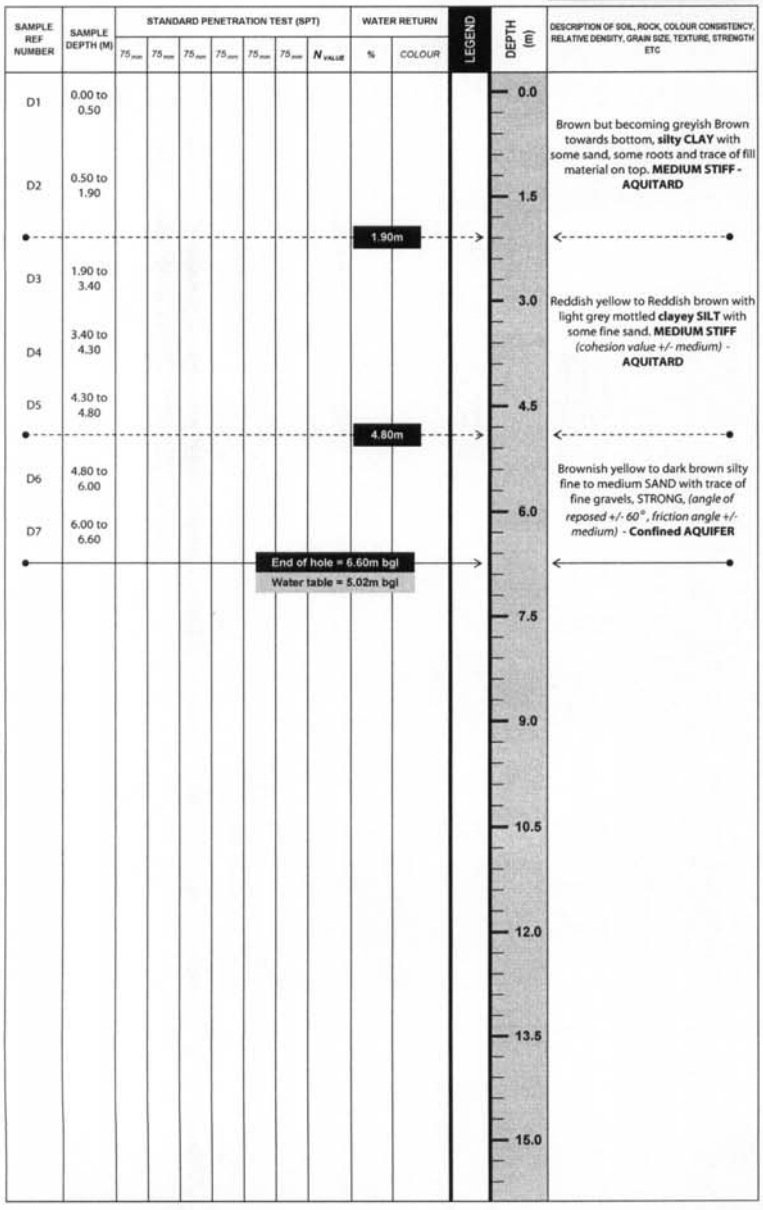
KERJA PENGGERUDIAN - LOG

NAHRIM

Maklumat Penggerudian dan Pembinaan Telaga

C.A.R.D
Consultancy . Administrative . Research . Development
http://www.multicallgroup.com

MW18



TAJUK PROJEK

CADANGAN MEMBINA TELAGA PEMONITORAN DAN TELAGA EKSPLORASI AIR TANAH DI KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

MAKLUMAT KERJA

Pemilik Projek

INSTITUT PENYELIDIKAN HIDRULIK KEBANGSAAN MALAYSIA (NAHRIM)

Lokasi Projek

KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

No. ID Telaga :	MW18
Dia. Gerudi :	100 mm
Aras Air Tanah :	5.02 m bgl
Nama Operator :	MUSTAFA KAMAL

Mula Kerja

Tarikh : 18/05/2009

Masa :

Tamat Kerja

Tarikh : 18/05/2009

Masa :

PENGESAHAN KERJA

Di Log oleh : RAZIP HJ ISMAIL

Diperiksa oleh : RAZIP HJ ISMAIL

SO di Tapak : -

MAKLUMAT PENTING

Format maklumat penggerudian dan pembinaan telaga ini disunting dari maklumat terbitan seperti buku teks, buletin, laman sesawang dan sebagainya dan data tercatat adalah data dari lapangan.

Salah tafsir - bagi mengelakkan salah pengertian berkaitan maklumat di dalam lampiran ini, sila hantarkan perkara berkaitan ke alamat enviro@multicallgroup.com

© MULTICALL CARD (M) SDN BHD, C.A.R.D 1999
December, 2008 - Rev. 11

Form Reference Number:
MCG/SILOG/FL-1 of 1

KERJA PENGGERUDIAN - LOG

NAHRIM

Maklumat Penggerudian dan Pembinaan Telaga

C.A.R.D
Consultancy : Administrative : Research : Development
http://www.multicallgroup.com

MW19

SAMPLE REF NUMBER	SAMPLE DEPTH (M)	STANDARD PENETRATION TEST (SPT) 75mm 75mm 75mm 75mm 75mm 75mm N VALUE	WATER RETURN %	WATER RETURN COLOUR	LEGEND	DEPTH (m)	DESCRIPTION OF SOIL, ROCK, COLOUR CONSISTENCY, RELATIVE DENSITY, GRAIN SIZE, TEXTURE, STRENGTH ETC
D1	0.00 to 1.20		100%	Light Grey		0.0	Medium to dark grey, **sandy SILT, SOFT** - *(cohesion value +/- low)* - **THIN AQUITARD**
			1.20m			1.5	
D2	1.20 to 6.00		100%	Medium Grey		3.0	
						4.5	
						6.0	Light to medium grey, **Silty SAND, LOOSE TO MEDIUM DENSE**, *(angle of reposed +/- 70°, friction angle +/- medium)* **UNCONFINED AQUIFER**
						7.5	
D3	6.00 to 12.00		100%	Light Grey		9.0	
						10.5	
			12.00m			12.0	
D4	12.00 to 13.50		90%	Light Brownish grey			Light grey to brownish grey, **Silty SAND, LOOSE TO MEDIUM DENSE**, *(angle of reposed +/- 70°, friction angle +/- medium)* **UNCONFINED AQUIFER**
			13.50m			13.5	
C1	13.50 to 14.00	CL = 0.50m, CRR = 0.05m, RQD = 0%	100%	Light Grey			Light to medium grey, highly fractured, WEAK ROCK, SILTSTONE etc. ***BEDROCK***
		End of hole = 14.00m bgl					
		Water table = 3.70m bgl				15.0	

TAJUK PROJEK

CADANGAN MEMBINA TELAGA PEMONITORAN DAN TELAGA EKSPLORASI AIR TANAH DI KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

MAKLUMAT KERJA

Pemilik Projek

INSTITUT PENYELIDIKAN HIDRULIK KEBANGSAAN MALAYSIA (NAHRIM)

Lokasi Projek

KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

No. ID Telaga :	MW19
Dia. Gerudi :	100 mm
Aras Air Tanah :	3.70 m bgl
Nama Operator :	MUSTAFA KAMAL

Mula Kerja

Tarikh : 06/05/2009

Masa :

Tamat Kerja

Tarikh : 07/05/2009

Masa :

PENGESAHAN KERJA

Di Log oleh : **RAZIP HJ ISMAIL**

Diperiksa oleh : **RAZIP HJ ISMAIL**

SO di Tapak : -

MAKLUMAT PENTING

Format maklumat penggerudian dan pembinaan telaga ini disunting dari maklumat terbitan seperti buku teks, buletin, laman sesawang dan sebagainya dan data tercatat adalah data dari lapangan.

Salah tafsir - bagi mengelakkan salah pengertian berkaitan maklumat di dalam lampiran ini, *sila hantarkan perkara* berkaitan ke alamat enviro@multicallgroup.com

MULTICALL CARD (M) SDN BHD, C.A.R.D 1999
December, 2008 - Rev. 11

Form Reference Number:
MCG/SILOG/FL-1 of 1

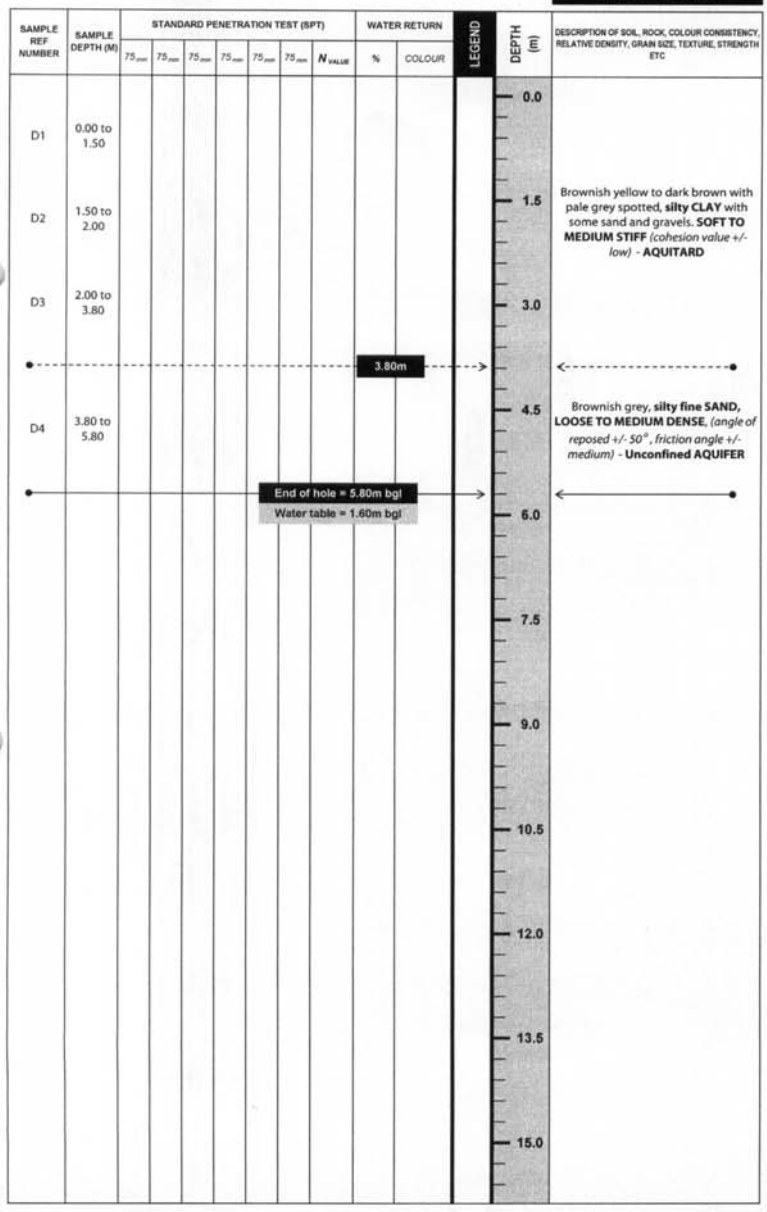
KERJA PENGGERUDIAN - LOG

NAHRIM

Maklumat Penggerudian dan Pembinaan Telaga

C.A.R.D
Consultancy · Administrative · Research · Development
http://www.multicallgroup.com

MW20



TAJUK PROJEK

CADANGAN MEMBINA TELAGA PEMONITORAN DAN TELAGA EKSPLORASI AIR TANAH DI KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

MAKLUMAT KERJA

Pemilik Projek

INSTITUT PENYELIDIKAN HIDRULIK KEBANGSAAN MALAYSIA (NAHRIM)

Lokasi Projek

KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

No. ID Telaga :	MW20
Dia. Gerudi :	100 mm
Aras Air Tanah :	1.60 m bgl
Nama Operator :	MUSTAFA KAMAL

Mula Kerja

Tarikh : 10/06/2009

Masa :

Tamat Kerja

Tarikh : 10/06/2009

Masa :

PENGESAHAN KERJA

Di Log oleh : RAZIP HJ ISMAIL

Diperiksa oleh : RAZIP HJ ISMAIL

SO di Tapak : -

MAKLUMAT PENTING

Format maklumat penggerudian dan pembinaan telaga ini disunting dari maklumat terbitan seperti buku teks, buletin, laman sesawang dan sebagainya dan data tercatat adalah data dari lapangan.

Salah tafsir - bagi mengelakkan salah pengertian berkaitan maklumat di dalam lampiran ini, sila hantarkan perkara berkaitan ke alamat enviro@multicallgroup.com

© MULTICALL CARD (M) SDN BHD, C.A.R.D 1999

December, 2008 - Rev. 11

Form Reference Number:
MCG/SILOG/FL-1 of 1

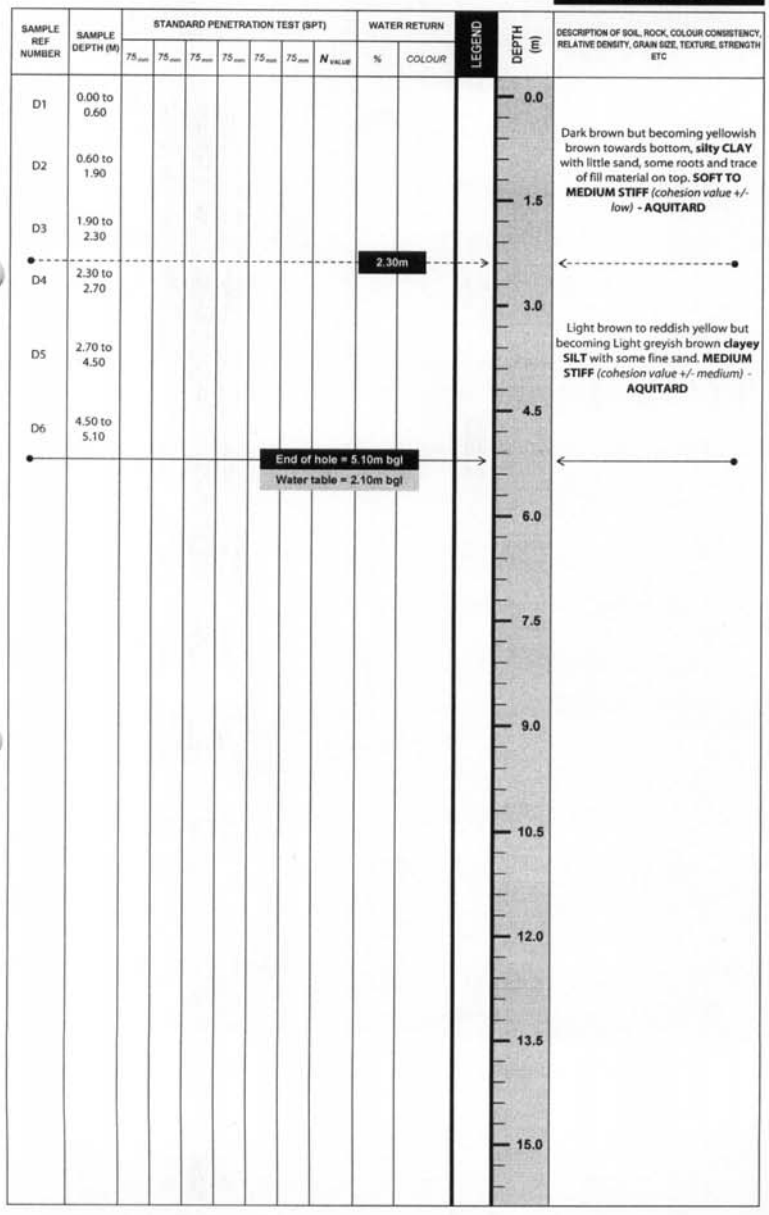
KERJA PENGGERUDIAN - LOG

NAHRIM

Maklumat Penggerudian dan Pembinaan Telaga

C.A.R.D
Consultancy . Administrative . Research . Development
http://www.multicallgroup.com

MW21



TAJUK PROJEK

CADANGAN MEMBINA TELAGA PEMONITORAN DAN TELAGA EKSPLORASI AIR TANAH DI KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

MAKLUMAT KERJA

Pemilik Projek

INSTITUT PENYELIDIKAN HIDRULIK KEBANGSAAN MALAYSIA (NAHRIM)

Lokasi Projek

KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

No. ID Telaga :	MW21
Dia. Gerudi :	100 mm
Aras Air Tanah :	2.10 m bgl
Nama Operator :	MUSTAFA KAMAL

Mula Kerja

Tarikh : 26/05/2009

Masa :

Tamat Kerja

Tarikh : 27/05/2009

Masa :

PENGESAHAN KERJA

Di Log oleh : RAZIP HJ ISMAIL

Diperiksa oleh : RAZIP HJ ISMAIL

SO di Tapak : -

MAKLUMAT PENTING

Format maklumat penggerudian dan pembinaan telaga ini disunting dari maklumat terbitan seperti buku teks, buletin, laman sesawang dan sebagainya dan data tercatat adalah data dari lapangan.

Salah tafsir - bagi mengelakkan salah pengertian berkaitan maklumat di dalam lampiran ini, sila hantarkan perkara berkaitan ke alamat enviro@multicallgroup.com

© MULTICALL CARD (M) SDN BHD, C.A.R.D 1999
December, 2008 - Rev. 11

Form Reference Number:
MCG/SILOG/FL-1 of 1

KERJA PENGGERUDIAN - LOG

NAHRIM

Maklumat Penggerudian dan Pembinaan Telaga

C.A.R.D
Consultancy Administrative Research Development
http://www.multicallgroup.com

MW22

SAMPLE REF NUMBER	SAMPLE DEPTH (M)	STANDARD PENETRATION TEST (SPT) 75mm 75mm 75mm 75mm 75mm 75mm N VALUE	WATER RETURN %	WATER RETURN COLOUR	LEGEND	DEPTH (m)	DESCRIPTION OF SOIL, ROCK, COLOUR CONSISTENCY, RELATIVE DENSITY, GRAIN SIZE, TEXTURE, STRENGTH ETC
D1	0.00 to 0.60					0.0	Dark brown but becoming greyish brown towards bottom, **silty CLAY** with little sand, some roots on top. ***SOFT TO MEDIUM STIFF*** *(cohesion value +/- low)* - **AQUITARD**
D2	0.60 to 1.20		1.20m			1.5	
D3	1.20 to 3.70					3.0	Light grey **clayey SILT** with some fine to medium sand, **MEDIUM STIFF** *(cohesion value +/- medium)* - **AQUITARD**
D4	3.70 to 4.00		End of hole = 4.00m bgl *Water table = 0.60m bgl*			4.5	
						6.0	
						7.5	
						9.0	
						10.5	
						12.0	
						13.5	
						15.0	

TAJUK PROJEK

CADANGAN MEMBINA TELAGA PEMONITORAN DAN TELAGA EKSPLORASI AIR TANAH DI KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

MAKLUMAT KERJA

Pemilik Projek

INSTITUT PENYELIDIKAN HIDRULIK KEBANGSAAN MALAYSIA (NAHRIM)

Lokasi Projek

KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

No. ID Telaga :	MW22
Dia. Gerudi :	100 mm
Aras Air Tanah :	0.6 m bgl
Nama Operator :	MUSTAFA KAMAL

Mula Kerja

Tarikh : 26/05/2009

Masa :

Tamat Kerja

Tarikh : 26/05/2009

Masa :

PENGESAHAN KERJA

Di Log oleh : RAZIP HJ ISMAIL

Diperiksa oleh : RAZIP HJ ISMAIL

SO di Tapak : -

MAKLUMAT PENTING

Format maklumat penggerudian dan pembinaan telaga ini disunting dari maklumat terbitan seperti buku teks, buletin, laman sesawang dan sebagainya dan data tercatat adalah data dari lapangan.

Salah tafsir - bagi mengelakkan salah pengertian berkaitan maklumat di dalam lampiran ini, sila hantarkan perkara berkaitan ke alamat enviro@multicallgroup.com

© MULTICALL CARD (M) SDN BHD, C.A.R.D 1999
December, 2008 - Rev. 11

Form Reference Number:
MCG/SILOG/FL-1 of 1

KERJA PENGGERUDIAN - LOG

NAHRIM

Maklumat Penggerudian dan Pembinaan Telaga

C.A.R.D
Consultancy . Administrative . Research . Development
http://www.multicallgroup.com

MW23

SAMPLE REF NUMBER	SAMPLE DEPTH (M)	STANDARD PENETRATION TEST (SPT) 75mm 75mm 75mm 75mm 75mm 75mm N VALUE	WATER RETURN %	WATER RETURN COLOUR	LEGEND	DEPTH (m)	DESCRIPTION OF SOIL, ROCK, COLOUR CONSISTENCY, RELATIVE DENSITY, GRAIN SIZE, TEXTURE, STRENGTH ETC
D1	0.00 to 4.50		100%	Light Grey		0.0 – 1.5 – 3.0 – 4.5	Light to medium grey, **Silty SAND, LOOSE**, *(angle of reposed +/- 70°, friction angle +/- low)* **UNCONFINED AQUIFER**
			4.50m				
D2	4.50 to 6.00		100%	Medium Grey			Medium to dark grey, **sandy CLAY, MEDIUM STIFF** - *(cohesion value +/- low)* - **AQUITARD, CLAY LENSE**
			6.00m			6.0 – 7.5 – 9.0	
D3	6.00 to 15.00		100%	Light Grey		10.5 – 12.0 – 13.5	Light to medium grey, **Silty SAND, LOOSE TO MEDIUM DENSE**, *(angle of reposed +/- 70°, friction angle +/- medium)* **UNCONFINED AQUIFER**
			15.00m				
C1	15.00 to 15.50	CL = 0.50m, CRR = 0.05m, RQD = 0%	100%	Light Grey		15.0	Light to medium grey, highly fractured, WEAK ROCK, SILTSTONE etc. **BEDROCK**
		End of hole = 15.50m bgl					
		Water table = 5.21m bgl					

TAJUK PROJEK

CADANGAN MEMBINA TELAGA PEMONITORAN DAN TELAGA EKSPLORASI AIR TANAH DI KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

MAKLUMAT KERJA

Pemilik Projek

INSTITUT PENYELIDIKAN HIDRULIK KEBANGSAAN MALAYSIA (NAHRIM)

Lokasi Projek

KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

No. ID Telaga :	MW23
Dia. Gerudi :	100 mm
Aras Air Tanah :	5.21 m bgl
Nama Operator :	MUSTAFA KAMAL

Mula Kerja

Tarikh : 15/05/2009

Masa :

Tamat Kerja

Tarikh : 16/05/2009

Masa :

PENGESAHAN KERJA

Di Log oleh : RAZIP HJ ISMAIL

Diperiksa oleh : RAZIP HJ ISMAIL

SO di Tapak : -

MAKLUMAT PENTING

Format maklumat penggerudian dan pembinaan telaga ini disunting dari maklumat terbitan seperti buku teks, buletin, laman sesawang dan sebagainya dan data tercatat adalah data dari lapangan.

Salah tafsir - bagi mengelakkan salah pengertian berkaitan maklumat di dalam lampiran ini, sila hantarkan perkara berkaitan ke alamat enviro@multicallgroup.com

© MULTICALL CARD (M) SDN BHD. C.A.R.D 1999

KERJA PENGGERUDIAN - LOG

NAHRIM

Maklumat Penggerudian dan Pembinaan Telaga

C.A.R.D
Consultancy . Administrative . Research . Development
http://www.multicallgroup.com

MW24

SAMPLE REF NUMBER	SAMPLE DEPTH (M)	STANDARD PENETRATION TEST (SPT) 75mm 75mm 75mm 75mm 75mm 75mm N VALUE	WATER RETURN %	WATER RETURN COLOUR	LEGEND	DEPTH (m)	DESCRIPTION OF SOIL, ROCK, COLOUR CONSISTENCY, RELATIVE DENSITY, GRAIN SIZE, TEXTURE, STRENGTH ETC
D1	0.00 to 0.90					0.0	Top Soil - Light to medium brown, **Silty SAND, LOOSE**, *(angle of reposed +/- 70°, friction angle +/- low)*
			0.90m				
D2	0.90 to 2.10					1.5	Greenish grey, **silty CLAY** with some fine sand, **SOFT** *(cohesion value +/- low)* - **AQUITARD**
			2.10m				
D3	2.10 to 3.70					3.0	Light to medium grey, **Silty fine SAND, LOOSE**, *(angle of reposed +/- 70°, friction angle +/- low)* - thin layer **UNCONFINE AQUIFER**
			3.70m				
D4	3.70 to 5.00					4.5	Brownish grey to medium grey, **clayey SILT** with some fine sand, **SOFT**, *(cohesion value +/- low)* - **AQUITARD**
			5.00m				
D5	5.00 to 6.00						Light grey, **silty SAND, LOOSE**, *(friction angle +/- low)* - **Confined AQUIFER??**
		End of hole = 6.00m bgl				6.0	
		Water table = 2.40m bgl					
						7.5	
						9.0	
						10.5	
						12.0	
						13.5	
						15.0	

TAJUK PROJEK

CADANGAN MEMBINA TELAGA PEMONITORAN DAN TELAGA EKSPLORASI AIR TANAH DI KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

MAKLUMAT KERJA

Pemilik Projek

INSTITUT PENYELIDIKAN HIDRULIK KEBANGSAAN MALAYSIA (NAHRIM)

Lokasi Projek

KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

No. ID Telaga :	MW24
Dia. Gerudi :	100 mm
Aras Air Tanah :	2.40 m bgl
Nama Operator :	MUSTAFA KAMAL

Mula Kerja

Tarikh : 12/06/2009

Masa :

Tamat Kerja

Tarikh : 12/06/2009

Masa :

PENGESAHAN KERJA

Di Log oleh : RAZIP HJ ISMAIL

Diperiksa oleh : RAZIP HJ ISMAIL

SO di Tapak : -

MAKLUMAT PENTING

Format maklumat penggerudian dan pembinaan telaga ini disunting dari maklumat terbitan seperti buku teks, buletin, laman sesawang dan sebagainya dan data tercatat adalah data dari lapangan.

Salah tafsir - bagi mengelakkan salah pengertian berkaitan maklumat di dalam lampiran ini, sila hantarkan perkara berkaitan ke alamat enviro@multicallgroup.com

© MULTICALL CARD (M) SDN BHD, C.A.R.D 1999

KERJA PENGGERUDIAN - LOG

NAHRIM

Maklumat Penggerudian dan Pembinaan Telaga

C.A.R.D
Consultancy . Administrative . Research . Development
http://www.multicallgroup.com

MW25

SAMPLE REF NUMBER	SAMPLE DEPTH (M)	STANDARD PENETRATION TEST (SPT) 75mm 75mm 75mm 75mm 75mm 75mm N VALUE	WATER RETURN %	WATER RETURN COLOUR	LEGEND	DEPTH (m)	DESCRIPTION OF SOIL, ROCK, COLOUR CONSISTENCY, RELATIVE DENSITY, GRAIN SIZE, TEXTURE, STRENGTH ETC
D1	0.00 to 1.20		100%	Light brown to medium grey		0.0	Yellowish grey but becoming light to medium grey towards bottom, **sandy SILT** with little sand, some roots and trace of fill material, **MEDIUM STIFF**
			1.20m			1.5	
D2	1.20 to 6.00		70%	Light grey to medium grey		3.0	Light grey with pale grey and reddish brown mottles **silty fine to medium SAND** with trace of gravels, **MEDIUM DENSE,** *(angle of reposed +/- 70°, friction angle +/- high)* - **Unconfined AQUIFER**
						4.5	
			6.00m			6.0	
D3	6.00 to 12.00		100%	Light grey to medium grey		7.5	Light grey with pale grey and reddish brown mottles **silty fine to medium SAND** with trace of gravels, **MEDIUM DENSE,** *(angle of reposed +/- 70°, friction angle +/- high)* - **Unconfined AQUIFER??**
						9.0	
						10.5	
			12.00m			12.0	
D4	12.00 to 13.50		100%	Light Grey			Light grey with brown mottles **fine to medium SAND** with trace of gravels, **MEDIUM DENSE,** *(angle of reposed +/- 70°, friction angle +/- high)* - **Unconfined AQUIFER??**
			13.50m			13.5	
C1	13.50 to 14.70	CL = 1.20m, CRR = 0.20m, RQD = 0%	100%	Light Grey			Light to medium grey, moderately weathered, highly fractured, STRONG interbeded SANDSTONE, SILTSTONE etc. **BEDROCK**
		End of hole = 14.70m bgl				15.0	
		Water table = 3.70m bgl					

TAJUK PROJEK

CADANGAN MEMBINA TELAGA PEMONITORAN DAN TELAGA EKSPLORASI AIR TANAH DI KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

MAKLUMAT KERJA

Pemilik Projek

INSTITUT PENYELIDIKAN HIDRULIK KEBANGSAAN MALAYSIA (NAHRIM)

Lokasi Projek

KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

No. ID Telaga :	MW25
Dia. Gerudi :	100 mm
Aras Air Tanah :	3.70 m bgl
Nama Operator :	MUSTAFA KAMAL

Mula Kerja

Tarikh : 06/05/2009

Masa :

Tamat Kerja

Tarikh : 07/05/2009

Masa :

PENGESAHAN KERJA

Di Log oleh : RAZIP HJ ISMAIL

Diperiksa oleh : RAZIP HJ ISMAIL

SO di Tapak : -

MAKLUMAT PENTING

Format maklumat penggerudian dan pembinaan telaga ini disunting dari maklumat terbitan seperti buku teks, buletin, laman sesawang dan sebagainya dan data tercatat adalah data dari lapangan.

Salah tafsir - bagi mengelakkan salah pengertian berkaitan maklumat di dalam lampiran ini, sila hantarkan perkara berkaitan ke alamat enviro@multicallgroup.com

© MULTICALL CARD (M) SDN BHD, C.A.R.D 1999

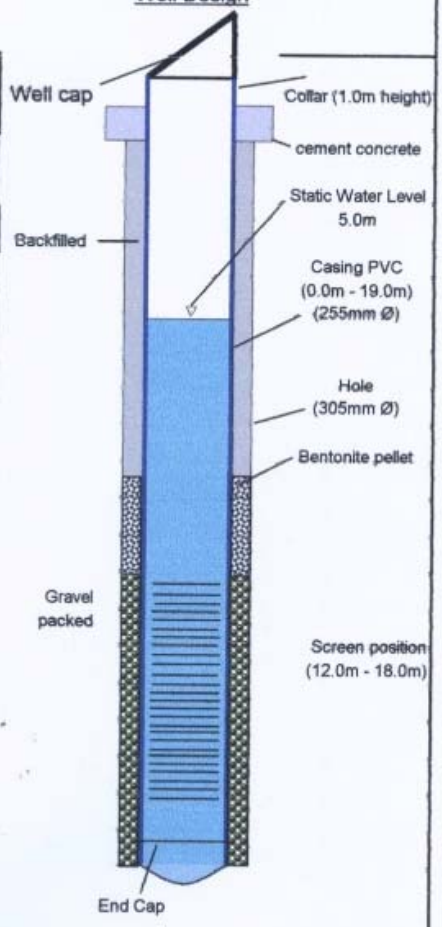
Tube Well No : DW1
Location : Cabang Sg Semenyih, Jenderam Hilir
: Dengkil, Selangor D.E.
Client : NAHRIM

Drilling Machine : Semi-Mechanised Bangka Drill
Drilling Method : Percussion
Well Depth : 19.0 meter.
Date Start : 11.9.2009
Date Complete : 16.09.2009

Discharge Rate (gallon/hr)	Depth (m)	Lithology Description
	0.0	Light Brownish to Dark Purplish Grey CLAY (0.0m - 5.0m)
	2.5	
	3.0	# clay-39,silt-50,sand10,gravel-1 Light Greyish Clayey SILT
	5.0	# clay-39,silt-50,sand10,gravel-1 Light Greyish Clayey SILT
	7.5	Decayed wood
	8.0	Light to Darkish Grey Silty SAND
	10.0	Light to Darkish Grey Silty SAND decaying wood
	12.5	# clay-6,silt-54,sand38,gravel-2
	13.0	# clay-7,silt-79,sand38,gravel-14
	14.0	Light to Darkish Grey Silty SAND with some gravels
	15.0	
	16.0	Dark Grey Silty SAND with little gravels
	17.5	
	19.0	Bedrock

Lithology

Well Design



laboratory analysis

Prepared by Wong
Post Driller
Date 17.09.2009

Approved by Abdul Latiff Ashaari
Designation Geologist
Date 22.10.2009

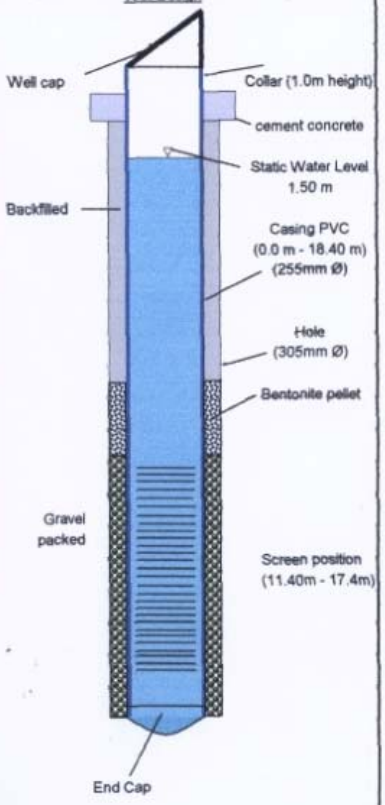
Tube Well No : DW2
Location : Cabang Sg Semenyih, Jenderam Hilir
: Dengkil, Selangor D.E.
Client : NAHRIM

Drilling Machine : Semi-Mechanised Bangka Drill
Drilling Method : Percussion
Well Depth : 18.40 meter.
Date Start : 23.09.2009
Date Complete : 25.09.2009

Discharge Rate (gallon/hr)	Depth (m)	Lithology Description
	0.0	Light Brownish to Dark Purplish Grey CLAY (0.0m - 5.0m)
	2.5	
	3	# clay-24,silt-47,sand23,gravel-6 Light Greyish Brown Clayey SILT
	5.0	# clay-24,silt-47,sand23,gravel-6 Light Greyish Gravelly SAND with some decayed woods (5.0 m - 8.0 m)
	7.5	
	8.0	# clay/silt-8,sand-56,gravel-36
	10.0	# clay/silt-0,sand44,gravel-36 Light to Darkish Grey Gravelly SAND
	12.5	
	13.0	# clay/silt-0,sand-44,gravel-36 Light to Darkish Grey Gravelly SAND
	15.0	
	16.0	# clay/silt-0,sand-44,gravel-36
	17.5	Light to Darkish Grey Gravelly SAND decayed wood
	18.4	Bedrock

Lithology

Well Design



laboratory analysis

Prepared by Wong
Post Driller
Date 27.09.2009

Approved by Abdul Latiff Ashaari
Designation Geologist
Date 15.10.2009

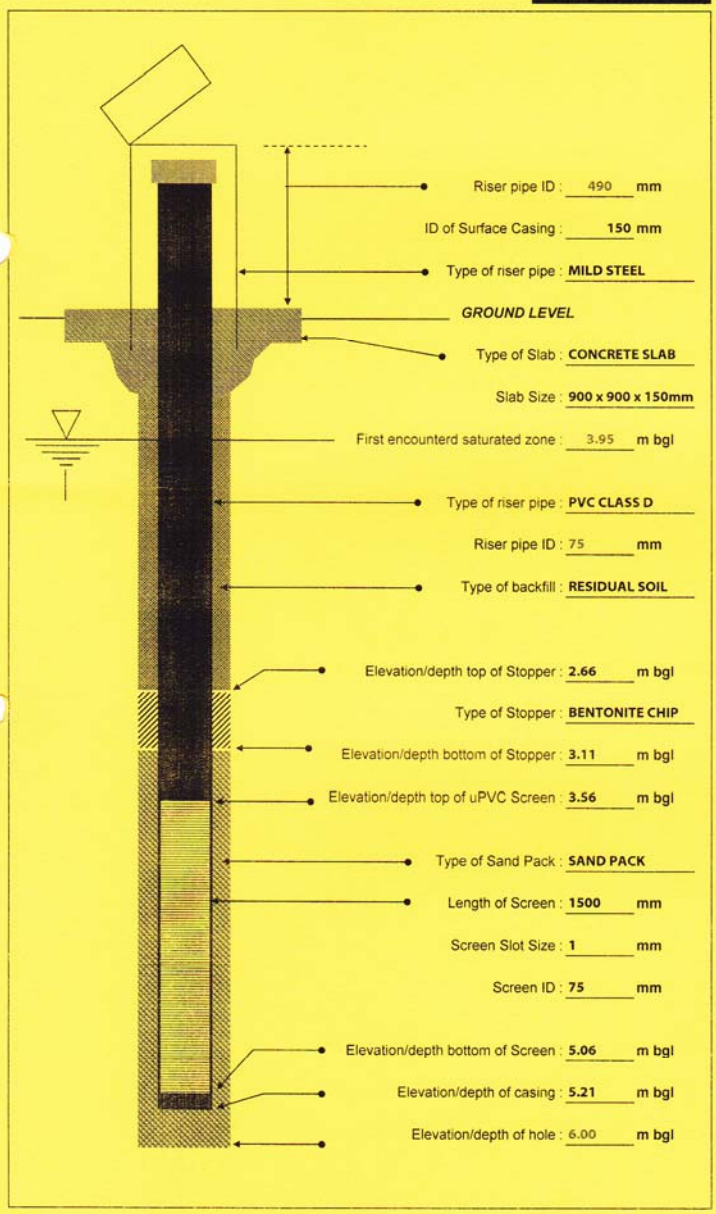
KERJA PEMBINAAN TELAGA

NAHRIM

Maklumat Pembinaan Telaga Pemonitoran

C.A.R.D
Consultancy : Administrative : Research : Development
http://www.multicallgroup.com

MW01



TAJUK PROJEK PROJEK

CADANGAN MEMBINA TELAGA PEMONITORAN DAN TELAGA EKSPLORASI AIR TANAH DI KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

MAKLUMAT KERJA

Pemilik Projek

INSTITUT PENYELIDIKAN HIDRULIK KEBANGSAAN MALAYSIA (NAHRIM)

Lokasi Projek

KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

No. ID Telaga : MW01

Dia. Gerudi : 100 mm

Aras Air Tanah : 3.95 m bgl

Nama Operator : MUSTAFA KAMAL

Mula Kerja

Tarikh : 06/05/2009

Masa :

Tamat Kerja

Tarikh : 07/05/2009

Masa :

PENGESAHAN KERJA

Dilukis oleh : SITI MUNIRAH AHMAD

Diperiksa oleh : RAZIP HJ ISMAIL

SO di Tapak : -

MAKLUMAT PENTING

Format maklumat penggerudian dan pembinaan telaga ini disunting dari maklumat terbitan seperti buku teks, buletin, laman sesawang dan sebagainya dan data tercatat adalah data dari lapangan.

Salah tafsir - bagi mengelakkan salah pengertian berkaitan maklumat di dalam lampiran ini, sila hantarkan perkara berkaitan ke alamat enviro@multicallgroup.com

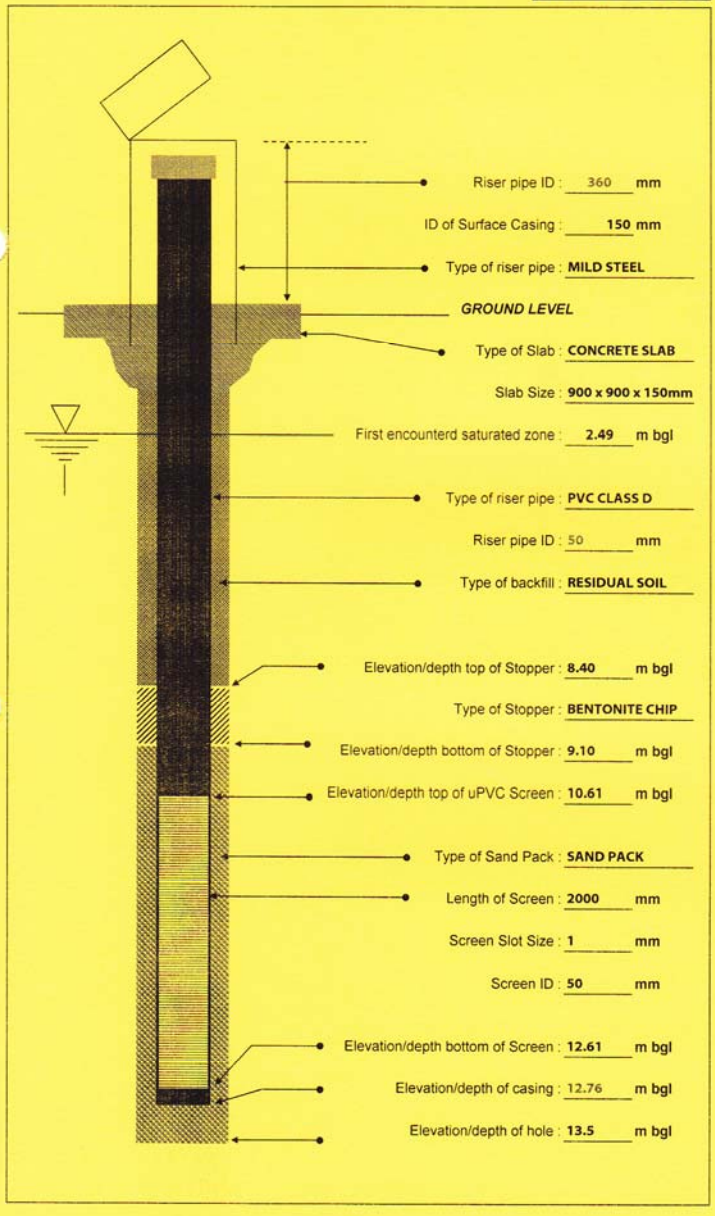
KERJA PEMBINAAN TELAGA

NAHRIM

Maklumat Pembinaan Telaga Pemonitoran

C.A.R.D
Consultancy : Administrative : Research : Development
http://www.multicallgroup.com

MW02



TAJUK PROJEK PROJEK

CADANGAN MEMBINA TELAGA PEMONITORAN DAN TELAGA EKSPLORASI AIR TANAH DI KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

MAKLUMAT KERJA

Pemilik Projek

INSTITUT PENYELIDIKAN HIDRULIK KEBANGSAAN MALAYSIA (NAHRIM)

Lokasi Projek

KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

No. ID Telaga : MW02

Dia. Gerudi : 100 mm

Aras Air Tanah : 2.49 m bgl

Nama Operator : MUSTAFA KAMAL

Mula Kerja

Tarikh : 29/04/2009

Masa :

Tamat Kerja

Tarikh : 29/04/2009

Masa :

PENGESAHAN KERJA

Dilukis oleh : SITI MUNIRAH AHMAD

Diperiksa oleh : RAZIP HJ ISMAIL

SO di Tapak : -

MAKLUMAT PENTING

Format maklumat penggerudian dan pembinaan telaga ini disunting dari maklumat terbitan seperti buku teks, buletin, laman sesawang dan sebagainya dan data tercatat adalah data dari lapangan.

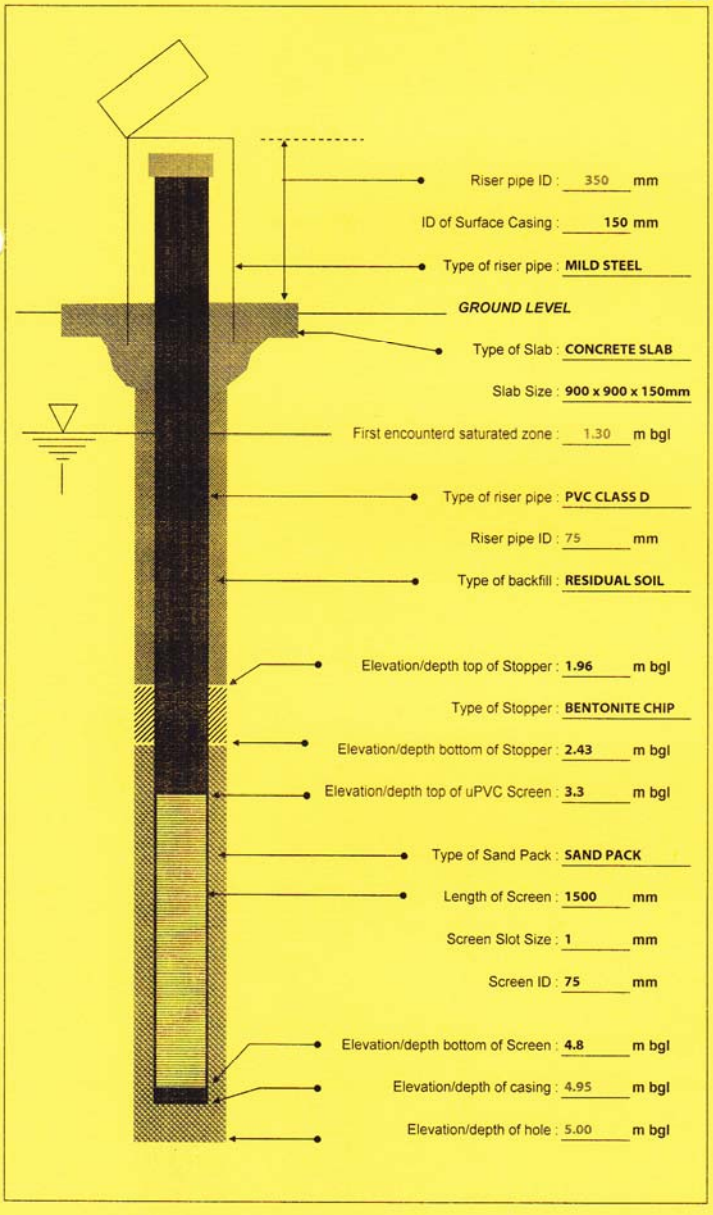
Salah tafsir - bagi mengelakkan salah pengertian berkaitan maklumat di dalam lampiran ini, sila hantarkan perkara berkaitan ke alamat enviro@multicallgroup.com

KERJA PEMBINAAN TELAGA

NAHRIM

Maklumat Pembinaan Telaga Pemonitoran

MW03



C.A.R.D

Consultancy . Administrative . Research . Development

http://www.multicallgroup.com

TAJUK PROJEK PROJEK

CADANGAN MEMBINA TELAGA PEMONITORAN DAN TELAGA EKSPLORASI AIR TANAH DI KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

MAKLUMAT KERJA

Pemilik Projek

INSTITUT PENYELIDIKAN HIDRULIK KEBANGSAAN MALAYSIA (NAHRIM)

Lokasi Projek

KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

No. ID Telaga : MW03

Dia. Gerudi : 100 mm

Aras Air Tanah : 1.30 m bgl

Nama Operator : MUSTAFA KAMAL

Mula Kerja

Tarikh : 06/05/2009

Masa :

Tamat Kerja

Tarikh : 07/05/2009

Masa :

PENGESAHAN KERJA

Dilukis oleh : SITI MUNIRAH AHMAD

Diperiksa oleh : RAZIP HJ ISMAIL

SO di Tapak : -

MAKLUMAT PENTING

Format maklumat penggerudian dan pembinaan telaga ini disunting dari maklumat terbitan seperti buku teks, buletin, laman sesawang dan sebagainya dan data tercatat adalah data dari lapangan.

Salah tafsir - bagi mengelakkan salah pengertian berkaitan maklumat di dalam lampiran ini, sila hantarkan perkara berkaitan ke alamat enviro@multicallgroup.com

KERJA PEMBINAAN TELAGA

NAHRIM

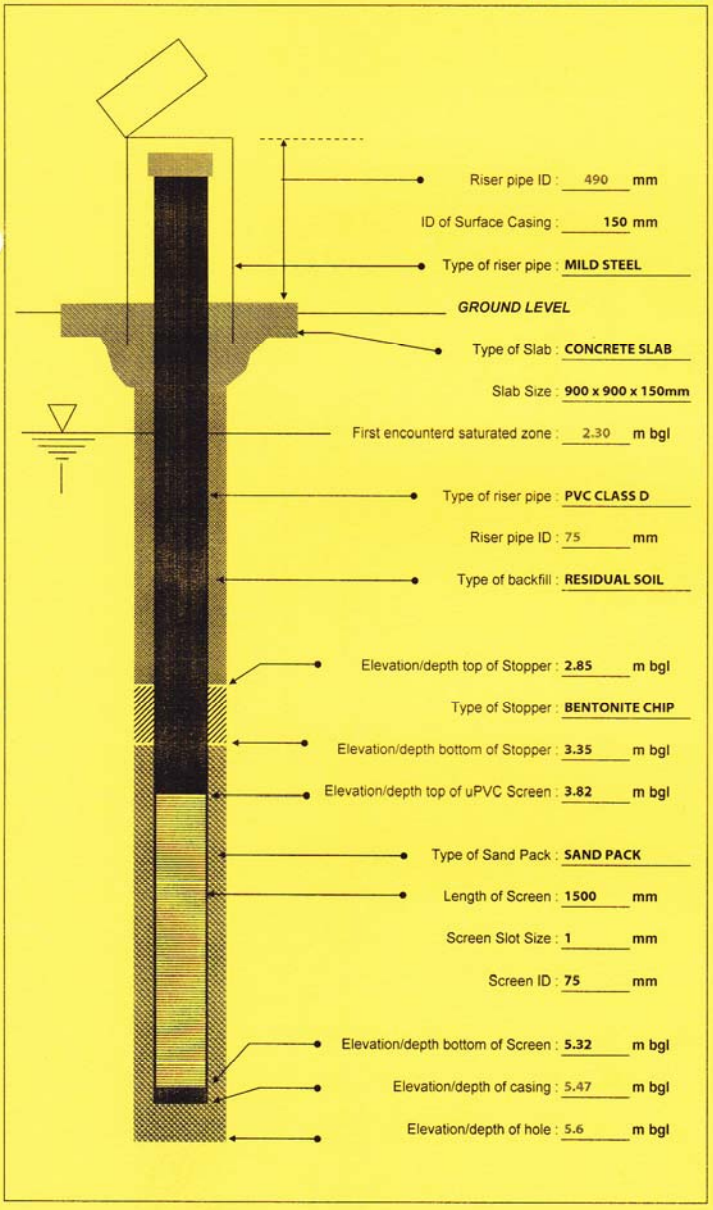
Maklumat Pembinaan Telaga Pemonitoran

C.A.R.D

Consultancy . Administrative . Research . Development

http://www.multicallgroup.com

MW04



TAJUK PROJEK PROJEK

CADANGAN MEMBINA TELAGA PEMONITORAN DAN TELAGA EKSPLORASI AIR TANAH DI KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

MAKLUMAT KERJA

Pemilik Projek

INSTITUT PENYELIDIKAN HIDRULIK KEBANGSAAN MALAYSIA (NAHRIM)

Lokasi Projek

KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

No. ID Telaga : MW04

Dia. Gerudi : 100 mm

Aras Air Tanah : 2.30 m bgl

Nama Operator : MUSTAFA KAMAL

Mula Kerja

Tarikh : 06/05/2009

Masa :

Tamat Kerja

Tarikh : 07/05/2009

Masa :

PENGESAHAN KERJA

Dilukis oleh : SITI MUNIRAH AHMAD

Diperiksa oleh : RAZIP HJ ISMAIL

SO di Tapak : -

MAKLUMAT PENTING

Format maklumat penggerudian dan pembinaan telaga ini disunting dari maklumat terbitan seperti buku teks, buletin, laman sesawang dan sebagainya dan data tercatat adalah data dari lapangan.

Salah tafsir - bagi mengelakkan salah pengertian berkaitan maklumat di dalam lampiran ini, sila hantarkan perkara berkaitan ke alamat enviro@multicallgroup.com

KERJA PEMBINAAN TELAGA

NAHRIM

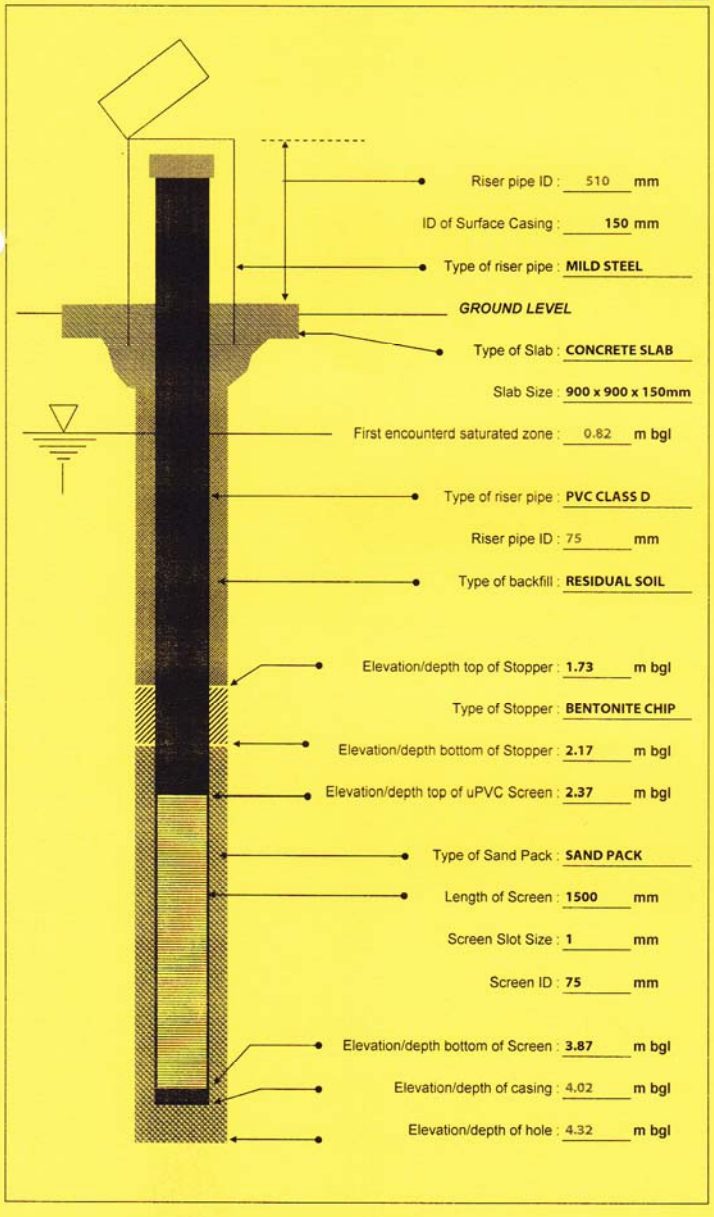
Maklumat Pembinaan Telaga Pemonitoran

C.A.R.D

Consultancy : Administrative : Research : Development

http://www.multicallgroup.com

MW05



TAJUK PROJEK PROJEK

CADANGAN MEMBINA TELAGA PEMONITORAN DAN TELAGA EKSPLORASI AIR TANAH DI KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

MAKLUMAT KERJA

Pemilik Projek

INSTITUT PENYELIDIKAN HIDRULIK KEBANGSAAN MALAYSIA (NAHRIM)

Lokasi Projek

KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

No. ID Telaga : MW05

Dia. Gerudi : 100 mm

Aras Air Tanah : 0.82 m bgl

Nama Operator : MUSTAFA KAMAL

Mula Kerja

Tarikh : 06/05/2009

Masa :

Tamat Kerja

Tarikh : 07/05/2009

Masa :

PENGESAHAN KERJA

Dilukis oleh : SITI MUNIRAH AHMAD

Diperiksa oleh : RAZIP HJ ISMAIL

SO di Tapak : -

MAKLUMAT PENTING

Format maklumat penggerudian dan pembinaan telaga ini disunting dari maklumat terbitan seperti buku teks, buletin, laman sesawang dan sebagainya dan data tercatat adalah data dari lapangan.

Salah tafsir - bagi mengelakkan salah pengertian berkaitan maklumat di dalam lampiran ini, sila hantarkan perkara berkaitan ke alamat enviro@multicallgroup.com

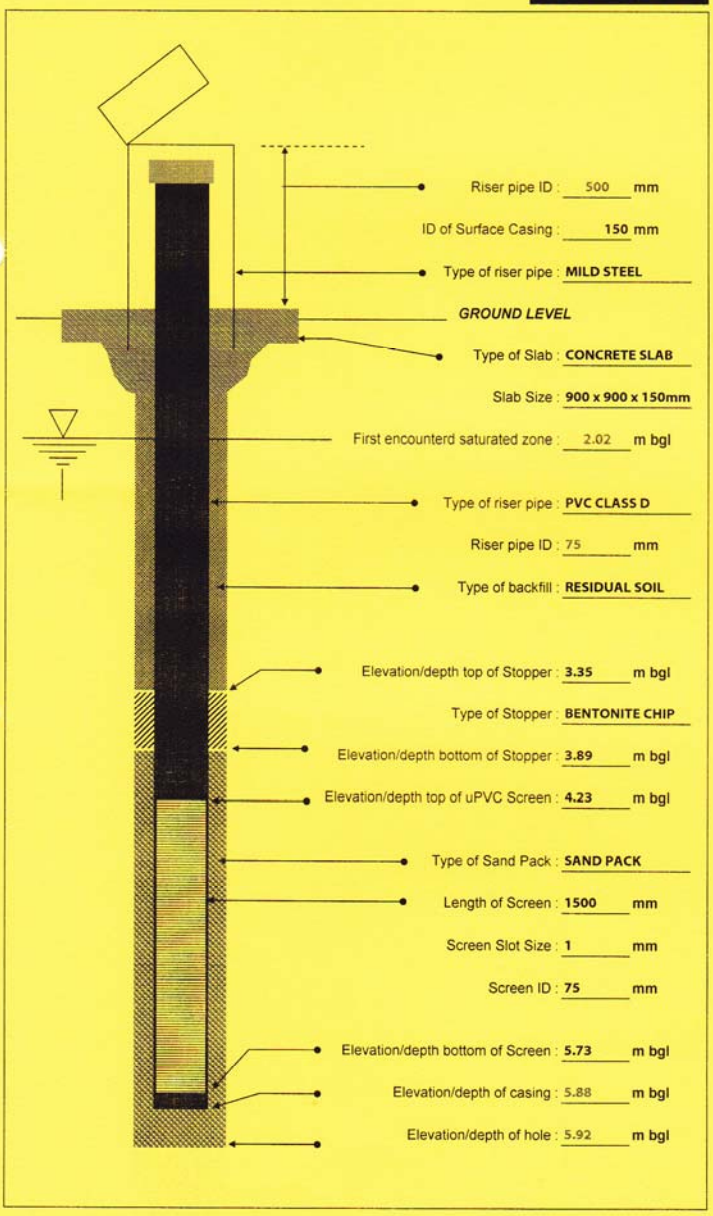
KERJA PEMBINAAN TELAGA

NAHRIM

Maklumat Pembinaan Telaga Pemonitoran

C.A.R.D
Consultancy : Administrative : Research : Development
http://www.multicallgroup.com

MW06



TAJUK PROJEK PROJEK

CADANGAN MEMBINA TELAGA PEMONITORAN DAN TELAGA EKSPLORASI AIR TANAH DI KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

MAKLUMAT KERJA

Pemilik Projek

INSTITUT PENYELIDIKAN HIDRULIK KEBANGSAAN MALAYSIA (NAHRIM)

Lokasi Projek

KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

No. ID Telaga : MW06

Dia. Gerudi : 100 mm

Aras Air Tanah : 2.02 m bgl

Nama Operator : MUSTAFA KAMAL

Mula Kerja

Tarikh : 06/05/2009

Masa :

Tamat Kerja

Tarikh : 07/05/2009

Masa :

PENGESAHAN KERJA

Dilukis oleh : SITI MUNIRAH AHMAD

Diperiksa oleh : RAZIP HJ ISMAIL

SO di Tapak : -

MAKLUMAT PENTING

Format maklumat penggerudian dan pembinaan telaga ini disunting dari maklumat terbitan seperti buku teks, buletin, laman sesawang dan sebagainya dan data tercatat adalah data dari lapangan.

Salah tafsir - bagi mengelakkan salah pengertian berkaitan maklumat di dalam lampiran ini, sila hantarkan perkara berkaitan ke alamat enviro@multicallgroup.com

KERJA PEMBINAAN TELAGA

NAHRIM

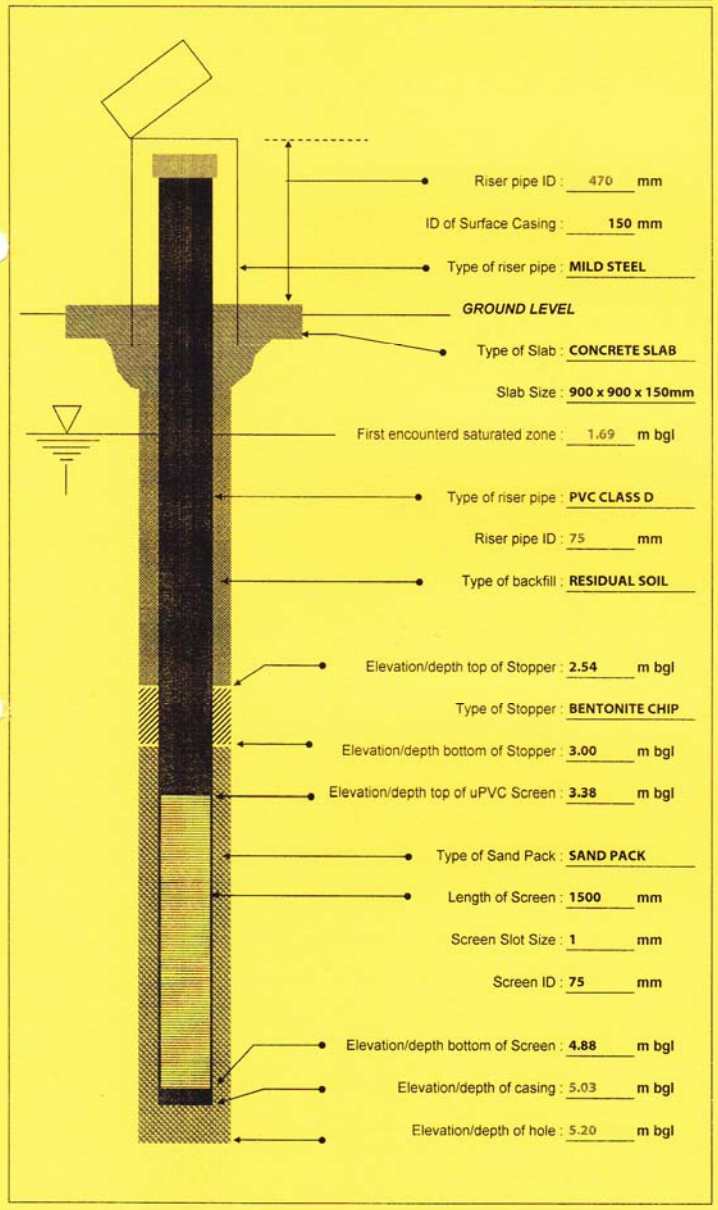
Maklumat Pembinaan Telaga Pemonitoran

C.A.R.D

Consultancy : Administrative : Research : Development

http://www.multicallgroup.com

MW07



TAJUK PROJEK PROJEK

CADANGAN MEMBINA TELAGA PEMONITORAN DAN TELAGA EKSPLORASI AIR TANAH DI KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

MAKLUMAT KERJA

Pemilik Projek

INSTITUT PENYELIDIKAN HIDRULIK KEBANGSAAN MALAYSIA (NAHRIM)

Lokasi Projek

KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

No. ID Telaga : MW07

Dia. Gerudi : 100 mm

Aras Air Tanah : 1.69 m bgl

Nama Operator : MUSTAFA KAMAL

Mula Kerja

Tarikh : 06/05/2009

Masa :

Tamat Kerja

Tarikh : 07/05/2009

Masa :

PENGESAHAN KERJA

Dilukis oleh : SITI MUNIRAH AHMAD

Diperiksa oleh : RAZIP HJ ISMAIL

SO di Tapak : -

MAKLUMAT PENTING

Format maklumat penggerudian dan pembinaan telaga ini disunting dari maklumat terbitan seperti buku teks, buletin, laman sesawang dan sebagainya dan data tercatat adalah data dari lapangan.

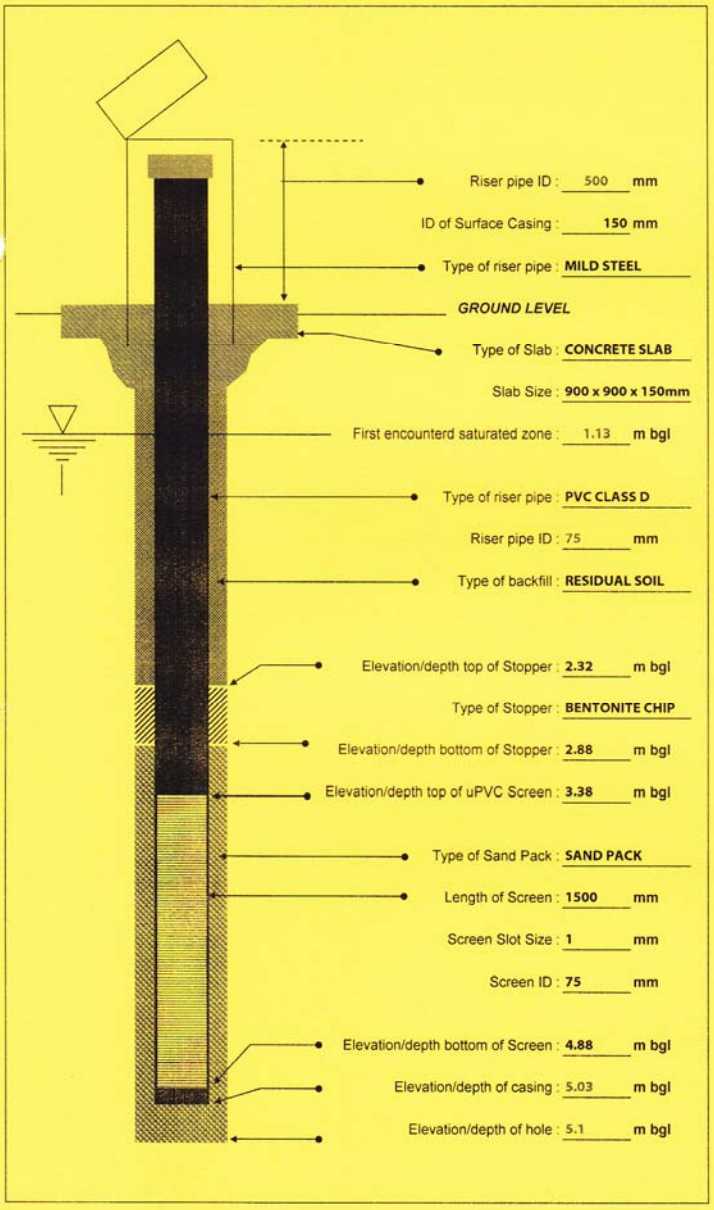
Salah tafsir - bagi mengelakkan salah pengertian berkaitan maklumat di dalam lampiran ini, sila hantarkan perkara berkaitan ke alamat enviro@multicallgroup.com

KERJA PEMBINAAN TELAGA

NAHRIM

Maklumat Pembinaan Telaga Pemonitoran

MW08



C.A.R.D

Consultancy . Administrative . Research . Development

http://www.multicallgroup.com

TAJUK PROJEK PROJEK

CADANGAN MEMBINA TELAGA PEMONITORAN DAN TELAGA EKSPLORASI AIR TANAH DI KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

MAKLUMAT KERJA

Pemilik Projek

INSTITUT PENYELIDIKAN HIDRULIK KEBANGSAAN MALAYSIA (NAHRIM)

Lokasi Projek

KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

No. ID Telaga : MW08

Dia. Gerudi : 100 mm

Aras Air Tanah : 1.13 m bgl

Nama Operator : MUSTAFA KAMAL

Mula Kerja

Tarikh : 06/05/2009

Masa :

Tamat Kerja

Tarikh : 07/05/2009

Masa :

PENGESAHAN KERJA

Dilukis oleh : SITI MUNIRAH AHMAD

Diperiksa oleh : RAZIP HJ ISMAIL

SO di Tapak : -

MAKLUMAT PENTING

Format maklumat penggerudian dan pembinaan telaga ini disunting dari maklumat terbitan seperti buku teks, buletin, laman sesawang dan sebagainya dan data tercatat adalah data dari lapangan.

Salah tafsir - bagi mengelakkan salah pengertian berkaitan maklumat di dalam lampiran ini, sila hantarkan perkara berkaitan ke alamat enviro@multicallgroup.com

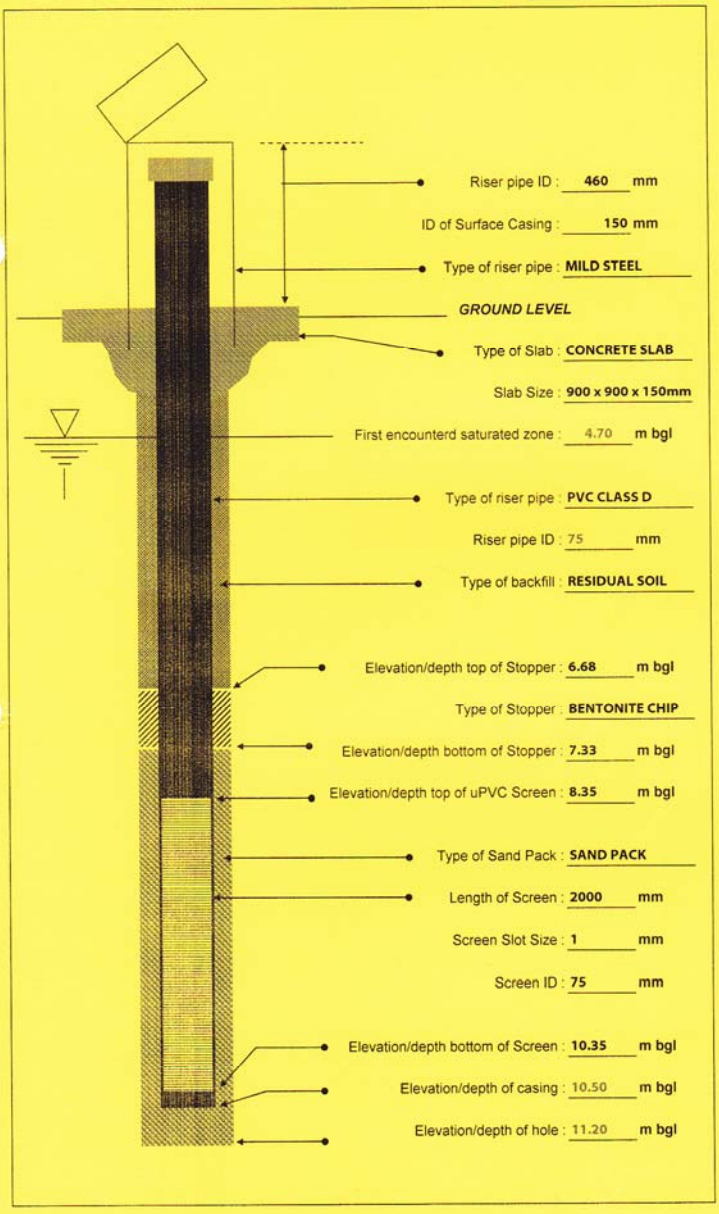
KERJA PEMBINAAN TELAGA

NAHRIM

Maklumat Pembinaan Telaga Pemonitoran

C.A.R.D
Consultancy : Administrative : Research : Development
http://www.multicallgroup.com

MW09



TAJUK PROJEK PROJEK

CADANGAN MEMBINA TELAGA PEMONITORAN DAN TELAGA EKSPLORASI AIR TANAH DI KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

MAKLUMAT KERJA

Pemilik Projek

INSTITUT PENYELIDIKAN HIDRULIK KEBANGSAAN MALAYSIA (NAHRIM)

Lokasi Projek

KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

No. ID Telaga : MW09

Dia. Gerudi : 100 mm

Aras Air Tanah : 4.70 m bgl

Nama Operator : MUSTAFA KAMAL

Mula Kerja

Tarikh : 06/07/2009

Masa :

Tamat Kerja

Tarikh : 08/07/2009

Masa :

PENGESAHAN KERJA

Dilukis oleh : SITI MUNIRAH AHMAD

Diperiksa oleh : RAZIP HJ ISMAIL

SO di Tapak : -

MAKLUMAT PENTING

Format maklumat penggerudian dan pembinaan telaga ini disunting dari maklumat terbitan seperti buku teks, buletin, laman sesawang dan sebagainya dan data tercatat adalah data dari lapangan.

Salah tafsir - bagi mengelakkan salah pengertian berkaitan maklumat di dalam lampiran ini, sila hantarkan perkara berkaitan ke alamat enviro@multicallgroup.com

KERJA PEMBINAAN TELAGA

NAHRIM

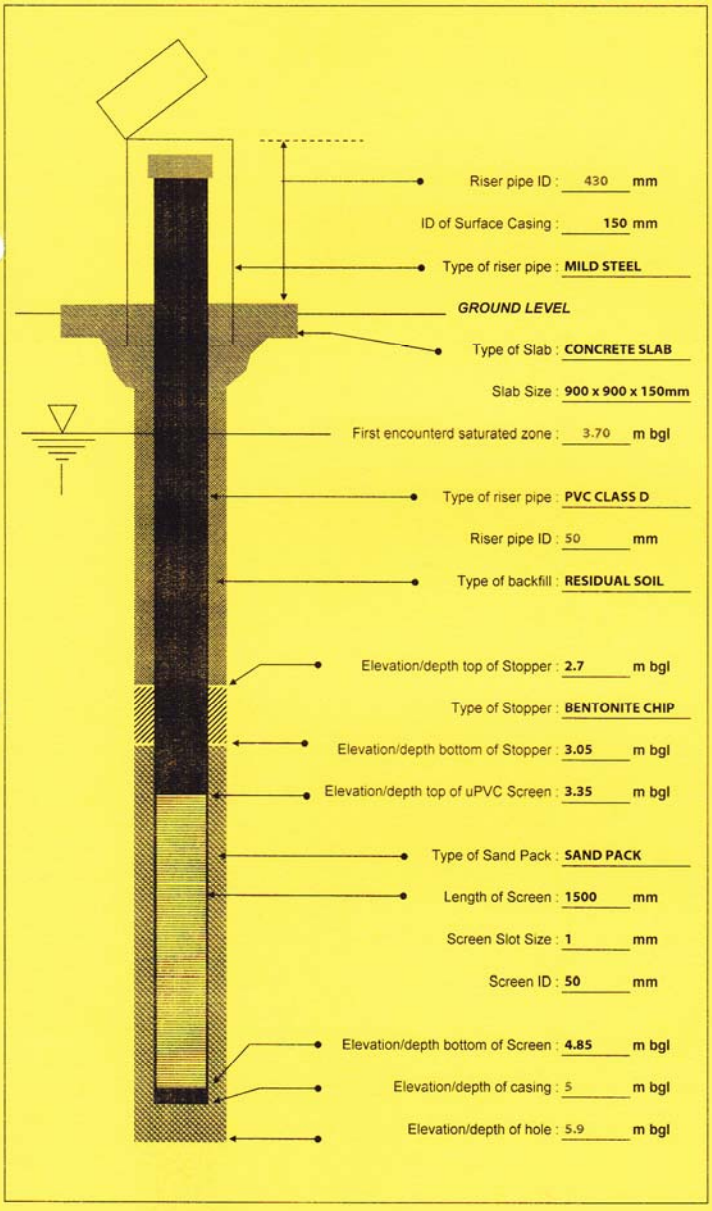
Maklumat Pembinaan Telaga Pemonitoran

C.A.R.D

Consultancy : Administrative, Research : Development

http://www.multicallgroup.com

MW10



TAJUK PROJEK PROJEK

CADANGAN MEMBINA TELAGA PEMONITORAN DAN TELAGA EKSPLORASI AIR TANAH DI KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

MAKLUMAT KERJA

Pemilik Projek

INSTITUT PENYELIDIKAN HIDRULIK KEBANGSAAN MALAYSIA (NAHRIM)

Lokasi Projek

KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

No. ID Telaga : MW10

Dia. Gerudi : 100 mm

Aras Air Tanah : 3.70 m bgl

Nama Operator : MUSTAFA KAMAL

Mula Kerja

Tarikh : 06/05/2009

Masa :

Tamat Kerja

Tarikh : 07/05/2009

Masa :

PENGESAHAN KERJA

Dilukis oleh : SITI MUNIRAH AHMAD

Diperiksa oleh : RAZIP HJ ISMAIL

SO di Tapak : -

MAKLUMAT PENTING

Format maklumat penggerudian dan pembinaan telaga ini disunting dari maklumat terbitan seperti buku teks, buletin, laman sesawang dan sebagainya dan data tercatat adalah data dari lapangan.

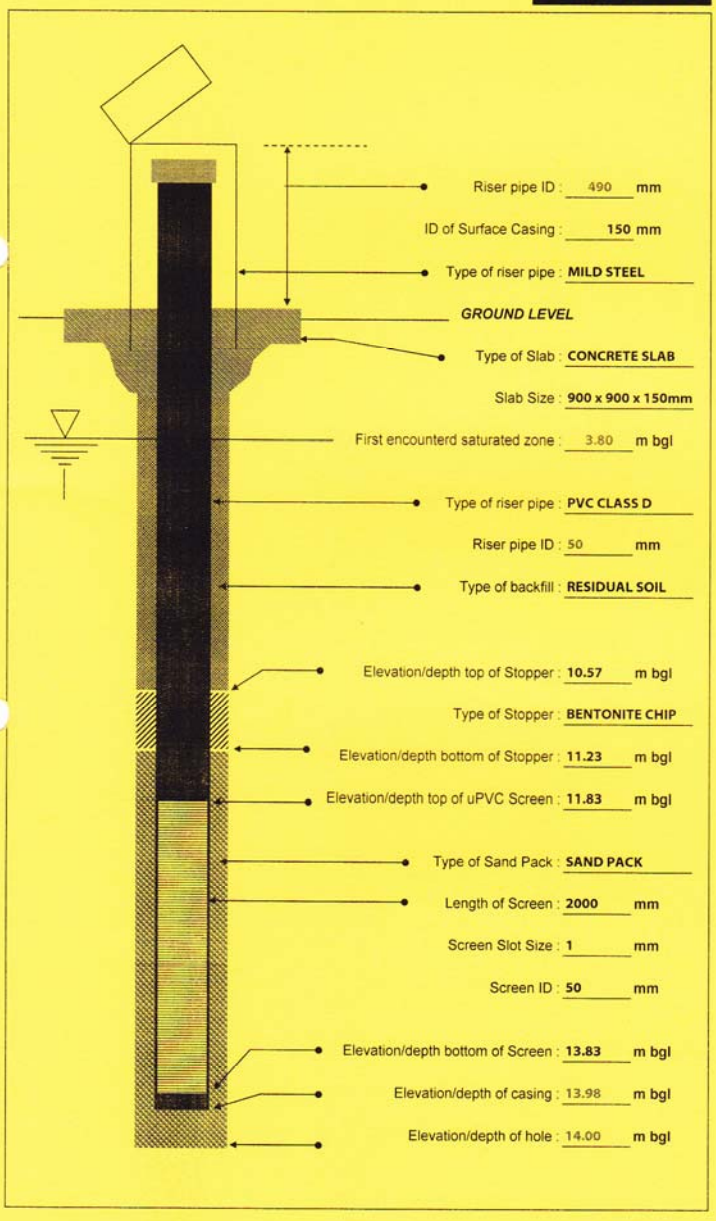
Salah tafsir - bagi mengelakkan salah pengertian berkaitan maklumat di dalam lampiran ini, sila hantarkan perkara berkaitan ke alamat enviro@multicallgroup.com

KERJA PEMBINAAN TELAGA

NAHRIM

Maklumat Pembinaan Telaga Pemonitoran

MW11



C.A.R.D

Consultancy . Administrative . Research . Development

http://www.multicallgroup.com

TAJUK PROJEK PROJEK

CADANGAN MEMBINA TELAGA PEMONITORAN DAN TELAGA EKSPLORASI AIR TANAH DI KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

MAKLUMAT KERJA

Pemilik Projek

INSTITUT PENYELIDIKAN HIDRULIK KEBANGSAAN MALAYSIA (NAHRIM)

Lokasi Projek

KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

No. ID Telaga : MW11

Dia. Gerudi : 100 mm

Aras Air Tanah : 3.80 m bgl

Nama Operator : MUSTAFA KAMAL

Mula Kerja

Tarikh : 04/05/2009

Masa :

Tamat Kerja

Tarikh : 05/05/2009

Masa :

PENGESAHAN KERJA

Dilukis oleh : SITI MUNIRAH AHMAD

Diperiksa oleh : RAZIP HJ ISMAIL

SO di Tapak : -

MAKLUMAT PENTING

Format maklumat penggerudian dan pembinaan telaga ini disunting dari maklumat terbitan seperti buku teks, buletin, laman sesawang dan sebagainya dan data tercatat adalah data dari lapangan.

Salah tafsir - bagi mengelakkan salah pengertian berkaitan maklumat di dalam lampiran ini, sila hantarkan perkara berkaitan ke alamat enviro@multicallgroup.com

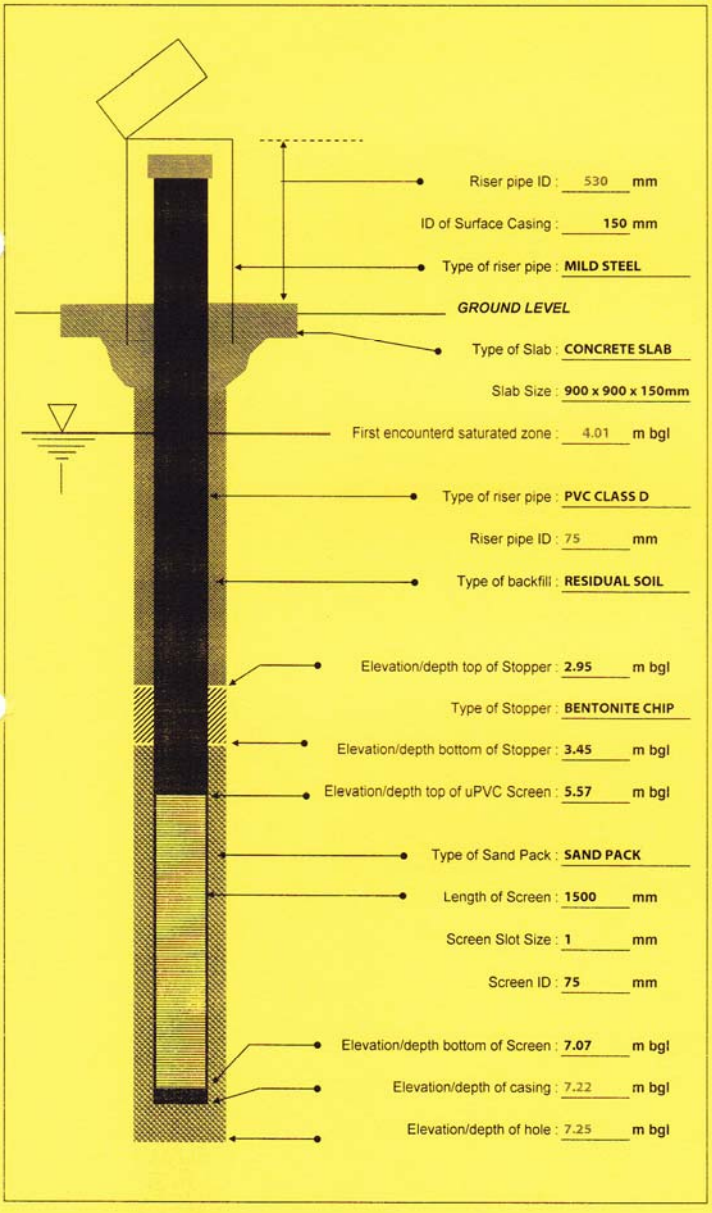
KERJA PEMBINAAN TELAGA

NAHRIM

Maklumat Pembinaan Telaga Pemonitoran

C.A.R.D
Consultancy . Administrative . Research . Development
http://www.multicallgroup.com

MW12



TAJUK PROJEK PROJEK

CADANGAN MEMBINA TELAGA PEMONITORAN DAN TELAGA EKSPLORASI AIR TANAH DI KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

MAKLUMAT KERJA

Pemilik Projek

INSTITUT PENYELIDIKAN HIDRULIK KEBANGSAAN MALAYSIA (NAHRIM)

Lokasi Projek

KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

No. ID Telaga : MW12

Dia. Gerudi : 100 mm

Aras Air Tanah : 4.01 m bgl

Nama Operator : MUSTAFA KAMAL

Mula Kerja

Tarikh : 06/05/2009

Masa :

Tamat Kerja

Tarikh : 07/05/2009

Masa :

PENGESAHAN KERJA

Dilukis oleh : SITI MUNIRAH AHMAD

Diperiksa oleh : RAZIP HJ ISMAIL

SO di Tapak : -

MAKLUMAT PENTING

Format maklumat penggerudian dan pembinaan telaga ini disunting dari maklumat terbitan seperti buku teks, buletin, laman sesawang dan sebagainya dan data tercatat adalah data dari lapangan.

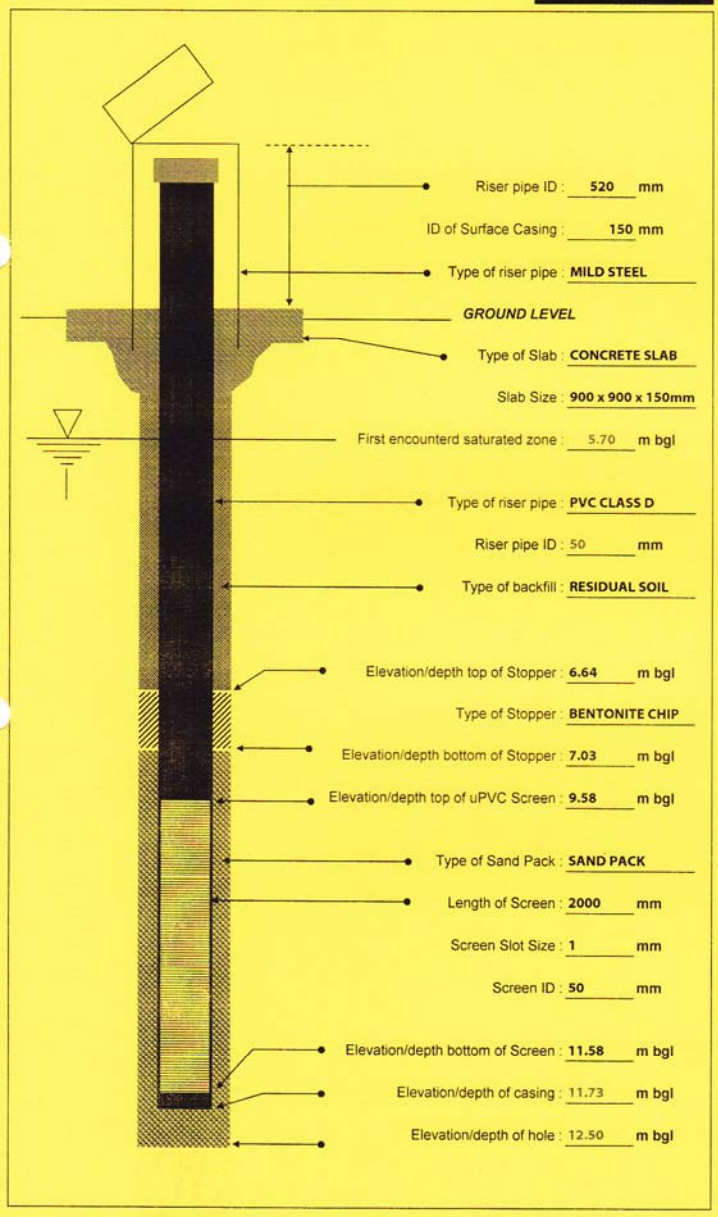
Salah tafsir - bagi mengelakkan salah pengertian berkaitan maklumat di dalam lampiran ini, sila hantarkan perkara berkaitan ke alamat enviro@multicallgroup.com

KERJA PEMBINAAN TELAGA

NAHRIM

Maklumat Pembinaan Telaga Pemonitoran

MW13



C.A.R.D

Consultancy : Administrative : Research : Development

http://www.multicallgroup.com

TAJUK PROJEK PROJEK

CADANGAN MEMBINA TELAGA PEMONITORAN DAN TELAGA EKSPLORASI AIR TANAH DI KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

MAKLUMAT KERJA

Pemilik Projek

INSTITUT PENYELIDIKAN HIDRULIK KEBANGSAAN MALAYSIA (NAHRIM)

Lokasi Projek

KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

No. ID Telaga : MW13

Dia. Gerudi : 100 mm

Aras Air Tanah : 5.70 m bgl

Nama Operator : MUSTAFA KAMAL

Mula Kerja

Tarikh : 09/05/2009

Masa :

Tamat Kerja

Tarikh : 09/05/2009

Masa :

PENGESAHAN KERJA

Dilukis oleh : SITI MUNIRAH AHMAD

Diperiksa oleh : RAZIP HJ ISMAIL

SO di Tapak : -

MAKLUMAT PENTING

Format maklumat penggerudian dan pembinaan telaga ini disunting dari maklumat terbitan seperti buku teks, buletin, laman sesawang dan sebagainya dan data tercatat adalah data dari lapangan.

Salah tafsir - bagi mengelakkan salah pengertian berkaitan maklumat di dalam lampiran ini, sila hantarkan perkara berkaitan ke alamat enviro@multicallgroup.com

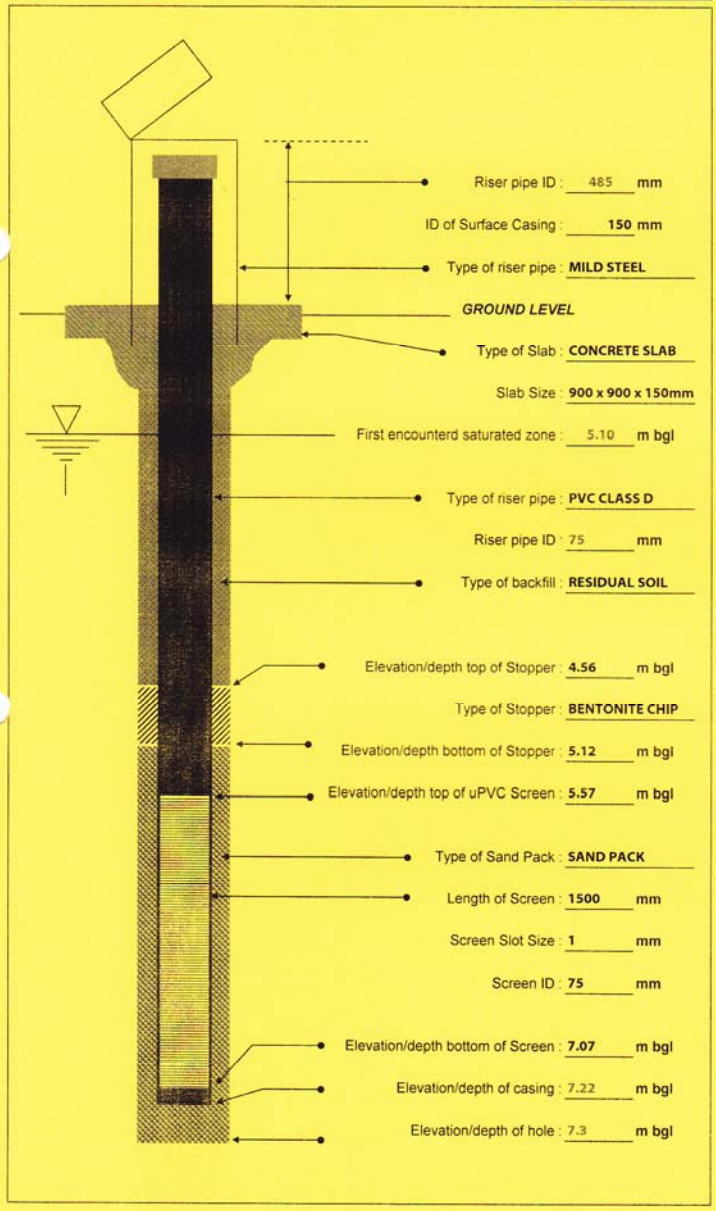
KERJA PEMBINAAN TELAGA

NAHRIM

Maklumat Pembinaan Telaga Pemonitoran

C.A.R.D
Consultancy : Administrative : Research : Development
http://www.multicallgroup.com

MW14



TAJUK PROJEK PROJEK

CADANGAN MEMBINA TELAGA PEMONITORAN DAN TELAGA EKSPLORASI AIR TANAH DI KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

MAKLUMAT KERJA

Pemilik Projek

INSTITUT PENYELIDIKAN HIDRULIK KEBANGSAAN MALAYSIA (NAHRIM)

Lokasi Projek

KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

No. ID Telaga : MW14

Dia. Gerudi : 100 mm

Aras Air Tanah : 5.10 m bgl

Nama Operator : MUSTAFA KAMAL

Mula Kerja

Tarikh : 06/05/2009

Masa :

Tamat Kerja

Tarikh : 07/05/2009

Masa :

PENGESAHAN KERJA

Dilukis oleh : SITI MUNIRAH AHMAD

Diperiksa oleh : RAZIP HJ ISMAIL

SO di Tapak : -

MAKLUMAT PENTING

Format maklumat penggerudian dan pembinaan telaga ini disunting dari maklumat terbitan seperti buku teks, buletin, laman sesawang dan sebagainya dan data tercatat adalah data dari lapangan.

Salah tafsir - bagi mengelakkan salah pengertian berkaitan maklumat di dalam lampiran ini, sila hantarkan perkara berkaitan ke alamat enviro@multicallgroup.com

KERJA PEMBINAAN TELAGA

NAHRIM

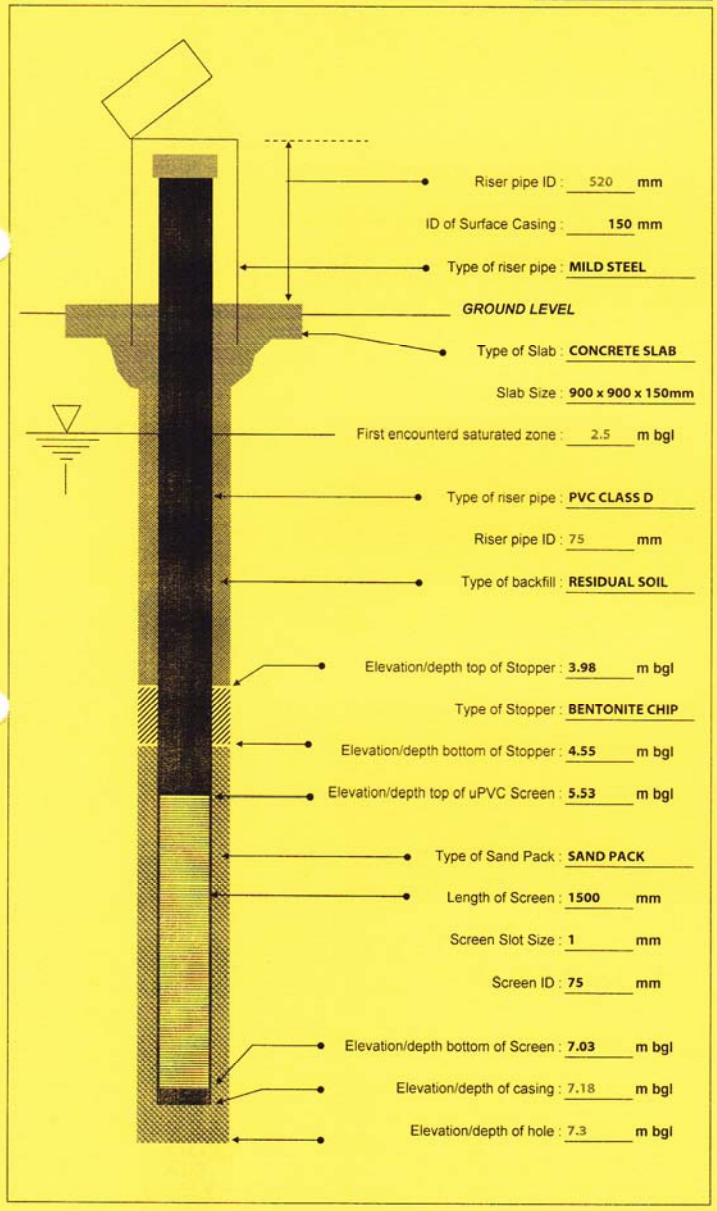
Maklumat Pembinaan Telaga Pemonitoran

C.A.R.D

Consultancy : Administrative : Research : Development

http://www.multicallgroup.com

MW15



TAJUK PROJEK PROJEK

CADANGAN MEMBINA TELAGA PEMONITORAN DAN TELAGA EKSPLORASI AIR TANAH DI KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

MAKLUMAT KERJA

Pemilik Projek

INSTITUT PENYELIDIKAN HIDRULIK KEBANGSAAN MALAYSIA (NAHRIM)

Lokasi Projek

KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

No. ID Telaga : MW15

Dia. Gerudi : 100 mm

Aras Air Tanah : 2.5 m bgl

Nama Operator : MUSTAFA KAMAL

Mula Kerja

Tarikh : 06/05/2009

Masa :

Tamat Kerja

Tarikh : 07/05/2009

Masa :

PENGESAHAN KERJA

Dilukis oleh : SITI MUNIRAH AHMAD

Diperiksa oleh : RAZIP HJ ISMAIL

SO di Tapak : -

MAKLUMAT PENTING

Format maklumat penggerudian dan pembinaan telaga ini disunting dari maklumat terbitan seperti buku teks, buletin, laman sesawang dan sebagainya dan data tercatat adalah data dari lapangan.

Salah tafsir - bagi mengelakkan salah pengertian berkaitan maklumat di dalam lampiran ini, sila hantarkan perkara berkaitan ke alamat enviro@multicallgroup.com

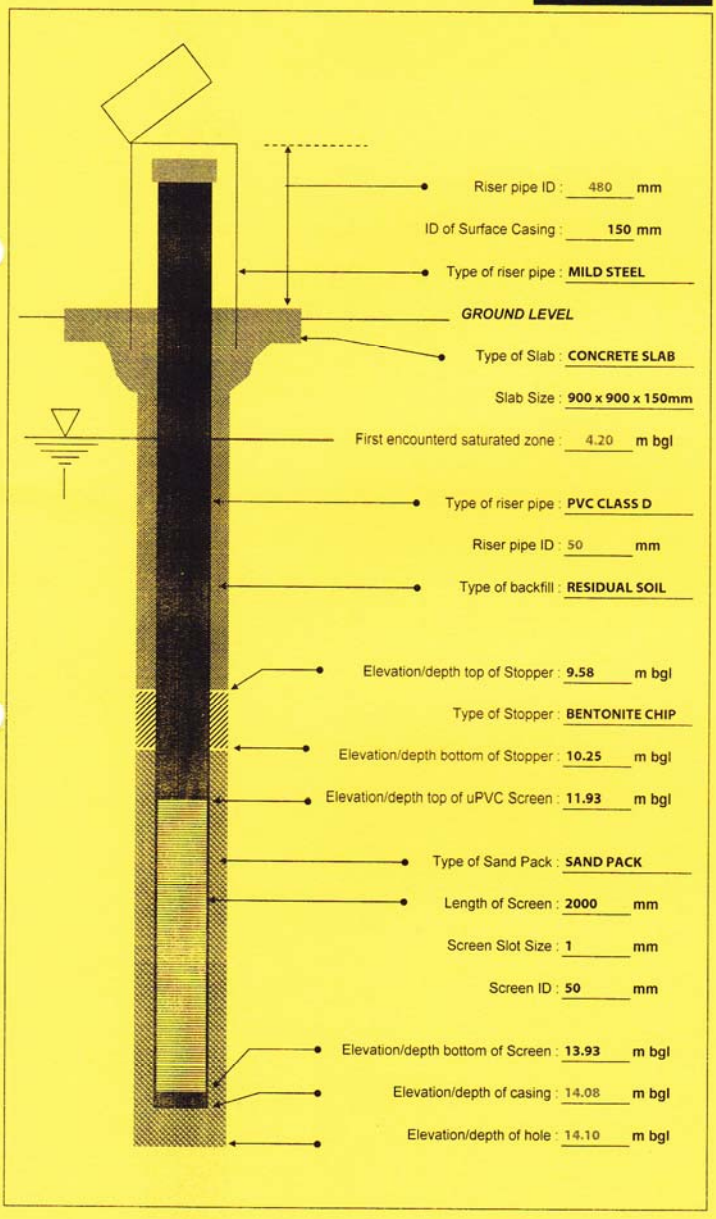
KERJA PEMBINAAN TELAGA

NAHRIM

Maklumat Pembinaan Telaga Pemonitoran

C.A.R.D
Consultancy - Administrative - Research - Development
http://www.multicallgroup.com

MW16



TAJUK PROJEK PROJEK

CADANGAN MEMBINA TELAGA PEMONITORAN DAN TELAGA EKSPLORASI AIR TANAH DI KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

MAKLUMAT KERJA

Pemilik Projek

INSTITUT PENYELIDIKAN HIDRULIK KEBANGSAAN MALAYSIA (NAHRIM)

Lokasi Projek

KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

No. ID Telaga : MW16

Dia. Gerudi : 100 mm

Aras Air Tanah : 4.20 m bgl

Nama Operator : MUSTAFA KAMAL

Mula Kerja

Tarikh : 06/05/2009

Masa :

Tamat Kerja

Tarikh : 07/05/2009

Masa :

PENGESAHAN KERJA

Dilukis oleh : SITI MUNIRAH AHMAD

Diperiksa oleh : RAZIP HJ ISMAIL

SO di Tapak : -

MAKLUMAT PENTING

Format maklumat penggerudian dan pembinaan telaga ini disunting dari maklumat terbitan seperti buku teks, buletin, laman sesawang dan sebagainya dan data tercatat adalah data dari lapangan.

Salah tafsir - bagi mengelakkan salah pengertian berkaitan maklumat di dalam lampiran ini, sila hantarkan perkara berkaitan ke alamat enviro@multicallgroup.com

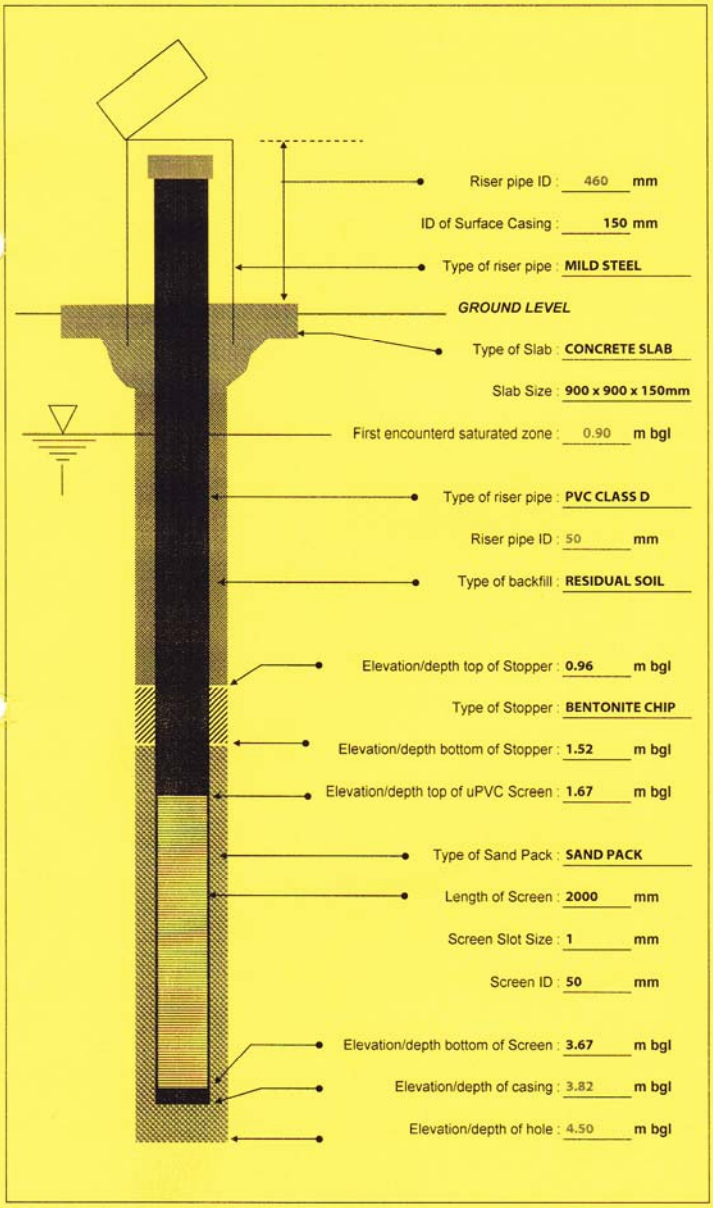
KERJA PEMBINAAN TELAGA

NAHRIM

Maklumat Pembinaan Telaga Pemonitoran

C.A.R.D
Consultancy . Administrative . Research . Development
http://www.multicallgroup.com

MW17



TAJUK PROJEK PROJEK

CADANGAN MEMBINA TELAGA PEMONITORAN DAN TELAGA EKSPLORASI AIR TANAH DI KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

MAKLUMAT KERJA

Pemilik Projek

INSTITUT PENYELIDIKAN HIDRULIK KEBANGSAAN MALAYSIA (NAHRIM)

Lokasi Projek

KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

No. ID Telaga : MW17

Dia. Gerudi : 100 mm

Aras Air Tanah : 0.90 m bgl

Nama Operator : MUSTAFA KAMAL

Mula Kerja

Tarikh : 30/05/2009

Masa :

Tamat Kerja

Tarikh : 30/05/2009

Masa :

PENGESAHAN KERJA

Dilukis oleh : SITI MUNIRAH AHMAD

Diperiksa oleh : RAZIP HJ ISMAIL

SO di Tapak : -

MAKLUMAT PENTING

Format maklumat penggerudian dan pembinaan telaga ini disunting dari maklumat terbitan seperti buku teks, buletin, laman sesawang dan sebagainya dan data tercatat adalah data dari lapangan.

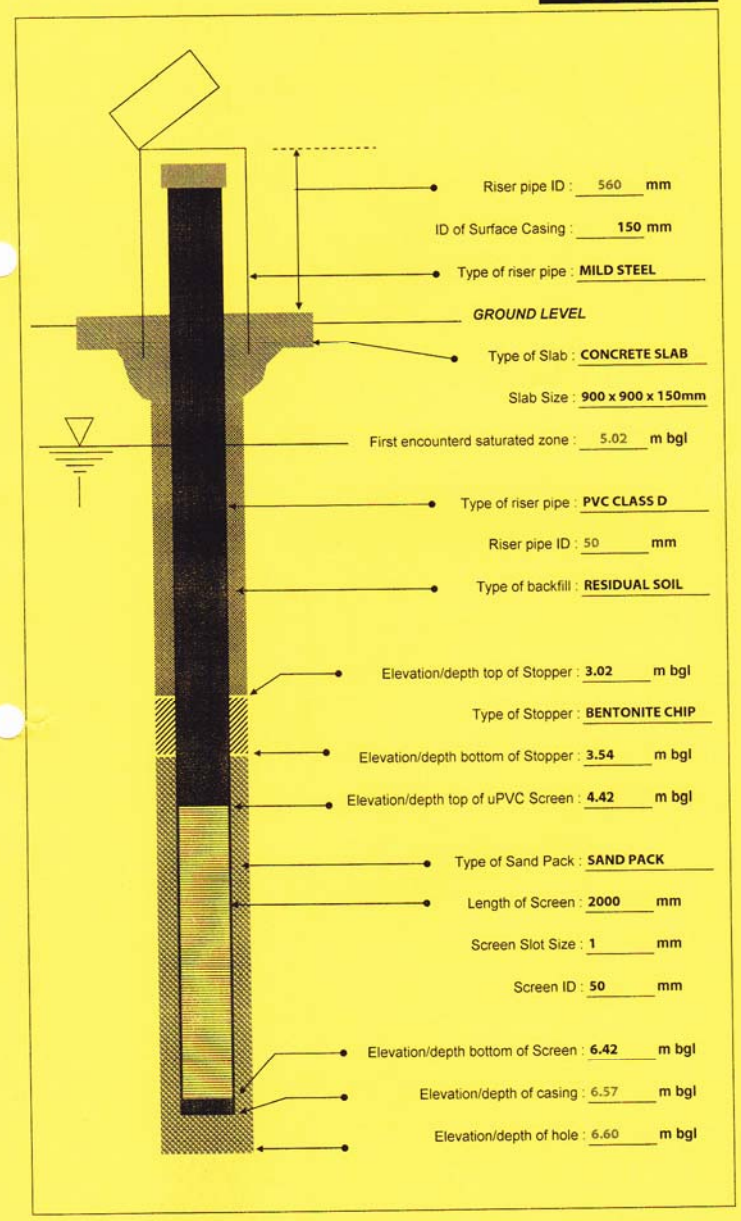
Salah tafsir - bagi mengelakkan salah pengertian berkaitan maklumat di dalam lampiran ini, sila hantarkan perkara berkaitan ke alamat enviro@multicallgroup.com

KERJA PEMBINAAN TELAGA

NAHRIM

Maklumat Pembinaan Telaga Pemonitoran

MW18



C.A.R.D

Consultancy . Administrative . Research : Development

http://www.multicallgroup.com

TAJUK PROJEK PROJEK

CADANGAN MEMBINA TELAGA PEMONITORAN DAN TELAGA EKSPLORASI AIR TANAH DI KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

MAKLUMAT KERJA

Pemilik Projek

INSTITUT PENYELIDIKAN HIDRULIK KEBANGSAAN MALAYSIA (NAHRIM)

Lokasi Projek

KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

No. ID Telaga : MW18

Dia. Gerudi : 100 mm

Aras Air Tanah : 5.02 m bgl

Nama Operator : MUSTAFA KAMAL

Mula Kerja

Tarikh : 18/05/2009

Masa :

Tamat Kerja

Tarikh : 18/05/2009

Masa :

PENGESAHAN KERJA

Dilukis oleh : SITI MUNIRAH AHMAD

Diperiksa oleh : RAZIP HJ ISMAIL

SO di Tapak : -

MAKLUMAT PENTING

Format maklumat penggerudian dan pembinaan telaga ini disunting dari maklumat terbitan seperti buku teks, buletin, laman sesawang dan sebagainya dan data tercatat adalah data dari lapangan.

Salah tafsir - bagi mengelakkan salah pengertian berkaitan maklumat di dalam lampiran ini, sila hantarkan perkara berkaitan ke alamat enviro@multicallgroup.com

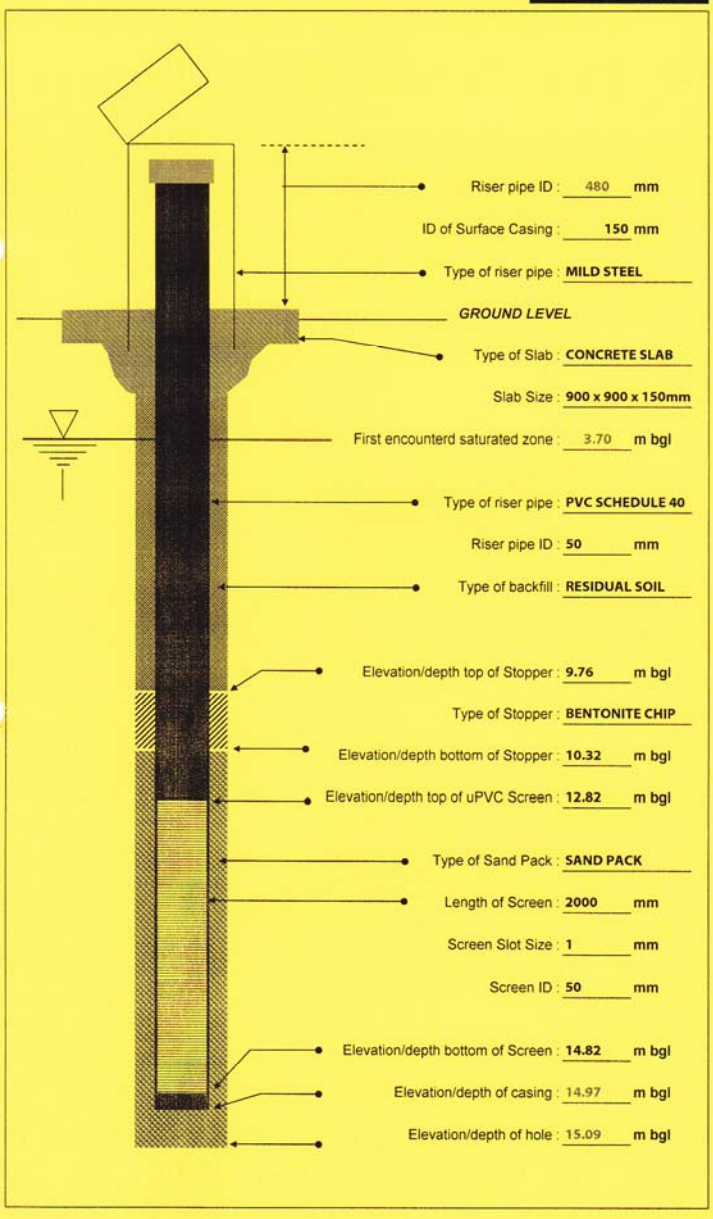
KERJA PEMBINAAN TELAGA

NAHRIM

Maklumat Pembinaan Telaga Pemonitoran

C.A.R.D
Consultancy . Administrative . Research . Development
http://www.multicallgroup.com

MW19



TAJUK PROJEK PROJEK

CADANGAN MEMBINA TELAGA PEMONITORAN DAN TELAGA EKSPLORASI AIR TANAH DI KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

MAKLUMAT KERJA

Pemilik Projek

INSTITUT PENYELIDIKAN HIDRULIK KEBANGSAAN MALAYSIA (NAHRIM)

Lokasi Projek

KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

No. ID Telaga : MW19

Dia. Gerudi : 100 mm

Aras Air Tanah : 3.70 m bgl

Nama Operator : MUSTAFA KAMAL

Mula Kerja

Tarikh : 06/05/2009

Masa :

Tamat Kerja

Tarikh : 06/05/2009

Masa :

PENGESAHAN KERJA

Dilukis oleh : SITI MUNIRAH AHMAD

Diperiksa oleh : RAZIP HJ ISMAIL

SO di Tapak : -

MAKLUMAT PENTING

Format maklumat penggerudian dan pembinaan telaga ini disunting dari maklumat terbitan seperti buku teks, buletin, laman sesawang dan sebagainya dan data tercatat adalah data dari lapangan.

Salah tafsir - bagi mengelakkan salah pengertian berkaitan maklumat di dalam lampiran ini, sila hantarkan perkara berkaitan ke alamat enviro@multicallgroup.com

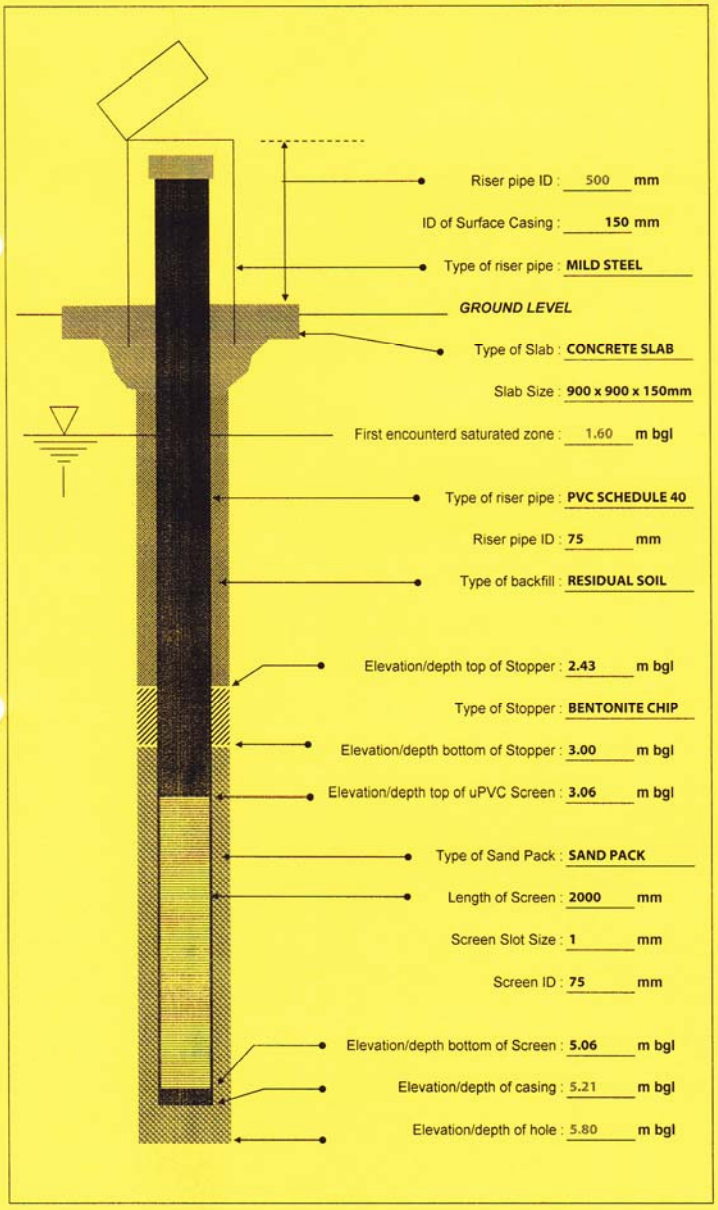
KERJA PEMBINAAN TELAGA

NAHRIM

Maklumat Pembinaan Telaga Pemonitoran

C.A.R.D
Consultancy . Administrative . Research . Development
http://www.multicallgroup.com

MW20



TAJUK PROJEK PROJEK

CADANGAN MEMBINA TELAGA PEMONITORAN DAN TELAGA EKSPLORASI AIR TANAH DI KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

MAKLUMAT KERJA

Pemilik Projek

INSTITUT PENYELIDIKAN HIDRULIK KEBANGSAAN MALAYSIA (NAHRIM)

Lokasi Projek

KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

No. ID Telaga : MW20

Dia. Gerudi : 100 mm

Aras Air Tanah : 1.60 m bgl

Nama Operator : MUSTAFA KAMAL

Mula Kerja

Tarikh : 10/06/2009

Masa :

Tamat Kerja

Tarikh : 10/06/2009

Masa :

PENGESAHAN KERJA

Dilukis oleh : SITI MUNIRAH AHMAD

Diperiksa oleh : RAZIP HJ ISMAIL

SO di Tapak : -

MAKLUMAT PENTING

Format maklumat penggerudian dan pembinaan telaga ini disunting dari maklumat terbitan seperti buku teks, buletin, laman sesawang dan sebagainya dan data tercatat adalah data dari lapangan.

Salah tafsir - bagi mengelakkan salah pengertian berkaitan maklumat di dalam lampiran ini, sila hantarkan perkara berkaitan ke alamat enviro@multicallgroup.com

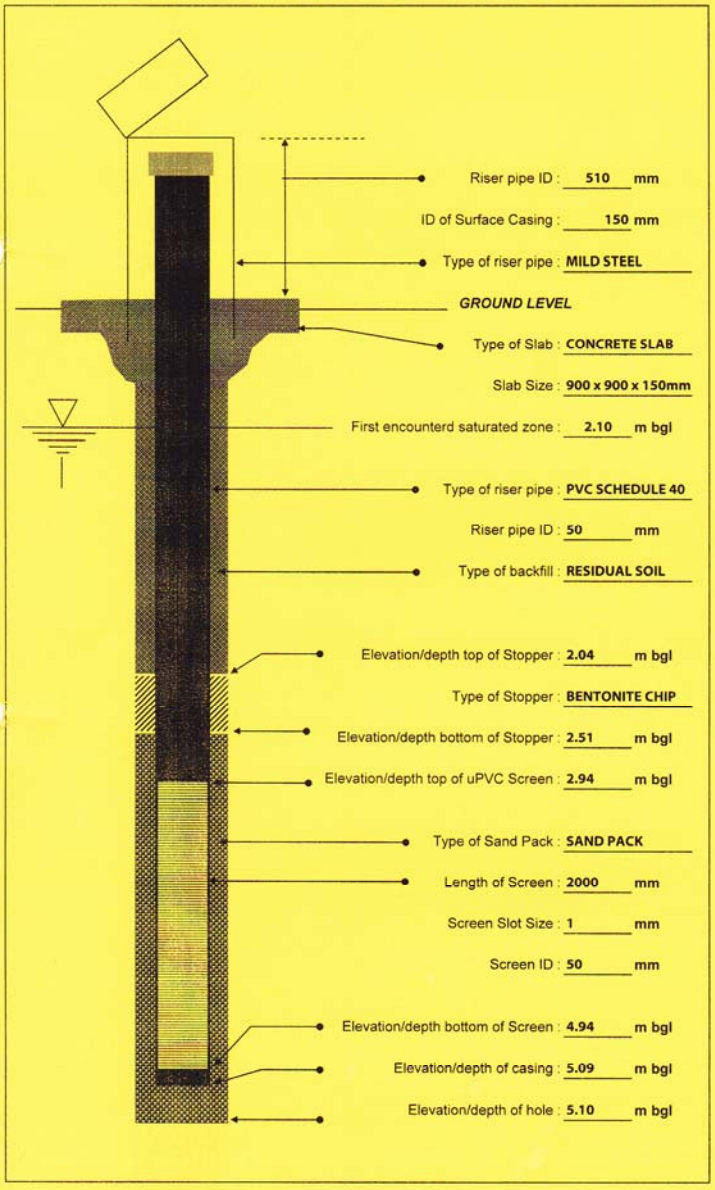
KERJA PEMBINAAN TELAGA

NAHRIM

Maklumat Pembinaan Telaga Pemonitoran

C.A.R.D
Consultancy : Administrative : Research : Development
http://www.multicallgroup.com

MW21



TAJUK PROJEK PROJEK

CADANGAN MEMBINA TELAGA PEMONITORAN DAN TELAGA EKSPLORASI AIR TANAH DI KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

MAKLUMAT KERJA

Pemilik Projek

INSTITUT PENYELIDIKAN HIDRULIK KEBANGSAAN MALAYSIA (NAHRIM)

Lokasi Projek

KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

No. ID Telaga : MW21

Dia. Gerudi : 100 mm

Aras Air Tanah : 2.10 m bgl

Nama Operator : MUSTAFA KAMAL

Mula Kerja

Tarikh : 26/05/2009

Masa :

Tamat Kerja

Tarikh : 27/05/2009

Masa :

PENGESAHAN KERJA

Dilukis oleh : SITI MUNIRAH AHMAD

Diperiksa oleh : RAZIP HJ ISMAIL

SO di Tapak : -

MAKLUMAT PENTING

Format maklumat penggerudian dan pembinaan telaga ini disunting dari maklumat terbitan seperti buku teks, buletin, laman sesawang dan sebagainya dan data tercatat adalah data dari lapangan.

Salah tafsir - bagi mengelakkan salah pengertian berkaitan maklumat di dalam lampiran ini, sila hantarkan perkara berkaitan ke alamat enviro@multicallgroup.com

© MULTICALL CARD (M) SDN BHD, C.A.R.D 1999

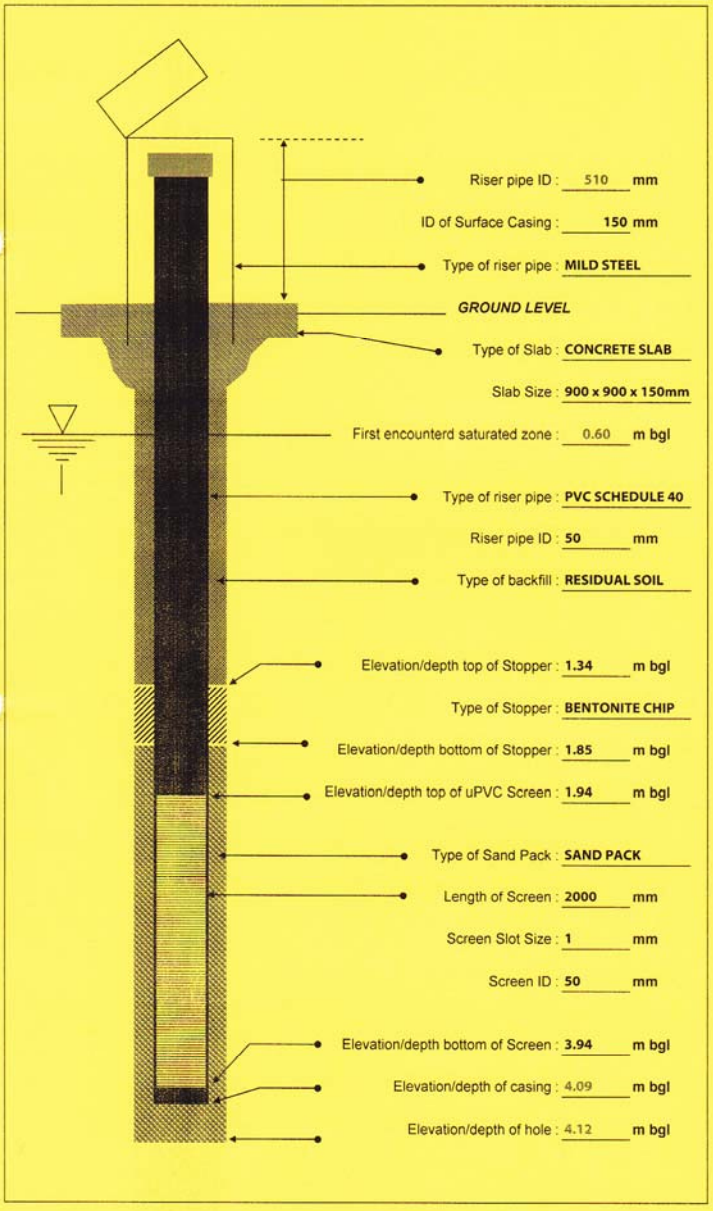
Form Reference Number:

KERJA PEMBINAAN TELAGA

NAHRIM

Maklumat Pembinaan Telaga Pemonitoran

MW22



C.A.R.D

Consultancy . Administrative . Research . Development

http://www.multicallgroup.com

TAJUK PROJEK PROJEK

CADANGAN MEMBINA TELAGA PEMONITORAN DAN TELAGA EKSPLORASI AIR TANAH DI KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

MAKLUMAT KERJA

Pemilik Projek

INSTITUT PENYELIDIKAN HIDRULIK KEBANGSAAN MALAYSIA (NAHRIM)

Lokasi Projek

KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

No. ID Telaga : MW22

Dia. Gerudi : 100 mm

Aras Air Tanah : 0.60 m bgl

Nama Operator : MUSTAFA KAMAL

Mula Kerja

Tarikh : 26/05/2009

Masa :

Tamat Kerja

Tarikh : 26/05/2009

Masa :

PENGESAHAN KERJA

Dilukis oleh : SITI MUNIRAH AHMAD

Diperiksa oleh : RAZIP HJ ISMAIL

SO di Tapak : -

MAKLUMAT PENTING

Format maklumat penggerudian dan pembinaan telaga ini disunting dari maklumat terbitan seperti buku teks, buletin, laman sesawang dan sebagainya dan data tercatat adalah data dari lapangan.

Salah tafsir - bagi mengelakkan salah pengertian berkaitan maklumat di dalam lampiran ini, sila hantarkan perkara berkaitan ke alamat enviro@multicallgroup.com

KERJA PEMBINAAN TELAGA

NAHRIM

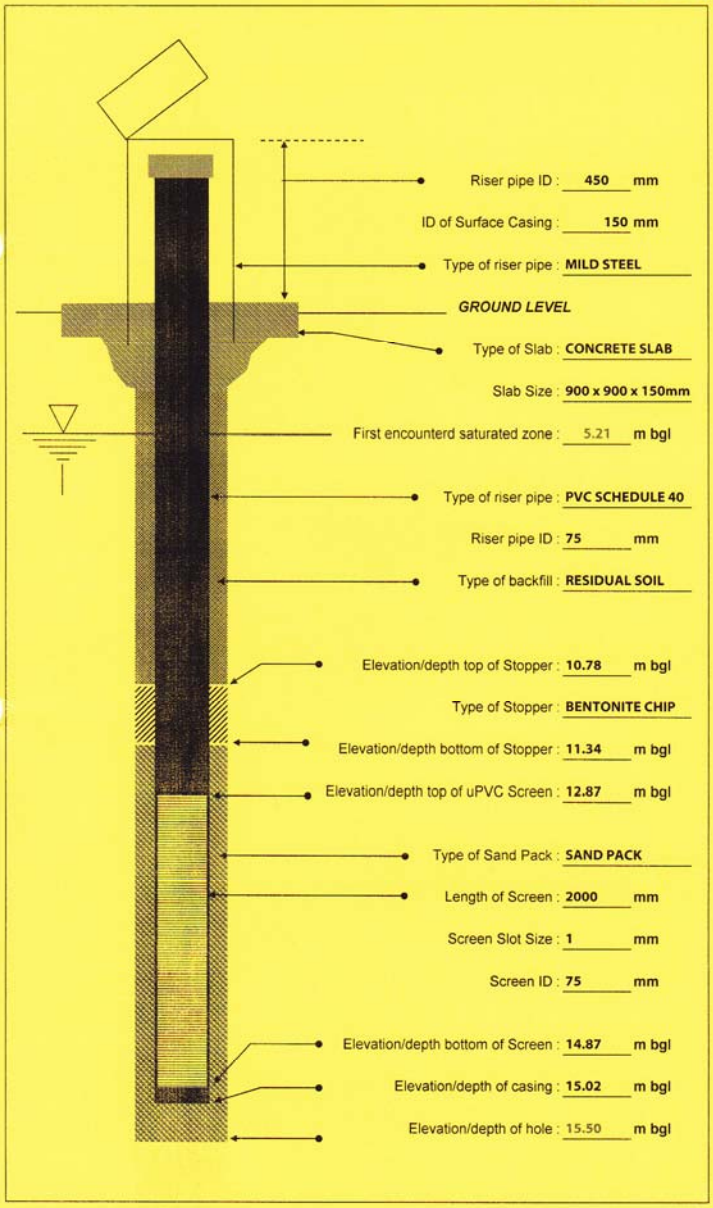
Maklumat Pembinaan Telaga Pemonitoran

C.A.R.D

Consultancy : Administrative : Research : Development

http://www.multicallgroup.com

MW23



TAJUK PROJEK PROJEK

CADANGAN MEMBINA TELAGA PEMONITORAN DAN TELAGA EKSPLORASI AIR TANAH DI KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

MAKLUMAT KERJA

Pemilik Projek

INSTITUT PENYELIDIKAN HIDRULIK KEBANGSAAN MALAYSIA (NAHRIM)

Lokasi Projek

KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

No. ID Telaga : MW23

Dia. Gerudi : 100 mm

Aras Air Tanah : 5.21 m bgl

Nama Operator : MUSTAFA KAMAL

Mula Kerja

Tarikh : 15/05/2009

Masa :

Tamat Kerja

Tarikh : 16/05/2009

Masa :

PENGESAHAN KERJA

Dilukis oleh : SITI MUNIRAH AHMAD

Diperiksa oleh : RAZIP HJ ISMAIL

SO di Tapak : -

MAKLUMAT PENTING

Format maklumat penggerudian dan pembinaan telaga ini disunting dari maklumat terbitan seperti buku teks, buletin, laman sesawang dan sebagainya dan data tercatat adalah data dari lapangan.

Salah tafsir - bagi mengelakkan salah pengertian berkaitan maklumat di dalam lampiran ini, sila hantarkan perkara berkaitan ke alamat enviro@multicallgroup.com

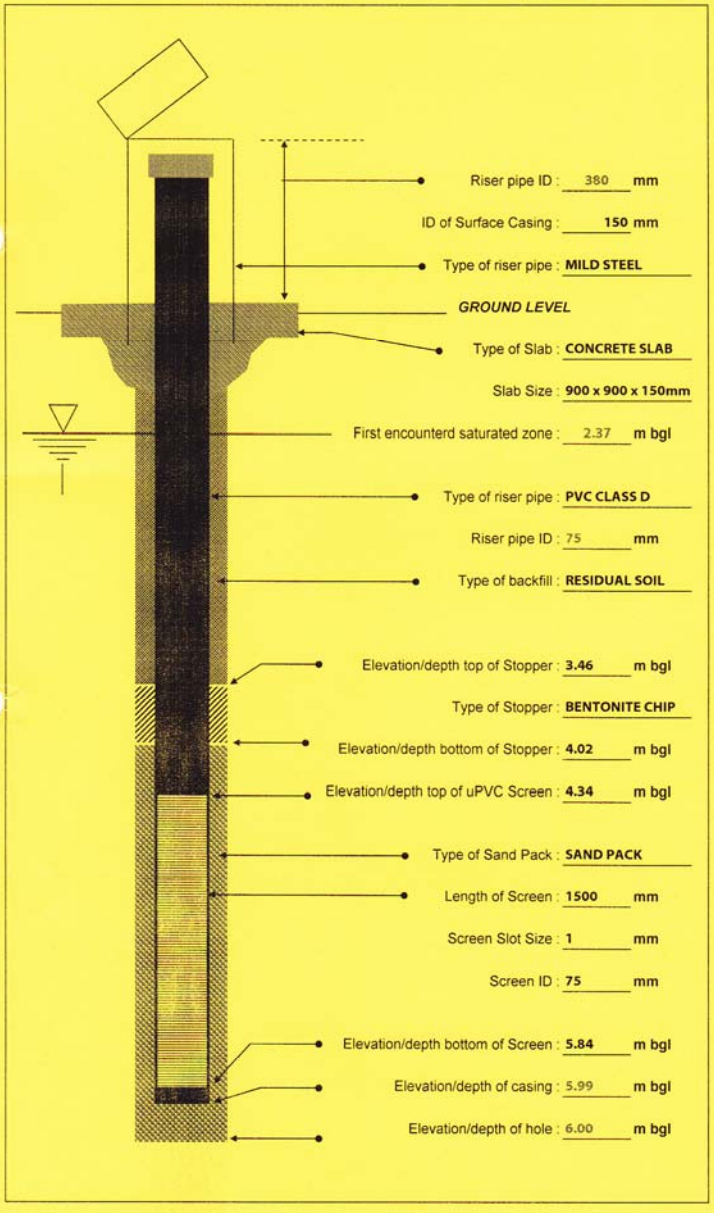
KERJA PEMBINAAN TELAGA

NAHRIM

Maklumat Pembinaan Telaga Pemonitoran

C.A.R.D
Consultancy . Administrative . Research . Development
http://www.multicallgroup.com

MW24



TAJUK PROJEK PROJEK

CADANGAN MEMBINA TELAGA PEMONITORAN DAN TELAGA EKSPLORASI AIR TANAH DI KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

MAKLUMAT KERJA

Pemilik Projek

INSTITUT PENYELIDIKAN HIDRULIK KEBANGSAAN MALAYSIA (NAHRIM)

Lokasi Projek

KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

No. ID Telaga : MW24

Dia. Gerudi : 100 mm

Aras Air Tanah : 2.37 m bgl

Nama Operator : MUSTAFA KAMAL

Mula Kerja

Tarikh : 06/05/2009

Masa :

Tamat Kerja

Tarikh : 07/05/2009

Masa :

PENGESAHAN KERJA

Dilukis oleh : SITI MUNIRAH AHMAD

Diperiksa oleh : RAZIP HJ ISMAIL

SO di Tapak : -

MAKLUMAT PENTING

Format maklumat penggerudian dan pembinaan telaga ini disunting dari maklumat terbitan seperti buku teks, buletin, laman sesawang dan sebagainya dan data tercatat adalah data dari lapangan.

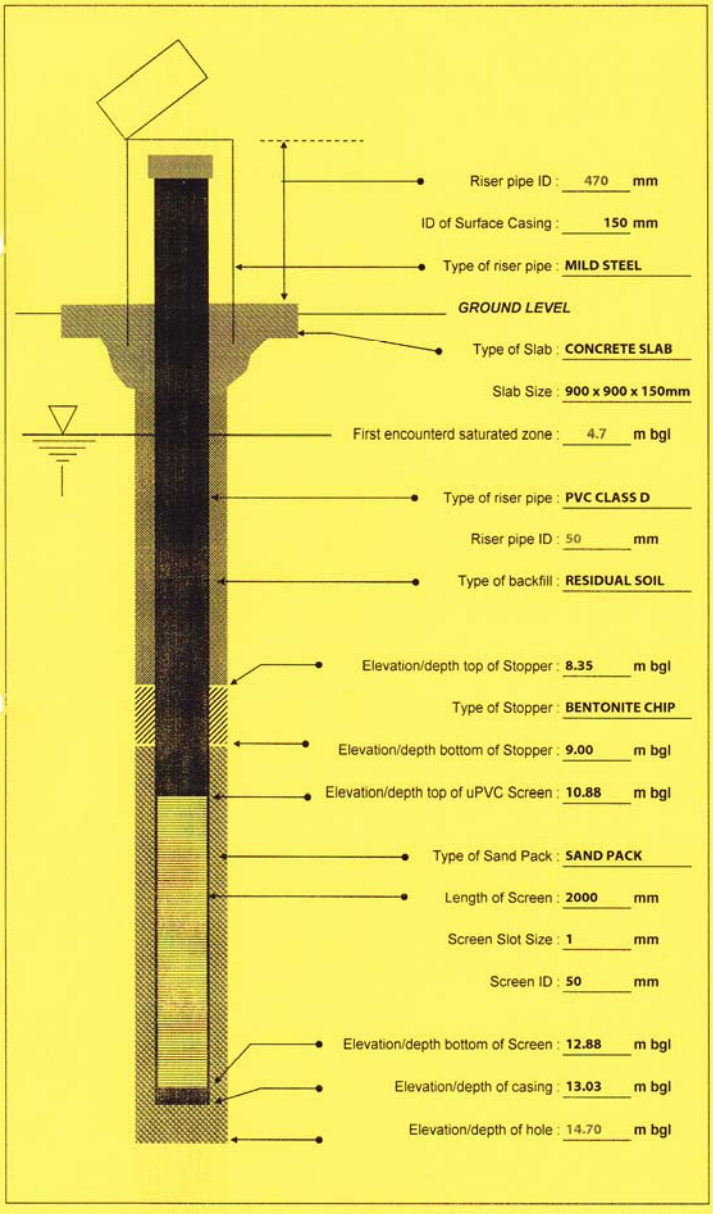
Salah tafsir - bagi mengelakkan salah pengertian berkaitan maklumat di dalam lampiran ini, sila hantarkan perkara berkaitan ke alamat enviro@multicallgroup.com

KERJA PEMBINAAN TELAGA

NAHRIM

Maklumat Pembinaan Telaga Pemonitoran

MW25



C.A.R.D

Consultancy . Administrative . Research . Development

http://www.multicallgroup.com

TAJUK PROJEK PROJEK

CADANGAN MEMBINA TELAGA PEMONITORAN DAN TELAGA EKSPLORASI AIR TANAH DI KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

MAKLUMAT KERJA

Pemilik Projek

INSTITUT PENYELIDIKAN HIDRULIK KEBANGSAAN MALAYSIA (NAHRIM)

Lokasi Projek

KAWASAN CABANG SUNGAI SEMENYIH DAN SUNGAI LANGAT SERTA KAWASAN-KAWASAN SEKITARNYA

No. ID Telaga : MW25

Dia. Gerudi : 100 mm

Aras Air Tanah : 4.7 m bgl

Nama Operator : MUSTAFA KAMAL

Mula Kerja

Tarikh : 06/05/2009

Masa :

Tamat Kerja

Tarikh : 07/05/2009

Masa :

PENGESAHAN KERJA

Dilukis oleh : SITI MUNIRAH AHMAD

Diperiksa oleh : RAZIP HJ ISMAIL

SO di Tapak : -

MAKLUMAT PENTING

Format maklumat penggerudian dan pembinaan telaga ini disunting dari maklumat terbitan seperti buku teks, buletin, laman sesawang dan sebagainya dan data tercatat adalah data dari lapangan.

Salah tafsir - bagi mengelakkan salah pengertian berkaitan maklumat di dalam lampiran ini, sila hantarkan perkara berkaitan ke alamat enviro@multicallgroup.com

APPENDIX B

PUMPING TEST RECORD AND ANALYSIS

TOTAL ENVIRONMENTAL SERVICES SDN BHD (256662-W)

Client	NAHRIM		
Location	JENDERAM HILIR, DENGKIL		
Well No	DW 2	Well Depth	17.4m
Pump Type	SP 60-7	Pump Maker	Grundfos
Riser Pipe	75mm Ø	Depth Install	12m

Notes:
Static Water Level = 5.36 m
Constant Head flowrate: 90.2m3/hr.

Pump stopped at 17.45 on 29/4/2010 upon completion of 168 hours Constant Head Pumping Test.

RECOVERY PERIOD

Date	HH:MM	Elapsed time min	Water level (m)	Drawdown (m)			Remarks
29/04/2010	17.45	0	7.30	1.94			
		10 (sec)	6.43	1.07			
		20 (sec)	6.28	0.92			
		30 (sec)	6.22	0.86			
		40 (sec)	6.20	0.84			
		50 (sec)	6.18	0.82			
	17.46	60 (sec)	6.15	0.79			
		70 (sec)	6.14	0.78			
		80 (sec)	6.13	0.77			
		90 (sec)	6.12	0.76			
		100 (sec)	6.11	0.75			
		110 (sec)	6.10	0.74			
	17.47	2	6.09	0.73			
	17.48	3	6.07	0.71			
	17.49	4	6.05	0.69			
	17.50	5	6.03	0.67			
	17.51	6	6.02	0.66			
	17.52	7	6.02	0.66			
	17.53	8	6.01	0.65			
	17.54	9	6.00	0.64			
	17.55	10	6.00	0.64			
	17.57	12	6.00	0.64			
	17.59	14	5.99	0.63			
	18.01	16	5.99	0.63			

Job

Measure By	Abu Bakar Adam	date	30/12/2009	Subject	168 hrs. Constant Head Test at Well No. DW2
Check By	Hasman Ibrahim	date	30/12/2009		Jenderam Hilir, Selangor.
Rectify By		date		Encl	page 1 of 3

TOTAL ENVIRONMENTAL SERVICES SDN BHD (256662-W)

Date	HH:MM	Elapsed time min	Water level (m)	Drawdown (m)	Discharge l / s	Discharge m^3/h	Remarks
22/04/2010	18.15	270	6.69	1.33	25.05	90.2	
	18.45	300	6.71	1.35			
	19.45	360	6.73	1.37			
	20.45	420	6.75	1.39			
	21.45	480	6.77	1.41			
	22.45	540	6.79	1.43			
	23.45	600	6.81	1.45			
23/04/2010	1.45	720	6.84	1.48			
	3.45	840	6.86	1.50			
	5.45	960	6.89	1.53			
	7.45	1080	6.92	1.56			
	9.45	1200	6.95	1.59			Hujan
	11.45	1320	6.93	1.57			
	13.45	1440	6.93	1.57			
	15.45	1560	6.94	1.58			
	17.45	1680	6.95	1.59			
	19.45	1800	6.96	1.60			
24/04/2010	0.45	2100	7.00	1.64			
	5.45	2400	7.04	1.68			
	10.45	2700	7.08	1.72			
	15.45	3000	7.10	1.74			
	20.45	3300	7.14	1.78			
25/04/2010	1.45	3600	7.16	1.80			
	6.45	3900	7.18	1.82			
	11.45	4200	7.21	1.85			
	16.45	4500	7.22	1.86			
	21.45	4800	7.25	1.89			
26/04/2010	5.45	5400	7.29	1.93			
	17.45	6000	7.32	1.96			
27/04/2010	5.45	6720	7.35	1.99	25.05	90.2	
	17.45	7440	7.38	2.02			Hujan
28/04/2010	5.45	8160	7.03	1.67			
	17.45	8880	7.15	1.79			
29/04/2010	5.45	9600	7.25	1.89			
	17.45	10320	7.30	1.94			
*** The Pumping unit was stopped at this peroid as agreed by the Client***							

Job

Measure By	Saiful Sapuan	date	22/04/2010	Subject	168 hrs. Constant Head Test at Well No. DW2
Check By	Hasman Ibrahim	date			Jenderam Hilir, Selangor.
Rectify By		date		Encl	page 3 of 3

TOTAL ENVIRONMENTAL SERVICES SDN BHD (256662-W)

Date	HH:MM	Elapsed time min	Water level mbRP	Drawdown (m)	Discharge l / s	Discharge m^3/h	Remarks
22/04/2010	13.59	14	6.50	1.14			
	14.00	15	6.51	1.15	25.05	90.2	
	14.01	16	6.51	1.15			
	14.02	17	6.52	1.16			
	14.03	18	6.52	1.16			
	14.04	19	6.53	1.17			
	14.05	20	6.53	1.17			
	14.10	25	6.54	1.18			
	14.15	30	6.55	1.19			
	14.20	35	6.56	1.20			
	14.25	40	6.56	1.20			
	14.30	45	6.57	1.21			
	14.35	50	6.57	1.21			
	14.40	55	6.58	1.22			
	14.50	60	6.58	1.22			
	14.55	65	6.58	1.22			
	15.00	70	6.59	1.23			
	15.05	75	6.59	1.23			
	15.10	80	6.59	1.23			
	15.15	85	6.60	1.24			
	15.20	90	6.60	1.24			
	15.25	95	6.60	1.24			
	15.30	100	6.61	1.25	25.05	90.2	
	15.35	105	6.61	1.25			
	15.40	110	6.62	1.26			
	15.45	115	6.62	1.26			
	15.55	120	6.62	1.26			
	16.05	130	6.62	1.26			
	16.15	140	6.63	1.27			
	16.15	150	6.63	1.27			
	16.35	170	6.64	1.28			
	16.55	190	6.65	1.29			
	17.15	210	6.66	1.30			
	17.45	240	6.67	1.31			

Job

Measure By	Saiful Sapuan	date	22/04/2010	Subject	168 hrs. Constant Head Test at Well No. DW2
Check By	Hasman Ibrahim	date			Jenderam Hilir, Selangor.
Rectify By		date		Encl	page 2 of 3

TOTAL ENVIRONMENTAL SERVICES SDN BHD (256662-W)

Client	NAHRIM		
Location	JENDERAM HILIR, DENGKIL		
Well No	DW 2	Well Depth	17.4m
Pump Type	SP 60-7	Pump Maker	Grundfos
Riser Pipe	75mm Ø	Depth Install	12m

Notes:
Static Water Level = 5.36 m
Constant Head flowrate: 90.2m3/hr.

CONSTANT HEAD PUMPING TEST

Date	HH:MM	Elapsed time min	Water level (m)	Drawdown (m)	Discharge l / s	Discharge m^3/hr.	Remarks
22/04/2010	13.45	0	5.36	0.00			
	13.45	20 (sec)	6.17	0.81			
		40 (sec)	6.22	0.86			
		50 (sec)	6.24	0.88			
	13.46	60 (sec)	6.26	0.90			
		70 (sec)	6.28	0.92			
		80 (sec)	6.31	0.95			
		90 (sec)	6.32	0.96			
		100 (sec)	6.33	0.97			
		110 (sec)	6.35	0.99	25.05	90.2	
	13.47	2	6.36	1.00			
	13.48	3	6.40	1.04			
	13.49	4	6.42	1.06			
	13.50	5	6.44	1.08			
	13.51	6	6.46	1.10			
	13.52	7	6.47	1.11			
	13.53	8	6.48	1.12			
	13.54	9	6.49	1.13			
	13.55	10	6.49	1.13			
	13.56	11	6.49	1.13			
	13.57	12	6.50	1.14			
	13.58	13	6.50	1.14			

Job

Measure By	Saiful Sapuan	date	22/04/2010	Subject	168 hrs. Constant Head Test at Well No. DW2
Check By	Hasman Ibrahim	date	26/11/2009		Jenderam Hilir, Selangor.
Rectify By		date		Encl	page 1 of 3

SWS - d6034 - Jenderam Hilir DW2-X11

TESS SDN BHD
29-B, JLN. PU TRA SULAIMAN 3,
68000 AMPANG, SELANGOR MALAYSIA
Tel: +60122059671: Fax: +60342601539

CONSTANT PUMPING AND RECOVERY TEST RECORDS

Well No.	DW1-1
Location	Kg. Jenderam Hilir, Dengkil Selangor

Client : Institut Penyelidikan Hidraulik Kebangsaan Malaysia (NAHRIM)

Engineer/Hydrogeologist : Hasman Ibrahim

Static Water Table Well Collar = 5.19m. (Collar Height =1.0 m OGL)

Well Construction Completed : By Others

Pumping Test Duration: **(10.00pm on 05/10/2009 to 8.20am On 07/12/2009)**

Discharge Measurement : Flow Meter / 90° V-Notch tank **= 51.6 m3/hour**

*W.L=(Water Level) * DD=(Draw Down)

CONSTANT DISCHARGE TEST					RECOVERY TEST					
Date/ Clock Time	Time Elpsd (min)	W.L.With Collar (m)	W.L. from Datum (m)	DD (m)	Date/ Clock Time	Time Elpsd (min)	W.L.With Collar (m)	W.L. from Datum(m)	Residual DD (m)	Remark
05/12/2009	0.0	5.19	4.19	0.00	06/12/2009	0.0	5.94	4.94	0.75	
10.00pm	0.5	5.59	4.59	0.40	9.20pm	0.5	5.60	4.60	0.41	
	1.0	5.62	4.62	0.43		1.0	5.55	4.55	0.36	
	1.5	5.64	4.64	0.45		1.5	5.50	4.50	0.31	
	2.0	5.66	4.66	0.47		2.0	5.50	4.50	0.31	
	2.5	5.68	4.68	0.49		2.5	5.47	4.47	0.28	
	3.0	5.68	4.68	0.49		3.0	5.45	4.45	0.26	
	3.5	5.69	4.69	0.50		3.5	5.44	4.44	0.25	
	4.0	5.69	4.69	0.50		4.0	5.44	4.44	0.25	
	4.5	5.69	4.69	0.50		4.5	5.43	4.43	0.24	
	5.0	5.70	4.70	0.51		5.0	5.42	4.42	0.23	
	6.0	5.71	4.71	0.52		6.0	5.42	4.42	0.23	
	7.0	5.71	4.71	0.52		7.0	5.41	4.41	0.22	
	8.0	5.72	4.72	0.53		8.0	5.41	4.41	0.22	
	9.0	5.72	4.72	0.53		9.0	5.40	4.40	0.21	
	10.0	5.72	4.72	0.53		10.0	5.40	4.40	0.21	
	15.0	5.73	4.73	0.54		15.0	5.39	4.39	0.20	
	20.0	5.74	4.74	0.55		20.0	5.39	4.39	0.20	
	25.0	5.74	4.74	0.55		25.0	5.38	4.38	0.19	
	30.0	5.74	4.74	0.55		30.0	5.38	4.38	0.19	
	35.0	5.74	4.74	0.55		35.0	5.37	4.37	0.18	
	40.0	5.74	4.74	0.55		40.0	5.36	4.36	0.17	
	45.0	5.74	4.74	0.55		45.0	5.36	4.36	0.17	
	50.0	5.75	4.75	0.56		50.0	5.35	4.35	0.16	
	55.0	5.75	4.75	0.56		55.0	5.35	4.35	0.16	
	60.0	5.75	4.75	0.56		60.0	5.34	4.34	0.15	
	70.0	5.75	4.75	0.56		120.0	5.34	4.34	0.15	
	80.0	5.76	4.76	0.57		140.0	5.34	4.34	0.15	
	90.0	5.76	4.76	0.57		160.0	5.34	4.34	0.15	
	100.0	5.76	4.76	0.57		180.0	5.34	4.34	0.15	
	120.0	5.77	4.77	0.58		210.0	5.34	4.34	0.15	
	160.0	5.78	4.78	0.59		240.0	5.34	4.34	0.15	
	200.0	5.79	4.79	0.60		270.0	5.33	4.33	0.14	
	250.0	5.80	4.80	0.61		300.0	5.33	4.33	0.14	
	300.0	5.81	4.81	0.62		360.0	5.33	4.33	0.14	
	350.0	5.82	4.82	0.63		420.0	5.33	4.33	0.14	
	400.0	5.83	4.83	0.64		480.0	5.32	4.32	0.13	
	450.0	5.84	4.84	0.65		540.0	5.32	4.32	0.13	
	500.0	5.85	4.85	0.66		600.0	5.32	4.32	0.13	
	550.0	5.86	4.86	0.67	07/12/2009	660.0	5.32	4.32	0.13	
	600.0	5.87	4.87	0.68	8.20pm	780.0				
	700.0	5.88	4.88	0.69						
	800.0	5.89	4.89	0.70						
	900.0	5.90	4.90	0.71						
	1000.0	5.91	4.91	0.72						
	1200.0	5.92	4.92	0.73						
06/12/2009	1400.0	5.94	4.94	0.75						
9.20pm	1600.0									
	1800.0									
	2000.0									
	2240.0									
	2480.0									
	2720.0									
	2960.0									
	3200.0									
	3440.0									
	3680.0									
	3920.0									

Recorded by:

Signature :

Name : HASMAN IBRAHIM

Date : 10/12/2009

Verified by:

Signature :

Name :

Date :

TESS SDN BHD
29-B, JLN. PUTRA SULAIMAN 3,
68000 AMPANG, SELANGOR MALAYSIA
Tel: +60122059671:Fax:+60342601539

STEP PUMPING TEST RECORDS

Well No.	DW1-1
Location	Kg. Jenderam Hilir, Dengkil Selangor

Client : Institut Penyelidikan Hidraulik Kebangsaan Malaysia (NAHRIM)

Engineer/Hydrogeologist : Hasman Ibrahim

Static Water Table Well Collar = 5.04m. (Collar Height =1.0 m OGL)

Pumping Test Duration: 11.00am on 05/12/2009 to 6.30pm on 05/12/2009

Discharge Measurement : Flow Meter / 900 V-Notch
*W.L (Water Level) *DD=(Draw Down)

Step No.5, Q=51.6m3/hr					Step No.					Remarks
Date/ Clock Time	Time Elpsd (min)	Water Level from Top of Casing (m)	Water Level from Datum (m)	Draw-Down (m)	Date/ Clock Time	Time Elpsd (min)	Water Level from Top of Casing (m)	Water Level from Datum (m)	Draw-Down (m)	
05/12/2009 5.00pm	0.0	5.60	4.60	0.56		0.0				Step 5: V-Notch= 16cm By Jacob's Formula; Q=51.6m3/hr
	0.5	5.63	4.63	0.59		0.5				
	1.0	5.66	4.66	0.62		1.0				
	1.5	5.69	4.69	0.65		1.5				
	2.0	5.69	4.69	0.65		2.0				
	2.5	5.69	4.69	0.65		2.5				
	3.0	5.69	4.69	0.65		3.0				
	3.5	5.69	4.69	0.65		3.5				
	4.0	5.69	4.69	0.65		4.0				
	4.5	5.69	4.69	0.65		4.5				
	5.0	5.69	4.69	0.65		5.0				
	6.0	5.69	4.69	0.65		6.0				
	7.0	5.70	4.70	0.66		7.0				
	8.0	5.70	4.70	0.66		8.0				
	9.0	5.70	4.70	0.66		9.0				
	10.0	5.70	4.70	0.66		10.0				
	15.0	5.70	4.70	0.66		15.0				
	20.0	5.70	4.70	0.66		20.0				
	25.0	5.70	4.70	0.66		25.0				
	30.0	5.70	4.70	0.66		30.0				
	35.0	5.70	4.70	0.66		35.0				
	40.0	5.70	4.70	0.66		40.0				
	45.0	5.71	4.71	0.67		45.0				
	50.0	5.71	4.71	0.67		50.0				
	55.0	5.71	4.71	0.67		55.0				
	60.0	5.71	4.71	0.67		60.0				
	70.0	5.72	4.72	0.68		70.0				
	80.0	5.72	4.72	0.68		80.0				
	90.0	5.72	4.72	0.68		90.0				

TESS SDN BHD
29-B, JLN . PU TRA SU LAIMAN 3,
68000 AMPAN G, SELAN GOR MALAYSIA
Tel: +60122059671:Fax:+60342601539

STEP PUMPING TEST RECORDS

Well No.	DW1-1
Location	Kg. Jenderam Hilir, Dengkil Selangor

Client : Institut Penyelidikan Hidraulik Kebangsaan Malaysia (NAHRIM)

Engineer/Hydrogeologist : Hasman Ibrahim

Static Water Table Well Collar = 5.04m. (Collar Height =1.0 m OGL)

Pumping Test Duration: 11.00am on 05/12/2009 to 6.30pm on 05/12/2009

Discharge Measurement : Flow Meter / 90^0 V-Notch
*W.L (Water Level) *DD=(Draw Down)

Step No.3, Q=36.9m3/hr					Step No.4, Q=43.9m3/hr					Remarks
Date/ Clock Time	Time Elpsd (min)	Water Level from Top of Casing (m)	Water Level from Datum (m)	Draw-Down (m)	Date/ Clock Time	Time Elpsd (min)	Water Level from Top of Casing (m)	Water Level from Datum (m)	Draw-Down (m)	
05/12/2009	0.0	5.41	4.41	0.37	05/12/2009	0.0	5.50	4.50	0.46	
2.00pm	0.5	5.46	4.46	0.42	3.30pm	0.5	5.56	4.56	0.52	Step 3
	1.0	5.47	4.47	0.43		1.0	5.56	4.56	0.52	V-Notch=
	1.5	5.47	4.47	0.43		1.5	5.57	4.57	0.53	14cm
	2.0	5.47	4.47	0.43		2.0	5.57	4.57	0.53	By Jacob's
	2.5	5.47	4.47	0.43		2.5	5.57	4.57	0.53	Formula;
	3.0	5.48	4.48	0.44		3.0	5.57	4.57	0.53	$Q=36.9m^3/hr$
	3.5	5.48	4.48	0.44		3.5	5.57	4.57	0.53	
	4.0	5.48	4.48	0.44		4.0	5.57	4.57	0.53	
	4.5	5.48	4.48	0.44		4.5	5.57	4.57	0.53	Step 4
	5.0	5.48	4.48	0.44		5.0	5.57	4.57	0.53	V-Notch=
	6.0	5.48	4.48	0.44		6.0	5.57	4.57	0.53	15cm
	7.0	5.48	4.48	0.44		7.0	5.57	4.57	0.53	By Jacob's
	8.0	5.48	4.48	0.44		8.0	5.57	4.57	0.53	Formula;
	9.0	5.48	4.48	0.44		9.0	5.57	4.57	0.53	$Q=43.9m^3/hr$
	10.0	5.48	4.48	0.44		10.0	5.57	4.57	0.53	
	15.0	5.48	4.48	0.44		15.0	5.58	4.58	0.54	
	20.0	5.48	4.48	0.44		20.0	5.58	4.58	0.54	
	25.0	5.48	4.48	0.44		25.0	5.58	4.58	0.54	
	30.0	5.49	4.49	0.45		30.0	5.58	4.58	0.54	
	35.0	5.49	4.49	0.45		35.0	5.58	4.58	0.54	
	40.0	5.49	4.49	0.45		40.0	5.58	4.58	0.54	
	45.0	5.49	4.49	0.45		45.0	5.58	4.58	0.54	
	50.0	5.49	4.49	0.45		50.0	5.59	4.59	0.55	
	55.0	5.49	4.49	0.45		55.0	5.59	4.59	0.55	
	60.0	5.49	4.49	0.45		60.0	5.59	4.59	0.55	
	70.0	5.49	4.49	0.45		70.0	5.59	4.59	0.55	
	80.0	5.50	4.50	0.46		80.0	5.59	4.59	0.55	
	90.0	5.50	4.50	0.46		90.0	5.60	4.60	0.56	

TESS SDN BHD
29-B, JLN. PUTRA SULAIMAN 3,
68000 AMPANG, SELANGOR MALAYSIA
Tel: +60122059671: Fax: +60342601539

STEP PUMPING TEST RECORDS

Well No.	DW1-1
Location	Kg. Jenderam Hilir, Dengkil Selangor

Client : Institut Penyelidikan Hidraulik Kebangsaan Malaysia (NAHRIM)

Engineer/Hydrogeologist : Hasman Ibrahim

Static Water Table Well Collar = 5.04m. (Collar Height =1.0 m OGL)

Pumping Test Duration: 11.00am on 05/12/2009 to 6.30pm on 05/12/2009

Discharge Measurement : Flow Meter / 90^0 V-Notch
*W.L (Water Level) *DD=(Draw Down)

Step No.1, Q= 25.1m3/hr					Step No.2, Q=30.7m3/hr					Remarks
Date/ Clock Time	Time Elpsd (min)	Water Level from Top of Casing (m)	Water Level from Datum (m)	Draw-Down (m)	Date/ Clock Time	Time Elpsd (min)	Water Level from Top of Casing (m)	Water Level from Datum (m)	Draw-Down (m)	
05/12/2009	0.0	5.04	4.04	0.00	05/12/2009	0.0	5.33	4.33	0.29	
11.00am	0.5	5.22	4.22	0.18	12.30pm	0.5	5.35	4.35	0.31	Step 1: V-Notch= 12cm. By Jacob's Formula; Q= 25.1m^3/hr
	1.0	5.24	4.24	0.20		1.0	5.37	4.37	0.33	
	1.5	5.25	4.25	0.21		1.5	5.38	4.38	0.34	
	2.0	5.26	4.26	0.22		2.0	5.38	4.38	0.34	
	2.5	5.27	4.27	0.23		2.5	5.39	4.39	0.35	
	3.0	5.27	4.27	0.23		3.0	5.39	4.39	0.35	
	3.5	5.28	4.28	0.24		3.5	5.39	4.39	0.35	
	4.0	5.28	4.28	0.24		4.0	5.39	4.39	0.35	
	4.5	5.28	4.28	0.24		4.5	5.39	4.39	0.35	
	5.0	5.29	4.29	0.25		5.0	5.39	4.39	0.35	Step 2: V-Notch= 13cm. By Jacob's Formula; Q=30.7m^3/hr
	6.0	5.29	4.29	0.25		6.0	5.39	4.39	0.35	
	7.0	5.29	4.29	0.25		7.0	5.39	4.39	0.35	
	8.0	5.29	4.29	0.25		8.0	5.39	4.39	0.35	
	9.0	5.30	4.30	0.26		9.0	5.39	4.39	0.35	
	10.0	5.30	4.30	0.26		10.0	5.39	4.39	0.35	
	15.0	5.30	4.30	0.26		15.0	5.39	4.39	0.35	
	20.0	5.31	4.31	0.27		20.0	5.39	4.39	0.35	
	25.0	5.31	4.31	0.27		25.0	5.39	4.39	0.35	
	30.0	5.31	4.31	0.27		30.0	5.39	4.39	0.35	
	35.0	5.31	4.31	0.27		35.0	5.39	4.39	0.35	
	40.0	5.31	4.31	0.27		40.0	5.40	4.40	0.36	
	45.0	5.31	4.31	0.27		45.0	5.40	4.40	0.36	
	50.0	5.32	4.32	0.28		50.0	5.40	4.40	0.36	
	55.0	5.32	4.32	0.28		55.0	5.40	4.40	0.36	
	60.0	5.32	4.32	0.28		60.0	5.40	4.40	0.36	
	70.0	5.33	4.33	0.29		70.0	5.40	4.40	0.36	
	80.0	5.33	4.33	0.29		80.0	5.40	4.40	0.36	
	90.0	5.33	4.33	0.29		90.0	5.41	4.41	0.37	

TOTAL ENVIRONMENTAL SERVICES SDN BHD (256662-W)
29-B, JALAN SULAIMAN 3, TMN PUTRA SULAIMAN, 68000 AMPANG, SELANGOR.
TEL: +603-42601584 FAX: +603-42601539

CONSTANT PUMPING AND RECOVERY TEST RECORDS

Client	Institut Penyelidikan Hidraulik Kebangsaan Malaysia (NAHRIM)

Well No.	DW1
Location	Dengkil, Selangor.

Engineer/Hydrogeologist : **Hasman Bin Ibrahim**

Static Water Level From Collar Height: **6.42m**.Collar Height = **1.0m** OGL

Well Construction Completed : By Others.

Pumping Test Duration: **10.10pm on 22/10/2009 to 10.10am on 26/10/2009**

Discharge Measurement : Flow Meter / 90° V-Notch tank **= 12.2 m3/hour**

***W.L**=(Water Level) ***DD**=(Draw Down)

CONSTANT DISCHARGE TEST					RECOVERY TEST					
Date/ Clock Time	Time Elpsd (min)	W.L.With Collar (m)	W.L. from Datum (m)	DD (m)	Date/ Clock Time	Time Elpsd (min)	W.L.With Collar (m)	W.L. from Datum(m)	Residual DD (m)	Remark
22/10/09	0.0	6.42	6.32	0.00	25/10/09	0.0	10.41	9.41	3.99	
10.10pm	0.5	8.52	8.42	2.10	10.10pm	0.5	8.47	7.47	2.05	
	1.0	8.99	8.89	2.57		1.0	7.58	6.58	1.16	
	1.5	9.31	9.21	2.89		1.5	7.02	6.02	0.60	
	2.0	9.45	9.35	3.03		2.0	6.71	5.71	0.29	
	2.5	9.58	9.48	3.16		2.5	6.59	5.59	0.17	
	3.0	9.64	9.54	3.22		3.0	6.54	5.54	0.12	
	3.5	9.73	9.63	3.31		3.5	6.52	5.52	0.10	
	4.0	9.75	9.65	3.33		4.0	6.52	5.52	0.10	
	4.5	9.81	9.71	3.39		4.5	6.52	5.52	0.10	
	5.0	9.85	9.75	3.43		5.0	6.52	5.52	0.10	
	6.0	9.87	9.77	3.45		6.0	6.51	5.51	0.09	
	7.0	9.91	9.81	3.49		7.0	6.52	5.52	0.10	
	8.0	9.92	9.82	3.50		8.0	6.52	5.52	0.10	
	9.0	9.95	9.85	3.53		9.0	6.52	5.52	0.10	
	10.0	9.97	9.87	3.55		10.0	6.51	5.51	0.09	
	15.0	10.03	9.93	3.61		15.0	6.52	5.52	0.10	
	20.0	10.05	9.95	3.63		20.0	6.52	5.52	0.10	
	25.0	10.09	9.99	3.67		25.0	6.48	5.48	0.06	
	30.0	10.12	10.02	3.70		30.0	6.51	5.51	0.09	
	35.0	10.12	10.02	3.70		35.0	6.50	5.50	0.08	
	40.0	10.15	10.05	3.73		40.0	6.50	5.50	0.08	
	45.0	10.16	10.06	3.74		45.0	6.50	5.50	0.08	
	50.0	10.16	10.06	3.74		50.0	6.49	5.49	0.07	
	55.0	10.17	10.07	3.75		55.0	6.48	5.48	0.06	
	60.0	10.18	10.08	3.76		60.0	6.49	5.49	0.07	
	70.0	10.21	10.11	3.79		120.0	6.48	5.48	0.06	
	80.0	10.21	10.11	3.79		140.0	6.47	5.47	0.05	
	90.0	10.22	10.12	3.80		160.0	6.47	5.47	0.05	
	100.0	10.23	10.13	3.81		180.0	6.47	5.47	0.05	
	120.0	10.25	10.15	3.83		210.0	6.46	5.46	0.04	
	160.0	10.28	10.18	3.86		240.0	6.46	5.46	0.04	
	200.0	10.31	10.21	3.89		270.0	6.46	5.46	0.04	
	250.0	10.36	10.26	3.94		300.0	6.46	5.46	0.04	
	300.0	10.37	10.27	3.95		360.0	6.46	5.46	0.04	
	350.0	10.38	10.28	3.96		420.0	6.47	5.47	0.05	
	400.0	10.41	10.31	3.99		480.0	6.48	5.48	0.06	
	450.0	10.41	10.31	3.99		540.0	6.51	5.51	0.09	
	500.0	10.42	10.32	4.00		600.0	6.51	5.51	0.09	
	550.0	10.45	10.35	4.03		660.0	6.55	5.55	0.13	
	600.0	10.47	10.37	4.05		720.0	6.53	5.53	0.11	
	700.0	10.51	10.41	4.09						
	800.0	10.53	10.43	4.11						
	900.0	10.54	10.44	4.12						
	1000.0	10.57	10.47	4.15						
	1200.0	10.59	10.49	4.17						
	1400.0	10.58	10.48	4.16						
	1600.0	10.59	10.49	4.17						
	1800.0	10.58	10.48	4.16						
	2000.0	10.57	10.47	4.15						
	2240.0	10.58	10.48	4.16						
	2480.0	10.59	10.49	4.17						
	2720.0	10.58	10.48	4.16						
	2960.0	10.57	10.47	4.15						
	3200.0	10.58	10.48	4.16						
	3440.0	10.59	10.49	4.17						
	3680.0	10.59	10.49	4.17						
	3920.0	10.58	10.48	4.16						
	4320.0	10.58	10.48	4.16						

Recorded by:

Signature HASMAN IBRAHIM
Name
Date 05/11/09

Verify by:

Signature
Name
Date

TOTAL ENVIRONMENTAL SERVICES SDN BHD (256662-W)
29-B, JALAN SULAIMAN 3, TMN PUTRA SULAIMAN, 68000 AMPANG, SELANGOR.
TEL: +603-42601584 FAX: +603-42601539

STEP PUMPING TEST RECORDS

Client	Institut Penyelidikan Hidraulik Kebangsaan Malaysia (NAHRIM)

Well No.	DW1
Location	Dengkil, Selangor.

Engineer/Hydrogeologist : Hasman Ibrahim

Static Water Table Well Collar= 6.50m. (Collar Height =1.0 m OGL)

Pumping Test Duration: 11.20am on 22/10/2009 to 6.00pm on 22/10/2009

Discharge Measurement : Flow Meter / 90° V-Notch
*W.L (Water Level) *DD=(Draw Down)

Step No.5, Q= 15.9 m3/hr.					Step No.6, Q= nil.					REMARKS
Date/ Clock Time	Time Elpsd (min)	Water Level from Top of Casing (m)	Water Level from Datum (m)	Draw-Down (m)	Date/ Clock Time	Time Elpsd (min)	Water Level from Top of Casing (m)	Water Level from Datum (m)	Draw-Down (m)	
22/10/09	0.0	9.02	8.02	2.52		0.0				
4.40pm	0.5	9.31	8.31	2.81		0.5				
	1.0	9.48	8.48	2.98		1.0				
	1.5	9.63	8.63	3.13		1.5				
	2.0	9.75	8.75	3.25		2.0				
	2.5	9.87	8.87	3.37		2.5				
	3.0	9.95	8.95	3.45		3.0				
	3.5	10.07	9.07	3.57		3.5				
	4.0	10.17	9.17	3.67		4.0				
	4.5	10.35	9.35	3.85		4.5				
	5.0	10.62	9.62	4.12		5.0				
	6.0	10.95	9.95	4.45		6.0				
	7.0	11.18	10.18	4.68		7.0				
	8.0	11.39	10.39	4.89		8.0				
	9.0	11.51	10.51	5.01		9.0				
	10.0	11.64	10.64	5.14		10.0				
	15.0	11.99	10.99	5.49		15.0				
	20.0	12.22	11.22	5.72		20.0				
	25.0	12.42	11.42	5.92		25.0				
	30.0	12.52	11.52	6.02		30.0				
	35.0	12.61	11.61	6.11		35.0				
	40.0	12.76	11.76	6.26		40.0				
	45.0	12.88	11.88	6.38		45.0				
	50.0	12.91	11.91	6.41		50.0				
	55.0	12.99	11.99	6.49		55.0				
	60.0	13.06	12.06	6.56		60.0				
	70.0	13.13	12.13	6.63		70.0				
	80.0	13.19	12.19	6.69		80.0				

TOTAL ENVIRONMENTAL SERVICES SDN BHD (256662-W)
29-B, JALAN SULAIMAN 3, TMN PUTRA SULAIMAN, 68000 AMPANG, SELANGOR.
TEL: +603-42601584 FAX: +603-42601539

STEP PUMPING TEST RECORDS

Client	Institut Penyelidikan Hidraulik Kebangsaan Malaysia (NAHRIM)

Well No.	DW1
Location	Dengkil, Selangor.

Engineer/Hydrogeologist : Hasman Ibrahim

Static Water Table Well Collar =6.50m. (Collar Height= 1.0 m OGL)

Pumping Test Duration: 11.20am on 22/10/2009 to 6.00pm on 22/10/2009

Discharge Measurement : Flow Meter / 90° V-Notch
*W.L (Water Level) *DD=(Draw Down)

Step No.3, Q= 9.1 m3/hr.					Step No.4, Q= 12.2 m3/hr.					REMARKS
Date/ Clock Time	Time Elpsd (min)	Water Level from Top of Casing (m)	Water Level from Datum (m)	Draw-Down (m)	Date/ Clock Time	Time Elpsd (min)	Water Level from Top of Casing (m)	Water Level from Datum (m)	Draw-Down (m)	
22/10/09	0.0	7.47	6.47	0.97	22/10/09	0.0	8.00	7.00	1.50	
2.00pm	0.5	7.81	6.81	1.31	3.20pm	0.5	8.28	7.28	1.78	
	1.0	7.98	6.98	1.48		1.0	8.36	7.36	1.86	
	1.5	8.03	7.03	1.53		1.5	8.40	7.40	1.90	
	2.0	8.03	7.03	1.53		2.0	8.46	7.46	1.96	
	2.5	7.98	6.98	1.48		2.5	8.52	7.52	2.02	
	3.0	7.95	6.95	1.45		3.0	8.58	7.58	2.08	
	3.5	7.93	6.93	1.43		3.5	8.61	7.61	2.11	
	4.0	7.92	6.92	1.42		4.0	8.64	7.64	2.14	
	4.5	7.93	6.93	1.43		4.5	8.64	7.64	2.14	
	5.0	7.93	6.93	1.43		5.0	8.65	7.65	2.15	
	6.0	7.94	6.94	1.44		6.0	8.69	7.69	2.19	
	7.0	7.93	6.93	1.43		7.0	8.71	7.71	2.21	
	8.0	7.94	6.94	1.44		8.0	8.72	7.72	2.22	
	9.0	7.94	6.94	1.44		9.0	8.74	7.74	2.24	
	10.0	7.95	6.95	1.45		10.0	8.76	7.76	2.26	
	15.0	7.95	6.95	1.45		15.0	8.79	7.79	2.29	
	20.0	7.96	6.96	1.46		20.0	8.85	7.85	2.35	
	25.0	7.96	6.96	1.46		25.0	8.87	7.87	2.37	
	30.0	7.97	6.97	1.47		30.0	8.89	7.89	2.39	
	35.0	7.97	6.97	1.47		35.0	8.93	7.93	2.43	
	40.0	7.97	6.97	1.47		40.0	8.92	7.92	2.42	
	45.0	7.98	6.98	1.48		45.0	8.95	7.95	2.45	
	50.0	7.99	6.99	1.49		50.0	8.95	7.95	2.45	
	55.0	7.99	6.99	1.49		55.0	8.97	7.97	2.47	
	60.0	7.99	6.99	1.49		60.0	8.97	7.97	2.47	
	70.0	7.99	6.99	1.49		70.0	9.00	8.00	2.50	
	80.0	8.00	7.00	1.50		80.0	9.02	8.02	2.52	

TOTAL ENVIRONMENTAL SERVICES SDN BHD (256662-W)
29-B, JALAN SULAIMAN 3, TMN PUTRA SULAIMAN, 68000 AMPANG, SELANGOR.
TEL: +603-42601584 FAX: +603-42601539

STEP PUMPING TEST RECORDS

Client	Institut Penyelidikan Hidraulik Kebangsaan Malaysia (NAHRIM)

Well No.	DW1
Location	Dengkil, Selangor.

Engineer/Hydrogeologist : Hasman Ibrahim

Static Water Table Well Collar= 6.50m. (Collar Height =1.0 m OGL)

Pumping Test Duration: 11.20am on 22/10/2009 to 6.00pm on 22/10/2009

Discharge Measurement : Flow Meter / 90̊ V-Notch
*W.L (Water Level) *DD=(Draw Down)

Step No.1, Q= 4.4 m3/hr.					Step No.2, Q= 6.6m3/hr.					REMARKS
Date/ Clock Time	Time Elpsd (min)	Water Level from Top of Casing (m)	Water Level from Datum (m)	Draw-Down (m)	Date/ Clock Time	Time Elpsd (min)	Water Level from Top of Casing (m)	Water Level from Datum (m)	Draw-Down (m)	
22/10/09	0.0	6.50	5.50	0.00	22/10/09	0.0	7.08	6.08	0.58	
11.20am	0.5	6.85	5.85	0.35	00.40pm	0.5	7.38	6.38	0.88	
	1.0	6.95	5.95	0.45		1.0	7.45	6.45	0.95	
	1.5	6.98	5.98	0.48		1.5	7.47	6.47	0.97	
	2.0	6.99	5.99	0.49		2.0	7.48	6.48	0.98	
	2.5	7.00	6.00	0.50		2.5	7.47	6.47	0.97	
	3.0	7.01	6.01	0.51		3.0	7.46	6.46	0.96	
	3.5	7.02	6.02	0.52		3.5	7.45	6.45	0.95	
	4.0	7.04	6.04	0.54		4.0	7.45	6.45	0.95	
	4.5	7.06	6.06	0.56		4.5	7.44	6.44	0.94	
	5.0	7.08	6.08	0.58		5.0	7.44	6.44	0.94	
	6.0	7.10	6.10	0.60		6.0	7.45	6.45	0.95	
	7.0	7.11	6.11	0.61		7.0	7.46	6.46	0.96	
	8.0	7.12	6.12	0.62		8.0	7.46	6.46	0.96	
	9.0	7.12	6.12	0.62		9.0	7.45	6.45	0.95	
	10.0	7.11	6.11	0.61		10.0	7.45	6.45	0.95	
	15.0	7.10	6.10	0.60		15.0	7.46	6.46	0.96	
	20.0	7.09	6.09	0.59		20.0	7.45	6.45	0.95	
	25.0	7.08	6.08	0.58		25.0	7.46	6.46	0.96	
	30.0	7.07	6.07	0.57		30.0	7.45	6.45	0.95	
	35.0	7.07	6.07	0.57		35.0	7.45	6.45	0.95	
	40.0	7.07	6.07	0.57		40.0	7.46	6.46	0.96	
	45.0	7.08	6.08	0.58		45.0	7.45	6.45	0.95	
	50.0	7.08	6.08	0.58		50.0	7.45	6.45	0.95	
	55.0	7.08	6.08	0.58		55.0	7.46	6.46	0.96	
	60.0	7.09	6.09	0.59		60.0	7.46	6.46	0.96	
	70.0	7.10	6.10	0.60		70.0	7.47	6.47	0.97	
	80.0	7.10	6.10	0.60		80.0	7.47	6.47	0.97	

TOTAL ENVIRONMENTAL SERVICES SDN BHD (256662-W)

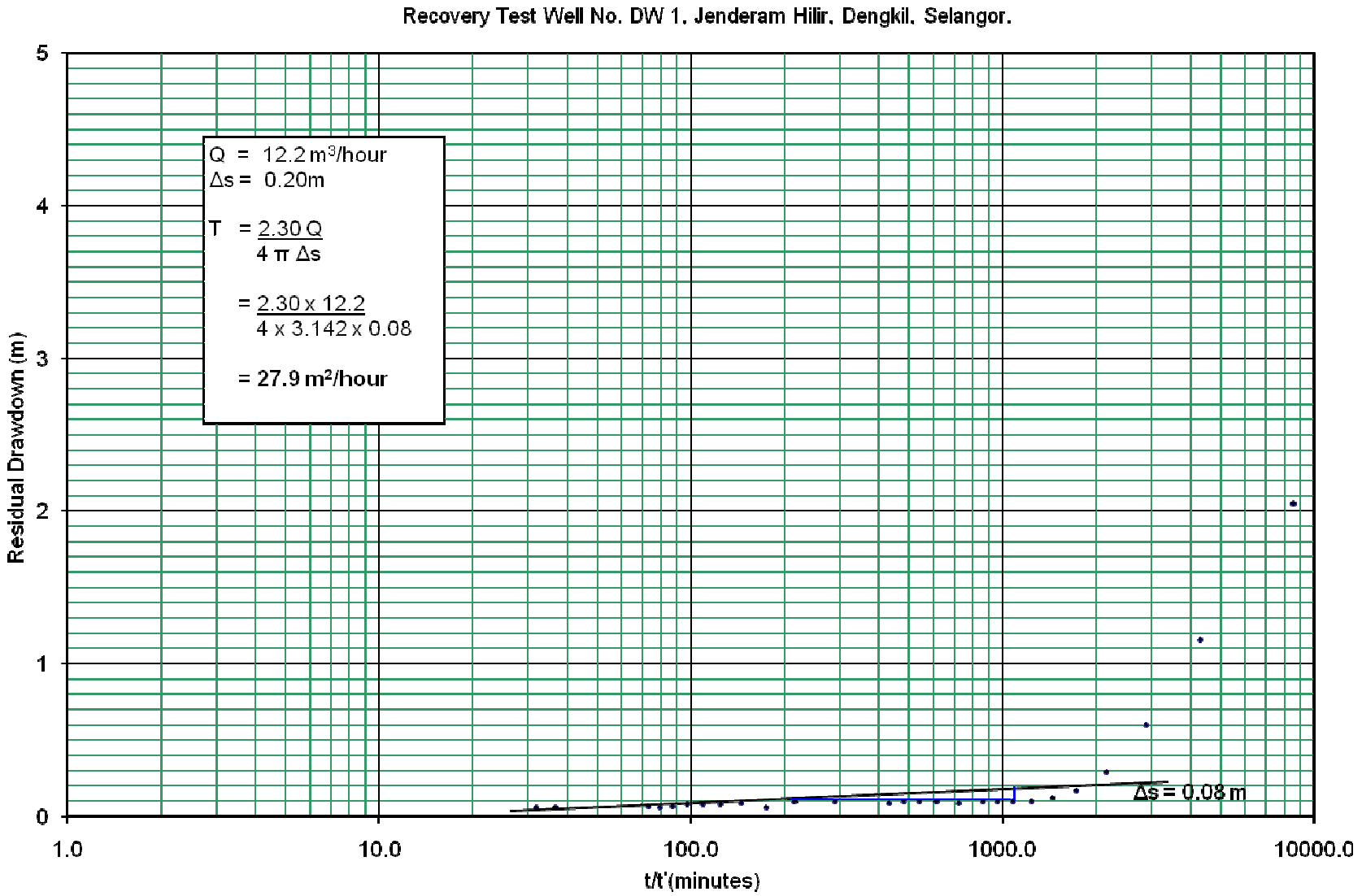
Date	HH:MM	Elapsed time min	Water level (m)	Drawdown (m)			Remarks
29/04/2010	18.03	18	5.99	0.63			
	18.05	20	5.99	0.63			
	18.10	25	5.99	0.63			
	18.15	30	5.98	0.62			
	18.25	40	5.98	0.62			
	18.35	50	5.98	0.62			
	18.45	60	5.97	0.61			
	19.00	75	5.97	0.61			
	19.15	90	5.96	0.60			
	19.30	105	5.96	0.60			
	19.45	120	5.96	0.60			
	20.15	150	5.95	0.59			
	20.45	180	5.94	0.58			
	21.15	210	5.93	0.57			
	21.45	240	5.92	0.56			
	22.15	270	5.89	0.53			
	22.45	300	5.85	0.49			
	23.45	360	5.80	0.44			
30/04/2010	0.45	420	5.76	0.40			
	1.45	480	5.72	0.36			
	2.45	540	5.69	0.33			
	3.45	600	5.67	0.31			
	5.45	720	5.64	0.28			
	7.45	840	5.63	0.27			
	9.45	960	5.63	0.27			
	11.45	1080	5.63	0.27			
	13.45	1200	5.63	0.27			
30/04/2010	15.45	1320	5.65	0.29			

Job

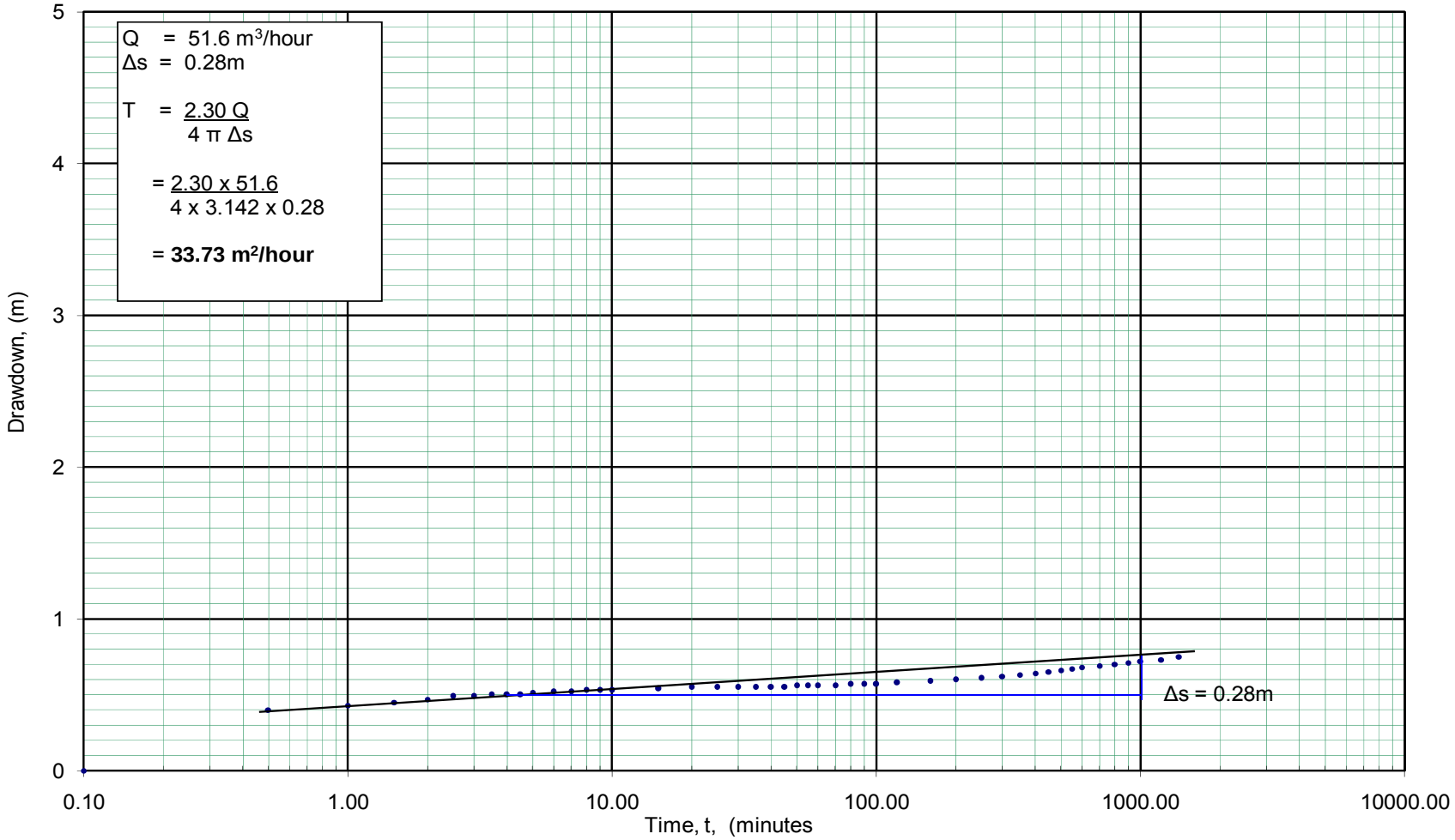
Measure By	Abu Bakar Adam	date	01/01/2010	Subject	168 hrs. Constant Head Test at Well No. DW2
Check By	Hasman Ibrahim	date	01/01/2010		Jenderam Hilir, Selangor.
Rectify By		date		Encl	page 2 of 3

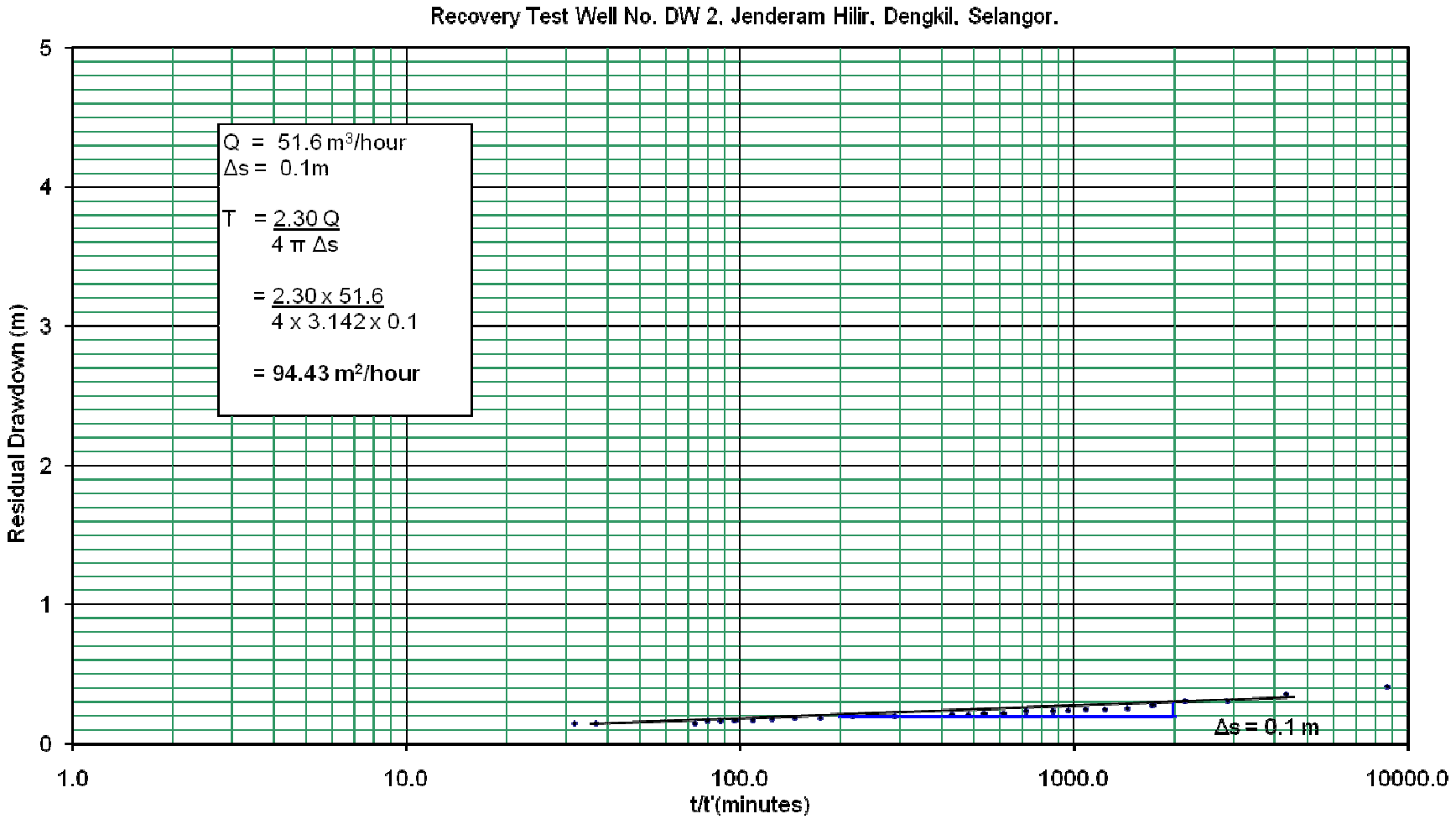
Result Constant dischagre and recovery for test well DW 1 and DW 2

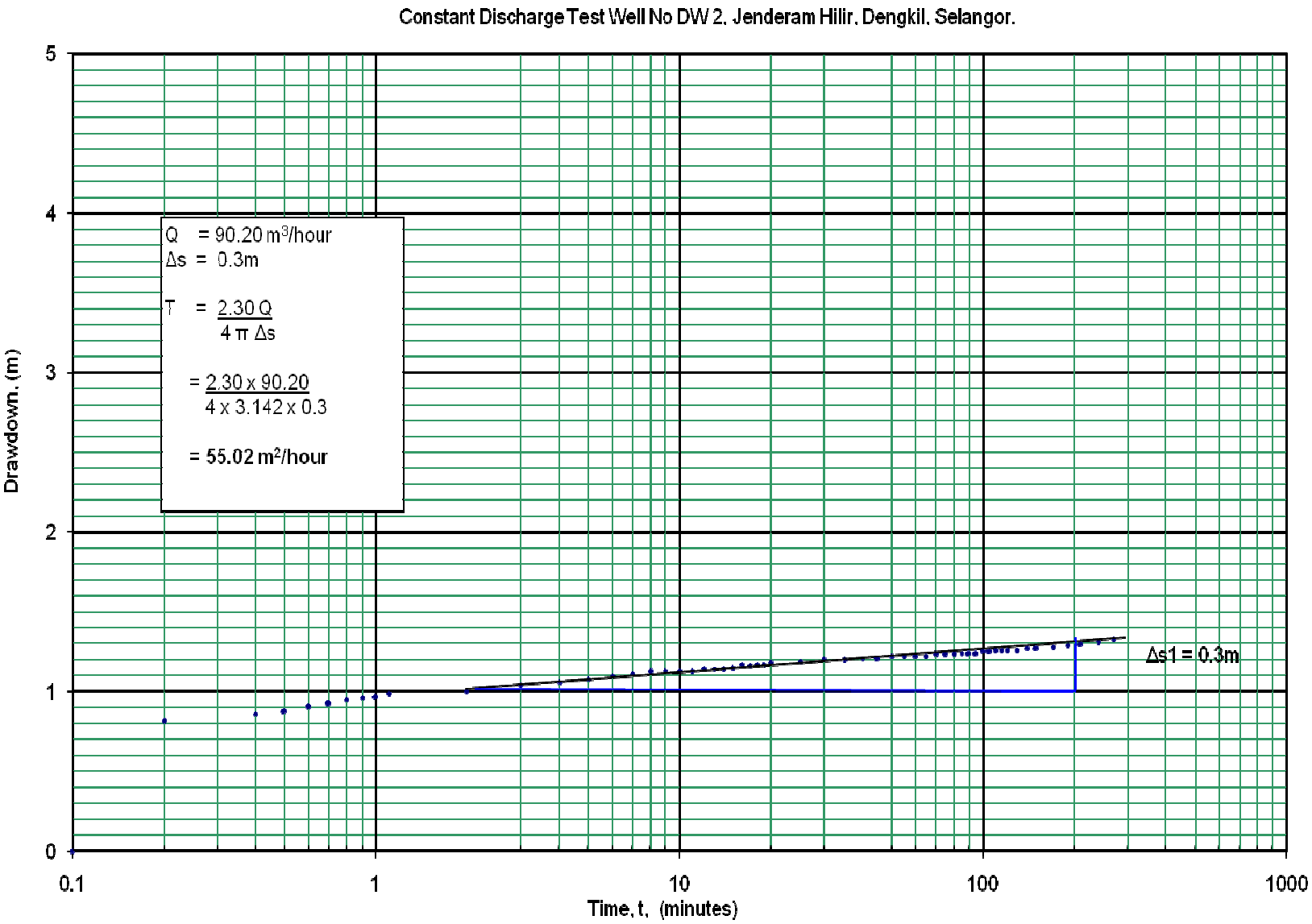


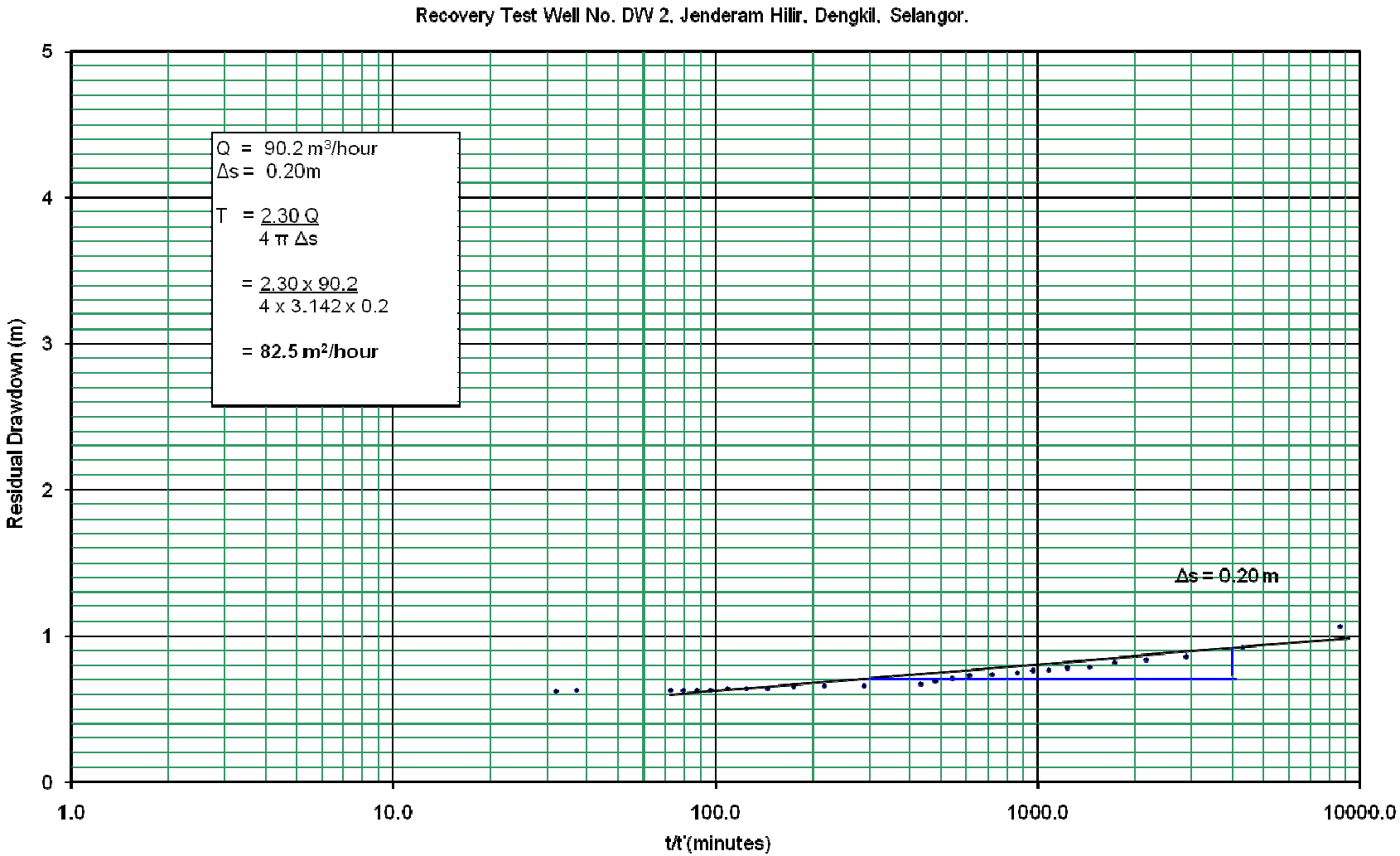

Recovery Test Well No. DW 1. Jenderam Hilir. Dengkil. Selangor.
Q = 12.2 m³/hour
Δs = 0.20m
T = 2.30 Q / 4 π Δs
= 2.30 x 12.2 / 4 x 3.142 x 0.08
= 27.9 m²/hour
Δs = 0.08 m
Residual Drawdown (m)
t/t'(minutes)
0
1
2
3
4
5
1.0
10.0
100.0
1000.0
10000.0

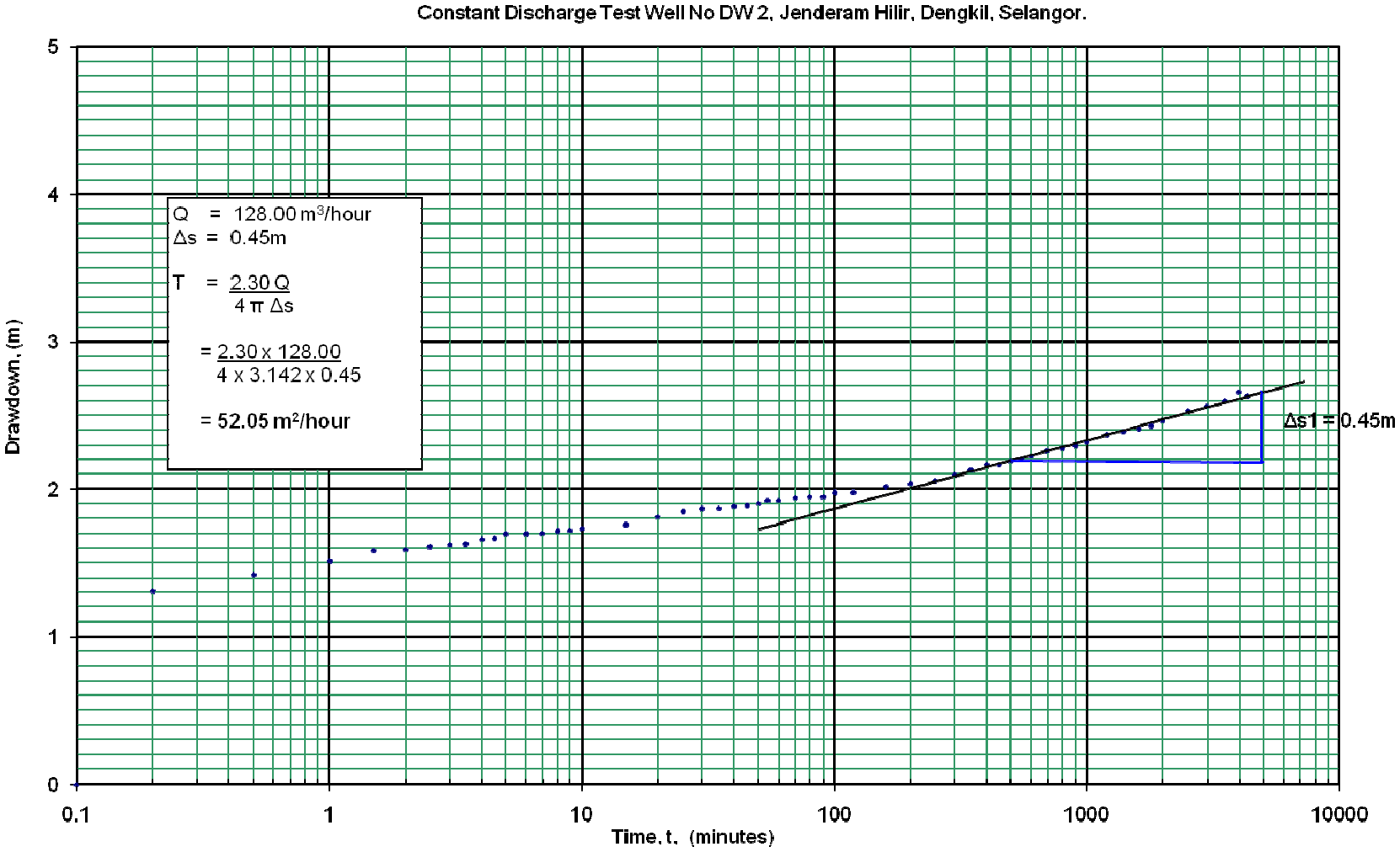
Constant Discharge Test Well No DW 2, Jenderam Hilir, Dengkil, Selangor.

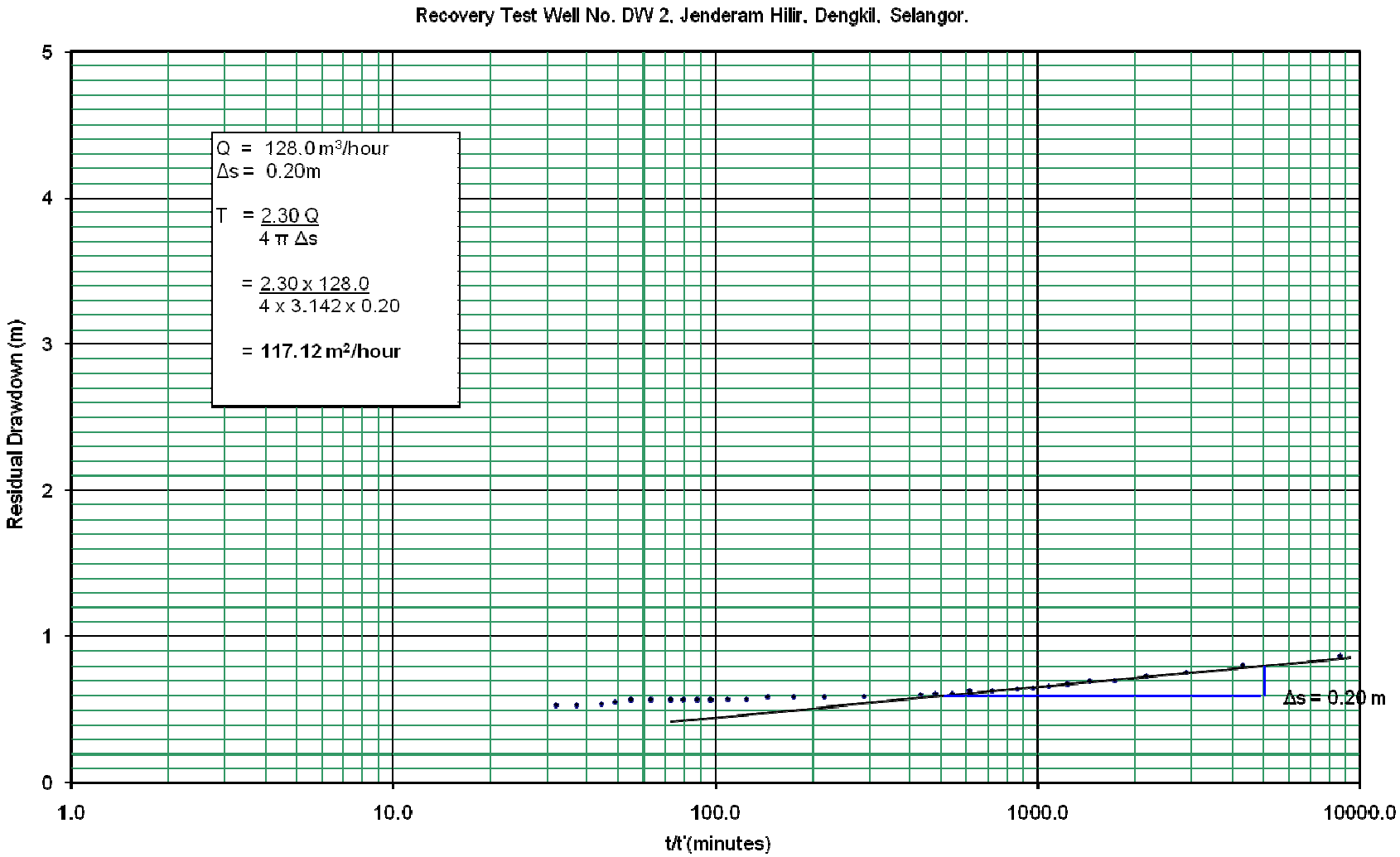



Recovery Test Well No. DW 2, Jenderam Hilir, Dengkil, Selangor.
Q = 51.6 m³/hour
Δs = 0.1m
T = 2.30 Q / 4 π Δs
= 2.30 x 51.6 / 4 x 3.142 x 0.1
= 94.43 m²/hour
Residual Drawdown (m)
t/t'(minutes)
Δs = 0.1 m
0
1
2
3
4
5
1.0
10.0
100.0
1000.0
10000.0


Constant Discharge Test Well No DW 2, Jenderam Hilir, Dengkil, Selangor.
Drawdown, (m)
Time, t, (minutes)
0
1
2
3
4
5
0.1
1
10
100
1000
Q = 90.20 m³/hour
Δs = 0.3m
T = 2.30 Q / 4 π Δs
= 2.30 x 90.20 / 4 x 3.142 x 0.3
= 55.02 m²/hour
Δs1 = 0.3m


Recovery Test Well No. DW 2, Jenderam Hilir, Dengkil, Selangor.
Q = 90.2 m3/hour
Δs = 0.20m
T = 2.30 Q / 4 π Δs
= 2.30 x 90.2 / 4 x 3.142 x 0.2
= 82.5 m2/hour
Δs = 0.20 m
Residual Drawdown (m)
t/t'(minutes)
0
1
2
3
4
5
1.0
10.0
100.0
1000.0
10000.0


Constant Discharge Test Well No DW 2, Jenderam Hilir, Dengkil, Selangor.
Q = 128.00 m³/hour
Δs = 0.45m
T = 2.30 Q / 4 π Δs
= 2.30 x 128.00 / 4 x 3.142 x 0.45
= 52.05 m²/hour
Δs1 = 0.45m
Drawdown, (m)
Time, t, (minutes)
0
1
2
3
4
5
0.1
1
10
100
1000
10000


Recovery Test Well No. DW 2, Jenderam Hilir, Dengkil, Selangor.
Q = 128.0 m³/hour
Δs = 0.20m
T = 2.30 Q / 4 π Δs
= 2.30 x 128.0 / 4 x 3.142 x 0.20
= 117.12 m²/hour
Residual Drawdown (m)
t/t'(minutes)
Δs = 0.20 m
0
1
2
3
4
5
1.0
10.0
100.0
1000.0
10000.0

Well Recovery Data

Pumping Well Well I.D. : DW 2 (Jenderam Hilir, Dengkil, Selangor)

Pumping Test: ~~Step Test /~~ Constant Discharge Test

Static Water Level : 4.05 m bgl

Final Pumping Level: 6.68 m bgl

Clock Time	Time Elapsed (min)	Water Level* (m)	Residual Drawdown (m)	% Recovery	Remarks
10.00 am	0.0	6.68	2.63	0.00%	
	0.5	4.92	0.87	66.92%	
	1.0	4.85	0.80	69.58%	
	1.5	4.81	0.76	71.10%	
	2.0	4.78	0.73	72.24%	
	2.5	4.75	0.70	73.38%	
	3.0	4.74	0.69	73.76%	
	3.5	4.72	0.67	74.52%	
	4.0	4.71	0.66	74.90%	
	4.5	4.70	0.65	75.29%	
	5.0	4.69	0.64	75.67%	
	6.0	4.68	0.63	76.05%	
	7.0	4.68	0.63	76.05%	
	8.0	4.66	0.61	76.81%	
	9.0	4.66	0.61	76.81%	
	10	4.65	0.60	77.19%	
	15	4.64	0.59	77.57%	
	20	4.63	0.58	77.95%	
	25	4.63	0.58	77.95%	
	30	4.63	0.58	77.95%	
	35	4.62	0.57	78.33%	
	40	4.62	0.57	78.33%	
	45	4.61	0.56	78.71%	
	50	4.61	0.56	78.71%	
	55	4.61	0.56	78.71%	
	60	4.61	0.56	78.71%	
	70	4.61	0.56	78.71%	
	80	4.61	0.56	78.71%	
	90	4.60	0.55	79.09%	
	100	4.59	0.54	79.47%	
	120	4.58	0.53	79.85%	
	140	4.58	0.53	79.85%	
	160	4.57	0.52	80.23%	
	180	4.57	0.52	80.23%	
	210	4.56	0.51	80.61%	
	240	4.55	0.50	80.99%	

APPENDIX C

SIEVE ANALYSIS RESULTS

Z-DSAC LABORATORIES (001144285-D)

CIDB MALAYSIA No. 1991102-SL054181

Site Investigation - Soil, Asphaltic & Concrete Testing - Chemical Testing - Field Instrumentation

Our Ref.: **Z 2609/09** Date : **September 14, 2009**

TEST REPORT

(This report is issued subject to the conditions set out overleaf)

The copyright of the confidential TEST REPORT is awned by Z-DSAC LABORATORIES.
This TEST REPORT cannot be reproduced or published in any form whatsoever or the information contained herein be used in any from of publication or advertisment without the written permission of Z-DSAC LABORATORIES.

1. Client : **NAHRIM**

2. Contractor : **MULTICALL CARD (M) SDN. BHD.**
27A&B, Jalan Perniaga, U1/34,
Hicom Glanmarie Industrial Park,
40150 Shah Alam, Selangor Darul Ehsan.

3. Project : ANALYSIS SAIZ BUTIRAN TELAGA PEMONITORAN DAN TELAGA EKSPLORASI AIR BAWAH TANAH DI JENDERAM HILIR, DENGKIL, SELANGOR DARUL EHSAN.

4. Test Requested By Client : **Determination of the :-**
Classification Tests. (BS 1377 : Part 2 : 1990)
1) Natural Moisture Content (Test 1)
2) Particle Size Distribution for Coarse-Grained Soils (Test 7A and 7B)
3) Particle Size Distribution for Fine-Grained Soils (Test 7C and 7D)

5. Type Of Meterial : **Soil**

6. Method of Testing : **BS 1377 : Part 2 : 1990**

7. Date Tested : 08.09.2009 - 14.09.2008

8. Results Please refers to the following page for the results.

.....

Z-DSAC LABORATORIES
MOHD NAWAHIDUDIN BIN MAHAMAD ISA
M. Sc. Building B. Sc. Building (U.K.)
TECHNICAL MANAGER
(001144285-D)

Professional Engineer : Ir. Kent Chow. B.E. (Hons.) P. Eng. MIEM.
Technical Manager : Haji Mohd Nawahidudin Mahamad Isa. M. Sc. Building B.Sc. Building (U.K)

S

Z-DSAC LABORATORIES (001144285-D)

CIDB MALAYSIA No. 1991102-SL054181

Site Investigation - Soil, Asphaltic & Concrete Testing - Chemical Testing - Field Instrumentation

SUMMARY OF LABORATORY TESTS

BS 1377 : Part 2 : 1990

Job. No. : **Z 2609/09**
Client : **NAHRIM**
Contractor : **MULTICALL CARD (M) SDN. BHD.**
Project : ANALYSIS SAIZ BUTIRAN TELAGA PEMONITORAN DAN TELAGA EKSPLORASI AIR BAWAH TANAH DI JENDERAM HILIR, DENGKIL, SELANGOR DARUL EHSAN.
Date Tested : **08.09.2009 - 14.09.2009**

BH No.	Sample No.	Depth		Natural Moisture Content %	Sieve Analysis			
		From m	To m		Gravel %	Sand %	Silt %	Clay %
MW1	1	3.60		44	1	85	9	5
MW4	1	4.30		24	0	63	13	24
MW5	1	1.50	9.45	44	1	86	8	5
MW6	1	4.00	5.80	46	0	79	11	10
MW8	1	2.00	3.30	21	1	73	12	14
	2	3.90	5.100	21	0	68	22	10
MW10	1	1.80	2.500	11	4	82	8	6
	2	2.50	3.700	49	0	9	32	59
	3	3.70	4.000	43	0	37	50	13
	4	4.00	5.90	23	0	91	5	4
MW11	1	6.00	13.50	21	1	76	17	6
MW12	1	3.00	3.60	5	9	86	3	2
	2	3.60	4.20	25	6	56	25	13
	3	4.20	5.00	19	6	79	7	8
MW13	1	3.00	6.00	17	12	82	4	2
	2	6.00	9.00	29	4	55	33	8
MW14	1	2.60	3.20	28	0	51	35	14
	2	4.60	5.200	25	1	96	2	1
MW15	1	5.00	7.300	20	8	91	0	1
MW16	1	1.00	3.000	26	8	53	19	20
	2	3.00	6.00	58	0	2	42	56
	3	6.00	13.00	57	0	1	37	62
MW17	1	1.20	4.50	20	10	71	11	8
MW18	1	4.80	6.00	21	8	66	20	6
MW19	1	1.20	6.00	21	0	90	6	4
	2	6.00	12.00	22	0	95	3	2
	3	12.00	13.500	19	2	75	13	10
MW20	1	3.80		27	0	83	9	8
MW23	1	6.00	15.000	16	2	96	1	1
MW24	1	2.10	3.700	28	2	68	14	16
MW25	1	12.00	12.50	21	0	91	5	4

Z-DSAC LABORATORIES
MOHD NAWAHIDUDIN BIN MAHAMAD ISA
M. Sc. Building B. Sc. Building (U.K.)
TECHNICAL MANAGER
(001144285-D)

Z-DSAC LABORATORIES (001144285-D)

CIDB MALAYSIA No. 1991102-SL054181

Site Investigation - Soil, Asphaltic & Concrete Testing - Chemical Testing - Field Instrumentation

NATURAL MOISTURE CONTENT

BS 1377 : Part 2 : 1990

Client : **NAHRIM**
Contractor : **MULTICALL CARD (M) SDN. BHD.**
Project : ANALYSIS SAIZ BUTIRAN TELAGA PEMONITORAN DAN TELAGA EKSPLORASI AIR BAWAH TANAH DI JENDERAM HILIR, DENGKIL, SELANGOR DARUL EHSAN.
Date : 08.09.2009
Lab. Ref. : Z 2609/09

Borehole no.	Sample no.	Depth (m)	Cont. no.	Wt. of wet soil + cont. W2 (gm)	Wt. of dry soil + cont. W3 (gm)	Wt. of container W1 (gm)	Wt. of dry soil W3 -W1	Wt. of moisture W2 - W3	Moisture content (W2-W3/W3-W1) X100	Average moisture content (%)
MW1	**1**	**3.60**	M1	51.11	43.00	15.01	27.99	8.11	28.97	
			M2	58.70	50.28	42.23	14.23	8.42	59.17	**44**
MW4	**1**	**4.30**	M3	59.48	50.76	14.80	35.96	8.72	24.25	
			M4	60.06	51.21	14.68	36.53	8.85	24.23	**24**
MW5	**1**	**1.50**	M5	51.43	40.00	14.24	25.76	11.43	44.37	
		9.45	M6	53.63	41.23	13.24	27.99	12.40	44.30	**44**
MW6	**1**	**4.00**	M7	57.14	43.45	13.87	29.58	13.69	46.28	
		5.80	M8	56.25	42.68	13.34	29.34	13.57	46.25	**46**
MW8	**1**	**2.00**	M9	60.54	52.53	15.00	37.53	8.01	21.34	
		3.30	M10	61.04	52.85	14.34	38.51	8.19	21.27	**21**
	2	**3.90**	M11	60.10	52.32	14.78	37.54	7.78	20.72	
		5.10	M12	60.47	52.61	14.63	37.98	7.86	20.70	**21**
MW10	**1**	**1.80**	M13	47.37	44.13	14.69	29.44	3.24	11.01	
		2.50	M14	48.55	45.13	14.05	31.08	3.42	11.00	**11**
	2	**2.50**	M15	54.02	40.79	13.59	27.20	13.23	48.64	
		3.70	M16	54.33	41.22	14.23	26.99	13.11	48.57	**49**
	3	**3.70**	M17	49.53	39.07	14.73	24.34	10.46	42.97	
		4.00	M18	50.34	39.63	14.68	24.95	10.71	42.93	**43**
	4	**4.00**	M19	64.70	54.88	13.03	41.85	9.82	23.46	
		5.90	M20	62.50	53.34	14.33	39.01	9.16	23.48	**23**
MW11	**1**	**6.00**	M21	58.45	50.54	13.60	36.94	7.91	21.41	
		13.50	M22	57.81	49.96	13.34	36.62	7.85	21.44	**21**
MW12	**1**	**3.00**	M23	54.35	52.46	14.11	38.35	1.89	4.93	
		3.60	M24	54.27	52.44	14.34	38.10	1.83	4.80	**5**
	2	**3.60**	M25	74.57	62.43	13.78	48.65	12.14	24.95	
		4.20	M26	73.62	61.87	14.63	47.24	11.75	24.87	**25**
	3	**4.20**	M27	64.68	56.46	12.65	43.81	8.22	18.76	
		5.00	M28	63.50	55.54	13.31	42.23	7.96	18.85	**19**
MW13	**1**	**3.00**	M29	62.38	55.37	15.27	40.10	7.01	17.48	
		6.00	M30	61.28	54.31	14.34	39.97	6.97	17.44	**17**
	2	**6.00**	M31	59.31	49.80	17.04	32.76	9.51	29.03	
		9.00	M32	59.20	49.07	14.23	34.84	10.13	29.08	**29**
MW14	**1**	**2.60**	M33	47.72	40.04	13.06	26.98	7.68	28.47	
		3.20	M34	48.85	41.01	13.31	27.70	7.84	28.30	**28**
	2	**4.60**	M35	54.55	46.57	14.65	31.92	7.98	25.00	
		5.20	M36	55.38	47.12	14.28	32.84	8.26	25.15	**25**

Z-DSAC LABORATORIES (001144285-D)

CIDB MALAYSIA No. 1991102-SL054181

Site Investigation - Soil, Asphaltic & Concrete Testing - Chemical Testing - Field Instrumentation

PARTICLE SIZE DISTRIBUTION GRADATION CURVE

BS 1377 : Part 2 : 1990

Client : **NAHRIM**
Contractor : **MULTICALL CARD (M) SDN. BHD.**
Project : ANALYSIS SAIZ BUTIRAN TELAGA PEMONITORAN DAN TELAGA EKSPLORASI
: AIR BAWAH TANAH DI JENDERAM HILIR, DENGKIL, SELANGOR DARUL EHSA

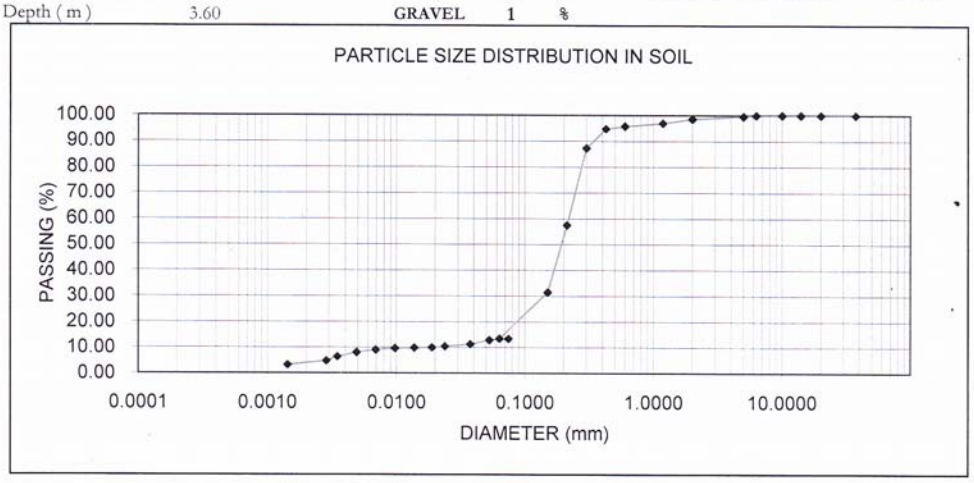
Sieve analysis (Coarse grained)			
BS Sieve	Weight Retained	Retained	Passing
mm	(gm)	%	%
37.5	0.00	0.00	100.00
20.0	0.00	0.00	100.00
14.0	0.00	0.00	100.00
10.0	0.00	0.00	100.00
6.3	0.00	0.00	100.00
5.0	0.20	0.40	99.60
2.0	0.49	0.98	98.62
1.180	0.82	1.64	96.98
0.600	0.60	1.20	95.78
0.425	0.49	0.98	94.80
0.300	3.74	7.48	87.32
0.212	14.91	29.82	57.50
0.150	12.98	25.96	31.54
0.063	8.99	17.98	13.56
TOTAL	**43.22**		

Borehole/ Sample No. : MW1 - 1
Depth (m) 3.60

Hydrometer analysis (Fine grained)						
Time	Elapsed Time	Hydrometer Reading Rh'	Rh'-Cm = Rh	Particle Diameter D (mm)	Modified Hydrometer Reading	% Finer Than D K %
9.50						
9.50	30 secs	4.15	3.95	0.0744	4.15	13.49
9.51	1 min	4.00	3.80	0.0527	4.00	13.00
9.52	2 mins	3.50	3.30	0.0374	3.50	11.38
9.54	5 mins	3.25	3.05	0.0237	3.25	10.56
9.58	8 mins	3.10	2.90	0.0188	3.10	10.08
9.65	15 mins	3.05	2.85	0.0137	3.05	9.91
9.80	30 mins	3.00	2.80	0.0097	3.00	9.75
10.50	1 hours	2.80	2.60	0.0069	2.80	9.10
11.50	2 hours	2.50	2.30	0.0049	2.50	8.13
13.50	4 hours	2.00	1.80	0.0035	2.00	6.50
15.50	6 hours	1.50	1.30	0.0028	1.50	4.88
9.50	24 hours	1.00	0.80	0.0014	1.00	3.25

CLAY	5	%
SILT	9	%
SAND	85	%
GRAVEL	1	%

Lab. Ref. : Z 2609/09
Date Tested : 11.09.2009
Tested By : Amir / Safri
Weight of Sample (gm) 50.00



Z-DSAC LABORATORIES (001144285-D)

CIDB MALAYSIA No. 1991102-SL054181

Site Investigation - Soil, Asphaltic & Concrete Testing - Chemical Testing - Field Instrumentation

PARTICLE SIZE DISTRIBUTION GRADATION CURVE

BS 1377 : Part 2 : 1990

Client : **NAHRIM**
Contractor : **MULTICALL CARD (M) SDN. BHD.**
Project : ANALYSIS SAIZ BUTIRAN TELAGA PEMONITORAN DAN TELAGA EKSPLORASI
: AIR BAWAH TANAH DI JENDERAM HILIR, DENGKIL, SELANGOR DARUL EHSA

Sieve analysis (Coarse grained)

BS Sieve mm	Weight Retained (gm)	Retained %	Passing %
37.5	0.00	0.00	100.00
20.0	0.00	0.00	100.00
14.0	0.00	0.00	100.00
10.0	0.00	0.00	100.00
6.3	0.00	0.00	100.00
5.0	0.00	0.00	100.00
2.0	0.00	0.00	100.00
1.180	1.00	2.00	98.00
0.600	7.01	14.02	83.98
0.425	4.63	9.26	74.72
0.300	5.29	10.58	64.14
0.212	5.61	11.22	52.92
0.150	3.78	7.56	45.36
0.063	4.18	8.36	37.00
TOTAL	**31.50**		

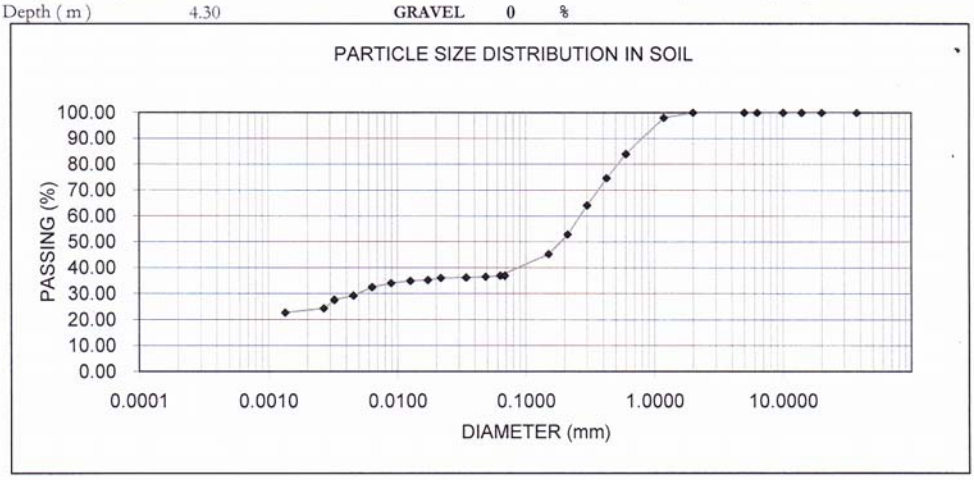
Borehole/ Sample No. : MW4 - 1
Depth (m) 4.30

Hydrometer analysis (Fine grained)

Time	Elapsed Time	Hydrometer Reading Rh'	Rh'-Cm = Rh	Particle Diameter D (mm)	Modified Hydrometer Reading	% Finer Than D K %
9.25						
9.25	30 secs	11.38	11.18	0.0683	11.38	36.99
9.26	1 min	11.25	11.05	0.0484	11.25	36.56
9.27	2 mins	11.15	10.95	0.0343	11.15	36.24
9.29	5 mins	11.10	10.90	0.0217	11.10	36.08
9.33	8 mins	10.85	10.65	0.0172	10.85	35.26
9.40	15 mins	10.75	10.55	0.0126	10.75	34.94
9.55	30 mins	10.50	10.30	0.0089	10.50	34.13
10.25	1 hours	10.00	9.80	0.0063	10.00	32.50
11.25	2 hours	9.00	8.80	0.0045	9.00	29.25
13.25	4 hours	8.50	8.30	0.0032	8.50	27.63
15.25	6 hours	7.50	7.30	0.0027	7.50	24.38
9.25	24 hours	7.00	6.80	0.0013	7.00	22.75

CLAY	**24**	%
SILT	**13**	%
SAND	**63**	%
GRAVEL	**0**	%

Lab. Ref. : Z 2609/09
Date Tested : 11.09.2009
Tested By : Amir / Safri
Weight of Sample (gm) 50.00



Z-DSAC LABORATORIES (001144285-D)

CIDB MALAYSIA No. 1991102-SL054181

Site Investigation - Soil, Asphaltic & Concrete Testing - Chemical Testing - Field Instrumentation

PARTICLE SIZE DISTRIBUTION GRADATION CURVE

BS 1377 : Part 2 : 1990

Client : **NAHRIM**
Contractor : **MULTICALL CARD (M) SDN. BHD.**
Project : ANALYSIS SAIZ BUTIRAN TELAGA PEMONITORAN DAN TELAGA EKSPLORASI
: AIR BAWAH TANAH DI JENDERAM HILIR, DENGKIL, SELANGOR DARUL EHSA

Sieve analysis (Coarse grained)

BS Sieve mm	Weight Retained (gm)	Retained %	Passing %
37.5	0.00	0.00	100.00
20.0	0.00	0.00	100.00
14.0	0.00	0.00	100.00
10.0	0.00	0.00	100.00
6.3	0.00	0.00	100.00
5.0	0.00	0.00	100.00
2.0	0.34	0.68	99.32
1.180	1.41	2.82	96.50
0.600	4.04	8.08	88.42
0.425	3.83	7.66	80.76
0.300	6.46	12.92	67.84
0.212	8.86	17.72	50.12
0.150	8.40	16.80	33.32
0.063	10.13	20.26	13.06
TOTAL	**43.47**		

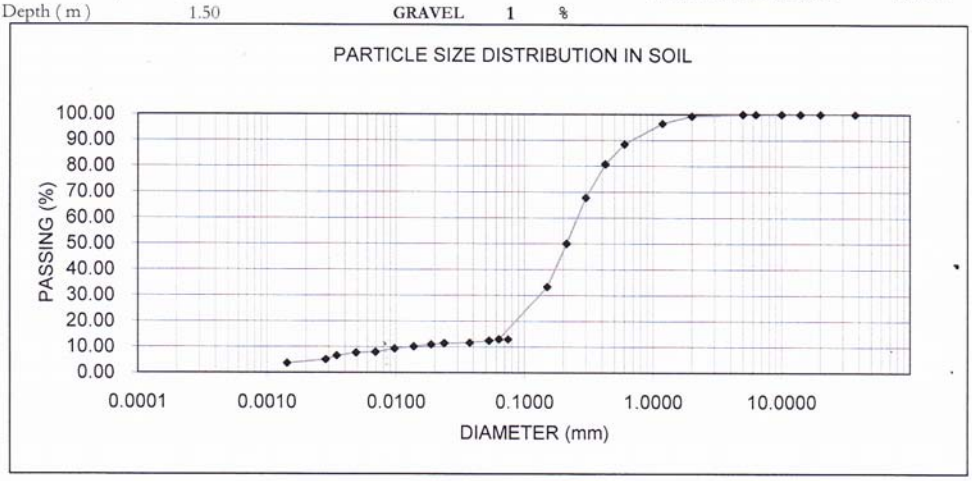
Borehole/ Sample No. : MW5 - 1
Depth (m) 1.50

Hydrometer analysis (Fine grained)

Time 9.55	Elapsed Time	Hydrometer Reading Rh'	Rh'-Cm = Rh	Particle Diameter D (mm)	Modified Hydrometer Reading	% Finer Than' D K %
9.55	30 secs	4.00	3.80	0.0745	4.00	13.00
9.56	1 min	3.85	3.65	0.0528	3.85	12.51
9.57	2 mins	3.60	3.40	0.0374	3.60	11.70
9.59	5 mins	3.55	3.35	0.0237	3.55	11.54
9.63	8 mins	3.40	3.20	0.0187	3.40	11.05
9.70	15 mins	3.15	2.95	0.0137	3.15	10.24
9.85	30 mins	2.90	2.70	0.0097	2.90	9.43
10.55	1 hours	2.50	2.30	0.0069	2.50	8.13
11.55	2 hours	2.40	2.20	0.0049	2.40	7.80
13.55	4 hours	2.05	1.85	0.0035	2.05	6.66
15.55	6 hours	1.60	1.40	0.0028	1.60	5.20
9.55	24 hours	1.15	0.95	0.0014	1.15	3.74

CLAY	5	%
SILT	8	%
SAND	86	%
GRAVEL	1	%

Lab. Ref. : Z 2609/09
Date Tested : 11.09.2009
Tested By : Amir / Safri
Weight of Sample (gm) 50.00



Z-DSAC LABORATORIES (001144285-D)

CIDB MALAYSIA No. 1991102-SL054181

Site Investigation - Soil, Asphaltic & Concrete Testing - Chemical Testing - Field Instrumentation

PARTICLE SIZE DISTRIBUTION GRADATION CURVE

BS 1377 : Part 2 : 1990

Client : **NAHRIM**
Contractor : **MULTICALL CARD (M) SDN. BHD.**
Project : ANALYSIS SAIZ BUTIRAN TELAGA PEMONITORAN DAN TELAGA EKSPLORASI
: AIR BAWAH TANAH DI JENDERAM HILIR, DENGKIL, SELANGOR DARUL EHSA

Sieve analysis (Coarse grained)

BS Sieve mm	Weight Retained (gm)	Retained %	Passing %
37.5	0.00	0.00	100.00
20.0	0.00	0.00	100.00
14.0	0.00	0.00	100.00
10.0	0.00	0.00	100.00
6.3	0.00	0.00	100.00
5.0	0.00	0.00	100.00
2.0	0.03	0.06	99.94
1.180	0.19	0.38	99.56
0.600	0.46	0.92	98.64
0.425	0.76	1.52	97.12
0.300	3.46	6.92	90.20
0.212	10.27	20.54	69.66
0.150	10.57	21.14	48.52
0.063	13.81	27.62	20.90
TOTAL	**39.55**		

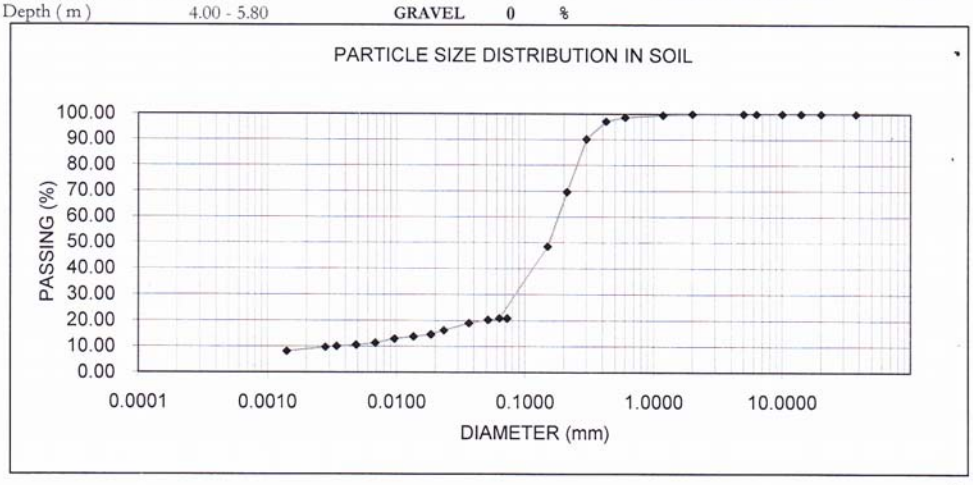
Borehole/ Sample No. : MW6 - 1
Depth (m) 4.00 - 5.80

Hydrometer analysis (Fine grained)

Time 10.00	Elapsed Time	Hydrometer Reading Rh'	Rh'-Cm = Rh	Particle Diameter D (mm)	Modified Hydrometer Reading	% Finer Than D K %
10.00	30 secs	6.42	6.22	0.0725	6.42	20.87
10.01	1 min	6.25	6.05	0.0514	6.25	20.31
10.02	2 mins	5.85	5.65	0.0365	5.85	19.01
10.04	5 mins	5.00	4.80	0.0233	5.00	16.25
10.08	8 mins	4.50	4.30	0.0185	4.50	14.63
10.15	15 mins	4.25	4.05	0.0136	4.25	13.81
10.30	30 mins	4.00	3.80	0.0096	4.00	13.00
11.00	1 hours	3.50	3.30	0.0068	3.50	11.38
12.00	2 hours	3.25	3.05	0.0048	3.25	10.56
14.00	4 hours	3.10	2.90	0.0034	3.10	10.08
16.00	6 hours	3.00	2.80	0.0028	3.00	9.75
10.00	24 hours	2.50	2.30	0.0014	2.50	8.13

CLAY	10	%
SILT	11	%
SAND	79	%
GRAVEL	0	%

Lab. Ref. : Z 2609/09
Date Tested : 11.09.2009
Tested By : Amir / Safri
Weight of Sample (gm) 50.00



Z-DSAC LABORATORIES (001144285-D)

CIDB MALAYSIA No. 1991102-SL054181

Site Investigation - Soil, Asphaltic & Concrete Testing - Chemical Testing - Field Instrumentation

PARTICLE SIZE DISTRIBUTION GRADATION CURVE

BS 1377 : Part 2 : 1990

Client : **NAHRIM**
Contractor : **MULTICALL CARD (M) SDN. BHD.**
Project : ANALYSIS SAIZ BUTIRAN TELAGA PEMONITORAN DAN TELAGA EKSPLORASI
: AIR BAWAH TANAH DI JENDERAM HILIR, DENGKIL, SELANGOR DARUL EHSA

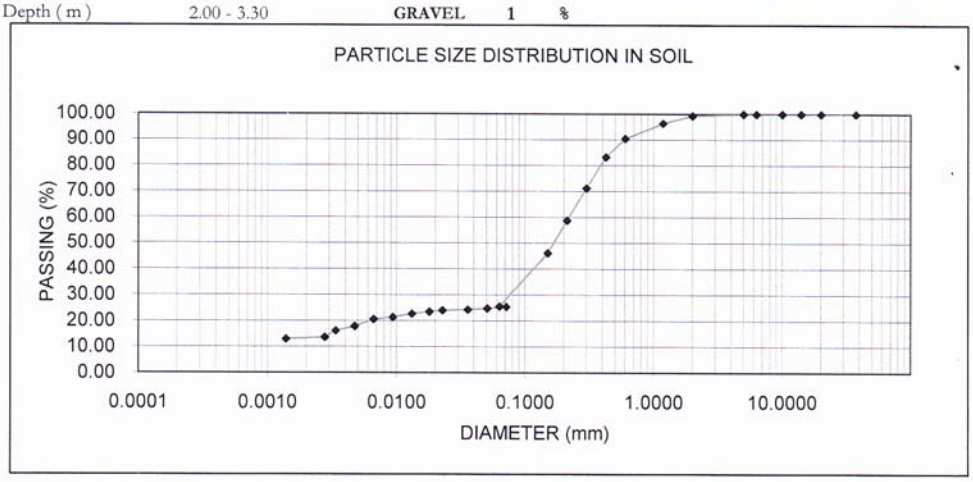
Sieve analysis (Coarse grained)			
BS Sieve	Weight Retained	Retained	Passing
mm	(gm)	%	%
37.5	0.00	0.00	100.00
20.0	0.00	0.00	100.00
14.0	0.00	0.00	100.00
10.0	0.00	0.00	100.00
6.3	0.00	0.00	100.00
5.0	0.00	0.00	100.00
2.0	0.34	0.68	99.32
1.180	1.46	2.92	96.40
0.600	3.00	6.00	90.40
0.425	3.58	7.16	83.24
0.300	6.00	12.00	71.24
0.212	6.25	12.50	58.74
0.150	6.29	12.58	46.16
0.063	10.27	20.54	25.62
TOTAL	**37.19**		

Borehole/ Sample No. : MW8 - 1
Depth (m) 2.00 - 3.30

Hydrometer analysis (Fine grained)						
Time	Elapsed Time	Hydrometer Reading Rh'	Rh'-Cm = Rh	Particle Diameter D (mm)	Modified Hydrometer Reading	% Finer Than D K %
9.20						
9.20	30 secs	7.85	7.65	0.0713	7.85	25.51
9.21	1 min	7.65	7.45	0.0506	7.65	24.86
9.22	2 mins	7.50	7.30	0.0358	7.50	24.38
9.24	5 mins	7.40	7.20	0.0227	7.40	24.05
9.28	8 mins	7.25	7.05	0.0180	7.25	23.56
9.35	15 mins	7.00	6.80	0.0132	7.00	22.75
9.50	30 mins	6.58	6.38	0.0093	6.58	21.39
10.20	1 hours	6.34	6.14	0.0066	6.34	20.61
11.20	2 hours	5.50	5.30	0.0047	5.50	17.88
13.20	4 hours	5.00	4.80	0.0034	5.00	16.25
15.20	6 hours	4.20	4.00	0.0028	4.20	13.65
9.20	24 hours	4.00	3.80	0.0014	4.00	13.00

CLAY	14	%
SILT	12	%
SAND	73	%
GRAVEL	1	%

Lab. Ref. : Z 2609/09
Date Tested : 11.09.2009
Tested By : Amir / Safri
Weight of Sample (gm) 50.00



Z-DSAC LABORATORIES (001144285-D)

CIDB MALAYSIA No. 1991102-SL054181

Site Investigation - Soil, Asphaltic & Concrete Testing - Chemical Testing - Field Instrumentation

PARTICLE SIZE DISTRIBUTION GRADATION CURVE

BS 1377 : Part 2 : 1990

Client : **NAHRIM**
Contractor : **MULTICALL CARD (M) SDN. BHD.**
Project : ANALYSIS SAIZ BUTIRAN TELAGA PEMONITORAN DAN TELAGA EKSPLORASI
: AIR BAWAH TANAH DI JENDERAM HILIR, DENGKIL, SELANGOR DARUL EHSA

Sieve analysis (Coarse grained)

BS Sieve mm	Weight Retained (gm)	Retained %	Passing %
37.5	0.00	0.00	100.00
20.0	0.00	0.00	100.00
14.0	0.00	0.00	100.00
10.0	0.00	0.00	100.00
6.3	0.00	0.00	100.00
5.0	0.00	0.00	100.00
2.0	0.00	0.00	100.00
1.180	0.14	0.28	99.72
0.600	0.46	0.92	98.80
0.425	1.13	2.26	96.54
0.300	3.59	7.18	89.36
0.212	6.74	13.48	75.88
0.150	7.23	14.46	61.42
0.063	14.96	29.92	31.50
TOTAL	**34.25**		

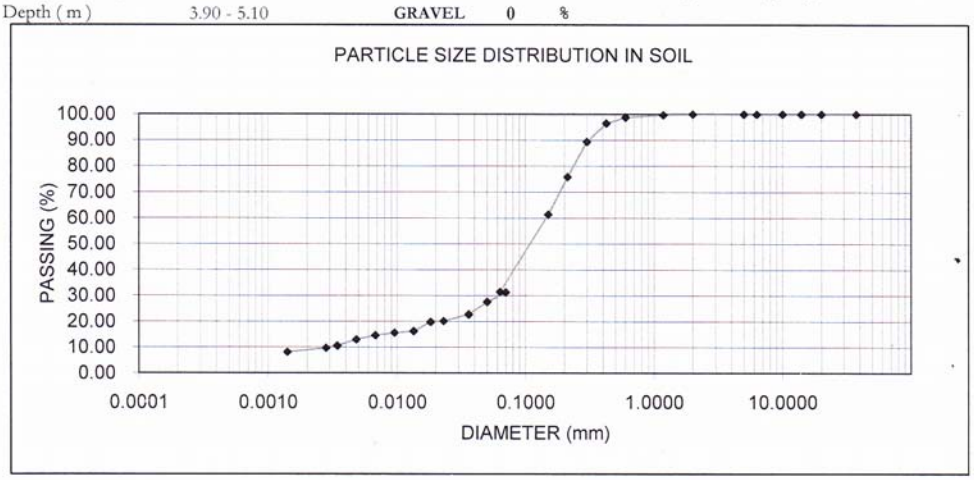
Borehole/ Sample No. : MW8 - 2
Depth (m) 3.90 - 5.10

Hydrometer analysis (Fine grained)

Time 8.30	Elapsed Time	Hydrometer Reading Rh'	Rh'-Cm = Rh	Particle Diameter D (mm)	Modified Hydrometer Reading	% Finer Than D K %
8.30	30 secs	9.63	9.43	0.0698	9.63	31.30
8.31	1 min	8.50	8.30	0.0501	8.50	27.63
8.32	2 mins	7.00	6.80	0.0360	7.00	22.75
8.34	5 mins	6.20	6.00	0.0230	6.20	20.15
8.38	8 mins	6.10	5.90	0.0182	6.10	19.83
8.45	15 mins	5.00	4.80	0.0135	5.00	16.25
8.60	30 mins	4.80	4.60	0.0095	4.80	15.60
9.30	1 hours	4.50	4.30	0.0068	4.50	14.63
10.30	2 hours	4.00	3.80	0.0048	4.00	13.00
12.30	4 hours	3.25	3.05	0.0034	3.25	10.56
14.30	6 hours	3.00	2.80	0.0028	3.00	9.75
8.30	24 hours	2.50	2.30	0.0014	2.50	8.13

CLAY	10	%
SILT	22	%
SAND	68	%
GRAVEL	0	%

Lab. Ref. : Z 2609/09
Date Tested : 11.09.2009
Tested By : Amir / Safri
Weight of Sample (gm) 50.00



Z-DSAC LABORATORIES (001144285-D)

CIDB MALAYSIA No. 1991102-SL054181

Site Investigation - Soil, Asphaltic & Concrete Testing - Chemical Testing - Field Instrumentation

PARTICLE SIZE DISTRIBUTION GRADATION CURVE

BS 1377 : Part 2 : 1990

Client : **NAHRIM**
Contractor : **MULTICALL CARD (M) SDN. BHD.**
Project : ANALYSIS SAIZ BUTIRAN TELAGA PEMONITORAN DAN TELAGA EKSPLORASI
: AIR BAWAH TANAH DI JENDERAM HILIR, DENGKIL, SELANGOR DARUL EHSA

Sieve analysis (Coarse grained)

BS Sieve mm	Weight Retained (gm)	Retained %	Passing %
37.5	0.00	0.00	100.00
20.0	0.00	0.00	100.00
14.0	0.00	0.00	100.00
10.0	0.00	0.00	100.00
6.3	0.00	0.00	100.00
5.0	0.25	0.50	99.50
2.0	1.62	3.24	96.26
1.180	6.69	13.38	82.88
0.600	12.62	25.24	57.64
0.425	6.24	12.48	45.16
0.300	6.00	12.00	33.16
0.212	4.13	8.26	24.90
0.150	2.28	4.56	20.34
0.063	3.29	6.58	13.76
TOTAL	**43.12**		

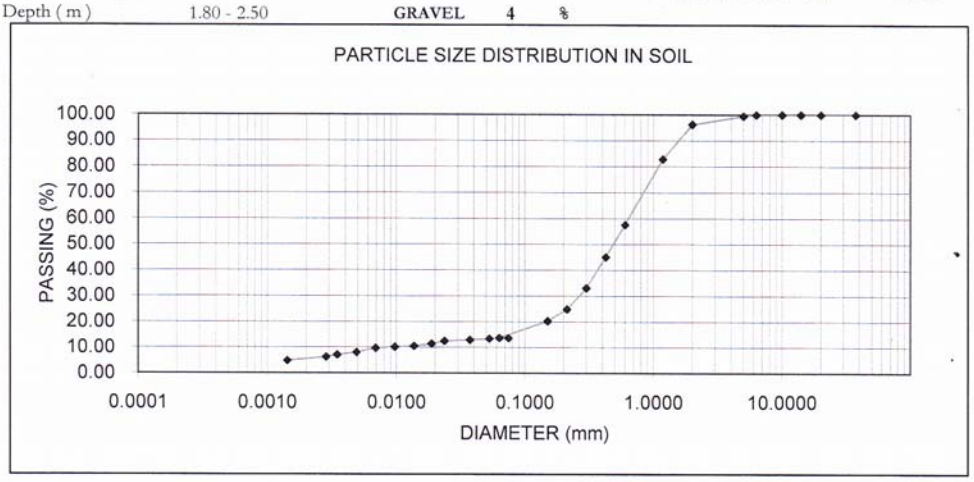
Borehole/ Sample No. : MW10 - 1
Depth (m) 1.80 - 2.50

Hydrometer analysis (Fine grained)

Time	Elapsed Time	Hydrometer Reading Rh'	Rh'-Cm = Rh	Particle Diameter D (mm)	Modified Hydrometer Reading	% Finer Than D K %
8.40						
8.40	30 secs	4.20	4.00	0.0743	4.20	13.65
8.41	1 min	4.15	3.95	0.0526	4.15	13.49
8.42	2 mins	4.00	3.80	0.0372	4.00	13.00
8.44	5 mins	3.85	3.65	0.0236	3.85	12.51
8.48	8 mins	3.55	3.35	0.0187	3.55	11.54
8.55	15 mins	3.25	3.05	0.0137	3.25	10.56
8.70	30 mins	3.15	2.95	0.0097	3.15	10.24
9.40	1 hours	3.00	2.80	0.0069	3.00	9.75
10.40	2 hours	2.50	2.30	0.0049	2.50	8.13
12.40	4 hours	2.20	2.00	0.0035	2.20	7.15
14.40	6 hours	1.95	1.75	0.0028	1.95	6.34
8.40	24 hours	1.50	1.30	0.0014	1.50	4.88

CLAY	6	%
SILT	8	%
SAND	82	%
GRAVEL	4	%

Lab. Ref. : Z 2609/09
Date Tested : 11.09.2009
Tested By : Amir / Safri
Weight of Sample (gm) 50.00



Z-DSAC LABORATORIES (001144285-D)

CIDB MALAYSIA No. 1991102-SL054181

Site Investigation - Soil, Asphaltic & Concrete Testing - Chemical Testing - Field Instrumentation

PARTICLE SIZE DISTRIBUTION GRADATION CURVE

BS 1377 : Part 2 : 1990

Client : **NAHRIM**
Contractor : **MULTICALL CARD (M) SDN. BHD.**
Project : ANALYSIS SAIZ BUTIRAN TELAGA PEMONITORAN DAN TELAGA EKSPLORASI
: AIR BAWAH TANAH DI JENDERAM HILIR, DENGKIL, SELANGOR DARUL EHSA

Sieve analysis (Coarse grained)

BS Sieve mm	Weight Retained (gm)	Retained %	Passing %
37.5	0.00	0.00	100.00
20.0	0.00	0.00	100.00
14.0	0.00	0.00	100.00
10.0	0.00	0.00	100.00
6.3	0.00	0.00	100.00
5.0	0.00	0.00	100.00
2.0	0.00	0.00	100.00
1.180	0.34	0.68	99.32
0.600	0.78	1.56	97.76
0.425	0.46	0.92	96.84
0.300	0.49	0.98	95.86
0.212	0.30	0.60	95.26
0.150	0.20	0.40	94.86
0.063	1.72	3.44	91.42
TOTAL	**4.29**		

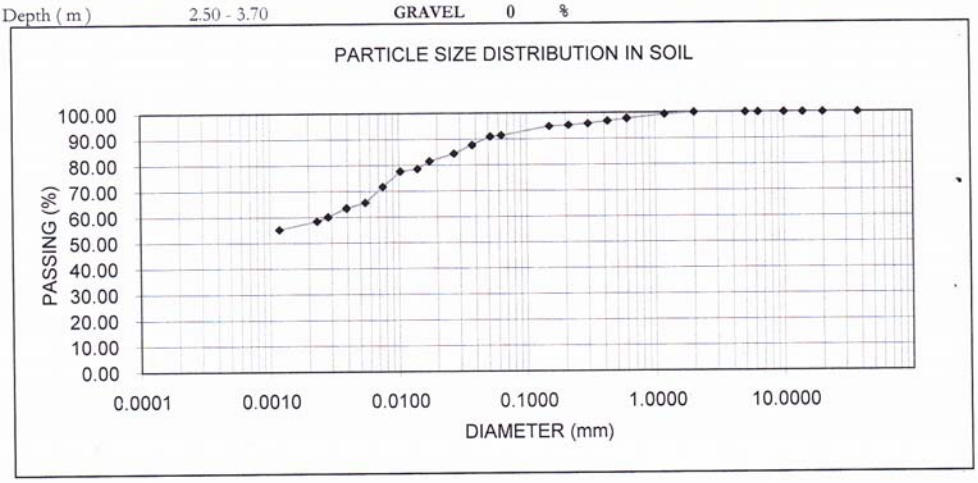
Borehole/ Sample No. : MW10 - 2
Depth (m) 2.50 - 3.70

Hydrometer analysis (Fine grained)

Time 8.55	Elapsed Time	Hydrometer Reading Rh'	Rh'-Cm = Rh	Particle Diameter D (mm)	Modified Hydrometer Reading	% Finer Than D K %
8.55	30 secs	28.00	27.80	0.0518	28.00	91.00
8.56	1 min	27.00	26.80	0.0375	27.00	87.75
8.57	2 mins	26.00	25.80	0.0270	26.00	84.50
8.59	5 mins	25.10	24.90	0.0174	25.10	81.58
8.63	8 mins	24.20	24.00	0.0140	24.20	78.65
8.70	15 mins	23.90	23.70	0.0103	23.90	77.68
8.85	30 mins	22.10	21.90	0.0075	22.10	71.83
9.55	1 hours	20.20	20.00	0.0055	20.20	65.65
10.55	2 hours	19.55	19.35	0.0039	19.55	63.54
12.55	4 hours	18.50	18.30	0.0028	18.50	60.13
14.55	6 hours	18.00	17.80	0.0023	18.00	58.50
8.55	24 hours	17.00	16.80	0.0012	17.00	55.25

CLAY	59	%
SILT	32	%
SAND	9	%
GRAVEL	0	%

Lab. Ref. : Z 2609/09
Date Tested : 11.09.2009
Tested By : Amir / Safri
Weight of Sample (gm) 50.00



Z-DSAC LABORATORIES (001144285-D)

CIDB MALAYSIA No. 1991102-SL054181

Site Investigation - Soil, Asphaltic & Concrete Testing - Chemical Testing - Field Instrumentation

PARTICLE SIZE DISTRIBUTION GRADATION CURVE

BS 1377 : Part 2 : 1990

Client : **NAHRIM**
Contractor : **MULTICALL CARD (M) SDN. BHD.**
Project : ANALYSIS SAIZ BUTIRAN TELAGA PEMONITORAN DAN TELAGA EKSPLORASI
: AIR BAWAH TANAH DI JENDERAM HILIR, DENGKIL, SELANGOR DARUL EHSA

Sieve analysis (Coarse grained)

BS Sieve mm	Weight Retained (gm)	Retained %	Passing %
37.5	0.00	0.00	100.00
20.0	0.00	0.00	100.00
14.0	0.00	0.00	100.00
10.0	0.00	0.00	100.00
6.3	0.00	0.00	100.00
5.0	0.00	0.00	100.00
2.0	0.07	0.14	99.86
1.180	0.25	0.50	99.36
0.600	0.25	0.50	98.86
0.425	0.15	0.30	98.56
0.300	0.24	0.48	98.08
0.212	0.31	0.62	97.46
0.150	0.41	0.82	96.64
0.063	16.82	33.64	63.00
TOTAL	**18.50**		

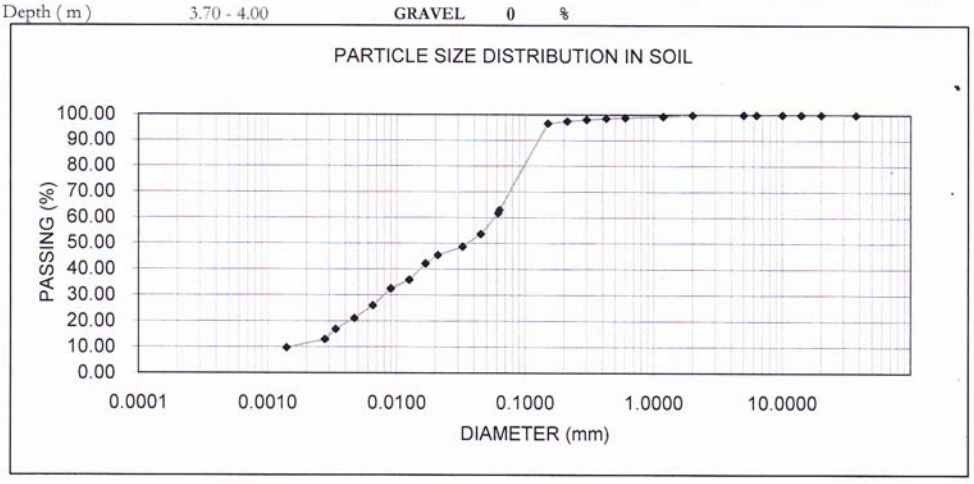
Borehole/ Sample No. : MW10 - 3
Depth (m) 3.70 - 4.00

Hydrometer analysis (Fine grained)

Time 8.10	Elapsed Time	Hydrometer Reading Rh'	Rh'-Cm = Rh	Particle Diameter D (mm)	Modified Hydrometer Reading	% Finer Than D K %
8.10	30 secs	19.00	18.80	0.0613	19.00	61.75
8.11	1 min	16.50	16.30	0.0450	16.50	53.63
8.12	2 mins	15.00	14.80	0.0325	15.00	48.75
8.14	5 mins	14.00	13.80	0.0209	14.00	45.50
8.18	8 mins	13.00	12.80	0.0167	13.00	42.25
8.25	15 mins	11.05	10.85	0.0125	11.05	35.91
8.40	30 mins	10.00	9.80	0.0090	10.00	32.50
9.10	1 hours	8.00	7.80	0.0065	8.00	26.00
10.10	2 hours	6.50	6.30	0.0047	6.50	21.13
12.10	4 hours	5.20	5.00	0.0034	5.20	16.90
14.10	6 hours	4.00	3.80	0.0028	4.00	13.00
8.10	24 hours	3.00	2.80	0.0014	3.00	9.75

CLAY	13	%
SILT	50	%
SAND	37	%
GRAVEL	0	%

Lab. Ref. : Z 2609/09
Date Tested : 11.09.2009
Tested By : Amir / Safri
Weight of Sample (gm) 50.00



Z-DSAC LABORATORIES (001144285-D)

CIDB MALAYSIA No. 1991102-SL054181

Site Investigation - Soil, Asphaltic & Concrete Testing - Chemical Testing - Field Instrumentation

PARTICLE SIZE DISTRIBUTION GRADATION CURVE

BS 1377 : Part 2 : 1990

Client : **NAHRIM**
Contractor : **MULTICALL CARD (M) SDN. BHD.**
Project : ANALYSIS SAIZ BUTIRAN TELAGA PEMONITORAN DAN TELAGA EKSPLORASI
: AIR BAWAH TANAH DI JENDERAM HILIR, DENGKIL, SELANGOR DARUL EHSA

Sieve analysis (Coarse grained)

BS Sieve	Weight Retained	Retained	Passing
mm	(gm)	%	%
37.5	0.00	0.00	100.00
20.0	0.00	0.00	100.00
14.0	0.00	0.00	100.00
10.0	0.00	0.00	100.00
6.3	0.00	0.00	100.00
5.0	0.00	0.00	100.00
2.0	0.11	0.22	99.78
1.180	2.97	5.94	93.84
0.600	12.22	24.44	69.40
0.425	9.19	18.38	51.02
0.300	9.07	18.14	32.88
0.212	5.93	11.86	21.02
0.150	2.27	4.54	16.48
0.063	3.59	7.18	9.30
TOTAL	**45.35**		

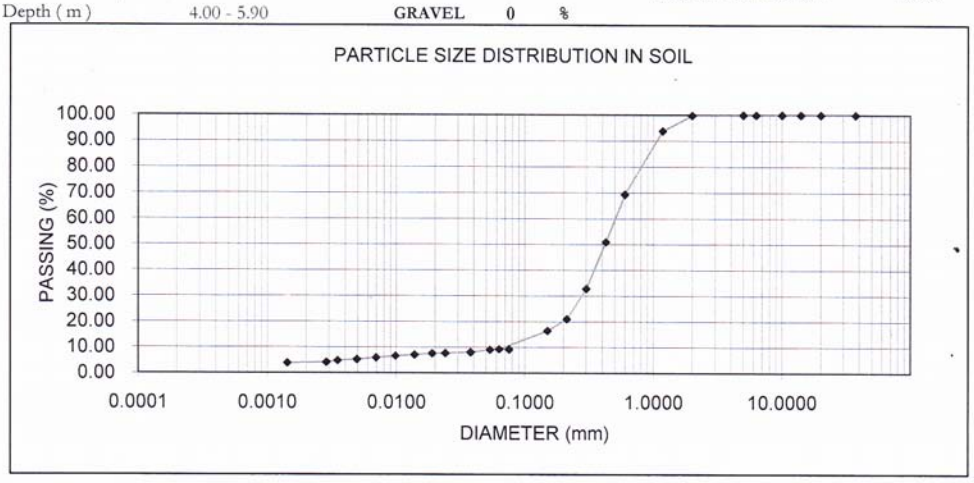
Borehole/ Sample No. : MW10 - 4
Depth (m) 4.00 - 5.90

Hydrometer analysis (Fine grained)

Time	Elapsed Time	Hydrometer Reading Rh'	Rh'-Cm = Rh	Particle Diameter D (mm)	Modified Hydrometer Reading	% Finer Than D K %
8.35						
8.35	30 secs	2.85	2.65	0.0754	2.85	9.26
8.36	1 min	2.80	2.60	0.0533	2.80	9.10
8.37	2 mins	2.50	2.30	0.0378	2.50	8.13
8.39	5 mins	2.40	2.20	0.0240	2.40	7.80
8.43	8 mins	2.35	2.15	0.0190	2.35	7.64
8.50	15 mins	2.20	2.00	0.0139	2.20	7.15
8.65	30 mins	2.05	1.85	0.0098	2.05	6.66
9.35	1 hours	1.85	1.65	0.0070	1.85	6.01
10.35	2 hours	1.65	1.45	0.0049	1.65	5.36
12.35	4 hours	1.50	1.30	0.0035	1.50	4.88
14.35	6 hours	1.30	1.10	0.0029	1.30	4.23
8.35	24 hours	1.20	1.00	0.0014	1.20	3.90

CLAY	4	%
SILT	5	%
SAND	91	%
GRAVEL	0	%

Lab. Ref. : Z 2609/09
Date Tested : 11.09.2009
Tested By : Amir / Safri
Weight of Sample (gm) 50.00



Z-DSAC LABORATORIES (001144285-D)

CIDB MALAYSIA No. 1991102-SL054181

Site Investigation - Soil, Asphaltic & Concrete Testing - Chemical Testing - Field Instrumentation

PARTICLE SIZE DISTRIBUTION GRADATION CURVE

BS 1377 : Part 2 : 1990

Client : **NAHRIM**
Contractor : **MULTICALL CARD (M) SDN. BHD.**
Project : ANALYSIS SAIZ BUTIRAN TELAGA PEMONITORAN DAN TELAGA EKSPLORASI
: AIR BAWAH TANAH DI JENDERAM HILIR, DENGKIL, SELANGOR DARUL EHSA

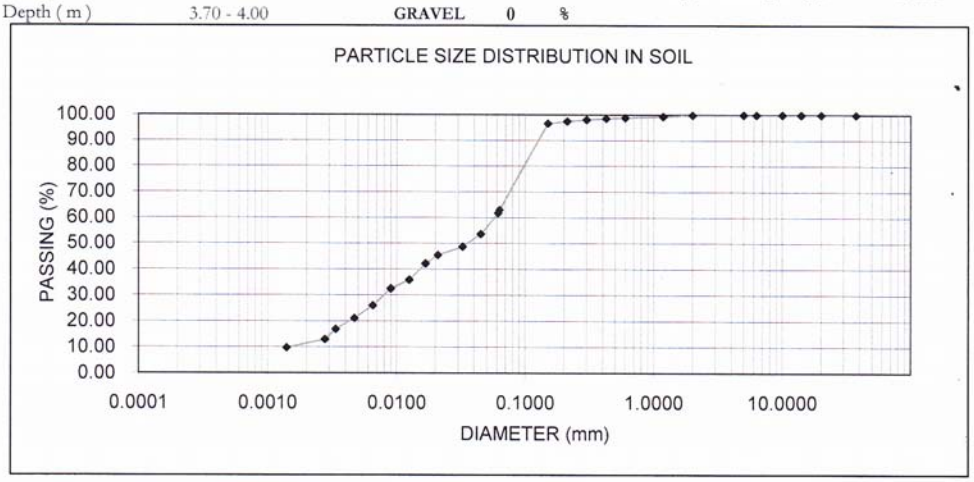
Sieve analysis (Coarse grained)			
BS Sieve	Weight Retained	Retained	Passing
mm	(gm)	%	%
37.5	0.00	0.00	100.00
20.0	0.00	0.00	100.00
14.0	0.00	0.00	100.00
10.0	0.00	0.00	100.00
6.3	0.00	0.00	100.00
5.0	0.00	0.00	100.00
2.0	0.07	0.14	99.86
1.180	0.25	0.50	99.36
0.600	0.25	0.50	98.86
0.425	0.15	0.30	98.56
0.300	0.24	0.48	98.08
0.212	0.31	0.62	97.46
0.150	0.41	0.82	96.64
0.063	16.82	33.64	63.00
TOTAL	**18.50**		

Borehole/ Sample No. : MW10 - 3
Depth (m) 3.70 - 4.00

Hydrometer analysis (Fine grained)						
Time	Elapsed Time	Hydrometer Reading Rh'	Rh'-Cm = Rh	Particle Diameter D (mm)	Modified Hydrometer Reading	% Finer Than D K %
8.10						
8.10	30 secs	19.00	18.80	0.0613	19.00	61.75
8.11	1 min	16.50	16.30	0.0450	16.50	53.63
8.12	2 mins	15.00	14.80	0.0325	15.00	48.75
8.14	5 mins	14.00	13.80	0.0209	14.00	45.50
8.18	8 mins	13.00	12.80	0.0167	13.00	42.25
8.25	15 mins	11.05	10.85	0.0125	11.05	35.91
8.40	30 mins	10.00	9.80	0.0090	10.00	32.50
9.10	1 hours	8.00	7.80	0.0065	8.00	26.00
10.10	2 hours	6.50	6.30	0.0047	6.50	21.13
12.10	4 hours	5.20	5.00	0.0034	5.20	16.90
14.10	6 hours	4.00	3.80	0.0028	4.00	13.00
8.10	24 hours	3.00	2.80	0.0014	3.00	9.75

CLAY	13	%
SILT	50	%
SAND	37	%
GRAVEL	0	%

Lab. Ref. : Z 2609/09
Date Tested : 11.09.2009
Tested By : Amir / Safri
Weight of Sample (gm) 50.00



Z-DSAC LABORATORIES (001144285-D)

CIDB MALAYSIA No. 1991102-SL054181

Site Investigation - Soil, Asphaltic & Concrete Testing - Chemical Testing - Field Instrumentation

PARTICLE SIZE DISTRIBUTION GRADATION CURVE

BS 1377 : Part 2 : 1990

Client : **NAHRIM**
Contractor : **MULTICALL CARD (M) SDN. BHD.**
Project : ANALYSIS SAIZ BUTIRAN TELAGA PEMONITORAN DAN TELAGA EKSPLORASI
: AIR BAWAH TANAH DI JENDERAM HILIR, DENGKIL, SELANGOR DARUL EHSA

Sieve analysis (Coarse grained)

BS Sieve	Weight Retained	Retained	Passing
mm	(gm)	%	%
37.5	0.00	0.00	100.00
20.0	0.00	0.00	100.00
14.0	0.00	0.00	100.00
10.0	0.00	0.00	100.00
6.3	0.00	0.00	100.00
5.0	0.00	0.00	100.00
2.0	0.11	0.22	99.78
1.180	2.97	5.94	93.84
0.600	12.22	24.44	69.40
0.425	9.19	18.38	51.02
0.300	9.07	18.14	32.88
0.212	5.93	11.86	21.02
0.150	2.27	4.54	16.48
0.063	3.59	7.18	9.30
TOTAL	**45.35**		

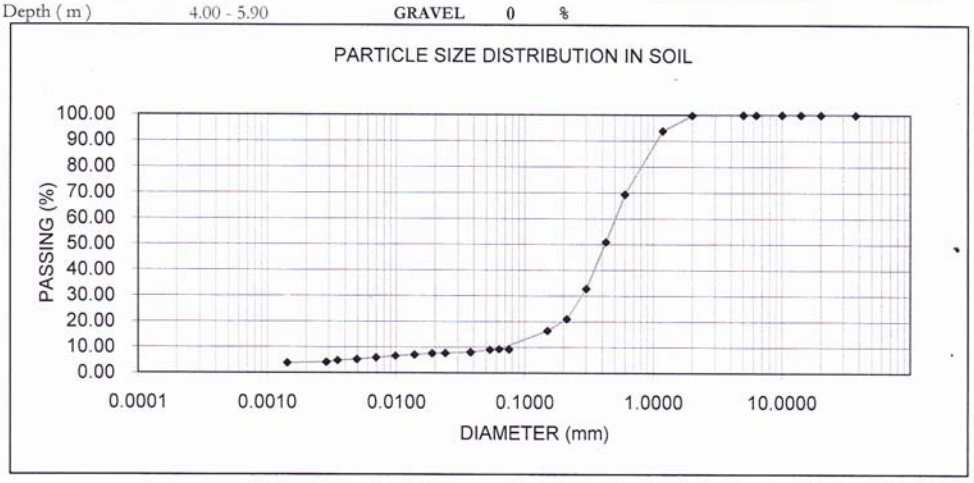
Borehole/ Sample No. : MW10 - 4
Depth (m) 4.00 - 5.90

Hydrometer analysis (Fine grained)

Time	Elapsed Time	Hydrometer Reading Rh'	Rh'-Cm = Rh	Particle Diameter D (mm)	Modified Hydrometer Reading	% Finer Than D K %
8.35						
8.35	30 secs	2.85	2.65	0.0754	2.85	9.26
8.36	1 min	2.80	2.60	0.0533	2.80	9.10
8.37	2 mins	2.50	2.30	0.0378	2.50	8.13
8.39	5 mins	2.40	2.20	0.0240	2.40	7.80
8.43	8 mins	2.35	2.15	0.0190	2.35	7.64
8.50	15 mins	2.20	2.00	0.0139	2.20	7.15
8.65	30 mins	2.05	1.85	0.0098	2.05	6.66
9.35	1 hours	1.85	1.65	0.0070	1.85	6.01
10.35	2 hours	1.65	1.45	0.0049	1.65	5.36
12.35	4 hours	1.50	1.30	0.0035	1.50	4.88
14.35	6 hours	1.30	1.10	0.0029	1.30	4.23
8.35	24 hours	1.20	1.00	0.0014	1.20	3.90

CLAY	4	%
SILT	5	%
SAND	91	%
GRAVEL	0	%

Lab. Ref. : Z 2609/09
Date Tested : 11.09.2009
Tested By : Amir / Safri
Weight of Sample (gm) 50.00



Z-DSAC LABORATORIES (001144285-D)

CIDB MALAYSIA No. 1991102-SL054181

Site Investigation - Soil, Asphaltic & Concrete Testing - Chemical Testing - Field Instrumentation

PARTICLE SIZE DISTRIBUTION GRADATION CURVE

BS 1377 : Part 2 : 1990

Client : **NAHRIM**
Contractor : **MULTICALL CARD (M) SDN. BHD.**
Project : ANALYSIS SAIZ BUTIRAN TELAGA PEMONITORAN DAN TELAGA EKSPLORASI
: AIR BAWAH TANAH DI JENDERAM HILIR, DENGKIL, SELANGOR DARUL EHSA

Sieve analysis (Coarse grained)

BS Sieve mm	Weight Retained (gm)	Retained %	Passing %
37.5	0.00	0.00	100.00
20.0	0.00	0.00	100.00
14.0	0.00	0.00	100.00
10.0	0.00	0.00	100.00
6.3	0.00	0.00	100.00
5.0	0.00	0.00	100.00
2.0	0.40	0.80	99.20
1.180	2.88	5.76	93.44
0.600	5.62	11.24	82.20
0.425	3.70	7.40	74.80
0.300	4.59	9.18	65.62
0.212	5.48	10.96	54.66
0.150	5.50	11.00	43.66
0.063	10.21	20.42	23.24
TOTAL	**38.38**		

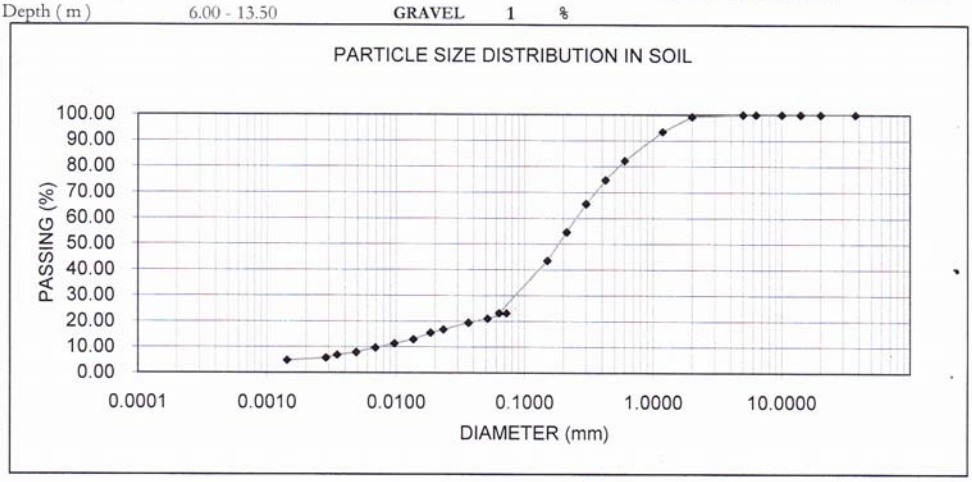
Borehole/ Sample No. : MW11 - 1
Depth (m) 6.00 - 13.50

Hydrometer analysis (Fine grained)

Time 8.25	Elapsed Time	Hydrometer Reading Rh'	Rh'-Cm = Rh	Particle Diameter D (mm)	Modified Hydrometer Reading	% Finer Than D K %
8.25	30 secs	7.15	6.95	0.0719	7.15	23.24
8.26	1 min	6.50	6.30	0.0512	6.50	21.13
8.27	2 mins	6.00	5.80	0.0364	6.00	19.50
8.29	5 mins	5.20	5.00	0.0233	5.20	16.90
8.33	8 mins	4.80	4.60	0.0185	4.80	15.60
8.40	15 mins	4.00	3.80	0.0136	4.00	13.00
8.55	30 mins	3.50	3.30	0.0097	3.50	11.38
9.25	1 hours	3.00	2.80	0.0069	3.00	9.75
10.25	2 hours	2.45	2.25	0.0049	2.45	7.96
12.25	4 hours	2.15	1.95	0.0035	2.15	6.99
14.25	6 hours	1.80	1.60	0.0028	1.80	5.85
8.25	24 hours	1.50	1.30	0.0014	1.50	4.88

CLAY	6	%
SILT	17	%
SAND	76	%
GRAVEL	1	%

Lab. Ref. : Z 2609/09
Date Tested : 11.09.2009
Tested By : Amir / Safri
Weight of Sample (gm) 50.00



Z-DSAC LABORATORIES (001144285-D)

CIDB MALAYSIA No. 1991102-SL054181

Site Investigation - Soil, Asphaltic & Concrete Testing - Chemical Testing - Field Instrumentation

PARTICLE SIZE DISTRIBUTION GRADATION CURVE

BS 1377 : Part 2 : 1990

Client : **NAHRIM**
Contractor : **MULTICALL CARD (M) SDN. BHD.**
Project : ANALYSIS SAIZ BUTIRAN TELAGA PEMONITORAN DAN TELAGA EKSPLORASI
: AIR BAWAH TANAH DI JENDERAM HILIR, DENGKIL, SELANGOR DARUL EHSA

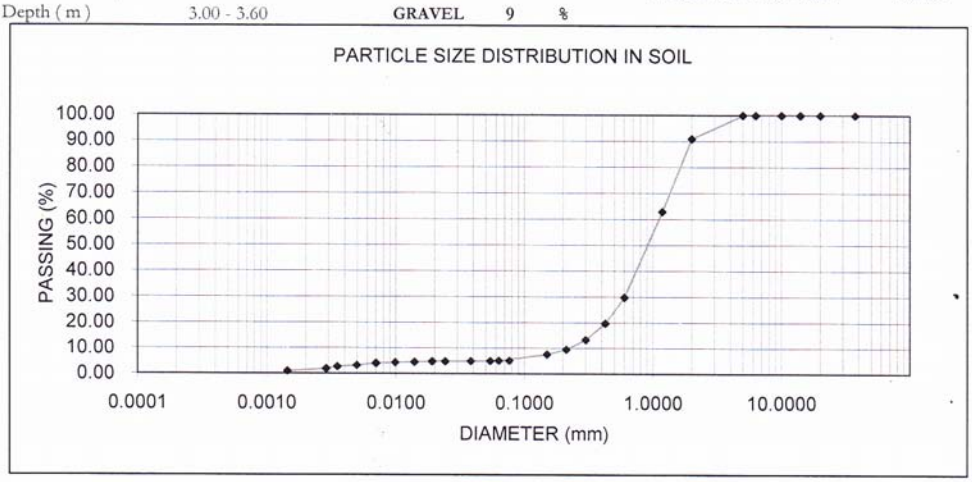
Sieve analysis (Coarse grained)			
BS Sieve	Weight Retained	Retained	Passing
mm	(gm)	%	%
37.5	0.00	0.00	100.00
20.0	0.00	0.00	100.00
14.0	0.00	0.00	100.00
10.0	0.00	0.00	100.00
6.3	0.00	0.00	100.00
5.0	0.00	0.00	100.00
2.0	4.56	9.12	90.88
1.180	13.98	27.96	62.92
0.600	16.55	33.10	29.82
0.425	5.02	10.04	19.78
0.300	3.22	6.44	13.34
0.212	1.88	3.76	9.58
0.150	0.97	1.94	7.64
0.063	1.24	2.48	5.16
TOTAL	**47.42**		

Borehole/ Sample No. : MW12 - 1
Depth (m) 3.00 - 3.60

Hydrometer analysis (Fine grained)						
Time	Elapsed Time	Hydrometer Reading Rh'	Rh'-Cm = Rh	Particle Diameter D (mm)	Modified Hydrometer Reading	% Finer Than D K %
8.20						
8.20	30 secs	1.58	1.38	0.0764	1.58	5.14
8.21	1 min	1.55	1.35	0.0540	1.55	5.04
8.22	2 mins	1.53	1.33	0.0382	1.53	4.97
8.24	5 mins	1.50	1.30	0.0242	1.50	4.88
8.28	8 mins	1.48	1.28	0.0191	1.48	4.81
8.35	15 mins	1.42	1.22	0.0140	1.42	4.62
8.50	30 mins	1.35	1.15	0.0099	1.35	4.39
9.20	1 hours	1.25	1.05	0.0070	1.25	4.06
10.20	2 hours	1.00	0.80	0.0050	1.00	3.25
12.20	4 hours	0.85	0.65	0.0035	0.85	2.76
14.20	6 hours	0.60	0.40	0.0029	0.60	1.95
8.20	24 hours	0.30	0.10	0.0014	0.30	0.98

CLAY	2	%
SILT	3	%
SAND	86	%
GRAVEL	9	%

Lab. Ref. : Z 2609/09
Date Tested : 11.09.2009
Tested By : Amir / Safri
Weight of Sample (gm) 50.00



Z-DSAC LABORATORIES (001144285-D)

CIDB MALAYSIA No. 1991102-SL054181

Site Investigation - Soil, Asphaltic & Concrete Testing - Chemical Testing - Field Instrumentation

PARTICLE SIZE DISTRIBUTION GRADATION CURVE

BS 1377 : Part 2 : 1990

Client : **NAHRIM**
Contractor : **MULTICALL CARD (M) SDN. BHD.**
Project : ANALYSIS SAIZ BUTIRAN TELAGA PEMONITORAN DAN TELAGA EKSPLORASI
: AIR BAWAH TANAH DI JENDERAM HILIR, DENGKIL, SELANGOR DARUL EHSA

Sieve analysis (Coarse grained)

BS Sieve mm	Weight Retained (gm)	Retained %	Passing %
37.5	0.00	0.00	100.00
20.0	0.00	0.00	100.00
14.0	0.00	0.00	100.00
10.0	0.00	0.00	100.00
6.3	0.00	0.00	100.00
5.0	0.56	1.12	98.88
2.0	2.24	4.48	94.40
1.180	3.69	7.38	87.02
0.600	6.44	12.88	74.14
0.425	3.73	7.46	66.68
0.300	3.95	7.90	58.78
0.212	3.36	6.72	52.06
0.150	2.55	5.10	46.96
0.063	4.44	8.88	38.08
TOTAL	**30.96**		

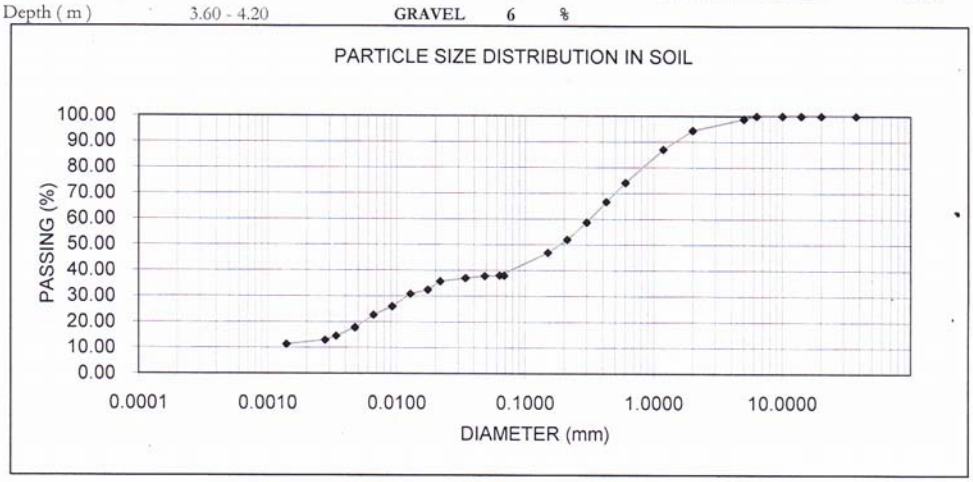
Borehole/ Sample No. : MW12 - 2
Depth (m) 3.60 - 4.20

Hydrometer analysis (Fine grained)

Time 9.45	Elapsed Time	Hydrometer Reading Rh'	Rh'-Cm = Rh	Particle Diameter D (mm)	Modified Hydrometer Reading	% Finer Than D K %
9.45	30 secs	11.70	11.50	0.0681	11.70	38.03
9.46	1 min	11.65	11.45	0.0481	11.65	37.86
9.47	2 mins	11.40	11.20	0.0342	11.40	37.05
9.49	5 mins	11.00	10.80	0.0217	11.00	35.75
9.53	8 mins	10.00	9.80	0.0174	10.00	32.50
9.60	15 mins	9.50	9.30	0.0128	9.50	30.88
9.75	30 mins	8.00	7.80	0.0092	8.00	26.00
10.45	1 hours	7.00	6.80	0.0066	7.00	22.75
11.45	2 hours	5.50	5.30	0.0047	5.50	17.88
13.45	4 hours	4.50	4.30	0.0034	4.50	14.63
15.45	6 hours	4.00	3.80	0.0028	4.00	13.00
9.45	24 hours	3.50	3.30	0.0014	3.50	11.38

CLAY	13	%
SILT	25	%
SAND	56	%
GRAVEL	6	%

Lab. Ref. : Z 2609/09
Date Tested : 11.09.2009
Tested By : Amir / Safri
Weight of Sample (gm) 50.00



Z-DSAC LABORATORIES (001144285-D)

CIDB MALAYSIA No. 1991102-SL054181

Site Investigation - Soil, Asphaltic & Concrete Testing - Chemical Testing - Field Instrumentation

PARTICLE SIZE DISTRIBUTION GRADATION CURVE

BS 1377 : Part 2 : 1990

Client : **NAHRIM**
Contractor : **MULTICALL CARD (M) SDN. BHD.**
Project : ANALYSIS SAIZ BUTIRAN TELAGA PEMONITORAN DAN TELAGA EKSPLORASI
: AIR BAWAH TANAH DI JENDERAM HILIR, DENGKIL, SELANGOR DARUL EHSA

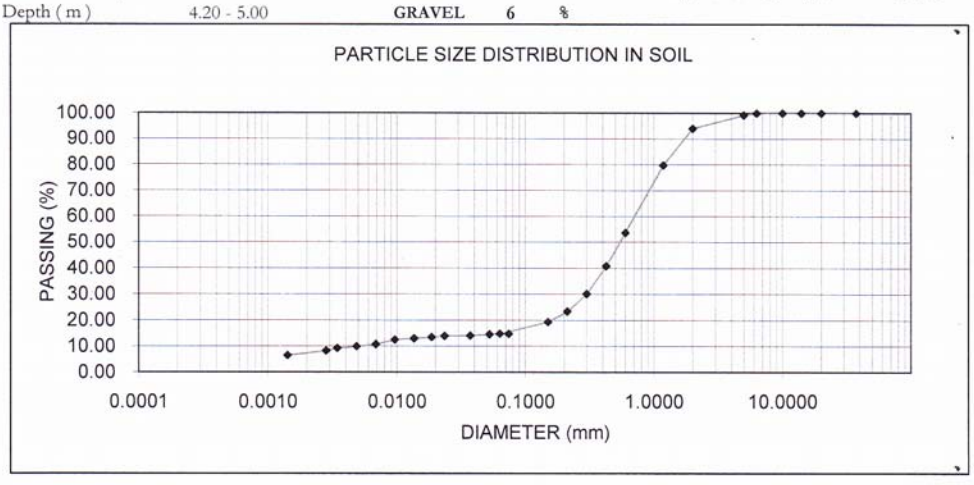
Sieve analysis (Coarse grained)			
BS Sieve	Weight Retained	Retained	Passing
mm	(gm)	%	%
37.5	0.00	0.00	100.00
20.0	0.00	0.00	100.00
14.0	0.00	0.00	100.00
10.0	0.00	0.00	100.00
6.3	0.00	0.00	100.00
5.0	0.39	0.78	99.22
2.0	2.58	5.16	94.06
1.180	7.15	14.30	79.76
0.600	13.00	26.00	53.76
0.425	6.44	12.88	40.88
0.300	5.38	10.76	30.12
0.212	3.36	6.72	23.40
0.150	2.01	4.02	19.38
0.063	2.27	4.54	14.84
TOTAL	**42.58**		

Borehole/ Sample No. : MW12 - 3
Depth (m) 4.20 - 5.00

Hydrometer analysis (Fine grained)						
Time	Elapsed Time	Hydrometer Reading Rh'	Rh'-Cm = Rh	Particle Diameter D (mm)	Modified Hydrometer Reading	% Finer Than D K %
9.30						
9.30	30 secs	4.55	4.35	0.0741	4.55	14.79
9.31	1 min	4.50	4.30	0.0524	4.50	14.63
9.32	2 mins	4.35	4.15	0.0371	4.35	14.14
9.34	5 mins	4.30	4.10	0.0235	4.30	13.98
9.38	8 mins	4.15	3.95	0.0186	4.15	13.49
9.45	15 mins	4.00	3.80	0.0136	4.00	13.00
9.60	30 mins	3.85	3.65	0.0096	3.85	12.51
10.30	1 hours	3.30	3.10	0.0069	3.30	10.73
11.30	2 hours	3.05	2.85	0.0049	3.05	9.91
13.30	4 hours	2.85	2.65	0.0034	2.85	9.26
15.30	6 hours	2.55	2.35	0.0028	2.55	8.29
9.30	24 hours	2.00	1.80	0.0014	2.00	6.50

CLAY	8	%
SILT	7	%
SAND	79	%
GRAVEL	6	%

Lab. Ref. : Z 2609/09
Date Tested : 11.09.2009
Tested By : Amir / Safri
Weight of Sample (gm) 50.00



Z-DSAC LABORATORIES (001144285-D)

CIDB MALAYSIA No. 1991102-SL054181

Site Investigation - Soil, Asphaltic & Concrete Testing - Chemical Testing - Field Instrumentation

PARTICLE SIZE DISTRIBUTION GRADATION CURVE

BS 1377 : Part 2 : 1990

Client : **NAHRIM**
Contractor : **MULTICALL CARD (M) SDN. BHD.**
Project : ANALYSIS SAIZ BUTIRAN TELAGA PEMONITORAN DAN TELAGA EKSPLORASI
: AIR BAWAH TANAH DI JENDERAM HILIR, DENGKIL, SELANGOR DARUL EHSA

Sieve analysis (Coarse grained)

BS Sieve mm	Weight Retained (gm)	Retained %	Passing %
37.5	0.00	0.00	100.00
20.0	0.00	0.00	100.00
14.0	0.00	0.00	100.00
10.0	0.00	0.00	100.00
6.3	0.00	0.00	100.00
5.0	2.40	4.80	95.20
2.0	3.80	7.60	87.60
1.180	5.89	11.78	75.82
0.600	8.60	17.20	58.62
0.425	4.75	9.50	49.12
0.300	5.46	10.92	38.20
0.212	5.53	11.06	27.14
0.150	4.51	9.02	18.12
0.063	5.99	11.98	6.14
TOTAL	**46.93**		

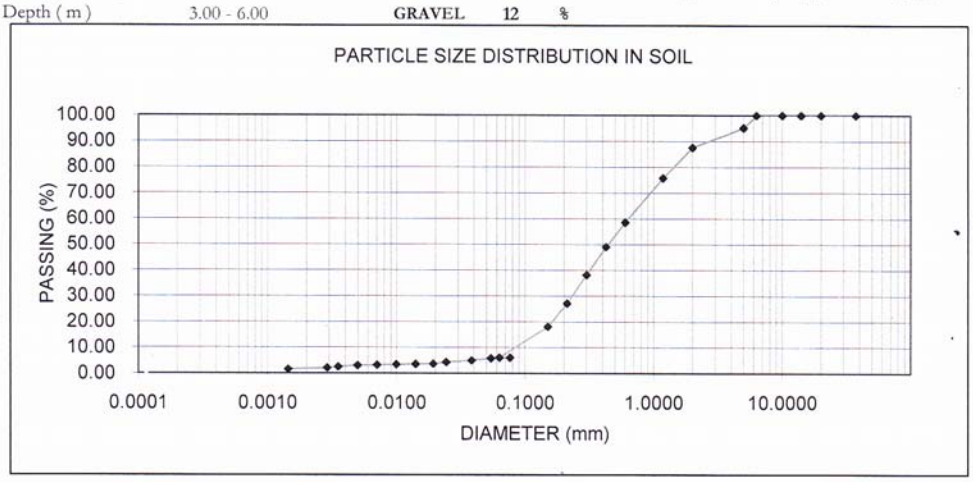
Borehole/ Sample No. : MW13 - 1
Depth (m) 3.00 - 6.00

Hydrometer analysis (Fine grained)

Time 8.45	Elapsed Time	Hydrometer Reading Rh'	Rh'-Cm = Rh	Particle Diameter D (mm)	Modified Hydrometer Reading	% Finer Than D K %
8.45	30 secs	1.88	1.68	0.0762	1.88	6.11
8.46	1 min	1.80	1.60	0.0539	1.80	5.85
8.47	2 mins	1.55	1.35	0.0382	1.55	5.04
8.49	5 mins	1.34	1.14	0.0242	1.34	4.36
8.53	8 mins	1.15	0.95	0.0192	1.15	3.74
8.60	15 mins	1.10	0.90	0.0140	1.10	3.58
8.75	30 mins	1.05	0.85	0.0099	1.05	3.41
9.45	1 hours	1.00	0.80	0.0070	1.00	3.25
10.45	2 hours	0.95	0.75	0.0050	0.95	3.09
12.45	4 hours	0.80	0.60	0.0035	0.80	2.60
14.45	6 hours	0.65	0.45	0.0029	0.65	2.11
8.45	24 hours	0.50	0.30	0.0014	0.50	1.63

CLAY	2	%
SILT	4	%
SAND	82	%
GRAVEL	12	%

Lab. Ref. : Z 2609/09
Date Tested : 11.09.2009
Tested By : Amir / Safri
Weight of Sample (gm) 50.00



Z-DSAC LABORATORIES (001144285-D)

CIDB MALAYSIA No. 1991102-SL054181

Site Investigation - Soil, Asphaltic & Concrete Testing - Chemical Testing - Field Instrumentation

PARTICLE SIZE DISTRIBUTION GRADATION CURVE

BS 1377 : Part 2 : 1990

Client : **NAHRIM**
Contractor : **MULTICALL CARD (M) SDN. BHD.**
Project : ANALYSIS SAIZ BUTIRAN TELAGA PEMONITORAN DAN TELAGA EKSPLORASI
: AIR BAWAH TANAH DI JENDERAM HILIR, DENGKIL, SELANGOR DARUL EHSA

Sieve analysis (Coarse grained)

BS Sieve mm	Weight Retained (gm)	Retained %	Passing %
37.5	0.00	0.00	100.00
20.0	0.00	0.00	100.00
14.0	0.00	0.00	100.00
10.0	0.00	0.00	100.00
6.3	0.00	0.00	100.00
5.0	0.00	0.00	100.00
2.0	0.25	0.50	99.50
1.180	1.77	3.54	95.96
0.600	9.23	18.46	77.50
0.425	6.46	12.92	64.58
0.300	7.36	14.72	49.86
0.212	7.27	14.54	35.32
0.150	6.02	12.04	23.28
0.063	7.23	14.46	8.82
TOTAL	**45.59**		

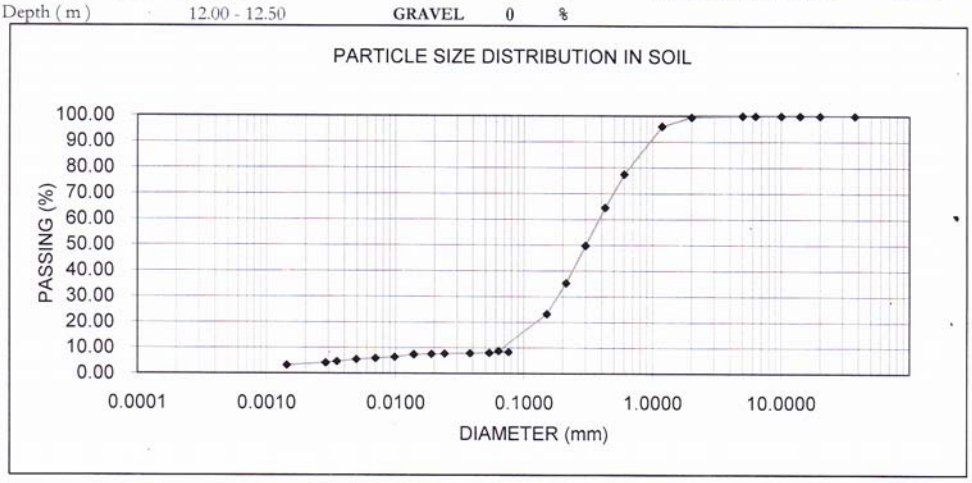
Borehole/ Sample No. : MW25 - 1
Depth (m) 12.00 - 12.50

Hydrometer analysis (Fine grained)

Time 9.40	Elapsed Time	Hydrometer Reading Rh'	Rh'-Cm = Rh	Particle Diameter D (mm)	Modified Hydrometer Reading	% Finer Than D K %
9.40	30 secs	2.60	2.40	0.0756	2.60	8.45
9.41	1 min	2.50	2.30	0.0535	2.50	8.13
9.42	2 mins	2.45	2.25	0.0379	2.45	7.96
9.44	5 mins	2.40	2.20	0.0240	2.40	7.80
9.48	8 mins	2.35	2.15	0.0190	2.35	7.64
9.55	15 mins	2.30	2.10	0.0138	2.30	7.48
9.70	30 mins	2.00	1.80	0.0098	2.00	6.50
10.40	1 hours	1.85	1.65	0.0070	1.85	6.01
11.40	2 hours	1.70	1.50	0.0049	1.70	5.53
13.40	4 hours	1.45	1.25	0.0035	1.45	4.71
15.40	6 hours	1.30	1.10	0.0029	1.30	4.23
9.40	24 hours	1.00	0.80	0.0014	1.00	3.25

CLAY	4	%
SILT	5	%
SAND	91	%
GRAVEL	0	%

Lab. Ref. : Z 2609/09
Date Tested : 11.09.2009
Tested By : Amir / Safri
Weight of Sample (gm) 50.00



Z-DSAC LABORATORIES (001144285-D)

CIDB MALAYSIA No. 1991102-SL054181

Site Investigation - Soil, Asphaltic & Concrete Testing - Chemical Testing - Field Instrumentation

PARTICLE SIZE DISTRIBUTION GRADATION CURVE

BS 1377 : Part 2 : 1990

Client : **NAHRIM**
Contractor : **MULTICALL CARD (M) SDN. BHD.**
Project : ANALYSIS SAIZ BUTIRAN TELAGA PEMONITORAN DAN TELAGA EKSPLORASI
: AIR BAWAH TANAH DI JENDERAM HILIR, DENGKIL, SELANGOR DARUL EHSA

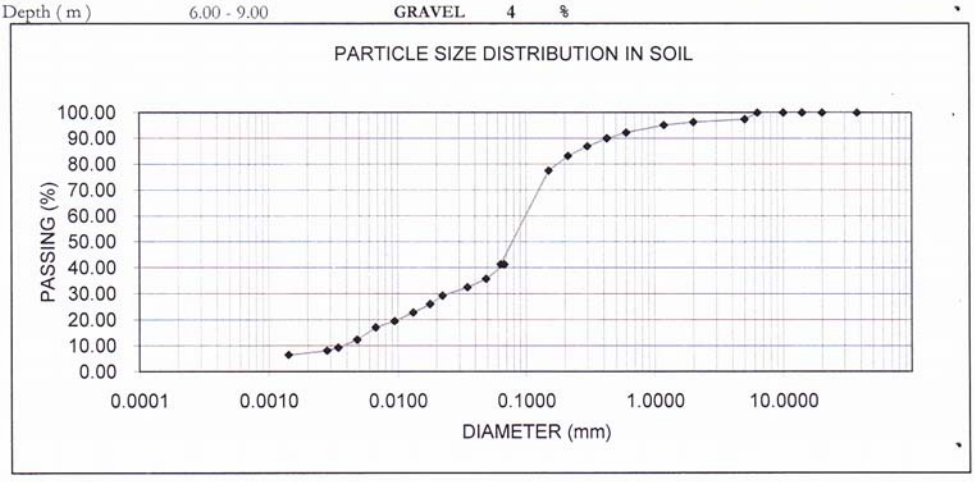
Sieve analysis (Coarse grained)			
BS Sieve mm	Weight Retained (gm)	Retained %	Passing %
37.5	0.00	0.00	100.00
20.0	0.00	0.00	100.00
14.0	0.00	0.00	100.00
10.0	0.00	0.00	100.00
6.3	0.00	0.00	100.00
5.0	1.28	2.56	97.44
2.0	0.56	1.12	96.32
1.180	0.57	1.14	95.18
0.600	1.47	2.94	92.24
0.425	1.12	2.24	90.00
0.300	1.54	3.08	86.92
0.212	1.87	3.74	83.18
0.150	2.80	5.60	77.58
0.063	18.11	36.22	41.36
TOTAL	**29.32**		

Borehole/ Sample No. : MW13 - 2
Depth (m) 6.00 - 9.00

Hydrometer analysis (Fine grained)						
Time 8.15	Elapsed Time	Hydrometer Reading Rh'	Rh'-Cm = Rh	Particle Diameter D (mm)	Modified Hydrometer Reading	% Finer Than D K %
8.15	30 secs	12.70	12.50	0.0672	12.70	41.28
8.16	1 min	11.00	10.80	0.0486	11.00	35.75
8.17	2 mins	10.00	9.80	0.0348	10.00	32.50
8.19	5 mins	9.00	8.80	0.0223	9.00	29.25
8.23	8 mins	8.00	7.80	0.0178	8.00	26.00
8.30	15 mins	7.00	6.80	0.0132	7.00	22.75
8.45	30 mins	6.00	5.80	0.0094	6.00	19.50
9.15	1 hours	5.25	5.05	0.0067	5.25	17.06
10.15	2 hours	3.80	3.60	0.0048	3.80	12.35
12.15	4 hours	2.85	2.65	0.0034	2.85	9.26
14.15	6 hours	2.50	2.30	0.0028	2.50	8.13
8.15	24 hours	2.00	1.80	0.0014	2.00	6.50

CLAY	8	%
SILT	33	%
SAND	55	%
GRAVEL	4	%

Lab. Ref. : Z 2609/09
Date Tested : 09.09.2009
Tested By : Amir / Safri
Weight of Sample (gm) 50.00



Z-DSAC LABORATORIES (001144285-D)

CIDB MALAYSIA No. 1991102-SL054181

Site Investigation - Soil, Asphaltic & Concrete Testing - Chemical Testing - Field Instrumentation

PARTICLE SIZE DISTRIBUTION GRADATION CURVE

BS 1377 : Part 2 : 1990

Client : **NAHRIM**
Contractor : **MULTICALL CARD (M) SDN. BHD.**
Project : ANALYSIS SAIZ BUTIRAN TELAGA PEMONITORAN DAN TELAGA EKSPLORASI
: AIR BAWAH TANAH DI JENDERAM HILIR, DENGKIL, SELANGOR DARUL EHSA

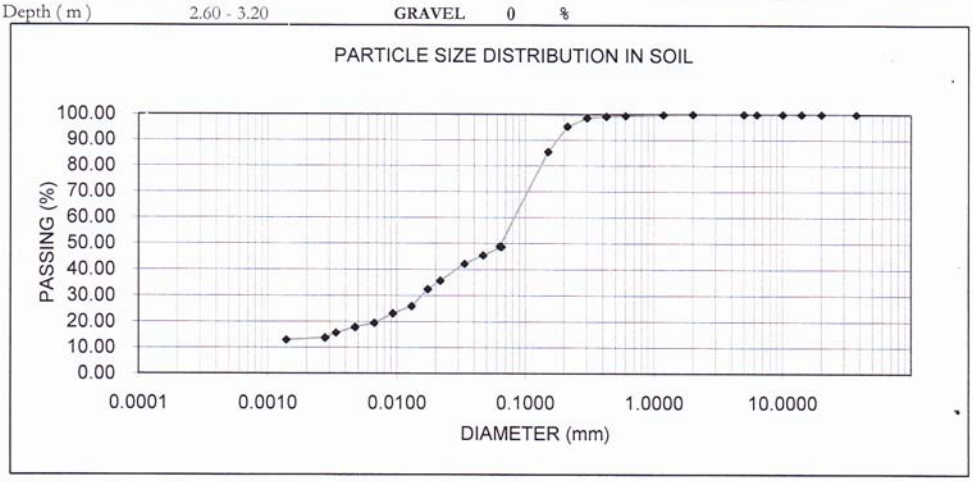
Sieve analysis (Coarse grained)			
BS Sieve	Weight Retained	Retained	Passing
mm	(gm)	%	%
37.5	0.00	0.00	100.00
20.0	0.00	0.00	100.00
14.0	0.00	0.00	100.00
10.0	0.00	0.00	100.00
6.3	0.00	0.00	100.00
5.0	0.00	0.00	100.00
2.0	0.00	0.00	100.00
1.180	0.09	0.18	99.82
0.600	0.20	0.40	99.42
0.425	0.12	0.24	99.18
0.300	0.29	0.58	98.60
0.212	1.66	3.32	95.28
0.150	4.94	9.88	85.40
0.063	18.24	36.48	48.92
TOTAL	**25.54**		

Borehole/ Sample No. : MW14 - 1
Depth (m) 2.60 - 3.20

Hydrometer analysis (Fine grained)						
Time	Elapsed Time	Hydrometer Reading Rh'	Rh'-Cm = Rh	Particle Diameter D (mm)	Modified Hydrometer Reading	% Finer Than D K %
8.30						
8.30	30 secs	15.00	14.80	0.0651	15.00	48.75
8.31	1 min	14.00	13.80	0.0467	14.00	45.50
8.32	2 mins	13.00	12.80	0.0335	13.00	42.25
8.34	5 mins	11.00	10.80	0.0217	11.00	35.75
8.38	8 mins	10.00	9.80	0.0174	10.00	32.50
8.45	15 mins	8.00	7.80	0.0130	8.00	26.00
8.60	30 mins	7.15	6.95	0.0093	7.15	23.24
9.30	1 hours	6.00	5.80	0.0067	6.00	19.50
10.30	2 hours	5.50	5.30	0.0047	5.50	17.88
12.30	4 hours	4.85	4.65	0.0034	4.85	15.76
14.30	6 hours	4.25	4.05	0.0028	4.25	13.81
8.30	24 hours	4.00	3.80	0.0014	4.00	13.00

CLAY	14	%
SILT	35	%
SAND	51	%
GRAVEL	0	%

Lab. Ref. : Z 2609/09
Date Tested : 09.09.2009
Tested By : Amir / Safri
Weight of Sample (gm) 50.00



Z-DSAC LABORATORIES (001144285-D)

CIDB MALAYSIA No. 1991102-SL054181

Site Investigation - Soil, Asphaltic & Concrete Testing - Chemical Testing - Field Instrumentation

PARTICLE SIZE DISTRIBUTION GRADATION CURVE

BS 1377 : Part 2 : 1990

Client : **NAHRIM**
Contractor : **MULTICALL CARD (M) SDN. BHD.**
Project : ANALYSIS SAIZ BUTIRAN TELAGA PEMONITORAN DAN TELAGA EKSPLORASI
: AIR BAWAH TANAH DI JENDERAM HILIR, DENGKIL, SELANGOR DARUL EHSA

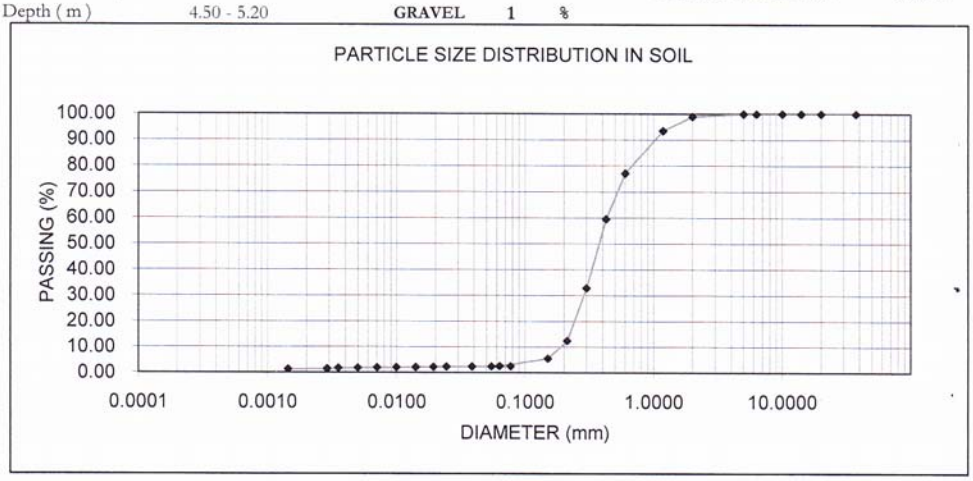
Sieve analysis (Coarse grained)			
BS Sieve mm	Weight Retained (gm)	Retained %	Passing %
37.5	0.00	0.00	100.00
20.0	0.00	0.00	100.00
14.0	0.00	0.00	100.00
10.0	0.00	0.00	100.00
6.3	0.00	0.00	100.00
5.0	0.00	0.00	100.00
2.0	0.53	1.06	98.94
1.180	2.72	5.44	93.50
0.600	8.19	16.38	77.12
0.425	8.78	17.56	59.56
0.300	13.34	26.68	32.88
0.212	10.21	20.42	12.46
0.150	3.46	6.92	5.54
0.063	1.48	2.96	2.58
TOTAL	**48.71**		

Borehole/ Sample No. : MW14 - 2
Depth (m) 4.50 - 5.20

Hydrometer analysis (Fine grained)						
Time 9.15	Elapsed Time	Hydrometer Reading Rh'	Rh'-Cm = Rh	Particle Diameter D (mm)	Modified Hydrometer Reading	% Finer Than D K %
9.15	30 secs	0.78	0.58	0.0770	0.78	2.54
9.16	1 min	0.76	0.56	0.0545	0.76	2.47
9.17	2 mins	0.74	0.54	0.0385	0.74	2.41
9.19	5 mins	0.72	0.52	0.0244	0.72	2.34
9.23	8 mins	0.70	0.50	0.0193	0.70	2.28
9.30	15 mins	0.65	0.45	0.0141	0.65	2.11
9.45	30 mins	0.63	0.43	0.0100	0.63	2.05
10.15	1 hours	0.61	0.41	0.0070	0.61	1.98
11.15	2 hours	0.58	0.38	0.0050	0.58	1.89
13.15	4 hours	0.55	0.35	0.0035	0.55	1.79
15.15	6 hours	0.45	0.25	0.0029	0.45	1.46
9.15	24 hours	0.40	0.20	0.0014	0.40	1.30

CLAY	1	%
SILT	2	%
SAND	96	%
GRAVEL	1	%

Lab. Ref. : Z 2609/09
Date Tested : 11.09.2009
Tested By : Amir / Safri
Weight of Sample (gm) 50.00



Z-DSAC LABORATORIES (001144285-D)

CIDB MALAYSIA No. 1991102-SL054181

Site Investigation - Soil, Asphaltic & Concrete Testing - Chemical Testing - Field Instrumentation

PARTICLE SIZE DISTRIBUTION GRADATION CURVE

BS 1377 : Part 2 : 1990

Client : **NAHRIM**
Contractor : **MULTICALL CARD (M) SDN. BHD.**
Project : ANALYSIS SAIZ BUTIRAN TELAGA PEMONITORAN DAN TELAGA EKSPLORASI
: AIR BAWAH TANAH DI JENDERAM HILIR, DENGKIL, SELANGOR DARUL EHSA

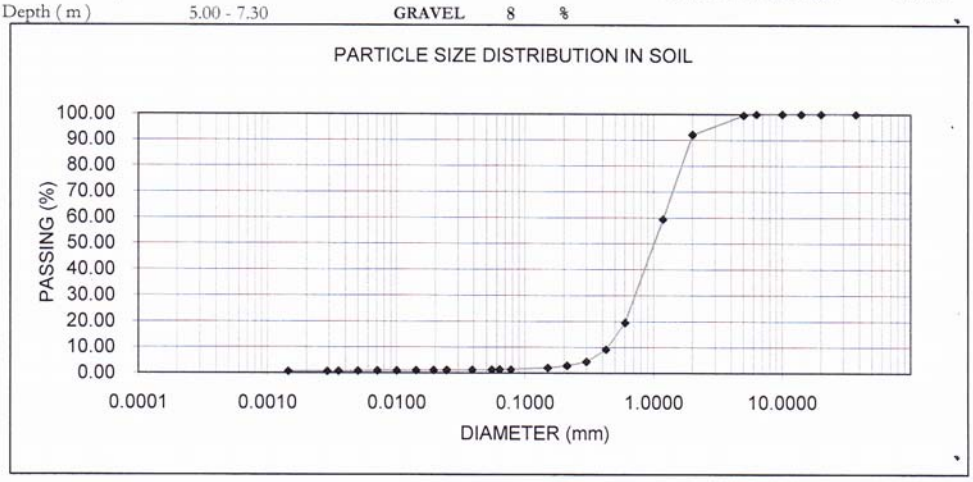
Sieve analysis (Coarse grained)			
BS Sieve mm	Weight Retained (gm)	Retained %	Passing %
37.5	0.00	0.00	100.00
20.0	0.00	0.00	100.00
14.0	0.00	0.00	100.00
10.0	0.00	0.00	100.00
6.3	0.00	0.00	100.00
5.0	0.20	0.40	99.60
2.0	3.76	7.52	92.08
1.180	16.34	32.68	59.40
0.600	19.93	39.86	19.54
0.425	5.17	10.34	9.20
0.300	2.37	4.74	4.46
0.212	0.79	1.58	2.88
0.150	0.39	0.78	2.10
0.063	0.36	0.72	1.38
TOTAL	**49.31**		

Borehole/ Sample No. : MW15 - 1
Depth (m) 5.00 - 7.30

Hydrometer analysis (Fine grained)						
Time	Elapsed Time	Hydrometer Reading Rh'	Rh'-Cm = Rh	Particle Diameter D (mm)	Modified Hydrometer Reading	% Finer Than D K %
9.35						
9.35	30 secs	0.42	0.22	0.0773	0.42	1.37
9.36	1 min	0.40	0.20	0.0547	0.40	1.30
9.37	2 mins	0.38	0.18	0.0387	0.38	1.24
9.39	5 mins	0.36	0.16	0.0245	0.36	1.17
9.43	8 mins	0.34	0.14	0.0193	0.34	1.11
9.50	15 mins	0.32	0.12	0.0141	0.32	1.04
9.65	30 mins	0.30	0.10	0.0100	0.30	0.98
10.35	1 hours	0.28	0.08	0.0071	0.28	0.91
11.35	2 hours	0.25	0.05	0.0050	0.25	0.81
13.35	4 hours	0.23	0.03	0.0035	0.23	0.75
15.35	6 hours	0.21	0.01	0.0029	0.21	0.68
9.35	24 hours	0.20	0.00	0.0014	0.20	0.65

CLAY	1	%
SILT	0	%
SAND	91	%
GRAVEL	8	%

Lab. Ref. : Z 2609/09
Date Tested : 11.09.2009
Tested By : Amir / Safri
Weight of Sample (gm) 50.00



Z-DSAC LABORATORIES (001144285-D)

CIDB MALAYSIA No. 1991102-SL054181

Site Investigation - Soil, Asphaltic & Concrete Testing - Chemical Testing - Field Instrumentation

PARTICLE SIZE DISTRIBUTION GRADATION CURVE

BS 1377 : Part 2 : 1990

Client : **NAHRIM**
Contractor : **MULTICALL CARD (M) SDN. BHD.**
Project : ANALYSIS SAIZ BUTIRAN TELAGA PEMONITORAN DAN TELAGA EKSPLORASI
: AIR BAWAH TANAH DI JENDERAM HILIR, DENGKIL, SELANGOR DARUL EHSA

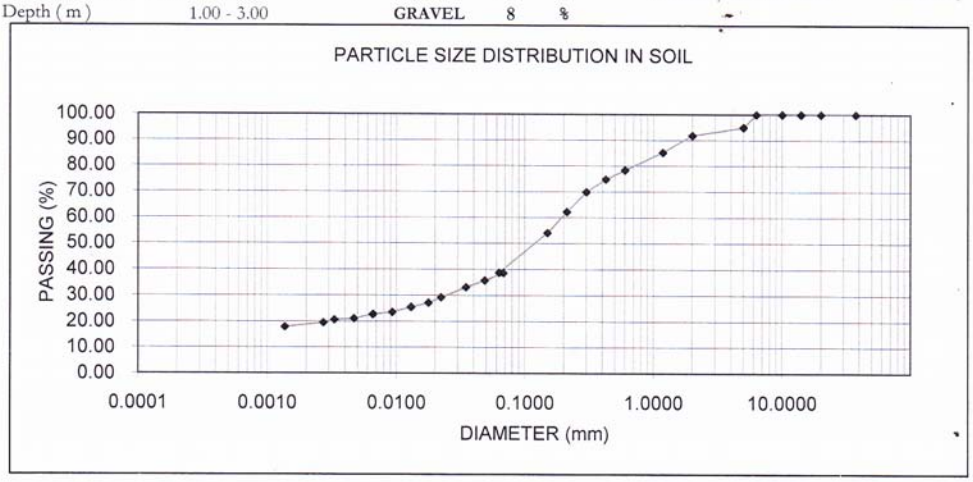
Sieve analysis (Coarse grained)			
BS Sieve	Weight Retained	Retained	Passing
mm	(gm)	%	%
37.5	0.00	0.00	100.00
20.0	0.00	0.00	100.00
14.0	0.00	0.00	100.00
10.0	0.00	0.00	100.00
6.3	0.00	0.00	100.00
5.0	2.49	4.98	95.02
2.0	1.60	3.20	91.82
1.180	3.31	6.62	85.20
0.600	3.42	6.84	78.36
0.425	1.78	3.56	74.80
0.300	2.44	4.88	69.92
0.212	3.85	7.70	62.22
0.150	4.05	8.10	54.12
0.063	7.69	15.38	38.74
TOTAL	**30.63**		

Borehole/ Sample No. : MW16 - 1
Depth (m) 1.00 - 3.00

Hydrometer analysis (Fine grained)						
Time	Elapsed Time	Hydrometer Reading Rh'	Rh'-Cm = Rh	Particle Diameter D (mm)	Modified Hydrometer Reading	% Finer Than D K %
8.20						
8.20	30 secs	11.90	11.70	0.0679	11.90	38.68
8.21	1 min	11.00	10.80	0.0486	11.00	35.75
8.22	2 mins	10.20	10.00	0.0347	10.20	33.15
8.24	5 mins	9.00	8.80	0.0223	9.00	29.25
8.28	8 mins	8.35	8.15	0.0177	8.35	27.14
8.35	15 mins	7.85	7.65	0.0130	7.85	25.51
8.50	30 mins	7.25	7.05	0.0093	7.25	23.56
9.20	1 hours	7.00	6.80	0.0066	7.00	22.75
10.20	2 hours	6.50	6.30	0.0047	6.50	21.13
12.20	4 hours	6.35	6.15	0.0033	6.35	20.64
14.20	6 hours	6.00	5.80	0.0027	6.00	19.50
8.20	24 hours	5.50	5.30	0.0014	5.50	17.88

CLAY	20	%
SILT	19	%
SAND	53	%
GRAVEL	8	%

Lab. Ref. : Z 2609/09
Date Tested : 09.09.2009
Tested By : Amir / Safri
Weight of Sample (gm) 50.00



Z-DSAC LABORATORIES (001144285-D)

CIDB MALAYSIA No. 1991102-SL054181

Site Investigation - Soil, Asphaltic & Concrete Testing - Chemical Testing - Field Instrumentation

PARTICLE SIZE DISTRIBUTION GRADATION CURVE

BS 1377 : Part 2 : 1990

Client : **NAHRIM**
Contractor : **MULTICALL CARD (M) SDN. BHD.**
Project : ANALYSIS SAIZ BUTIRAN TELAGA PEMONITORAN DAN TELAGA EKSPLORASI
: AIR BAWAH TANAH DI JENDERAM HILIR, DENGKIL, SELANGOR DARUL EHSA

Sieve analysis (Coarse grained)

BS Sieve mm	Weight Retained (gm)	Retained %	Passing %
37.5	0.00	0.00	100.00
20.0	0.00	0.00	100.00
14.0	0.00	0.00	100.00
10.0	0.00	0.00	100.00
6.3	0.00	0.00	100.00
5.0	0.00	0.00	100.00
2.0	0.15	0.30	99.70
1.180	0.04	0.08	99.62
0.600	0.06	0.12	99.50
0.425	0.04	0.08	99.42
0.300	0.03	0.06	99.36
0.212	0.05	0.10	99.26
0.150	0.06	0.12	99.14
0.063	0.37	0.74	98.40
TOTAL	**0.80**		

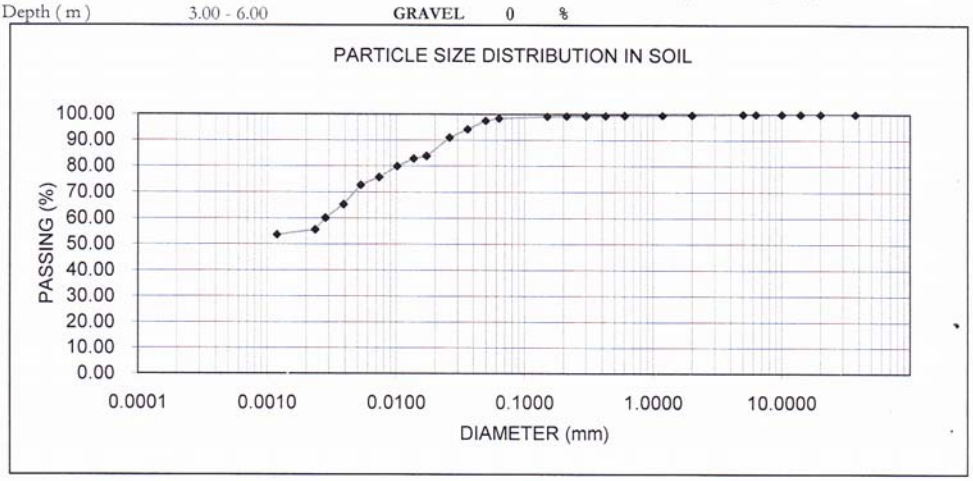
Borehole/ Sample No. : MW16 - 2
Depth (m) 3.00 - 6.00

Hydrometer analysis (Fine grained)

Time	Elapsed Time	Hydrometer Reading Rh'	Rh'-Cm = Rh	Particle Diameter D (mm)	Modified Hydrometer Reading	% Finer Than D K %
9.05						
9.05	30 secs	30.00	29.80	0.0495	30.00	97.50
9.06	1 min	29.00	28.80	0.0358	29.00	94.25
9.07	2 mins	28.00	27.80	0.0259	28.00	91.00
9.09	5 mins	25.80	25.60	0.0172	25.80	83.85
9.13	8 mins	25.50	25.30	0.0137	25.50	82.88
9.20	15 mins	24.60	24.40	0.0102	24.60	79.95
9.35	30 mins	23.30	23.10	0.0074	23.30	75.73
10.05	1 hours	22.40	22.20	0.0053	22.40	72.80
11.05	2 hours	20.10	19.90	0.0039	20.10	65.33
13.05	4 hours	18.50	18.30	0.0028	18.50	60.13
15.05	6 hours	17.10	16.90	0.0024	17.10	55.58
9.05	24 hours	16.50	16.30	0.0012	16.50	53.63

CLAY	56	%
SILT	42	%
SAND	2	%
GRAVEL	0	%

Lab. Ref. : Z 2609/09
Date Tested : 11.09.2009
Tested By : Amir / Safri
Weight of Sample (gm) 50.00 .



Z-DSAC LABORATORIES (001144285-D)

CIDB MALAYSIA No. 1991102-SL054181

Site Investigation - Soil, Asphaltic & Concrete Testing - Chemical Testing - Field Instrumentation

PARTICLE SIZE DISTRIBUTION GRADATION CURVE

BS 1377 : Part 2 : 1990

Client : **NAHRIM**
Contractor : **MULTICALL CARD (M) SDN. BHD.**
Project : ANALYSIS SAIZ BUTIRAN TELAGA PEMONITORAN DAN TELAGA EKSPLORASI
: AIR BAWAH TANAH DI JENDERAM HILIR, DENGKIL, SELANGOR DARUL EHSA

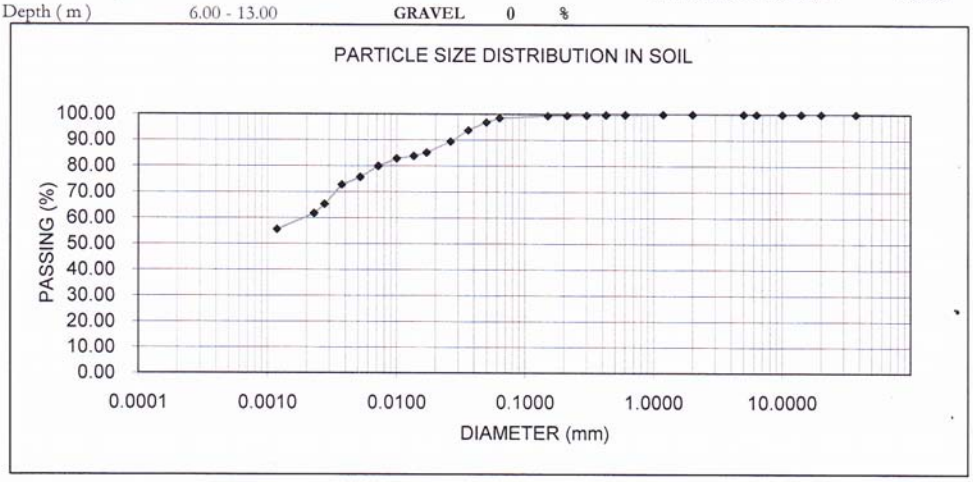
Sieve analysis (Coarse grained)			
BS Sieve	Weight Retained	Retained	Passing
mm	(gm)	%	%
37.5	0.00	0.00	100.00
20.0	0.00	0.00	100.00
14.0	0.00	0.00	100.00
10.0	0.00	0.00	100.00
6.3	0.00	0.00	100.00
5.0	0.00	0.00	100.00
2.0	0.00	0.00	100.00
1.180	0.02	0.04	99.96
0.600	0.07	0.14	99.82
0.425	0.04	0.08	99.74
0.300	0.05	0.10	99.64
0.212	0.05	0.10	99.54
0.150	0.06	0.12	99.42
0.063	0.46	0.92	98.50
TOTAL	**0.75**		

Borehole/ Sample No. : MW16 - 3
Depth (m) 6.00 - 13.00

Hydrometer analysis (Fine grained)						
Time	Elapsed Time	Hydrometer Reading Rh'	Rh'-Cm = Rh	Particle Diameter D (mm)	Modified Hydrometer Reading	% Finer Than D K %
9.10						
9.10	30 secs	29.80	29.60	0.0497	29.80	96.85
9.11	1 min	28.85	28.65	0.0360	28.85	93.76
9.12	2 mins	27.50	27.30	0.0262	27.50	89.38
9.14	5 mins	26.20	26.00	0.0170	26.20	85.15
9.18	8 mins	25.80	25.60	0.0136	25.80	83.85
9.25	15 mins	25.50	25.30	0.0100	25.50	82.88
9.40	30 mins	24.60	24.40	0.0072	24.60	79.95
10.10	1 hours	23.30	23.10	0.0052	23.30	75.73
11.10	2 hours	22.40	22.20	0.0037	22.40	72.80
13.10	4 hours	20.10	19.90	0.0027	20.10	65.33
15.10	6 hours	19.00	18.80	0.0023	19.00	61.75
9.10	24 hours	17.10	16.90	0.0012	17.10	55.58

CLAY	62	%
SILT	37	%
SAND	1	%
GRAVEL	0	%

Lab. Ref. : Z 2609/09
Date Tested : 11.09.2009
Tested By : Amir / Safri
Weight of Sample (gm) 50.00



Z-DSAC LABORATORIES (001144285-D)

CIDB MALAYSIA No. 1991102-SL054181

Site Investigation - Soil, Asphaltic & Concrete Testing - Chemical Testing - Field Instrumentation

PARTICLE SIZE DISTRIBUTION GRADATION CURVE

BS 1377 : Part 2 : 1990

Client : **NAHRIM**
Contractor : **MULTICALL CARD (M) SDN. BHD.**
Project : ANALYSIS SAIZ BUTIRAN TELAGA PEMONITORAN DAN TELAGA EKSPLORASI
: AIR BAWAH TANAH DI JENDERAM HILIR, DENGKIL, SELANGOR DARUL EHSA

Sieve analysis (Coarse grained)

BS Sieve	Weight Retained	Retained	Passing
mm	(gm)	%	%
37.5	0.00	0.00	100.00
20.0	0.00	0.00	100.00
14.0	0.00	0.00	100.00
10.0	0.00	0.00	100.00
6.3	0.00	0.00	100.00
5.0	0.39	0.78	99.22
2.0	4.43	8.86	90.36
1.180	6.25	12.50	77.86
0.600	7.13	14.26	63.60
0.425	4.80	9.60	54.00
0.300	5.73	11.46	42.54
0.212	4.88	9.76	32.78
0.150	3.25	6.50	26.28
0.063	3.56	7.12	19.16
TOTAL	**40.42**		

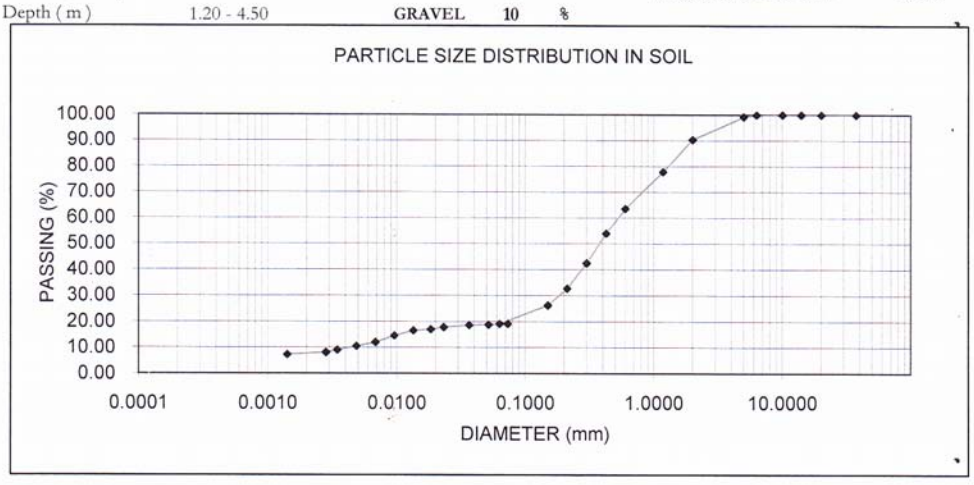
Borehole/ Sample No. : MW17 - 1
Depth (m) 1.20 - 4.50

Hydrometer analysis (Fine grained)

Time	Elapsed Time	Hydrometer Reading Rh'	Rh'-Cm = Rh	Particle Diameter D (mm)	Modified Hydrometer Reading	% Finer Than D K %
8.05						
8.05	30 secs	5.89	5.69	0.0730	5.89	19.14
8.06	1 min	5.80	5.60	0.0516	5.80	18.85
8.07	2 mins	5.75	5.55	0.0365	5.75	18.69
8.09	5 mins	5.50	5.30	0.0232	5.50	17.88
8.13	8 mins	5.25	5.05	0.0184	5.25	17.06
8.20	15 mins	5.10	4.90	0.0134	5.10	16.58
8.35	30 mins	4.50	4.30	0.0096	4.50	14.63
9.05	1 hours	3.70	3.50	0.0068	3.70	12.03
10.05	2 hours	3.25	3.05	0.0048	3.25	10.56
12.05	4 hours	2.80	2.60	0.0034	2.80	9.10
14.05	6 hours	2.50	2.30	0.0028	2.50	8.13
8.05	24 hours	2.25	2.05	0.0014	2.25	7.31

CLAY	8	%
SILT	11	%
SAND	71	%
GRAVEL	10	%

Lab. Ref. : Z 2609/09
Date Tested : 09.09.2009
Tested By : Amir / Safri
Weight of Sample (gm) 50.00



Z-DSAC LABORATORIES (001144285-D)

CIDB MALAYSIA No. 1991102-SL054181

Site Investigation - Soil, Asphaltic & Concrete Testing - Chemical Testing - Field Instrumentation

PARTICLE SIZE DISTRIBUTION GRADATION CURVE

BS 1377 : Part 2 : 1990

Client : **NAHRIM**
Contractor : **MULTICALL CARD (M) SDN. BHD.**
Project : ANALYSIS SAIZ BUTIRAN TELAGA PEMONITORAN DAN TELAGA EKSPLORASI
: AIR BAWAH TANAH DI JENDERAM HILIR, DENGKIL, SELANGOR DARUL EHSA

Sieve analysis (Coarse grained)

BS Sieve	Weight Retained	Retained	Passing
mm	(gm)	%	%
37.5	0.00	0.00	100.00
20.0	0.00	0.00	100.00
14.0	0.00	0.00	100.00
10.0	0.00	0.00	100.00
6.3	0.00	0.00	100.00
5.0	0.25	0.50	99.50
2.0	3.69	7.38	92.12
1.180	9.93	19.86	72.26
0.600	11.70	23.40	48.86
0.425	3.65	7.30	41.56
0.300	2.46	4.92	36.64
0.212	2.22	4.44	32.20
0.150	1.39	2.78	29.42
0.063	1.85	3.70	25.72
TOTAL	**37.14**		

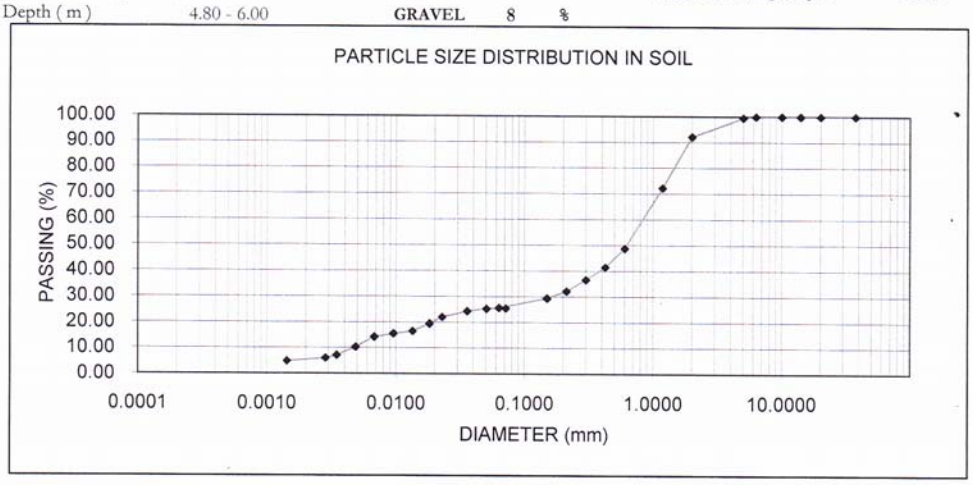
Borehole/ Sample No. : MW18 - 1
Depth (m) 4.80 - 6.00

Hydrometer analysis (Fine grained)

Time	Elapsed Time	Hydrometer Reading Rh'	Rh'-Cm = Rh	Particle Diameter D (mm)	Modified Hydrometer Reading	% Finer Than D K %
8.05						
8.05	30 secs	7.85	7.65	0.0713	7.85	25.51
8.06	1 min	7.80	7.60	0.0505	7.80	25.35
8.07	2 mins	7.50	7.30	0.0358	7.50	24.38
8.09	5 mins	6.80	6.60	0.0228	6.80	22.10
8.13	8 mins	6.00	5.80	0.0182	6.00	19.50
8.20	15 mins	5.10	4.90	0.0134	5.10	16.58
8.35	30 mins	4.80	4.60	0.0095	4.80	15.60
9.05	1 hours	4.40	4.20	0.0068	4.40	14.30
10.05	2 hours	3.20	3.00	0.0048	3.20	10.40
12.05	4 hours	2.20	2.00	0.0035	2.20	7.15
14.05	6 hours	1.85	1.65	0.0028	1.85	6.01
8.05	24 hours	1.50	1.30	0.0014	1.50	4.88

CLAY	6	%
SILT	20	%
SAND	66	%
GRAVEL	8	%

Lab. Ref. : Z 2609/09
Date Tested : 11.09.2009
Tested By : Amir / Safri
Weight of Sample (gm) 50.00



Z-DSAC LABORATORIES (001144285-D)

CIDB MALAYSIA No. 1991102-SL054181

Site Investigation - Soil, Asphaltic & Concrete Testing - Chemical Testing - Field Instrumentation

PARTICLE SIZE DISTRIBUTION GRADATION CURVE

BS 1377 : Part 2 : 1990

Client : **NAHRIM**
Contractor : **MULTICALL CARD (M) SDN. BHD.**
Project : ANALYSIS SAIZ BUTIRAN TELAGA PEMONITORAN DAN TELAGA EKSPLORASI
: AIR BAWAH TANAH DI JENDERAM HILIR, DENGKIL, SELANGOR DARUL EHSA

Sieve analysis (Coarse grained)

BS Sieve mm	Weight Retained (gm)	Retained %	Passing %
37.5	0.00	0.00	100.00
20.0	0.00	0.00	100.00
14.0	0.00	0.00	100.00
10.0	0.00	0.00	100.00
6.3	0.00	0.00	100.00
5.0	0.00	0.00	100.00
2.0	0.22	0.44	99.56
1.180	4.82	9.64	89.92
0.600	14.11	28.22	61.70
0.425	8.71	17.42	44.28
0.300	7.01	14.02	30.26
0.212	4.04	8.08	22.18
0.150	2.66	5.32	16.86
0.063	3.21	6.42	10.44
TOTAL	**44.78**		

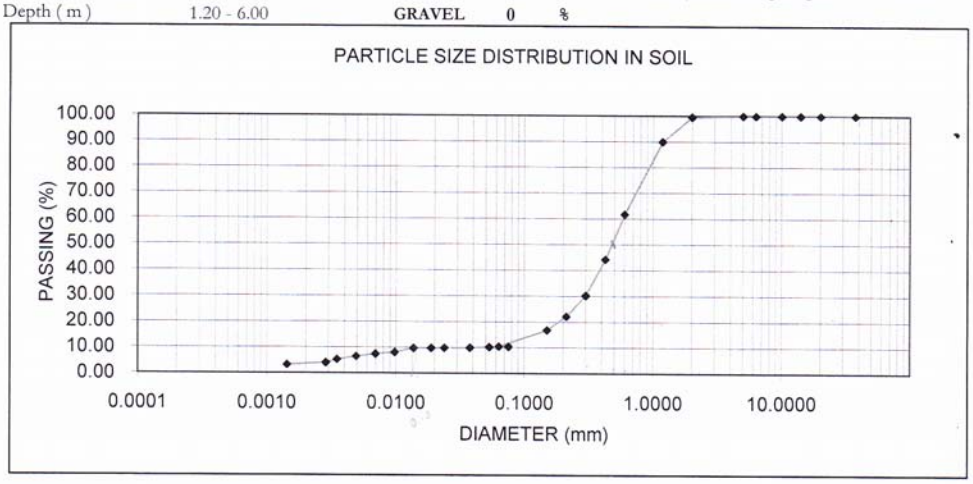
Borehole/ Sample No. : MW19 - 1
Depth (m) 1.20 - 6.00

Hydrometer analysis (Fine grained)

Time 8.00	Elapsed Time	Hydrometer Reading Rh'	Rh'-Cm = Rh	Particle Diameter D (mm)	Modified Hydrometer Reading	% Finer Than D K %
8.00	30 secs	3.20	3.00	0.0751	3.20	10.40
8.01	1 min	3.15	2.95	0.0532	3.15	10.24
8.02	2 mins	3.08	2.88	0.0376	3.08	10.01
8.04	5 mins	3.05	2.85	0.0238	3.05	9.91
8.08	8 mins	3.02	2.82	0.0188	3.02	9.82
8.15	15 mins	3.00	2.80	0.0137	3.00	9.75
8.30	30 mins	2.50	2.30	0.0098	2.50	8.13
9.00	1 hours	2.30	2.10	0.0069	2.30	7.48
10.00	2 hours	2.00	1.80	0.0049	2.00	6.50
12.00	4 hours	1.65	1.45	0.0035	1.65	5.36
14.00	6 hours	1.25	1.05	0.0029	1.25	4.06
8.00	24 hours	1.00	0.80	0.0014	1.00	3.25

CLAY	4	%
SILT	6	%
SAND	90	%
GRAVEL	0	%

Lab. Ref. : Z 2609/09
Date Tested : 11.09.2009
Tested By : Amir / Safri
Weight of Sample (gm) 50.00



Z-DSAC LABORATORIES (001144285-D)

CIDB MALAYSIA No. 1991102-SL054181

Site Investigation - Soil, Asphaltic & Concrete Testing - Chemical Testing - Field Instrumentation

PARTICLE SIZE DISTRIBUTION GRADATION CURVE

BS 1377 : Part 2 : 1990

Client : **NAHRIM**
Contractor : **MULTICALL CARD (M) SDN. BHD.**
Project : ANALYSIS SAIZ BUTIRAN TELAGA PEMONITORAN DAN TELAGA EKSPLORASI
: AIR BAWAH TANAH DI JENDERAM HILIR, DENGKIL, SELANGOR DARUL EHSA

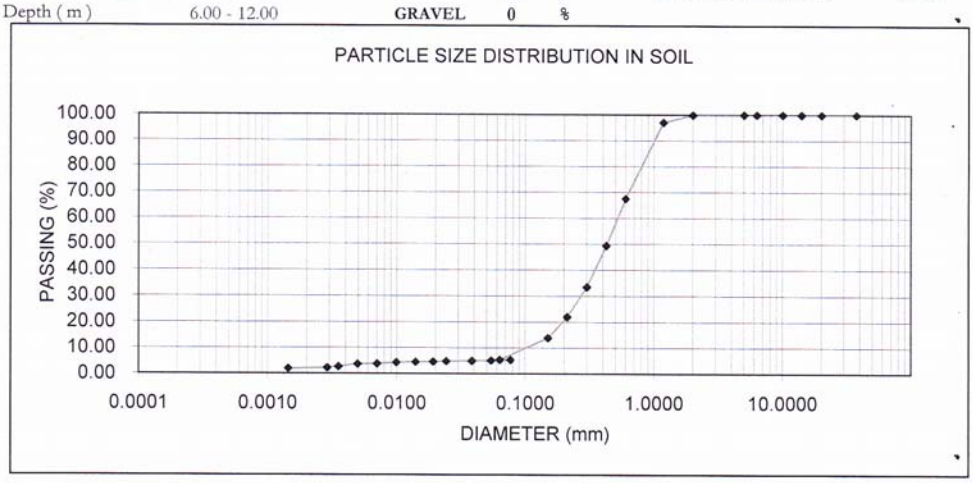
Sieve analysis (Coarse grained)			
BS Sieve mm	Weight Retained (gm)	Retained %	Passing %
37.5	0.00	0.00	100.00
20.0	0.00	0.00	100.00
14.0	0.00	0.00	100.00
10.0	0.00	0.00	100.00
6.3	0.00	0.00	100.00
5.0	0.00	0.00	100.00
2.0	0.06	0.12	99.88
1.180	1.41	2.82	97.06
0.600	14.75	29.50	67.56
0.425	9.05	18.10	49.46
0.300	7.95	15.90	33.56
0.212	5.75	11.50	22.06
0.150	4.03	8.06	14.00
0.063	4.26	8.52	5.48
TOTAL	**47.26**		

Borehole/ Sample No. : MW19 - 2
Depth (m) 6.00 - 12.00

Hydrometer analysis (Fine grained)						
Time 8.10	Elapsed Time	Hydrometer Reading Rh'	Rh'-Cm = Rh	Particle Diameter D (mm)	Modified Hydrometer Reading	% Finer Than D K %
8.10	30 secs	1.67	1.47	0.0763	1.67	5.43
8.11	1 min	1.60	1.40	0.0540	1.60	5.20
8.12	2 mins	1.55	1.35	0.0382	1.55	5.04
8.14	5 mins	1.50	1.30	0.0242	1.50	4.88
8.18	8 mins	1.45	1.25	0.0191	1.45	4.71
8.25	15 mins	1.42	1.22	0.0140	1.42	4.62
8.40	30 mins	1.35	1.15	0.0099	1.35	4.39
9.10	1 hours	1.20	1.00	0.0070	1.20	3.90
10.10	2 hours	1.15	0.95	0.0050	1.15	3.74
12.10	4 hours	0.85	0.65	0.0035	0.85	2.76
14.10	6 hours	0.70	0.50	0.0029	0.70	2.28
8.10	24 hours	0.60	0.40	0.0014	0.60	1.95

CLAY	2	%
SILT	3	%
SAND	95	%
GRAVEL	0	%

Lab. Ref. : Z 2609/09
Date Tested : 09.09.2009
Tested By : Amir / Safri
Weight of Sample (gm) 50.00



Z-DSAC LABORATORIES (001144285-D)

CIDB MALAYSIA No. 1991102-SL054181

Site Investigation - Soil, Asphaltic & Concrete Testing - Chemical Testing - Field Instrumentation

PARTICLE SIZE DISTRIBUTION GRADATION CURVE

BS 1377 : Part 2 : 1990

Client : **NAHRIM**
Contractor : **MULTICALL CARD (M) SDN. BHD.**
Project : ANALYSIS SAIZ BUTIRAN TELAGA PEMONITORAN DAN TELAGA EKSPLORASI
: AIR BAWAH TANAH DI JENDERAM HILIR, DENGKIL, SELANGOR DARUL EHSA

Sieve analysis (Coarse grained)

BS Sieve	Weight Retained	Retained	Passing
mm	(gm)	%	%
37.5	0.00	0.00	100.00
20.0	0.00	0.00	100.00
14.0	0.00	0.00	100.00
10.0	0.00	0.00	100.00
6.3	0.00	0.00	100.00
5.0	0.00	0.00	100.00
2.0	1.05	2.10	97.90
1.180	3.56	7.12	90.78
0.600	8.64	17.28	73.50
0.425	6.60	13.20	60.30
0.300	7.23	14.46	45.84
0.212	4.95	9.90	35.94
0.150	2.75	5.50	30.44
0.063	3.56	7.12	23.32
TOTAL	**38.34**		

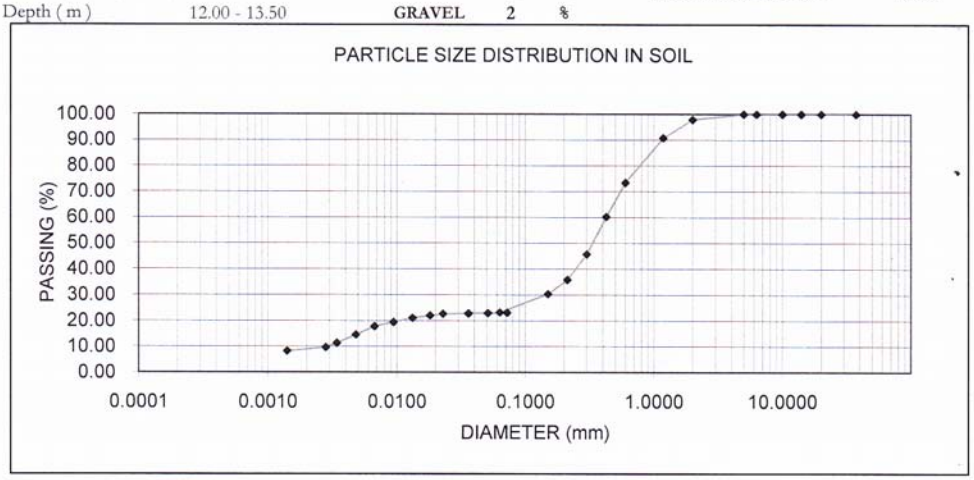
Borehole/ Sample No. : MW19 - 3
Depth (m) 12.00 - 13.50

Hydrometer analysis (Fine grained)

Time	Elapsed Time	Hydrometer Reading Rh'	Rh'-Cm = Rh	Particle Diameter D (mm)	Modified Hydrometer Reading	% Finer Than D K %
9.00						
9.00	30 secs	7.15	6.95	0.0719	7.15	23.24
9.01	1 min	7.10	6.90	0.0509	7.10	23.08
9.02	2 mins	7.05	6.85	0.0360	7.05	22.91
9.04	5 mins	7.00	6.80	0.0228	7.00	22.75
9.08	8 mins	6.80	6.60	0.0181	6.80	22.10
9.15	15 mins	6.50	6.30	0.0132	6.50	21.13
9.30	30 mins	6.00	5.80	0.0094	6.00	19.50
10.00	1 hours	5.50	5.30	0.0067	5.50	17.88
11.00	2 hours	4.50	4.30	0.0048	4.50	14.63
13.00	4 hours	3.50	3.30	0.0034	3.50	11.38
15.00	6 hours	3.00	2.80	0.0028	3.00	9.75
9.00	24 hours	2.55	2.35	0.0014	2.55	8.29

CLAY	10	%
SILT	13	%
SAND	75	%
GRAVEL	2	%

Lab. Ref. : Z 2609/09
Date Tested : 11.09.2009
Tested By : Amir / Safri
Weight of Sample (gm) 50.00



Z-DSAC LABORATORIES (001144285-D)

CIDB MALAYSIA No. 1991102-SL054181

Site Investigation - Soil, Asphaltic & Concrete Testing - Chemical Testing - Field Instrumentation

PARTICLE SIZE DISTRIBUTION GRADATION CURVE

BS 1377 : Part 2 : 1990

Client : **NAHRIM**
Contractor : **MULTICALL CARD (M) SDN. BHD.**
Project : ANALYSIS SAIZ BUTIRAN TELAGA PEMONITORAN DAN TELAGA EKSPLORASI
: AIR BAWAH TANAH DI JENDERAM HILIR, DENGKIL, SELANGOR DARUL EHSA

Sieve analysis (Coarse grained)

BS Sieve mm	Weight Retained (gm)	Retained %	Passing %
37.5	0.00	0.00	100.00
20.0	0.00	0.00	100.00
14.0	0.00	0.00	100.00
10.0	0.00	0.00	100.00
6.3	0.00	0.00	100.00
5.0	0.00	0.00	100.00
2.0	0.09	0.18	99.82
1.180	0.41	0.82	99.00
0.600	1.88	3.76	95.24
0.425	2.56	5.12	90.12
0.300	5.39	10.78	79.34
0.212	7.37	14.74	64.60
0.150	6.89	13.78	50.82
0.063	17.16	34.32	16.50
TOTAL	**41.75**		

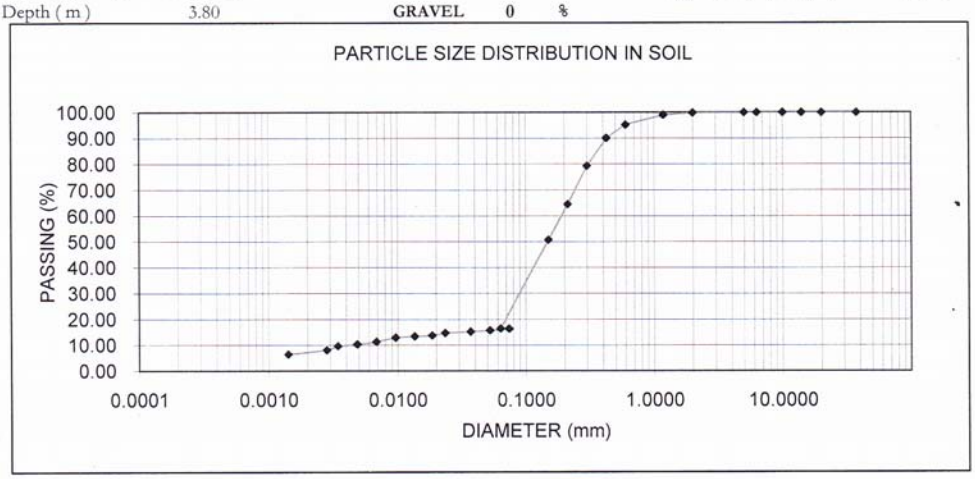
Borehole/ Sample No. : MW20 - 1
Depth (m) 3.80

Hydrometer analysis (Fine grained)

Time	Elapsed Time	Hydrometer Reading Rh'	Rh'-Cm = Rh	Particle Diameter D (mm)	Modified Hydrometer Reading	% Finer Than D K %
8.50						
8.50	30 secs	5.05	4.85	0.0736	5.05	16.41
8.51	1 min	4.85	4.65	0.0522	4.85	15.76
8.52	2 mins	4.70	4.50	0.0370	4.70	15.28
8.54	5 mins	4.55	4.35	0.0234	4.55	14.79
8.58	8 mins	4.25	4.05	0.0186	4.25	13.81
8.65	15 mins	4.15	3.95	0.0136	4.15	13.49
8.80	30 mins	4.00	3.80	0.0096	4.00	13.00
9.50	1 hours	3.50	3.30	0.0068	3.50	11.38
10.50	2 hours	3.20	3.00	0.0048	3.20	10.40
12.50	4 hours	3.00	2.80	0.0034	3.00	9.75
14.50	6 hours	2.50	2.30	0.0028	2.50	8.13
8.50	24 hours	2.00	1.80	0.0014	2.00	6.50

CLAY	8	%
SILT	9	%
SAND	83	%
GRAVEL	0	%

Lab. Ref. : Z 2609/09
Date Tested : 11.09.2009
Tested By : Amir / Safri
Weight of Sample (gm) 50.00



Z-DSAC LABORATORIES (001144285-D)

CIDB MALAYSIA No. 1991102-SL054181

Site Investigation - Soil, Asphaltic & Concrete Testing - Chemical Testing - Field Instrumentation

PARTICLE SIZE DISTRIBUTION GRADATION CURVE

BS 1377 : Part 2 : 1990

Client : **NAHRIM**
Contractor : **MULTICALL CARD (M) SDN. BHD.**
Project : ANALYSIS SAIZ BUTIRAN TELAGA PEMONITORAN DAN TELAGA EKSPLORASI
: AIR BAWAH TANAH DI JENDERAM HILIR, DENGKIL, SELANGOR DARUL EHSA

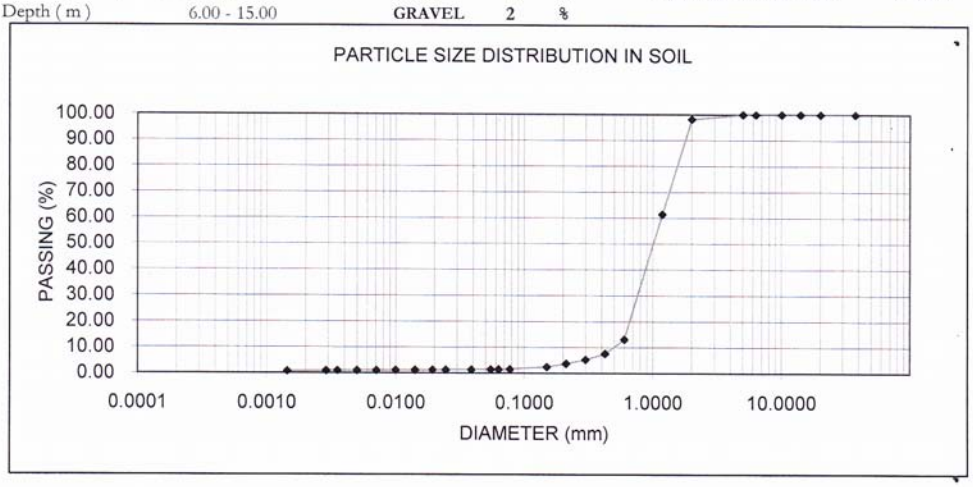
Sieve analysis (Coarse grained)			
BS Sieve	Weight Retained	Retained	Passing
mm	(gm)	%	%
37.5	0.00	0.00	100.00
20.0	0.00	0.00	100.00
14.0	0.00	0.00	100.00
10.0	0.00	0.00	100.00
6.3	0.00	0.00	100.00
5.0	0.00	0.00	100.00
2.0	0.90	1.80	98.20
1.180	18.38	36.76	61.44
0.600	24.11	48.22	13.22
0.425	2.75	5.50	7.72
0.300	1.17	2.34	5.38
0.212	0.79	1.58	3.80
0.150	0.63	1.26	2.54
0.063	0.49	0.98	1.56
TOTAL	**49.22**		

Borehole/ Sample No. : MW23 - 1
Depth (m) 6.00 - 15.00

Hydrometer analysis (Fine grained)						
Time	Elapsed Time	Hydrometer Reading Rh'	Rh'-Cm = Rh	Particle Diameter D (mm)	Modified Hydrometer Reading	% Finer Than D K %
8.00						
8.00	30 secs	0.48	0.28	0.0773	0.48	1.56
8.01	1 min	0.45	0.25	0.0546	0.45	1.46
8.02	2 mins	0.44	0.24	0.0386	0.44	1.43
8.04	5 mins	0.42	0.22	0.0244	0.42	1.37
8.08	8 mins	0.40	0.20	0.0193	0.40	1.30
8.15	15 mins	0.38	0.18	0.0141	0.38	1.24
8.30	30 mins	0.36	0.16	0.0100	0.36	1.17
9.00	1 hours	0.35	0.15	0.0071	0.35	1.14
10.00	2 hours	0.33	0.13	0.0050	0.33	1.07
12.00	4 hours	0.31	0.11	0.0035	0.31	1.01
14.00	6 hours	0.30	0.10	0.0029	0.30	0.98
8.00	24 hours	0.25	0.05	0.0014	0.25	0.81

CLAY	1	%
SILT	1	%
SAND	96	%
GRAVEL	2	%

Lab. Ref. : Z 2609/09
Date Tested : 09.09.2009
Tested By : Amir / Safri
Weight of Sample (gm) 50.00



Z-DSAC LABORATORIES (001144285-D)

CIDB MALAYSIA No. 1991102-SL054181

Site Investigation - Soil, Asphaltic & Concrete Testing - Chemical Testing - Field Instrumentation

PARTICLE SIZE DISTRIBUTION GRADATION CURVE

BS 1377 : Part 2 : 1990

Client : **NAHRIM**
Contractor : **MULTICALL CARD (M) SDN. BHD.**
Project : ANALYSIS SAIZ BUTIRAN TELAGA PEMONITORAN DAN TELAGA EKSPLORASI
: AIR BAWAH TANAH DI JENDERAM HILIR, DENGKIL, SELANGOR DARUL EHSA

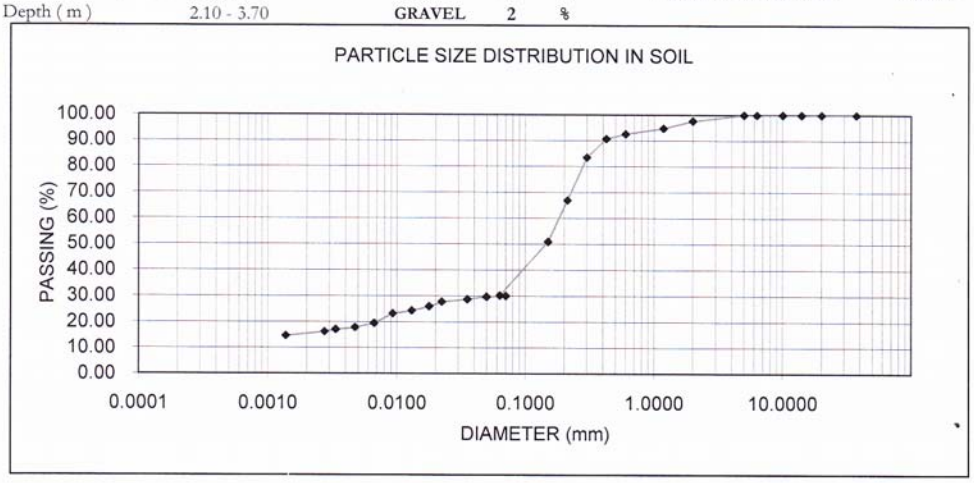
Sieve analysis (Coarse grained)			
BS Sieve	Weight Retained	Retained	Passing
mm	(gm)	%	%
37.5	0.00	0.00	100.00
20.0	0.00	0.00	100.00
14.0	0.00	0.00	100.00
10.0	0.00	0.00	100.00
6.3	0.00	0.00	100.00
5.0	0.00	0.00	100.00
2.0	1.17	2.34	97.66
1.180	1.41	2.82	94.84
0.600	1.11	2.22	92.62
0.425	0.95	1.90	90.72
0.300	3.60	7.20	83.52
0.212	8.28	16.56	66.96
0.150	7.97	15.94	51.02
0.063	10.40	20.80	30.22
TOTAL	**34.89**		

Borehole/ Sample No. : MW24 - 1
Depth (m) 2.10 - 3.70

Hydrometer analysis (Fine grained)						
Time	Elapsed Time	Hydrometer Reading Rh'	Rh'-Cm = Rh	Particle Diameter D (mm)	Modified Hydrometer Reading	% Finer Than D K %
8.25						
8.25	30 secs	9.25	9.05	0.0702	9.25	30.06
8.26	1 min	9.15	8.95	0.0497	9.15	29.74
8.27	2 mins	8.85	8.65	0.0353	8.85	28.76
8.29	5 mins	8.55	8.35	0.0224	8.55	27.79
8.33	8 mins	8.00	7.80	0.0178	8.00	26.00
8.40	15 mins	7.50	7.30	0.0131	7.50	24.38
8.55	30 mins	7.15	6.95	0.0093	7.15	23.24
9.25	1 hours	6.00	5.80	0.0067	6.00	19.50
10.25	2 hours	5.50	5.30	0.0047	5.50	17.88
12.25	4 hours	5.25	5.05	0.0034	5.25	17.06
14.25	6 hours	5.00	4.80	0.0027	5.00	16.25
8.25	24 hours	4.50	4.30	0.0014	4.50	14.63

CLAY	16	%
SILT	14	%
SAND	68	%
GRAVEL	2	%

Lab. Ref. : Z 2609/09
Date Tested : 09.09.2009
Tested By : Amir / Safri
Weight of Sample (gm) 50.00



APPENDIX D

RESULTS OF GROUNDWATER ANALYSIS

Results of groundwater analysis in study area

PERMULAB SDN. BHD.

NEXT STOP analysis

contributing to nature and environment professionally

WATER | FOOD | MICROBIOLOGY | ENVIRONMENTAL | CONSULTANCY | CO. NO. 392059-X

TEST CERTIFICATE

REG. NO. : PLW-000610-00004459-10

COMPANY NAME : TOTAL ENVIRONMENTAL SERVICES SDN BHD

ATTENTION TO : EN. HASMAN IBRAHIM / MR WONG
SAMPLE SOURCE : Jenderam Hilir
SAMPLE DESCRIPTION : One (1) no. of Water Sample
SAMPLE MARKING : Well No. DW2
SAMPLING DATE : 29 April 2010
RECEIVED DATE : 30 April 2010
REPORTED DATE : 07 May 2010

On analysis of the sample(s) submitted, the result(s) obtained as follows:

NO	PARAMETER	METHOD REF. NO.	UNIT	RESULT
1	TURBIDITY	APHA 2130B	NTU	69
2	COLOUR	APHA 2120B	TCU	10
3	pH	APHA 4500-H B	-	5.79
4	CONDUCTIVITY	APHA 2510B	µS/cm	111
5	MANGANESE as Mn	APHA - 3120B	mg/L	0.702
6	IRON as Fe	APHA - 3120B	mg/L	8.44
7	NITRATE NITROGEN as N	APHA 4500-NO_3^- D	mg/L	0.59
8	NITRITE NITROGEN as N	APHA 4500-NO_2^- B	mg/L	0.009
9	TOTAL DISSOLVED SOLIDS	APHA 2540C	mg/L	73
10	TOTAL SOLIDS	APHA 2540B	mg/L	92
11	CHLORIDE as Cl	APHA 4500-Cl B	mg/L	1.0
12	AMMONIACAL NITROGEN as N	APHA 4500-NH_3 B&F	mg/L	0.7
13	FLUORIDE as F	APHA 4500-F B&D	mg/L	ND (<0.02)
14	CARBONATE ALKALINITY as $CaCO_3$	APHA 2320B	mg/L	ND (<0.5)
15	BICARBONATE ALKALINITY as $CaCO_3$	APHA 2320B	mg/L	37
16	TOTAL HARDNESS as $CaCO_3$	APHA 2340C	mg/L	30
17	SODIUM as Na	APHA - 3120B	mg/L	6.61

Opinion and interpretation expressed herein are outside the scope of SAMM accreditation. This report shall not be reproduced except in full and prior approval of PERMULAB SDN. BHD.

TEST CERTIFICATE

REG. NO. : PLW-000610-00004459-10

COMPANY NAME : TOTAL ENVIRONMENTAL SERVICES SDN BHD

NO	PARAMETER	METHOD REF. NO.	UNIT	RESULT
18	CALCIUM as Ca	APHA - 3120B	mg/L	6.49
19	POTASSIUM as K	APHA - 3120B	mg/L	3.42
20	ALUMINIUM as Al	APHA - 3120B	mg/L	ND (<0.007)
21	MAGNESIUM as Mg	APHA - 3120B	mg/L	2.03
22	MERCURY as Hg	APHA 3112B	mg/L	ND (<0.0008)
23	CADMIUM as Cd	APHA - 3120B	mg/L	ND (<0.002)
24	SELENIUM as Se	APHA - 3120B	mg/L	ND (<0.010)
25	ARSENIC as As	In-house No.W68	mg/L	ND (<0.001)
26	LEAD as Pb	APHA - 3120B	mg/L	ND (<0.010)
27	CHROMIUM as Cr	APHA - 3120B	mg/L	ND (<0.010)
28	SILVER as Ag	APHA - 3120B	mg/L	ND (<0.006)
29	COPPER as Cu	APHA - 3120B	mg/L	ND (<0.004)
30	ZINC as Zn	APHA - 3120B	mg/L	ND (<0.006)
31	SULPHATE as SO_4	APHA 4500-SO_4^{2-} E	mg/L	63.1
32	SILICA as SiO_2	APHA 4500-SiO_2 C	mg/L	15.4
33	COBALT as Co	APHA - 3120B	mg/L	0.027
34	BARIUM as Ba	APHA - 3120B	mg/L	0.092
35	STRONTIUM as Sr	APHA - 3120B	mg/L	0.025
36	NICKEL as Ni	APHA - 3120B	mg/L	ND (<0.001)
37	TOTAL PHOSPHORUS as P	In-House No. W86 (based on APHA - 3120B)	mg/L	0.759

NOTE:

1. ND - Not Detected;< - Less Than The Minimum Detection Limit Reported

METHOD REFERENCE(S):

1. Standard Methods For The Examination Of Water and Waste Water (1998) 20th Edition, APHA, AWWA, WEF.

Opinion and interpretation expressed herein are outside the scope of SAMM accreditation. This report shall not be reproduced except in full and prior approval of PERMULAB SDN. BHD.

TEST CERTIFICATE

REG. NO. : PLW-000610-00004459-10 **PAGE 03 OF 03**

COMPANY NAME : TOTAL ENVIRONMENTAL SERVICES SDN BHD

MR. LAM KAH CHEN
CHEMIST (A.M.I.C.)
IKM NO. A2242/4769/05

MS. YONG LI PENG
CHEMIST (L.M.I.C.)
IKM NO. L/1734/5632/2009

Opinion and interpretation expressed herein are outside the scope of SAMM accreditation. This report shall not be reproduced except in full and prior approval of PERMULAB SDN. BHD.

APPENDIX E

RESULT OF MICROORGANISM COUNTING

Results of microorganism analysis in study area

Para:SEAD (UM)

Laboratory water sample no.: NAHRIM S/10

Parasitology Report

Remarks: Both Giardia and Cryptosporidium are not present in the water sample.

Signature:

Name: DR. YVONNE LIM AI LIAN
PROFESOR MADYA
JABATAN PARASITOLOGI
FAKULTI PERUBATAN
UNIVERSITI MALAYA
50603 KUALA LUMPUR

Date: 26/4/2010

2

Para:SEAD (UM) Laboratory water sample no.: NAHRIM 1/10

Form for water sample

Para : SEAD

PARASITES: SOUTH EAST ASIAN DIAGNOSTIC LABORATORY

Sampling data

Station no: SW 1

Sampling site: Sungai Langat

Type of water: River water

Date and time collected: 20/4/2010 10 am

Sampled volume: 10 L

Turbidity (NTU): -

Other parameters: -

Sender: En Mohd Khairul

Parasitological Analysis

Concentrated volume: 10 ml

Analysed volume: 50 µl

Date and time of analysis: 21/4/2010 10 am

Analyst: Mohd Redzuan Ahmad Naziri

Results

No of *Giardia* cysts counted on the slide: 29

Giardia cysts / liter: 2.9

No of *Cryptosporidium* oocysts counted on the slide: 0

Cryptosporidium oocysts / liter: 0

1

Para:SEAD (UM)

Laboratory water sample no.: NAHRIM 1/10

Parasitology Report

Remarks: Only Giardia cysts were found (concentration of 2.9 cysts/litre) in the sampled water.

Signature:

Name: DR. YVONNE LIM AI LIAN
PROFESOR MADYA
JABATAN PARASITOLOGI
FAKULTI PERUBATAN
UNIVERSITI MALAYA
50603 KUALA LUMPUR

Date: 26/4/2010

2

Para:SEAD (UM) Laboratory water sample no.: NAHRIM 2/10

Form for water sample

Para : SEAD

PARASITES: SOUTH EAST ASIAN DIAGNOSTIC LABORATORY

Sampling data

Station no: SW 2

Sampling site: Sungai Langat

Type of water: River water

Date and time collected: 20/4/2010 10.30 am

Sampled volume: 10 L

Turbidity (NTU): -

Other parameters: -

Sender: En. Mohd Khairul

Parasitological Analysis

Concentrated volume: 10 ml

Analysed volume: 50 µl

Date and time of analysis: 21/4/2010 10 am

Analyst: Wan Hafiz Wan Ismail

Results

No of *Giardia* cysts counted on the slide: 1

Giardia cysts / liter: 0.1

No of *Cryptosporidium* oocysts counted on the slide: 0

Cryptosporidium oocysts / liter: 0

1

Para:SEAD (UM)

Laboratory water sample no.: NAHEIM 2/10

Parasitology Report

Remarks: Only Giardia cysts were found (concentration of 0.1 cysts/litre) in the sampled water.

Signature:

Name: DR. YVONNE LIM AI LIAN
PROFESOR MADYA
JABATAN PARASITOLOGI
FAKULTI PERUBATAN
UNIVERSITI MALAYA
50603 KUALA LUMPUR

Date: 26/4/2010

Para:SEAD (UM) Laboratory water sample no.: MAHRIM 3/10

Form for water sample

Para : SEAD

PARASITES: SOUTH EAST ASIAN DIAGNOSTIC LABORATORY

Sampling data

Station no: Well

Sampling site: Sg. Langat

Type of water: Well water

Date and time collected: 23/4/2010 12pm

Sampled volume: 10 L

Turbidity (NTU): -

Other parameters: -

Sender: En. Mohd Khairul

Parasitological Analysis

Concentrated volume: 10 ml

Analysed volume: 50 ml

Date and time of analysis: 23/4/2010 2pm

Analyst: Wan Hafiz b Wan Ismail

Results

No of *Giardia* cysts counted on the slide: 0

Giardia cysts / liter: 0

No of *Cryptosporidium* oocysts counted on the slide: 0

Cryptosporidium oocysts / liter: 0

1

APPENDIX F

PHOTO OF THE STUDY AREA

F.1: Drilling preparation production well construction













F.2:Pumping test conducted in test well DW 1 and DW 2













F.3: Monitoring of groundwater level









F.4; Monitoring of groundwater quality













F.5: Collecting groundwater sample for water quality analysis








F.6:Water Intakes and water treatment plant in Jenderam Hilir and Putrajaya













F.7: Sungai Langat and pond in study area













F.8: Comparison between the water from the well and the Langat River



