

DEVELOPMENT OF RAINFALL TEMPORAL
PATTERN OF KUANTAN RIVER BASIN

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B. ENG(HONS.) CIVIL ENGINEERING

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DEVELOPMENT OF RAINFALL TEMPORAL PATTERN
IN KUANTAN RIVER BASIN

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for the award of the
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ABSTRAK

Malaysia terletak di garisan khatulistiwa dimana ia mengalami cuaca panas dan lembap sepanjang tahun. Malaysia juga mempunyai dua jenis monsun yang menyebabkan hujan lebat dan kerap berlaku. Atas sebab hujan yang melampau, tanah sekeliling mudah ditenggelami air. Taburan hujan temporal digunakan dalam reka bentuk struktur hidraulik dan hidrologi seperti yang terdapat dalam Manual Saliran Mesra Alam Malaysia 2 (MSMA 2). Walaubagaimanapun, temporal hujan yang terdapat didalam MSMA dibangunkan berdasarkan rantau atau kawasan tertentu. Di dalam kajian ini, taburan temporal bagi Sungai Kuantan adalah berdasarkan stesen. Objektif kajian ini adalah untuk menghasilkan taburan hujan temporal untuk Sungai Kuantan menggunakan Kaedah Taburan Masa Huff dan Kaedah WRRI dan membandingkan hasil dapatan kajian antara Kaedah Taburan Masa Huff dan Kaedah WRRI. Taburan hujan dibahagikan kepada 60 minit, 120 minit dan 180 minit tempoh hujan. Setiap tempoh hujan dibahagikan kepada empat kuartil diikuti dengan pengiraan seperti yang termaktub mengikut HTDM untuk menghasilkan taburan temporal. Bagi WRRI Method pula, tempoh hujan perlu disusun semula agar jumlah hujan yang tinggi berada di tengah dan jumlah hujan yang rendah berada di permulaan dan akhiran. Analisis dijalankan bagi kedua-dua kaedah dan dibandingkan keduanya dalam bentuk peratusan. Terdapat perbezaan bagi taburan temporal yang dihasilkan. Berdasarkan analysis taburan hujan temporal yang dihasilkan menggunakan HTDM dan WRRI method, perbezaan didalam semua graf yang diplotkan mempunyai nilai antara 2% ke 57%. Peratusan tertinggi yang dicatat antara tiga tempoh itu 56.68% dan yang paling rendah adalah 2.54%.

ABSTRACT

Malaysia is located at equatorial region which having hot and humid climate through all year. Malaysia will also be having two monsoons which cause a heavy and frequent rain during that period of time. Due to the extreme rainfall, the land is easily flooding. Rainfall temporal pattern is used in designing hydraulic and hydrology structures as in Manual Saliran Mesra Alam Malaysia 2 (MSMA 2). However, MSMA 2's temporal pattern are develop based on region. In this study, the temporal pattern is developed based on stations at Kuantan River Basin. The objectives of the study are to develop Rainfall Temporal Pattern for Kuantan River Basin using Huff Time Distribution Method and WRRI Method and also to compare the result obtained between Huff Time Distribution Method (HTDM) and WRRI Method. The rainfalls are categorized for 60 minutes, 120 minutes and 180 minutes event. Each event are divided to four quartiles and calculated in accordance with Huff Time Method to produce the temporal pattern. While WRRI Method, the events are first rearrange so that the highest depth of rain is set at the middle of storm duration. The analysis is run for both method and compared in terms of percentage. There was a differences in the temporal pattern developed. Based on the analysis of the rainfall temporal pattern developed by HTDM and WRRI method, the differences in each graph plotted varies from about 2% to 57%. The highest percentage of differences of the three events is 56.68% and the lowest is 2.54%.

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LIST OF SYMBOLS

$P(t)$	Depth of precipitation of time
P	Total depth of precipitation
$\Delta\tau$	Time based
i_j	Dimensionless fraction
h	Height of triangle
i	Rainfall Intensity
$\%$	Percentage
$\%cum$	Cumulative of Percentage
Ave	Average

LIST OF ABBREVIATIONS

NM	North Monsoon
SM	South monsoon
Met Malaysia	Jabatan Meteorologi Malaysia
MSMA2	Manual Sistem Saliran Air Malaysia Second Edition
HTDM	Huff Time Distribution Method
WRRI	Water Resources Research Institute
RTP	Rainfall temporal pattern
DID	Department of Irrigation and Drainage
AVM	Average Variability Method
SCS	Soil Conservation Service
PUB	Singapore's National Water Agency
DEWS	Department of Energy and Water Supply
QUDM	Queensland Urban Drainage Manual
MEWR	Ministry of the Environment and Water
Kg.	Kampung
Sg.	Sungai
Ranc.	Rancangan
Pej.	Pejabat
JPS	Jabatan Perairan dan Saliran
N	Negeri
Ldg.	Ladang

CHAPTER 1

INTRODUCTION

1.1 Background Of Study

Flood can be deciphered as water overflowing or over pouring or spill from its bound area. The causes can be because of, heavy rain, snow melt, hurricanes, tsunamis, dams and many other factors. In Malaysia however, the flood main cause is usually by the heavy rain or a non-stopping rain.

Malaysia is a country located at southeast of Asia and having two parts of land, that are Peninsular of Malaysia and Island of Borneo. The country is located at the equatorial region. Due to that, the climate is hot and humid through all year. In Malaysia, there are two types of monsoon that will occur. The Southeast Monsoon (SM) which occur from May to September and the Northeast Monsoon (NM) which occur from October to March. Monsoon occur because of change in temperature between the land and sea. According to Jabatan Meteorologi Malaysia (MetMalaysia) updated 2016, the regions that will be affected by NM are Kelantan, Terengganu, Pahang and South of Sarawak. These areas are most likely will going through a heavy and frequent rain during that period of time.

When rain is pouring, the water will infiltrate into the soil. But if soil was saturated, it cannot uptake more water. So, runoff is most likely to occur if heavy rainfall were to fall. However, the after effect does not always be a flood. But other side factor may contributed to the event of flood. Kuantan is the main city of Pahang and it is a developed area and going through rapid urbanization. A developed area has high impervious area since the land was used for housing area, city complex, company offices, road, parks and other places. A low impervious area makes it have low chances for the water to infiltrate the soil. Due to that, water easily accumulates and was

confined at the area. Drainage systems play an important role in order to control the water flow. The drainage systems as well as other hydraulic and hydrology structures such as dam were design based on rainfall distribution and intensity as one of the factor.

Although rainfall is to be expected, the distribution may differ from places. The MetMalaysia has also provided the expected maximum monthly rainfall distribution by region as in Table 1.1. However, history shows that the climate of Malaysia has change little by little over the pass decades. Rainfall and flood is closely related to one another. In Malaysia, almost every year the east coast areas are having a heavy rainfall in most area and flood will happen at low-level ground.

Table 1.1 : Expected maximum monthly rainfall distribution

STATE	RAINFALL DISTRIBUTION
Kelantan, Terengganu	600 mm (November)
Pahang and East of Johor	600 mm (December)
Sarawak	400-700 mm (January)

Source : Jabatan Meteorologi Malaysia's Website

According to Tahir (2015), one of the worst floods that ever occur in Malaysia is on December 2014 which happened at Kelantan. The main cause is due to heavy rain that pouring from 21 December 2014 to 23 December 2014. Provided an aerial view of Pengkalan Chepa, Kelantan in Figure 1.1. Also, according to Bernama (2013) on 3 December 2013, Kuantan was enduring a four days non-stop rain which have causes the capital to be incapacitated. The water level has also reached 2 meter height in some areas. Refer to Figure 1.2.



Figure 1.1 : Aerial view shows houses and plantations submerged in floodwaters in Pengkalan Chepa, near Kota Bharu, Kelantan on December 28, 2014

Sources : <http://www.themalaymailonline.com/malaysia/article/worst-floods-in-kelantan-confirms-nsc>



Figure 1.2 : An aerial view of Kuantan on 3rd December 2013

Sources : <http://www.thesundaily.my/news/896679>

From here, it proved how closely related the rainfall with flooding. And these heavy rain not only bringing water but also destruction of property, loss, health problem and if not careful, death can also be the outcome.

As many researchers have studied on rainfall, they have come up with ways and relations between rainfall and flood. Rainfall has its own distribution and the data can actually be analyzed to obtain rainfall temporal pattern. Rainfall temporal pattern is very useful for hydraulic and hydrology design structure. It can be used for designing of water catchment area. In Manual Sistem Saliran Air Malaysia or also known as Urban Stormwater Management Manual for Malaysia Second Edition (MSMA2), the temporal patterns obtained are based on region in Malaysia. So having to develop the rainfall temporal pattern at stations based at Kuantan River basin will give a more reliable data to be used in designing hydrology and hydraulics structure at Pahang compared to MSMA's temporal pattern.

1.2 Problem Statement

Weather or climate change is a natural thing to happen at all area. Although it can be predicted by the forecast technologies, it is not something that can be controlled. The change in climate and weather condition can influenced the humidity, wind and temperature of that particular area. It can actually affect human day to day activities. If an extreme condition were to occur, it can cause more problems for a long term period.

Rainfall as mentioned before is closely related to flood. In the event of extreme rainfall which means a heavy rainfall occur for a long period of time, an area can easily submerge in the rain water. River, swales and drains are function to channel the water away and to control the flow of water. Kuantan River is the main river in Pahang and carries most of the water when rain and channeled it away. Having analysis on rainfall temporal pattern of Kuantan River can help in designing hydraulic and hydrology structure which will help in controlling water flow.

Kuantan area is known of having heavy rainfall since it was located at east coast region which will go through a monsoon season every year. The effect of the rainfall is flooding almost every year which cause damage to properties. Having to develop temporal pattern that station is based at Kuantan River can help in designing hydraulic and hydrology structure in a more accurate design since the station is more specify and near affected areas.

Although in MSMA there is already a temporal pattern being developed, it is however the stations were based on region. So if the temporal pattern is general for that

region. If in case for designing a more specific area, the temporal pattern is not relevant to be of used as the rain distribution is vary in different area. So the temporal pattern in MSMA did not actually represent the actual data of certain area.

1.3 Objectives

The objectives of this study are :

- 1.To develop Rainfall Temporal Pattern for Kuantan River Basin using WRII and Huff Time Distribution Method (HTDM).
- 2.To compare the result obtained from both methods.

1.4 Scope Of Study

The scope of this study are :

1. The area is Kuantan River Basin at Pahang that has 10 stations.
2. Data analysis use WRII Method and Huff Time Distribution Method.
3. The study need 5 minutes interval of rainfall event from 2008 until 2016.
4. The rainfall event used in the study were 60 minutes, 120 minutes and 180 minutes rainfall event.
5. Data of rainfall event were obtained from Department of Irrigation and Drainage Malaysia (DID).

1.5 Significance Of Study

The rainfall temporal pattern (RTP) developed in MSMA is based on region in Malaysia. For this study however, RTP were developed based on station that are located at Kuantan River. By having this, a more reliable temporal pattern can be obtained. So the new RTP can be used as a new guideline to design hydraulic and hydrology structure. Thus, the drainage system can be improved by using a new rainfall distribution as the data.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Disasters around the globe had been happening long before centuries. This fatal attraction can cause great turmoil to human and nation. Disaster can simply cause the mother nature itself. Mother nature is something that cannot be stopped. It can give the land a hurricane, earthquakes, volcano eruption, tsunami, sinkhole, avalanches, blizzard, extreme condition, flood, land slide and many others types. History has proved itself that these phenomenon result turbulence that left the people and nation devastated. Properties were damage, parting and missing families and friends, wounded, losses and others.

True that we cannot control the phenomenon, let alone stop it. In most cases, human are at loss. But phenomenon can be predicted. The old days has taught us how to reduce the after effects and to control the situation not to become worst. Nowadays, technologies and engineering has helped a lot in overcoming the after effects of these situations. Although not all mother nature can be helped with current technologist and engineering, but some of the non-extreme condition can be helped.

Flood in particular happened frequently and cause by rainfall. According to Baker (2016), flood can be in a few types. There are flash flood, urban flood, regional flood, ice jam flood and storm surge flood. Floods bring water to the land and sink the ground. A normal rainfall normally would not result in flood. But heavy rainfall may be it. Rainfall is not the only factor that cause flood. Many factors such as poor drainage and the rise of impervious area also part of the contribution. Urbanization is something that cannot be avoided. However, technologies and engineering can work to control and reduces the bad outcomes.

2.1.1 World Flood Disaster

Looking back in history, disaster by flood can be deadliest. Water current can be so powerful that it can sweep and push over almost everything. Homes, building, vehicles, plants and crops were all damaged. In 1931, China go through a deadliest flood that ever happened in history. Baker (2016) state that in his book *The World's Worst Floods*, the flood covered more than 80 thousand square kilometer and took the lives of about 4 million people. Not only that, more than 80 million people are left without homes. Figure 2.1 is a Dyke Breach during the 1931's flood.

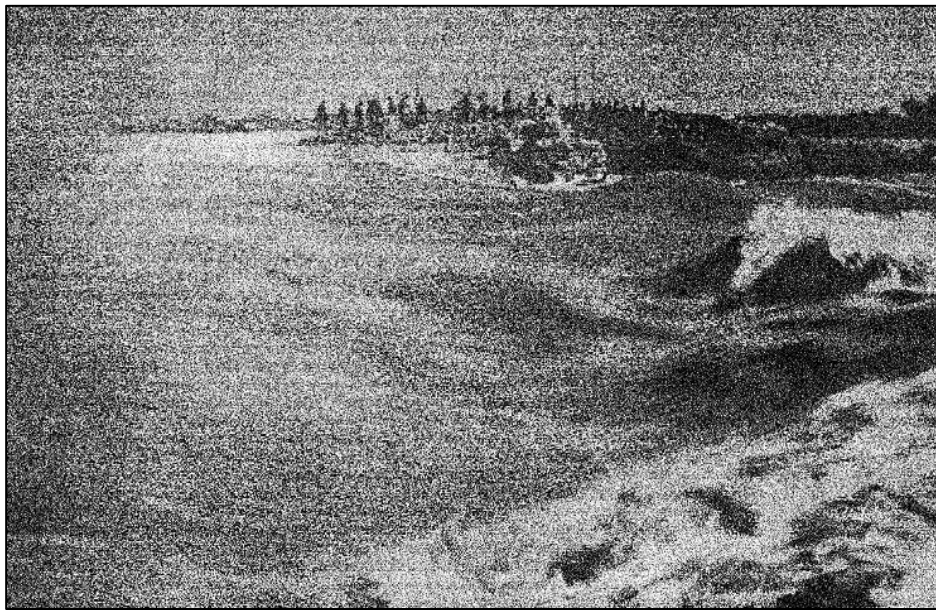


Figure 2.1 : A Dyke Breach During the 1931 Flood

Source: The Report of the National Flood Relief Commission (Accessed at www.archive.org)

Courtney (2015) state that, “during periods of excessive rainfall and poor hydraulic governance, however, rising water and neglected dykes allowed rivers and lakes to reclaim the plains that had been occupied by human beings”. This statement in other words also means the hydraulic properties and structure play major part in controlling the water flow. Excessive rainfall should be able to be control despite the urbanization by the human has blocked it normal current.

Another country that has been fighting with natural disaster almost every year and always turned out to be a life taking event is Japan. In 2015, Japan experienced one of its deadliest flood in history. Wakatsuki et al. (2015) in CNN's news reported that in

Joso, Japan, the raging brown floodwaters spawned from Tropical Storm Etau, which has dumped more than 60 centimeters (2 feet) of rain over some areas since Monday and add several weeks of near-daily downpours as the rainy season lingers, and swaths of eastern Japan are now deluged.

The flood was so bad, that they needed a helicopter to landed on the roof of a shopping center where dozens of people had been stranded overnight (Wakatsuki et al., 2015). This is yet another proof that rainfall can be fatal and paralyze the whole place.

2.1.2 Malaysia's Flood Disaster

Malaysia is stated at near the equatorial lines is known of having to go through a monsoon season every year from December to March. The effect areas are the region near East Coast part such as Kelantan, Pahang, Terengganu and Johor. Almost every year, rain will pour down very frequently and sometimes non-stop for few days. During December 2014, the worst flood has occurred which leaves the whole country in shock and devastated. According to Utusan Malaysia on 26th December 2014, more than 100,000 people have been evacuated. This show how serious the flood at the affected area is.

DID in their Taklimat Banjir Pantai Timur on 14th to 27th December 2014, there are a few reasons for the flood to occur. Firstly, the rain has been pouring over more than 10 days of time. Certainly such rain caused the catchment area not being able to absorb more rain water. The effect of that is runoff started to occur and increase water level of the water accumulation in low area. Not only that, there are release of water from Empangan Kenyir, Empangan Chenderoh and Empangan Timah Tasoh which caused the increased of water level at downstream area of Terengganu River, Perak River and Perlis River. Next is the high tide from the sea and not to mention the affected area is a low lying area.

Adding all the causes together has make the situation worsen day by day. The isohyet of the affected area at Peninsular Malaysia on 15th , 20th , and 22nd December 2014 is shown in Figure 2.2, Figure 2.3, and Figure 2.4 respectively.

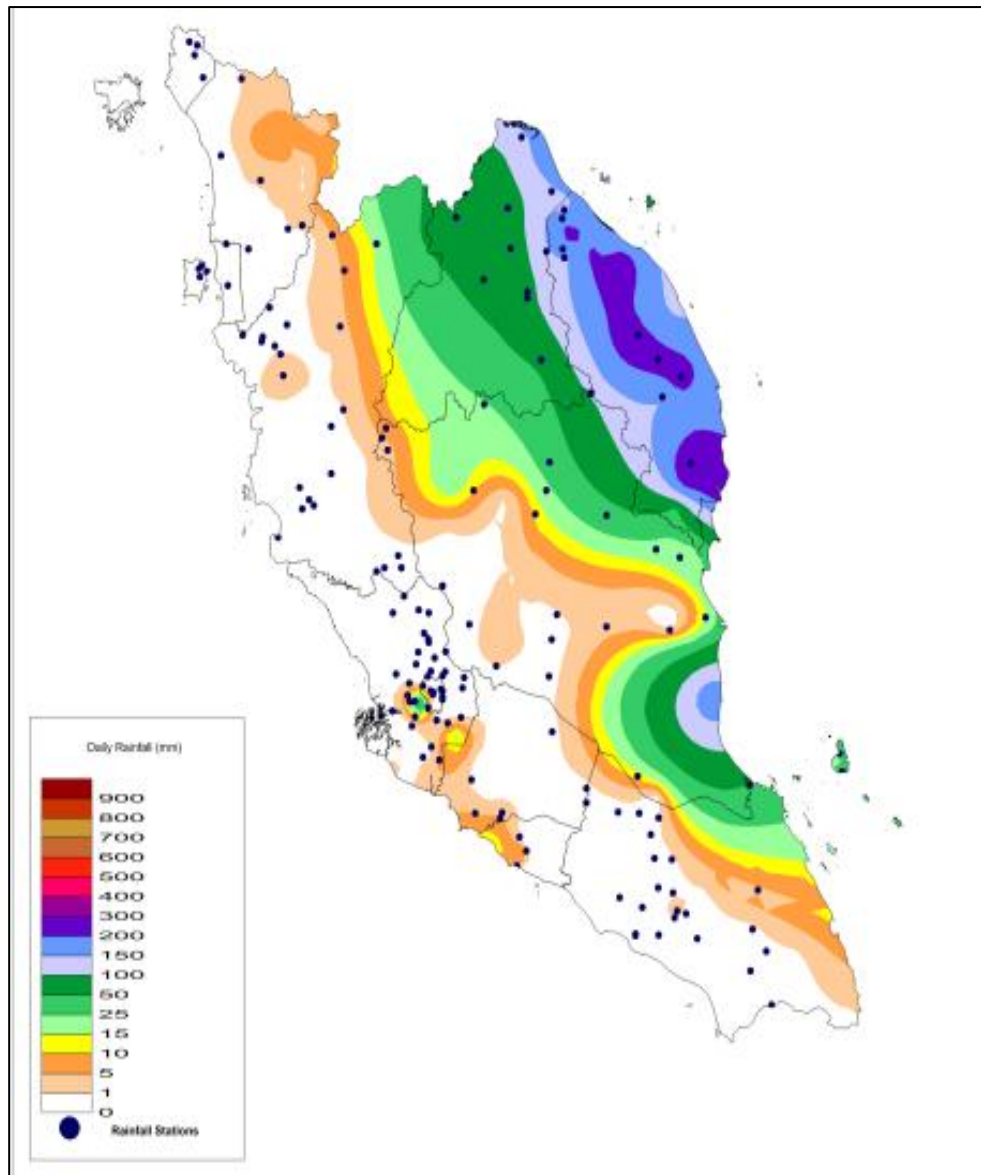


Figure 2.2 : Isohyet of Peninsular Malaysia on 15th December 2014

Source : Taklimat Banjir Pantai Timur by DID

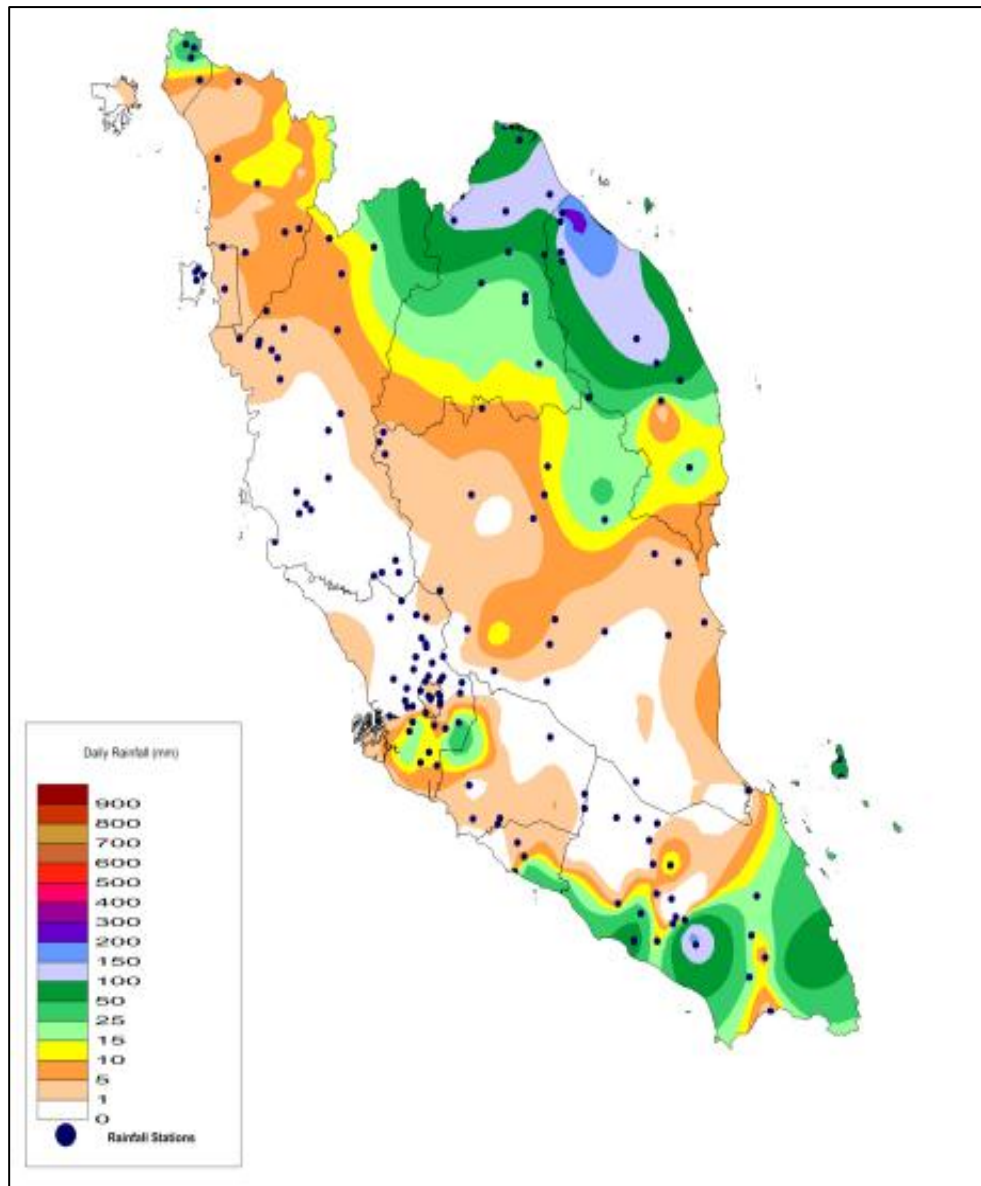


Figure 2.3 : Isohyet of Peninsular Malaysia on 20th December 2014

Source : Taklimat Banjir Pantai Timur by DID

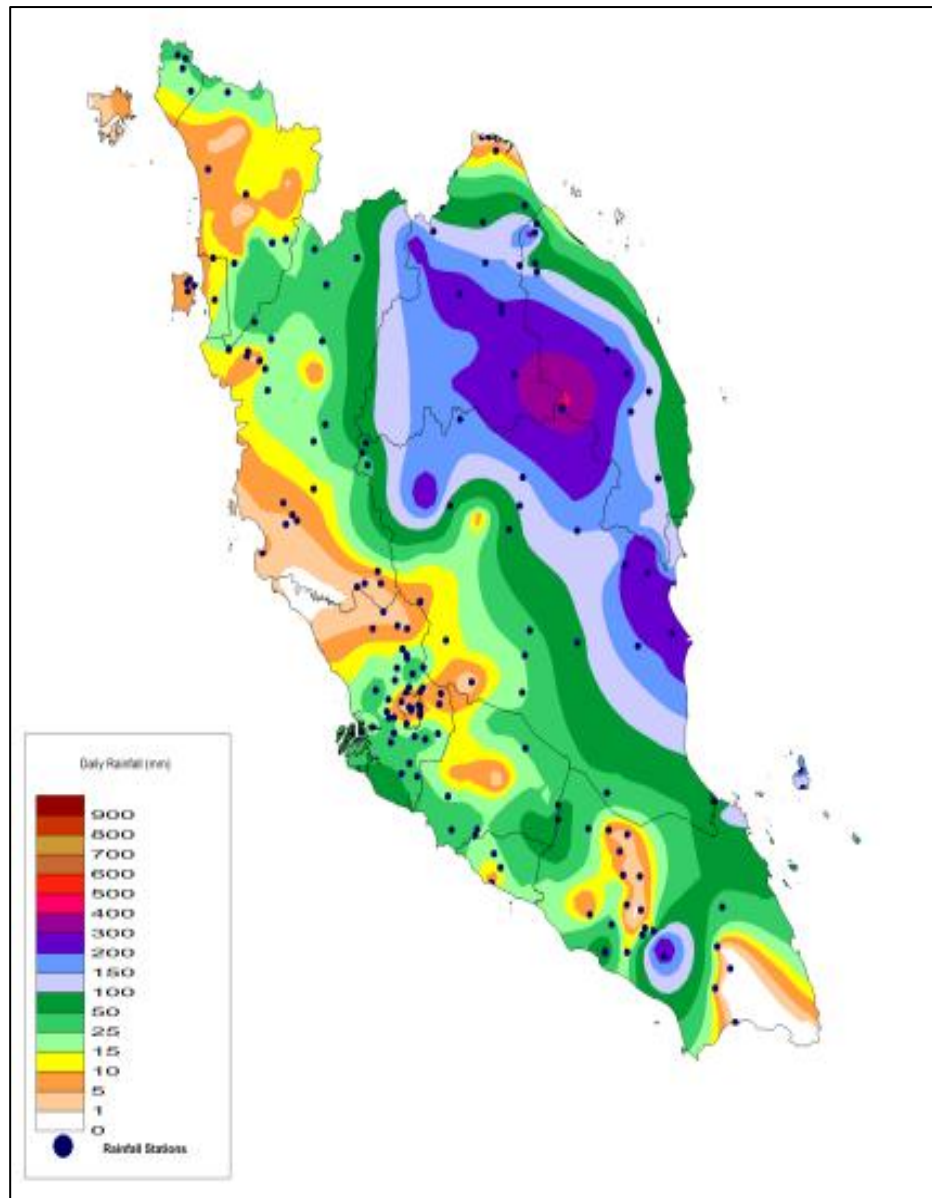


Figure 2.4 : Isohyet of Peninsular Malaysia on 22nd December 2014

Source : Taklimat Banjir Pantai Timur by DID

2.1.3 Kuantan River

During the December 2014 flood, the most affected area is Kelantan, Terengganu and Pahang. The flood is so worst that most road and path are blocked. Clean water supply, electricity and shelter are at some place is limited. They were to share together and wait until the water level is normal again.

The DID has updated the water level at some of the station at rivers in Pahang has risen to danger level. If the river cannot take in more water, the water is likely to overflow and worsen the flooded area. The water level status in Pahang by DID shows in Figure 2.5.

STATUS ARAS AIR - PAHANG				
<div> <div>Berjaga-jaga</div> <div>Amaran</div> <div>Bahaya</div> </div>				
Bil.	Lembangan Sungai	Nama Stesen	Aras Air Tertinggi 2014 (m)	Aras Air Tertinggi Direkodkan (m)
1.	Sg Kuantan	Bukit Kenau	22.42 (6)	28.28 (2010)
2.	Sg Kuantan	Pasir Kemudi	9.39 (1)	7.69 (2006)
3.	Sg Kuantan	Kuantan Bypass	7.08 (-)	8.2 (2013)
4.	Sg. Tembeling	Kuala Tahan	77.52 (1)	72.31 (2013)
5.	Sg. Pahang	Sg. Yap	59.44 (1)	54.28 (2007)
6.	Sg. Pahang	Temerloh	33.70 (4)	35.12 (1971)
7.	Sg. Pahang	Lubuk Paku	20.03 (7)	33.43 (2007)

Figure 2.5 : Water level status of Pahang state.

Source : Taklimat Banjir Pantai Timur by DID

2.2 Rainfall Temporal Pattern

Since Malaysia is located at the equatorial region, it is hot and humid through all year. Malaysia did not have the four seasons like winter, summer, autumn and spring. Unlike other countries that are not at equatorial region, we did not experienced such change in season. However, rainy season is happening and at some point can be bad. We experience rainy seasons through the Southeast Monsoon (SM) which occur from

May to September and the Northeast Monsoon (NM) which occur from October to March.

The rain season is can be extreme that it could result in flooding. Flooding is natural disaster that occurs every year in Malaysia. However, such disaster can be overcome or reduced by hydraulics and hydrological structure. By studying rainfall temporal pattern (RTP), we can analyze its distribution and intensity to be used when designing hydraulics and hydrological structure.

According to Golkar (2009), rainfall temporal distribution pattern is an important factor in irrigation and drainage, watershed management, damming, civil engineering, soil erosion and flood potential studies. So, the rainfall can be analyze further and used it to apply in engineering design..

Another equally important style is the caption. All captions for figures, tables and equations are formatted using their respective styles prepared in this template.

2.3 Method Developing RTP

Rainfall distribution has long been studied by researcher to aid with current technologies and engineering works. One of the studies is to develop RTP. There are a few ways to develop RTP such as using Average Variability Method (AVM), Soil Conservation Services (SCS), Huff Time Method and Triangular Method.

2.3.1 Soil Conservation Method

Alharthy (2006) mention that SCS type curves are in the form of percentage mass (cumulative) curves based on 24-hour rainfall of the desired frequency. If a single precipitation depth of desired frequency is known, the SCS type curve is rescaled (multiplied by the known number) to get the time distribution. For durations less than 24 hour, the steepest part of the type curve for required duration is used.

The steps for developing hyetograph using SCS are,

- Compute P/i (from DDF/IDF curves or equations)
- Pick a SCS type curve based on location

- If $T_d = 24$ hour, multiply (rescale) the type curve with P to get the design mass curve. If T_d is less than 24 hour, pick the steepest part of the curve for rescaling
- Get the incremental precipitation from the rescaled mass curve to develop the design hyetograph

2.3.2 Huff Time Distribution Method

According to Smith (2010), Huff suggested a family of non-dimensional, storm distribution patterns. The events were divided into four groups in which the peak rainfall intensity occurs in the first, second, third or fourth quarter of the storm duration. Within each group the distribution was plotted for different probabilities of occurrence. MIDUSS uses the median curve for each of the four quartile distributions. A non-dimensional curve is illustrated in Figure 2.6.

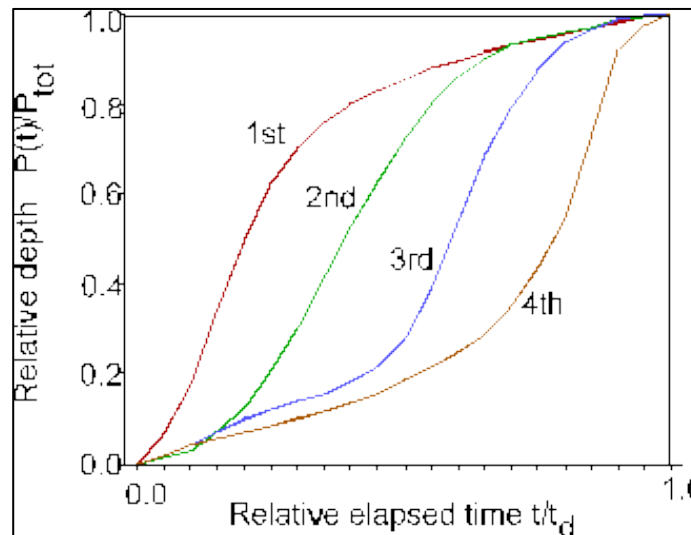


Figure 2.6 : Non-dimensional curve of Huff's storm distribution

Source : <http://www.alanasmith.com/theory-Derivation-Huff-Storm.htm>

To define a storm of this type provide values for the total depth of rainfall (in millimeters or inches), the duration of the storm (in minutes) and the quartile distribution required (i.e. 1, 2, 3 or 4). The four quartile Huff distributions are approximated by a series of chords joining points defined by the non-dimensional values in the Table 2.1. Figure 2.7 shows a typical curve (not to scale) which for clarity uses only a very small number of steps. The time base for the NH dimensionless points defining the 'curve' is subdivided into dimensionless time steps defined by,

$$\Delta\tau = \frac{NH-1}{NDT} \quad 2.1$$

Where,

NH = number of points defining the Huff curve (shown as $NH = 7$ but usually much more)

NDT = number of rainfall intensities required (shown as only 15 in Figure 2.7).

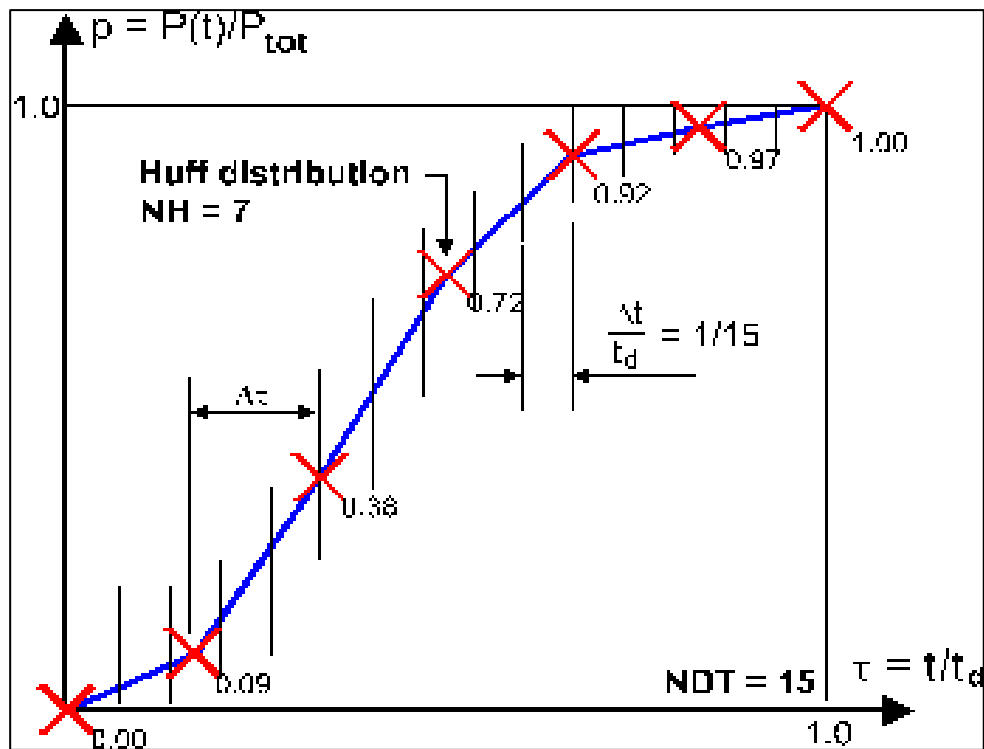


Figure 2.7 : Discretization of a Huff curve.

Source : <http://www.alanasmith.com/theory-Derivation-Huff-Storm.htm>

The values of the dimensionless fractions P_k and P_{k+1} at the start and finish of each time-step are obtained by linear interpolation and the corresponding rainfall intensity is then given as:

$$i_j = \frac{(p_{k+1} - p_k)p_{tot}}{\Delta\tau} \quad 2.2$$

Where,

$$p_{k+1} = p_m + (p_{m+1} - p_m)(h - m)$$

$$m = INT(h)$$

$$h = j. \Delta \tau + 1$$

2.3.3 Triangular Hyetograph Method

For triangular hyetograph method, an example of hyetograph is as shown in Figure 2.8. The steps are,

- Compute P/i (from DDF/IDF curves or equations) for,

$$P = \frac{1}{2} T_d h \quad 2.3$$

$$h = \frac{2P}{T_d} \quad 2.4$$

- Use above equations to get t_a , t_b , T_d and h (r is available for various locations) for,

T_d : hyetograph base length = precipitation duration

t_a : time before the peak

r : storm advancement coefficient = t_a/T_d

t_b : recession time = $T_d - t_a = (1-r)T_d$

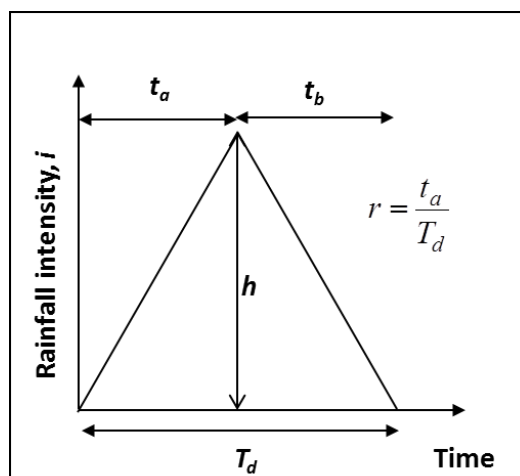


Figure 2.8 : an example of hyetograph for triangular method

Source : www.ce.utexas.edu/prof/maidment/GradHydro2010/Visual/DesignStorms.ppt

2.3.4 Alternating Block Method

For this method, the steps are,

- Using T , find i for $\Delta t, 2\Delta t, 3\Delta t, \dots, n\Delta t$ using the IDF curve for the specified location for,

$$i = \frac{c}{(T_d)^{e+f}} \quad 2.5$$

Where,

i = design rainfall intensity

T_d = duration of storm

c, e, f = coefficients

- Using i compute P for $\Delta t, 2\Delta t, 3\Delta t, \dots, n\Delta t$. This gives cumulative P .
- Compute incremental precipitation from cumulative P .
- Pick the highest incremental precipitation (maximum block) and place it in the middle of the hyetograph. Pick the second highest block and place it to the right of the maximum block, pick the third highest block and place it to the left of the maximum block, pick the fourth highest block and place it to the right of the maximum block (after second block), and so on until the last block.

2.3.5 Average Variability Method (AVM)

For this method, it was also used by Malaysia in MSMA2. Bustami et. al (2012), use AVM in their study on Development of Temporal Rainfall Pattern for Southern Region Of Sarawak. In their study, the temporal pattern is taken for 10 minutes, 15 minutes, 30 minutes, 60 minutes, 120 minutes, 180 minutes and 360 minutes duration. Figure 2.9 is sample analysis for 15 minutes rainfall duration for Gedong station. While, Figure 2.10 is sample of rainfall temporal pattern.

1	2	3	4	5	6	7	8	9	10	11	12
Date	Rain in mm	Rank	Rain in Each Period			Rank of Each Period's Rainfall			% of Rain in Period of Each Rank		
			Period			Period			Rank		
			1	2	3	1	2	3	1	2	3
06.11.99	11.5	1	4.5	6.5	0.5	2	1	3	57	39	4
28.12.04	11.5	2	4.5	6.5	0.5	2	1	3	57	39	4
31.12.06	9.0	3	2.5	4.0	2.5	1.5	3	1.5	44	28	28
11.04.04	8.5	4	5.5	2.0	1.0	1	2	3	65	24	12
02.02.04	8.0	5	0.5	6.5	1.0	3	1	2	81	13	6
16.03.04	8.0	6	4.0	2.5	1.5	1	2	3	50	31	19
05.11.99	6.5	7	3.0	3.0	0.5	1.5	1.5	3	46	46	8
29.07.06	6.5	8	1.0	4.0	1.5	3	1	2	62	23	15
20.10.00	5.5	9	0.5	2.0	3.0	3	2	1	55	36	9
02.04.02	5.5	10	1.5	2.5	1.5	2.5	1	2.5	45	27	27
Average						2.05	1.55	2.40	56	31	13
Assigned Rank						2	1	3			
Period						1	2	3			
Final Pattern (% of Total Rainfall)						31	56	13			

Figure 2.9 : Sample analysis for 15 minutes rainfall duration for Gedong station.
Source : UNIMAS E-Journal of Civil Engineering, Vol. 3 (Special Issue) 2012

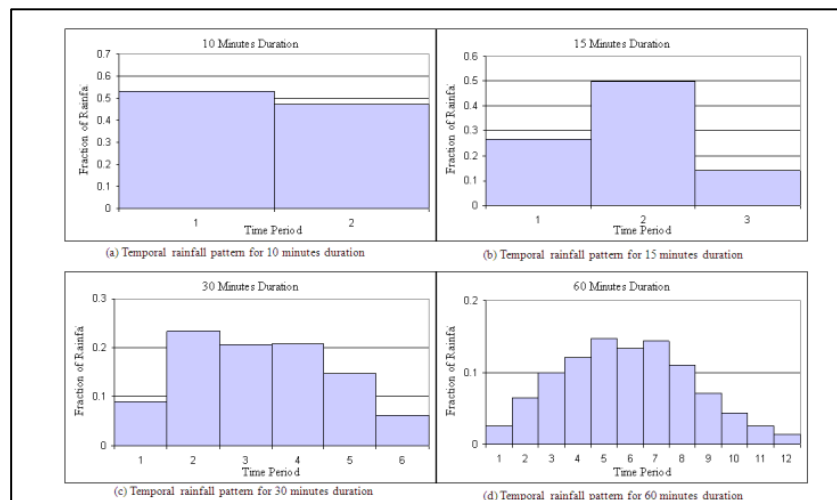


Figure 2.10 : Sample of rainfall temporal pattern
Source : UNIMAS E-Journal of Civil Engineering, Vol. 3 (Special Issue) 2012

2.4 Guidelines Uses By Other Countries

In Malaysia, MSMA2 is used as guideline in designing rainfall temporal pattern. The design storm are used for designing hydraulics and hydrological structure such is water catchment area and drainage system. In Singapore, the manual used is “Managing Stormwater For Our Future” by Singapore’s National Water Agency (PUB). While in Queensland, the Department of Energy and Water Supply (DEWS) published the “Queensland Urban Drainage Manual” (QUDM) with latest edition is 2013 as the manual in use.

2.4.1 Singapore's Stormwater Manual

In Singapore, the Singapore's National Water Agency (PUB), produce the Managing Stormwater For Our Future Manual Book. According to PUB (2016), Singapore uses two separate systems to collect rainwater and used water with two-third of Singapore act as water catchment and enhance flood protection, PUB adopts a 'Source-Pathway-Receptor' approach, which looks at catchment-wide solutions to achieve higher flood protection. Referring to Figure 2.5 is "Source-Pathway-Receptor" receptor map.

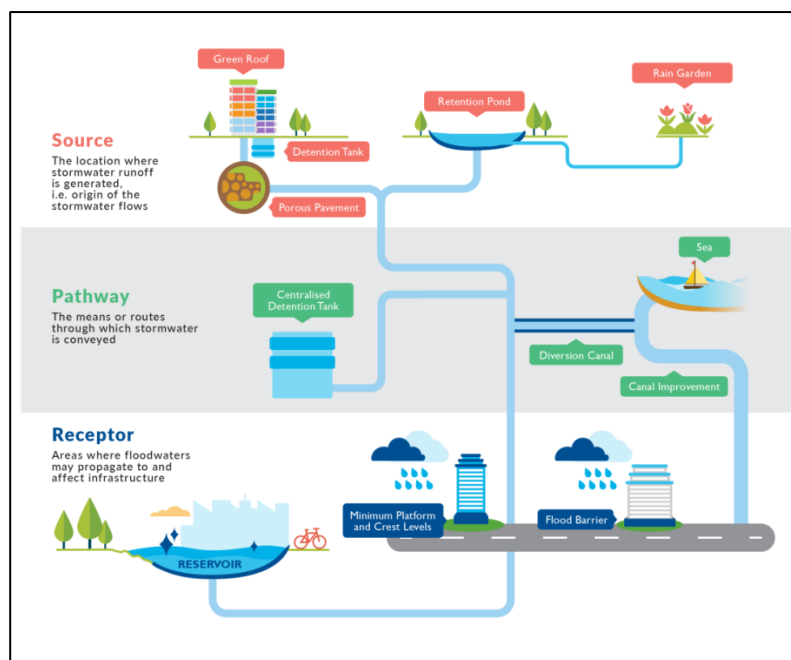


Figure 2.11 : "Source-Pathway-Receptor" receptor map

Sources : PUB Official's website

The 'Source-Pathway-Receptor' approach was adopted by PUB in 2012 following recommendations from the Expert Panel on Drainage Design and Flood Protection Measures that was appointed by the Ministry of the Environment and Water Resources (MEWR) in June 2011. The "Managing Stormwater for Our Future" publication presents an overview of PUB's stormwater management strategies, approach and requirements that will help prepare Singapore for the future. It also outlines plans for 12 waterways in Singapore (PUB, 2016).

2.4.2 Queensland's Stormwater Manual

QUDM (2013) state that the manual is to assist the engineers and stormwater designers in planning and design of urban drainage systems within Queensland. The aim of the manual (Figure 2.6) is to provide details of technical and regulatory aspects to be considered during the planning, design and management of urban stormwater drainage systems, and to provide details of appropriate design methods and computational procedures. Both hydrologic and hydraulic procedures are considered as well as environmental and legal aspects. The prime objective of Queensland Urban Drainage Manual (QUDM) is to address:

- the design of stormwater conveyance structures (not water quality) that exist from the downslope allotment boundary to the edge of the defined watercourse.
- the hydraulic design of structures that cross floodplains, such as constructed open drains and cross-drainage structures.

The hydrologic procedures provided in the Manual are considered appropriate for small urban catchments of up to 500 hectares.

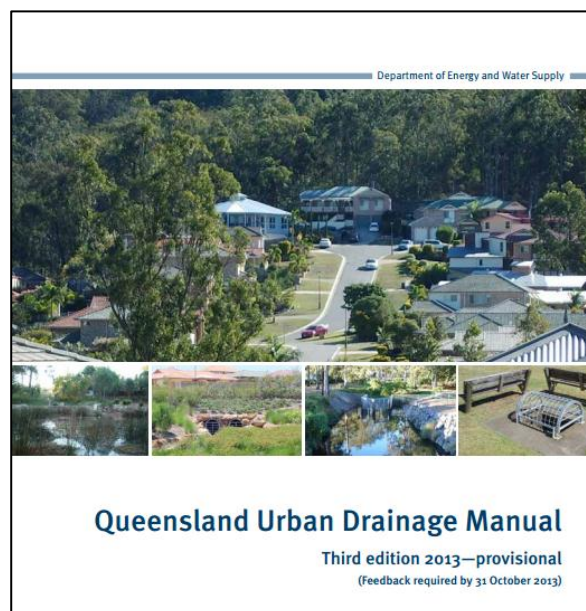


Figure 2.12 : Queensland Urban Drainage Manual (QUDM)

Source : https://www.dews.qld.gov.au/__data/assets/pdf_file/0008/78128/qudm2013-provisional.pdf

CHAPTER 3

METHODOLOGY

3.1 Introduction

To complete the study, the process started with selecting the study area based on problem statement and significance of study obtained. The study area also included selection of rainfall station at Kuantan River Basin. Next is data collection process. The data taken is in 5 minutes interval of rainfall event data from 2000 to 2016. After collecting the data, the process proceeded to extracting the rainfall events of 60 minutes, 120minutes, and 180 minutes. After that, proceed to analyse the data obtained. In the study, the method selected is WRRI and Huff Time Method as the two methods were both produced same type of output. So the terms in comparing both method was of the same parameter.

In this chapter, the process is being elaborate more on study area, data collection and data analysis.

3.2 Flowchart

Figure 3.1 shows the flow chart of the study methodology starting with study area followed by data collection, analysis and conclusion from the results.

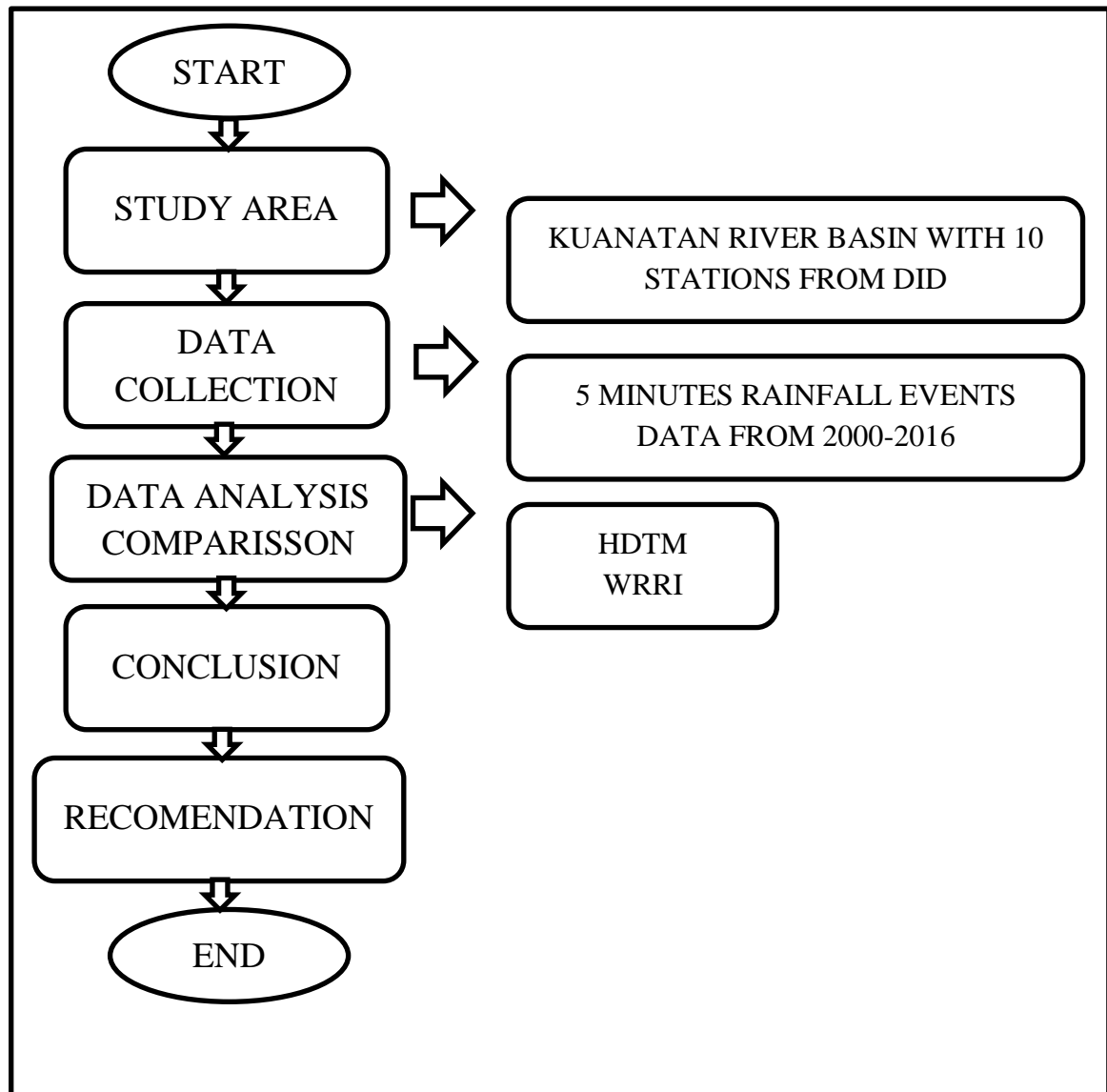


Figure 3.1 : Flowchart of methodology

3.3 Study Area

The area selected for this study is Kuantan River Basin which is located at Kuantan, Pahang. Kuantan is located at east coast area where Monsoon season occur every year. As a result, the area is dealing with flood every year. The worst flood occur is during December 2013. Figure 3.2 is the map of Hydrological Stations in Pahang while Figure 3.3 is the close-up view of Kuantan River along with the station of rainfall.

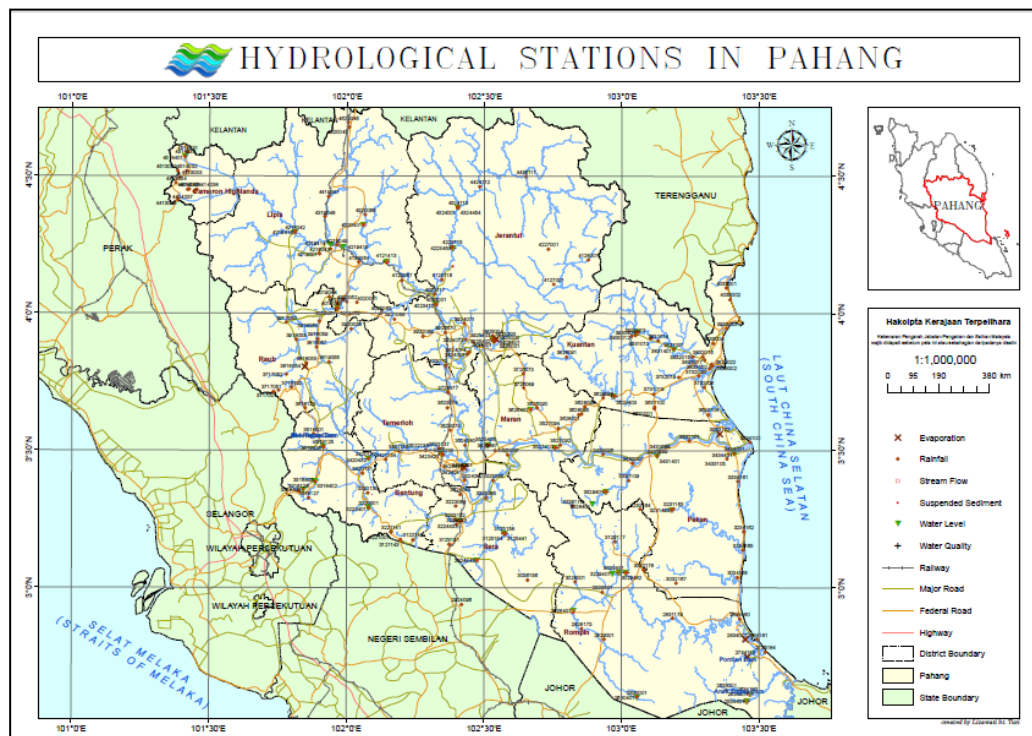


Figure 3.2 : The map of Kuantan

Source : DID Official Website

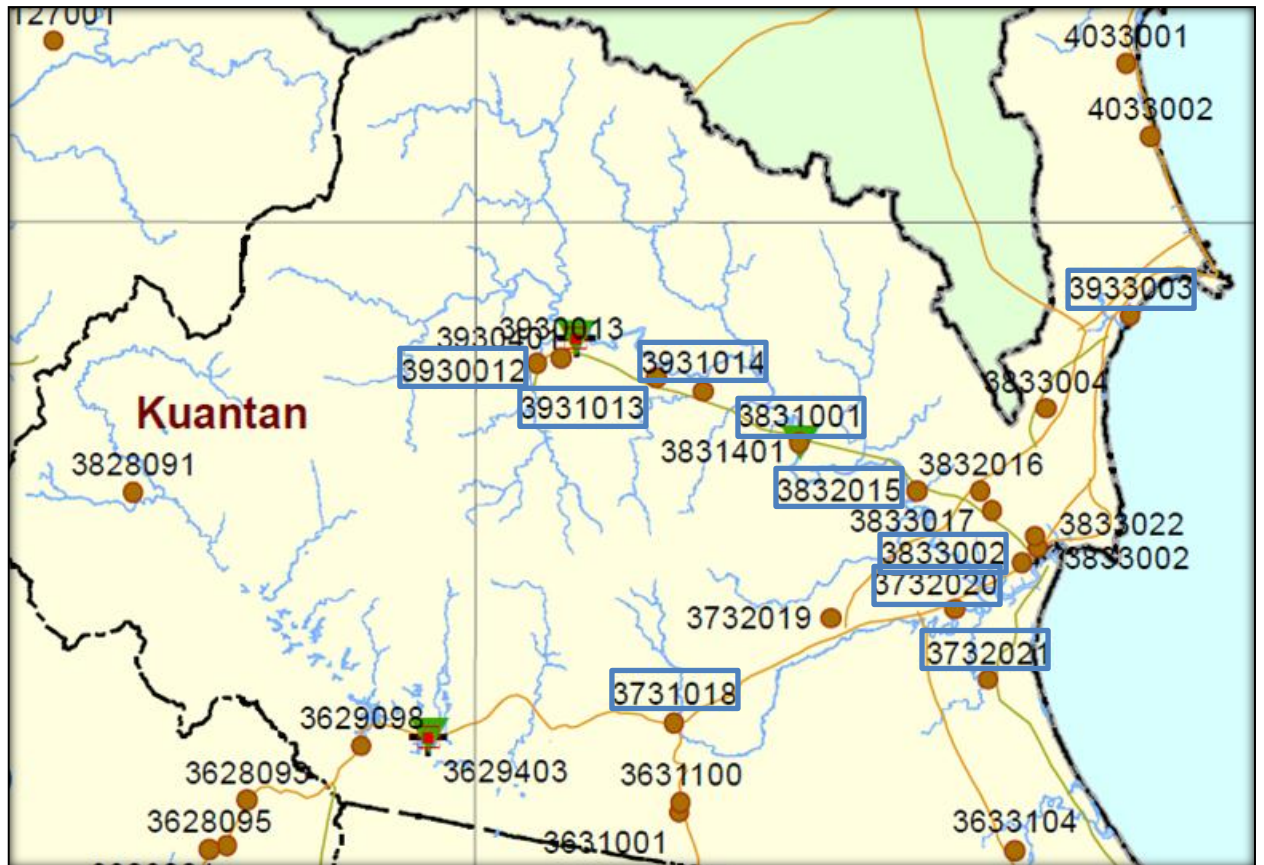


Figure 3.3 : Close-up stations located at Kuantan River

Source : DID Official Website

3.4 Data Collection

The data use for the analysis is 5 minutes interval of rainfall which taken from each of 10 stations located at Kuantan River Basin. For a more reliable result, the data is taken from 2000 to 2016. The data is collected from Department of Irrigation and Drainage Malaysia. Table 3.1 shows the rainfall station of Kuantan River.

Table 3.1 : The Rainfall station of Kuantan River.

STATIONS' ID	STATION'S NAME
3631001	KG. PULAU MANIS
3731018	JKR. GAMBANG
3732020	PAYA BESAR
3732021	KG. SG. SOI
3832015	RANC. PAM PAYA PINANG
3833002	PEJ.JPS. N. PAHANG
3930012	SG. LEMBING PCCL MILL
3931013	LDG.NADA
3931014	LDG.KUALA REMAN
3933003	BALOK

3.5 METHOD OF CALCULATION

After collection of data, the analysis will be using two methods. The method used is Water Resources Research Institute Method and Huff Time Distribution Method.

3.5.1 Water Resources Research Institute Method (WRRI)

WRRI method is a new method in developing rainfall temporal pattern. This method is almost identical to Huff Time Distribution Method. According to El-Sayed (2017) the rainfall event is arranged in such way that the highest depth of rainfall is in the middle and the lowest is the first and the last. Figure 3.4 is the simple step to follow to develop using WRRI method.

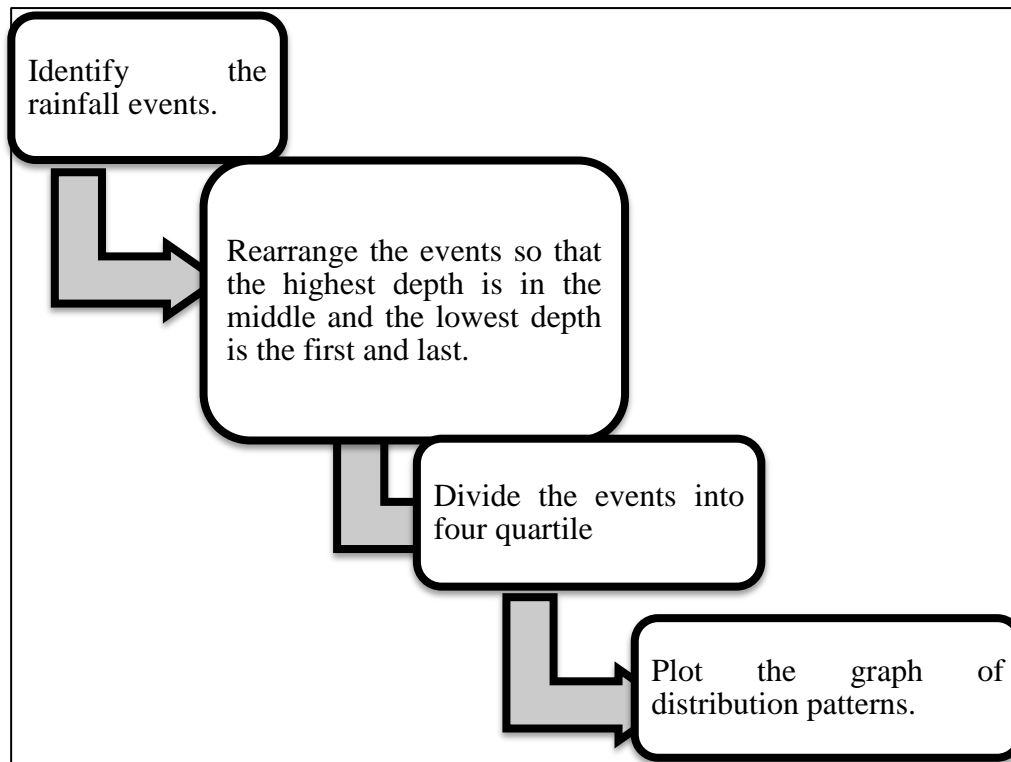


Figure 3.4 :The step using WRI Method.

3.5.2 HUFF TIME DISTRIBUTION METHOD

For Huff method, it is almost similar with SCS method. The pattern of the graft distribution is slightly different.

Viessman (2003) in book *Introduction To Hydrology* mention that procedure for Huff Time Method are first to identify the storm and separate it based on the record of rainfall obtained. Then, the recorded storm is divided to distribution patterns of four equal probability group (quartile) from most severe to mildest. After that, start constructing distribution pattern (median curve) for all quartile.

The formula used to develop the curve is $\Delta\tau = \frac{NH-1}{NDT}$ where NH is number of points defining the Huff curve and NDT is number of rainfall intensities required.

3.6 Comparison

Since both method has the same way to develop and the result obtained were of the same parameter and dimension, the comparison were made based on the percentage of cumulative rainfall depth of each event. For example, the first point of cumulative

percentage from first point of 1st Quartile of HTDM's 60 minutes rainfall event of Balok was compared with first point of 1st Quartile of WRRRI's 60 minutes rainfall event of Balok. Both method was of the same dimension. Taking out the differences between the two point and add with the next differences of the next point. The cumulative of differences was calculated and divided with total point from HTDM since HTDM is the first method used and it is the older method. Then it was times with 100 to find the percentage.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Introduction

In this study, the rainfall data is collected from Department of Irrigation and Drainage (DID) and the rainfall events of 60 minutes, 120 minutes and 180 minutes were extracted in order to develop the rainfall temporal pattern. The summary of rainfall events are as shown in Table 4.1. The patterns are developed using Huff Time Method and WRRI method and were compared afterwards. The analysis and comparison of both methods are discussed further in this chapter.

Table 4.1 : Summary of Rainfall Event

Station	Durations			Total
	60	120	180	
Kg. Pulau Manis	52	13	13	78
Jkr. Gambang	83	26	8	117
Paya Besar	44	17	11	72
Kg. Sg. Soi	54	17	8	73
Ranc. Pam Paya Pinang	55	17	7	79
Pej.Jps. N. Pahang	115	28	7	150
Sg. Lembing Pccl Mill	134	31	16	181
Ldg.Nada	69	22	5	96
Ldg.Kuala Reman	55	29	2	86
Balok	38	18	6	62

4.2 Huff Time Distribution Method

The rainfall events used to develop using this method are 60 minutes, 120 minutes and 180 minutes. The reasoning is because this method required the event to be divided into four equal quartiles. Therefore, such selections are chosen as the event can be equally divided by four quartiles. The results are laid out in form of curve by connecting each point of rainfall event of 5 minutes interval plotted. The analysis for Kg. Pulau Manis Station is in Table 4.2 for (a), (b), (c) and (d) are 1st, 2nd, 3rd and 4th Quartile respectively. However for other station, the analysis are as shown in Appendix A.

4.2.1 Kg. Pulau Manis

In this station, for 60 minutes duration there are 52 events recorded. The highest curve plotted in 60 minutes duration is in the second quartile while the lowest is in first quartile. And for third and fourth quartile, the curves are about the same. The curves plotted for 60 minutes duration of Kg. Pulau Manis Station using HTDM are as shown in Figure 4.1.

Table 4.2(a) : Analysis using HTDM for 1st Quartile of 60 minutes rainfall events of Kg. Pulau Manis.

1st Quartile		Depth																								
minutes	%cum	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
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	0
5	33	1.3	0.3	0.6	0.4	2.5	0.4	0.1	0.2	0.1	0.2	0.2	0.5	6	0.2	0.1	0.7	0.2	1.6	0.1	0.1	0.6	0.1	0.2	1	0.2
5	67	2	1	0.2	0.3	7.9	6.2	0.1	4.4	0.1	1	0.2	6.3	2	0.2	0.1	6.7	1.4	0.5	0.4	0.2	0.2	0.1	0.8	2.6	2.3
5	100	3.6	0.7	0.2	0.3	8.1	3.9	0.1	4.4	0.1	5.5	0.2	4.1	2.8	0.2	0.1	3.5	1.3	0.5	0.5	0.2	0.4	0.1	0.4	4.9	2.3

1st Quartile		Depth																								
minutes	%cum	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
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	0
5	33	0.3	1.1	1.3	0.5	0.3	1.2	0.1	0.5	3	1.9	0.6	1.1	0.4	0.3	0.2	1.4	0.1	0.1	0.1	0.1	0.5	0.2	0.1	1.2	0.1
5	67	0.3	3.2	0.9	0.5	0.9	1.2	0.2	0.1	5.5	6.6	0.3	3.6	0.7	1	0.4	1.3	0.2	0.1	0.2	3.3	0.1	0.2	0.1	0.8	0.1
5	100	0.2	2.1	1.2	0.1	1	3.5	0.2	0.1	3.9	7.4	0.2	3.9	0.5	0.4	0.1	0.4	0.2	0.1	0.2	2	0.1	0.2	0.1	1	0.1

1st Quartile		Depth				
minutes	%cum	51	52	AVERAGE	PERCENTILE	%CUM
0	0	0	0	0	0	0
5	33	0.2	0.1	0.67	18.18	18.18
5	67	0.2	0.1	1.53	41.30	59.48
5	100	0.1	0.1	1.50	40.52	100
				3.70		

Table 4.2(b) : Analysis using HTDM for 2nd Quartile of 60 minutes rainfall events of Kg. Pulau Manis.

2nd Quartile	% cum	Depth																								
minutes		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
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	0
5	33	6.8	0.4	0.1	0.3	5.9	4.2	0.1	2.3	0.1	7.4	0.1	0.8	1.6	0.2	0.2	0.1	1.2	0.2	0.6	1.6	1.8	0.1	0.4	4.4	0.5
5	67	7.8	0.3	0.1	0.4	2.7	6.2	0.1	1.6	0.1	1.2	0.1	0.3	1.1	0.4	0.3	0.1	1	0.2	0.7	0.1	0.1	0.1	0.2	5	0.3
5	100	5.9	0.2	0.1	0.8	0.8	3.1	0.1	1.3	0.1	3.2	0.1	0.1	0.5	0.8	0.6	0.1	0.6	0.1	0.5	0.1	0.1	0.4	0.1	7.1	0.2

2nd Quartile	% cum	Depth																									
minutes		26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	
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	0	
5	33	0.2	0.8	0.4	0.1	0.6	4.5	0.1	0.1	3.4	3.2	0.1	4.1	0.2	0.2	0.1	0.3	0.3	0.1	0.1	1	0.1	0.1	0.1	1.8	0.1	
5	67	0.3	0.3	0.3	0.1	0.4	1.4	0.1	0.1	2.9	1.1	0.1	3.3	0.4	0.2	0.1	1.4	0.2	0.1	0.1	1.4	0.1	0.1	0.1	1.3	0.1	
5	100	0.3	0.1	0.2	0.1	0.3	1.7	0.1	0.2	1.4	0.4	0.2	2.4	0.3	0.1	0.5	0.9	0.2	0.1	0.1	0.9	0.1	0.1	0.1	0.4	0.1	

2nd Quartile	% cum	Depth		AVERAGE	PERCENTAGE	%CUM
minutes		51	52			
0	0	0	0	0	0	0
5	33	0.1	0.1	1.23	42.78	42.78
5	67	0.1	0.1	0.90	31.36	74.14
5	100	0.1	0.1	0.74	25.86	100
				2.87		

Table 4.2(c) : Analysis using HTDM for 3rd Quartile of 60 minutes rainfall events of Kg. Pulau Manis.

3rd Quartile		Depth																								
minutes	%cum	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
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	0
5	33	3.7	0.2	0.1	0.6	1.8	0.8	0.1	1.2	0.1	1.4	0.1	0.1	0.2	0.3	0.4	0.1	0.4	0.1	1.5	0.1	0.1	1.6	0.1	5.5	0.2
5	67	1.8	0.1	0.1	0.4	2.8	1.4	0.1	0.7	0.1	0.3	0.3	0.1	0.2	0.2	0.3	0.1	0.1	0.1	1.2	0.1	0.1	2.2	0.1	2.8	0.1
5	100	0.7	0.1	0.2	0.2	1.7	2.1	0.1	0.4	0.1	0.2	0.4	0.1	1.3	0.1	0.8	0.1	0.1	0.1	0.7	0.1	0.1	0.9	0.1	2	0.1

3rd Quartile	%cum	Depth																								
minutes		26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
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	0
5	33	0.1	0.1	0.2	0.3	0.2	0.1	0.1	0.2	0.6	0.2	0.2	5.2	0.1	0.1	1.7	0.3	0.2	0.1	0.1	0.5	0.1	0.1	0.1	0.1	0.1
5	67	0.1	0.1	0.3	0.4	0.2	0.1	0.1	0.4	0.5	0.4	0.2	3.5	0.1	0.1	1.7	0.1	0.1	0.1	0.2	0.4	0.1	0.1	0.1	0.1	0.1
5	100	0.1	0.1	0.5	0.4	0.2	0.1	0.1	0.7	0.4	0.7	0.2	4	0.1	0.1	1.1	0.1	0.1	0.1	0.2	0.3	0.1	0.1	0.1	0.1	0.1

3rd Quartile	%cum	Depth				
minutes		51	52	AVERAGE	PERCENTAGE	%CUM
0	0	0	0	0	0	0
5	33	0.1	0.1	0.62	39.73	39.73
5	67	0.1	0.1	0.49	31.68	71.41
5	100	0.1	0.1	0.44	28.59	100
				1.55		

Table 4.2(d) : Analysis using HTDM for 4th Quartile of 60 minutes rainfall events of Kg. Pulau Manis.

4th Quartile	%cum	Depth																								
minutes		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
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	0
5	33	0.4	0.1	0.2	0.3	0.5	1.1	0.1	0.3	0.1	1.5	0.4	0.1	0.9	0.1	0.5	0.1	0.1	0.1	0.4	0.1	0.1	1.2	0.1	3.3	0.1
5	67	0.4	0.1	0.2	0.5	0.3	0.3	0.1	0.4	0.1	1.2	0.4	0.1	1	0.1	0.2	0.1	0.1	0.1	0.3	0.1	0.1	0.4	0.1	1.1	0.1
5	100	0.2	0.1	0.1	0.3	0.1	0.3	0.1	0.3	0.1	0.4	0.1	0.1	0.9	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.3	0.1

4th Quartile	%cum	Depth																								
minutes		26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
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	0
5	33	0.2	0.1	0.4	0.5	0.2	0.1	0.1	0.3	0.4	0.4	0.1	0.6	0.1	0.2	0.3	0.1	0.1	0.1	0.2	0.2	0.1	0.1	0.1	0.1	0.1
5	67	0.3	0.1	0.2	0.2	0.2	0.1	0.3	0.3	0.3	0.3	0.1	0.3	0.4	0.3	0.2	0.1	0.1	0.5	0.2	0.2	0.1	1.3	0.1	0.1	0.1
5	100	0.1	0.1	0.1	0.2	0.1	0.1	0.2	0.3	0.2	0.3	0.1	0.1	0.6	0.1	0.1	0.1	0.1	1.6	0.1	0.2	0.1	1.7	0.1	0.1	0.1

4th Quartile	%cum	depth		AVERAGE	PERCENTAGE	%CUM
minutes		51	52			
0	0	0	0	0	0	0
5	33	0.1	0.1	0.34	40.09	40.09
5	67	0.1	0.1	0.28	33.03	73.12
5	100	0.1	0.1	0.23	26.88	100
				0.85		

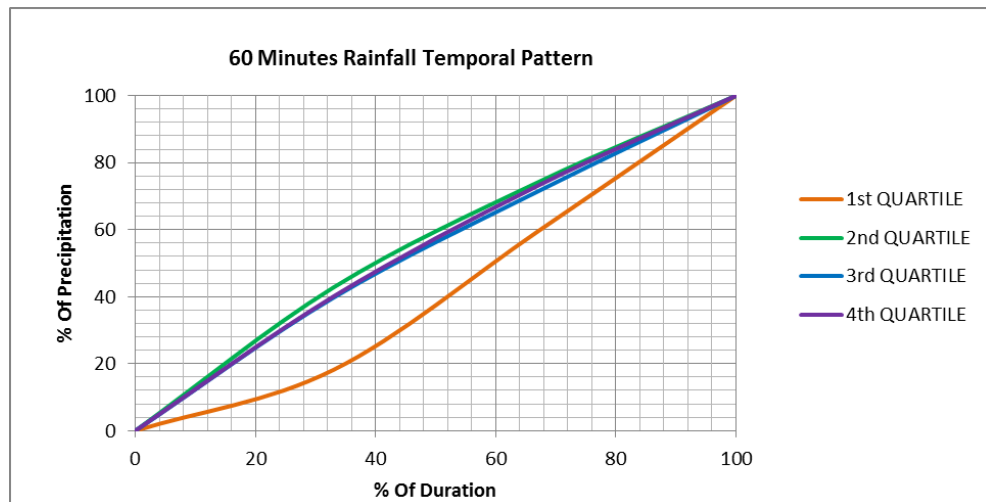


Figure 4.1 : 60 minutes Rainfall Temporal Pattern of Kg. Pulau Manis using HTDM.

For 120 minutes duration there are 13 events recorded. The curve for the first, second and fourth quartiles are about the same while the third quartile has the lowest curve. The curves plotted for 120 minutes duration of Kg. Pulau Manis using HTDM are as shown in Figure 4.2.

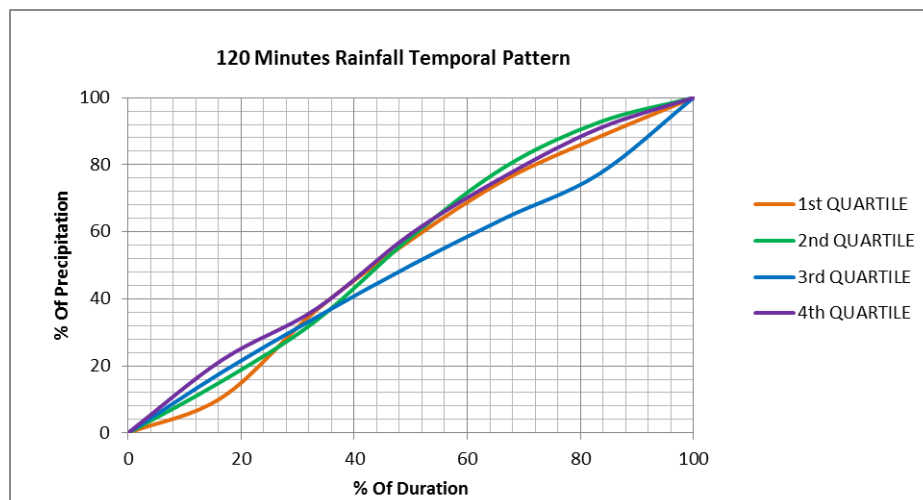


Figure 4.2 : 120 minutes Rainfall Temporal Pattern of Kg. Pulau Manis using HTDM.

For 180 minutes duration there are 13 events recorded. The second quartile has the highest curve while the third quartile has the lowest curve. The curves plotted for 180 minutes duration of Kg. Pulau Manis using HTDM are as shown in Figure 4.3.

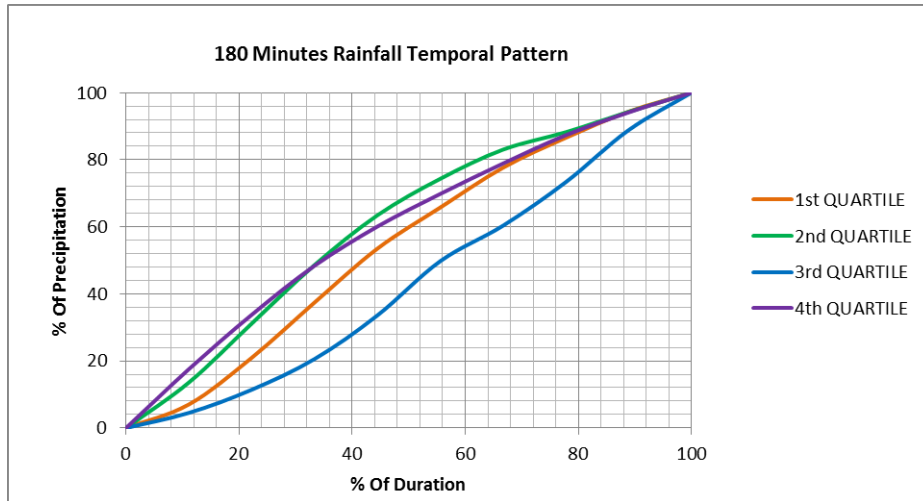


Figure 4.3 : 180 minutes Rainfall Temporal Pattern of Kg. Pulau Manis using HTDM.

4.2.2 JKR Gambang

In this station, for 60 minutes duration there are 83 events recorded. The analysis of the rainfall events are as shown in. The highest curve plotted in 60 minutes duration is in the fourth quartile while the lowest is in first quartile. The curves plotted for 60 minutes duration of JKR Gambang using HTDM are as shown in Figure 4.4.

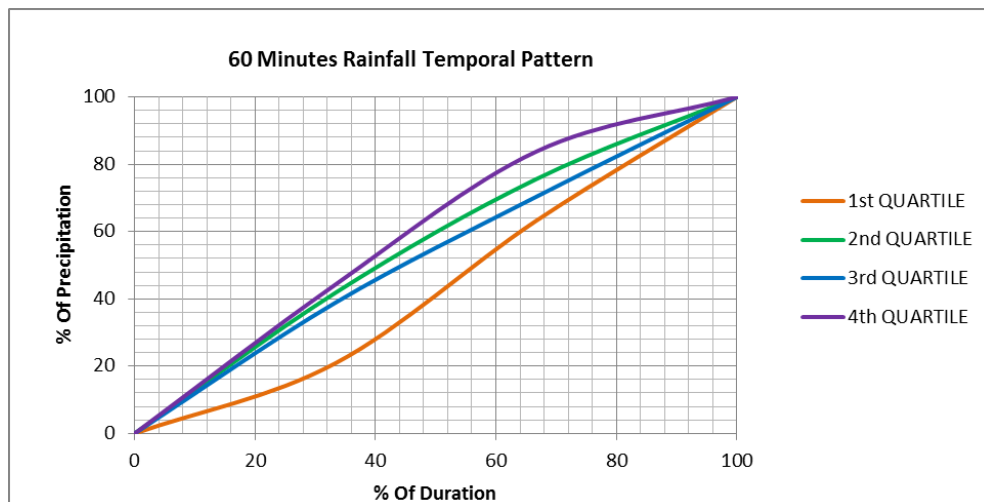


Figure 4.4 : 60 minutes Rainfall Temporal Pattern of JKR Gambang Station using HTDM.

For 120 minutes duration there are 26 events recorded. The highest curve plotted in 120 minutes duration is in the fourth quartile while the first, second and third quartile has about the same curve. The curves plotted for 120 minutes duration of JKR Gambang using HTDM are as shown in Figure 4.5.

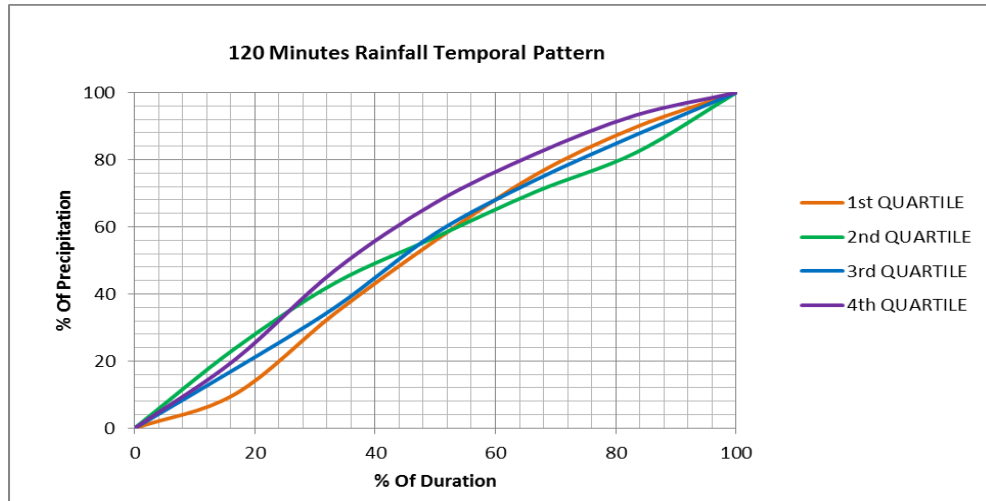


Figure 4.5 : 120 minutes Rainfall Temporal Pattern of JKR Gambang Station using HTDM.

For 180 minutes duration there are 8 events recorded. The highest curve plotted in 180 minutes duration is in the second quartile while the third quartile has the lowest curve and the first and fourth quartile has about the same curve. The curves plotted for 180 minutes duration of JKR Gambang using HTDM are as shown in Figure 4.6

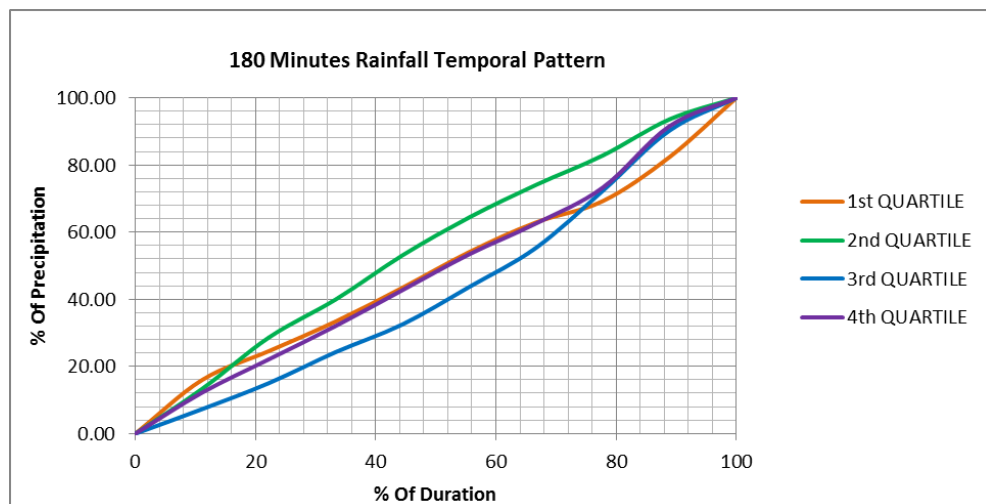


Figure 4.6 : 180 minutes Rainfall Temporal Pattern of JKR Gambang Station using HTDM.

4.2.3 Paya Besar

In this station, for 60 minutes duration there are 44 events recorded. The highest curve plotted in 60 minutes duration is in the third quartile while the lowest is in first quartile. The curves plotted for 60 minutes duration of Paya Besar using HTDM are as shown in Figure 4.7.

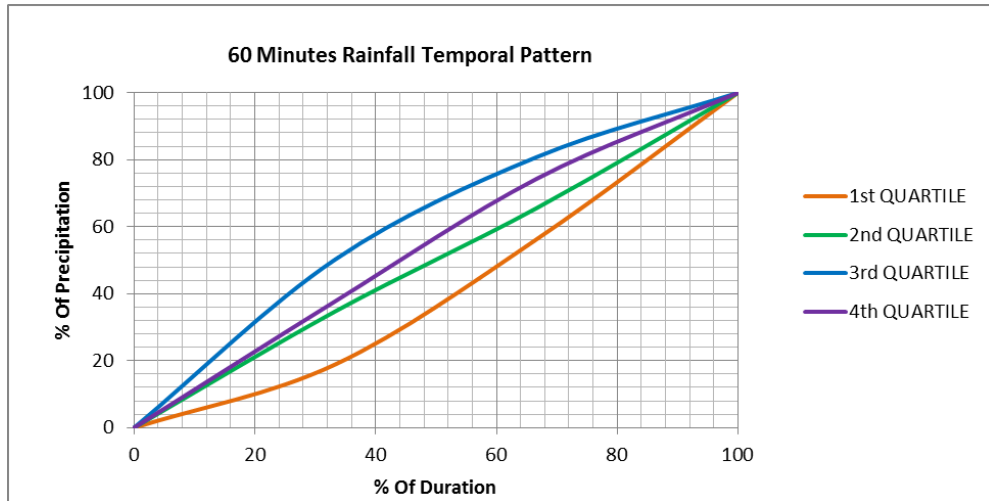


Figure 4.7 : 60 minutes Rainfall Temporal Pattern of Paya Besar Station using HTDM.

For 120 minutes duration there are 17 events recorded. The highest curve plotted in 120 minutes duration is in the third quartile while the lowest is in first quartile. The curves plotted for 120 minutes duration of Paya Besar using HTDM are as shown in Figure 4.8.

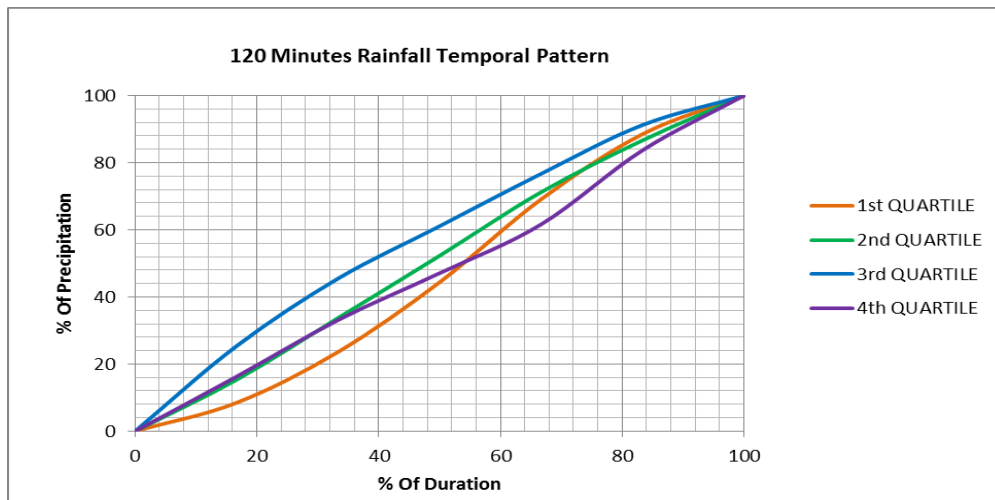


Figure 4.8 : 120 minutes Rainfall Temporal Pattern of Paya Besar Station using HTDM.

For 180 minutes duration there are 11 events recorded. The highest curve plotted in 180 minutes duration is in the fourth quartile while the lowest is in first quartile. The curves plotted for 180 minutes duration of Paya Besar using HTDM are as shown in Figure 4.9.

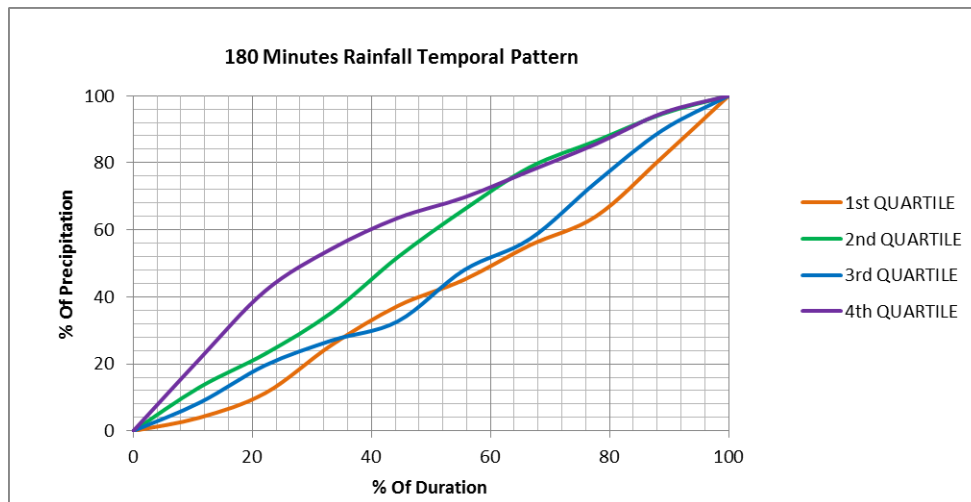


Figure 4.9 : 180 minutes Rainfall Temporal Pattern of Paya Besar Station using HTDM

4.2.4 Kg. Sg. Soi

In this station, for 60 minutes duration there are 54 events recorded. The highest curve plotted in 60 minutes duration is in the fourth quartile while the lowest is in first quartile. The curves plotted for 60 minutes duration of Kg. Sg. Soi using HTDM are as shown in Figure 4.10.

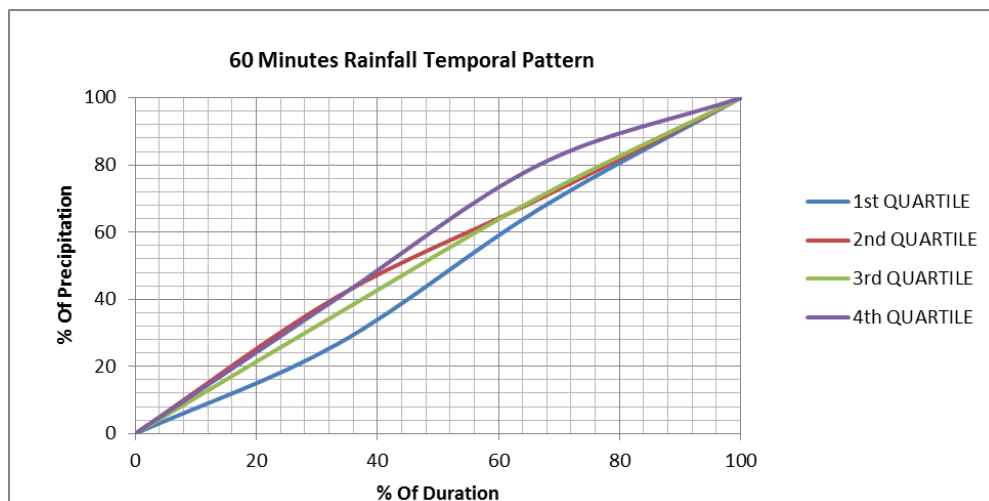


Figure 4.10 : 60 minutes Rainfall Temporal Pattern of Kg. Sg. Soi Station using HTDM.

For 120 minutes duration there are 17 events recorded. The highest curve plotted in 120 minutes duration is in the fourth quartile while the lowest is in second quartile. The curves plotted for 120 minutes duration of Kg. Sg. Soi using HTDM are as shown in Figure 4.11.

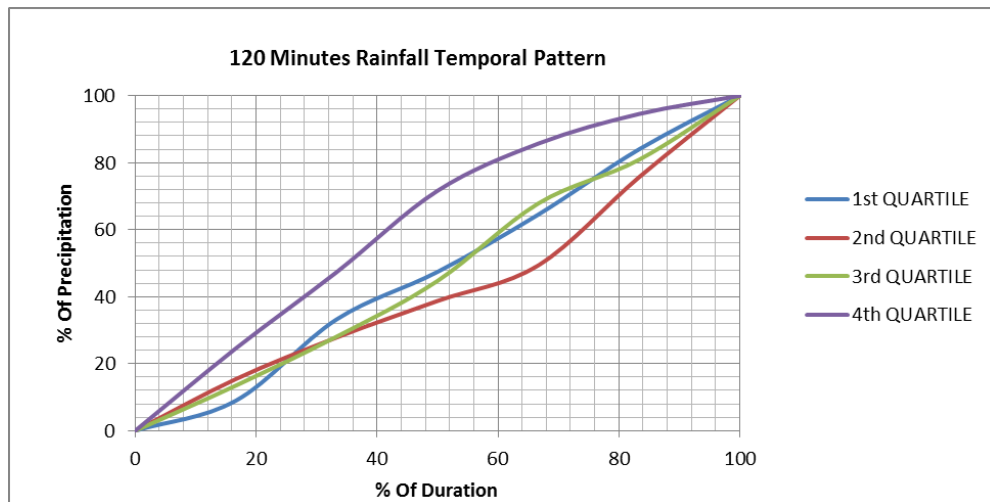


Figure 4.11 : 120 minutes Rainfall Temporal Pattern of Kg. Sg. Soi Station using HTDM.

For 180 minutes duration there are 8 events recorded. The highest curve plotted in 180 minutes duration is in the fourth quartile while the lowest is in third quartile. The curves plotted for 180 minutes duration of Kg. Sg. Soi using HTDM are as shown in Figure 4.12.

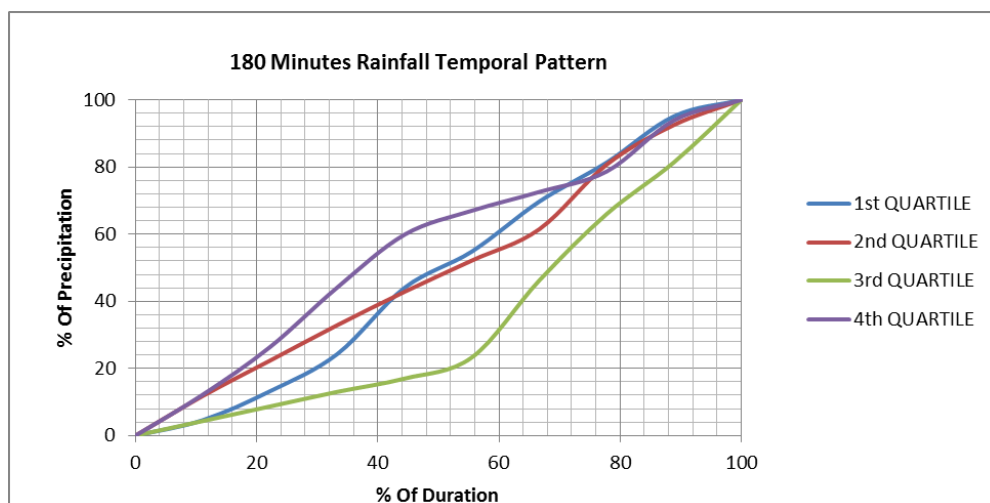


Figure 4.12 : 180 minutes Rainfall Temporal Pattern of Kg. Sg. Soi Station using HTDM.

4.2.5 Rancangan Pam Paya Pinang

In this station, for 60 minutes duration there are 55 events recorded. The highest curve plotted in 60 minutes duration is in the fourth quartile while the lowest is in first quartile. The second and third quartile were about the same. The curves plotted for 60

minutes duration of Rancangan Pam Paya Pinang using HTDM are as shown in Figure 4.13.

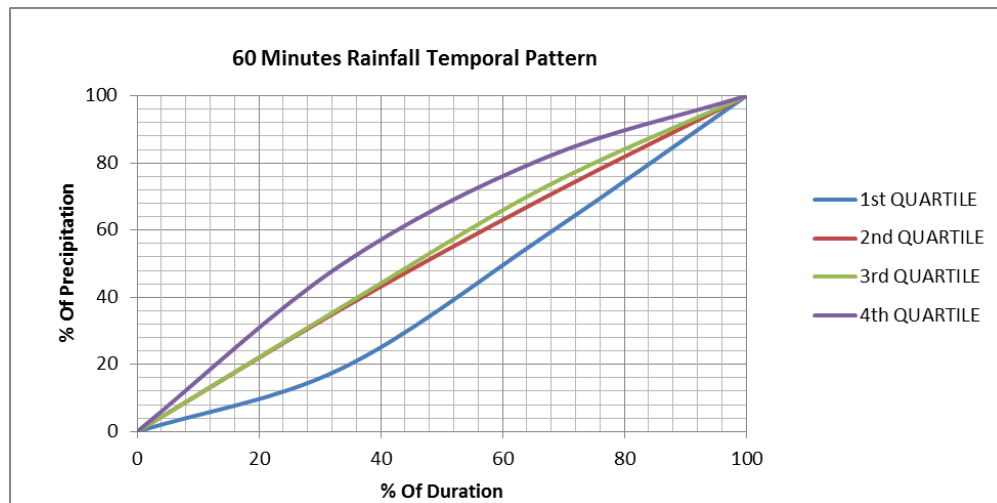


Figure 4.13 : 60 minutes Rainfall Temporal Pattern of Rancangan Pam Paya Pinang Station using HTDM .

For 120 minutes duration there are 17 events recorded. The highest curve plotted in 120 minutes duration is in the third quartile while the other three quartiles were about the same. The curves plotted for 120 minutes duration of Rancangan Pam Paya Pinang using HTDM are as shown in Figure 4.14.

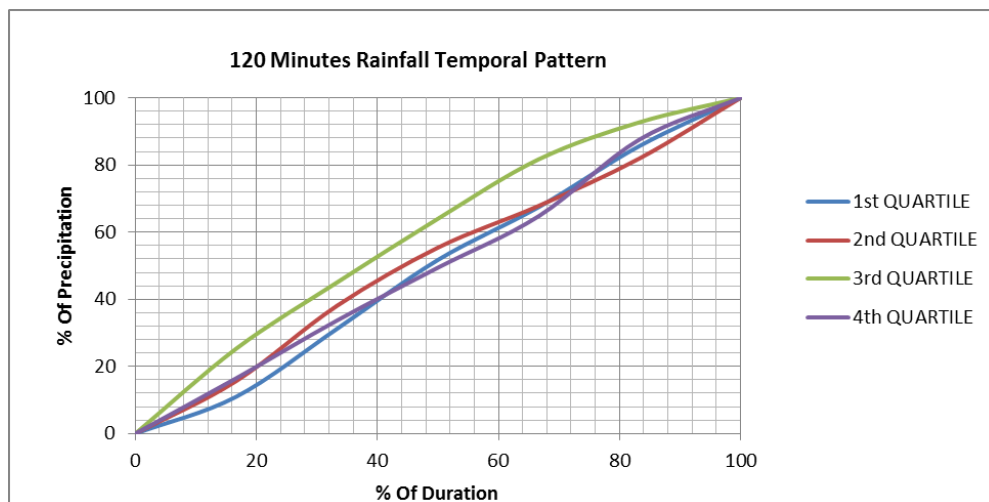


Figure 4.14 : 120 minutes Rainfall Temporal Pattern of Paya Besar Station using HTDM.

For 180 minutes duration there are 7 events recorded. The curves plotted in 180 minutes duration were about the same for first, second and fourth quartile while the

lowest is in third quartile. The curves plotted for 180 minutes duration of Paya Besar using HTDM are as shown in Figure 4.15.

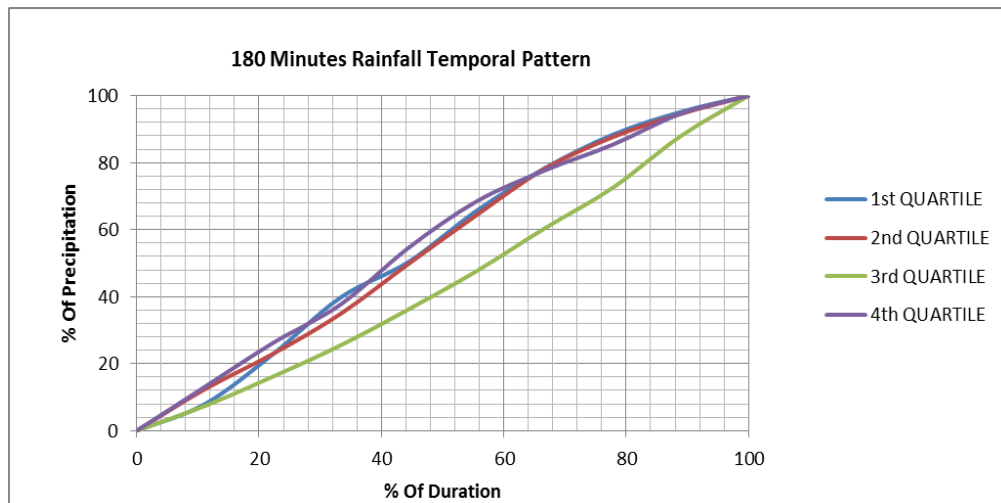


Figure 4.15 : 180 minutes Rainfall Temporal Pattern of Paya Besar Station using HTDM.

4.2.6 Pejabat JPS N. Pahang

In this station, for 60 minutes duration there are 115 events recorded. The highest curve plotted in 60 minutes duration is in the fourth quartile while the lowest is in first quartile. The curves plotted for 60 minutes duration of Pejabat JPS N. Pahang using HTDM are as shown in Figure 4.16.

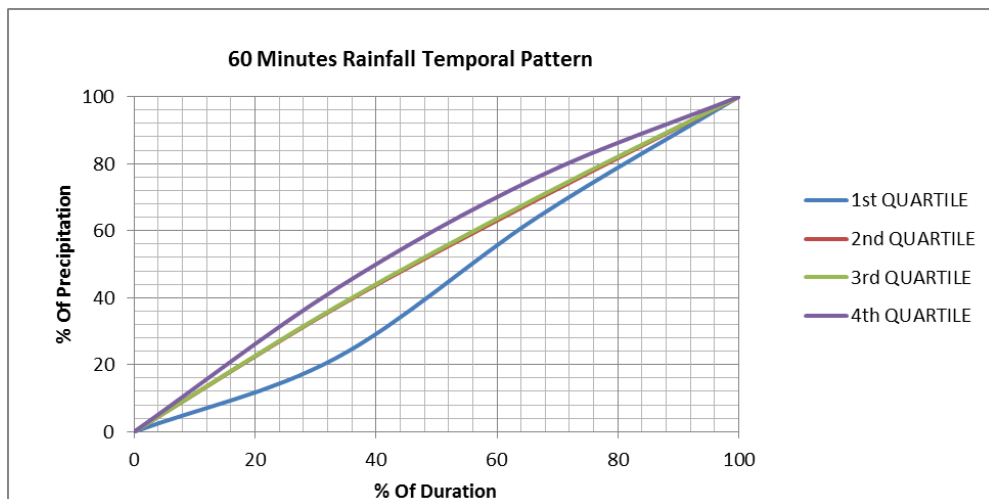


Figure 4.16 : 60 minutes Rainfall Temporal Pattern of Pejabat JPS N. Pahang Station using HTDM.

For 120 minutes duration there are 28 events recorded. The highest curve plotted in 120 minutes duration is in the second quartile while the lowest is in first quartile. The curves plotted for 120 minutes duration Pejabat JPS N. Pahang using HTDM are as shown in Figure 4.17.

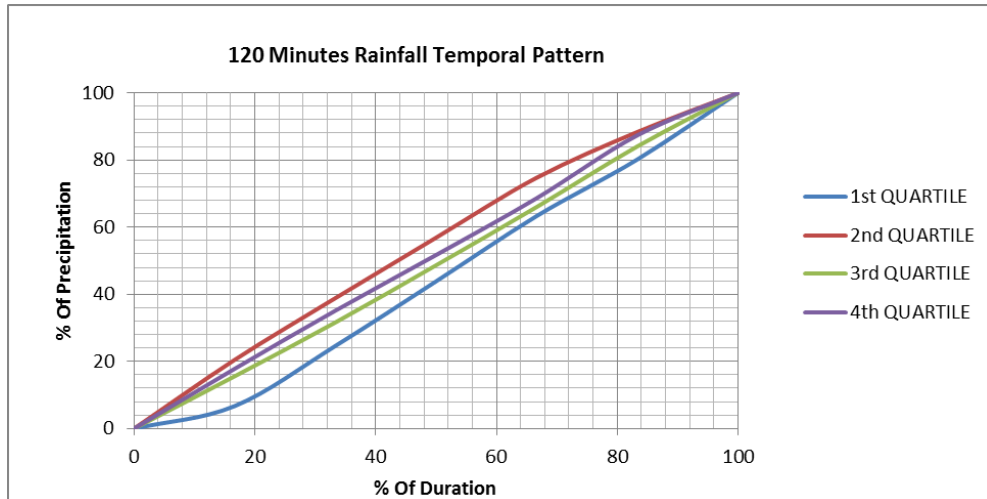


Figure 4.17 : 120 minutes Rainfall Temporal Pattern of Pejabat JPS N. Pahang Station using HTDM.

For 180 minutes duration there are 7 events recorded. The analysis of the rainfall events are as shown in. The highest curve plotted in 180 minutes duration is in the first quartile while the lowest is in third quartile. The curves plotted for 180 minutes duration of Pejabat JPS N. Pahang using HTDM are as shown in Figure 4.18.

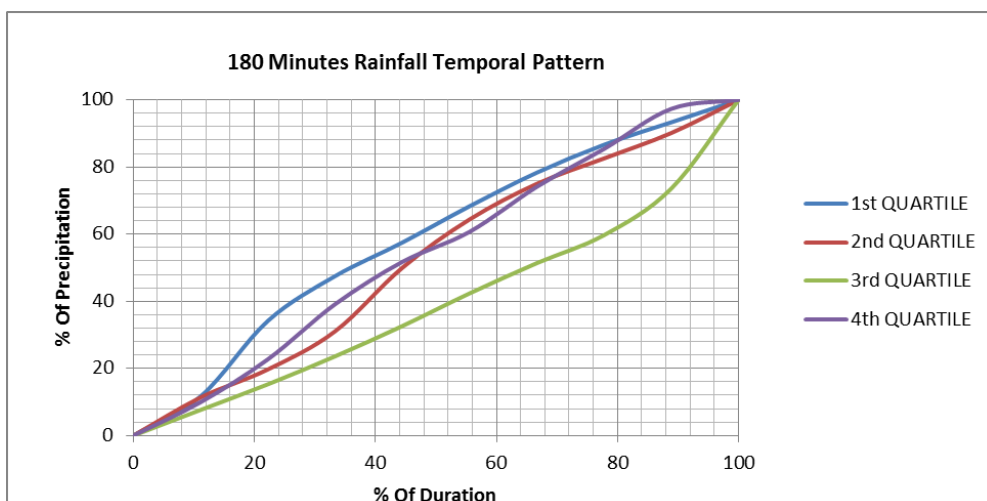


Figure 4.18 : 180 minutes Rainfall Temporal Pattern of Pejabat JPS N. Pahang Station using HTDM.

4.2.7 Sg. Lembing PCCL Mill

In this station, for 60 minutes duration there are 134 events recorded. In the 60 minutes duration the second ,third quartile and fourth has quite the same curve while the lowest is in first quartile. The curves plotted for 60 minutes duration of Sg. Lembing PCCL Mill using HTDM are as shown in Figure 4.19.

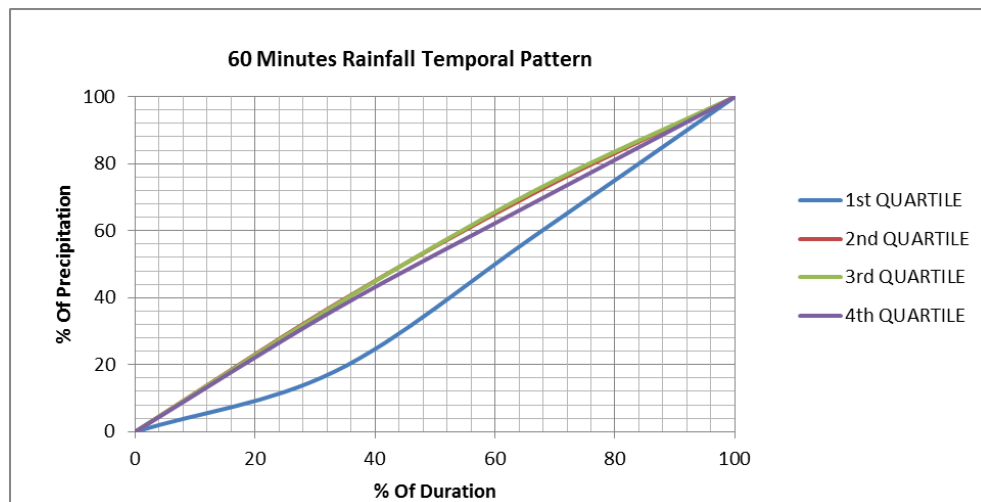


Figure 4.19 : 60 minutes Rainfall Temporal Pattern of Sg. Lembing PCCL Mill Station using HTDM.

For 120 minutes duration there are 31 events recorded. The highest curve plotted in 120 minutes duration is in the fourth quartile while the lowest is in second quartile. The curves plotted for 120 minutes duration Sg. Lembing PCCL Mill using HTDM are as shown in Figure 4.20.

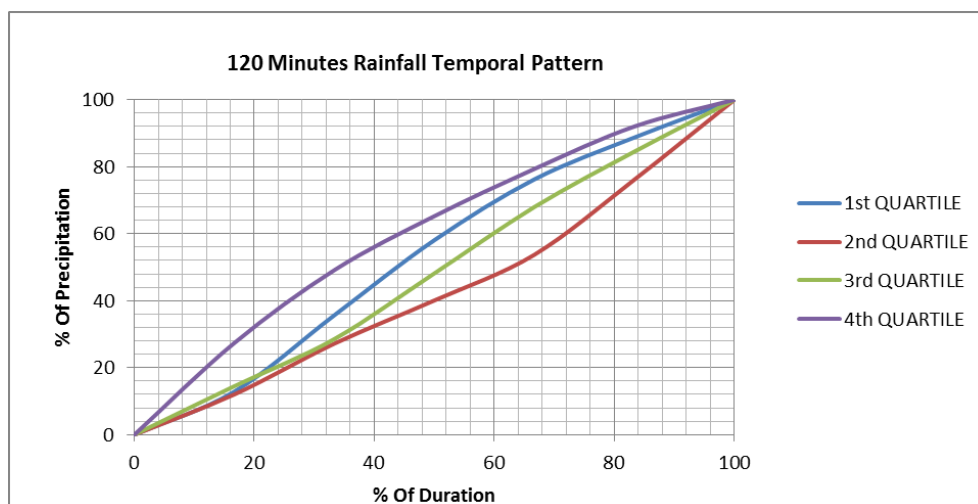


Figure 4.20 : 120 minutes Rainfall Temporal Pattern of Sg. Lembing PCCL Mill Station using HTDM.

For 180 minutes duration there are 16 events recorded. The highest curve plotted in 180 minutes duration is in the second quartile while the lowest is in first quartile. The curves plotted for 180 minutes duration of Sg. Lembing PCCL Mill using HTDM are as shown in Figure 4.21.

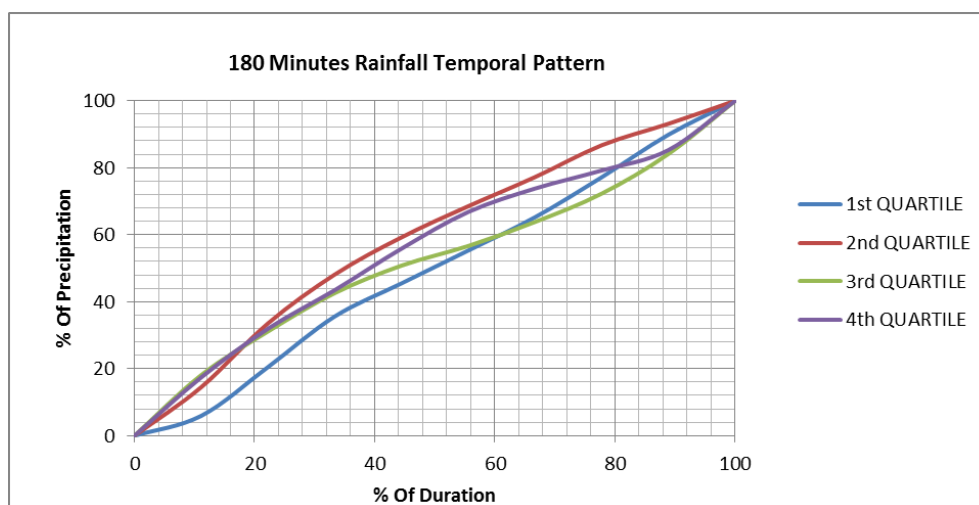


Figure 4.21 : 180 minutes Rainfall Temporal Pattern of Sg. Lembing PCCL Mill Station using HTDM.

4.2.8 Ldg Nada

In this station, for 60 minutes duration there are 69 events recorded. The highest curve plotted in 60 minutes duration is in the fourth quartile while the lowest is in first

quartile. The curves plotted for 60 minutes duration of Ldg. Nada using HTDM are as shown in Figure 4.22.

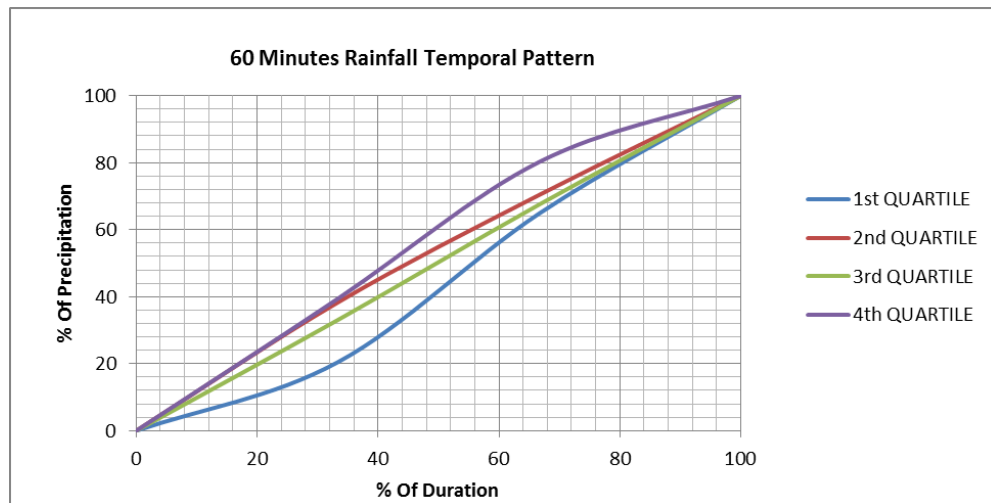


Figure 4.22 : 60 minutes Rainfall Temporal Pattern of Ldg. Nada Station using HTDM

For 120 minutes duration there are 22 events recorded. The highest curve plotted in 120 minutes duration is in the fourth quartile while the other quartiles are about the same. The curves plotted for 120 minutes duration of Ldg. Nada using HTDM are as shown in Figure 4.23.

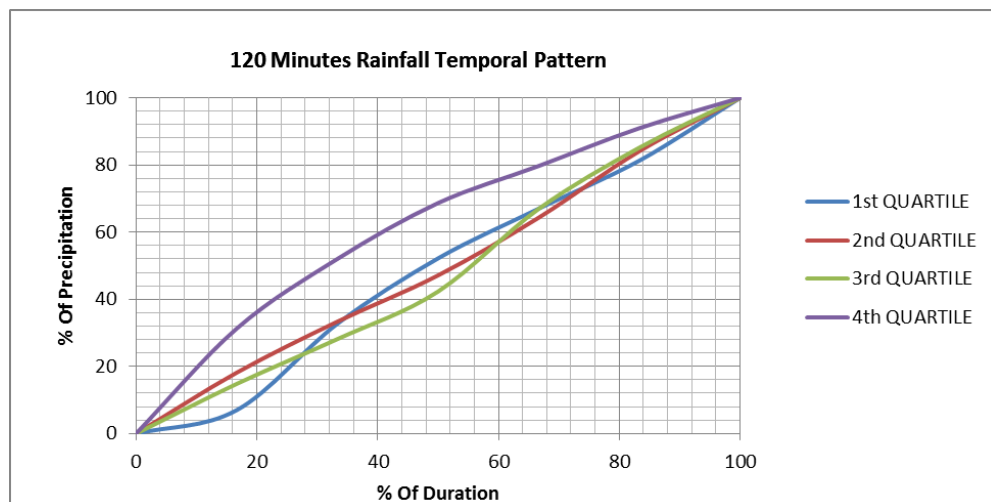


Figure 4.23 : 120 minutes Rainfall Temporal Pattern of Ldg. Nada Station using HTDM

For 180 minutes duration there are 5 events recorded. The curves plotted in 180 minutes duration were not in a smooth line. However the lines were about the same. The curves plotted for 180 minutes duration of Ldg. Nada using HTDM are as shown in Figure 4.24.

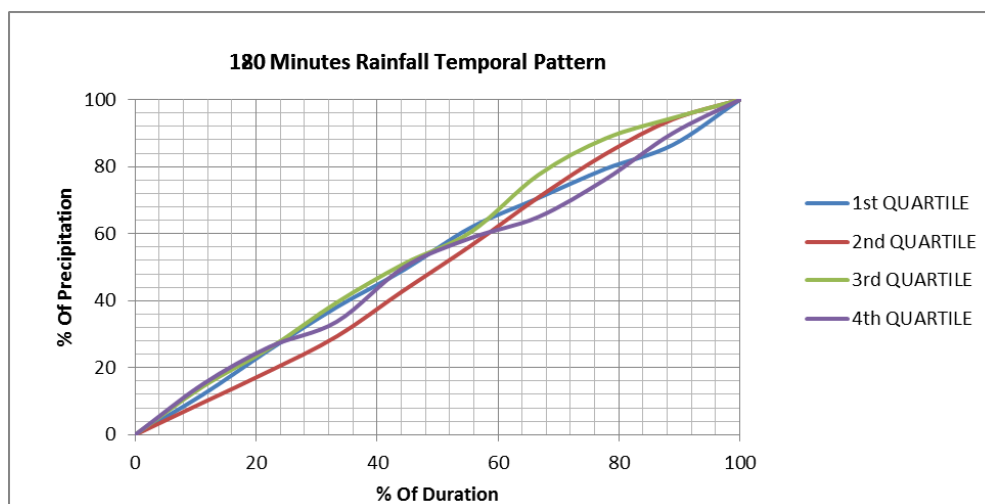


Figure 4.24 : 180 minutes Rainfall Temporal Pattern of Ldg. Nada Station using HTDM

4.2.9 Ldg Kuala Reman

In this station, for 60 minutes duration there are 55 events recorded.. The highest curve plotted in 60 minutes duration is in the fourth quartile while the lowest is in first quartile. The curves plotted for 60 minutes duration of Ldg Kuala Reman using HTDM are as shown in Figure 4.25.

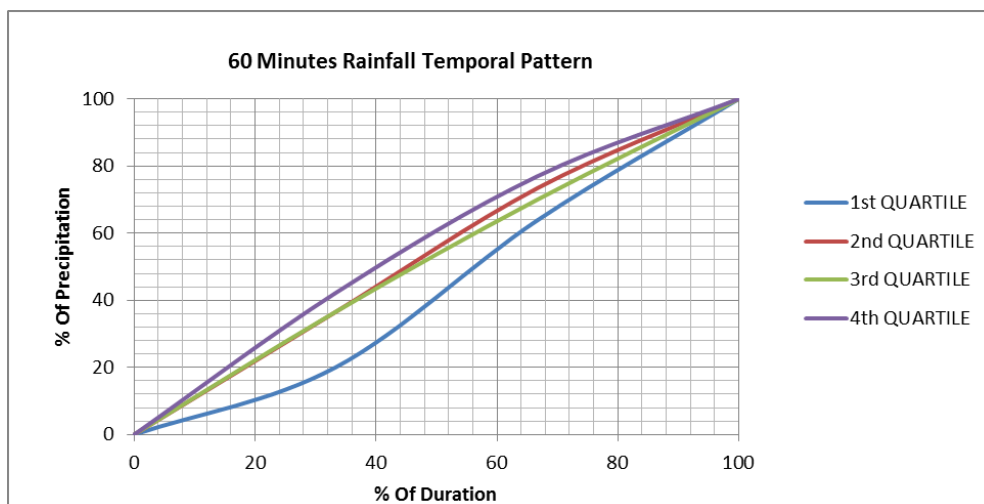


Figure 4.25 : 60 minutes Rainfall Temporal Pattern of Ldg Kuala Reman Station using HTDM.

For 120 minutes duration there are 29 events recorded. The highest curve plotted in 120 minutes duration is in the third quartile while the other quartile has about the same curve. The curves plotted for 120 minutes duration of Ldg Kuala Reman using HTDM are as shown in Figure 4.26.

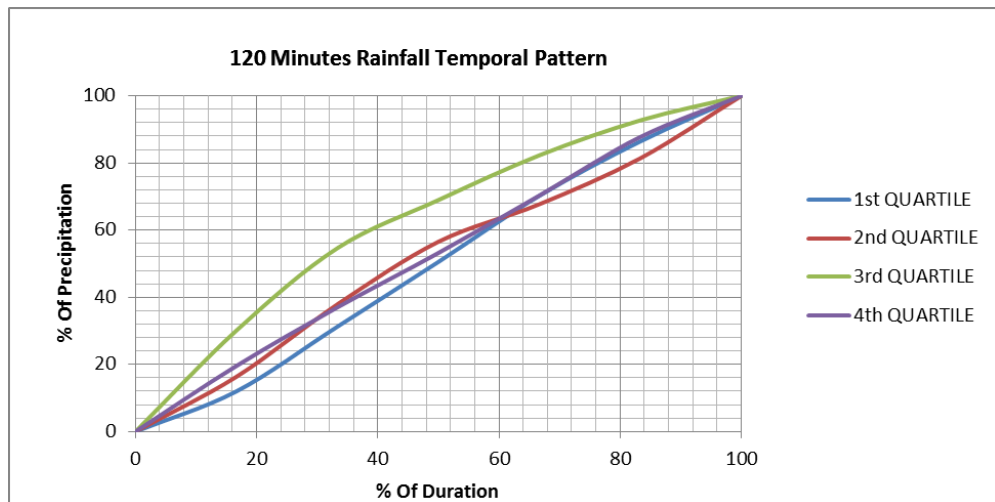


Figure 4.26 : 120 minutes Rainfall Temporal Pattern of Ldg Kuala Reman Station using HTDM.

For 180 minutes duration there are 2 events recorded. The highest curve plotted in 180 minutes duration is in the third quartile while the lowest is in first quartile. The curves plotted for 180 minutes duration of Ldg Kuala Reman using HTDM are as shown in Figure 4.27.

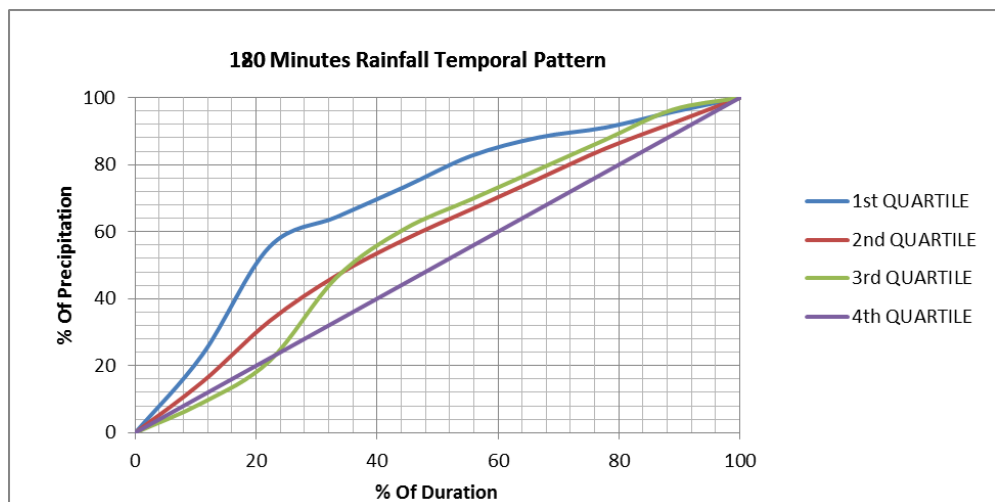


Figure 4.27 : 180 minutes Rainfall Temporal Pattern of Ldg Kuala Reman Station using HTDM.

4.2.10 Balok

In this station, for 60 minutes duration there are 38 events recorded.. The highest curve plotted in 60 minutes duration is in the third quartile while the lowest is in first

quartile. The curves plotted for 60 minutes duration of Balok using HTDM are as shown in Figure 4.28.

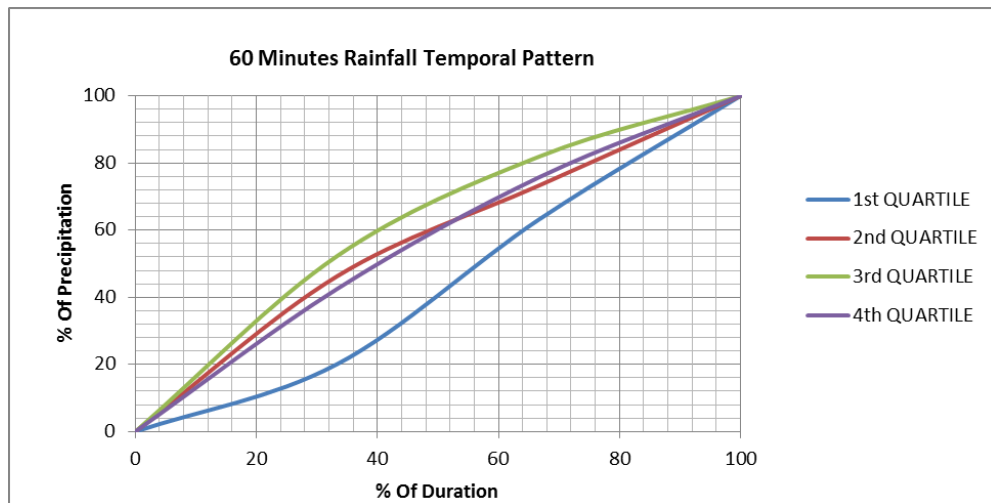


Figure 4.28 : 60 minutes Rainfall Temporal Pattern of Balok Station using HTDM.

For 120 minutes duration there are 18 events recorded. The highest curve plotted in 120 minutes duration is in the fourth quartile while the lowest is in second quartile. The curves plotted for 120 minutes duration of Paya Besar using HTDM are as shown in Figure 4.29.

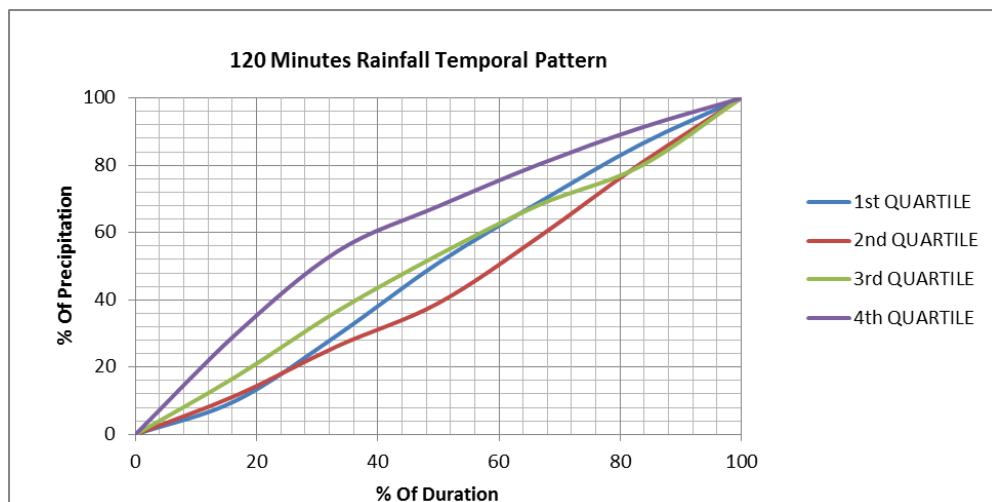


Figure 4.29 : 120 minutes Rainfall Temporal Pattern of Balok Station using HTDM

For 180 minutes duration there are 6 events recorded. The highest curve plotted in 180 minutes duration is in the fourth quartile while the lowest is in second quartile. The curves plotted for 180 minutes duration of Balok using HTDM are as shown in Figure 4.29.

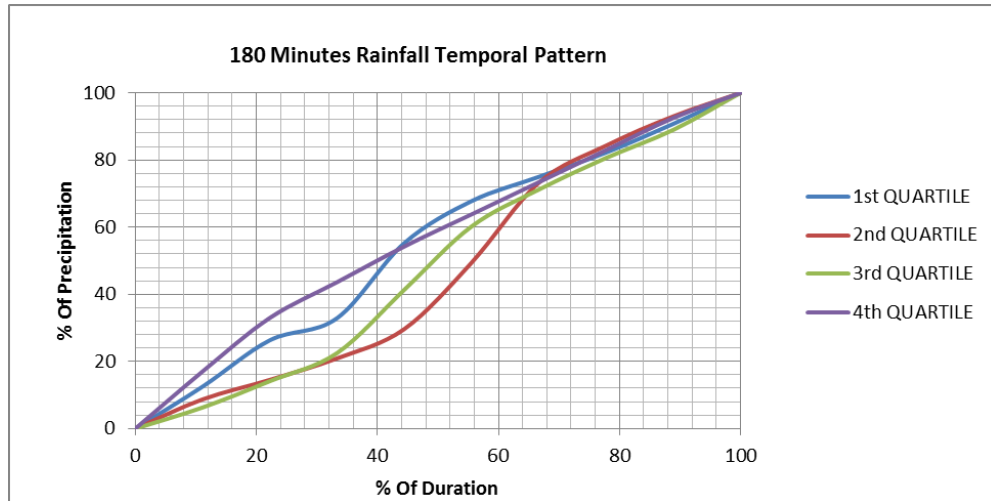


Figure 4.29 : 120 minutes Rainfall Temporal Pattern of Balok Station using HTDM.

4.3 WRRI METHOD

The rainfall events used to develop using this method are 60 minutes, 120 minutes and 180 minutes. This method is quite similar with Huff Time Method which required the event to be divided into four equal quartiles. However, before dividing into four quartiles, the rainfall depth is rearrange so that the highest is in the middle and the lowest is the first and last. The results are laid out in form of curve by connecting each point of rainfall event of 5 minutes interval plotted. The analysis for Kg. Pulau Manis Station is in Table 4.2 for (a), (b), (c) and (d) are 1st, 2nd, 3rd and 4th Quartile respectively. However for other example of the analysis are as shown in Appendix B.

4.3.1 Kg. Pulau Manis

In this station, for 60 minutes duration there are 52 events recorded.. The highest curve plotted in 60 minutes duration is in the third quartile while the lowest is in second quartile. The curves plotted for 60 minutes duration of Kg. Pulau. Manis using WRRI Method are as shown in Figure 4.31.

Table 4.2(a) : Analysis of 4th Quartile of 60 minutes rainfall events of Kg. Pulau. Manis Station

1st Quartile		Depth																								
minutes	%cum	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
5	33	0.4	0.1	0.1	0.6	0.3	0.3	0.1	0.3	0.1	0.2	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	1	0.1
5	67	0.7	0.1	0.1	0.4	0.8	0.8	0.1	0.4	0.1	0.4	0.1	0.1	0.9	0.1	0.2	0.1	0.1	0.1	0.4	0.1	0.1	0.1	0.1	2	0.1
5	100	1.8	0.2	0.1	0.4	1.8	1.4	0.1	0.7	0.1	1.2	0.2	0.1	1	0.2	0.2	0.1	0.2	0.1	0.5	0.1	0.1	0.2	0.1	2.8	0.2

1st Quartile		Depth																								
minutes	%cum	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
5	33	0.1	0.1	0.2	0.1	0.2	0.1	0.1	0.1	0.3	0.3	0.1	0.3	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1
5	67	0.1	0.1	0.2	0.1	0.2	0.1	0.1	0.1	0.4	0.4	0.1	1.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1
5	100	0.2	0.1	0.3	0.2	0.2	0.1	0.1	0.2	0.6	0.4	0.2	3.3	0.3	0.2	0.2	0.3	0.1	0.1	0.1	0.4	0.1	0.1	0.1	0.1	0.1

1st Quartile	%cum	51	52	ave	%	%Cum
minutes		0.1	0.1	0.17	19.59	19.59
5	33	0.1	0.1	0.25	29.84	49.43
5	67	0.1	0.1	0.43	50.57	100
5	100			0.84		

Table 4.2(b) : Analysis of 2nd Quartile of 60 minutes rainfall events of Kg. Pulau. Manis Station

2nd Quartile	%cum	Depth																								
minutes		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
5	33	3.6	0.3	0.2	0.3	2.7	3.1	0.1	1.3	0.1	1.4	0.2	0.3	1.3	0.2	0.3	0.1	0.6	0.2	0.6	0.1	0.1	0.4	0.2	4.4	0.2
5	67	5.9	0.4	0.2	0.3	5.9	4.2	0.1	2.3	0.1	3.2	0.4	0.8	2	0.3	0.5	0.7	1.2	0.5	0.7	0.2	0.4	1.2	0.4	5	0.5
5	100	7.8	1	0.6	0.2	8.1	6.2	0.1	4.4	0.1	7.4	0.4	6.3	6	0.8	0.8	6.7	1.4	1.6	1.5	1.6	1.8	2.2	0.8	7.1	2.3

2nd Quartile	%cum	Depth																								
minutes		26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
5	33	0.3	0.3	0.4	0.4	0.3	1.2	0.1	0.3	2.9	1.1	0.2	3.6	0.4	0.2	0.4	0.4	0.2	0.1	0.2	0.9	0.1	0.2	0.1	0.8	0.1
5	67	0.3	1.1	0.9	0.5	0.6	1.7	0.2	0.4	3.4	3.2	0.2	4	0.5	0.3	1.1	1.3	0.2	0.1	0.2	1.4	0.1	0.2	0.1	1.2	0.1
5	100	0.3	3.2	1.3	0.5	1	4.5	0.3	0.7	5.5	7.4	0.6	5.2	0.7	1	1.7	1.4	0.3	1.6	0.2	3.3	0.5	1.7	0.1	1.8	0.1

2nd Quartile	%cum	Depth		ave	%	%Cum
minutes		51	52			
5	33	0.1	0.1	0.725	17.05882	17.05882
5	67	0.1	0.1	1.171154	27.55656	44.61538
5	100	0.2	0.1	2.353846	55.38462	100
				4.25		

Table 4.2(c) : Analysis of 3rd Quartile of 60 minutes rainfall events of Kg. Pulau. Manis Station

3rd Quartile	%cum	Depth																								
minutes		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
5	33	6.8	0.7	0.2	0.3	7.9	6.2	0.1	4.4	0.1	5.5	0.4	4.1	2.8	0.4	0.6	3.5	1.3	0.5	1.2	0.2	0.6	1.6	0.4	5.5	2.3
5	67	3.7	0.3	0.2	0.3	2.8	3.9	0.1	1.6	0.1	1.5	0.3	0.5	1.6	0.2	0.4	0.1	1	0.2	0.7	0.1	0.2	0.9	0.2	4.9	0.3
5	100	2	0.2	0.2	0.3	2.5	2.1	0.1	1.2	0.1	1.2	0.2	0.1	1.1	0.2	0.3	0.1	0.4	0.1	0.5	0.1	0.1	0.4	0.1	3.3	0.2

3rd Quartile	%cum	Depth																								
minutes		26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
5	33	0.3	2.1	1.2	0.5	0.9	3.5	0.2	0.5	3.9	6.6	0.3	4.1	0.6	0.4	1.7	1.4	0.2	0.5	0.2	2	0.1	1.3	0.1	1.3	0.1
5	67	0.3	0.8	0.5	0.4	0.4	1.4	0.2	0.3	3	1.9	0.2	3.9	0.4	0.3	0.5	0.9	0.2	0.1	0.2	1	0.1	0.2	0.1	1	0.1
5	100	0.2	0.1	0.4	0.3	0.3	1.2	0.1	0.3	1.4	0.7	0.2	3.5	0.4	0.2	0.3	0.3	0.2	0.1	0.2	0.5	0.1	0.1	0.1	0.4	0.1

3rd Quartile	%cum	Depth		ave	%	%Cum
minutes		51	52			
5	33	0.2	0.1	1.767308	55.49517	55.49517
5	67	0.1	0.1	0.859615	26.99275	82.48792
5	100	0.1	0.1	0.557692	17.51208	100
				3.184615		

Table 4.2(d) : Analysis of 4th Quartile of 60 minutes rainfall events of P Kg. Pulau. Manis Station

4th Quartile	%cum	Depth																								
minutes		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
5	33	1.3	0.1	0.1	0.4	1.7	1.1	0.1	0.4	0.1	1	0.1	0.1	0.9	0.2	0.2	0.1	0.1	0.1	0.4	0.1	0.1	0.1	0.1	2.6	0.1
5	67	0.4	0.1	0.1	0.5	0.5	0.4	0.1	0.3	0.1	0.3	0.1	0.1	0.5	0.1	0.1	0.1	0.1	0.1	0.3	0.1	0.1	0.1	0.1	1.1	0.1
5	100	0.2	0.1	0.1	0.8	0.1	0.3	0.1	0.2	0.1	0.2	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.3	0.1

4th Quartile	%cum	Depth																									
minutes		26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	
5	33	0.2	0.1	0.3	0.2	0.2	0.1	0.1	0.2	0.5	0.4	0.1	2.4	0.2	0.1	0.2	0.1	0.1	0.1	0.1	0.3	0.1	0.1	0.1	0.1	0.1	
5	67	0.1	0.1	0.2	0.1	0.2	0.1	0.1	0.1	0.4	0.3	0.1	0.6	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	
5	100	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	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	0.1	0.1	

4th Quartile	%cum	Depth		ave	%	%Cum
minutes		51	52			
5	33	0.1	0.1	0.351923	52.13675	52.13675
5	67	0.1	0.1	0.190385	28.20513	80.34188
5	100	0.1	0.1	0.132692	19.65812	100
				0.675		

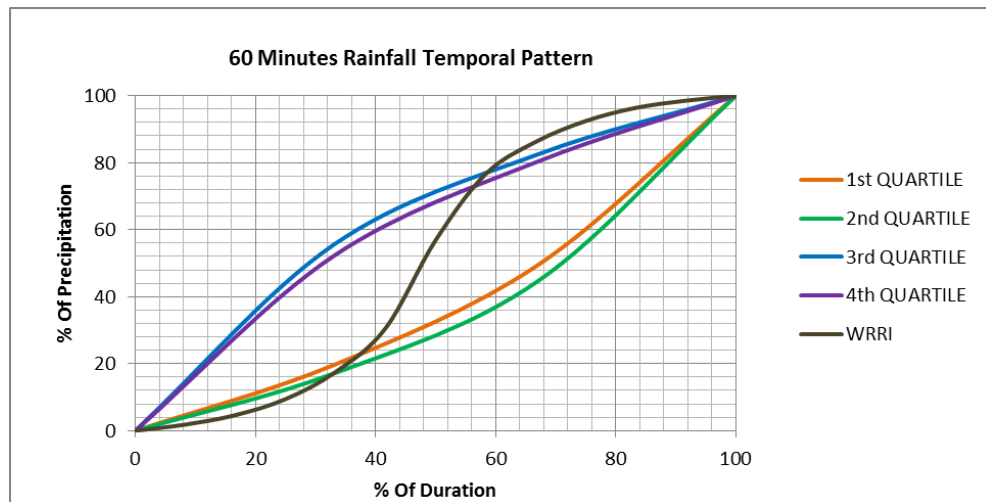


Figure 4.31 : 60 minutes Rainfall Temporal Pattern of Kg Pulau Manis Station using WRII Method.

For 120 minutes duration there are 1 events recorded. The highest curve plotted in 120 minutes duration is in the third quartile while the lowest is in second quartile. The curves plotted for 120 minutes duration of Paya Besar using WRII Method are as shown in Figure 4.32.

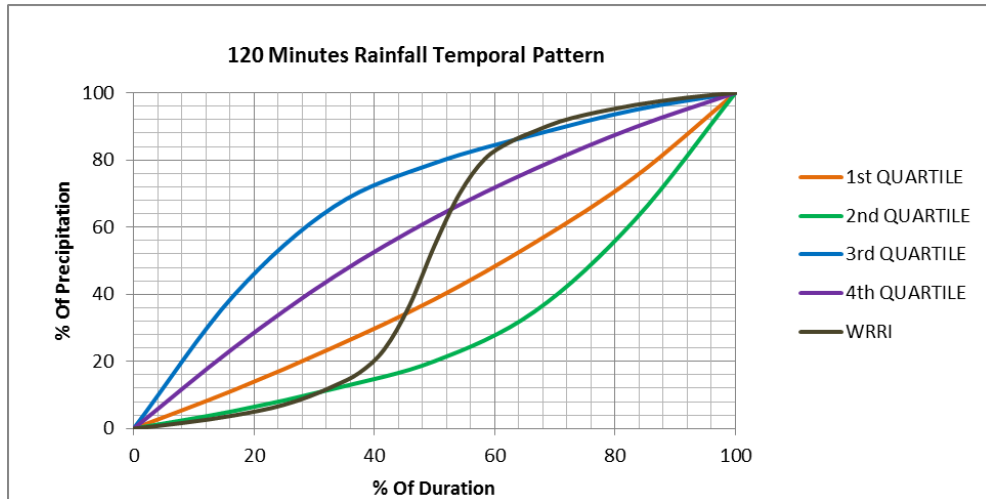


Figure 4.32 : 120 minutes Rainfall Temporal Pattern of Kg Pulau Manis Station using WRII Method.

For 180 minutes duration there are 11 events recorded. The highest curve plotted in 180 minutes duration is in the third quartile while the lowest is in second quartile. The curves plotted for 180 minutes duration of Paya Besar using WRII Method are as shown in Figure 4.33.

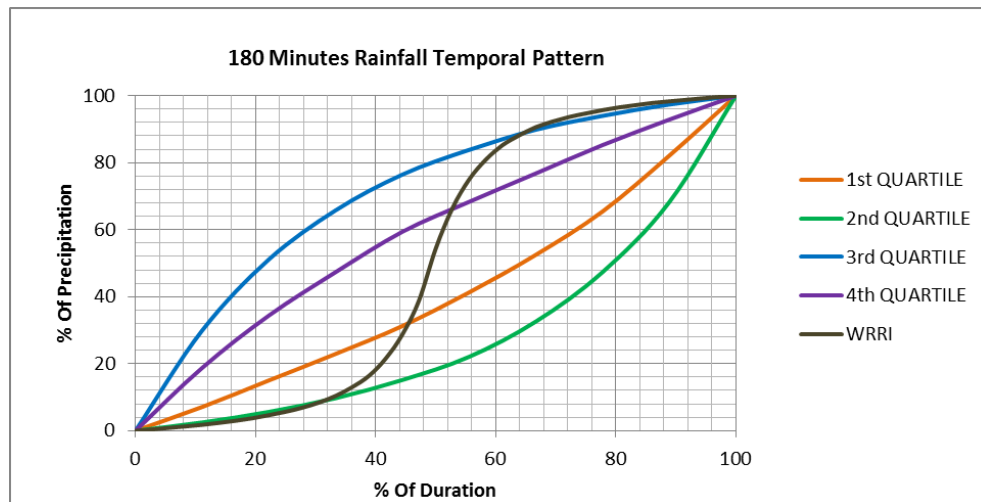


Figure 4.33 : 180 minutes Rainfall Temporal Pattern of Kg Pulau Manis Station using WRI Method.

4.3.2 JKR Gambang

In this station, for 60 minutes duration there are 83 events recorded. The highest curve plotted in 60 minutes duration is in the third quartile while the lowest is in second quartile. The curves plotted for 60 minutes duration of JKR Gambang Station using WRI Method are as shown in Figure 4.34.

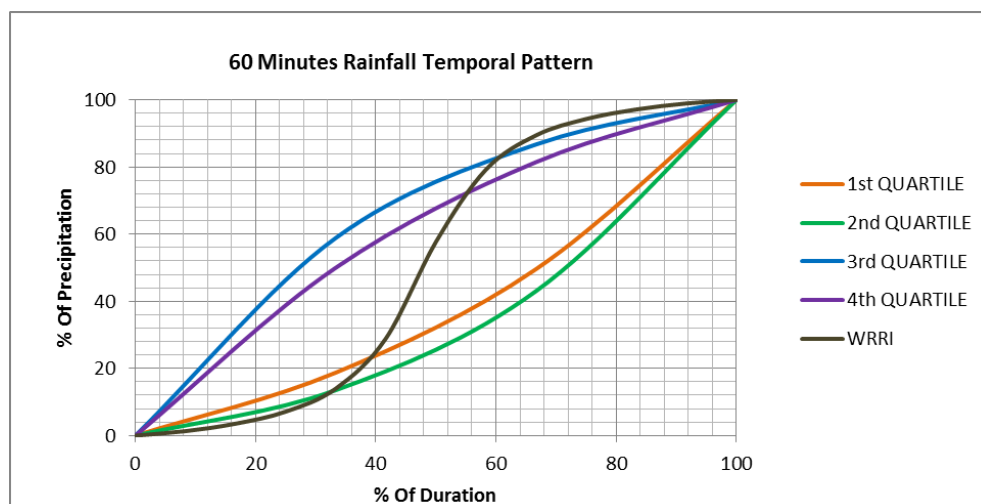


Figure 4.34 : 60 minutes Rainfall Temporal Pattern of JKR Gambang Station using WRI Method.

For 120 minutes duration there are 26 events recorded. The highest curve plotted in 120 minutes duration is in the third quartile while the lowest is in first

quartile. The curves plotted for 120 minutes duration of JKR Gambang Station using WRRI Method are as shown in Figure 4.10.

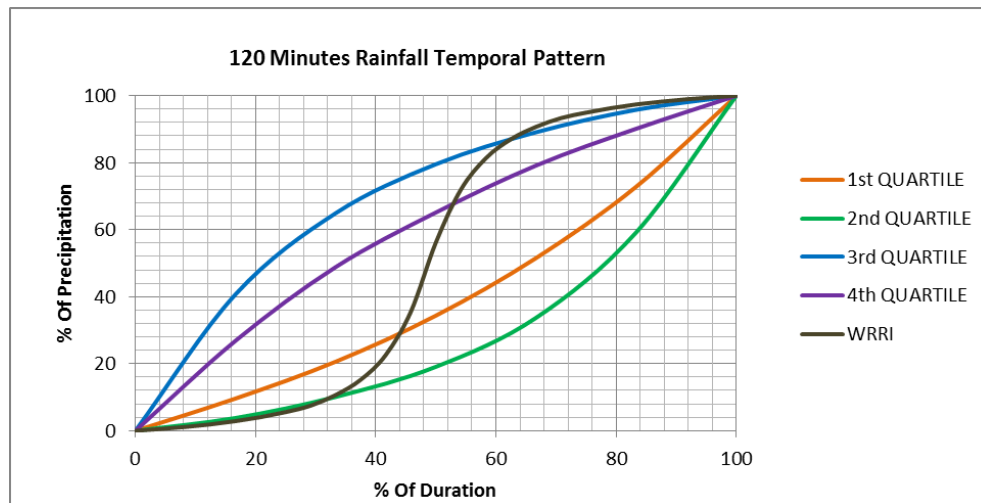


Figure 4.35 : 120 minutes Rainfall Temporal Pattern of JKR Gambang Station using WRRI Method.

For 180 minutes duration there are 8 events recorded. The highest curve plotted in 180 minutes duration is in the third quartile while the lowest is in second quartile. The curves plotted for 180 minutes duration of JKR Gambang Station using WRRI Method n are as shown in Figure 4.11.

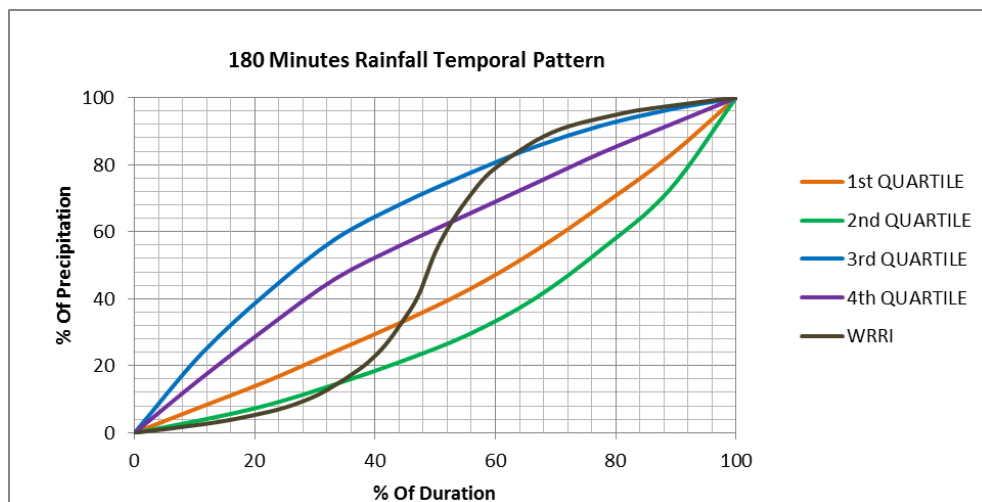


Figure 4.36 : 120 minutes Rainfall Temporal Pattern of JKR Gambang Station using WRRI Method.

4.3.3 Paya Besar

In this station, for 60 minutes duration there are 44 events recorded. The highest curve plotted in 60 minutes duration is in the fourth quartile while the lowest is in first quartile. The curves plotted for 60 minutes duration of Paya Besar using WRRI Method are as shown in Figure 4.37.

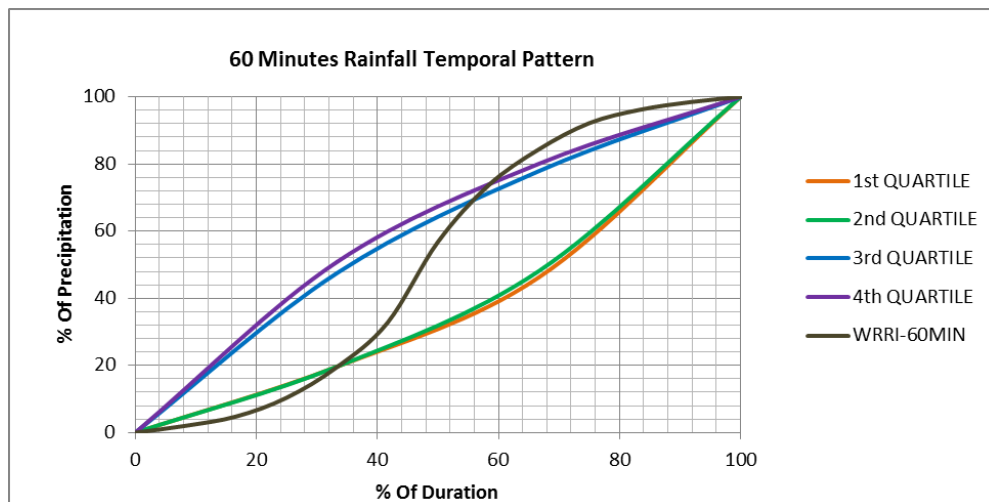


Figure 4.37 : 60 minutes Rainfall Temporal Pattern of Paya Besar Station using WRRI Method.

For 120 minutes duration there are 17 events recorded. The highest curve plotted in 120 minutes duration is in the third quartile while the lowest is in second quartile. The curves plotted for 120 minutes duration of Paya Besar using WRRI Method are as shown in Figure 4.38.

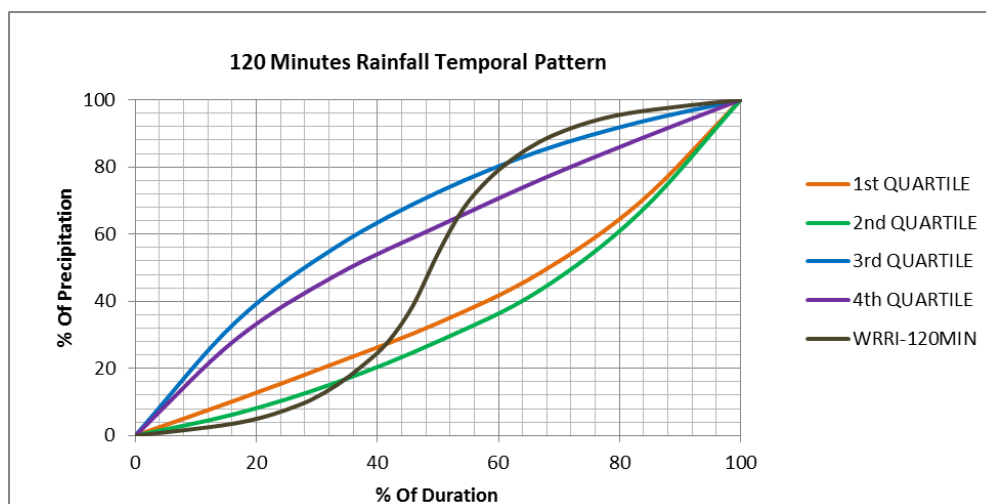


Figure 4.38 : 120 minutes Rainfall Temporal Pattern of Paya Besar Station using WRII Method.

For 180 minutes duration there are 11 events recorded. The highest curve plotted in 180 minutes duration is in the fourth quartile while the lowest is in first quartile. The curves plotted for 180 minutes duration of Paya Besar using WRII Method are as shown in Figure 4.39.

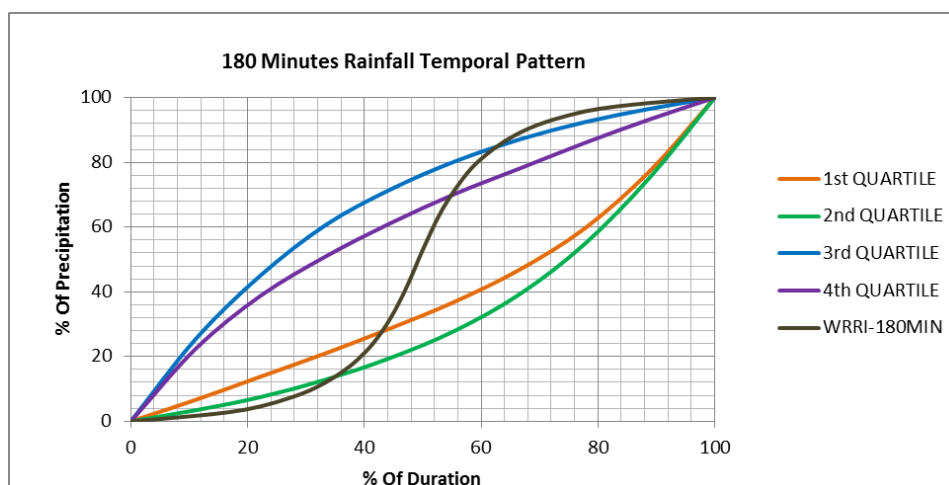


Figure 4.39 : 180 minutes Rainfall Temporal Pattern of Paya Besar Station using WRII Method.

4.3.4 Kg. Sg. Soi

In this station, for 60 minutes duration there are 54 events recorded. The highest curve plotted in 60 minutes duration is in the third quartile while the lowest is in first

quartile. The curves plotted for 60 minutes duration of Kg. Sg. Soi using WRRI Method are as shown in Figure 4.40.

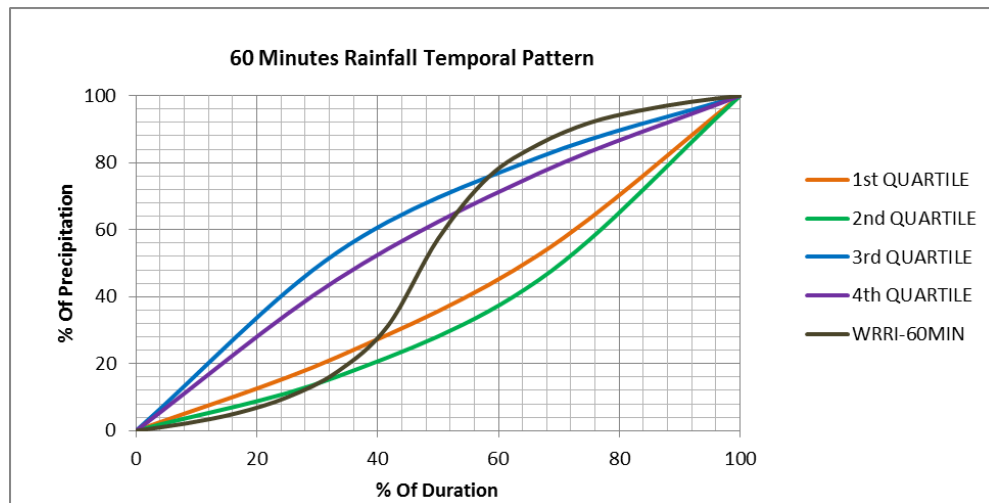


Figure 4.40 : 60 minutes Rainfall Temporal Pattern Kg. Sg. Soi Station using WRRI Method.

For 120 minutes duration there are 17 events recorded. The highest curve plotted in 120 minutes duration is in the third quartile while the lowest is in second quartile. The curves plotted for 120 minutes duration of Kg. Sg. Soi using WRRI Method are as shown in Figure 4.41.

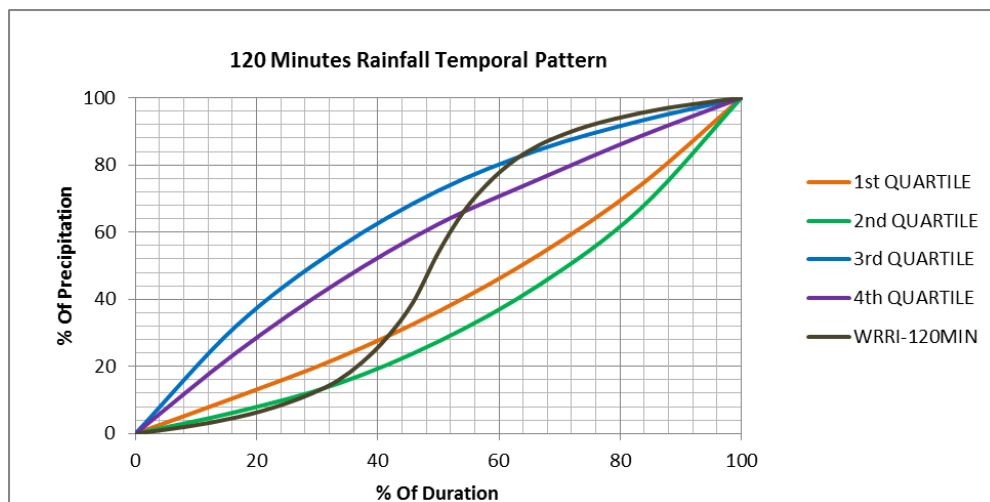


Figure 4.41 : 120 minutes Rainfall Temporal Pattern of Kg. Sg. Soi Station using WRRI Method.

For 180 minutes duration there are 8 events recorded. The highest curve plotted in 180 minutes duration is in the third quartile while the lowest is in second quartile. The curves plotted for 180 minutes duration Kg. Sg. Soi using WRRI Method are as shown in Figure 4.42.

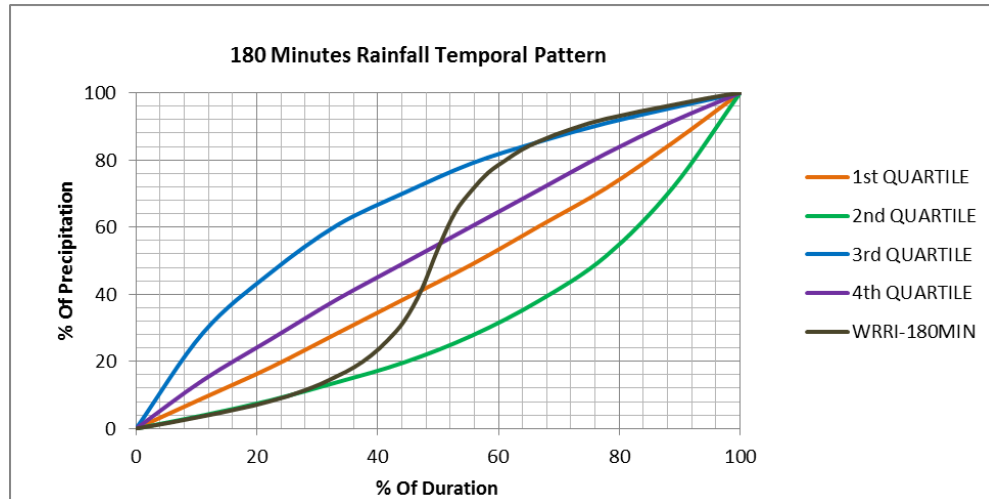


Figure 4.42 : 120 minutes Rainfall Temporal Pattern of Kg. Sg. Soi Station using WRRI Method.

4.3.5 Rancangan Pam Paya Pinang

In this station, for 60 minutes duration there are 55 events recorded. The highest curve plotted in 60 minutes duration is in the fourth quartile while the lowest is in first quartile. The curves plotted for 60 minutes duration of Rancangan Pam Paya Pinang using WRRI Method are as shown in Figure 4.43.

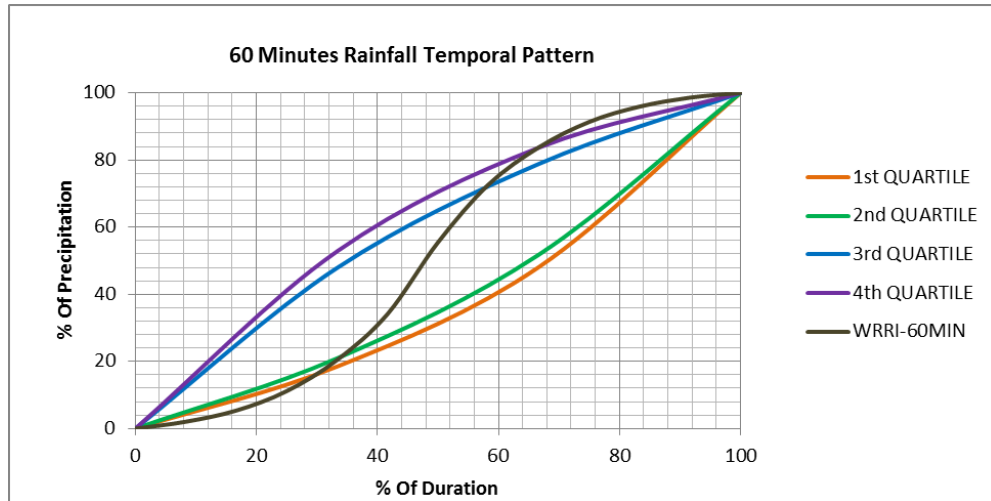


Figure 4.43 : 60 minutes Rainfall Temporal Pattern of Rancangan Pam Paya Pinang using WRI Method.

For 120 minutes duration there are 17 events recorded. The highest curve plotted in 120 minutes duration is in the third quartile while the lowest is in second quartile. The curves plotted for 120 minutes duration of Paya Besar using WRI Method are as shown in Figure 4.44.

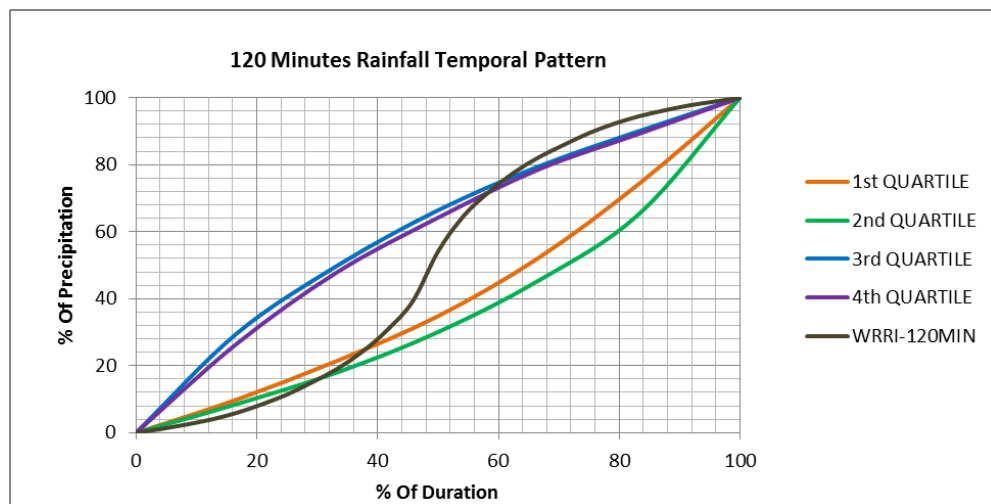


Figure 4.44 : 120 minutes Rainfall Temporal Pattern of Rancangan Pam Paya Pinang using WRI Method.

For 180 minutes duration there are 7 events recorded. The highest curve plotted in 180 minutes duration is in the third quartile while the other quartile has about the same curve. The curves plotted for 180 minutes duration of Rancangan Pam Paya Pinang using WRI Method are as shown in Figure 4.45

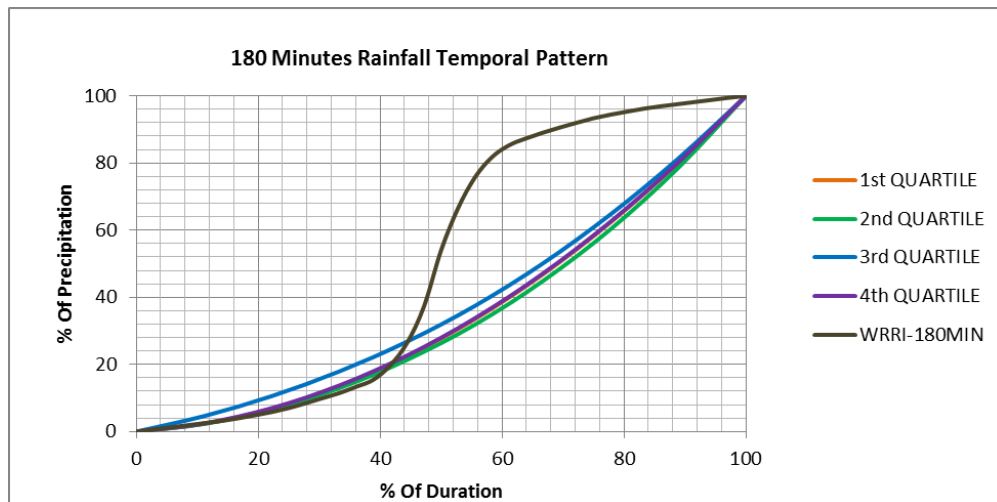


Figure 4.45 : 180 minutes Rainfall Temporal Pattern of Rancangan Pam Paya Pinang using WRI Method.

4.3.6 Pejabat JPS N. Pahang

In this station, for 60 minutes duration there are 115 events recorded. The highest curve plotted in 60 minutes duration is in the third quartile while the lowest is in fourth quartile. The curves plotted for 60 minutes duration of Pejabat JPS N. Pahang using WRI Method are as shown in Figure 4.46.

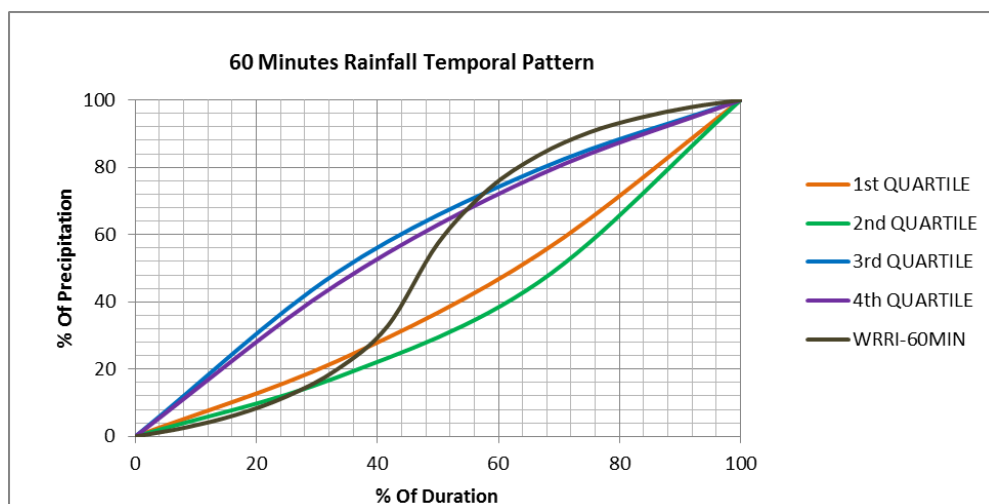


Figure 4.46 : 60 minutes Rainfall Temporal Pattern of Pejabat JPS N. Pahang using WRI Method.

For 120 minutes duration there are 28 events recorded. The highest curve plotted in 120 minutes duration is in the third quartile while the lowest is in second

quartile. The curves plotted for 120 minutes duration Pejabat JPS N. Pahang using WRRI Method are as shown in Figure 4.47.

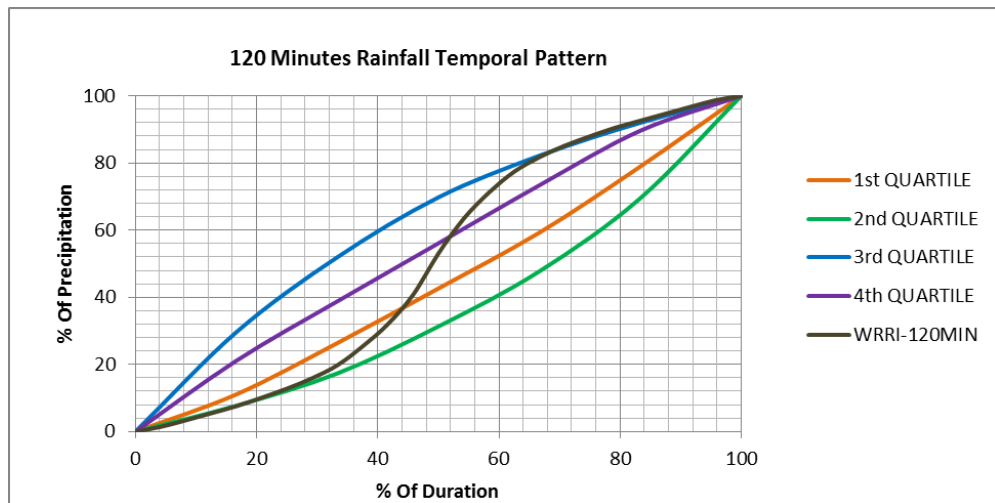


Figure 4.47 : 120 minutes Rainfall Temporal Pattern of Pejabat JPS N. Pahang using WRRI Method.

For 180 minutes duration there are 7 events recorded. The highest curve plotted in 180 minutes duration is in the third quartile while the lowest is in second quartile. The curves plotted for 180 minutes duration of Pejabat JPS N. Pahang using WRRI Method are as shown in Figure 4.48.

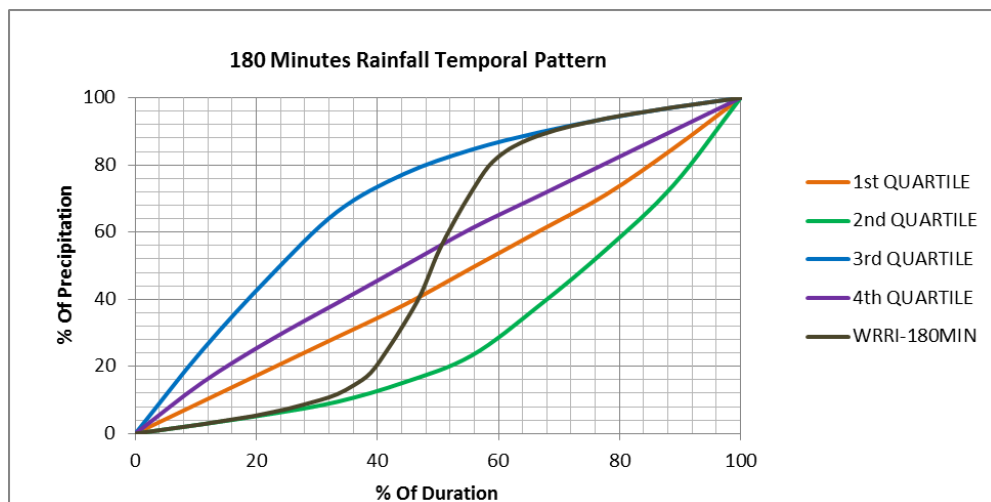


Figure 4.48 : 180 minutes Rainfall Temporal Pattern of Pejabat JPS N. Pahang using WRRI Method.

4.3.7 Sg. Lembing PCCL Mill Station

In this station, for 60 minutes duration there are 134 events recorded. The highest curve plotted in 60 minutes duration is in the third and fourth quartile while the lowest is in second quartile. The curves plotted for 60 minutes duration of Sg. Lembing PCCL Mill using WRI Method are as shown in Figure 4.49.

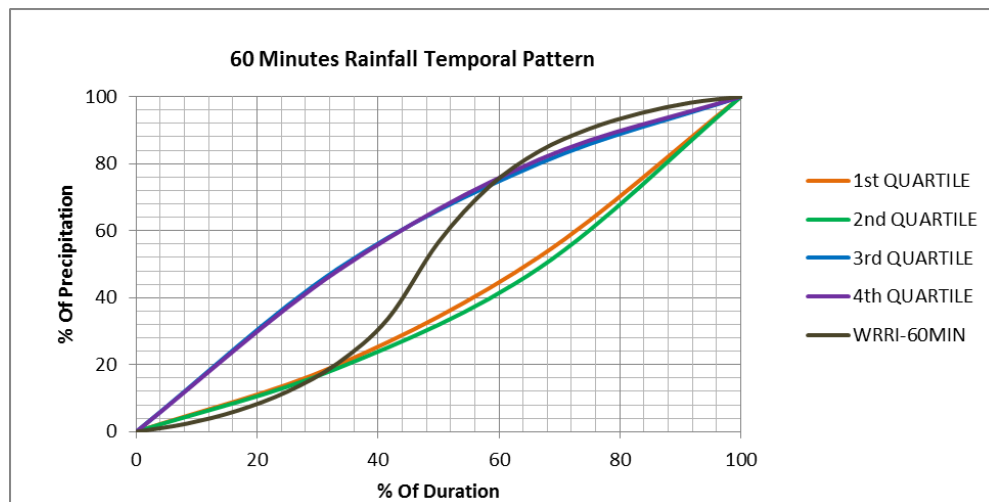


Figure 4.49 : 60 minutes Rainfall Temporal Pattern of Sg. Lembing PCCL Mill using WRI Method.

For 120 minutes duration there are 31 events recorded.. The highest curve plotted in 120 minutes duration is in the fourth quartile while the lowest is in first quartile. The curves plotted for 120 minutes duration Sg. Lembing PCCL Mill using WRI Method are as shown in Figure 4.50

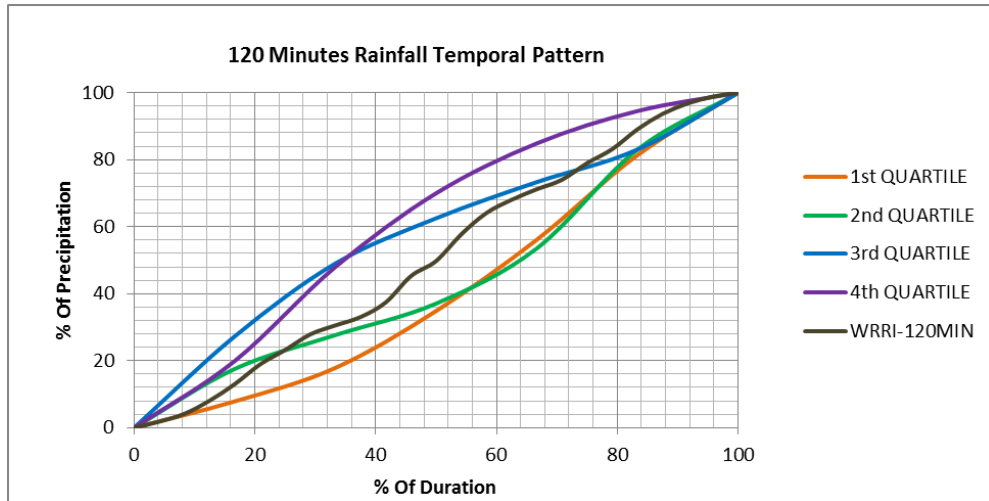


Figure 4.50 : 120 minutes Rainfall Temporal Pattern of Sg. Lembing PCCL Mill using WRII Method.

For 180 minutes duration there are 16 events recorded. The highest curve plotted in 180 minutes duration is in the fourth quartile while the lowest is in first quartile. The curves plotted for 180 minutes duration of Sg. Lembing PCCL Mill using WRII Method are as shown in Figure 4.51.

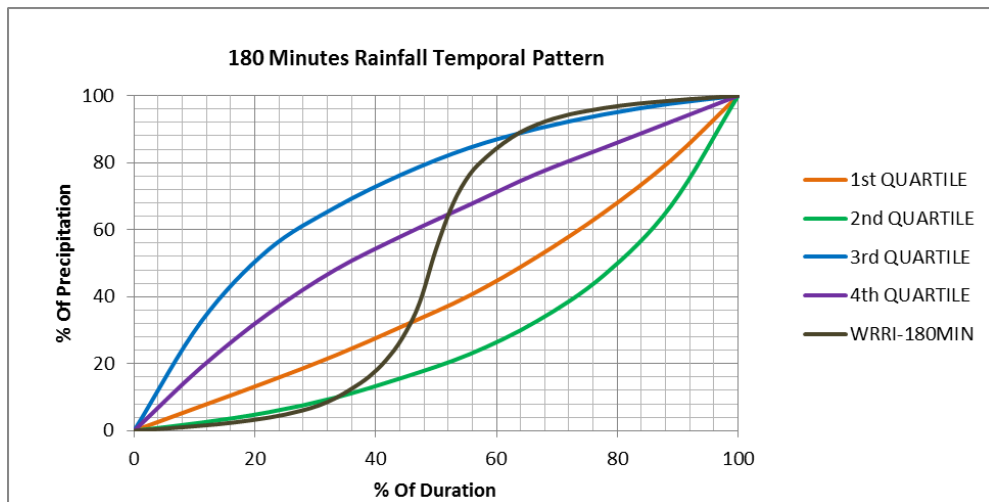


Figure 4.51 : 180 minutes Rainfall Temporal Pattern of Sg. Lembing PCCL Mill using WRII Method.

4.3.8 Ldg Kuala Nada

In this station, for 60 minutes duration there are 69 events recorded. The highest curve plotted in 60 minutes duration is in the third quartile while the lowest is in first quartile. The curves plotted for 60 minutes duration of Ldg Kuala Nada using WRRI Method are as shown in Figure 4.52.

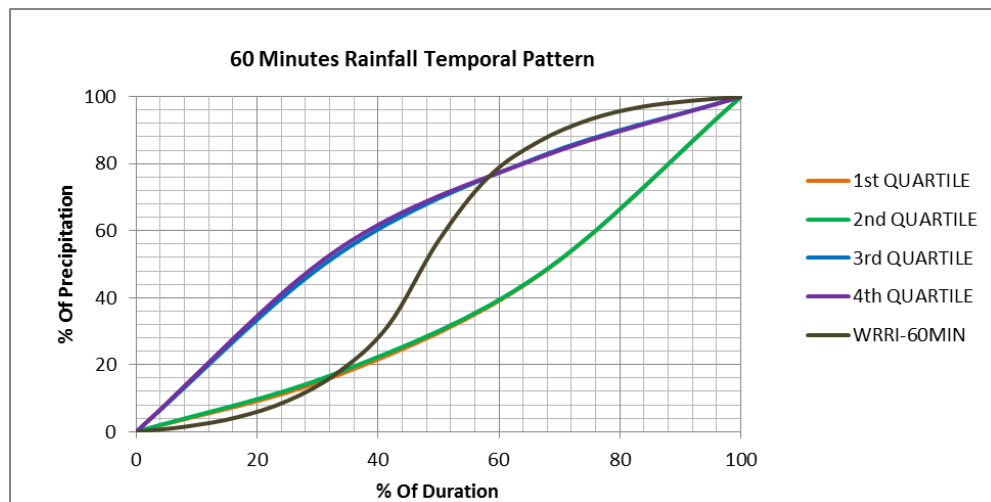


Figure 4.52 : 60 minutes Rainfall Temporal Pattern of Ldg Kuala Nada using WRRI Method.

For 120 minutes duration there are 22 events recorded. The highest curve plotted in 120 minutes duration is in the third and fourth quartile while the lowest is in first and second quartile. The curves plotted for 120 minutes duration of Ldg Kuala Nada using WRRI Method are as shown in Figure 4.53.

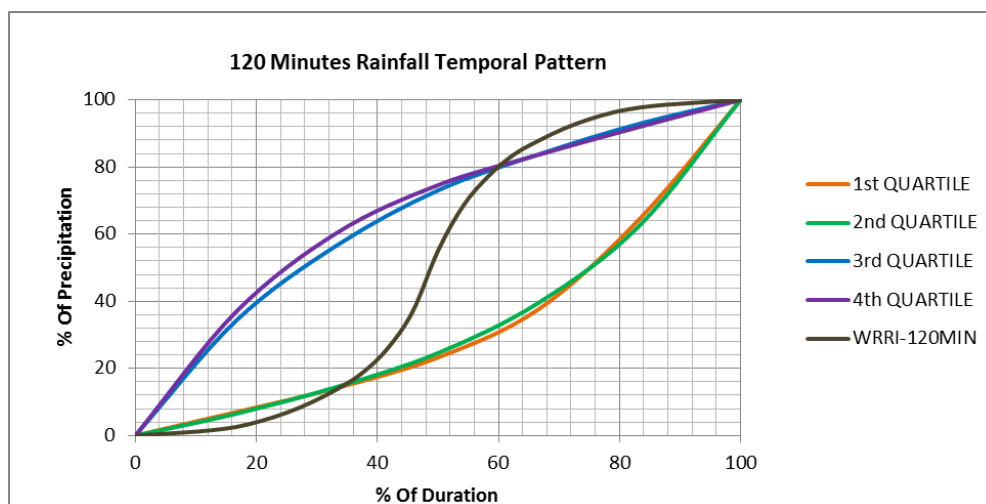


Figure 4.53 : 120 minutes Rainfall Temporal Pattern of Ldg Kuala Nada using WRII Method.

For 180 minutes duration there are 5 events recorded. The highest curve plotted in 180 minutes duration is in the third quartile while the lowest is in second quartile. The curves plotted for 180 minutes duration of Ldg Kuala Nada using WRII Method are as shown in Figure 4.53.

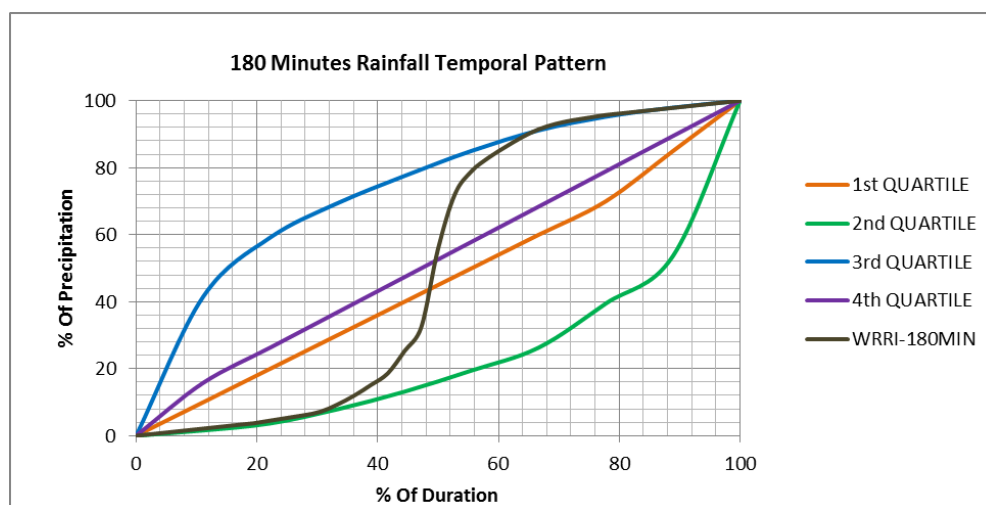


Figure 4.53 : 120 minutes Rainfall Temporal Pattern of Ldg Kuala Nada using WRII Method.

4.3.9 Ldg. Kuala Reman

In this station, for 60 minutes duration there are 55 events recorded. The highest curve plotted in 60 minutes duration is in the third and fourth quartile while the lowest

is in first and second quartile. The curves plotted for 60 minutes duration of Ldg Kuala Reman using WRRI Method are as shown in Figure 4.55.

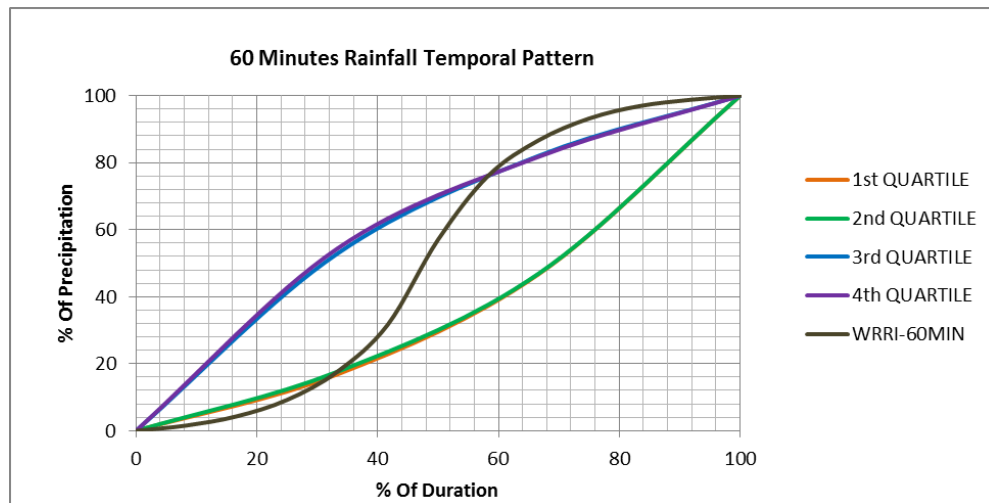


Figure 4.55 : 60 minutes Rainfall Temporal Ldg Kuala Reman using WRRI Method.

For 120 minutes duration there are 29 events recorded. The highest curve plotted in 120 minutes duration is in the third and fourth quartile while the lowest is in first and second quartile. The curves plotted for 120 minutes duration of Ldg Kuala Reman using WRRI Method are as shown in Figure 4.56.

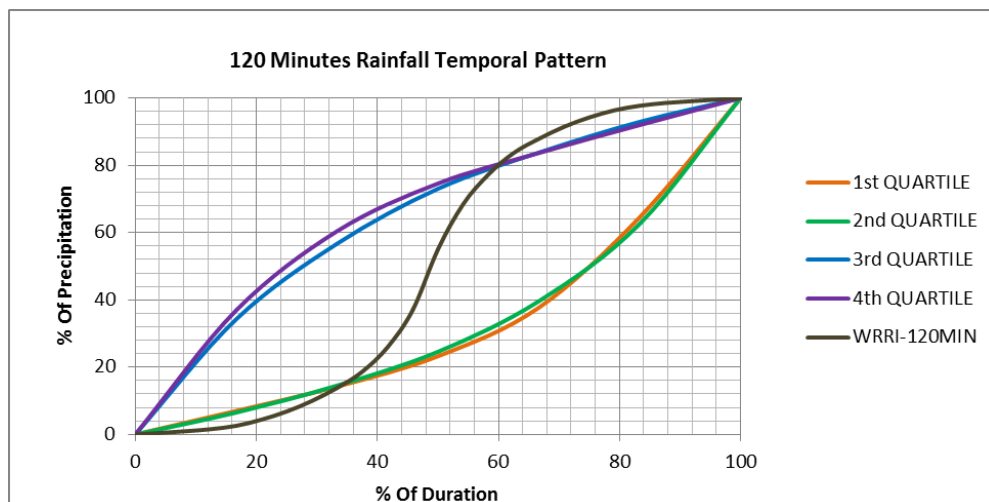


Figure 4.56 : 120 minutes Rainfall Temporal Pattern of Ldg Kuala Reman using WRRI Method.

For 180 minutes duration there are 2 events recorded. The highest curve plotted in 180 minutes duration is in the third quartile while the lowest is in second quartile.

The curves plotted for 180 minutes duration of of Ldg Kuala Reman using WRRI Method are as shown in Figure 4.57.

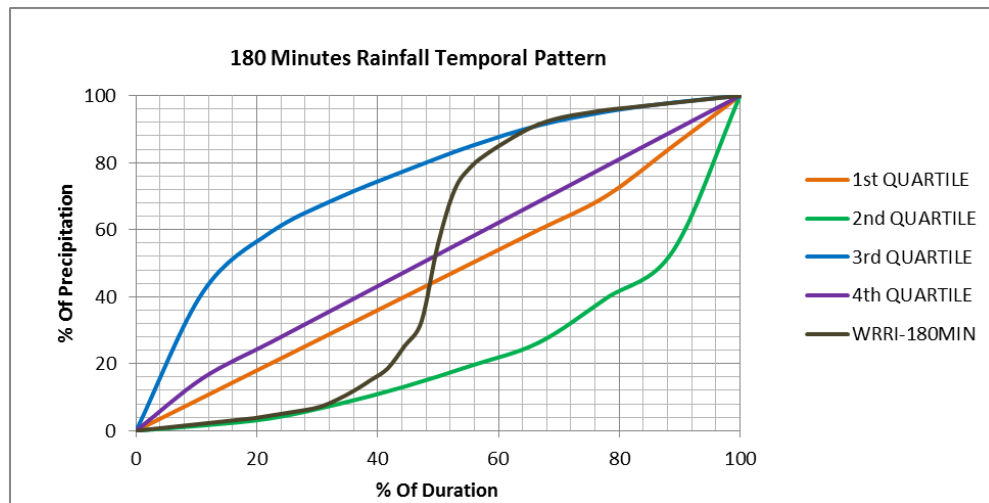


Figure 4.57 :180 minutes Rainfall Temporal Pattern of Ldg Kuala Reman using WRRI Method.

4.3.10 Balok

In this station, for 60 minutes duration there are 38 events recorded. The highest curve plotted in 60 minutes duration is in the third quartile while the lowest is in first quartile. The curves plotted for 60 minutes duration of Balok using WRRI Method are as shown in Figure 4.58.

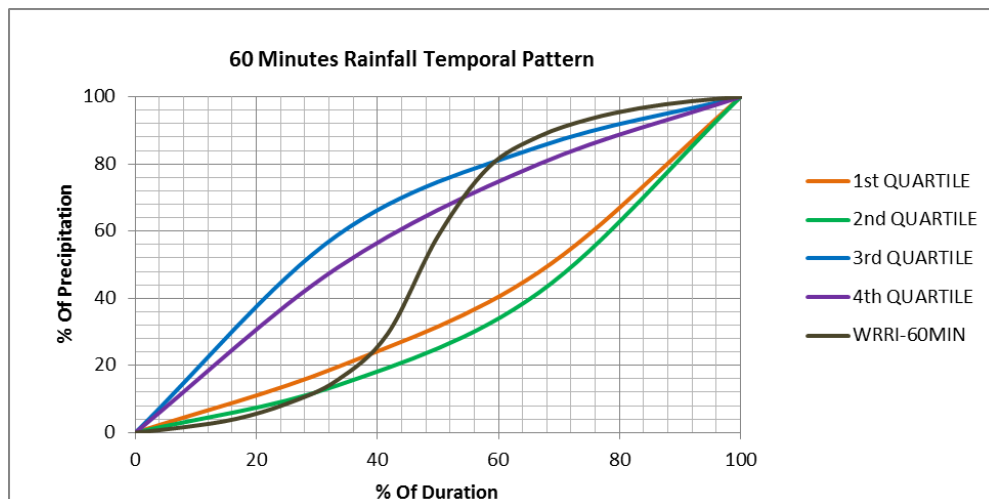


Figure 4.58 : 60 minutes Rainfall Temporal Pattern of Balok using WRRI Method.

For 120 minutes duration there are 18 events recorded. The highest curve plotted in 120 minutes duration is in the third quartile while the lowest is in second quartile. The curves plotted for 120 minutes duration of Balok using WRRI Method are as shown in Figure 4.59.

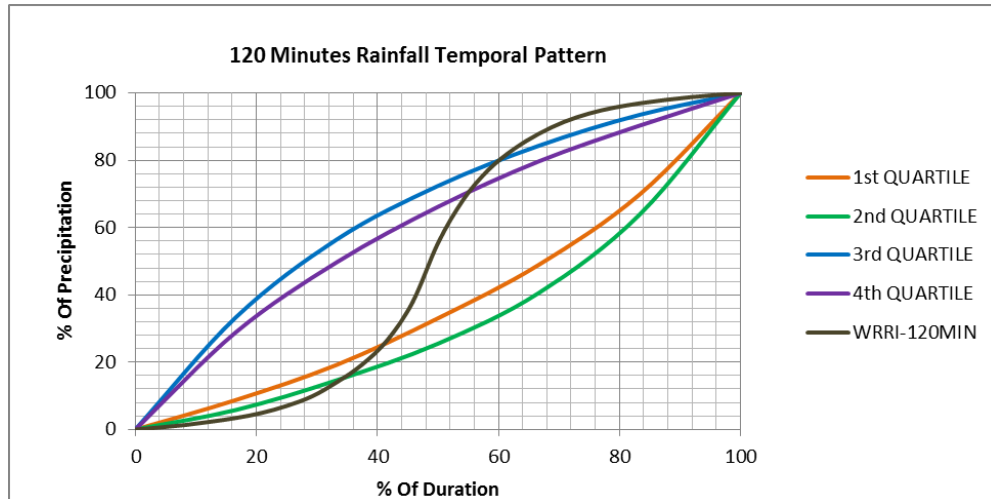


Figure 4.59 : 120 minutes Rainfall Temporal Pattern of Paya Besar Station

For 180 minutes duration there are 6 events recorded. The highest curve plotted in 180 minutes duration is in the third quartile while the lowest is in second quartile. The curves plotted for 180 minutes duration of Balok using WRRI Method are as shown in Figure 4.60.

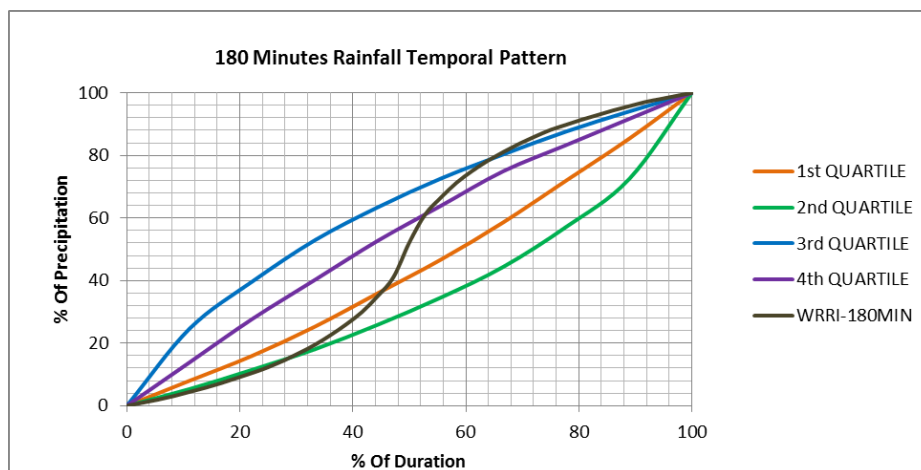


Figure 4.60 : 180 minutes Rainfall Temporal Pattern of Balok using WRRI Method.

4.4 COMPARISON OF BOTH METHOD

Both methods used rainfall event of 60 minutes, 120 minutes and 180 minutes. The rainfall event were also divided into four quartiles thus produce four curve for each type of event. To compare the results obtained from both methods, the difference in the point plotted was obtained and calculated in terms of percentage.

4.4.1 Kg. Pulau Manis

Table 4.4 for (a), (b), and (c) shows the comparison of 60 minutes, 120 minutes and 180 minutes rainfall event respectively for Kg Pulau Manis. For 60 minutes rainfall event, the 1st Quartile has the lowest percentage in difference while the 2nd quartile has the highest percentage in difference. For 120 minutes rainfall event, the highest percentage in difference is in second quartile and the lowest is in fourth quartile. While, in 180 minutes rainfall event, the highest percentage is in third quartile and the lowest is in fourth quartile.

Table 4.4 (a) : Comparison between Huff Time Method and WRII Method for 60 minutes rainfall event of Kg Pulau Manis.

60 minutes Rainfall			
Quartile	WRII	HTDM	Difference (%)
1st Quartile	69.0205	77.65625	14.75932
2nd Quartile	61.67421	116.9241	47.25279
3rd Quartile	137.9831	111.1386	24.15405
4th Quartile	132.4786	113.2118	17.01835

Table 4.4 (b) : Comparison between Huff Time Method and WRII Method for 120 minutes rainfall event of Kg Pulau Manis.

120 minutes Rainfall			
Quartile	WRII	HTDM	Difference (%)
1st Quartile	204.7297	268.7722	24.43079
2nd Quartile	134.4097	279.562	51.92134
3rd Quartile	367.5277	244.0909	50.57
4th Quartile	299.2701	285.7868	5.475101

Table 4.4 (c) : Comparison between Huff Time Method and WRI Method for 180 minutes rainfall event of Kg Pulau Manis.

180 minutes Rainfall			
Quartile	WRI	HTDM	Difference (%)
1st Quartile	317.5	443.1628	28.39123
2nd Quartile	203.1068	496.5823	59.09906
3rd Quartile	588.2593	342.3077	71.85104
4th Quartile	483.0357	489.9351	2.153744

4.4.1 JKR Gambang

Table 4.5 for (a), (b), and (c) shows the comparison of 60 minutes, 120 minutes and 180 minutes rainfall event respectively for JKR Gambang. For 60 minutes rainfall event, the 4th Quartile has the lowest percentage in difference while the 2nd quartile has the highest percentage in difference. For 120 minutes rainfall event, the highest percentage in difference is in second quartile and the lowest is in fourth quartile. While, in 180 minutes rainfall event, the highest percentage is in third quartile and the lowest is in fourth quartile.

Table 4.5 (a) : Comparison between Huff Time Method and WRI Method for 60 minutes rainfall event of JKR Gambang.

60 minutes Rainfall			
Quartile	WRI	HTDM	Difference (%)
1st Quartile	68.34239	84.06914	18.70692
2nd Quartile	56.59004	117.4182	51.8047
3rd Quartile	145.6061	109.2214	33.3128
4th Quartile	131.4626	128.0242	6.290642

Table 4.5 (b) : Comparison between Huff Time Method and WRI Method for 120 minutes rainfall event of JKR Gambang.

120 minutes Rainfall			
Quartile	WRI	HTM	Difference (%)
1st Quartile	189.0034	265.6195	28.84429
2nd Quartile	125.9245	276.5816	54.47111
3rd Quartile	370.1876	273.1196	35.54046
4th Quartile	310.2273	309.7668	5.187522

Table 4.5 (c) : Comparison between Huff Time Method and WRRI Method for 180 minutes rainfall event of JKR Gambang.

180 minutes Rainfall			
Quartile	WRRI	HTM	Difference (%)
1st Quartile	328.1553	386.0656	17.6046
2nd Quartile	244.741	450	45.61312
3rd Quartile	542.8037	340.7767	59.28429
4th Quartile	465.3061	390.0763	19.28591

4.4.1 Paya Besar

Table 4.6 for (a), (b), and (c) shows the comparison of 60 minutes, 120 minutes and 180 minutes rainfall event respectively for Paya Besar. For 60 minutes rainfall event, the 3rd Quartile has the lowest percentage in difference while the 2nd quartile has the highest percentage in difference. For 120 minutes rainfall event, the highest percentage in difference is in second quartile and the lowest is in third quartile. While, in 180 minutes rainfall event, the highest percentage is in third quartile and the lowest is in fourth quartile.

Table 4.6 (a) : Comparison between Huff Time Method and WRRI Method for 60 minutes rainfall event of Paya Besar.

60 minutes rainfall			
Quartile	WRRI	HTDM	Difference (%)
1st Quartile	65.89147	75.20661	14.30559
2nd Quartile	67.78485	100.3416	32.44591
3rd Quartile	125.4366	131.063	4.292863
4th Quartile	130.9278	112.1212	16.77347

Table 4.6 (b) : Comparison between Huff Time Method and WRRI Method for 120 minutes rainfall event of Paya Besar.

120 minutes Rainfall			
Quartile	WRRI	HTM	Difference (%)
1st Quartile	183.5294	234.1513	23.41433
2nd Quartile	159.9415	259.2742	38.31182
3rd Quartile	340.9513	300	13.65043
4th Quartile	303.4247	241.8605	25.45443

Table 4.6 (c) : Comparison between Huff Time Method and WRII Method for 180 minutes rainfall event of Paya Besar.

180 minutes Rainfall			
Quartile	WRII	HTM	Difference (%)
1st Quartile	291.1602	324.6809	13.47979
2nd Quartile	241.049	449.2063	46.33893
3rd Quartile	559.3502	357.0093	56.67664
4th Quartile	501.2121	508.9412	2.546968

4.4.1 Kg. Sg. Soi

Table 4.7 for (a), (b), and (c) shows the comparison of 60 minutes, 120 minutes and 180 minutes rainfall event respectively for Kg Sg. Soi. For 60 minutes rainfall event, the 4th Quartile has the lowest percentage in difference while the 2nd quartile has the highest percentage in difference. For 120 minutes rainfall event, the highest percentage in difference is in 3rd quartile and the lowest is in 4th quartile. While, in 180 minutes rainfall event, the highest percentage is in 3rd quartile and the lowest is in 1st quartile

Table 4.7 (a) : Comparison between Huff Time Method and WRII Method for 60 minutes rainfall event of Kg Sg. Soi.

60 minutes Rainfall			
Quartile	WRII	HTDM	Difference (%)
1st Quartile	74.5283	93.43434	20.23457
2nd Quartile	61.16634	110.5701	44.68093
3rd Quartile	134.8732	106.0755	27.14825
4th Quartile	122.0077	120.3267	6.719777

Table 4.7 (b) : Comparison between Huff Time Method and WRII Method for 120 minutes rainfall event of Kg Sg. Soi.

120 minutes Rainfall			
Quartile	WRII	HTDM	Difference (%)
1st Quartile	196.9697	238.2353	18.91788
2nd Quartile	159.9755	207.0886	22.75021
3rd Quartile	337.3547	235.0932	43.49828
4th Quartile	295.9732	323.8722	8.614209

Table 4.7 (c) : Comparison between Huff Time Method and WRII Method for 180 minutes rainfall event of Kg Sg. Soi.

180 minutes Rainfall			
Quartile	WRII	HTDM	Difference (%)
1st Quartile	360.2273	387.2973	13.97101
2nd Quartile	234.8148	396.8944	40.83696
3rd Quartile	556.8513	260.0791	114.1085
4th Quartile	433.7349	454.8223	7.113275

4.4.1 Rancangan Pam Paya Pinang

Table 4.8 for (a), (b), and (c) shows the comparison of 60 minutes, 120 minutes and 180 minutes rainfall event respectively for Ranc. Pam Paya Pinang. For 60 minutes rainfall event, the 4th Quartile has the lowest percentage in difference while the 2nd quartile has the highest percentage in difference. For 120 minutes rainfall event, the highest percentage in difference is in 2nd and the lowest is in 3rd quartile. While, in 180 minutes rainfall event, the highest percentage is in 2nd quartile and the lowest is in 3rd quartile

Table 4.8 (a) : Comparison between Huff Time Method and WRII Method for 60 minutes rainfall event of Ranc. Pam Paya Pinang.

60 minutes Rainfall			
Quartile	WRII	HTM	Difference (%)
1st Quartile	66.61871	76.4977	12.9141
2nd Quartile	72.74375	105.7888	31.23685
3rd Quartile	126.7159	109.353	15.8778
4th Quartile	136.4991	130.792	4.363465

Table 4.8(b) : Comparison between Huff Time Method and WRII Method for 120 minutes rainfall event of Ranc. Pam Paya Pinang.

120 minutes Rainfall			
Quartile	WRII	HTM	Difference (%)
1st Quartile	192.8328	247.179	21.98659
2nd Quartile	167.4863	259.0028	35.33415
3rd Quartile	315.5286	308.8608	5.331286
4th Quartile	306.6421	252.0599	21.65443

Table 4.8 (c) : Comparison between Huff Time Method and WRII Method for 180 minutes rainfall event Ranc. Pam Paya Pinang.

180 minutes Rainfall			
Quartile	WRII	HTM	Difference (%)
1st Quartile	267.8391	448.4536	40.27497
2nd Quartile	258.8242	444.7273	41.8016
3rd Quartile	293.5435	353.6913	17.00574
4th Quartile	269.3904	457.6923	41.14159

4.4.1 Pejabat JPS N. Pahang

Table 4.9 for (a), (b), and (c) shows the comparison of 60 minutes, 120 minutes and 180 minutes rainfall event respectively for Pej JPS N Pahang. For 60 minutes rainfall event, the 4th Quartile has the lowest percentage in difference while the 2nd quartile has the highest percentage in difference. For 120 minutes rainfall event, the highest percentage in difference is in 2nd quartile and the lowest is in 1st quartile. While, in 180 minutes rainfall event, the highest percentage is in 3rd quartile and the lowest is in 4th quartile.

Table 4.9 (a) : Comparison between Huff Time Method and WRII Method for 60 minutes rainfall event of Pej JPS N Pahang.

60 minutes Rainfall			
Quartile	WRII	HTM	Difference (%)
1st Quartile	76.55218	85.96244	11.97684
2nd Quartile	63.46685	106.3178	40.30461
3rd Quartile	128.1354	107.1093	19.63051
4th Quartile	123.0139	118.5578	3.758613

Table 4.9 (b) : Comparison between Huff Time Method and WRII Method for 120 minutes rainfall event of Pej JPS N Pahang.

120 minutes Rainfall			
Quartile	WRII	HTM	Difference (%)
1st Quartile	218.3556	218.7398	5.784136
2nd Quartile	173.6618	279.3617	37.83622
3rd Quartile	325.5961	245.9911	32.36092
4th Quartile	279.065	260.7207	7.036004

Table 4.9 (c) : Comparison between Huff Time Method and WRI Method for 180 minutes rainfall event of Pej JPS N Pahang.

180 minutes Rainfall			
Quartile	WRI	HTM	Difference (%)
1st Quartile	361.6438	477.5	24.26307
2nd Quartile	223.4409	424.2424	47.3318
3rd Quartile	580.4627	306.25	89.53885
4th Quartile	434.7222	441.1277	6.348684

4.4.1 Sg. Lembing PCCL Mill

Table 4.10 for (a), (b), and (c) shows the comparison of 60 minutes, 120 minutes and 180 minutes rainfall event respectively for Sg. Lembing PCCL Mill. For 60 minutes rainfall event, the 1st Quartile has the lowest percentage in difference while the 2nd quartile has the highest percentage in difference. For 120 minutes rainfall event, the highest percentage in difference is in 1st quartile and the lowest is in 4th quartile. While, in 180 minutes rainfall event, the highest percentage is in 2nd quartile and the lowest is in 4th quartile.

Table 4.10 (a) : Comparison between Huff Time Method and WRI Method for 60 minutes rainfall event of Sg. Lembing PCCL Mill.

60 minutes Rainfall			
Quartile	WRI	HTM	Difference (%)
1st Quartile	72.18045	76.57958	10.76241
2nd Quartile	67.86003	109.4044	37.97321
3rd Quartile	128.7083	109.7662	17.25677
4th Quartile	129.319	105.0245	23.13225

Table 4.10 (b) : Comparison between Huff Time Method and WRI Method for 120 minutes rainfall event of Sg. Lembing PCCL Mill.

120 minutes Rainfall			
Quartile	WRI	HTM	Difference (%)
1st Quartile	198.0583	271.6033	27.07813
2nd Quartile	218.8295	209.2091	7.695126
3rd Quartile	295.2197	243.7311	22.33867
4th Quartile	317.3633	313.1455	6.822312

Table 4.10 (c) : Comparison between Huff Time Method and WRI Method for 180 minutes rainfall event of Sg. Lembing PCCL Mill.

180 minutes Rainfall			
Quartile	WRI	HTM	Difference (%)
1st Quartile	313.7615	394.984	21.28064
2nd Quartile	202.7281	480.8912	57.84326
3rd Quartile	596.511	419.401	42.22926
4th Quartile	481.068	453.6804	6.036745

4.4.1 Ldg Nada

Table 4.11 for (a), (b), and (c) shows the comparison of 60 minutes, 120 minutes and 180 minutes rainfall event respectively for Ldg Nada. For 60 minutes rainfall event, the 4th Quartile has the lowest percentage in difference while the 2nd quartile has the highest percentage in difference. For 120 minutes rainfall event, the highest percentage in difference is in 3rd quartile and the lowest is in 4th quartile. While, in 180 minutes rainfall event, the highest percentage is in 3rd quartile and the lowest is in 4th quartile.

Table 4.13 (a) : Comparison between Huff Time Method and WRI Method for 60 minutes rainfall event of Ldg Nada.

60 minutes Rainfall			
Quartile	WRI	HTM	Difference (%)
1st Quartile	74.48133	85.28926	17.28197
2nd Quartile	61.50075	108.702	43.42259
3rd Quartile	133.4029	100.5752	32.64
4th Quartile	122.4599	119.6446	6.894072

Table 4.11 (b) : Comparison between Huff Time Method and WRI Method for 120 minutes rainfall event of Ldg Nada.

120 minutes Rainfall			
Quartile	WRI	HTM	Difference (%)
1st Quartile	169.3182	240.2652	29.62029
2nd Quartile	145.9321	247.1306	40.94938
3rd Quartile	349.2958	237.4425	47.10752
4th Quartile	335.9477	322.7477	4.08987

.Table 4.11 (c) : Comparison between Huff Time Method and WRII Method for 180 minutes rainfall event of Ldg Nada.

180 minutes Rainfall			
Quartile	WRII	HTM	Difference (%)
1st Quartile	366.6667	423.0159	13.32083
2nd Quartile	180.25	406.2753	55.63353
3rd Quartile	628.0347	451.7007	39.0378
4th Quartile	432	415	4.578313

4.4.1 Ldg Kuala Reman

Table 4.12 for (a), (b), and (c) shows the comparison of 60 minutes, 120 minutes and 180 minutes rainfall event respectively for Ldg. Kuala Reman. For 60 minutes rainfall event, the 4th Quartile has the lowest percentage in difference while the 2nd quartile has the highest percentage in difference. For 120 minutes rainfall event, the highest percentage in difference is in 2nd quartile and the lowest is in 3rd quartile. While, in 180 minutes rainfall event, the highest percentage is in 2nd quartile and the lowest is in 4th quartile.

Table 4.12 (a) : Comparison between Huff Time Method and WRII Method for 60 minutes rainfall event of Ldg. Kuala Reman.

60 minutes Rainfall			
Quartile	WRII	HTM	Difference (%)
1st Quartile	63.60544	83.85734	24.15042
2nd Quartile	64.54992	109.9507	41.29197
3rd Quartile	134.9502	106.5698	26.6308
4th Quartile	136.1751	119.1589	14.28029

Table 4.12 (b) : Comparison between Huff Time Method and WRII Method for 120 minutes rainfall event of Ldg. Kuala Reman.

120 minutes Rainfall			
Quartile	WRII	HTM	Difference (%)
1st Quartile	146.7269	250.5081	41.4283
2nd Quartile	147.8608	259.957	43.12106
3rd Quartile	340.7378	328.7794	3.637223
4th Quartile	347.5936	267.8899	29.7524

Table 4.12 (c) : Comparison between Huff Time Method and WRI Method for 180 minutes rainfall event of Ldg. Kuala Reman..

180 minutes Rainfall			
Quartile	WRI	HTM	Difference (%)
1st Quartile	365	574.1525	36.42804
2nd Quartile	165.2632	472.7273	65.04049
3rd Quartile	617.0068	469.6429	31.37787
4th Quartile	421.0526	400	5.263158

4.4.1 Balok

Table 4.13 for (a), (b), and (c) shows the comparison of 60 minutes, 120 minutes and 180 minutes rainfall event respectively for Balok. For 60 minutes rainfall event, the 3rd Quartile has the lowest percentage in difference while the 2nd quartile has the highest percentage in difference. For 120 minutes rainfall event, the highest percentage in difference is in 3rd quartile and the lowest is in 4th quartile. While, in 180 minutes rainfall event, the highest percentage is in 3rd quartile and the lowest is in 4th quartile.

Table 4.13 (a) : Comparison between Huff Time Method and WRI Method for 60 minutes rainfall event of Balok.

60 minutes Rainfall			
Quartile	WRI	HTM	Difference (%)
1st Quartile	67.27941	83.23077	19.16522
2nd Quartile	55.71699	119.5652	53.40033
3rd Quartile	143.8914	134.1794	7.238107
4th Quartile	129.0476	118.2109	9.16731

Table 4.13 (b) : Comparison between Huff Time Method and WRI Method for 120 minutes rainfall event of Balok.

120 minutes Rainfall			
Quartile	WRI	HTM	Difference (%)
1st Quartile	179.9163	245.8846	26.82895
2nd Quartile	150.4543	216.2921	30.43932
3rd Quartile	340.2736	255.3382	33.26385
4th Quartile	314.9758	323.741	2.707461

Table 4.13 (c) : Comparison between Huff Time Method and WRI Method for 180 minutes rainfall event of Balok

180 minutes Rainfall			
Quartile	WRI	HTM	Difference (%)
1st Quartile	348	442.7632	21.40267
2nd Quartile	269.5473	373.8372	27.89714
3rd Quartile	515.5251	385.3403	33.78437
4th Quartile	448.6111	460.6383	3.483449

4.5 RANGES IN DIFFERENCES

After comparing the result of both methods and obtaining the percentage in differences, the range of differences in each quartile of the 60 minutes, 120 minutes and 180 minutes rainfall can also be produced. The ranges are tabulated in Table 4.14, Table 4.15 and Table 4.16 for 60 minutes, 120 minutes and 180 minutes rainfall event respectively.

It can be seen that for 60 minutes event, the lowest range is in 4th quartile that is between 3.76% to 14.28%. For 120 minutes event, the lowest range is also in 4th quartile that is in between 2.71% to 29.75%. Lastly for 180 minutes event, the lowest range is also in 4th quartile that is in between 2.13% to 19.29%.

For highest range obtained, in 60 minutes event it is in 2nd quartile that is between 31.24% to 53.40%. In 120 minutes event it is also in 2nd quartile that is between 7.70% to 54.47%. Lastly in 180 minutes event, the highest is in 3rd quartile that is between 31.38% to 89.54%.

By these result, all three types of event has lowest range in 4th quartile and the highest range for 60 minutes and 120 minutes is in 2nd quartile and 180 minutes is in 3rd quartile.

Table 4.14 : Range in difference for 60 minutes Rainfall Event

60 minutes Rainfall		
1st Quartile	10.76241	24.15042
2nd Quartile	31.23685	53.40033
3rd Quartile	4.292863	33.3128
4th Quartile	3.758613	14.28029

Table 4.15 : Range in difference for 120 minutes Rainfall Event

120 minutes Rainfall		
1st Quartile	5.784136	41.4283
2nd Quartile	7.695126	54.47111
3rd Quartile	3.637223	50.57
4th Quartile	2.707461	29.7524

Table 4.16 : Range in difference for 180 minutes Rainfall Event

180 minutes Rainfall		
Quartile		
1st Quartile	13.32083	40.27497
2nd Quartile	27.89714	65.04049
3rd Quartile	31.37787	89.53885
4th Quartile	2.153744	19.28591

CHAPTER 5

CONCLUSION

5.1 Introduction

In this the study, the objectives were to develop rainfall temporal pattern using HTDM and WRI Method and to compare the result of both methods afterwards. The study was for Kuantan River Basin which consisted of ten stations along the river basin. The rainfall event of 60 minutes, 120 minutes and 180 minutes were extracted in order to proceed on the analysis. The analysis were done through and presented in terms of plotting of graph of depth (cumulative percentage) versus duration(cumulative percentage). The graphs plotted produced curves of quartile. The quartile from HTDM were then compared with quartile from WRI. Both method were compared in term of percentage of differences. The differences are obtained from the cumulative rainfall depth of both methods. As the analysis were done, different range of percentage in differences were obtained and from that, the highest and lowest range can be observed.

5.2 Conclusion

The rainfall temporal pattern of all ten stations of Kuantan River Basin were developed using Huff Time Method and WRI Method and curves of all the four quartile were produced. Afterwards, the curves from both were compared and percentage of differences in each point were also obtained. From that, this study manage to find the range in differences and which quartile produce the highest and lowest range in differences.

Based on the analysis of the rainfall temporal pattern developed by HTDM and WRI method, the differences in each graph plotted varies from about 2% to 89%. It

can also be seen that the 4th Quartile has the lowest range in all the three types of rainfall events. While for the highest range, it is 2nd Quartile for 60 minutes and 120 minutes event and 3rd Quartile for 180 minutes event. Some of the graph has a very different pattern from most of the other graphs. This may contributed to the high percentage of differences. The reason why the graph has vary curve between all stations is because the data used in the study is real data obtained from DID. So there are variations of data. Other reasons maybe due to poor maintenance of station which resulting in losses of data in some stations. So the data uses were missing and inaccurate in some part.

In conclusion, this study manage to achieve the objective of the research that are to developed the rainfall temporal pattern using Huff Time Method and WRRI Method and to compared the result from both method.

5.3 Recommendation

In order to improve the result of this study, there are a few recommendation that can be done. Such recommendations are as follow;

- Develop the rainfall temporal pattern using other method and compared with MSMA2.
- Testing the temporal pattern with real hydraulic and hydrology design and compared the result with both method.
- To have more research to which method are best to use and describe the rainfall temporal pattern.

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APPENDIX A

DATA ANALYSIS USING HTDM

Table 1 (a) : Analysis using HTDM for 1st Quartile of 60 minutes rainfall events of JKR Gampang

1st Quartile		Depth																								
minutes	%cum	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
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	0
5	33.33	1.9	0.1	0.6	0.4	2.3	1.8	0.7	0.9	0.1	0.1	0.1	0.1	0.2	0.2	1.7	6.3	3.2	0.2	0.1	0.3	0.8	4.4	3.1	2.6	0.1
5	66.67	2.1	0.9	2.4	0.9	1.8	0.7	1.8	1.6	0.1	0.2	0.1	0.1	0.2	0.2	3.8	11	5.5	0.9	0.3	3.3	8.6	7.9	6.7	6.4	1.5
5	100	1	0.7	1.1	0.7	2.5	0.1	2	1.4	0.1	0.2	0.1	0.1	0.2	0.2	2.3	5.4	4.4	0.4	0.3	1.5	5.1	7.2	2.8	2.6	3.3

1st Quartile		Depth																								
minutes	%cum	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
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	0
5	33.33	0.2	0.1	0.4	0.2	0.6	0.1	1.1	0.1	0.9	1.9	2.1	0.1	2.8	0.2	0.2	0.1	2	0.1	0.1	9.5	0.1	0.1	0.1	0.1	0.4
5	66.67	3.6	0.5	0.2	0.4	1.6	1.5	2	0.1	1.2	1.7	6.2	0.2	4.1	0.7	0.2	0.2	1.5	0.3	0.2	6.9	0.3	0.5	0.3	0.4	0.2
5	100	3.4	1.4	0.1	0.6	0.8	0.2	7.5	0.1	3.5	0.6	4.9	0.2	12	0.6	0.2	0.2	0.5	2	0.2	1.4	0.2	0.8	0.3	0.1	0.1

1st Quartile		Depth																								
minutes	%cum	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
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	0
5	33.33	0.1	3	0.2	1.5	0.1	0.2	0.1	0.1	0.1	0.1	0.5	5.1	0.2	0.8	0.7	0.1	2.5	0.8	1.6	1.7	3.4	0.3	2.3	0.1	0.1
5	66.67	0.1	3.4	2.7	0.8	0.2	0.3	0.1	0.3	0.1	0.2	0.5	8.8	0.5	2.1	1.9	0.4	8.4	0.3	3.4	1.1	7.2	2.7	8.9	0.1	0.1
5	100	0.1	1.2	1.3	0.5	0.2	0.2	0.1	0.2	0.1	0.2	0.1	5.2	1.6	2.6	2.1	1.1	6.5	0.3	1.4	1.3	5.6	7.1	9.6	0.1	0.1

1st Quartile	%cum	Depth								Average	Percentage	%Cum
minutes		76	77	78	79	80	81	82	83			
0	0	0	0	0	0	0	0	0	0	0	0	0
5	33.33	0.3	1.3	1.7	0.1	0.3	0.1	2.5	1.4	1.08	20.86	20.86
5	66.67	2.3	4.2	1.3	0.1	0.2	7.5	0.1	7	2.18	42.35	63.21
5	100	0.4	3.3	0.4	0.1	0.2	9.3	0.1	7.3	1.90	36.79	100
										5.16		

Table 1(b) : Analysis using HTDM for 2nd Quartile of 60 minutes rainfall events of JKR Gambang

2nd Quartile	%cum	Depth																								
minutes		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
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	0
5	33.33	2.8	1.2	0.4	0.4	4.9	0.1	0.4	0.5	0.1	0.2	0.1	0.1	0.2	0.2	1	3.3	3.9	0.4	0.3	2.9	3.7	2.4	3.8	0.4	3.8
5	66.67	1	1.7	0.2	0.6	4.9	0.1	0.8	0.4	0.1	0.3	0.1	0.1	0.2	0.3	1	1.1	0.1	0.5	0.3	5.2	1.6	0.7	1.8	0.3	5.1
5	100	0.6	2.5	0.2	0.4	5	0.1	0.6	0.4	0.1	0.2	0.1	0.1	0.2	5.2	0.8	0.4	0.1	0.4	0.3	4.5	0.3	0.4	1.7	0.4	4

2nd Quartile	%cum	Depth																									
minutes		26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	
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	0	
5	33.33	4.4	5.5	0.1	1.6	0.5	0.2	7.9	0.1	2.5	0.3	0.3	0.1	13.8	0.3	0.3	0.1	0.1	1.2	0.2	0.5	0.1	0.1	0.3	0.1	0.1	
5	66.67	5.9	6.8	0.1	0.9	0.2	0.1	8.4	0.1	0.9	0.5	0.1	0.1	5.9	0.7	0.2	0.1	0.1	1.3	0.3	0.5	0.1	0.1	0.4	0.1	0.1	
5	100	3.1	5.5	0.1	0.5	0.2	0.1	3.3	0.1	0.8	2.8	0.1	0.1	2.8	1.1	0.1	0.1	0.1	1.2	0.2	0.4	0.1	0.1	0.4	0.1	0.1	

2nd Quartile		Depth																								
minutes	%cum	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
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	0
5	33.33	0.1	1.7	0.6	1.8	0.3	0.3	0.1	0.2	0.1	0.3	0.1	3.3	7	0.1	2.9	1.8	8.8	0.2	0.7	1.2	0.9	0.5	3.9	0.1	0.1
5	66.67	0.1	1.7	0.4	5	0.4	0.3	0.1	0.2	0.1	0.3	0.1	3.7	7.7	0.1	2.7	3.3	1.8	0.2	0.2	0.6	0.3	0.1	3.2	0.1	0.1
5	100	0.6	0.2	0.4	5	0.3	0.2	0.1	0.5	0.1	1.5	0.1	1.4	3.1	0.1	1.8	2.1	0.3	0.2	0.2	0.8	0.9	0.1	1.1	0.1	0.1

2nd Quartile		Depth										
minutes	%cum	76	77	78	79	80	81	82	83	Average	Percentage	%Cum
0	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
5	33.33	0.2	8.7	0.1	0.1	0.2	4.6	0.1	6.1	1.63	41.82	41.82
5	66.67	0.2	7.5	0.1	0.1	0.2	1.1	0.1	4.8	1.32	33.79	75.60
5	100	0.2	2.9	0.1	0.1	0.2	0.2	0.1	1.4	0.95	24.40	100.00
										3.90		

Table 1(c) : Analysis using HTDM for 3rd Quartile of 60 minutes rainfall events of JKR Gambang

3rd Quartile		Depth																								
minutes	%cum	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
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	0
5	33.33	1	2.8	0.2	0.1	4.6	0.1	0.5	0.4	0.1	0.1	0.1	0.2	0.2	3.7	0.2	0.2	0.1	0.2	0.3	2.6	0.1	0.3	1.4	0.4	2
5	66.67	0.7	2.3	0.8	0.1	2.7	0.1	0.9	0.3	0.8	0.1	0.1	0.4	0.1	3.3	0.2	0.2	0.1	0.2	0.3	2.8	0.1	0.2	0.7	0.4	1.9
5	100	0.3	0.8	0.4	0.1	1.7	0.1	1.4	0.2	3.5	0.1	0.1	0.3	0.1	2	0.5	0.3	0.1	0.2	0.3	3.1	0.1	0.1	0.7	0.3	1.2

3rd Quartile	%cum	Depth																								
minutes		26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
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	0
5	33.33	0.6	5.9	0.1	0.4	0.1	0.1	1.4	0.1	1.7	1.6	0.1	0.1	1.1	1.2	0.1	0.1	0.1	4.8	0.1	0.5	0.1	0.1	0.2	0.6	0.4
5	66.67	0.1	3.1	0.1	1.1	0.1	0.1	0.3	0.1	0.2	0.9	0.1	0.1	0.9	2.4	0.1	0.1	0.1	4.1	0.1	0.8	0.1	0.1	0.1	0.1	0.2
5	100	0.1	1.2	0.1	0.4	0.1	0.1	0.2	0.1	0.3	0.8	0.1	0.1	0.3	1.3	0.1	0.1	0.1	3.2	0.1	0.5	0.1	0.1	0.1	0.1	0.1

3rd Quartile		Depth																								
minutes	%cum	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
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	0
5	33.33	0.5	0.2	0.1	3	0.3	0.1	0.1	0.6	0.1	2.2	0.1	0.5	2.9	0.1	1.4	0.8	0.9	0.3	0.2	0.7	3.6	0.1	0.3	0.1	0.1
5	66.67	0.1	0.1	0.1	2.3	0.3	0.1	0.8	0.2	0.1	1	0.1	0.4	4.5	0.1	0.6	0.5	0.5	0.2	0.2	0.5	0.9	0.1	0.4	0.2	0.1
5	100	0.1	0.1	0.1	1.4	0.2	0.1	4.1	0.2	0.2	0.6	0.1	0.2	1.5	0.1	0.3	0.2	0.4	0.1	0.3	1.2	1.9	0.1	0.3	0.2	7.5

3rd Quartile		Depth										
minutes	%cum	76	77	78	79	80	81	82	83	Average	Percentage	%Cum
0	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
5	33.33	1.7	2.1	0.1	0.1	0.2	0.2	2.8	0.4	0.85	38.87	38.87
5	66.67	0.8	0.8	0.7	0.1	0.1	0.6	4	0.2	0.69	31.47	70.35
5	100	1.3	0.6	1.3	0.1	0.1	0.2	0.7	0.1	0.65	29.65	100.00
										2.18		

Table 1(d) : Analysis using HTDM for 4th Quartile of 60 minutes rainfall events of JKR Gambang

4th Quartile		Depth																								
minutes	%cum	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
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	0
5	33.33	0.1	0.7	0.3	0.1	1.9	1.3	1.7	0.1	2	0.1	0.1	0.2	0.1	1	0.2	0.3	0.1	1.1	0.4	2.5	0.1	0.1	0.5	0.5	0.7
5	66.67	0.1	0.7	0.3	0.1	1	4.7	1	0.1	0.4	0.1	0.1	0.2	0.1	1.8	0.2	0.3	0.1	0.8	0.4	1.8	0.1	0.1	1.1	0.6	0.4
5	100	0.1	0.1	0.2	0.1	0.4	0.5	0.4	0.1	0.2	0.1	0.1	0.2	0.1	0.4	0.1	0.1	0.1	0.1	0.2	0.5	0.1	0.1	0.5	0.1	0.1

4th Quartile	%cum	Depth																								
minutes		26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
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	0
5	33.33	0.1	1	0.1	0.2	0.1	0.1	0.2	0.1	0.5	0.4	0.1	0.1	0.1	0.6	0.1	0.1	0.1	0.8	0.1	0.2	0.1	0.1	0.1	0.1	0.1
5	66.67	0.1	0.5	0.1	0.2	0.1	0.9	0.2	0.1	0.2	0.3	0.3	0.1	0.1	0.2	0.1	0.1	0.1	0.7	0.1	0.2	0.1	0.1	0.1	0.1	0.1
5	100	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.7	0.1	0.1	0.2	0.1	0.1	0.1	0.3	0.1	0.1	0.1	0.1	0.1	0.1	0.1

4th Quartile		Depth																								
minutes	%cum	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
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	0
5	33.33	0.1	0.1	0.1	0.8	0.2	0.1	4.9	0.2	0.5	0.3	0.2	0.2	1.9	0.1	0.4	0.1	0.1	0.1	1.6	0.7	1.2	0.1	0.1	0.2	3.6
5	66.67	0.1	0.1	0.1	0.4	0.2	0.1	3	0.2	0.2	0.3	0.3	0.2	1	0.1	0.4	0.1	0.1	0.1	5.8	0.4	1.2	0.1	0.1	0.3	0.3
5	100	0.1	0.1	0.1	0.2	0.2	0.1	0.8	0.1	0.2	0.1	0.1	0.1	0.2	0.1	0.3	0.1	0.1	0.1	1.9	0.3	0.4	0.1	0.1	0.1	0.1

4th Quartile		Depth										
minutes	%cum	76	77	78	79	80	81	82	83	Average	Percentage	%Cum
0	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
5	33.33	1.8	0.2	1.4	0.1	0.1	0.2	0.3	0.1	0.53	44.25	44.25
5	66.67	0.5	0.2	0.4	0.1	0.1	0.3	0.5	0.1	0.47	39.52	83.77
5	100	0.4	0.1	0.2	0.1	0.1	0.3	0.2	0.1	0.19	16.23	100.00
										1.20		

Table 2(a) : Analysis using HTDM for 1st Quartile of 120 minutes rainfall events of JKR Gambang

1st Quartile		Depth																								
minutes	%cum	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
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	0
5	16.67	3.9	1	0.1	0.1	1.4	1.7	0.4	0.1	1.9	0.2	0.2	0.2	3.6	2.4	0.1	0.1	1.7	0.1	3.3	0.6	0.2	0.1	0.5	3.3	0.2
5	33.33	5.5	2.4	0.1	0.1	5.8	2.4	4.8	0.1	7.9	0.4	0.2	0.6	9.1	1.8	0.4	0.1	3.4	0.1	5.3	4.9	0.4	0.1	1.5	0.4	0.4
5	50	4.4	2.4	0.1	0.1	1.2	3.4	3.2	0.1	6.2	0.4	0.2	2	12.4	0.4	0.5	0.1	5.4	0.1	2.8	2.1	0.1	0.1	0.1	0.2	0.6
5	66.67	0.7	2	0.1	0.1	2.3	3.6	2.3	0.1	5.9	0.2	0.1	3.7	11.8	0.3	1.5	0.1	6	0.1	0.7	1.5	0.1	0.1	0.1	0.2	0.4
5	83.33	0.2	0.8	0.1	0.1	2.7	3.5	2.6	0.1	4.5	0.2	0.1	3.9	6.2	0.3	4.5	0.1	3.9	0.1	0.3	1	0.1	0.1	0.1	0.4	0.5
5	100	0.1	0.3	0.1	0.3	3.4	1.9	2.7	0.1	3.7	0.2	0.1	4.3	2.7	0.3	3.1	0.1	2.4	0.1	0.2	0.4	0.2	0.1	0.1	0.1	1.3

1st Quartile		Depth			
minutes	%cum	26	ave	%	%cum
0	0	0	0	0	0
5	16.67	1.3	1.10	10.13	10.13
5	33.33	10.2	2.63	24.14	34.27
5	50	12.8	2.36	21.67	55.95
5	66.67	11.5	2.13	19.59	75.54
5	83.33	3.8	1.55	14.19	89.73
5	100	0.8	1.12	10.27	100.00
			10.90		

Table 2(b) : Analysis using HTDM for 2nd Quartile of 120 minutes rainfall events of JKR Gambang

2nd Quartile		Depth																								
minutes	%cum	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
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	0
5	16.67	0.1	0.1	0.1	0.7	3.8	0.8	2	0.4	1.1	0.2	0.1	4.2	1.2	0.1	0.8	0.1	1.1	0.1	0.1	0.1	0.2	1.3	1	0.1	1.4
5	33.33	0.1	0.1	0.1	0.4	3	0.5	1.6	0.7	0.4	0.2	0.1	1.4	2	0.1	0.3	0.1	0.7	0.1	0.1	0.1	0.6	0.5	3	0.1	1.1
5	50	0.1	0.1	0.1	0.3	0.8	0.3	0.8	2	1.5	0.1	0.1	1.3	0.9	0.1	0.1	0.2	0.3	0.1	0.1	0.1	0.3	0.5	1.5	0.1	0.3
5	66.67	0.1	0.1	0.1	0.3	0.1	0.2	0.5	1.6	0.6	0.1	0.2	1.5	1.3	0.1	0.1	0.2	0.2	0.1	0.2	0.6	0.2	1.2	0.7	0.1	0.4
5	83.33	0.1	0.1	0.1	0.6	0.1	0.2	0.5	0.5	0.3	0.1	0.3	1.7	0.6	0.1	0.1	0.2	0.1	0.1	0.2	0.1	0.1	2.1	0.6	0.1	0.6
5	100	0.3	0.1	0.1	1.6	0.1	0.1	0.6	0.3	0.5	0.1	0.2	1.8	0.3	0.2	0.4	0.2	0.1	0.2	0.2	0.1	0.1	3.6	2.8	0.1	0.7

2nd Quartile		Depth			
minutes	%cum	26	ave	%	%cum
0	0	0	0.00	0.00	0.00
5	16.67	0.2	0.82	23.75	23.75
5	33.33	0.2	0.68	19.53	43.29
5	50	0.2	0.47	13.65	56.94
5	66.67	1.4	0.47	13.54	70.48
5	83.33	0.9	0.40	11.65	82.13
5	100	1.3	0.62	17.87	100.00
			3.47		

Table 2(c) : Analysis using HTDM for 3rd Quartile of 120 minutes rainfall events of JKR Gambang

3rd Quartile		Depth																								
minutes	%cum	1				5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
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	0
5	16.67	0.3	0.1	0.1	1.1	0.1	0.1	0.6	0.4	0.4	0.1	0.1	1	0.2	0.2	1.3	0.2	0.1	0.2	0.1	0.1	0.2	1.4	4.4	0.1	0.3
5	33.33	1.3	0.1	0.1	1.3	0.1	0.1	0.3	0.3	0.6	0.1	0.1	1.2	0.1	0.1	1	0.2	0.1	0.2	0.1	0.1	1.4	0.9	0.8	0.1	0.2
5	50	4.3	0.1	0.1	1.9	0.1	0.1	0.2	0.2	1.1	0.1	0.1	1.3	0.1	0.1	1.4	0.2	0.2	0.2	0.3	0.1	2.8	0.6	0.5	0.1	0.1
5	66.67	5.5	0.1	0.1	0.7	0.1	0.1	0.1	0.2	0.8	0.1	0.1	0.5	0.1	0.1	0.4	0.3	0.2	0.2	0.4	0.1	1.3	0.1	0.4	0.1	0.1
5	83.33	3.8	0.2	0.1	0.3	0.1	0.1	0.1	0.1	0.5	0.1	0.1	0.2	0.1	0.1	1	0.2	0.2	0.2	0.1	0.1	0.9	0.1	0.2	0.1	0.1
5	100	3.3	0.2	0.1	0.3	0.1	0.1	0.1	0.1	0.4	0.1	0.1	0.4	0.1	0.1	0.6	0.1	0.1	0.2	0.1	0.3	0.7	0.1	0.2	0.1	1.2

3rd Quartile		Depth			
minutes	%cum	26	ave	%	%cum
0	0	0	0.00	0.00	0.00
5	16.67	1.1	0.55	17.63	17.63
5	33.33	4	0.57	18.37	36.00
5	50	1.6	0.69	22.07	58.08
5	66.67	0.7	0.50	15.91	73.98
5	83.33	1.8	0.42	13.44	87.42
5	100	1	0.39	12.58	100.00
			3.12		

Table 2(d) : Analysis using HTDM for 4th Quartile of 120 minutes rainfall events of JKR Gambang

4th Quartile		Depth																								
minutes	%cum	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
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	0
5	16.67	6.4	0.2	1.2	0.3	0.1	0.1	0.1	0.1	0.2	0.1	0.1	1.2	0.1	0.1	0.8	0.1	0.1	0.2	0.1	0.7	0.7	0.1	0.2	0.1	0.3
5	33.33	9	0.2	1.3	0.2	0.1	0.1	0.1	0.1	0.3	0.1	0.1	3.2	0.1	0.1	0.7	0.1	0.1	0.3	0.1	0.1	0.6	0.1	0.2	0.1	0.8
5	50	4.4	0.2	0.5	0.4	0.1	0.1	0.1	0.1	0.5	0.1	0.1	1.8	0.1	0.1	2.3	0.1	0.1	0.3	0.1	0.1	0.5	0.1	0.8	0.1	0.6
5	66.67	0.8	0.1	0.2	0.6	0.1	0.1	0.1	0.1	0.4	0.1	0.1	1.2	0.1	0.1	0.7	0.1	0.2	0.2	0.1	0.1	0.2	0.1	3.2	0.1	0.8
5	83.33	0.8	0.1	0.2	0.5	0.1	0.1	0.1	0.1	0.4	0.1	0.1	0.4	0.1	0.1	0.4	0.1	0.3	0.2	1	0.1	0.2	0.1	1.8	0.2	0.2
5	100	0.2	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.3	0.1	0.1	0.2	0.5	0.1	0.2	0.1	0.4	0.2	0.2

4th Quartile		Depth			
minutes	%cum	26	ave	%	%cum
0	0	0	0.00	0.00	0.00
5	16.67	0.3	0.54	20.41	20.41
5	33.33	0.1	0.70	26.68	47.08
5	50	0.1	0.53	20.12	67.20
5	66.67	0.1	0.38	14.58	81.78
5	83.33	0.1	0.30	11.52	93.29
5	100	0.6	0.18	6.71	100.00
			2.64		

Table 3(a) : Analysis using HTDM for 1st Quartile of 180 minutes rainfall events of JKR Gambang

1st Quartile		depth										
minutes	%cum	1	2	3	4	5	6	7	8	ave	%	%cum
0	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
5	11.11	1.6	0.1	5.1	0.2	0.3	0.2	0.2	0.1	0.98	15.98	15.98
5	22.22	0.2	0.1	2.6	0.2	0.4	0.2	0.2	0.3	0.53	8.61	24.59
5	33.33	0.8	0.1	0.9	1.1	0.8	0.2	0.1	0.3	0.54	8.81	33.40
5	44.44	2.6	0.1	0.9	0.1	0.6	0.1	0.1	0.4	0.61	10.04	43.44
5	55.56	3.7	0.1	0.2	0.1	0.4	0.1	0.1	0.5	0.65	10.66	54.10
5	66.67	3	0.1	0.2	0.1	0.2	0.1	0.1	0.5	0.54	8.81	62.91
5	77.78	1.8	0.1	0.2	0.1	0.2	0.2	0.1	0.4	0.39	6.35	69.26
5	88.89	2.8	0.1	0.2	1.1	0.3	0.5	1.2	0.2	0.80	13.11	82.38
5	100	2.8	0.1	0.2	3.3	0.3	0.7	1	0.2	1.08	17.62	100.00
										6.10		

Table 3(b) : Analysis using HTDM for 2nd Quartile of 180 minutes rainfall events of JKR Gambang

2nd Quartile		depth										
minutes/	%cum	1	2	3	4	5	6	7	8	ave	%	%cum
0	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
5	11.11	1.9	0.1	1.7	1.8	0.6	0.8	0.1	0.3	0.91	13.32	13.32
5	22.22	1.2	0.2	3.9	1.5	0.4	0.8	0.1	0.3	1.05	15.33	28.65
5	33.33	1.6	0.2	2.7	0.6	0.2	0.6	0.1	0.2	0.78	11.31	39.96
5	44.44	2.6	0.2	3.1	0.3	0.2	0.5	0.1	0.2	0.90	13.14	53.10
5	55.56	1.6	0.2	2.3	0.2	0.6	1	0.1	0.2	0.78	11.31	64.42
5	66.67	1.4	0.3	1	0.2	0.6	1.5	0.1	0.2	0.66	9.67	74.09
5	77.78	1	0.3	1.5	0.2	0.4	1.1	0.1	0.2	0.60	8.76	82.85
5	88.89	1.7	0.3	2.5	0.2	0.1	0.8	0.1	0.2	0.74	10.77	93.61
5	100	0.9	0.4	1.3	0.2	0.1	0.3	0.1	0.2	0.44	6.39	100.00
										6.85		

Table 3(c) : Analysis using HTDM for 3rd Quartile of 180 minutes rainfall events of JKR Gambang

3rd Quartile		depth										
minutes	%cum	1	2	3	4	5	6	7	8	ave	%	%cum
0	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
5	11.11	0.1	0.4	0.2	0.1	0.1	0.3	0.1	0.2	0.19	7.28	7.28
5	22.22	0.1	0.5	0.2	0.1	0.1	0.3	0.1	0.2	0.20	7.77	15.05
5	33.33	0.1	0.4	0.6	0.1	0.1	0.3	0.1	0.2	0.24	9.22	24.27
5	44.44	0.1	0.3	0.4	0.1	0.2	0.3	0.1	0.2	0.21	8.25	32.52
5	55.56	0.1	0.3	0.2	0.1	0.4	0.4	0.6	0.2	0.29	11.17	43.69
5	66.67	0.1	0.4	0.2	0.1	0.7	0.5	0.2	0.2	0.30	11.65	55.34
5	77.78	0.2	0.4	0.2	0.1	0.7	0.5	1.2	0.2	0.44	16.99	72.33
5	88.89	0.2	0.3	0.1	0.1	0.1	0.5	2.2	0.2	0.46	17.96	90.29
5	100	0.3	0.4	0.1	0.1	0.1	0.5	0.3	0.2	0.25	9.71	100.00
										2.58		

Table 3(d) : Analysis using HTDM for 4th Quartile of 180 minutes rainfall events of JKR Gambang

4th Quartile		depth										
minutes	%cum	1				5	6	7	8	ave	%	%cum
0	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
5	11.11	0.3	0.3	0.1	0.1	0.1	0.4	0.1	0.2	0.20	12.21	12.21
5	22.22	0.1	0.3	0.1	0.1	0.1	0.4	0.1	0.1	0.16	9.92	22.14
5	33.33	0.1	0.3	0.1	0.1	0.1	0.4	0.1	0.1	0.16	9.92	32.06
5	44.44	0.1	0.3	0.1	0.3	0.1	0.3	0.1	0.1	0.18	10.69	42.75
5	55.56	0.1	0.3	0.1	0.3	0.1	0.3	0.1	0.1	0.18	10.69	53.44
5	66.67	0.1	0.2	0.1	0.3	0.1	0.2	0.1	0.1	0.15	9.16	62.60
5	77.78	0.1	0.1	0.1	0.2	0.2	0.2	0.4	0.1	0.18	10.69	73.28
5	88.89	0.2	0.3	0.1	0.2	0.2	0.2	1.1	0.1	0.30	18.32	91.60
5	100	0.2	0.1	0.1	0.2	0.1	0.1	0.2	0.1	0.14	8.40	100.00
										1.64		

Table 4(a) : Analysis using HTDM for 1st Quartile of 60 minutes rainfall events of Paya Besar Station

1st Quartile	%cum	depth																								
minutes		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
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	0
5	33.33	0.7	0.2	0.1	0.1	0.2	0.1	0.1	0.2	1	6	0.1	3	0.3	0.1	0.4	0.1	0.5	0.3	0.1	0.2	0.2	0.2	0.1	0.1	0.5
5	66.67	0.4	0.8	0.3	0.1	0.2	0.1	0.1	0.7	0.4	7.9	0.1	2.5	1.1	0.2	0.8	0.5	0.1	2	0.1	5.3	0.3	0.4	0.1	0.1	0.3
5	100	0.1	0.1	0.4	0.1	2.3	0.1	0.1	2.4	1	10.2	0.1	0.8	1.7	0.2	0.8	0.4	0.1	0.5	0.1	8.2	0.2	1.4	0.1	0.1	0.2

1st Quartile		Depth																					
minutes	%cum	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	ave	%	%cum
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	33.33	0.2	0.3	0.1	0.1	1	0.7	0.1	0.1	0.2	0.1	0.6	0.5	0.4	0.2	0.7	0.1	0.1	0.1	0.1	0.47	18.92	18.92
5	66.67	0.2	1.2	0.5	0.1	2.1	0.9	0.1	0.1	0.2	0.1	7.1	0.1	0.3	0.6	1.5	0.2	0.3	0.1	0.1	0.93	37.37	56.29
5	100	0.3	2.9	0.2	0.1	2	0.4	0.1	0.1	0.1	0.1	5	0.1	0.1	2.6	0.7	0.2	0.7	0.1	0.1	1.08	43.71	100
																					2.48		

Table 4(b) : Analysis using HTDM for 2nd Quartile of 60 minutes rainfall events of Paya Besar Station

2nd Quartile		Depth																								
minutes		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
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	0
5	33.33	0.1	0.1	0.5	0.1	5.6	0.1	0.1	0.3	0.6	3.5	0.1	1.3	1.2	0.3	0.5	1.4	0.1	0.4	0.1	5.1	0.2	0.8	0.1	0.1	0.8
5	66.67	0.1	0.1	0.5	0.1	3.1	0.1	0.1	0.1	2.2	2.1	0.1	0.9	0.6	0.3	0.1	1.5	0.1	0.6	0.1	4.1	0.1	1	0.1	0.1	1.2
5	100	0.2	0.1	0.4	0.2	2.7	0.1	0.1	0.1	1.2	1.5	0.1	0.8	1.4	0.1	0.1	1	0.5	4.1	0.1	3.7	0.1	1.1	0.1	0.1	0.8

2nd Quartile		Depth																					
minutes	%cum	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	ave	%	%cum
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	33.33	0.6	1.7	0.2	0.1	0.8	0.1	0.1	0.2	0.1	0.1	7.3	0.1	0.1	4.3	0.5	0.2	0.5	0.1	0.1	0.93	34.76	34.76
5	66.67	1.1	2.4	1.9	0.1	1.1	0.1	0.1	0.2	0.1	0.1	6	0.1	0.1	1.8	0.5	0.4	0.4	0.1	0.1	0.82	30.83	65.58
5	100	1.3	4.1	0.8	0.1	1.6	0.1	0.1	0.2	0.1	0.1	7.8	0.1	0.1	1.3	0.6	0.6	0.4	0.1	0.1	0.92	34.42	100
																					2.66		

Table 4(c) : Analysis using HTDM for 3rd Quartile of 60 minutes rainfall events of Paya Besar Station

3rd Quartile	%cum	Depth																								
minutes		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
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	0
5	33.33	0.7	0.1	0.4	0.2	3.9	0.1	0.1	0.1	0.5	5.3	0.1	0.7	2	0.1	0.1	2.5	1.1	2.2	0.1	4.4	0.1	0.2	0.1	0.2	2.4
5	66.67	0.6	0.1	0.2	0.2	2.8	0.1	0.1	0.1	0.5	4	0.1	0.3	1.7	0.1	0.1	1.8	0.1	1	0.1	1.4	0.1	0.1	0.1	0.2	1.7
5	100	0.4	0.1	0.2	0.1	1.2	0.1	0.1	0.1	0.6	0.8	0.1	0.2	1.5	0.1	0.1	1.5	0.1	0.5	0.1	1	0.1	0.1	0.1	0.2	0.2

3rd Quartile		Depth																					
minutes	%cum	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	ave	%	%cum
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	33.33	0.8	7.1	0.3	0.1	1.8	0.1	0.1	0.2	0.1	0.1	6.1	0.1	0.1	2.4	0.3	0.8	0.3	0.1	0.1	1.11	50.26	50.26
5	66.67	1.5	0.6	0.1	0.1	1.5	0.1	0.1	0.3	0.1	0.1	4.3	0.1	0.1	1	0.2	1.3	0.3	0.1	0.1	0.67	30.55	80.80
5	100	1.6	0.2	0.1	0.1	1.3	0.1	0.1	0.2	0.1	0.1	2.5	0.5	0.1	0.8	0.1	0.6	0.3	0.1	0.1	0.42	19.20	100.00
																					2.20		

Table 4(d) : Analysis using HTDM for 4th Quartile of 60 minutes rainfall events of Paya Besar Station

4th Quartile		Depth																								
minutes	%cum	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
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	0
5	33.33	0.5	0.1	0.2	0.1	0.2	0.1	1.6	0.1	1.1	0.5	0.1	0.2	2.7	0.2	0.1	0.5	0.1	0.2	0.1	0.2	0.1	0.1	0.8	0.3	0.1
5	66.67	0.6	1.1	0.2	0.1	0.2	0.1	1.2	0.1	2.2	0.3	0.1	0.2	1.9	0.2	0.1	0.3	0.1	0.2	0.1	0.2	0.1	0.1	1.8	0.4	0.1
5	100	0.1	2.4	0.2	0.1	0.2	0.1	0.2	0.1	0.9	0.1	0.1	0.1	0.4	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	3.4	0.3	0.1

4th Quartile	%cum	Depth																			ave	%	%cum
minutes		26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44			
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
5	33.33	1.3	0.4	0.1	0.1	1.4	0.1	0.1	0.1	0.9	0.1	0.9	1.6	0.1	0.2	0.1	0.4	0.3	0.1	0.1	0.43	37.78	37.78
5	66.67	0.4	0.5	0.1	0.1	1.4	0.1	0.1	0.1	1	0.1	0.7	0.4	0.1	0.2	0.1	0.3	0.2	0.1	0.1	0.41	36.57	74.34
5	100	0.1	0.3	0.1	0.1	0.7	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.29	25.66	100.00
																					1.13		

Table 5(a) : Analysis using HTDM for 1st Quartile of 120 minutes rainfall events of Paya Besar Station

1 st Quartile		Depth																			
minute	%cum	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	ave	%	%cum
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	16.67	0.1	0.7	0.1	0.3	1.1	1	0.1	0.2	0.1	0.1	0.1	0.5	0.1	2	0.1	1.6	0.1	0.49	8.49	8.49
5	33.33	0.3	0.4	0.2	1.1	2.5	0.3	0.1	0.2	0.1	0.2	0.1	1.5	0.1	4.3	0.1	3	0.3	0.87	15.13	23.62
5	50	0.2	0.2	0.2	1.8	1	0.6	0.1	0.2	0.1	0.2	0.1	1.1	0.1	11.5	0.1	2.5	0.3	1.19	20.76	44.38
5	66.67	0.2	0.2	0.3	1.2	0.9	2.4	0.1	0.2	0.1	0.2	0.1	1.8	0.1	11.8	0.1	4.1	0.4	1.42	24.74	69.12
5	83.33	0.2	0.4	0.3	0.9	0.8	0.7	0.1	0.2	0.1	0.2	0.1	1.3	0.1	8.4	0.1	4.9	0.2	1.12	19.43	88.55
5	100	0.1	0.6	0.2	0.6	0.6	1	0.1	0.2	0.1	0.1	0.1	1.2	0.1	2.6	0.1	3.3	0.2	0.66	11.45	100.00
																			5.75		

Table 5(b) : Analysis using HTDM for 2nd Quartile of 120 minutes rainfall events of Paya Besar Station

2nd Quartile	minutes	%cum	Depth																	ave	%	%cum
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17			
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
	5	16.67	0.1	0.4	0.2	0.4	0.4	0.9	0.1	0.2	0.1	0.1	0.1	2.4	0.1	3	0.1	2.6	0.2	0.67	15.32	15.32
	5	33.33	0.1	0.3	0.2	0.3	0.3	1.8	0.1	0.2	0.1	0.1	0.1	1.1	0.1	6.3	0.1	2.4	0.1	0.81	18.41	33.74
	5	50	0.1	0.3	0.2	0.3	0.2	2.2	0.1	0.3	0.8	0.1	0.1	4	0.1	3.6	0.1	1.2	0.1	0.81	18.55	52.28
	5	66.67	0.1	0.4	0.2	0.4	0.2	2.8	0.2	0.2	0.4	0.1	1.6	3.8	0.1	2.6	0.2	0.6	0.2	0.83	18.95	71.24
	5	83.33	0.1	0.4	0.1	0.4	0.2	3.2	0.4	0.1	0.3	0.1	0.8	3.4	0.1	1	0.2	0.3	0.4	0.68	15.46	86.69
	5	100	0.1	0.3	0.1	0.4	0.4	2.5	0.4	0.1	0.1	0.1	0.9	1.7	0.1	1.5	0.2	0.2	0.8	0.58	13.31	100.00
																				4.38		

Table 5 (c) : Analysis using HTDM for 3rd Quartile of 120 minutes rainfall events of Paya Besar Station

3rd Quartile	minutes	%cum	Depth																	ave	%	%cum
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17			
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
	5	16.67	0.1	0.2	0.1	0.3	0.8	2.3	0.4	0.1	0.1	0.1	0.7	0.4	0.2	2.3	0.2	0.2	1.1	0.56	25.40	25.40
	5	33.33	0.1	0.2	0.1	0.2	0.6	1.8	0.4	0.1	0.1	0.1	0.4	0.2	0.4	1.4	0.2	0.3	1	0.45	20.11	45.50
	5	50	0.1	0.2	0.1	0.2	0.3	2	0.5	0.1	0.1	0.1	0.4	0.2	0.1	0.7	0.2	0.3	0.3	0.35	15.61	61.11
	5	66.67	0.1	0.2	0.1	0.2	0.2	1	0.9	0.1	0.1	0.1	1.2	0.8	0.1	0.3	0.2	0.1	0.2	0.35	15.61	76.72
	5	83.33	0.1	0.2	0.1	0.1	0.2	0.6	0.6	0.1	0.1	0.1	1.8	0.7	0.1	0.2	0.2	0.1	0.2	0.32	14.55	91.27
	5	100	0.1	0.2	0.1	0.1	0.6	0.6	0.3	0.1	0.1	0.1	0.4	0.1	0.1	0.1	0.1	0.1	0.1	0.19	8.73	100.00
																				2.22		

Table 5(d) : Analysis using HTDM for 4th Quartile of 120 minutes rainfall events of Paya Besar Station

4th Quartile	minutes	%cum	Depth																	ave	%	%cum
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17			
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
	5	16.67	0.1	0.3	0.1	0.1	0.5	0.4	0.1	0.1	0.1	0.1	0.3	0.1	0.1	0.1	0.1	0.1	0.1	0.16	16.28	16.28
	5	33.33	0.1	0.4	0.1	0.1	0.6	0.3	0.1	0.1	0.1	0.1	0.2	0.1	0.2	0.1	0.1	0.1	0.1	0.17	16.86	33.14
	5	50	0.1	0.1	0.1	0.1	0.4	0.3	0.1	0.1	0.1	0.1	0.2	0.1	0.2	0.1	0.1	0.1	0.1	0.14	13.95	47.09
	5	66.67	0.1	0.1	0.1	0.1	0.2	0.2	0.1	0.1	0.2	0.1	0.2	0.1	0.5	0.1	0.1	0.1	0.1	0.15	14.53	61.63
	5	83.33	0.1	0.1	0.1	0.1	0.2	0.2	0.1	0.1	0.2	0.1	1.6	0.1	0.4	0.1	0.1	0.1	0.1	0.22	22.09	83.72
	5	100	0.6	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.5	0.1	0.2	0.1	0.1	0.1	0.1	0.16	16.28	100.00
																				1.01		

Table 6(a) : Analysis using HTDM for 1st Quartile of 180 minutes rainfall events of Paya Besar Station

1st Quartile	minutes	%cum	Depth											ave	%	%cum
			1	2	3	4	5	6	7	8	9	10	11			
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	5	11.11	0.3	0.3	0.1	0.4	0.3	0.1	0.5	0.2	0.1	0.4	0.1	2.80	3.97	3.97
	5	22.22	0.6	0.5	0.1	1.7	0.3	0.1	0.1	0.3	0.1	1.3	0.1	5.20	7.38	11.35
	5	33.33	0.8	1	0.1	6.5	0.2	0.1	0.1	0.8	0.1	0.3	0.1	10.10	14.33	25.67
	5	44.44	0.7	1	0.1	3.6	0.2	0.1	0.1	2.1	0.1	0.1	0.1	8.20	11.63	37.30
	5	55.55	0.4	1.9	0.1	1	0.2	0.1	0.1	1.4	0.1	0.1	0.1	5.50	7.80	45.11
	5	66.67	0.3	1.2	0.1	1.5	0.3	0.1	0.1	3.4	0.1	0.1	0.1	7.30	10.35	55.46
	5	77.78	0.3	1.4	0.1	1.9	0.3	0.5	0.1	1	0.1	0.3	0.1	6.10	8.65	64.11
	5	88.89	0.2	2.4	0.1	7.1	0.3	1.2	0.1	0.2	0.1	0.6	0.1	12.40	17.59	81.70
	5	100	0.2	2.2	0.1	6.8	0.2	1.3	0.1	0.2	0.1	1.6	0.1	12.90	18.30	100.00
														70.50		

Table 6(b) : Analysis using HTDM for 2nd Quartile of 180 minutes rainfall events of Paya Besar Station

2nd Quartile		Depth													
minutes	%cum	1	2	3	4	5	6	7	8	9	10	11	ave	%	%cum
0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
5	11.11	0.2	1.7	0.2	4.9	0.2	2.5	0.2	0.2	0.1	2	0.1	12.30	13.02	13.02
5	22.22	0.2	0.9	0.2	2.3	0.4	2.6	0.2	0.3	0.1	2.1	0.2	9.50	10.05	23.07
5	33.33	0.3	0.6	0.2	2	0.2	2.9	2.9	0.9	0.1	1.3	0.2	11.60	12.28	35.34
5	44.44	0.6	0.9	0.1	1.4	0.1	3	5.9	1.1	0.1	2.2	0.2	15.60	16.51	51.85
5	55.55	0.6	1.4	0.1	0.8	0.1	3.1	2.7	1.1	0.1	3.2	0.2	13.40	14.18	66.03
5	66.67	0.3	0.8	0.1	0.4	0.1	3.1	3.2	0.9	0.6	2.3	0.2	12.00	12.70	78.73
5	77.78	0.3	0.5	0.1	0.2	0.1	0.6	1.4	1.2	0.8	2.1	0.1	7.40	7.83	86.56
5	88.89	0.3	0.8	0.1	0.2	0.1	0.4	0.8	1.7	0.5	2.6	0.1	7.60	8.04	94.60
5	100	0.2	0.7	0.1	0.3	0.1	0.3	0.2	1.8	0.5	0.8	0.1	5.10	5.40	100.00
													94.50		

Table 6(c) : Analysis using HTDM for 3rd Quartile of 180 minutes rainfall events of Paya Besar Station

3rd Quartile		Depth													
minutes	%cum	1	2	3	4	5	6	7	8	9	10	11	ave	%	%cum
0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
5	11.11	0.2	1.6	0.1	0.6	0.1	0.2	0.1	2.5	2.4	0.2	0.1	8.10	8.41	8.41
5	22.22	0.4	0.9	0.1	0.4	0.1	0.2	0.1	3.4	4.9	0.2	0.1	10.80	11.21	19.63
5	33.33	0.5	0.6	0.1	0.4	0.1	0.1	0.1	2.2	2.7	0.2	0.1	7.10	7.37	27.00
5	44.44	0.3	0.3	0.1	0.2	0.1	0.1	0.5	2	1.6	0.2	0.1	5.50	5.71	32.71
5	55.55	0.3	0.1	0.1	0.2	0.1	0.1	4.3	4.2	4.9	0.3	0.1	14.70	15.26	47.98
5	66.67	0.2	0.1	0.1	0.1	0.2	0.1	1.5	2.4	3.7	0.5	0.1	9.00	9.35	57.32
5	77.78	0.1	0.1	0.1	0.1	0.3	0.3	7.1	2.8	2.3	3	0.1	16.30	16.93	74.25
5	88.89	0.1	0.1	0.1	0.1	0.3	0.4	8.4	0.9	1.1	3.3	0.1	14.90	15.47	89.72
5	100	0.1	0.1	0.1	0.1	0.3	0.3	6.5	0.6	0.3	1.4	0.1	9.90	10.28	100.00
													96.30		

Table 6(d) : Analysis using HTDM for 4th Quartile of 180 minutes rainfall events of Paya Besar Station

4th Quartile	%cum	Depth											ave	%	%cum
minutes		1	2	3	4	5	6	7	8	9	10	11			
0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
5	11.11	0.1	0.1	0.1	0.1	0.2	0.1	5.6	0.2	0.1	2.4	0.1	9.10	21.41	21.41
5	22.22	0.1	0.1	0.1	0.1	0.1	0.1	5.1	0.2	0.1	2.6	0.1	8.70	20.47	41.88
5	33.33	0.1	0.2	0.1	0.1	0.1	0.1	1.7	0.2	0.1	2.5	0.1	5.30	12.47	54.35
5	44.44	0.1	0.2	0.1	0.1	0.1	0.1	1.8	0.2	0.1	1	0.1	3.90	9.18	63.53
5	55.55	0.1	0.3	0.1	0.1	0.1	0.1	0.1	0.2	0.1	1.3	0.1	2.60	6.12	69.65
5	66.67	0.1	0.4	0.2	0.1	0.1	0.1	0.1	0.4	0.1	1.7	0.1	3.40	8.00	77.65
5	77.78	0.1	0.6	0.2	0.1	0.1	0.1	0.1	0.4	0.1	1.5	0.1	3.40	8.00	85.65
5	88.89	0.1	0.3	0.4	0.1	0.1	0.3	0.2	0.3	0.1	1.9	0.1	3.90	9.18	94.82
5	100	0.1	0.1	0.2	0.1	0.1	0.7	0.3	0.1	0.1	0.3	0.1	2.20	5.18	100.00
													42.50		

Table 7(a) : Analysis using HTDM for 1st Quartile of 60 minutes rainfall events of Kg. Sg. Soi Station

1st Quartile	%cum	Depth																								
Minutes		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
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	0
5	33.33	1.1	0.1	3.6	0.1	0.7	0.4	0.1	0.2	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.2	1.6	2	0.8	0.5	0.4	0.1	0.4
5	66.67	0.6	0.1	1.7	0.4	0.8	6.3	0.1	0.2	0.1	0.1	0.1	0.1	0.6	3.1	0.1	0.1	0.3	0.7	4.7	3	2.5	0.2	2.9	0.1	0.3
5	100	0.3	0.1	0.5	1.8	2.2	6	0.1	0.2	0.1	0.1	0.1	0.1	1.8	2.6	0.1	0.1	0.2	1.4	1.1	2.2	1.3	0.1	0.3	0.1	0.3

1st Quartile		Depth																								
Minutes	%cum	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
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	0
5	33.33	0.1	0.3	0.1	0.1	0.1	0.2	0.3	0.2	0.4	0.8	0.5	1.5	6.5	0.1	0.1	0.1	0.1	1.6	0.1	0.1	0.1	1.7	0.1	0.5	1.6
5	66.67	0.1	0.4	0.2	0.1	0.1	2.4	0.7	0.3	0.3	0.6	0.6	0.6	5.5	0.2	0.1	0.6	0.1	0.8	0.1	0.1	0.2	1.7	0.1	0.3	1.5
5	100	0.1	0.4	0.2	0.1	0.1	3.3	0.1	0.2	0.3	3.6	0.7	0.2	3.7	0.2	0.1	0.4	0.1	0.2	0.1	0.1	0.2	0.5	0.1	0.2	0.1

1st Quartile		Depth						
Minutes	%cum	51	52	53	54	Average	Percentage	%Cum
0	0	0	0	0	0	0	0	0
5	33.33	0.1	0.6	0.2	0.1	0.585185	26.59933	26.59933
5	66.67	0.1	0.2	0.5	0.1	0.885185	40.23569	66.83502
5	100	0.1	0.2	0.5	0.1	0.72963	33.16498	100
						2.2		

Table 7(b) : Analysis using HTDM for 2nd Quartile of 60 minutes rainfall events of Kg. Sg. Soi Station

2nd Quartile	%cum	Depth																									
Minutes		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	
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	0	0
5	33.33	0.2	0.1	0.3	2.2	1.4	5.9	0.1	0.2	0.1	0.1	0.1	0.1	0.7	0.8	0.1	0.1	0.1	3.2	0.5	0.4	3.7	0.1	0.1	0.1	0.6	
5	66.67	0.2	0.1	0.2	1.1	1.2	4.8	0.1	0.2	0.2	0.1	0.1	0.1	0.7	0.1	0.1	0.1	0.1	0.4	2.5	0.1	1.7	0.2	0.1	0.1	1.5	
5	100	0.2	0.1	0.3	0.2	0.5	4.5	0.1	0.2	0.2	0.1	0.1	0.1	0.5	0.1	0.1	0.1	0.1	3.1	1.7	0.1	2.5	1.3	0.1	0.1	0.5	

2nd Quartile	%cum	Depth																								
Minutes		26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
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	0
5	33.33	0.2	0.4	0.2	0.2	0.1	3.7	0.1	0.3	0.4	0.4	0.7	0.2	3.8	0.2	0.1	0.2	0.1	0.2	0.1	0.1	0.2	0.2	0.1	0.1	0.1
5	66.67	0.3	0.2	0.2	0.3	0.1	0.4	0.1	0.5	0.3	0.1	0.5	0.1	2.3	0.3	0.1	0.2	0.9	0.2	0.1	0.1	0.3	0.1	0.1	0.1	0.1
5	100	0.5	0.2	0.1	0.1	0.1	0.4	0.1	0.4	0.2	0.1	0.5	0.1	0.9	0.3	0.2	0.1	1.6	1	0.1	0.3	0.2	0.1	0.1	0.1	0.1

2nd Quartile	%cum	Depth				Average	Percentage	%Cum
Minutes		51	52	53	54			
0	0	0	0	0	0	0	0	0
5	33.33	0.1	0.1	0.3	0.1	0.635185	40.73634	40.73634
5	66.67	0.1	0.1	0.1	0.1	0.453704	29.09739	69.83373
5	100	0.3	0.1	0.1	0.1	0.47037	30.16627	100
						1.559259		

Table 7(c) : Analysis using HTDM for 3rd Quartile of 60 minutes rainfall events of Kg. Sg. Soi Station

3rd Quartile	%cum	Depth																								
Minutes		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
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	0
5	33.33	0.3	0.1	0.3	0.2	0.5	3.9	0.1	0.1	0.2	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1	2.9	1.8	0.1	1.4	1	0.1	0.1	0.4
5	66.67	0.3	0.1	0.2	0.3	0.4	2.8	0.1	0.1	0.2	0.1	0.1	3.2	0.2	0.1	0.1	0.1	0.1	3.4	1.6	0.1	0.3	1	0.1	0.1	0.5
5	100	0.2	0.1	0.2	0.4	0.2	1.3	0.1	0.1	0.2	0.1	0.1	2.2	0.2	0.1	0.1	0.1	0.1	3.1	1.3	0.1	0.1	0.7	0.5	1.5	0.1

3rd Quartile	%cum	Depth																								
Minutes		26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
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	0
5	33.33	0.6	0.1	0.1	0.1	0.1	0.3	0.1	0.4	0.2	0.1	0.1	0.1	0.4	0.3	0.2	0.1	0.2	2.1	0.1	0.3	0.2	0.2	0.1	0.1	0.1
5	66.67	0.5	0.1	0.1	0.1	0.2	0.1	0.1	0.4	0.1	0.1	0.1	0.1	0.1	0.3	0.2	0.1	0.2	1.2	0.1	0.3	0.2	0.2	0.1	0.1	0.1
5	100	0.2	0.1	0.1	0.1	0.2	0.1	0.1	0.3	0.1	0.1	0.1	0.1	0.1	0.2	0.3	0.1	0.2	0.9	0.1	0.2	0.1	0.2	0.1	0.1	0.2

3rd Quartile	%cum	Depth				Average	Percentage	%Cum
Minutes		51	52	53	54			
0	0	0	0	0	0	0	0	0
5	33.33	0.3	0.1	0.1	0.1	0.401852	35.63218	35.63218
5	66.67	0.1	0.1	0.1	0.1	0.392593	34.81117	70.44335
5	100	0.1	0.1	0.1	0.1	0.333333	29.55665	100
						1.127778		

Table 7(d) : Analysis using HTDM for 4th Quartile of 60 minutes rainfall events of Kg. Sg. Soi Station

4th Quartile	%cum	Depth																								
Minutes		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
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	0
5	33.33	0.2	0.1	0.2	0.4	0.4	0.8	0.1	0.1	0.2	0.1	0.1	1.8	0.2	0.1	0.1	0.1	0.2	1.8	1	0.1	0.1	0.2	0.9	5	0.1
5	66.67	0.3	0.1	0.9	1.8	0.7	0.3	0.9	0.1	0.2	0.1	0.1	1.1	0.2	0.1	0.1	0.1	0.2	3.1	1	0.1	0.1	0.2	0.7	3.6	0.1
5	100	0.2	0.1	1	0.2	0.1	0.2	0.5	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.2	1.7	0.3	0.1	0.5	0.1	0.4	0.5	0.1

4th Quartile	%cum	Depth																								
Minutes		26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
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	0
5	33.33	0.2	0.1	0.1	0.1	0.6	0.1	1.8	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.3	0.1	1.6	0.5	0.1	0.2	0.1	0.2	0.2	0.1	0.2
5	66.67	0.4	0.1	0.1	0.1	0.3	0.1	0.6	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.5	0.4	0.1	0.2	0.1	0.2	0.2	0.4	0.4
5	100	0.2	0.1	0.1	0.1	0.2	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.4	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.2

4th Quartile	%cum	Depth				Average	Percentage	%Cum
Minutes		51						
0	0	0	0	0	0	0	0	0
5	33.33	0.1	0.1	0.1	0.1	0.411111	40.29038	40.29038
5	66.67	0.1	0.1	0.1	0.1	0.405556	39.74592	80.0363
5	100	0.1	0.1	0.1	0.1	0.203704	19.9637	100
						1.02037		

Table 8(a) : Analysis using HTDM for 1st Quartile of 120 minutes rainfall events of Kg. Sg. Soi Station

1 st Quartile	%cum	Depth																	Ave	%	%Cum
Minutes		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17			
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	16.67	0.1	0.2	0.2	0.1	0.2	0.2	2.1	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.7	0.29	9.01	9.01
5	33.33	0.1	0.2	0.2	0.2	0.5	0.2	2.8	0.4	0.2	0.1	0.2	3.2	0.3	0.1	0.1	0.1	4.3	0.78	24.26	33.27
5	50	0.1	0.6	0.2	0.2	0.2	0.2	1.4	0.4	0.4	0.1	0.2	1.5	0.3	0.1	0.1	0.1	1.6	0.45	14.15	47.43
5	66.67	0.1	0.5	0.2	0.1	0.3	3.8	0.4	0.4	0.7	0.1	0.2	0.2	0.3	0.1	0.1	0.1	1.7	0.55	17.10	64.52
5	83.33	0.1	0.3	0.2	0.1	1.4	4.7	0.3	0.7	0.1	0.2	0.5	0.1	0.3	0.1	0.1	0.1	1.3	0.62	19.49	84.01
5	100	0.1	0.3	0.3	0.1	1	3.5	0.2	0.6	0.1	0.3	0.6	0.1	0.3	0.1	0.1	0.1	0.9	0.51	15.99	100
																			3.2		

Table 8(b) : Analysis using HTDM for 2nd Quartile of 120 minutes rainfall events of Kg. Sg. Soi Station

2 nd Quartile	Minutes	%cum	Depth																	Ave	%	%Cum
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17			
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
	5	16.67	0.1	0.3	0.3	0.1	0.1	2.2	0.2	0.5	0.1	0.2	0.7	0.1	0.2	0.1	0.1	0.1	0.7	0.36	15.44	15.44
	5	33.33	0.1	0.3	0.1	0.1	0.1	1.4	0.2	0.5	0.1	0.1	0.6	0.1	0.2	0.1	0.1	0.1	0.7	0.29	12.41	27.85
	5	50	0.1	0.4	0.1	0.1	0.1	1.4	0.2	0.5	0.1	0.1	0.3	0.2	0.2	0.1	0.1	0.1	0.2	0.25	10.89	38.73
	5	66.67	0.1	1	0.1	0.1	0.1	0.6	0.2	0.4	0.1	0.1	0.2	0.6	0.2	0.1	0.1	0.1	0.1	0.25	10.63	49.37
	5	83.33	0.1	1.8	0.1	0.1	0.1	0.3	0.2	0.4	0.1	0.3	0.3	6	0.2	0.1	0.1	0.1	0.1	0.61	26.33	75.70
	5	100	0.1	2	0.1	0.1	0.1	0.4	0.2	0.4	0.1	1.4	0.4	3.5	0.4	0.1	0.1	0.1	0.1	0.56	24.30	100.00
																				2.32		

Table 8(c) Analysis using HTDM for 3rd Quartile of 120 minutes rainfall events of Kg. Sg. Soi Station

3 rd Quartile	Minutes	%cum	Depth																	Ave	%	%Cum
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17			
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
	5	16.67	0.1	2.2	0.1	0.1	0.1	0.5	0.2	0.3	0.1	2.4	0.5	1.2	0.5	0.1	0.1	0.1	0.1	0.51	13.51	13.51
	5	33.33	0.1	2.7	0.1	0.2	0.1	0.7	0.2	0.3	0.1	3.1	0.5	0.5	0.4	0.1	0.1	0.1	0.1	0.55	14.60	28.11
	5	50	0.7	2.5	0.1	0.3	1.6	0.6	0.3	0.2	0.1	1.9	0.8	0.7	0.4	0.1	0.1	0.1	0.2	0.63	16.61	44.72
	5	66.67	0.6	3.1	0.1	0.1	2.6	3.3	0.3	0.2	0.1	0.6	0.1	2.8	0.4	0.1	0.1	0.1	0.3	0.88	23.14	67.86
	5	83.33	0.4	1.2	0.1	0.1	1.1	1.1	0.2	0.3	0.1	0.1	0.1	2.4	0.4	0.1	0.1	0.2	0.4	0.49	13.04	80.90
	5	100	0.4	0.6	0.2	0.1	1.4	2.7	0.2	0.3	0.1	0.1	0.1	4.1	0.3	0.1	0.1	0.2	1.3	0.72	19.10	100.00
																				3.79		

Table 8(d) : Analysis using HTDM for 4th Quartile of 120 minutes rainfall events of Kg. Sg. Soi Station

4 th Quartile	Minutes	%cum	Depth																	Ave	%	%Cum
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17			
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
	5	16.67	0.5	0.3	0.2	0.1	2.4	4.2	0.2	0.1	0.1	0.1	0.1	3.4	0.3	0.1	0.1	0.2	0.7	0.77	24.62	24.62
	5	33.33	0.1	0.2	0.2	0.1	0.6	4.1	0.1	0.1	0.1	0.1	0.1	1.2	0.2	0.1	0.1	0.2	4.5	0.71	22.74	47.37
	5	50	0.1	0.6	0.1	0.1	0.8	2.9	0.1	0.1	0.1	0.1	0.1	0.9	0.2	0.1	0.1	0.3	6.2	0.76	24.25	71.62
	5	66.67	0.1	0.2	0.1	0.1	0.5	1.5	0.1	0.1	0.7	0.1	0.1	0.7	0.2	0.1	0.1	0.3	2.5	0.44	14.10	85.71
	5	83.33	0.1	0.2	0.1	0.1	0.3	0.7	0.1	0.1	0.6	0.1	0.1	0.7	0.2	0.1	0.3	0.3	0.6	0.28	8.83	94.55
	5	100	0.1	0.1	0.1	0.1	0.2	0.2	0.1	0.1	0.3	0.1	0.1	0.3	0.1	0.1	0.3	0.3	0.3	0.17	5.45	100.00
																				3.13		

Table 8(a) : Analysis using HTDM for 1st Quartile of 180 minutes rainfall events of Kg. Sg. Soi Station

1st Quartile	Minutes	%cum	Depth								Ave	%	%Cum
			1	2	3	4	5	6	7	8			
	0	0	0	0	0	0	0	0	0	0	0	0	0
	5	11.11	0.1	0.1	0.1	0.1	0.2	0.6	0.3	0.2	0.21	4.59	4.59
	5	22.22	0.1	0.1	0.1	0.1	0.4	0.5	1.7	0.2	0.40	8.65	13.24
	5	33.33	0.1	0.1	0.1	0.1	0.1	1.2	2.2	0.2	0.51	11.08	24.32
	5	44.44	0.1	0.1	0.1	0.1	0.1	3.8	2.8	0.2	0.91	19.73	44.05
	5	55.55	0.1	0.1	0.1	0.1	0.1	0.7	2.6	0.2	0.50	10.81	54.86
	5	66.67	0.2	0.2	0.1	0.1	0.4	1.2	3.1	0.2	0.69	14.86	69.73
	5	77.78	0.2	0.2	0.1	0.1	0.7	0.9	1.9	0.2	0.54	11.62	81.35
	5	88.89	0.2	0.2	0.1	0.1	0.5	2.7	1.1	0.2	0.64	13.78	95.14
	5	100	0.2	0.2	0.2	0.1	0.1	0.2	0.4	0.4	0.23	4.86	100.00
											4.63		

Table 8(b) : Analysis using HTDM for 2nd Quartile of 180 minutes rainfall events of Kg. Sg. Soi Station

2nd Quartile	%cum	Depth								Ave	%	%Cum
Minutes		1	2	3	4	5	6	7	8			
0	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
5	11.11	0.2	0.2	0.2	0.3	0.1	0.2	0.2	0.5	0.24	11.80	11.80
5	22.22	0.1	0.2	0.2	0.3	0.1	0.1	0.2	0.5	0.21	10.56	22.36
5	33.33	0.1	0.3	0.2	0.1	0.2	0.1	0.3	0.4	0.21	10.56	32.92
5	44.44	0.1	0.2	0.2	0.1	0.3	0.1	0.3	0.3	0.20	9.94	42.86
5	55.55	0.2	0.2	0.2	0.1	0.2	0.1	0.3	0.2	0.19	9.32	52.17
5	66.67	0.2	0.2	0.2	0.1	0.1	0.3	0.2	0.2	0.19	9.32	61.49
5	77.78	0.2	0.1	0.2	0.2	0.1	2	0.2	0.1	0.39	19.25	80.75
5	88.89	0.2	0.1	0.2	0.2	0.1	0.8	0.2	0.1	0.24	11.80	92.55
5	100	0.2	0.1	0.2	0.1	0.1	0.2	0.2	0.1	0.15	7.45	100.00
										2.01		

Table 8(c) : Analysis using HTDM for 3rd Quartile of 180 minutes rainfall events of Kg. Sg. Soi Station

3rd Quartile	%cum	Depth								Ave	%	%Cum
Minutes		1	2	3	4	5	6	7	8			
0	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
5	11.11	0.1	0.1	0.2	0.1	0.1	0.2	0.2	0.1	0.14	4.35	4.35
5	22.22	0.1	0.1	0.2	0.1	0.1	0.2	0.2	0.1	0.14	4.35	8.70
5	33.33	0.1	0.1	0.2	0.1	0.1	0.2	0.2	0.1	0.14	4.35	13.04
5	44.44	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.1	0.13	3.95	17.00
5	55.55	0.1	0.1	0.1	0.1	0.5	0.3	0.3	0.1	0.20	6.32	23.32
5	66.67	0.1	0.1	0.1	0.1	3.2	1.8	0.3	0.1	0.73	22.92	46.25
5	77.78	0.1	0.1	0.1	0.1	2	2.2	0.3	0.1	0.63	19.76	66.01
5	88.89	0.1	0.1	0.1	0.1	2.4	0.7	0.3	0.1	0.49	15.42	81.42
5	100	0.1	0.1	0.1	0.1	0.5	3.4	0.3	0.1	0.59	18.58	100.00
										3.16		

Table 8(d) : Analysis using HTDM for 4th Quartile of 180 minutes rainfall events of Kg. Sg. Soi Station

4th Quartile		Depth										
Minutes	%cum	1	2	3	4	5	6	7	8	Ave	%	%Cum
0	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
5	11.11	0.1	0.1	0.3	0.1	0.1	1.3	0.3	0.1	0.30	12.18	12.18
5	22.22	0.1	0.1	0.4	0.1	0.1	1.6	0.3	0.1	0.35	14.21	26.40
5	33.33	0.1	0.1	0.5	0.1	0.1	2.2	0.3	0.1	0.44	17.77	44.16
5	44.44	0.1	0.1	0.5	0.1	0.1	1.8	0.3	0.1	0.39	15.74	59.90
5	55.55	0.1	0.1	0.4	0.1	0.1	0.3	0.2	0.1	0.18	7.11	67.01
5	66.67	0.1	0.1	0.1	0.1	0.1	0.3	0.2	0.1	0.14	5.58	72.59
5	77.78	0.1	0.1	0.1	0.1	0.1	0.4	0.2	0.1	0.15	6.09	78.68
5	88.89	0.1	0.1	0.1	0.1	0.4	1.9	0.2	0.1	0.38	15.23	93.91
5	100	0.1	0.1	0.1	0.1	0.2	0.4	0.1	0.1	0.15	6.09	100.00
										2.46		

Table 9(a) : Analysis using HTDM for 1st Quartile of 60 minutes rainfall events of Rancangan Pam Paya Pinang Station

1st Quartile		Depth																								
Minutes	%cum	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
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	0
5	33.33	1	2.5	0.5	2	0.5	0.5	1	0.5	1.5	1.5	0.5	0.5	1	2	2	0.5	0.5	0.5	0.5	0.5	7	0.5	4	1.4	0.4
5	66.67	7	6	1	3.5	3.5	7	1	0.5	1	3	0.5	0.5	7	7	1	4	1.5	3.5	0.5	0.5	12.5	0.5	6	2.7	0.9
5	100	5.5	13	0.5	3.5	5	5.5	1	1.5	0.5	4.5	1	2.5	4	7	3.5	6	1	7.5	0.5	0.5	11.5	1.5	3.5	0.1	0.8

1st Quartile		Depth																								
Minutes	%cum	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
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	0
5	33.33	0.2	0.7	0.8	3.3	0.1	0.1	0.6	0.1	0.1	1.2	0.1	0.2	0.1	0.4	0.1	0.4	0.1	1.6	0.1	0.1	0.2	0.1	0.1	2.3	1
5	66.67	0.3	2.7	1.7	6.8	0.1	0.1	0.1	0.3	0.1	1.7	0.2	0.6	0.1	0.8	0.1	0.2	0.4	7.2	0.6	0.3	0.6	0.2	0.9	4.1	0.4
5	100	1.8	2.6	2.8	4.6	0.1	0.1	0.1	0.3	0.1	0.8	0.2	0.3	0.1	1.5	0.1	0.1	0.4	6.1	0.3	0.4	0.9	0.2	4.5	1.9	2.9

1st Quartile		Depth															Ave	%	%Cum
Minutes	%cum	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65			
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
5	33.33	0.2	2.9	0.1	1	3	2.7	0.6	7.3	3.3	0.1	0.2	1.7	0.4	0.1	1.6	1.12	18.59	18.59
5	66.67	1.9	4	0.1	0.4	0.2	4.5	0.2	8.4	8.6	0.3	0.2	3.7	7	0.1	1.3	2.36	39.32	57.91
5	100	4.1	3.3	0.1	1.4	0.2	3.2	0.2	7.3	3.7	0.3	0.2	5.2	7.7	0.1	2.8	2.53	42.09	100.00
																	6.01		

Table 9(b) : Analysis using HTDM for 2nd Quartile of 60 minutes rainfall events of Rancangan Pam Paya Pinang Station

2nd Quartile		Depth																									
Minutes		%cum	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
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	0	0
5	33.33	5	12	1	2	3	3	0.5	0.5	4	8	4	4.5	3	4.5	4	9.5	1	7.5	0.5	0.5	9	2	3.5	0.1	0.8	
5	66.67	4	5	1	1.5	6	5.5	1	0.5	4.5	7.5	4	4.5	3	5	4.5	6	1.5	4.5	0.5	1.5	6	2	3	0.1	1.3	
5	100	2	6	0.5	0.5	2.5	4	0.5	6	2	4.5	3	4.5	2	5.5	6	4	1	4.5	0.5	2.5	5.5	5	2	0.1	1.2	

2nd Quartile		Depth																								
Minutes	%cum	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
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	0
5	33.33	2.3	0.4	4.4	3.6	0.1	0.1	0.2	0.3	0.1	0.2	0.1	0.1	0.1	1.8	0.1	0.1	0.3	3.7	0.1	3	0.8	0.2	3.9	1.3	7.2
5	66.67	0.7	0.6	4.7	0.7	0.1	0.1	0.5	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.3	2.3	0.1	10.8	0.8	0.2	2.9	1.3	4.8
5	100	0.7	0.5	4.3	0.7	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.3	0.6	0.1	7.9	1.2	0.2	2.5	1.2	2.6

2nd Quartile	%cum	Depth																	
Minutes		51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	Ave	%	%Cum
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
5	33.33	1.7	1.3	0.1	1.6	0.7	1.7	0.3	3.4	1.1	0.2	0.2	3.9	6.8	0.1	2	2.35	36.30	36.30
5	66.67	2	0.5	0.1	1.6	0.3	0.7	0.7	7.4	0.2	0.2	0.2	2.7	6.1	0.1	1.4	2.15	33.19	69.49
5	100	2.3	0.5	0.1	4.1	2.7	0.2	0.3	7	0.3	0.1	0.2	3.6	6.2	0.1	1.1	1.98	30.51	100.00
																	6.48		

Table 9(c) : Analysis using HTDM for 3rd Quartile of 60 minutes rainfall events of Rancangan Pam Paya Pinang Station

3rd Quartile		Depth																									
Minutes		%cum	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
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	0	0
5	33.33	3	3	0.5	0.5	4	6	1	3.5	2	2	4	2	1.5	3.5	4.5	1	1	3	0.5	1.5	4.5	1.5	2	0.9	1.1	
5	66.67	3.5	1.5	1.5	1	5	5	0.5	2	2	1	1.5	2.5	0.5	4	3.5	3.5	2.5	1.5	0.5	0.5	4	2.5	2	2.6	0.6	
5	100	1	1	1.5	2.5	3	4.5	0.5	2	3.5	1	2.5	0.5	1.5	2	1.5	2.5	2.5	0.5	0.5	3	1.5	2	1.5	1.2	0.5	

3rd Quartile	%cum	Depth																									
Minutes		26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	
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	0	
5	33.33	2.1	0.1	7	0.8	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.3	1	0.1	5.1	0.1	0.2	1.2	1	1.9	
5	66.67	5.6	0.1	6.9	0.5	0.1	0.2	0.1	0.1	1.3	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.3	0.3	0.1	7.7	0.1	0.2	1.8	0.6	6.1	
5	100	7.5	0.1	2	0.4	0.1	0.6	0.1	0.1	0.8	0.1	0.1	0.1	0.1	0.1	0.1	1.1	0.4	0.2	0.1	3.3	0.1	0.2	0.7	0.3	3.9	

3rd Quartile		Depth																	
Minutes	%cum	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	Ave	%	%Cum
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
5	33.33	2.1	0.3	0.1	3.7	5	0.1	0.2	9.5	0.4	0.1	0.2	2.8	4.3	0.1	0.7	1.69	36.81	36.81
5	66.67	0.8	0.6	0.1	3.2	2	0.1	0.1	7.2	0.9	0.1	0.2	0.8	1.6	0.1	0.8	1.64	35.74	72.54
5	100	0.1	0.5	0.3	1.9	1.5	0.2	0.1	5.5	0.2	0.1	0.2	1.7	0.7	0.1	2	1.26	27.46	100.00
																	4.59		

Table 9(d) : Analysis using HTDM for 4th Quartile of 60 minutes rainfall events of Rancangan Pam Paya Pinang Station

4th Quartile		Depth																								
Minutes	%cum	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
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	0
5	33.33	0.5	0.5	3.5	1.5	1.5	3.5	0.5	2	2	1.5	1.5	0.5	0.5	1	1.5	0.5	2	1	0.5	3	2	2	1	0.7	0.2
5	66.67	0.5	0.5	2	1	1.5	2.5	0.5	1	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1	0.5	0.5	1.5	1	0.5	1	0.3	0.2
5	100	0.5	0.5	0.5	0.5	1	2	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	0.5	0.5	0.5	0.5	0.3	0.1

4th Quartile		Depth																								
Minutes	%cum	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
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	0
5	33.33	6.8	0.1	0.8	0.5	0.1	0.4	0.1	0.1	0.4	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.6	0.2	0.1	0.7	0.1	0.2	1	0.2	2.6
5	66.67	4.3	0.1	0.5	0.2	0.1	0.3	0.1	0.1	0.4	0.4	0.1	1.7	0.1	0.4	0.1	0.2	0.6	0.2	0.5	0.2	0.1	0.2	0.3	0.2	1
5	100	2.8	0.1	1.2	0.2	0.1	0.3	0.1	0.1	0.1	0.2	0.1	0.3	0.1	0.1	0.1	0.5	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.1	0.1

4th Quartile		Depth																		
Minutes	%cum	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	Ave	%	%Cum
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
5	33.33	2.6	0.1	0.2	0.4	2.3	0.5	0.3	0.1	9.6	0.1	0.1	0.2	0.2	0.8	0.1	1.1	1.03	49.44	49.44
5	66.67	1	0.1	0.2	0.3	2.4	0.2	0.6	0.1	4.8	0.1	0.1	0.2	0.2	0.3	0.1	0.5	0.66	31.90	81.35
5	100	0.1	0.1	0.1	0.1	1.1	0.2	0.5	0.1	0.5	0.1	0.1	0.2	0.1	0.2	0.1	0.3	0.39	18.65	100.00
																		2.08		

Table 10(a) : Analysis using HTDM for 1st Quartile of 120 minutes rainfall events of Rancangan Pam Paya Pinang Station

1st Quartile		Depth																			
Minutes	%cum	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Ave	%	%cum
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	16.67	3	0.5	3.5	0.1	0.3	0.1	0.1	0.2	1.6	0.1	0.2	0.1	0.1	0.7	0.2	0.1	0.4	0.66	10.99	10.99
5	33.33	2	0.5	8	0.3	0.6	0.1	0.1	2.5	4.1	0.1	0.3	0.2	0.2	0.9	0.2	0.1	0.6	1.22	20.23	31.23
5	50	2.5	1	5	0.4	2.9	0.1	0.1	5.9	1.6	0.1	0.1	0.2	0.2	0.2	0.2	0.1	0.5	1.24	20.53	51.75
5	66.67	3.5	0.5	3.5	0.4	2.1	0.1	0.1	1.6	1.7	0.1	0.1	0.1	0.3	0.2	0.2	0.1	1.6	0.95	15.76	67.51
5	83.33	5	0.5	5	0.4	1.2	0.1	0.1	0.7	3.1	0.1	0.1	0.1	0.2	0.1	0.2	0.2	1.6	1.10	18.19	85.70
5	100	6	1	3	0.3	0.1	0.1	0.1	0.4	1.8	0.1	0.1	0.1	0.2	0.1	0.3	0.2	0.8	0.86	14.30	100.00
																			6.05		

Table 10(b) Analysis using HTDM for 2nd Quartile of 120 minutes rainfall events of Rancangan Pam Paya Pinang Station

2nd Quartile		Depth																	Ave	%	%cum
Minutes	%cum	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17			
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
5	16.67	4.5	1	0.5	0.3	0.1	0.1	0.1	0.3	3.2	0.1	0.1	0.1	0.2	0.1	0.2	0.2	0.2	0.66	15.65	15.65
5	33.33	2.5	4.5	4	0.3	0.1	0.1	0.1	0.7	2.7	0.1	0.1	0.1	0.2	0.1	0.2	0.2	0.2	0.95	22.44	38.09
5	50	2.5	2	3.5	0.3	0.1	0.1	0.1	0.4	2.3	0.1	0.1	0.1	0.2	0.1	0.2	0.2	0.2	0.74	17.31	55.40
5	66.67	1.5	0.5	3.5	0.3	0.1	0.1	0.1	0.2	1.7	0.1	0.1	0.1	0.2	0.1	0.1	0.2	0.1	0.53	12.47	67.87
5	83.33	1	1	5	0.2	0.1	0.2	0.1	0.2	1.2	0.2	0.1	0.1	0.2	0.2	0.1	0.2	0.1	0.60	14.13	81.99
5	100	1	2	5	0.2	2.3	0.2	0.1	0.1	0.9	0.2	0.1	0.1	0.2	0.2	0.1	0.2	0.1	0.76	18.01	100.00
																			4.25		

Table 10(c) : Analysis using HTDM for 3rd Quartile of 120 minutes rainfall events of Rancangan Pam Paya Pinang Station

3rd Quartile		Depth																	Ave	%	%cum
Minutes	%cum	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17			
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
5	16.67	0.5	1.5	6.5	0.2	2.7	0.4	0.1	0.1	0.7	0.2	0.1	0.1	0.1	0.2	0.1	0.3	0.2	0.82	25.32	25.32
5	33.33	1	1	4.5	0.2	0.3	0.3	0.7	0.1	1.4	0.2	0.2	0.1	0.1	0.1	0.1	0.4	0.2	0.64	19.71	45.03
5	50	1	1	3	0.2	2.1	0.2	0.2	0.1	0.4	1.1	0.2	0.1	0.1	0.1	0.1	0.4	0.2	0.62	18.99	64.01
5	66.67	1.5	0.5	3	0.2	2.7	0.2	0.2	0.1	0.3	0.1	0.1	0.1	0.1	0.1	0.1	0.3	0.2	0.58	17.72	81.74
5	83.33	1.5	0.5	2	0.2	0.3	0.1	0.1	0.1	0.5	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.36	11.03	92.77
5	100	1	0.5	1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.24	7.23	100.00
																			3.25		

Table 10(d) : Analysis using HTDM for 4th Quartile of 120 minutes rainfall events of Rancangan Pam Paya Pinang Station

4th Quartile		Depth																			
Minutes	%cum	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Ave	%	%cum
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
5	16.67	1	1.5	0.5	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	0.1	0.26	16.48	16.48
5	33.33	1	1	1	0.1	0.1	0.1	0.1	0.2	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.27	17.23	33.71
5	50	0.5	0.5	1.5	0.1	0.1	0.1	0.1	0.2	0.1	0.3	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.25	15.73	49.44
5	66.67	0.5	1	1	0.1	0.1	0.1	0.1	0.2	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.24	15.36	64.79
5	83.33	1	1	2.5	0.1	0.1	0.1	0.1	0.2	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.36	22.85	87.64
5	100	0.5	0.5	0.5	0.1	0.1	0.1	0.5	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.19	12.36	100.00
																			1.57		

Table 11(a) : Analysis using HTDM for 1st Quartile of 180 minutes rainfall events of Rancangan Pam Paya Pinang Station

1st Quartile		Depth									
Minutes	%cum	1	2	3	4	5	6	7	Ave	%	%Cum
0	0	0	0	0	0	0	0	0	0	0	0
5	11.11	0.1	2.5	0.3	0.5	0.1	1.8	2.4	1.10	7.94	7.94
5	22.22	0.7	4.9	1.1	0.4	1.7	2.1	3.5	2.06	14.85	22.78
5	33.33	1.1	4.6	0.2	0.3	4.8	1.3	4.2	2.36	17.01	39.79
5	44.44	1.6	4	0.1	0.4	2.2	0.6	1.4	1.47	10.62	50.41
5	55.55	0.5	7.6	0.1	0.5	2.2	0.3	3.6	2.11	15.26	65.67
5	66.67	0.2	3.1	0.5	0.8	3.4	0.1	4.2	1.76	12.68	78.35
5	77.78	0.2	1.2	1.3	1	3.9	0.1	2	1.39	10.00	88.35
5	88.89	0.1	0.7	0.4	0.7	3.6	0.1	1	0.94	6.80	95.15
5	100	0.1	0.1	0.9	0.7	1.5	0.1	1.3	0.67	4.85	100.00
									13.86		

Table 11(b) : Analysis using HTDM for 2nd Quartile of 180 minutes rainfall events of Rancangan Pam Paya Pinang Station

2nd Quartile		Depth									
Minutes	%cum	1	2	3	4	5	6	7	Ave	%	%Cum
0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
5	11.11	0.1	0.1	0.7	0.2	0.7	0.1	1.5	0.49	12.36	12.36
5	22.22	0.1	0.1	0.4	0.2	0.7	0.1	1.3	0.41	10.55	22.91
5	33.33	0.1	0.1	0.6	0.3	0.4	0.1	1.7	0.47	12.00	34.91
5	44.44	0.1	0.1	1.3	0.3	0.3	0.1	1.9	0.59	14.91	49.82
5	55.55	0.1	0.1	0.9	0.4	0.1	0.1	2.3	0.57	14.55	64.36
5	66.67	0.1	0.1	0.4	0.9	0.1	0.1	2.1	0.54	13.82	78.18
5	77.78	0.2	0.1	0.2	1	0.1	0.1	0.9	0.37	9.45	87.64
5	88.89	0.3	0.1	0.2	0.7	0.1	0.1	0.4	0.27	6.91	94.55
5	100	0.3	0.1	0.1	0.4	0.1	0.1	0.4	0.21	5.45	100.00
									3.93		

Table 11(c) : Analysis using HTDM for 3rd quartile of 180 minutes rainfall events of Rancangan Pam Paya Pinang Station

4th Quartile		Depth									
Minutes	%cum	1	2	3	4	5	6	7	Ave	%	%Cum
0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
5	11.11	0.1	0.2	0.1	0.3	0.4	0.1	0.5	0.24	13.08	13.08
5	22.22	0.1	0.2	0.1	0.3	0.4	0.1	0.5	0.24	13.08	26.15
5	33.33	0.1	0.1	0.2	0.4	0.3	0.1	0.3	0.21	11.54	37.69
5	44.44	0.2	0.1	0.5	0.7	0.3	0.1	0.3	0.31	16.92	54.62
5	55.55	0.3	0.1	0.6	0.3	0.3	0.1	0.1	0.26	13.85	68.46
5	66.67	0.2	0.1	0.4	0.2	0.1	0.1	0.1	0.17	9.23	77.69
5	77.78	0.1	0.1	0.3	0.2	0.1	0.1	0.1	0.14	7.69	85.38
5	88.89	0.1	0.1	0.5	0.2	0.1	0.1	0.1	0.17	9.23	94.62
5	100	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.10	5.38	100.00
									1.86		

Table 11(d) : Analysis using HTDM for 4th quartile of 180 minutes rainfall events of Rancangan Pam Paya Pinang Station

3rd Quartile		Depth									
Minutes	%cum	1	2	3	4	5	6	7	Ave	%	%Cum
0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
5	11.11	0.2	0.1	0.1	0.2	0.1	0.1	0.3	0.16	7.38	7.38
5	22.22	0.2	0.3	0.1	0.2	0.2	0.1	0.2	0.19	8.72	16.11
5	33.33	0.2	0.3	0.1	0.2	0.3	0.1	0.2	0.20	9.40	25.50
5	44.44	0.2	0.3	0.1	0.2	0.4	0.1	0.3	0.23	10.74	36.24
5	55.55	0.3	0.2	0.1	0.3	0.4	0.1	0.3	0.24	11.41	47.65
5	66.67	0.2	0.2	0.1	0.5	0.4	0.1	0.4	0.27	12.75	60.40
5	77.78	0.2	0.2	0.1	0.4	0.4	0.1	0.4	0.26	12.08	72.48
5	88.89	0.2	0.3	0.1	0.5	0.5	0.3	0.4	0.33	15.44	87.92
5	100	0.1	0.2	0.1	0.3	0.4	0.3	0.4	0.26	12.08	100.00
									2.13		

APPENDIX B

DATA ANALYSIS USING WRII

Table 12(a) : Analysis using WRII for 1st Quartile of 60 minutes rainfall events of Ldg Nada Station

1st Quartile	%cum	Depth																								
Minutes		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
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	0
5	33.33	0.1	0.1	0.1	0.1	0.7	0.1	0.3	0.2	0.1	0.1	0.1	0.1	0.5	0.1	0.1	0.2	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.3
5	66.67	0.1	0.1	0.1	0.1	0.8	0.1	0.4	0.3	0.1	0.1	0.1	0.1	0.6	0.1	0.1	0.2	0.1	0.2	0.1	0.3	0.1	0.1	0.1	0.1	0.3
5	100	0.1	0.2	0.1	0.1	0.9	0.4	0.9	0.5	0.1	0.1	0.1	0.1	1.1	0.3	0.1	0.2	0.1	0.3	0.1	0.4	0.2	0.2	0.1	0.1	0.4

1st Quartile		Depth																									
Minutes		%cum	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
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	0	0
5	33.33	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.3	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.1	0.1	0.1
5	66.67	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.3	0.1	1	0.2	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.4	0.3	0.1	0.1	0.1
5	100	0.1	0.1	0.2	0.2	0.1	0.1	0.1	0.2	0.4	0.1	1.3	0.3	0.1	0.2	0.1	0.2	0.1	2.3	0.7	0.1	0.6	0.3	0.1	0.1	0.1	0.1

1st Quartile	%cum	Depth																				Ave	%	%Cum
Minutes		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19				
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
5	33.33	0.1	0.1	0.1	0.1	0.7	0.1	0.1	0.1	0.1	0.1	0.3	0.3	0.2	0.2	0.2	0.1	0.3	0.1	0.2	0.1565217	22.406639	22.406639	
5	66.67	0.1	0.2	0.1	0.1	1.2	0.1	0.1	0.1	0.1	0.1	0.8	0.4	0.3	0.5	0.2	0.1	0.3	0.1	0.3	0.2072464	29.66805	52.074689	
5	100	0.4	0.2	0.1	0.1	1.5	0.3	0.1	0.1	0.1	0.1	1	0.6	0.8	0.6	0.2	0.1	0.6	0.1	0.7	0.3347826	47.925311	100	
																					0.6985507			

Table 12(b) : Analysis using WRRI for 2nd Quartile of 60 minutes rainfall events of Ldg Nada Station

2nd Quartile		Depth																								
Minutes	%cum	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
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	0
5	33.33	0.1	0.3	1.2	0.1	1.6	1.1	1.4	0.8	0.1	0.1	0.2	0.2	3.2	0.7	0.2	0.2	0.2	0.4	0.1	0.8	0.4	0.4	0.2	0.1	0.8
5	66.67	0.3	0.7	3.2	0.2	2.4	1.4	1.5	1	0.1	0.3	0.3	0.2	4.7	1.1	0.2	0.3	0.2	0.5	0.2	1.5	0.6	0.7	0.3	0.7	0.9
5	100	0.5	1.5	6.9	0.2	3.3	3.1	1.9	2	0.2	1.6	0.7	0.2	7.9	4.6	2.2	0.3	0.2	0.6	0.2	1.9	2.8	1.1	1	5.2	1.3

2nd Quartile	%cum	Depth																									
Minutes		26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	
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	0	0
5	33.33	0.1	0.1	0.2	0.4	0.1	0.1	0.1	2.5	0.5	0.3	3.4	0.3	0.1	0.3	0.1	0.3	0.1	5.9	1.1	0.1	1.2	0.8	0.1	0.1	0.1	0.1
5	66.67	0.2	0.1	0.2	0.5	0.1	0.1	0.1	4.1	0.8	0.7	3.9	0.3	0.3	1.6	0.4	0.6	0.2	6.2	1.6	0.1	1.5	1.1	0.2	0.4	0.2	0.2
5	100	2.9	0.1	0.2	1.1	0.1	0.2	0.3	6	4.2	2.4	7.2	0.5	0.4	6.7	1.8	0.8	0.5	10.1	2.2	0.2	1.7	3.2	0.6	0.7	0.6	0.6

2nd Quartile		Depth																							
Minutes	%cum	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69					
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Ave	%	%Cum		
5	33.33	0.7	0.2	0.1	0.1	3.6	0.4	0.5	0.1	0.1	0.1	2	1.1	0.9	0.7	0.4	0.1	1.1	0.1	1.1	0.6768116	17.609351	17.609351		
5	66.67	0.9	0.5	0.1	0.1	4.5	0.7	1.8	0.1	0.1	0.1	2.9	1.7	1.4	1.3	0.5	0.1	2.6	0.1	1.2	1.0101449	26.282051	43.891403		
5	100	2.2	0.7	0.2	0.7	5.9	4.2	5	0.5	0.2	0.3	3.9	3.4	3.1	2.1	0.6	0.1	7.3	0.1	2.2	2.1565217	56.108597	100		
																					3.8434783				

Table 12(c) : Analysis using WRRI for 3rd Quartile of 60 minutes rainfall events of Ldg Nada Station

3rd Quartile		Depth																								
Minutes	%cum	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
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	0
5	33.33	0.3	0.8	5.4	0.2	2.5	2.8	1.7	1.8	0.2	0.6	0.3	0.2	5.1	1.9	1.8	0.3	0.2	0.5	0.2	1.8	1.2	0.8	0.9	1.5	0.9
5	66.67	0.1	0.6	1.4	0.1	2	1.3	1.4	1	0.1	0.1	0.2	0.2	4.7	0.9	0.2	0.2	0.2	0.5	0.2	1.4	0.5	0.4	0.3	0.6	0.9
5	100	0.1	0.3	0.1	0.1	1.1	0.9	1	0.7	0.1	0.1	0.2	0.1	3	0.7	0.1	0.2	0.2	0.3	0.1	0.7	0.3	0.3	0.2	0.1	0.7

3rd Quartile		Depth																								
Minutes	%cum	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
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	0
5	33.33	0.6	0.1	0.2	0.5	0.1	0.2	0.2	4.1	1.6	1.1	5.6	0.4	0.3	5.6	1	0.6	0.2	9.5	1.8	0.2	1.5	1.6	0.2	0.4	0.4
5	66.67	0.2	0.1	0.2	0.4	0.1	0.1	0.1	2.7	0.8	0.6	3.7	0.3	0.1	1.4	0.3	0.3	0.2	6.2	1.3	0.1	1.4	0.9	0.1	0.2	0.1
5	100	0.1	0.1	0.2	0.3	0.1	0.1	0.1	1.5	0.5	0.1	2.3	0.3	0.1	0.3	0.1	0.3	0.1	3.9	0.9	0.1	0.7	0.5	0.1	0.1	0.1

3rd Quartile	%cum	Depth																						
Minutes		51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	Ave	%	%Cum	
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
5	33.33	1.1	0.6	0.2	0.5	5	1.9	2.4	0.1	0.2	0.2	3.4	2.6	1.6	1.8	0.5	0.1	3.5	0.1	1.3	1.4347826	51.670146	51.670146	
5	66.67	0.7	0.4	0.1	0.1	4.1	0.6	0.9	0.1	0.1	0.1	2.3	1.1	1.2	0.8	0.5	0.1	1.7	0.1	1.2	0.8347826	30.06263	81.732777	
5	100	0.6	0.2	0.1	0.1	3	0.4	0.1	0.1	0.1	0.1	1.5	0.6	0.8	0.6	0.3	0.1	0.7	0.1	0.8	0.5072464	18.267223	100	
																					2.7768116			

Table 12(d) : Analysis using WRRI for 4th Quartile of 60 minutes rainfall events of Ldg Nada Station

4th Quartile		Depth																								
Minutes	%cum	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
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	0
5	33.33	0.1	0.2	0.1	0.1	0.8	0.2	0.7	0.4	0.1	0.1	0.1	0.1	0.6	0.1	0.1	0.2	0.1	0.2	0.1	0.3	0.1	0.2	0.1	0.1	0.4
5	66.67	0.1	0.1	0.1	0.1	0.7	0.1	0.3	0.2	0.1	0.1	0.1	0.1	0.5	0.1	0.1	0.2	0.1	0.2	0.1	0.2	0.1	0.1	0.1	0.1	0.3
5	100	0.1	0.1	0.1	0.1	0.4	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.3

4th Quartile		Depth																								
Minutes	%cum	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
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	0
5	33.33	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.3	0.1	1.2	0.2	0.1	0.2	0.1	0.1	0.1	0.3	0.4	0.1	0.5	0.3	0.1	0.1	0.1
5	66.67	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.4	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.1	0.1	0.1
5	100	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.1	0.1	0.1

4th Quartile		Depth																						
Minutes		%cum	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	Ave	%	%Cum
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
5	33.33	0.1	0.2	0.1	0.1	1.4	0.1	0.1	0.1	0.1	0.1	0.9	0.5	0.5	0.5	0.2	0.1	0.5	0.1	0.3	0.2434783	44.919786	44.919786	
5	66.67	0.1	0.2	0.1	0.1	1.2	0.1	0.1	0.1	0.1	0.1	0.8	0.3	0.2	0.3	0.2	0.1	0.3	0.1	0.2	0.1768116	32.620321	77.540107	
5	100	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.2	0.1	0.1	0.2	0.1	0.2	0.1217391	22.459893	100	
																					0.542029			

Table 13(a) : Analysis using WRRI for 1st Quartile of 120 minutes rainfall events of Ldg Nada Station

1st Quartile		Depth																										
Minutes	%cum	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22					
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Ave	%	%Cum		
5	16.67	0.2	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.11	7.10	7.10		
5	33.33	0.2	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.2	0.1	0.1	0.1	0.3	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.13	7.95	15.06		
5	50	0.2	0.1	0.1	0.1	0.1	0.1	0.4	0.3	0.1	0.2	0.1	0.1	0.2	1	0.2	0.1	0.1	0.1	0.8	0.1	0.1	0.1	0.21	13.35	28.41		
5	66.67	0.2	0.1	0.1	0.1	0.1	0.1	0.5	0.5	0.1	0.3	0.1	0.1	0.2	1.3	0.2	0.1	0.1	0.2	1.9	0.2	0.1	0.1	0.30	19.03	47.44		
5	83.33	0.3	0.1	0.1	0.1	0.1	0.1	0.5	0.8	0.1	0.4	0.1	0.1	0.2	1.7	0.4	0.1	0.1	0.2	2.1	0.5	0.1	0.2	0.38	23.86	71.31		
5	100	0.4	0.1	0.1	0.1	0.1	0.1	0.6	0.8	0.1	0.6	0.1	0.1	0.2	2.2	0.5	0.1	0.1	0.4	2.4	0.5	0.2	0.3	0.46	28.69	100.00		
																								1.60				

Table 13(b) : Analysis using WRRI for 2nd Quartile of 120 minutes rainfall events of Ldg Nada Station

2nd Quartile	%cum	Depth																									
Minutes		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22				
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Ave	%	%Cum	
5	16.67	0.4	0.1	0.1	0.1	0.2	0.1	0.8	1.3	0.1	0.7	0.1	0.1	0.2	2.4	0.7	0.2	0.1	0.7	2.9	0.7	0.2	0.4	0.57	5.86	5.86	
5	33.33	0.5	0.2	0.1	0.1	0.2	0.4	1.1	1.6	0.1	1	0.1	0.1	0.3	3.2	0.8	0.2	0.3	1.2	2.9	0.9	0.2	0.4	0.72	7.39	13.25	
5	50	2	0.2	0.1	0.1	0.2	0.7	1.8	2.8	0.1	1.4	0.1	0.1	0.4	4.4	1	0.2	0.5	2.5	3.3	1.4	0.2	1.1	1.12	11.44	24.69	
5	66.67	2.3	0.2	0.1	0.1	0.3	1.4	2.5	3.1	0.1	1.7	0.1	0.1	0.5	5	1.3	0.2	1.7	2.9	3.7	2.3	0.3	2.3	1.46	14.97	39.66	
5	83.33	5.2	0.3	0.2	0.1	0.3	3.2	2.7	3.8	0.2	4.2	0.1	0.1	0.7	7.8	1.6	0.4	4	4.1	4	2.7	0.6	2.8	2.23	22.83	62.48	
5	100	8.4	0.3	0.3	0.2	0.3	5.1	4	7.3	0.4	9.2	0.1	0.1	0.7	10.5	1.9	0.5	9.3	4.7	6.3	6.1	0.7	4.3	3.67	37.52	100.00	
																								9.78			

Table 14(a) : Analysis using WRI for 1st Quartile of 180 minutes rainfall events of Ldg Nada Station

1st Quartile		Depth							
Minutes	%cum	1	2	3	4	5			
0	0	0	0	0	0	0	Ave	%	%Cum
5	11.11	0.1	0.1	0.1	0.1	0.1	0.10	9.80	9.80
5	22.22	0.1	0.1	0.1	0.1	0.1	0.10	9.80	19.61
5	33.33	0.1	0.1	0.1	0.1	0.1	0.10	9.80	29.41
5	44.44	0.1	0.1	0.1	0.1	0.1	0.10	9.80	39.22
5	55.55	0.1	0.1	0.1	0.1	0.1	0.10	9.80	49.02
5	66.67	0.1	0.1	0.1	0.2	0.1	0.12	11.76	60.78
5	77.78	0.1	0.1	0.1	0.2	0.1	0.12	11.76	72.55
5	88.89	0.1	0.2	0.1	0.2	0.1	0.14	13.73	86.27
5	100	0.1	0.2	0.1	0.2	0.1	0.14	13.73	100.00
							1.02		

Table 14(b) : Analysis using WRI for 2nd Quartile of 180 minutes rainfall events of Ldg Nada Station

2nd Quartile		Depth							
Minutes	%cum	1	2	3	4	5			
0	0	0	0	0	0	0	Ave	%	%Cum
5	11.11	0.1	0.3	0.2	0.2	0.1	0.18	2.25	2.25
5	22.22	0.1	0.4	0.3	0.3	0.1	0.24	3.00	5.25
5	33.33	0.1	0.5	0.4	0.3	0.2	0.30	3.75	9.00
5	44.44	0.1	0.6	0.4	0.3	0.2	0.32	4.00	13.00
5	55.55	0.1	0.7	0.5	0.5	0.4	0.44	5.50	18.50
5	66.67	0.1	1	0.6	0.7	0.5	0.58	7.25	25.75
5	77.78	0.1	1	0.7	1.2	2.5	1.10	13.75	39.50
5	88.89	0.1	1.1	1	4.3	4.5	2.20	27.50	67.00
5	100	0.1	1.4	1.3	4.7	5.7	2.64	33.00	100.00
							8.00		

Table 14(c) : Analysis using WRRI for 3rd Quartile of 180 minutes rainfall events of Ldg Nada Station

3rd Quartile		Depth							
Minutes	%cum	1	2	3	4	5			
0	0	0	0	0	0	0	Ave	%	%Cum
5	11.11	0.1	1.2	1.2	4.3	5.6	2.48	35.84	35.84
5	22.22	0.1	1	0.9	3.9	3.6	1.90	27.46	63.29
5	33.33	0.1	1	0.7	0.9	1.2	0.78	11.27	74.57
5	44.44	0.1	0.9	0.6	0.5	0.5	0.52	7.51	82.08
5	55.55	0.1	0.7	0.4	0.4	0.2	0.36	5.20	87.28
5	66.67	0.1	0.5	0.4	0.3	0.2	0.30	4.34	91.62
5	77.78	0.1	0.4	0.3	0.3	0.2	0.26	3.76	95.38
5	88.89	0.1	0.3	0.2	0.2	0.1	0.18	2.60	97.98
5	100	0.1	0.2	0.1	0.2	0.1	0.14	2.02	100.00
							6.92		

Table 14(d) : Analysis using WRRI for 4th Quartile of 180 minutes rainfall events of Ldg Nada Station

4th Quartile		Depth							
Minutes	%cum	1	2	3	4	5			
0	0	0	0	0	0	0	Ave	%	%Cum
5	11.11	0.1	0.2	0.1	0.2	0.1	0.14	14.00	14.00
5	22.22	0.1	0.2	0.1	0.2	0.1	0.14	14.00	28.00
5	33.33	0.1	0.1	0.1	0.2	0.1	0.12	12.00	40.00
5	44.44	0.1	0.1	0.1	0.1	0.1	0.10	10.00	50.00
5	55.55	0.1	0.1	0.1	0.1	0.1	0.10	10.00	60.00
5	66.67	0.1	0.1	0.1	0.1	0.1	0.10	10.00	70.00
5	77.78	0.1	0.1	0.1	0.1	0.1	0.10	10.00	80.00
5	88.89	0.1	0.1	0.1	0.1	0.1	0.10	10.00	90.00
5	100	0.1	0.1	0.1	0.1	0.1	0.10	10.00	100.00
							1.00		

Table 15(a) : Analysis using WRRI for 1st Quartile of 60 minutes rainfall events of Ldg Kuala Reman Station

1st Quartile		Depth																								
minutes	%cum	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
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	0
5	33.33	0.1	0.2	0.3	0.1	0.1	0.1	0.4	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	0.1	0.1	0.1	0.2	0.9
5	66.67	0.2	0.4	0.3	0.1	0.1	0.1	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	0.1	0.2	0.1	0.2	0.3	2.1
5	100	0.4	0.6	0.4	0.1	0.1	0.1	1.5	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.4	0.2	0.1	0.3	0.1	0.1	0.2	0.1	0.2	0.4	2.2

1st Quartile		Depth																								
Minutes	%cum	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
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	0
5	33.33	0.3	0.2	0.1	0.2	0.3	0.2	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.2	0.2	0.1	0.2	0.2	0.3	0.1	0.1	0.1	0.8	0.5	0.1
5	66.67	0.7	0.2	0.1	0.2	0.5	1.1	0.2	0.1	0.2	0.2	0.1	0.1	0.1	1.2	0.2	0.1	0.2	0.2	0.8	0.2	0.1	0.1	1.1	1	0.1
5	100	1.8	0.5	0.1	0.2	1	2.2	0.3	0.1	0.2	0.2	0.1	0.1	0.2	1.4	0.2	0.1	0.6	1.3	5	0.5	0.1	0.1	1.4	1.1	0.1

1st Quartile		Depth							
Minutes	%cum	51	52	53	55	55	Ave	%	%Cum
0	0	0	0	0	0	0	0	0	0
5	33.33	0.1	0.4	0.1	0.2	0.1	0.18	16.84	16.84
5	66.67	0.1	1.6	0.1	0.2	0.1	0.32	29.93	46.77
5	100	0.1	3.5	0.1	0.3	0.1	0.57	53.23	100.00
							1.07		

Table 15(b) : Analysis using WRRI for 2nd Quartile of 60 minutes rainfall events of Ldg Kuala Reman Station

2nd Quartile		Depth																								
minutes	%cum	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
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	0
5	33.33	1.2	1	0.7	0.1	0.4	0.3	2.7	0.4	0.1	0.1	0.2	0.1	0.1	0.2	0.5	0.3	0.1	0.3	0.1	0.1	0.3	0.2	0.3	1	2.8
5	66.67	2.2	3.5	2.5	0.3	0.9	2	5.6	1	0.1	0.2	0.4	0.3	0.1	0.2	2.4	0.4	0.7	0.5	0.1	0.1	0.4	0.8	0.3	1.6	4.3
5	100	3.1	8.4	3.9	0.4	2.2	6.5	7	2.1	0.1	0.3	2.8	0.4	0.2	0.2	2.9	1	2.5	1	0.1	0.5	1.1	5.5	2.9	2.8	4.7

2nd Quartile		Depth																								
Minutes	%cum	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
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	0
5	33.33	4.9	1	0.1	0.4	1	4.7	0.3	0.1	0.2	0.2	0.2	0.1	0.3	3.4	0.2	0.2	2.2	1.6	8.5	1	0.1	0.2	1.6	1.6	0.1
5	66.67	6.7	2.3	0.8	0.6	1.5	4.9	0.3	0.1	0.3	0.3	0.2	0.1	0.9	5.6	0.2	0.2	3.3	3.1	10.3	2.5	0.2	0.2	1.8	2.4	0.8
5	100	10.4	3.3	2.4	1.2	2.5	8.5	0.5	0.1	0.5	0.4	0.4	0.2	4.5	8.8	0.4	0.2	7.1	3.7	12.6	7.4	0.2	0.3	2.9	4.2	2.5

2nd Quartile		Depth							
Minutes	%cum	51	52	53	55	55	Ave	%	%Cum
0	0	0	0	0	0	0	0	0	0
5	33.33	0.2	5.2	0.1	0.4	0.1	0.98	17.61	17.61
5	66.67	0.6	6.8	0.1	1.1	0.5	1.63	29.33	46.94
5	100	0.9	9.9	0.3	1.9	1.3	2.95	53.06	100.00
							5.55		

Table 15(c) : Analysis using WRRI for 3rd Quartile of 60 minutes rainfall events of Ldg Kuala Reman Station

3rd Quartile		Depth																								
minutes	%cum	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
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	0
5	33.33	1.2	1	0.7	0.1	0.4	0.3	2.7	0.4	0.1	0.1	0.2	0.1	0.1	0.2	0.5	0.3	0.1	0.3	0.1	0.1	0.3	0.2	0.3	1	2.8
5	66.67	2.2	3.5	2.5	0.3	0.9	2	5.6	1	0.1	0.2	0.4	0.3	0.1	0.2	2.4	0.4	0.7	0.5	0.1	0.1	0.4	0.8	0.3	1.6	4.3
5	100	3.1	8.4	3.9	0.4	2.2	6.5	7	2.1	0.1	0.3	2.8	0.4	0.2	0.2	2.9	1	2.5	1	0.1	0.5	1.1	5.5	2.9	2.8	4.7

3rd Quartile		Depth																								
Minutes	%cum	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
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	0
5	33.33	9.7	3.2	1.2	0.7	2	5.3	0.4	0.1	0.4	0.4	0.2	0.2	4	6.3	0.3	0.2	3.7	3.1	10.7	5.5	0.2	0.2	2.6	2.6	1.7
5	66.67	6	1.4	0.6	0.4	1.1	4.8	0.3	0.1	0.3	0.2	0.2	0.1	0.4	4	0.2	0.2	2.7	3.1	8.8	2.3	0.1	0.2	1.6	2.3	0.1
5	100	3.2	0.7	0.1	0.2	1	2.4	0.3	0.1	0.2	0.2	0.2	0.1	0.3	2.2	0.2	0.1	1.7	1.4	8.2	0.9	0.1	0.1	1.4	1.3	0.1

3rd Quartile		Depth							
Minutes	%cum	51	52	53	55	55	Ave	%	%Cum
0	0	0	0	0	0	0	0	0	0
5	33.33	0.8	8.4	0.2	1.6	0.9	2.22	52.88	52.88
5	66.67	0.4	5.2	0.1	1	0.3	1.23	29.19	82.07
5	100	0.1	3.7	0.1	0.3	0.1	0.75	17.93	100.00
							4.20		

Table 15(d) : Analysis using WRRI for 4th Quartile of 60 minutes rainfall events of Ldg Kuala Reman Station

4th Quartile		Depth																								
minutes	%cum	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
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	0
5	33.33	0.3	0.4	0.4	0.1	0.1	0.1	1.3	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.2	0.1	0.1	0.2	0.1	0.2	0.4	2.1
5	66.67	0.1	0.4	0.3	0.1	0.1	0.1	0.4	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	0.2	0.1	0.1	0.2	1
5	100	0.1	0.2	0.2	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	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.6

4th Quartile		Depth																								
Minutes	%cum	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
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	0
5	33.33	0.7	0.4	0.1	0.2	0.6	1.3	0.2	0.1	0.2	0.2	0.1	0.1	0.1	1.4	0.2	0.1	0.3	0.6	2.8	0.3	0.1	0.1	1.2	1	0.1
5	66.67	0.6	0.2	0.1	0.2	0.3	0.4	0.2	0.1	0.2	0.2	0.1	0.1	0.1	0.3	0.2	0.1	0.2	0.2	0.4	0.1	0.1	0.1	1.1	0.7	0.1
5	100	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.2	0.2	0.2	0.1	0.1	0.1	0.6	0.4	0.1

4th Quartile		Depth							
Minutes	%cum	51	52	53	55	55	Ave	%	%Cum
0	0	0	0	0	0	0	0	0	0
5	33.33	0.1	3.3	0.1	0.3	0.1	0.43	54.38	54.38
5	66.67	0.1	0.6	0.1	0.2	0.1	0.22	27.42	81.80
5	100	0.1	0.4	0.1	0.2	0.1	0.14	18.20	100.00
							0.79		

Table 16(a) : Analysis using WRRI for 1st Quartile of 120 minutes rainfall events of Ldg Kuala Reman Station

1st Quartile		Depth																								
minutes	%cum	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
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	0
5	16.67	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.2	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
5	33.33	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.3	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
5	50	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.1	0.1	0.1	0.3	0.1	0.1	0.1	0.1	0.1	0.1	0.3	0.1	0.5	0.1	0.2	0.1	0.1
5	66.67	0.1	0.2	0.1	0.1	0.2	0.1	0.2	0.2	0.1	0.1	0.2	0.4	0.1	0.1	0.1	0.1	0.1	0.1	0.9	0.1	1.5	0.2	0.3	0.1	0.1
5	83.33	0.1	0.2	0.2	0.2	0.2	0.1	0.2	0.3	0.1	0.1	0.5	0.5	0.1	0.1	0.1	0.1	0.1	0.2	3.2	0.1	2.7	0.5	1	0.1	0.1
5	100	0.1	0.2	0.3	0.4	0.3	0.1	0.2	0.3	0.1	0.1	1	0.5	0.2	0.1	0.1	0.1	0.1	0.2	4.3	0.1	2.8	1.9	1.1	0.1	0.1

1st Quartile		Depth						
Minutes	%cum	26	27	28	29	Ave	%	%Cum
0	0	0	0	0	0	0	0	0
5	16.67	0.1	0.1	0.1	0.1	0.11	7.00	7.00
5	33.33	0.1	0.1	0.1	0.1	0.11	7.22	14.22
5	50	0.1	0.1	0.1	0.1	0.14	9.03	23.25
5	66.67	0.3	0.1	0.1	0.1	0.22	14.45	37.70
5	83.33	0.4	0.1	0.1	0.2	0.41	26.86	64.56
5	100	0.5	0.1	0.1	0.2	0.54	35.44	100.00
						1.53		

Table 16(b) : Analysis using WRRI for 2nd Quartile of 120 minutes rainfall events of Ldg Kuala Reman Station

2nd Quartile		Depth																								
minutes	%cum	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
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	0
5	16.67	0.1	0.2	0.6	0.8	0.5	0.1	0.3	0.5	0.1	0.1	1.2	0.7	0.2	0.1	0.3	0.1	0.1	0.3	5.2	0.1	3	2.1	1.6	0.1	0.1
5	33.33	0.1	0.2	0.7	0.9	0.8	0.1	0.5	1.3	0.2	0.1	1.3	1	0.2	0.1	0.3	0.1	0.3	0.4	5.6	0.1	3.3	2.7	2.1	0.1	0.1
5	50	0.1	0.2	1	1.3	0.9	0.1	1	1.6	0.2	0.1	1.4	1.1	0.2	0.3	1	0.1	0.5	0.4	5.8	0.1	4	3.6	2.4	0.1	0.1
5	66.67	0.1	0.2	3.1	2.1	1.1	0.1	1.4	1.9	0.2	0.1	1.5	1.7	0.3	0.8	3.1	0.1	0.6	0.6	8	1.5	4.5	3.7	3.6	0.1	0.2
5	83.33	0.1	0.3	4.8	8	1.5	0.1	2.3	2.1	0.2	0.2	1.7	3.5	0.7	0.9	4	0.2	1.5	1	9.7	2.2	5	5.8	4.7	0.2	0.5
5	100	0.1	0.4	5	9.2	12	0.1	4.6	3.4	0.2	0.2	1.8	7.8	0.9	2.3	6.7	0.3	2.1	1.2	11.1	3.7	9.7	6.8	8.7	0.3	1

2nd Quartile		Depth						
Minutes	%cum	26	27	28	29	Ave	%	%Cum
0	0	0	0	0	0	0	0	0
5	16.67	1.4	0.2	0.1	0.2	0.70	6.51	6.51
5	33.33	2	0.2	0.1	0.2	0.87	8.01	14.53
5	50	2.8	0.2	0.6	0.3	1.09	10.06	24.58
5	66.67	3.4	0.9	1.9	0.3	1.62	15.04	39.62
5	83.33	5.4	1.8	3.3	0.3	2.48	22.99	62.61
5	100	7.2	3.5	6.1	0.7	4.04	37.39	100.00
						10.80		

Table 16(c) : Analysis using WRRI for 3rd Quartile of 120 minutes rainfall events of Ldg Kuala Reman Station

3rd Quartile		Depth																								
minutes	%cum	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
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	0
5	16.67	0.1	0.3	4.8	8.1	4	0.1	3.6	2.2	0.2	0.2	1.7	4.5	0.8	1.5	4.3	0.2	2	1.1	10.6	2.6	6.1	6.3	5.9	0.3	0.6
5	33.33	0.1	0.2	4.6	3.1	1.3	0.1	1.6	2.1	0.2	0.1	1.5	1.9	0.6	0.8	3.1	0.1	1.4	0.6	8.9	2	4.7	5.7	4	0.2	0.3
5	50	0.1	0.2	3	1.5	0.9	0.1	1.2	1.9	0.2	0.1	1.4	1.3	0.3	0.6	2.8	0.1	0.5	0.5	7.5	0.5	4.4	3.7	3	0.1	0.1
5	66.67	0.1	0.2	0.9	0.9	0.8	0.1	0.7	1.5	0.2	0.1	1.3	1	0.2	0.3	0.6	0.1	0.5	0.4	5.7	0.1	3.9	2.7	2.2	0.1	0.1
5	83.33	0.1	0.2	0.7	0.8	0.5	0.1	0.5	0.7	0.2	0.1	1.2	0.9	0.2	0.1	0.3	0.1	0.2	0.4	5.6	0.1	3.1	2.5	2.1	0.1	0.1
5	100	0.1	0.2	0.6	0.7	0.3	0.1	0.2	0.3	0.1	0.1	1.1	0.6	0.2	0.1	0.1	0.1	0.1	0.3	4.6	0.1	3	2	1.3	0.1	0.1

3rd Quartile		Depth						
Minutes	%cum	26	27	28	29	Ave	%	%Cum
0	0	0	0	0	0	0	0	0
5	16.67	6.3	2.5	6	0.4	3.01	34.26	34.26
5	33.33	3.8	1.7	2.2	0.3	1.97	22.45	56.71
5	50	3.4	0.5	1.4	0.3	1.43	16.33	73.04
5	66.67	2.1	0.2	0.1	0.3	0.94	10.75	83.79
5	83.33	1.9	0.2	0.1	0.2	0.80	9.14	92.94
5	100	1.1	0.1	0.1	0.2	0.62	7.06	100.00
						8.79		

Table 16(d) : Analysis using WRRI for 4th Quartile of 120 minutes rainfall events of Ldg Kuala Reman Station

4th Quartile		Depth																								
minutes	%cum	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
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	0
5	16.67	0.1	0.2	0.2	0.3	0.2	0.1	0.2	0.3	0.1	0.1	0.9	0.5	0.2	0.1	0.1	0.1	0.1	0.2	3.8	0.1	2.7	1	1.1	0.1	0.1
5	33.33	0.1	0.2	0.1	0.2	0.2	0.1	0.2	0.2	0.1	0.1	0.5	0.5	0.1	0.1	0.1	0.1	0.1	0.2	1	0.1	2.4	0.4	0.8	0.1	0.1
5	50	0.1	0.2	0.1	0.1	0.2	0.1	0.2	0.2	0.1	0.1	0.2	0.3	0.1	0.1	0.1	0.1	0.1	0.1	0.8	0.1	0.8	0.2	0.2	0.1	0.1
5	66.67	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.1	0.1	0.1	0.3	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1
5	83.33	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.2	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
5	100	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	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

4th Quartile		Depth						
Minutes	%cum	26	27	28	29	Ave	%	%Cum
0	0	0	0	0	0	0	0	0
5	16.67	0.5	0.1	0.1	0.2	0.48	36.90	36.90
5	33.33	0.3	0.1	0.1	0.2	0.30	23.53	60.43
5	50	0.2	0.1	0.1	0.1	0.18	14.17	74.60
5	66.67	0.1	0.1	0.1	0.1	0.12	9.09	83.69
5	83.33	0.1	0.1	0.1	0.1	0.11	8.29	91.98
5	100	0.1	0.1	0.1	0.1	0.10	8.02	100.00
						1.29		

**Table 17(a) : Analysis using WRRI for 1st Quartile of 180 minutes rainfall events of
Ldg Kuala Reman Station**

1st Quartile		Depth				
Minutes	%cum	1	2	Ave	%	%Cum
0	0	0	0	0	0	0
5	11.11	0.1	0.1	0.1	10	10
5	22.22	0.1	0.1	0.1	10	20
5	33.33	0.1	0.1	0.1	10	30
5	44.44	0.1	0.1	0.1	10	40
5	55.55	0.1	0.1	0.1	10	50
5	66.67	0.1	0.1	0.1	10	60
5	77.78	0.1	0.1	0.1	10	70
5	88.89	0.1	0.2	0.15	15	85
5	100	0.1	0.2	0.15	15	100
				1		

**Table 17(b) : Analysis using WRRI for 2nd Quartile of 180 minutes rainfall events of
Ldg Kuala Reman Station**

2nd Quartile		Depth				
Minutes	%cum	1	2	Ave	%	%Cum
0	0	0	0	0	0	0
5	11.11	0.1	0.2	0.15	1.58	1.58
5	22.22	0.1	0.3	0.2	2.11	3.68
5	33.33	0.4	0.4	0.4	4.21	7.89
5	44.44	0.6	0.4	0.5	5.26	13.16
5	55.55	0.8	0.4	0.6	6.32	19.47
5	66.67	0.9	0.4	0.65	6.84	26.32
5	77.78	2	0.5	1.25	13.16	39.47
5	88.89	2.1	0.6	1.35	14.21	53.68
5	100	7.5	1.3	4.4	46.32	100.00
5				9.5		

Table 17(c) : Analysis using WRRI for 3rd Quartile of 180 minutes rainfall events of Ldg Kuala Reman Station

3rd Quartile		Depth				
Minutes	%cum	1	2	Ave	%	%Cum
0	0	0	0	0	0	0
5	11.11	5.4	0.7	3.05	41.50	41.50
5	22.22	2	0.6	1.3	17.69	59.18
5	33.33	1	0.5	0.75	10.20	69.39
5	44.44	0.8	0.4	0.6	8.16	77.55
5	55.55	0.7	0.4	0.55	7.48	85.03
5	66.67	0.5	0.4	0.45	6.12	91.16
5	77.78	0.3	0.3	0.3	4.08	95.24
5	88.89	0.1	0.3	0.2	2.72	97.96
5	100	0.1	0.2	0.15	2.04	100.00
5				7.35		

Table 17(d) : Analysis using WRRI for 4th Quartile of 180 minutes rainfall events of Ldg Kuala Reman Station

4th Quartile		Depth				
Minutes	%cum	1	2	Ave	%	%Cum
0	0	0	0	0	0	0
5	11.11	0.1	0.2	0.15	15.79	15.79
5	22.22	0.1	0.1	0.1	10.53	26.32
5	33.33	0.1	0.1	0.1	10.53	36.84
5	44.44	0.1	0.1	0.1	10.53	47.37
5	55.55	0.1	0.1	0.1	10.53	57.89
5	66.67	0.1	0.1	0.1	10.53	68.42
5	77.78	0.1	0.1	0.1	10.53	78.95
5	88.89	0.1	0.1	0.1	10.53	89.47
5	100	0.1	0.1	0.1	10.53	100.00
5				0.95		

Table 18(a) : Analysis using WRRI for 1st Quartile of 60 minutes rainfall events of Balok Station

1st Quartile		Depth																								
Minutes	%cum	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
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	0
5	33.33	0.1	0.1	0.1	0.1	0.2	0.1	0.3	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	0.5	0.1	0.1	0.1	0.2
5	66.67	0.1	0.1	0.2	0.1	0.3	0.1	0.4	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.8	0.1	0.7	0.1	0.2	0.1	0.2
5	100	0.1	0.1	0.4	0.1	0.5	0.1	0.5	0.1	0.2	0.1	0.1	0.2	0.2	0.1	0.1	0.1	0.1	0.1	2.8	0.1	1.3	0.3	0.2	0.2	0.2

1st Quartile		Depth														
Minutes	%cum	26	27	28	29	30	31	32	33	34	35	36	37	Ave	%	%Cum
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	33.33	0.1	0.1	0.1	0.2	0.1	0.2	0.1	0.1	0.1	0.4	0.1	0.2	0.14	19.49	19.49
5	66.67	0.1	0.1	0.1	0.2	0.1	0.2	0.1	0.1	0.1	1	0.1	0.2	0.20	28.31	47.79
5	100	0.1	0.1	0.1	0.5	0.1	0.2	0.3	0.3	0.2	1.7	0.1	0.3	0.37	52.21	100.00
														0.72		

Table 18(b) : Analysis using WRRI for 2nd Quartile of 60 minutes rainfall events of Balok Station

2nd Quartile		Depth																								
Minutes	%cum	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
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	0
5	33.33	0.1	0.3	1.1	1.1	0.7	0.1	0.5	0.1	0.3	0.1	0.1	0.3	0.3	0.1	0.2	0.1	0.2	0.3	3.9	0.1	1.9	0.3	0.4	0.3	0.7
5	66.67	1.1	1	2	1.4	1	0.3	1.8	0.1	0.3	0.2	0.1	0.4	0.9	0.1	1.6	0.3	0.2	2.3	4.5	0.1	2.5	0.5	1.5	0.4	2.8
5	100	6.5	1	5.4	1.9	1.3	0.6	3	0.4	0.4	0.3	0.4	0.8	3.1	2.8	2.3	1	0.2	5.7	7	0.1	4.1	2.1	2.6	0.5	6.4

2nd Quartile		Depth														
Minutes	%cum	26	27	28	29	30	31	32	33	34	35	36	37	Ave	%	%Cum
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	33.33	2.1	0.1	0.1	0.7	0.5	0.1	0.4	0.9	0.5	0.2	2.4	0.2	0.4	0.58	14.02
5	66.67	2.9	1	0.2	1.5	0.7	0.4	0.7	3.6	1	0.2	3.3	0.2	0.7	1.15	27.67
5	100	5.5	2.5	0.3	2.7	0.9	0.6	1.1	8.3	2.3	0.2	5.7	1.3	1	2.43	58.31
															4.17	

Table 18(c) : Analysis using WRI for 3rd Quartile of 60 minutes rainfall events of Balok Station

3rd Quartile		Depth																								
Minutes	%cum	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
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	0
5	33.33	3.4	1	3.8	1.7	1.1	0.4	1.8	0.4	0.3	0.3	0.2	0.6	2.6	1.2	2.2	0.5	0.2	4.2	4.9	0.1	2.6	1.5	1.8	0.4	5.4
5	66.67	0.1	0.3	1.4	1.1	0.8	0.2	0.6	0.1	0.3	0.2	0.1	0.3	0.7	0.1	0.3	0.2	0.2	1.8	4.3	0.1	2.4	0.4	1.2	0.3	1.4
5	100	0.1	0.1	0.5	0.4	0.5	0.1	0.5	0.1	0.2	0.1	0.1	0.2	0.2	0.1	0.1	0.1	0.1	0.2	3	0.1	1.6	0.3	0.2	0.2	0.3

3rd Quartile		Depth															
Minutes		%cum	26	27	28	29	30	31	32	33	34	35	36	37	Ave	%	%Cum
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	33.33	3.3	2	0.2	2.7	0.7	0.5	0.9	4.1	2.1	0.2	4	0.6	1	1.71	58.73	
5	66.67	2.2	0.1	0.2	0.9	0.6	0.3	0.6	1.2	0.6	0.2	2.8	0.2	0.4	0.77	26.43	
5	100	2	0.1	0.1	0.4	0.5	0.1	0.3	0.5	0.5	0.2	1.9	0.1	0.3	0.43	14.84	
															2.91		

Table 18(d) : Analysis using WRRI for 4th Quartile of 60 minutes rainfall events of Balok Station

4th Quartile		Depth																								
Minutes	%cum	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
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	0
5	33.33	0.1	0.1	0.3	0.1	0.3	0.1	0.4	0.1	0.2	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	1.7	0.1	1.1	0.2	0.2	0.2	0.2
5	66.67	0.1	0.1	0.1	0.1	0.2	0.1	0.3	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.4	0.1	0.5	0.1	0.2	0.1	0.2
5	100	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	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1

4th Quartile		Depth														
Minutes	%cum	26	27	28	29	30	31	32	33	34	35	36	37	Ave	%	%Cum
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	33.33	1	0.1	0.1	0.1	0.4	0.1	0.2	0.1	0.2	0.2	1	0.1	0.3	0.27	49.05
5	66.67	0.5	0.1	0.1	0.1	0.2	0.1	0.2	0.1	0.1	0.1	0.9	0.1	0.2	0.17	30.95
5	100	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.4	0.1	0.1	0.11	20.00
															0.55	

Table 19(a) : Analysis using WRRI for 1st Quartile of 120 minutes rainfall events of Balok Station

1st Quartile	%cum	Depth																				
Minutes		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Ave	%	%Cum
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	16.67	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.1	0.1	0.12	8.79	8.79
5	33.33	0.1	0.1	0.1	0.1	0.4	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.3	0.3	0.1	0.1	0.14	10.46	19.25
5	50	0.1	0.1	0.1	0.1	0.4	0.1	0.1	0.3	0.1	0.1	0.1	0.1	0.1	0.1	0.9	0.3	0.1	0.1	0.18	13.81	33.05
5	66.67	0.1	0.1	0.1	0.1	0.4	0.1	0.1	0.4	0.1	0.1	0.1	0.1	0.2	0.1	1.2	0.3	0.1	0.1	0.21	15.90	48.95
5	83.33	0.1	0.1	0.1	0.1	0.5	0.1	0.1	0.7	0.1	0.1	0.1	0.6	0.2	0.2	1.4	0.3	0.1	0.1	0.28	20.92	69.87
5	100	0.1	0.1	0.1	0.1	0.6	0.1	0.1	1.2	0.1	0.1	0.1	1.8	0.3	0.2	1.7	0.3	0.1	0.1	0.40	30.13	100.00
																				1.33		

Table 19(b) : Analysis using WRRI for 2nd Quartile of 120 minutes rainfall events of Balok Station

2nd Quartile	%cum	Depth																				
Minutes		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Ave	%	%Cum
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	16.67	0.1	0.2	0.1	0.1	1.3	0.1	0.1	1.5	0.1	0.1	0.1	2.5	0.3	0.2	2.1	0.4	0.2	0.1	0.53	5.81	5.81
5	33.33	0.1	0.2	0.2	0.2	1.9	0.1	0.1	3.6	0.1	0.1	0.1	2.8	0.4	0.2	3.6	0.4	0.4	0.1	0.81	8.84	14.66
5	50	0.1	0.3	0.2	0.2	2.5	0.1	0.2	4.2	0.1	0.1	0.1	4.2	0.4	0.2	4	0.4	0.5	0.1	0.99	10.84	25.50
5	66.67	0.1	0.5	0.2	0.2	3.4	0.7	0.2	4.8	0.1	0.1	0.3	7.3	0.5	0.2	4.7	0.5	0.9	0.2	1.38	15.08	40.58
5	83.33	0.1	2.1	0.2	0.3	4.3	2.3	0.2	7.8	0.1	0.1	0.7	7.9	1.5	1.1	7	0.5	2	0.3	2.14	23.32	63.90
5	100	0.1	3.4	0.2	0.4	5.8	3	0.6	14.3	0.1	0.1	1.1	11.1	4	1.7	8.2	1	3.8	0.7	3.31	36.10	100.00
																				9.17		

Table 19(c) : Analysis using WRRI for 3rd Quartile of 120 minutes rainfall events of Balok Station

3rd Quartile	%cum	Depth																				
Minutes		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Ave	%	%Cum
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	16.67	0.1	2.7	0.2	0.3	4.8	2.4	0.2	8	0.1	0.1	0.8	8.4	2.1	1.2	7.9	0.8	3.5	0.4	2.44	33.43	33.43
5	33.33	0.1	1	0.2	0.2	3.6	1.5	0.2	6.9	0.1	0.1	0.5	7.4	0.9	0.4	4.9	0.5	1.7	0.2	1.69	23.10	56.53
5	50	0.1	0.4	0.2	0.2	3.4	0.5	0.2	4.4	0.1	0.1	0.2	5.2	0.4	0.2	4.2	0.4	0.6	0.1	1.16	15.88	72.42
5	66.67	0.1	0.2	0.2	0.2	2.3	0.1	0.2	3.8	0.1	0.1	0.1	2.9	0.4	0.2	3.8	0.4	0.5	0.1	0.87	11.93	84.35
5	83.33	0.1	0.2	0.2	0.1	1.6	0.1	0.1	2	0.1	0.1	0.1	2.6	0.3	0.2	3.5	0.4	0.3	0.1	0.67	9.19	93.54
5	100	0.1	0.1	0.1	0.1	0.9	0.1	0.1	1.3	0.1	0.1	0.1	2.5	0.3	0.2	1.9	0.3	0.1	0.1	0.47	6.46	100.00
																				7.31		

Table 19(d) : Analysis using WRRI for 4th Quartile of 120 minutes rainfall events of Balok Station

4th Quartile	%cum	Depth																					
Minutes		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Ave	%	%Cum	
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	16.67	0.1	0.1	0.1	0.1	0.5	0.1	0.1	0.9	0.1	0.1	0.1	1.4	0.2	0.2	1.4	0.3	0.1	0.1	0.33	28.99	28.99	
5	33.33	0.1	0.1	0.1	0.1	0.5	0.1	0.1	0.6	0.1	0.1	0.1	0.2	0.2	0.2	1.2	0.3	0.1	0.1	0.24	20.77	49.76	
5	50	0.1	0.1	0.1	0.1	0.4	0.1	0.1	0.3	0.1	0.1	0.1	0.1	0.2	0.1	0.9	0.3	0.1	0.1	0.19	16.43	66.18	
5	66.67	0.1	0.1	0.1	0.1	0.4	0.1	0.1	0.3	0.1	0.1	0.1	0.1	0.1	0.1	0.4	0.3	0.1	0.1	0.16	13.53	79.71	
5	83.33	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.3	0.1	0.1	0.12	10.63	90.34	
5	100	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	0.1	0.2	0.2	0.1	0.1	0.11	9.66	100.00	
																				1.15			

Table 20(a) : Analysis using WRRI for 1st Quartile of 180 minutes rainfall events of Balok Station

4th Quartile		Depth								
Minutes	%cum	1	2	3	4	5	6	Ave	%	%Cum
0	0	0	0	0	0	0	0	0	0	0
5	11.11	0.1	0.1	0.1	0.1	0.1	0.1	0.10	8.00	8.00
5	22.22	0.1	0.1	0.1	0.1	0.1	0.1	0.10	8.00	16.00
5	33.33	0.1	0.1	0.1	0.1	0.1	0.2	0.12	9.33	25.33
5	44.44	0.1	0.1	0.1	0.1	0.1	0.3	0.13	10.67	36.00
5	55.55	0.1	0.1	0.1	0.1	0.1	0.3	0.13	10.67	46.67
5	66.67	0.1	0.1	0.1	0.1	0.1	0.4	0.15	12.00	58.67
5	77.78	0.1	0.1	0.1	0.2	0.1	0.4	0.17	13.33	72.00
5	88.89	0.1	0.1	0.1	0.2	0.1	0.4	0.17	13.33	85.33
5	100	0.1	0.2	0.1	0.2	0.1	0.4	0.18	14.67	100.00
								1.25		

Table 20(b) : Analysis using WRRI for 2nd Quartile of 180 minutes rainfall events of Balok Station

4th Quartile		Depth								
Minutes	%cum	1	2	3	4	5	6	Ave	%	%Cum
0	0	0	0	0	0	0	0	0	0	0
5	11.11	0.1	0.2	0.1	0.3	0.1	0.5	0.22	5.35	5.35
5	22.22	0.1	0.2	0.2	0.3	0.1	0.6	0.25	6.17	11.52
5	33.33	0.1	0.2	0.2	0.4	0.1	0.6	0.27	6.58	18.11
5	44.44	0.1	0.2	0.2	0.6	0.1	0.7	0.32	7.82	25.93
5	55.55	0.1	0.2	0.2	0.7	0.1	0.8	0.35	8.64	34.57
5	66.67	0.1	0.2	0.2	0.9	0.1	0.9	0.40	9.88	44.44
5	77.78	0.1	0.3	0.2	1.4	0.1	1	0.52	12.76	57.20
5	88.89	0.1	0.3	0.2	1.5	0.1	1.5	0.62	15.23	72.43
5	100	0.1	0.3	0.2	2.8	0.1	3.2	1.12	27.57	100.00
								4.05		

Table 20(c) : Analysis using WRRI for 3rd Quartile of 180 minutes rainfall events of Balok Station

4th Quartile		Depth								
Minutes	%cum	1	2	3	4	5	6	Ave	%	%Cum
0	0	0	0	0	0	0	0	0	0	0
5	11.11	0.1	0.3	0.2	2.1	0.1	2.6	0.90	24.66	24.66
5	22.22	0.1	0.3	0.2	1.4	0.1	1.2	0.55	15.07	39.73
5	33.33	0.1	0.3	0.2	1.2	0.1	1	0.48	13.24	52.97
5	44.44	0.1	0.2	0.2	0.8	0.1	0.9	0.38	10.50	63.47
5	55.55	0.1	0.2	0.2	0.6	0.1	0.8	0.33	9.13	72.60
5	66.67	0.1	0.2	0.2	0.4	0.1	0.7	0.28	7.76	80.37
5	77.78	0.1	0.2	0.2	0.4	0.1	0.6	0.27	7.31	87.67
5	88.89	0.1	0.2	0.2	0.3	0.1	0.5	0.23	6.39	94.06
5	100	0.1	0.2	0.1	0.3	0.1	0.5	0.22	5.94	100.00
								3.65		

Table 20(d) : Analysis using WRRI for 4th Quartile of 180 minutes rainfall events of Balok Station

4th Quartile		Depth								
Minutes	%cum	1	2	3	4	5	6	Ave	%	%Cum
0	0	0	0	0	0	0	0	0	0	0
5	11.11	0.1	0.1	0.1	0.2	0.1	0.4	0.17	13.89	13.89
5	22.22	0.1	0.1	0.1	0.2	0.1	0.4	0.17	13.89	27.78
5	33.33	0.1	0.1	0.1	0.1	0.1	0.4	0.15	12.50	40.28
5	44.44	0.1	0.1	0.1	0.1	0.1	0.4	0.15	12.50	52.78
5	55.55	0.1	0.1	0.1	0.1	0.1	0.3	0.13	11.11	63.89
5	66.67	0.1	0.1	0.1	0.1	0.1	0.3	0.13	11.11	75.00
5	77.78	0.1	0.1	0.1	0.1	0.1	0.1	0.10	8.33	83.33
5	88.89	0.1	0.1	0.1	0.1	0.1	0.1	0.10	8.33	91.67
5	100	0.1	0.1	0.1	0.1	0.1	0.1	0.10	8.33	100.00
								1.20		

