DETERMINATION OF RAINFALL PATTERN AND FLOW RATE AT TASIK CHINI

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DETERMINATION OF RAINFALL PATTERN AND FLOW RATE AT TASIK CHINI

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Thesis submitted in fulfillment of the requirements
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Specially dedicated to my beloved parents,

my father Hanapi Bin Husin and my mother Noor Zakiah Binti Mohd Yunus

To my beloved siblings,

Noor Amalina Binti Hanapi , Mohammad Akram Bin Hanapi, Noor 'Alini Binti Hanapi, and Noor Amirah Suraya Binti Hanapi

To my beloved supervisor,

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To my friends and coursemates,

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For all their encouragement, patience, and unconditional support

Thank you so much, only ALLAH can repay all of your kindness

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ABSTRAK

Kajian ini menerangkan analisis data sekunder yang dikumpul untuk mengenalpasti corak hujan di Tasik Chini. Data yang dikumpul akan digunakan untuk penyelidikan dan perancang aktiviti-aktiviti sekitar kawasan Tasik Chini. Data hujan dikumpul dari Jabatan Pengairan dan Saliran (JPS) dan stesen hidrologi baru yang telah ditubuhkan di Kampung Melai. Untuk JPS, stesen hidrologi telah dipilih untuk kajian ini adalah di Kampung Batu Gong, Paya Membang dan Kampung Salong dengan stesen nombor 3330109, masing-masing 3430097 dan 3.429.096. Manakala, stesen hidrologi baru adalah Kampung Melai. Lokasi ini dipilih kerana ia terletak berhampiran dengan Jemberau Sungai dan Sungai Chini di mana ia berhampiran dengan aktiviti pembalakan dan perlombongan. Selain itu, semua data hujan yang digunakan untuk dianalisis dan dikira jumlah hujan tahunan dan jumlah hujan bulanan untuk empat Stesen Hidrologi di Tasik Chini selama 10 tahun bagi mendapatkan nilai tertinggi hujan turun. Stesen Hidrologi yang berhampiran di Tasik Chini telah dipilih, dengan merujuk kepada Stesen Hidrologi dinyatakan dalam MSMA2. Fungsi Stesen Hidrologi adalah untuk mengira intensiti jumlah hujan turun bagi kawasan tersebut. Untuk Stesen Paya Membang jumlah purata hujan bulanan 811 mm (antara tahun 2008 sehingga 2017). Manakala, purata hujan bulanan yang tertinggi untuk Stesen Gong Kampung Batu dan Stesen Kampung Salong, masing-masing mencatatkan nilai 449 mm dan 549 mm. Berbanding dengan Stesen Kampung Melai, jumlah purata hujan bulanan adalah 435,4 mm. Satu formula telah digunakan untuk semua data hujan semua (ARI). Antara ARI digunakan adalah ARI 5 tahun ARI 10 tahun ARI, 20 tahun ARI, 50 tahun ARI dan 100 tahun ARI. analisis hidrologi telah digunakan untuk mengumpul data. Lengkuk IDF telah dibangunkan untuk jangka masa 5 minit, 15 minit, 60 minit, 180 minit, 360 minit, 720 minit, 1440 minit, 2880 minit dan 4320 minit. Kemudian, objektif kedua kajian ini dicapai dengan menentukan dan analisis kadar aliran di Sungai Jemberau dan Sungai Chini (Navigation Lock). Daripada analisis kadar aliran tertinggi adalah 4,382 m^3/s yang di Sungai Chini (Navigation Lock). Manakala, kadar aliran terendah juga di Sungai Chini (Navigation Lock) dengan 0.0 m^3/s.

ABSTRACT

This research described analysis studies on the collected secondary data in order to identify the rainfall pattern in Tasik Chini. The collected data be used for research and planning the activities surrounding Tasik Chini area. The rainfall data are collected from Jabatan Pengairan dan Saliran (JPS) and a new hydrological station which is was set up at Kampung Melai. For JPS, the hydrological station had be chosen for this study are at Kampung Batu Gong, Paya Membang and Kampung Salong with station number 3330109, 3430097 and 3429096 respectively. While, the new hydrological station is Kampung Melai. This location was selected because of it is closed to the River Jemberau and Sungai Chini which closed to logging and mining activities. After that, all the rainfall data are used to analysis and calculate the total annual rainfall and total monthly rainfall for four Rainfall Hydrology Station at Tasik Chini with 10 years duration to get the highest value of rainfall. The closed Hydrology Station in Tasik Chini were chosen refer to the Hydrology Station stated in MSMA2. The function of the Hydrology Station is to calculate the Rainfall Intensity of the location with the highest total value of rainfall. For Station of Paya membang the highest average monthly rainfall is 811 mm (between 2008 until 2017). While, the highest average monthly rainfall for Kampung Batu Gong Station and Kampung Salong Station are 449 mm and 549 mm respectively. Compare to the Kampung Melai Station, the amount average monthly rainfall is 435.4 mm. A single formula was applied to all rainfall data of all average recurrence intervals (ARIs). ARIs used were ranging from 5 years ARI 10 years ARI, 20 years ARI, 50 years ARI and 100 years ARI. Hydrological analysis was used to gather data. The IDF Curves were developed for durations of 5 minutes, 15 minutes, 60 minutes, 180 minutes, 360 minute, 720 minutes, 1440 minutes, 2880 minutes and 4320 minutes. Later, the second objective of the study is achieved by determine and analysis the flow rate at Sungai Jemberau and Sungai Chini (Navigation Lock). From the analysis the highest flow rate is 4.382 m^3/s which is at Sungai Chini (Navigation Lock). While, the lowest flow rate also at Sungai Chini (Navigation Lock) with 0.0 m^3/s.

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i	Average rainfall intensity (mm/hr)
T	Average recurrence interval – ARI (0.5<T<12 month and 2<T<100 year)
d	Storm duration (hours)
ʎ, k, θ and ɳ	Fitting constants dependent on the rain gauge location

LIST OF ABBREVIATIONS

D.I.D	Department of Irragation and Drainage
JPS	Jabatan Pengairan dan Saliran
Stn.	Station
Kg.	Kampung
Max.	Maximum

CHAPTER 1

INTRODUCTION

1.1 Background of Study

Studies on rainfall behaviour have attracted a lot of attention from scientists throughout the world. Previous studies have been carried out to investigate the changes in rainfall pattern temporally and spatially. Some findings indicate significant positive trends in rainfall. Which is in recent years, several extreme and drought events have been reported in Malaysia. For example, an extreme rainfall event from 9 to 11 December 2004 caused severe floods over the east coast of Peninsular Malaysia (Juneng et al. 2007). In addition, due to the cold surges of the northeast monsoon, abnormally heavy rainfall occurred in the southern part of Peninsular Malaysia for several days in late December 2006 and in the middle of January 2007, causing massive floods in the region (Malaysian Met. Department 2006, 2007).

Referring to Tangang et al. (2008), the influences from the Borneo vortex, the Madden-Julian Oscillation, and the Indian Ocean Dipole also play an important role in contributing to the massive floods during those periods. On the other hand, Malaysia also experienced numerous drought occurrences with the most significance one in the 1997/98 El Niño, which had an extensive impact on the environment and social activities across the whole nation. Some parts of the nation were threatened by extensive wild forest fire due to prolonged dry weather conditions. These events have raised concern in researches on the behaviour of daily rainfall such as the frequency of wet days, the mean intensity of rain during wet days, the mean amount for extreme events, and the mean lengths of wet and dry spells, which have gradually changed over the years, possibly due to global climatic change.

This present study intends to provide a trend analysis of the behaviour of seasonal rainfall in Peninsular Malaysia over the past 30 years. This includes giving details of the spatial description of several rainfall indices such as the total amount of rainfall, frequency of wet days, rainfall intensity, and the extreme indices that have been considered in the study.

1.2 Problem Statement

Minor activity is influenced by weather conditions, monitoring of weather conditions can help in controlling the activity. The weather change is not same at the Tasik Chini area and the nearest place it is important to monitor and study the pattern of weather at surrounding the hydrological data is needed. These differences can be monitored by the Hydrological station at Tasik Chini. Besides that, whether condition will give influence to the flow of river nearby.

1.3 Research Objective

The objectives of this study are as following:

i. To identify the trend of rainfall pattern at Tasik Chini.
ii. To identify the flow rate and amount of rainfall at station Kampung Melai, Tasik Chini.

1.4 Scopes of Study

Some of the scope of the study should be conducted to ensure that the objectives are met. The scopes were:

i. Develop rainfall pattern at selected JPS hydrological station in Tasik Chini.
ii. Analyse the rainfall data from selected JPS hydrological station and data collected using rain gauge at Kampung Melai, Tasik Chini.
iii. Analyse the stream flow pattern at Sungai Jemberau and Sungai Chini in Tasik Chini.

1.5 Significant of Study

From this study, the future researchers can understand relationship between rainfall pattern and flow rate at Tasik Chini. The rainfall pattern, humidity and others data were collected by rain gauge at Kampung Melai can be used as a reference for researcher since there is no weather station in Tasik Chini. Besides, the data obtained from Department of Irrigation and Drainage (DID) and Department of Surveying and Mapping (DSM) from previous year can be used to observe the trend of changing patterns of rainfall and river flow.

CHAPTER 2

LITERATURE REVIEW

2.1 Rainfall Characteristics

In Malaysia, the rainfall is depends on two monsoon seasons which is southwest monsoon and northeast monsoon. Southwest monsoon seasons where originated from deserts of Australia usually started from May to August whereas the northeast monsoon seasons which originated from China and north Pacific commence between November and February. Besides, there are two transition period of inter-monsoon period which usually start from March to April and from September to October which brings heavy rainfall. The direction of the wind in this inter-monsoon season is variable and usually more than 10 knots (Ho & Yusof, 2012). Due to the seasonal rainfall in Malaysia, the probability for occurrence of rainfall amount is varying during the whole year (Suhaila & Jemain, 2009).

Seasonal variation of rainfall in Peninsular Malaysia is can divided into three main types. The first is over the east coast districts, November, December and January are the months with maximum rainfall, while June and July are the driest month in most districts. The second is over the over the rest of the Peninsular with the exception of the southwest coastal area, the monthly rainfall pattern shows two periods of maximum rainfall separated by two periods of minimum rainfall. The primary maximum generally occurs in October - November while the secondary maximum generally occurs in April - May the north western region, the primary minimum occurs in January - February with the secondary minimum in June-July while elsewhere the primary minimum occurs in June-July with the secondary minimum in February.

The third is the rainfall pattern over the southwest coastal area is much affected by early morning from May to August with the result that the double maximum and minimum pattern is no longer discernible. October and November are month with maximum rainfall and February the month with minimum rainfall. The March-April-May maximum and June-July minimum are absent or indistinct.

The rainfall is an important consideration in design runoff conveyance and erosion control system. The rain gauge can be measure the amount of rainfall since it has a quite high level of accuracy in measuring the amount of rainfall (Pettazi & Salson, 2012).

2.2 Malaysia Climate

Malaysia is located at South East part of Asia where Peninsular Malaysia and East Malaysia is separated by the South China Sea. There are thirteen states and three federal territories in the country. Malaysia is observed to have a tropical climate, means the average temperature of the country are usually range from 21°C to 32°C and the humidity is range in between 70% to 90% (Tangang et al, 2012), The climate is affected by the northeast and southwest monsoons, tropical winds that alternative during the course of the year. The northeast monsoon blows from November to March and the southwest monsoon from May to September.

Climate change is expected to cause adverse health consequences. A direct impact could be dead due to heat stress or respiratory disease due to air pollution, while indirect effects could include increased food and water borne diseases, resulting from changes in rainfall pattern. There could be an increase in vector borne diseases such as, malaria and dengue fever as change in temperature will increase the available of suitable breeding habitats for the vector. In addition climate change will have adverse impacts on electricity production and consumption, and the oil and gas industries. Operational and maintenance costs of electricity producers will be substantially increased to provide the necessary protection for power plants located along the coasts due to increased coastal erosion. A rise in the air and water temperature will reduce plant efficiency and power output leading to higher production costs. There will also be an increase in the consumption of electricity if there is a rise in the air temperature, as it would result in an increased use of air conditioning (Gleick. P.H, 1989).

2.3 Hydrology

Hydrological analysis was carried out to evaluate water level characteristics of the water body as well as their drainage systems (Gray, 1970 & Ceballas and Schnabel, 1998). Annual total rainfall for the Chini area ranged from 1487.7 mm to 3071.4 mm, the highest rainfall of 3071.4 mm was recorded in 1994 and the lowest of 1487.7mm in 1997 It had been shown in Figure 2.3 (a). The average rainfall was 2235mm/year or 186mm/month. The total annual rain days in the study area ranged from 154 to 197 or an average of 178 days/year or 15 days/month. The highest total rain days were identified in 1993 and 1994 at 197 and 190 days respectively, while the figure for 1997 was 154 days in Figure 2.3 (b). For 2004, a total of 159 rain days was identified in Figure 2.3 (c). The highest number of rain days (21 days) was obtained during the wet season, especially during October to December, while February recorded the lowest number of rain days (5 days) in 2004. The highest rainfall recorded was 553.5 mm in October 2004 and the lowest recorded was 16.2 mm in February 2004 in Figure 2.3 (d). The total annual rainfall was 2192 mm in 2004. During the half year of 2005, total rainfall ranged from 5.3mm (February) to 182.9 mm (May), equivalent to an average of 98 mm/month in Figure 2.3 (e). Total rain days for the same year ranged from 1 day (February) to 11 days (June) equivalent to an average of 7 days/month in Figure 2.3 (f).

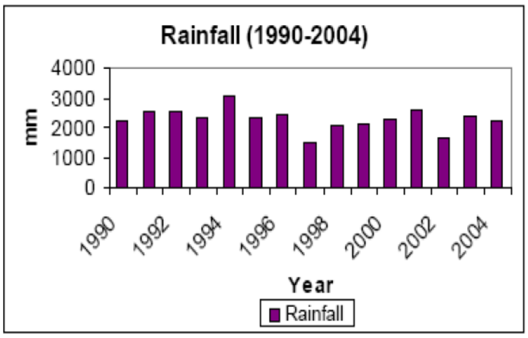


Figure 2.3 (a) *Distribution of rainfall pattern from 1990 to 2004*

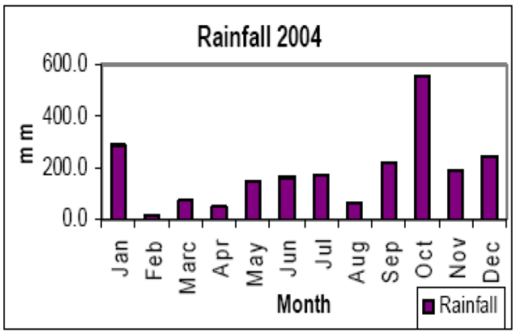


Figure 2.3 (b) *Distribution of rainfall pattern from January to December 2004*

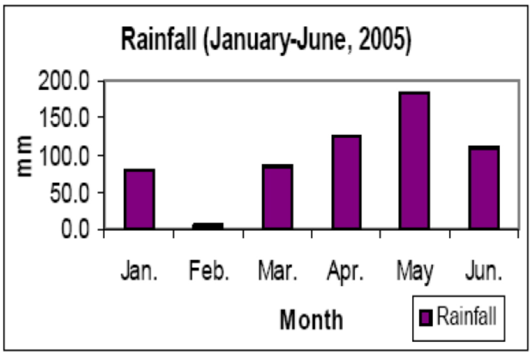


Figure 2.3 (c) *Distribution of rainfall pattern from January to June 2005*

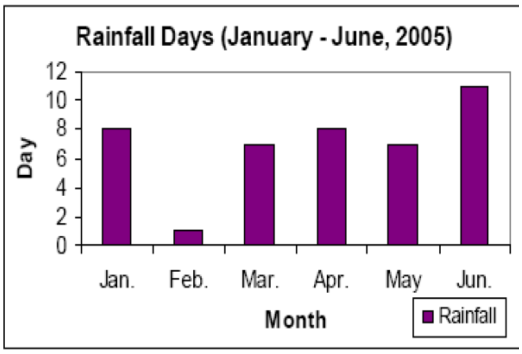


Figure 2.3 (d) *Distribution of rain days from 1990 to 2004*

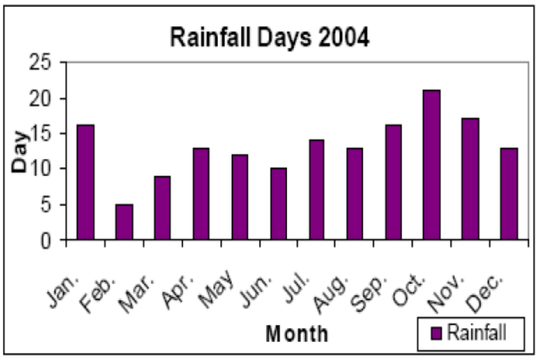


Figure 2.3 (e) *Distribution of rain days from January to December 2004*

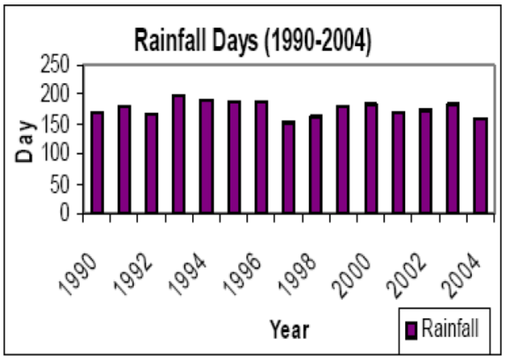


Figure 2.3 (f) *Distribution of rain days from January to June 2005*

2.4 Rainfall Intensity

The amount of rain that falls over time is call as rainfall intensity. It is measured by height of the water layer that covering the ground in a period of time. High or low intensity is depends on the local circumstances. Generally, if high intensity of rainfall on steep slopes, may lead to flash flood, while for the flat areas it may lead to ponding or urban floods when the drainage capacity is insufficient for the intensity of the falling rain.(Floodsites,http://www.floodsite.net/juniorfloodsite/html/en/student/thingstoknow/ hydrology/rainfallintensity.html). Equations 1 below show the Intensity of Rainfall empirical equation.

$i = \lambda Tk / (d+\theta)^{\eta}$ ……... (Equation 2.4)

i = Average rainfall intensity (mm/hr),
T = Average recurrence interval – ARI ($0.5<T<12$ month and $2<T<100$ year),
d = Storm duration (hours),
λ, k, θ and η = Fitting constants dependent on the rain gauge location

2.5 Intensity Duration Frequency (IDF)

Rainfall intensity duration frequency (IDF) Curves are graphical representations of the amount of water that falls within a given period of time in catchment areas (Dupont and Allen, 2000).The_design of any infrastructure requires an understanding of the desired function of the structure and the physical environment in which it must perform this function. Thus, in the case of storm water management, the dimensions of various components of the infrastructure system are based on the return period of heavy rainfall events. (Koutsoyiannis et al.1998 and Koutsoyiannis, 2003) cited that the IDF relationship is a mathematical relationship between the rainfall intensity *i*, the duration *d*, and the return period *T* (or, equivalently, the annual frequency of exceedance *f* typically referred to as 'frequency' only). Indeed the IDF-curves allow for the estimation of the return period of an observed rainfall event or conversely of the rainfall amount corresponding to a given return period for different aggregation times.

2.5.1 Properties of IDF Curves

1. In a logarithmic system of coordinates, IDF relationships are almost parallel decreasing lines. These curves cannot cross each other.
2. For any duration of rainfall, one can establish the intensity of rainfall so long as the frequency of occurrence is given.
3. For any return period, high rainfall intensities are recorded in short duration. In other words the most intense rains are of short duration.

2.5.2 Properties of IDF Curves

Average recurrence interval or annual recurrence interval is the average period or expected value of period between exceedances of a given rainfall total accumulated over a given duration. In this term, periods between exceedances are random. Average Recurrence Interval is also known as return period which is an estimate of the interval of time between events like an earthquake, flood or river discharge flow of a certain intensity or size. Return period is the statistical measurement denoting the average recurrence interval over an extended period of time, and usually required to dimension structures so that they are capable of withstanding an event of a certain return period with its associated intensity.

2.5.3 Uses of IDF Curve

1. Design of hydraulic structures (such as culverts and bridges), roads, and urban drainage systems.
2. Management of municipal infrastructure including sewers, storm water management ponds and street curb.
3. Design of safe and economical structures for the control, storage, and routing of storm water and surface drainage.
4. The IDF relationships are used in the rational method to determine the average rainfall intensity for a selected time of concentration.

2.5.4 Uses of IDF Curve

Three important parameters consists of frequency, duration and intensity were involved in IDF Curve to representing design storm

a) Obtaining raw data

From a recording rain gauge, which gives the cumulative depth of rainfall with time, one can derive and plot a hyetograph of any duration from the storm record. From the hyetograph plotted or calculated, one can then pick the maximum of each durations for the year to constitute the maximum intensity.

b) Identification of extreme events

After obtaining the raw data, the most extreme rainfall events occurring over selected durations within each year are identified. A set of durations is typically selected that is skewed towards the shorter durations in order to obtain data that will accurately represent the relationship between duration and intensity for shorter duration storms.

c) Performance of probability analyses on extreme events

The series of extreme events identified, each fitted to a statistical distribution in order to evaluate the probabilities associated with events of differing magnitudes. Recognizing that the recurrence interval of a storm is the inverse of its probability of occurrence, the fitting of a statistical distribution also allows for the calculation of the magnitude of the storms related to particular recurrence intervals and the calculation of recurrence interval of storms of given magnitudes.

d) Plotting of results

Once steps obtaining raw data, identified extreme events and analyses on extreme event have been performed for each storm duration, plots can be made showing the relationship between rainfall and recurrence interval along lines representing storms with durations equal to those selected in identified of extreme events.

2.6 Temporal Rainfall Pattern

The purpose of designing rainfall temporal patterns is to represent the typical variation of rainfall intensities during a typical storm burst. It shows the temporal distribution of rainfall within the design storm which is an important factor that affects the runoff volume, magnitude and timing of the peak discharge. Realistic estimates of temporal distributions are obtained by analysis of local rainfall data from recording gauge network

In Malaysia, daily and annual rainfall volumes are recorded in rainfall gauges which are recorded on a daily basis. The gauges are used throughout the country alongside a small number of pluviometers. Daily rainfall data is normally readily available at or close to any location of interest for urban storm water studies. The volume rainfall influences the runoff volume and can be computed into, among others, the calculation of storm water quality.

A study on temporal pattern is important for flood estimation as well as runoff computation, and further influence the water resource management and planning. Rainfall analyses are important for the primary aspect for hydrological designs, and temporal rainfall pattern provides the general rainfall event that may happen in the proposed project site to the designers. Among the methods available to develop temporal rainfall pattern are Average Variability Method, Huff Time Distributions, Triangular Hyetograph and SCS method.

An 1982 update of recommends temporal patterns adopted for design storms in Peninsular Malaysia were prepared for six standard duration (0.5, 3, 6, 12, 24 and 72 hours) recommended that patterns of duration of one hour or less to be based on while the longer durations can be based on. In Australia, the national guideline of design flood estimation known as the Australian Rainfall and Runoff (AR&R) Recommends the Design Event Approach as the preferred method of rainfall runoff modeling which involves formulation of a ‘design rainfall event’ and use of a runoff rioting model to convert the rainfall event into stream flow event (I.E.Aust.,1997). The standard duration recommended by Australian Rainfall and Runoff (AR&R) for urban storm water studies are as tabled in Table 2.6.

Table 2.6 Standard Duration Recommended

Standard Duration (min)	Number of Time Intervals	Time Interval (min)
10	2	5
15	3	5
30	6	5
60	12	5
120	8	15
180	6	30
360	6	60

Source: *D.H.Barton, ACT (1987)*

2.6.1 Method of Develop Temporal Rainfall Pattern

There are several methods which can be used to generate temporal patterns consisting Triangular Distribution, SCS Time Distribution and Huff Time Distribution.

a) Triangular Distribution

The triangle is the simplest form in the design depth design hyetograph because when it rains, P and length, D were determined, the length of the base and the height of the triangle can be searched. Therefore, the intensity of the peak, i_{max} is 2P / D which is obtained by solving hyetograph height triangle as shown in Figure 2.6.1 (a). Peak time *tp* is the critical time in which produce the peak intensity. When the triangle is formed, the intensity at regular intervals may be searched or analytical graphics for inclusion in the rainfall-runoff model (Warren and Gary, 1996).

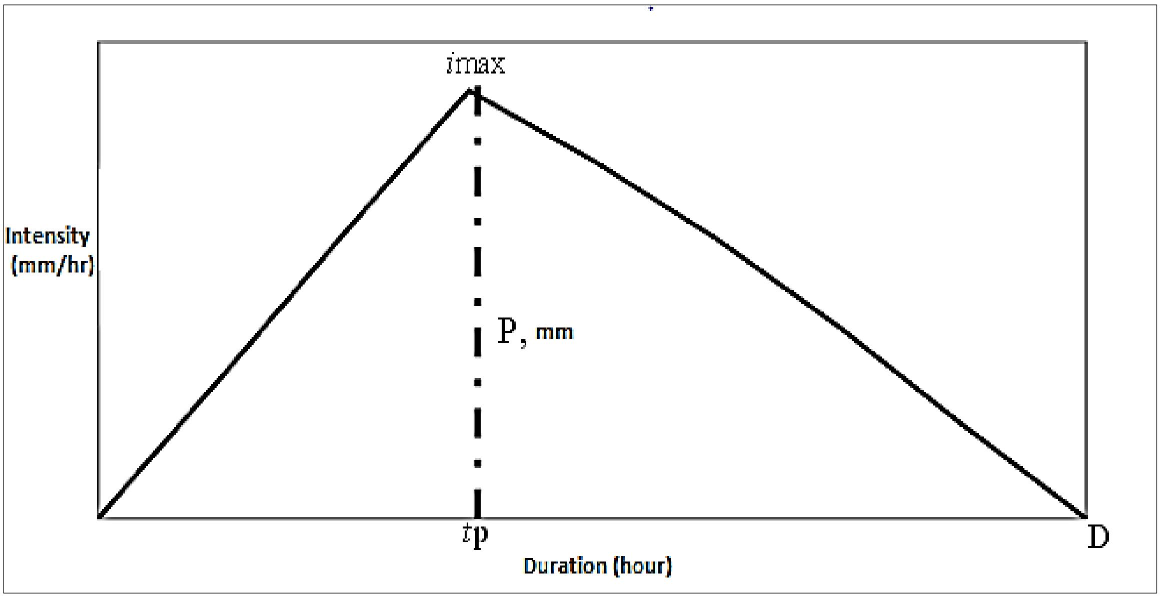


Figure 2.6.1 (a) *Triangular Distribution*
Source: Warren and Gary, (1996)

b) SCS Time Distribution

SCS Time Distribution is critical to storm the small dam design or other small structures, often considered uniform. SCS uses a uniform distribution for short term storm. Figure 2.6.1 (b) Distribution SCS Time to storm six hours was used in the construction of an emergency spillway and freeboard hydrograph. The same curve as 50 percent Huff (median) for the second quartile curve (Warren and Gary, 1996)

SCS also developed a 24-hour rainfall to represent the volume of rainfall and runoff critical for peak flow rate from the watershed, often studied by the engineers themselves. Intensity can caused the maximum peak flow of a small basin. This can happen at different events or on long term storm. The distribution of 24-hour storm is longer than from the need to obtain a peak flow of small watersheds but it should be to get the volume of runoff. Because of this, SCS uses the storm to 24 hours as peak flow studies, the volume of runoff, and hydrograph of runoff water from ordinary study watershed (Warren and Gary, 1996).

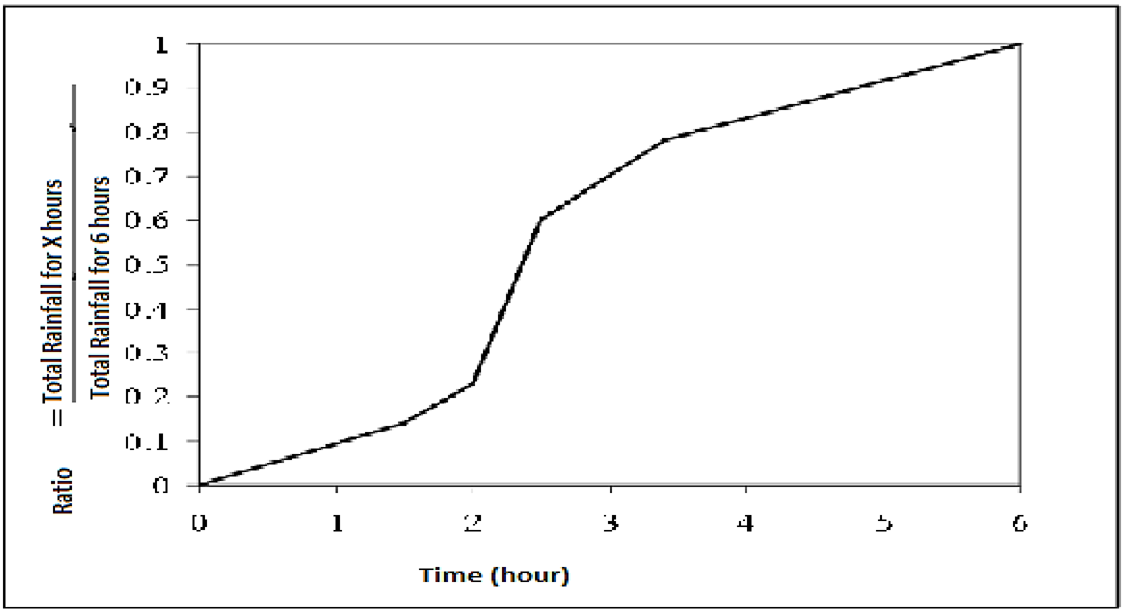


Figure 2.6.1 (b) *SCS Time Distribution*
Source: Warren and Garry, (1996)

c) Huff Time Distribution

Huff Time Distribution is a graph of cumulative rainfall per cent against the cumulative percentage of time. The resulting graph is curved. Huff has divided into four possible patterns of storms so heavy (first quartile) to pharmacist (fourth quartile) (Warren and Gary, 1996). Figure 2.6.1(c) is the curve that describes the distribution of rainfall over time. The probability of 90% means that the distribution is equalled or surpassed in 10 % of total cases. Curve 50 percent chance of storms first quartile or median is recommended to be used for most applications Examples of applications that use it is as RRL and ILLUDAS for the simulation model.

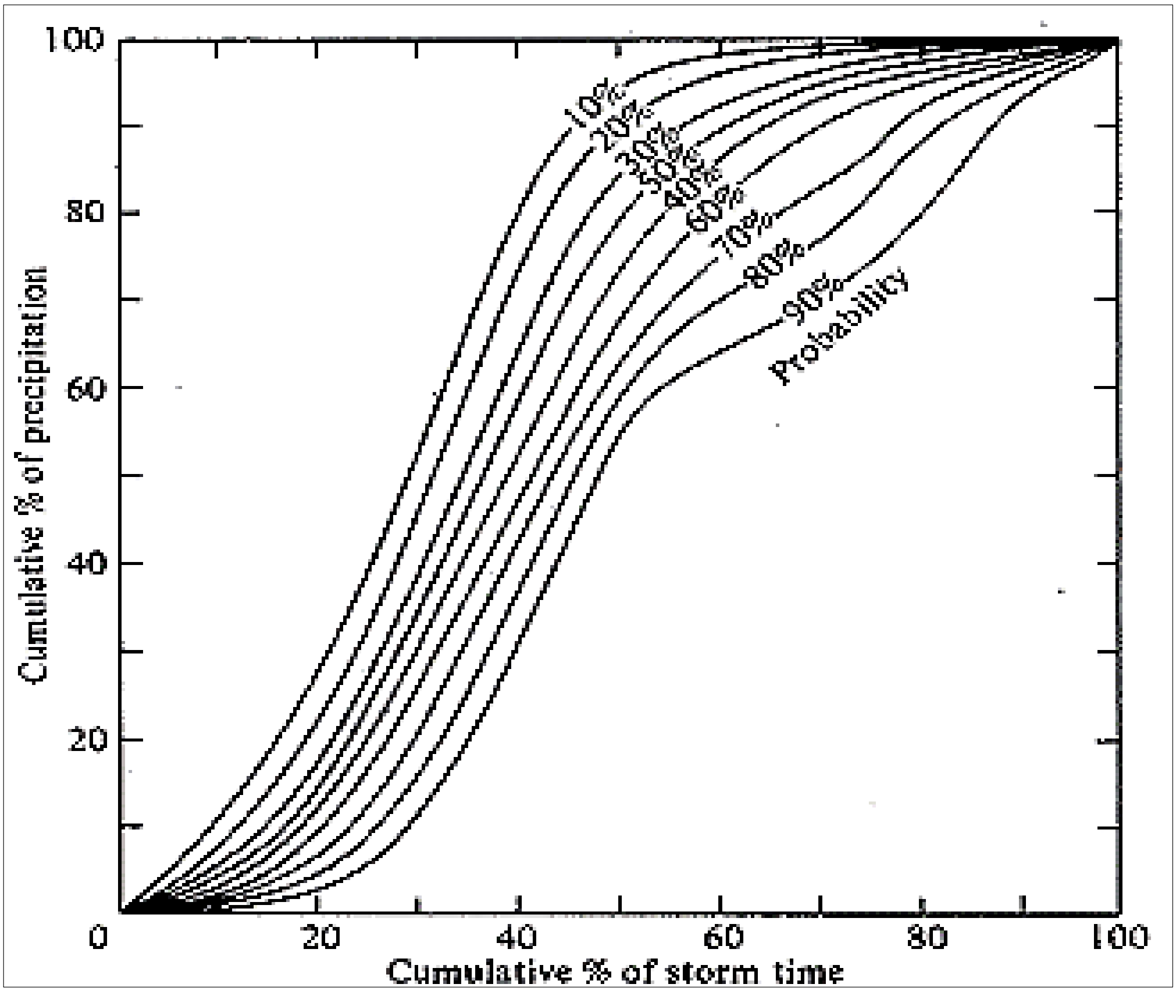


Figure 2.6.1 (c) *Huff Time Distribution*
Source: Warren and Gary,(1996)

2.6.2 Temporal Rainfall Pattern in MSMA

Updating Procedure 1 Hydrology in 1982 makes recommendations for developing temporal rainfall pattern for the design storm for Peninsular Malaysia. There are six periods in a pattern 0.5 hours, 3 hours, 6 hours, 12 hours, 24 hours, and 72 hours (MSMA 2000).

Nine rainfall stations located in different areas in Peninsular Malaysia have been used in this analysis. The data used are from July 1970 to June 1979, for nine years. MSMA, 2000, states that in interfering with the proper time period distribution and best obtained through analysis of local rainfall data from a network of rain gauges record. Therefore, MSMA develop temporal rainfall patterns of local rainfall data points measured in short time intervals (15 minutes or less). The procedure used is to extract patterns of rainfall for the storm annual maximum rainfall for each station.

In MSMA consists of temporal rainfall patterns representing the two areas in Peninsular Malaysia for the West Coast and the East Coast of Peninsular Malaysia. Data temporal rainfall patterns are not available for Sabah and Sarawak. MASMA for Sabah and Sarawak suggest using temporal rainfall patterns for the East Coast of Peninsular Malaysia because the climate situation is almost the same.

2.7 Stream Flow

Stream flow from each feeder river of the Tasik Chini is relatively low; ranging from 0.0042 to 0.9083 m^3/s or an average of 0.1674 m^3/s. The stream flow of Sungai Kuala Merupuk was the highest at 0.9083 m^3/s, and that of Sungai Melai the lowest at 0.0042 m^3/s. Sungai Datang was considered a dead river because there was no water flowing. Similar inferences were obtained on earlier observations of different feeder rivers of Tasik Chini (Muhd. Barzani et al., 2005; Tan Choon Chek et al., 2005). The range values of discharge from the feeder river based on each sampling are as follows: 0.033 m^3/s to 0.6166 m^3/s on October, 0.172 m^3/s to 0.9083 m^3/s on December 2004, 0.0118 m^3/s to 0.207 m^3/s on February 2005, 0.0042 m^3/s to 0.2448 m^3/s on March and 0.0029 m^3/s to 0.0718 m^3/s on April 2005. The respective average steam flow of the nine Feeder Rivers of the Tasik Chini on October, December 2004, February, March and April 2005 were 0.2162 m^3/s, 0.5308 m^3/s, 0.0624 m^3/s, 0.0655 m^3/s and 0.0157 m^3/s. The stream flows of those rivers mainly depend on rainfall events. The highest steam flows were recorded during the wet season, especially in October (0.6166 m^3/s) and December 2004 (0.9083 m^3/s), while the dry season, especially February to April 2005 recorded the lowest steam flows (0.0118 m^3/s, 0.0042 m^3/s and 0.0029 m^3/s) in Figure 2.7 (a). The results obtained fall within the threshold (0.0026 m^3/s to 1.248 m^3/s) as measured by Mohd Ekhwan (2004) using Artificial Neural Network (ANN) in Figure 2.7 (b).

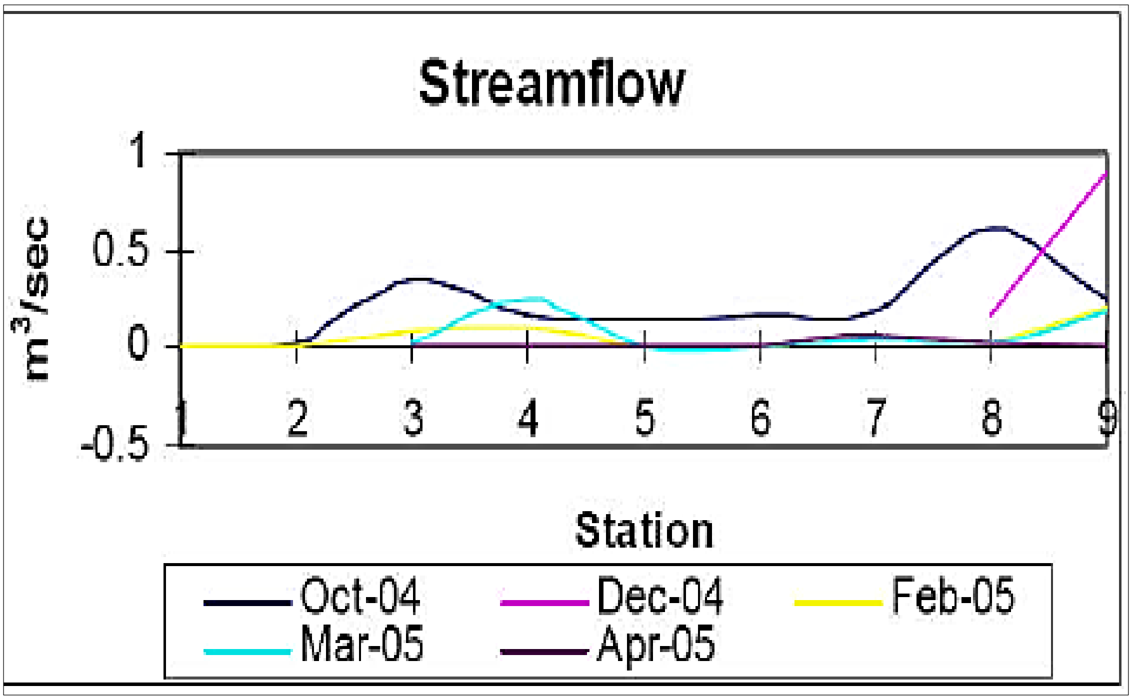


Figure 2.7 (a) *Stream flow in nine sampling station*

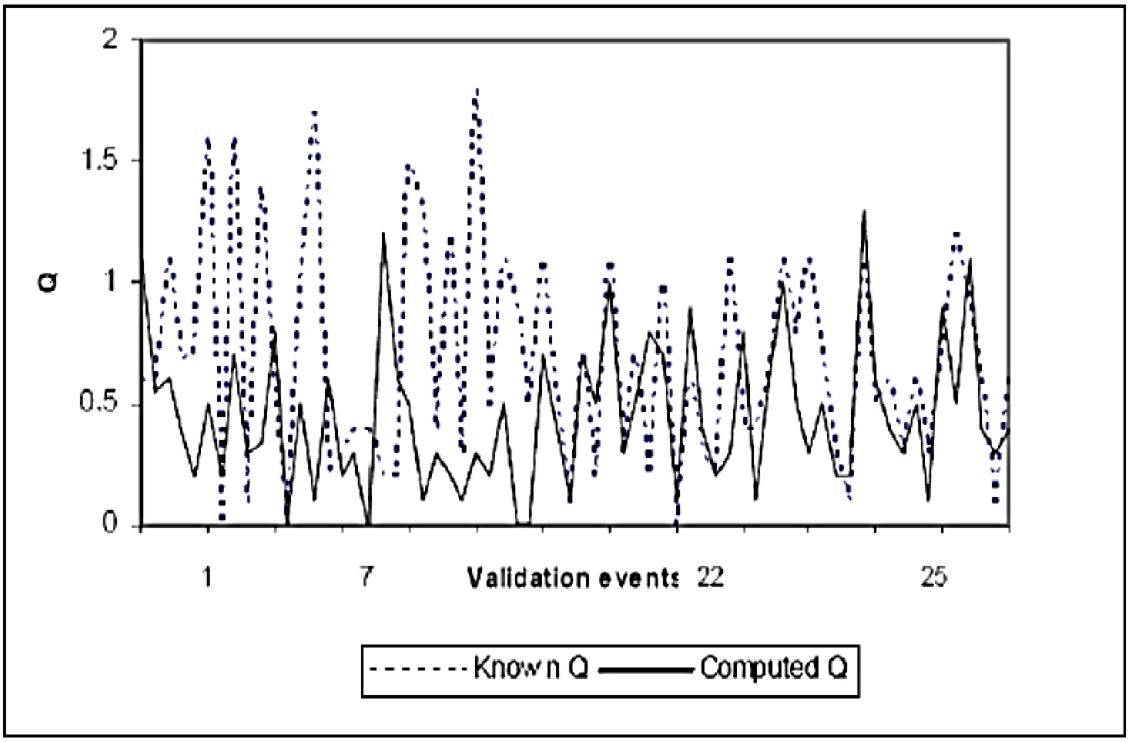


Figure 2.7 (b) *Stream flow in nine sampling station*

2.8 River Discharge

River discharge is defined as the volume of water passing a measuring point or gauging station in a river in a given time. It is measured in cubic metres per second (cumecs). The overall discharge from the drainage basin depends on the relationship between precipitation and storage factors and can be summarised as follows:

Drainage basin discharge = precipitation - evaporate-transpiration + or - changes in

Discharge can be illustrated using hydrographs. These can show annual patterns of flow (the river regime) in response to climate. Short-term variations in discharge are shown using a flood of storm hydrograph.

2.8.1 The Storm Hydrograph

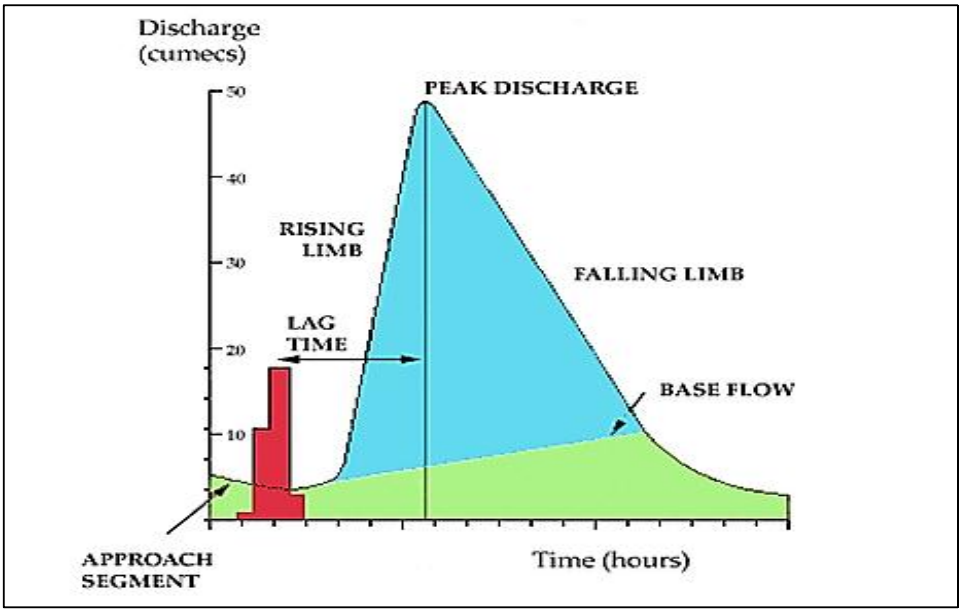


Figure 2.8.1 *Graph of relationship between discharges versus time*

The storm hydrograph (shown to the left) shows variations in a river's discharge over a short period of time, usually during a rainstorm. The starting and finishing level show the base flow of the river. As storm water enters the drainage basin the discharge rises, shown by the rising limb, to reach the peak discharge, which indicates the highest flow in the channel. The receding limb shows the fall in the discharge back to the base level. The time delay between maximum rainfall amount and peak discharge is the lag time.

2.8.2 Factors Affecting a River's Discharge

a) Rock and soil type

- Permeable rocks ad soils (such as sandy soils) absorb water easily, so surface run-off is rare
- Impermeable rock and soils (such as clay soils) are more closely packed. Rainwater can’t infiltrate, so water reaches the river more quickly.
- Pervious rocks (like limestone) allow water to pass through joints, and porous rocks (like chalk) have spaces between the rock particles.

b) Land use

- In urban areas, surfaces like roads are impermeable – water can’t soak into the ground. Instead, it runs into drains, gathers speed and joins rainwater from other drains – eventually spilling into the river
- In rural areas, ploughing up and down (instead of across) hillsides creates channels which allow rainwater to reach rivers faster increasing discharge
- Deforestation means less interception, so rain reaches the ground faster. The ground is likely to become saturated and surface run-off will increase.

c) Rainfall

- The amount and type of rainfall will affect a river’s discharge
- Antecedent rainfall is rain that has already happened. It can mean that the ground has become saturated. Further rain will then flow as surface run-off towards the river
- Heavy continual rain, or melting snow, means more water flowing into the river

d) Relief

- Steep slopes mean that rainwater is likely to run straight over the surface before it can infiltrate. On more gentle slopes infiltration is more likely.

e) Weather conditions

- Hot dry weather can bake the soil, so that when it rains the water can't soak in. Instead, it will run off the surface, straight into the river.
- High temperatures increase evaporation rates from water surfaces, and transpiration from plants – reducing discharge
- Long periods of extreme cold weather can lead to frozen ground, so that water cannot soak in

2.9 Current Meter

Flow through a large penstock such as used at a hydroelectric power plant can be measured by averaging the flow velocity over the entire area. Propeller-type current meters (similar to the purely mechanical Ekman current meter, but now with electronic data acquisition) can be traversed over the area of the penstock and velocities averaged to calculate total flow. This may be on the order of hundreds of cubic meters per second. The flow must be kept steady during the traverse of the current meters. Methods for testing hydroelectric turbines are given in IEC standard 41. Such flow measurements are often commercially important when testing the efficiency of large turbines.

The most common method used by the USGS for measuring discharge is the mechanical current-meter method. In this method, the stream channel cross section is divided into numerous vertical subsections. In each subsection, the area is obtained by measuring the width and depth of the subsection, and the water velocity is determined using a current meter. The discharge in each subsection is computed by multiplying the subsection area by the measured velocity. The total discharge is then computed by summing the discharge of each subsection.

Numerous types of equipment and methods are used by USGS personnel to make current-meter measurements because of the wide range of stream conditions throughout the United States. Subsection width is generally measured using a cable, steel tape, or similar piece of equipment. Subsection depth is measured using a wading rod, if conditions permit, or by suspending a sounding weight from a calibrated cable and reel system off a bridge, cableway, or boat or through a hole drilled in ice.

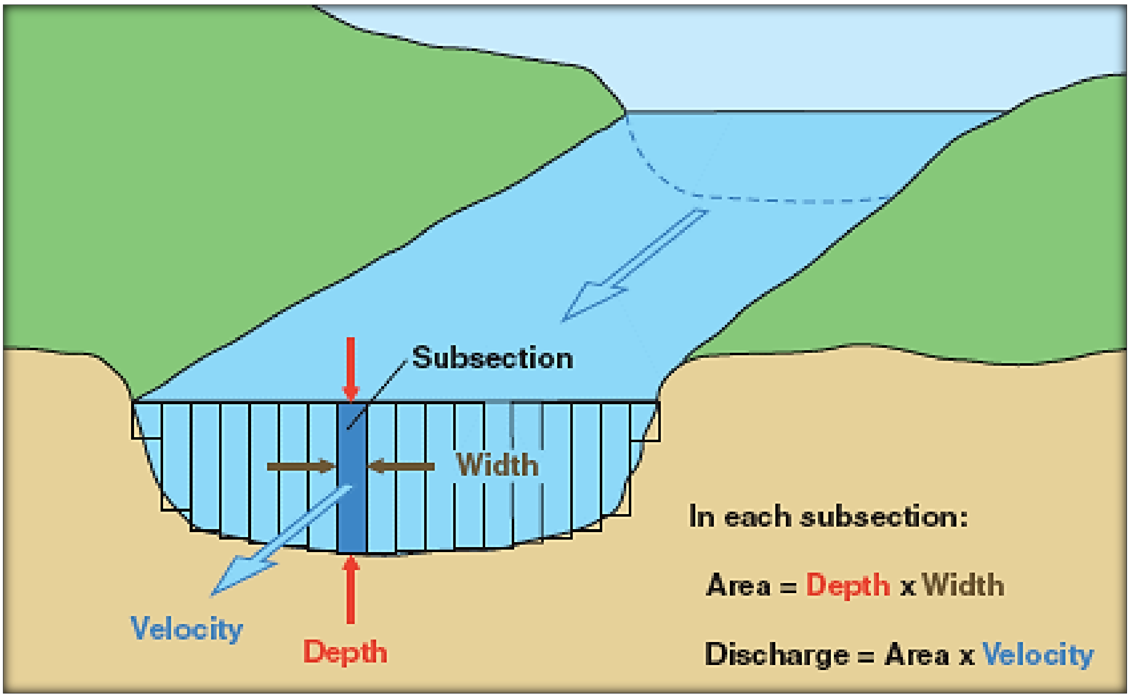


Figure 2.9(a) *River Gauging Method*

Current-meter discharge measurements are made by determining the discharge in each subsection of a channel cross section and summing the subsection discharges to obtain a total discharge.

In order to calculate the flow of rives, the velocity and cross-sectional area need to be determined. As the depth of the river will very, the best method is to divide the stream into sections of equal width, often 1 meter, and measure the depth of each section. The cross-section area can then be calculated for each section, and the sum of the areas of all the sections will be the cross-sectional area of the river.

The velocity is then measured using a current meter, which is shown in figure below. The current meter consist of a propeller which points upstream and is turned by the water flowing past. The propeller is connected to a counter which records the number of complete revolutions the propeller makes in a set time

CHAPTER 3

STUDY AREA AND METHODOLOGY

3.1 Introduction

Pahang is the largest state in Peninsular Malaysia with land area of 35960 square kilometer. About two-thirds of land area in Pahang is covered with tropical rainforest that become home for endangered animals such as tapir, leopards and tigers. Besides, the capital city of Pahang is Kuantan, which located along east coast region. Whereas the loyal town of Pahang is Pekan. Figure 3.1 (a) shown the location of Pahang. Pekan is located on banks Pahang River which is about 50 kilometer of south of Kuantan and 280 kilometer from Kuala Lumpur. This district was located at latitude 3°29'31.54"N and longitude 103°23'22.36" E. The land area of Pekan about 3,805 square kilometer. In Figure 3.1 (b) shown the location of Pekan.

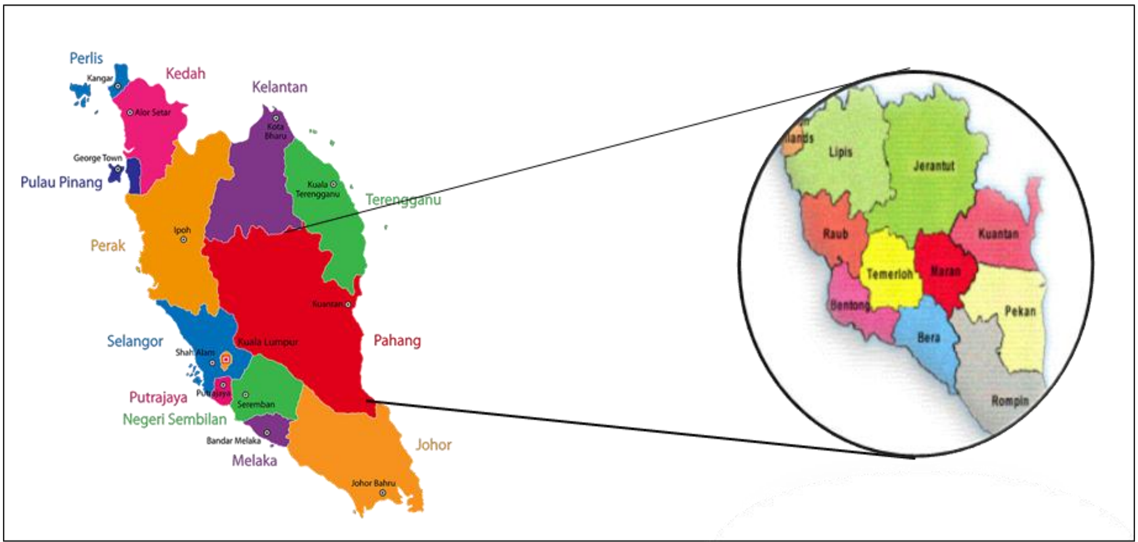


Figure 3.1 (a) *Location of Pahang in Peninsular Malaysia*

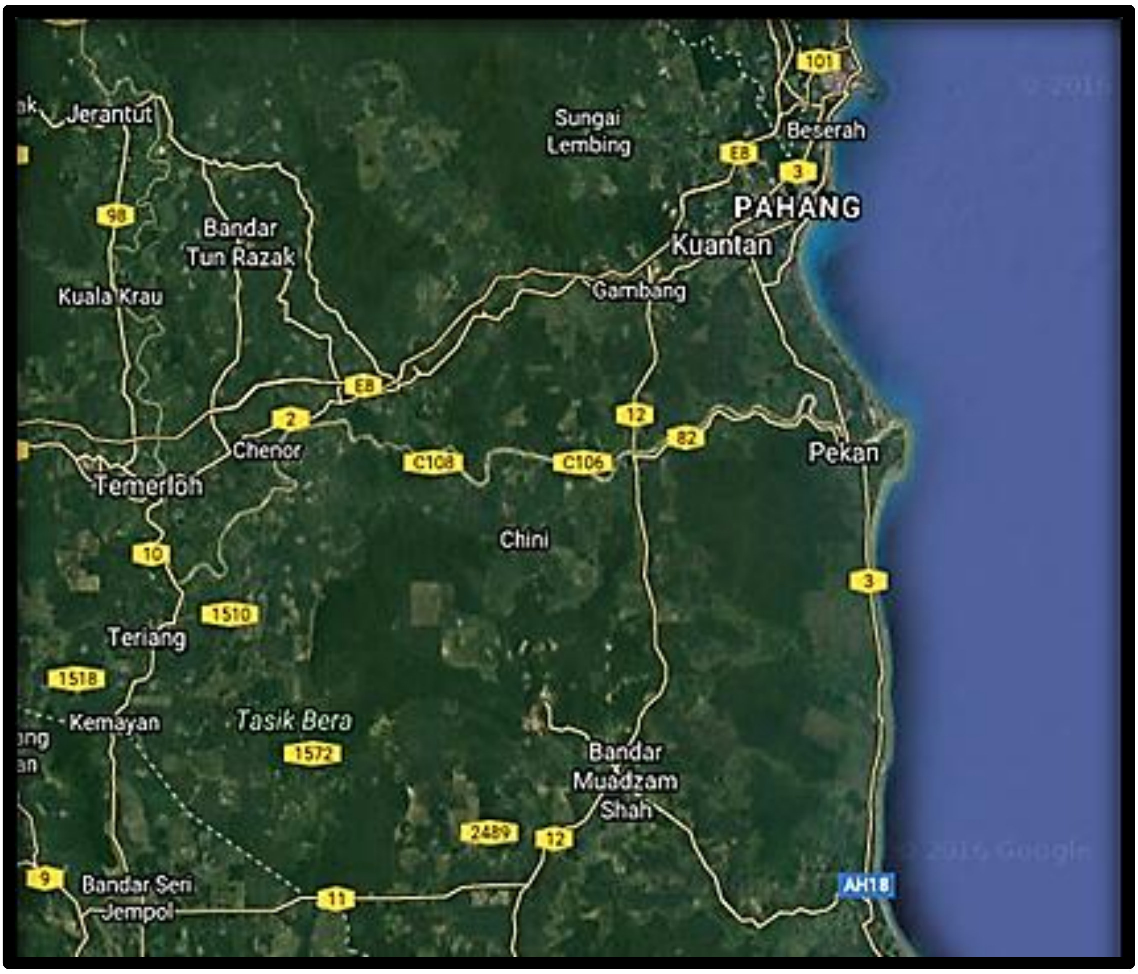


Figure 3.1 (b) *Location of Pekan in Pahang State*

At Pekan, there is one of famous lake which is Tasik Chini. The Chini Lake is located in the south eastern region of the state of Pahang, This lake was located approximately 100 km from Kuantan, the capital of Pahang. The lake system lies between 3°26’35.56" to 3°27′1.52" N and 102°53′30.37" to 102°54′37.46"E and comprises 12 open water bodies that called “laut” by the local people and linked to the Pahang River by the Chini River. A few communities of the indigenous Jakun tribe live around the lake. Figure 3(c)(i) shown the map of Tasik Chini. While Figure 3(c)(ii) shown view of Tasik Chini from Google Earth.

The Chini Lake is the second largest natural fresh-water lake in Malaysia covering 202 hectares of open water and 700 ha of Riparian, Peat, Mountain and Lowland Dipterocarp forests. The Chini Lake is surrounded by variously low hills and undulating land which constitute the watershed for the region. There are three hilly surrounding the lake: (1) Bt. Ketaya (209 m) located southeast; (2) Bt. Tebakang (210 m) at the north and (3) Bt. Chini (641 m) located southwest.

The study area has a humid tropical climate with two monsoon seasons, characterized by the following bimodal pattern: southwest and northeast monsoons bringing rainfall which varies from 1488 to 3071 mm annually. The mean annual rainfall is 2,500 mm and the temperature range is from 21 to 32°C. Potential evapo-transpiration (PE) lies Statistical Analysis: Statistical analysis was conducted between 500 to 1000 mm

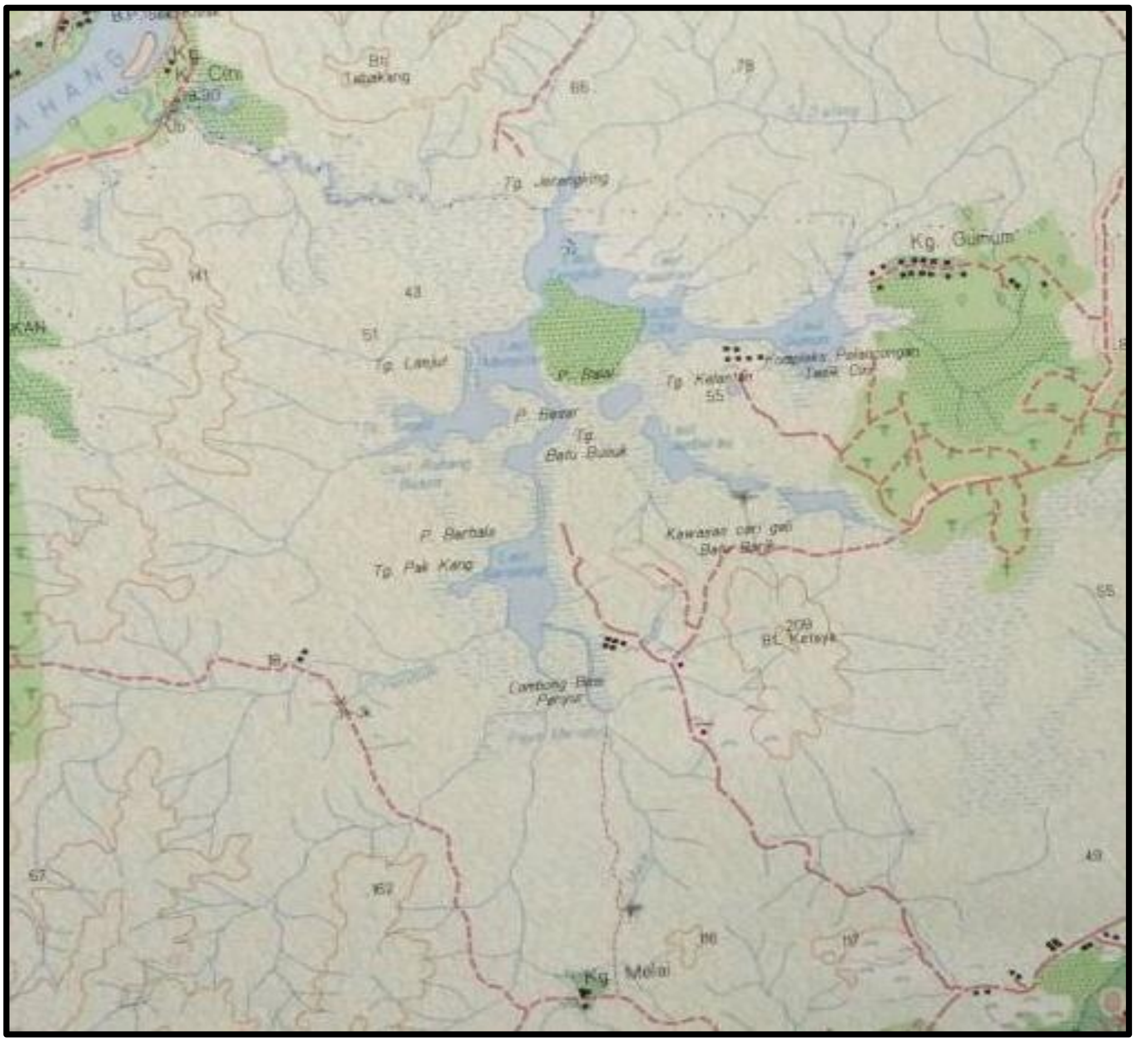


Figure 3.1 (c) (i) *Map of Tasik Chini*

Figure 3.1 (c) (ii) *View of Tasik Chini from Google Earth*
Source: 2017) *Google Earth*

3.2 Location of JPS Hydrological Station

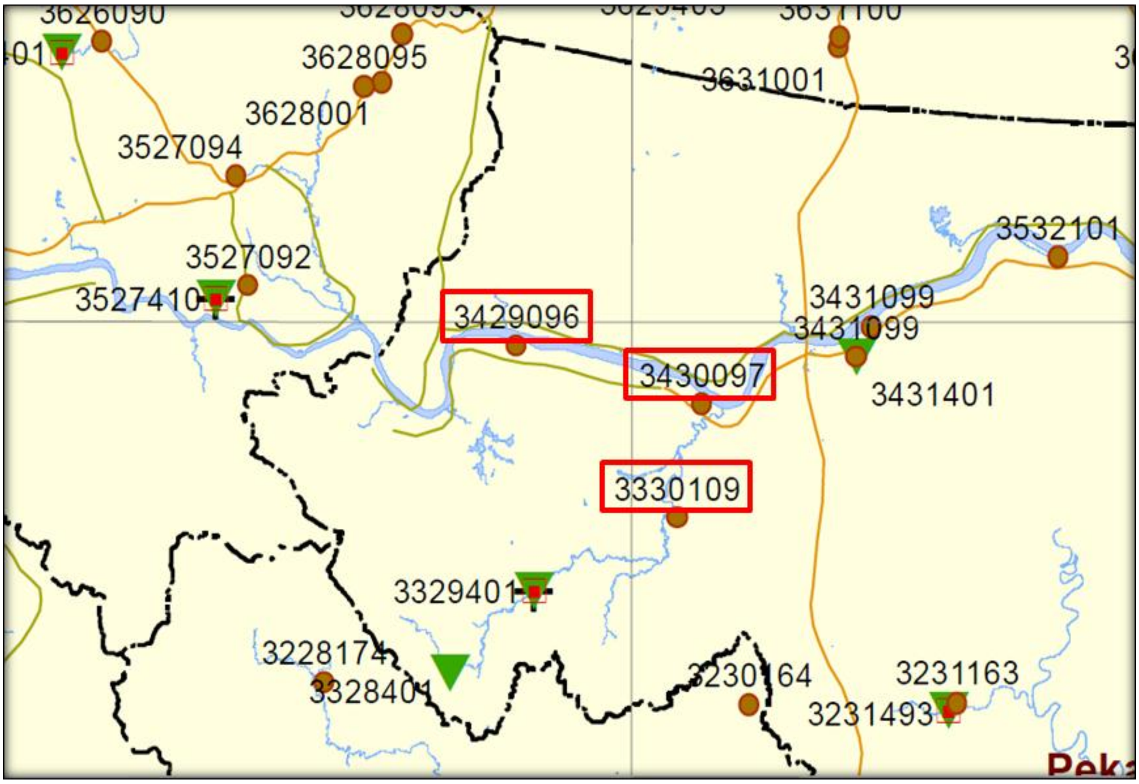


Figure 3.2 *Map of Pekan Hydrological Station*
Source: (2017) *Department of Irrigation and Drainage (D.I.D), Negeri Pahang*

Table 3.2 Nearest location of JPS Hydrological Station at Tasik Chini

Station No.	Function	Station Name	Latidude	Longitude
3330109	Rainfall	Kampung Batu Gong	03°23'25"	103° 01'35"
3429096	Rainfall	Kampung Salong	03° 29'10"	102° 56'00"
3430097	Rainfall	Paya Membang	03° 27'15"	103° 02'25"

Source: (2017) *Department of Irrigation and Drainage (D.I.D), Negeri Pahang*

Figure 3.2 shows the location hydrological station at Pekan, Pahang. There are many hydrological station which is for rainfall station, evaporation, water level and discharge of water station catchment data. Buts, there are 4 of them were selected. Which are 3 of them are hydrological station for rainfall and the remaining hydrological station are for stream flow. The selected station are Kampung Batu Gong, Kampung Salong, Paya Membang, and Sungai Mentiga. Table 3.2 shown the nearest location of Hydrological Station at Tasik Chini, Pekan, Pahang.

Tasik Chini is the study area. There is many place with river and consist sub river for example Sungai Gumum, Sungai Chok, Sungai Chini Upstream, Sungai Chini Downstream, Sungai Melai Upstream, Sungai Melai Downstream, Sungai Jeraking, Sungai Jemberau, Sungai Serodong, Sungai Celau, Sungai Kenawar and Sungai Perupok. For more detail, is area that nearly with Terengganu state and nearly with Jerantut and Maran area that contact with some of the main river

3.3 Location of Rain Gauge.

The rain gauge was set up at area Kampung Melai at Tasik Chini, Pekan, Pahang. Rain gauge used to gather and measure the amount of rainfall over a set period of time. When connected to a flow meter, the rain gauge enables the flow meter to print rainfall data on its chart or store rainfall data in memory. Most rain gauges generally measure the rainfall in millimeters.

Figure 3.3 *Location of rain gauge at Kampung Melai, Pekan, Pahang*

3.4 Flow Chart

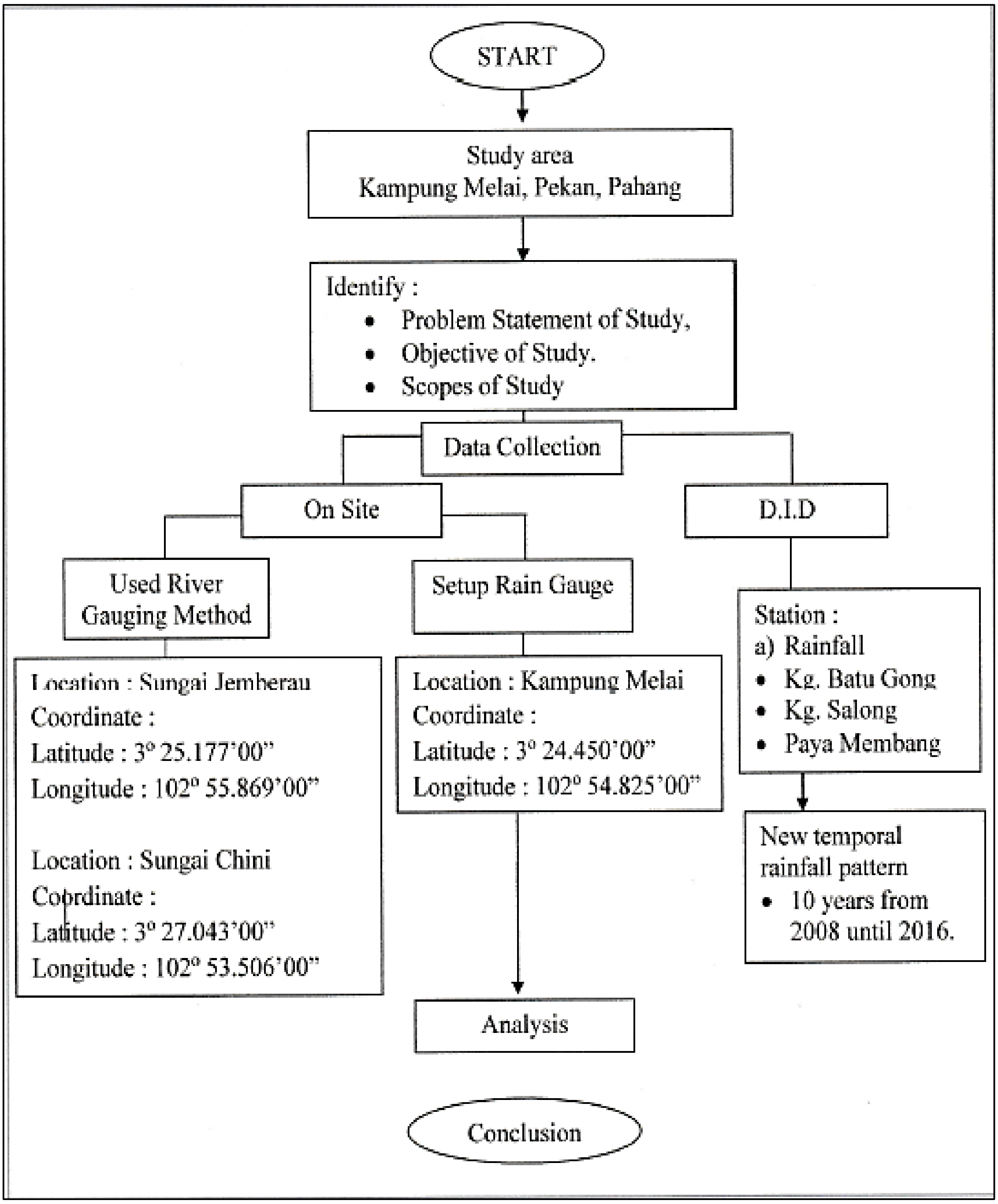


Figure 3.4 *Flow chart of methodology*

Figure 3.4 shows the flow chart of the methodology that had been used during the research. First step is literature survey which is research on common problem. Second, planning on how analyse and get the title of project and objective. Third, data collection which is the source of data is from the agencies that engaged in the information. Lastly, discussion on improvement the objective and solution of problem statement.

3.5 Calibration of Rain Gauge (HOBO)

The tipping-bucket mechanism is a simple and highly reliable device. Absolutely accurate rain gauge calibration can be obtained only with laboratory equipment, but an approximate field check can be easily done. The rain gauge must be calibrated with a controlled rate of flow of water through the tipping bucket mechanism.

The maximum rainfall rate that the rain gauge smart sensor can accurately measure is one mm of rain per hour (36 seconds between bucket tips). Therefore, the rain gauge should be field calibrated using a water flow rate equivalent to, or less than, one inch of rain per hour (more than 36 seconds between bucket tips). If the flow rate is increased, a properly calibrated instrument will read low. Decreasing the rate of flow will not materially affect the calibration. The reason for this is obvious if the tipping bucket assembly is observed in operation. With water falling into one side of the tipping bucket, there comes a point when the mass of the water starts to tip the bucket. Some time is required for the bucket to tip (a few milliseconds). During the first 50% of this tipping time water continues to flow into the filled bucket; the last 50% of this tipping time water flows into the empty bucket. The amount of water flowing during the first 50% of time is error, the faster the flow rate the greater the error. At flow rates of one inch per hour (20 mm/hr) or less, the water actually drips into the buckets rather than flowing. Under this condition, the bucket tips between drips, and no error water is added to a full moving bucket.

Figure 3.5 *Rain gauge (HOBO)*

3.5.1 Procedure Check Calibration of Rain Gauge (HOBO)

Procedure check calibration of rain gauge (HOBO)

1. Firstly, the selected location of rain gauge need to cleaned from tree, bush and so on.
2. Tripod was set up at appropriate height approximately over nail.
3. Obtain a plastic or metal container of at least one litre capacity. Make a very small hole (a pinhole) in the bottom of the container.
4. Place the container in the top funnel of the Rain Gauge. The pinhole should be positioned so that the water does not drip directly down the funnel orifice.
5. Follow the instructions for the Rain Gauge model you have:
   - RG3-M: Pour exactly 373 ml of water into the container. Each tip of the bucket represents 0.2 mm of rainfall.
6. If it takes less than one hour for this water to run out, then the hole (from step 1) is too large. Repeat the test with a smaller hole.
7. Successful field calibration of this sort should result in one hundred tips plus or minus two.
8. Adjusting screws are located on the outside bottom of the Rain Gauge housing. These two socket head set screws require a 5/64 inch Allen wrench. Turning the screws clockwise increases the number of tips per measured amount of water. Turning the screws counter-clockwise decreases the number of tips per measured amount of water. A 1/4 turn on both screws either clockwise or counter-clockwise increases or decreases the number of tips by approximately one tip. Adjust both screws equally; if you turn one a half turn, then turn the other a half turn.
9. Repeat Steps 3–6 as necessary until the Rain Gauge has been successfully calibrated.

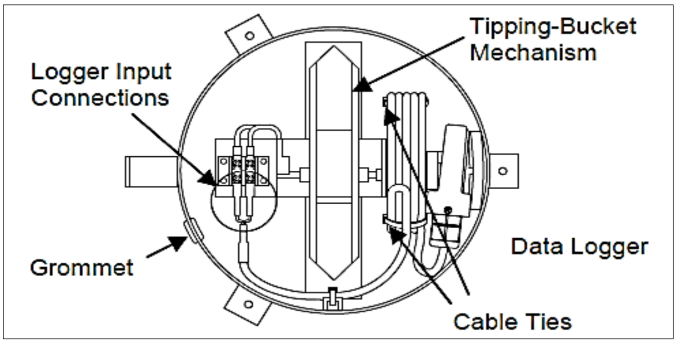


Figure 3.5.1 *Cross section of rain gauge*

3.5.2 Procedure Check Calibration of \Rain Gauge (HOBO)

The HOBO Event/Temperature data logger requires an Onset-supplied Optic USB Base Station and Coupler (part no: BASE-U-1), and HOBOware version2.1 or later software to connect to computer. If possible, avoid connecting at temperatures below 0°C (32°F) or above 50°C 122°F).

Procedure connecting the logger to computer:

1. USB connector on the base station into an available USB port on computer was plugged. Figure 3.5.2 (a) shown USB was plugging USB into USB port on computer

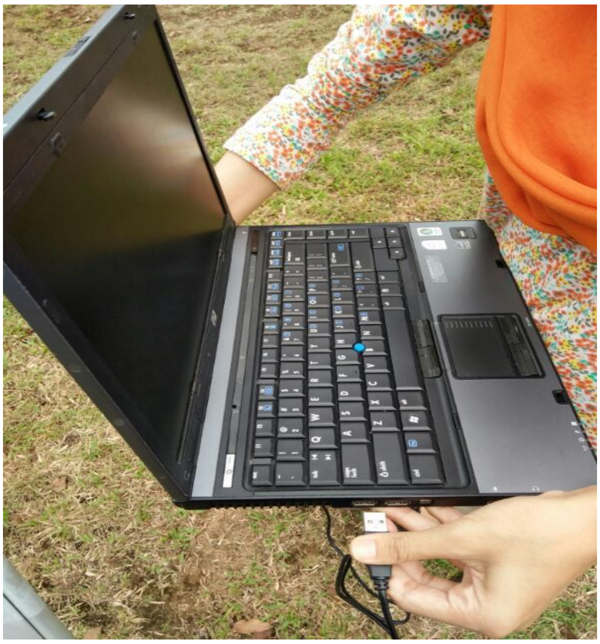


Figure 3.5.2 (a) *Plugging USB into USB port on*

2. The logger and the base station into the coupler was insert, as shown in Figure 3.5.2 (b). Make sure that the logger is inserted in the end of the coupler that has the magnet, and that the ridges on the base station and logger are aligned with the grooves in the coupler.

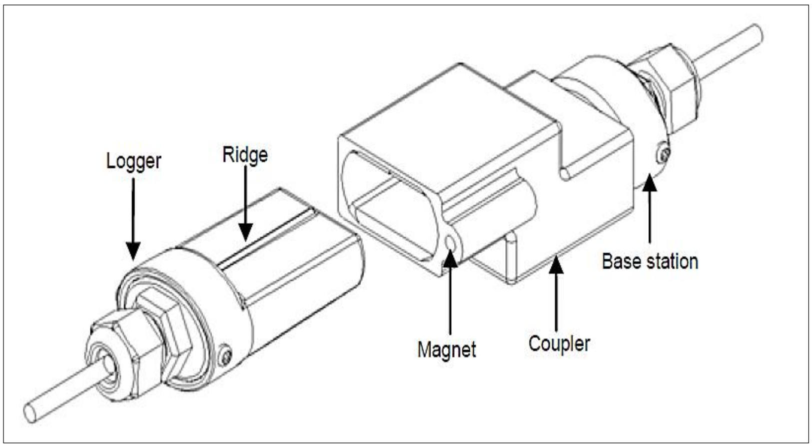


Figure 3.5.2 (b) *Inserting logger into base station*

3. If the logger has never been connected to the computer before, it may take a few seconds for the new hardware to be detected.

4. The logger software to launch and read out the logger was used.

   Note: Refer to the software user's guide for complete details on launching, reading out, and viewing data from the logger.

3.6 Procedure of Data Collection from Rain Gauge at Site

3.6.1 Procedure of Data Collection

The data collection is rainfall data collection from rain gauge at Sungai Melai in Tasik Chini. To collect the data.

3 Software HOBOwave need to installed.
4 After install the software, use wire connection to laptop. This is to ensure the rainfall data had been transferred to the laptop.
5 After collect the rainfall data. The data need to convert into Microsoft Excel. To convert the data.

3.6.2 Procedure of rainfall data collection convertion

Rainfall data from HOBOwave need to convert into Microsoft Excel.

1. Click icon HOBOwave. Figure 3.6.2(a) shown HOBOwave icon.

Figure 3.6.2 (a) *HOBOwave icon*

2. Click Plot. After that, the data collection had been appeared. It was shown in Figure 3.6.2(b).

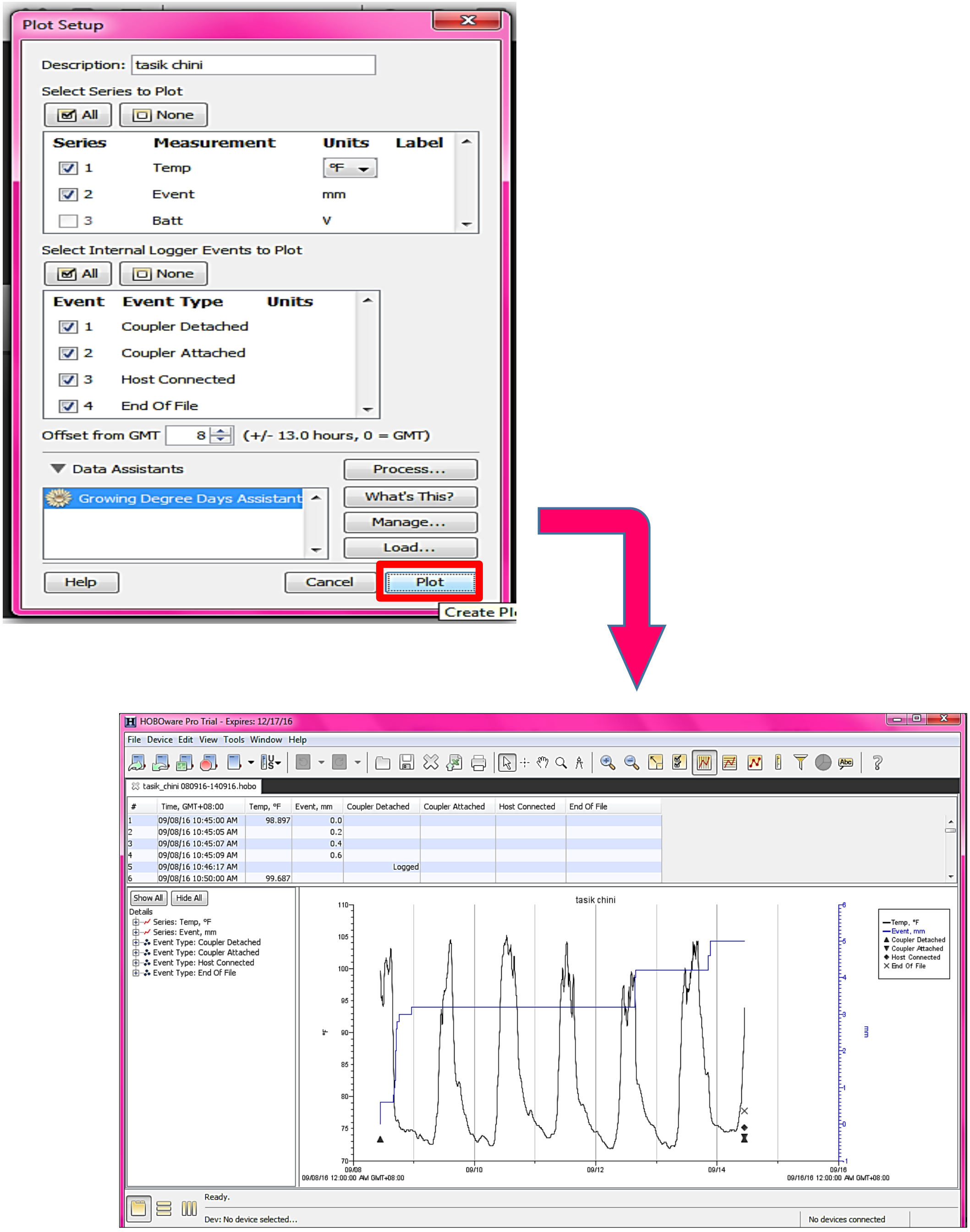


Figure 3.6.2 (b) *Plotting the data*

3. Click icon Export Table Data. It were shown in Figure 3.6.2(c). After the data had been converted.

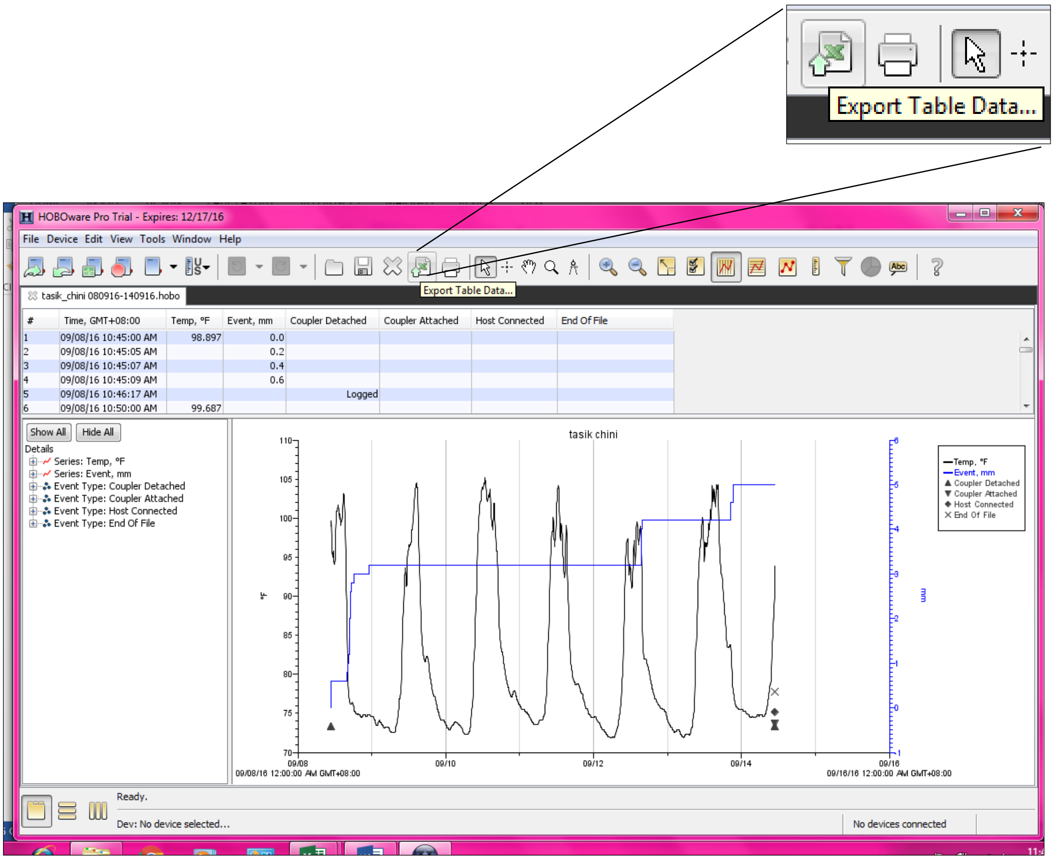
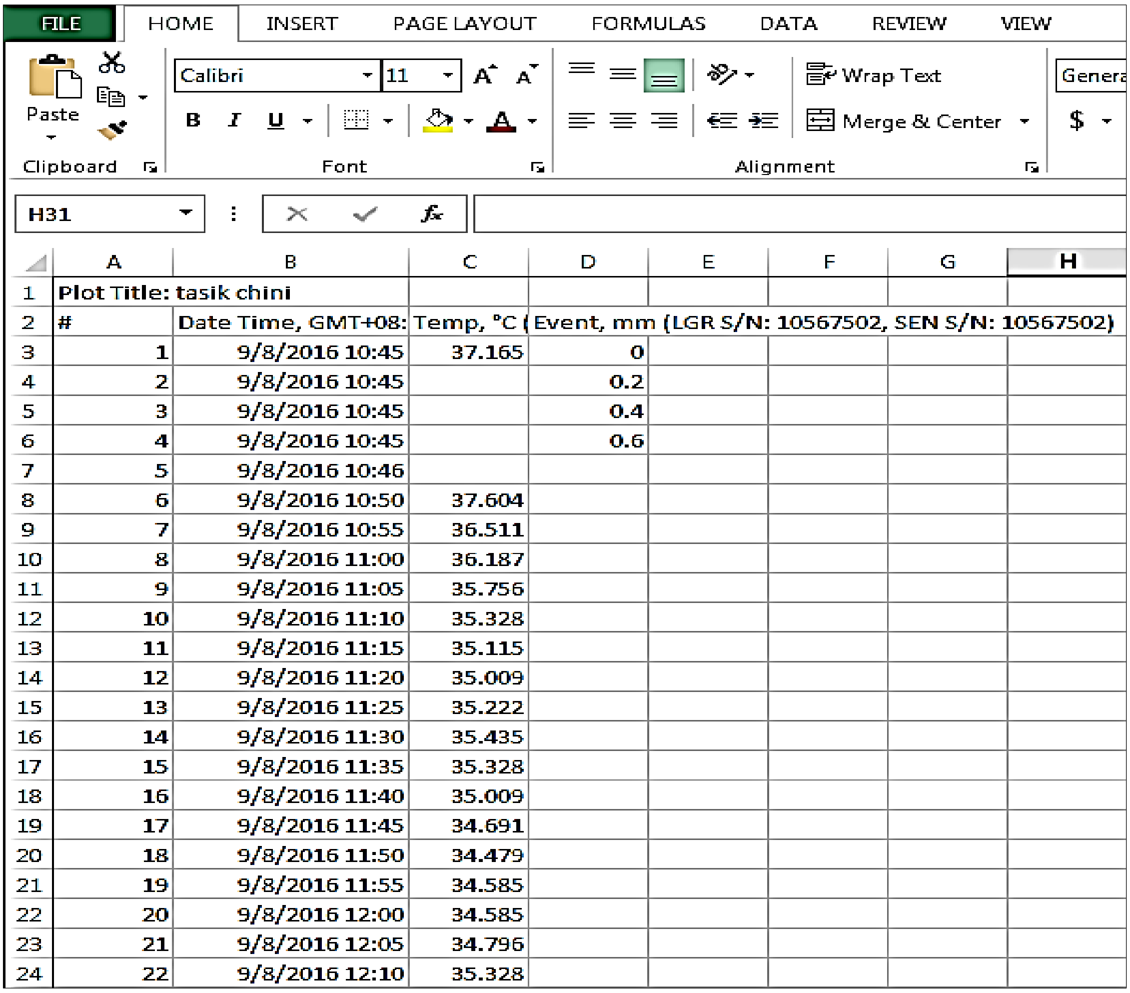


Figure 3.6.2 (c) *Exporting the data*

6 Double click icon Microsoft Excel that had been renamed. E.g : ‘DATA HUJAN TASIK CHINI (140916 -290916). Figure below shown the data was rename.

Figure 3.6.2 (d) *Rename the data*

7 After click the icon. Data from Microsoft Excel were appeared. Figure 3.6.2(e) shown was appeared.



	A	B	C	D	E	F	G	H
1	Plot Title: tasik chini							
2	#	Date Time, GMT+08:	Temp, °C (	Event, mm (LGR S/N: 10567502, SEN S/N: 10567502)				
3	1	9/8/2016 10:45	37.165	0				
4	2	9/8/2016 10:45		0.2				
5	3	9/8/2016 10:45		0.4				
6	4	9/8/2016 10:45		0.6				
7	5	9/8/2016 10:46						
8	6	9/8/2016 10:50	37.604					
9	7	9/8/2016 10:55	36.511					
10	8	9/8/2016 11:00	36.187					
11	9	9/8/2016 11:05	35.756					
12	10	9/8/2016 11:10	35.328					
13	11	9/8/2016 11:15	35.115					
14	12	9/8/2016 11:20	35.009					
15	13	9/8/2016 11:25	35.222					
16	14	9/8/2016 11:30	35.435					
17	15	9/8/2016 11:35	35.328					
18	16	9/8/2016 11:40	35.009					
19	17	9/8/2016 11:45	34.691					
20	18	9/8/2016 11:50	34.479					
21	19	9/8/2016 11:55	34.585					
22	20	9/8/2016 12:00	34.585					
23	21	9/8/2016 12:05	34.796					
24	22	9/8/2016 12:10	35.328					

Figure 3.6.2 (e) *Data appear*

3.6.3 Procedure Data Analysis

After that, the data collected need to analysis. To analysis, the data need to summerise into Average Daily Rainfall/Average Monthly rainfall/ Average Annually Rainfall. Figure 3.6.2 was shown the rainfall data from day by day. While, Table 3.6.2 (a) was shown the rainfall data from month to month. Chart 3.6.3 (a) shown Average Monthly rainfall at Tasik Chini on 2016 respectively.

DATE	CULMULATIF	TOTAL RAINFALL PER DAY (mm)	DURATION
1	5.2	5.2	-
2	43.8	38.6	15.18 - 16.11
3	45.2	1.4	-
4	0	0	-
5	47	1.8	-
6	0	0	-
7	0	0	-
8	0	0	-
9	0	0	-
10	0	0	-
11	60.6	13.8	18.51 - 19.04
12	0	0	-
13	0	0	-
14	60.8	0.2	-
15	74.8	14	21.50 - 21.59 / 22.15 - 22.27
16	75	0.2	-
17	76.4	1.4	-
18	89.4	13	17.06 - 17.17 / 17.46 - 18.08
19	0	0	-
20	108.8	19.4	17.41 - 18.08 / 18.31 - 19.29
21	125.6	17.8	-
22	133.2	7.6	14.37 - 14.51
23	194	60.8	12.46 - 12.59 / 13.26 - 13.49 / 14. 30 - 14.43 / 16.21 - 16.52
24	367.2	173.2	06.46 - 09.04 / 10.45 - 23.59
25	395.6	28.4	00.00 - 01.49
26	412.8	17.2	12.33 - 12.49
27	433.6	20.8	06.35 - 06.49
28	433.8	0.2	-
29	434	0.2	-
30	0	0	-
31	435.4	1.4	-

Figure 3.6.3 *Rainfall data from day by day*

Table 3.6.2 (a) : Average rainfall data from month to month

Summary of Result For Tasik Chini			
Months of 2016	Total Rainfall (mm)	Cumulative Rainfall (mm)	Avg Rainfall per day (mm)
Jan-16	N/A	N/A	N/A
Feb-16	N/A	N/A	N/A
Mar-16	N/A	N/A	N/A
Apr-16	N/A	N/A	N/A
May-16	N/A	N/A	N/A
Jun-16	N/A	N/A	N/A
Jul-16	N/A	N/A	N/A
Aug-16	N/A	N/A	N/A
Sep-16	115	115	3.8
Oct-16	192.8	307.8	6.2
Nov-16	198.4	506.2	6.6

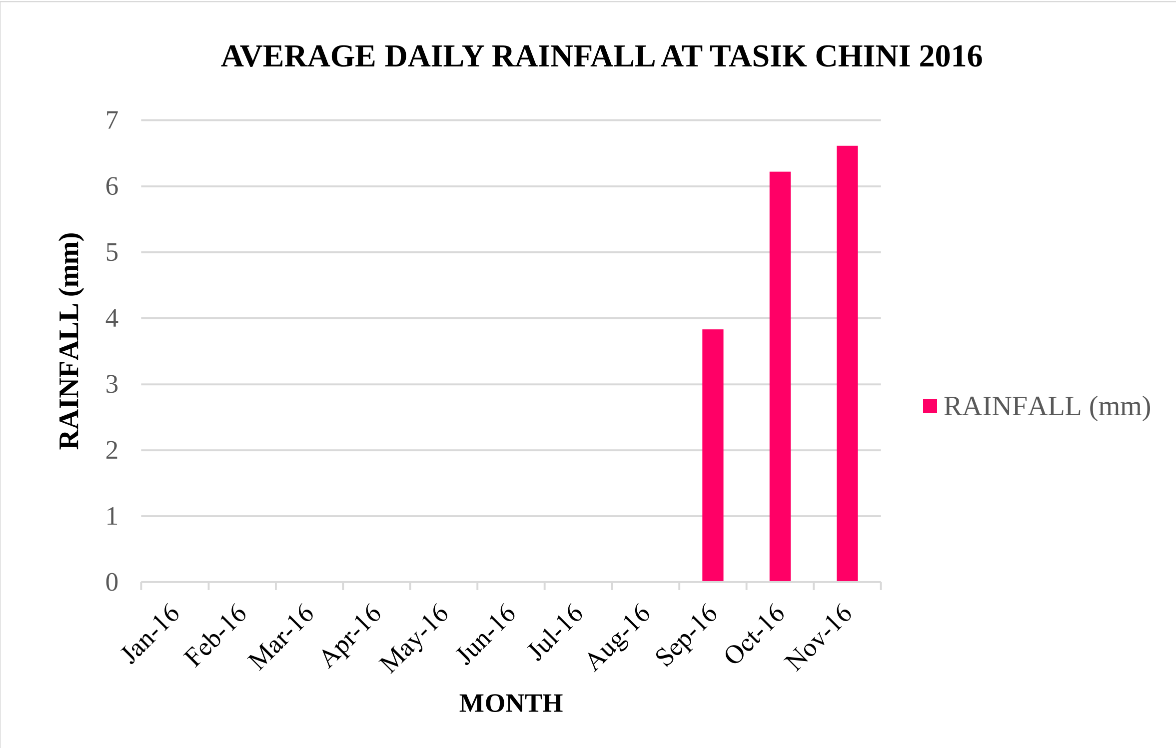


Chart 3.6.3 (a) : Average daily rainfall at Tasik Chini on 2016

3.7 Procedure of Analysis Rainfall Data from JPS at Selected Station

3.7.1 Procedure Data Analysis

Rainfall data was collected from Department of Irrigation and Drainage (D.I.D) for 15 years at some of the hydrological station in Kuantan. There are 6 hydrological stations that involved to get rainfall, evaporation and water level data. Figure 3.5.1 shows the example of raw rainfall data from D.I.D.

```
~~~ NIWA Tideda ~~~ JPS Ampang                              21-NOV-2016 15:41
~~~ PDAY ~~~  VER 1.9
Source is F:\datatideda\RFMANUAL.mtd
24 hour periods ending at 8:00:00am each day.
Daily totals        Year 2000        site 3527092 LUBOK PAKU at PAHANG
Rain mm
```

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1	?	0.5	25.0	12.0	60.0	4.5	0.0	0.0	0.0	9.0	0.0	41.5	
2	7.0	0.0	1.0	25.0	32.5	27.0	0.0	18.0	0.5	58.0	0.0	2.5	
3	47.0	2.0	0.5	3.5	31.5	0.0	5.0	1.0	0.5	5.0	3.0	0.0	
4	14.5	0.5	2.0	2.0	22.5	0.0	0.0	2.0	0.0	7.0	0.0	13.5	
5	76.5	0.5	28.5	0.0	1.0	0.0	0.0	0.0	0.0	0.5	0.0	2.5	
6	33.0	0.0	0.0	1.5	1.0	4.5	0.0	0.0	25.0	0.0	13.5	5.5	
7	0.0	17.0	44.0	2.5	6.0	1.0	0.0	2.0	0.0	0.0	0.0	58.5	
8	1.0	3.0	39.0	0.5	0.0	14.0	0.0	0.0	39.0	0.0	11.0	0.0	
9	0.0	0.0	0.0	4.5	0.0	0.0	0.0	8.0	0.0	0.5	11.5	0.0	
10	0.0	2.5	1.0	60.5	0.0	0.0	0.0	0.5	0.5	0.0	0.0	0.0	
11	0.0	0.0	11.0	0.0	0.0	7.0	0.0	1.5	6.5	0.0	0.0	0.0	
12	9.0	0.0	9.0	0.5	0.0	0.0	0.0	0.5	3.0	7.0	5.5	0.0	
13	0.0	0.0	2.5	0.0	0.0	0.0	0.0	9.5	0.0	7.5	3.5	0.0	
14	0.0	5.0	0.0	0.0	0.0	14.0	0.0	0.0	1.0	18.0	11.5	0.0	
15	0.0	11.0	0.0	0.0	0.5	10.0	0.0	40.0	1.0	0.0	11.0	5.5	
16	0.0	1.0	0.5	24.0	0.0	0.0	0.0	0.5	2.0	6.5	5.5	0.0	
17	0.5	15.5	1.0	27.5	0.0	0.5	0.5	0.0	0.0	0.0	0.0	11.5	
18	0.0	2.0	6.0	8.0	0.0	0.0	0.0	0.0	37.0	0.0	22.5	13.0	
19	20.0	13.0	1.5	21.5	0.0	0.0	28.0	0.0	17.5	0.0	0.0	15.5	
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.0	1.5	0.0	5.0	1.0	
21	0.0	0.0	0.0	18.0	2.5	0.0	22.0	0.0	19.5	0.0	4.5	15.0	
22	0.0	1.5	0.0	0.0	0.5	8.5	8.0	0.0	15.0	48.5	2.5	1.0	
23	3.0	0.0	0.0	1.0	2.0	0.0	9.5	0.0	0.0	3.5	3.5	15.0	
24	1.0	31.0	0.5	11.5	0.0	0.0	0.0	0.0	0.0	1.5	0.0	22.0	
25	90.0	9.0	1.5	0.5	0.0	0.0	25.0	35.0	0.5	25.0	0.5	1.0	
26	1.0	3.5	9.0	21.5	0.0	0.0	1.0	0.5	0.0	20.0	1.5	0.0	
27	1.0	1.0	0.0	1.0	0.0	27.0	0.0	0.0	23.0	56.0	22.0	0.0	
28	8.0	4.5	20.0	47.0	0.0	1.0	8.5	0.0	0.0	8.0	2.5	60.0	
29	12.0	6.0	2.5	0.0	0.0	0.0	0.0	5.5	3.0	3.0	1.5	1.0	
30	4.0		2.0	4.5	0.5	0.0	0.0	3.5	7.0	0.0	11.5	22.0	
31	1.5		7.0		0.0		1.0	5.5		27.0		9.0	
Min	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
Tot	330.0	130.0	215.0	298.5	160.5	119.0	108.5	143.5	203.0	311.5	153.5	316.5	2489.5
Max	90.0	31.0	44.0	60.5	60.0	27.0	28.0	40.0	39.0	58.0	22.5	60.0	90.0
NO>0.0	18	20	22	22	12	12	10	17	19	19	20	20	211

Figure 3.7.1 *Example of raw rainfall data from D.I.D*

3.7.2 Data Analysis

After collect all the data next steps is doing the analysis. The analysis is to determine pattern of rainfall for each of selected station. This rainfall pattern can be compare with other station based on annually, monthly and so on. Figure 3.7.2 shown the data that had been analysis from data collected before. Besides, chart 3.7.2 shown the rainfall pattern at station Kampung Batu Gong on 2008.

MONTHLY RAINFALL DATA AT STATION 3330109 KAMPUNG BATU GONG ON 2008

MONTH	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DIS
MIN						0	0	0	0	0	0	0
TOT						11	301.5	201.5	71	196.5	185.5	187.5
MAX						7.5	75.5	52	14.5	28	75.5	49.5
NO>0.0	0	0	0	0	0	2	14	14	13	14	16	13

Figure 3.7.2 *Data that had been analysis from Department of Irrigation and Drainage, Pahang*

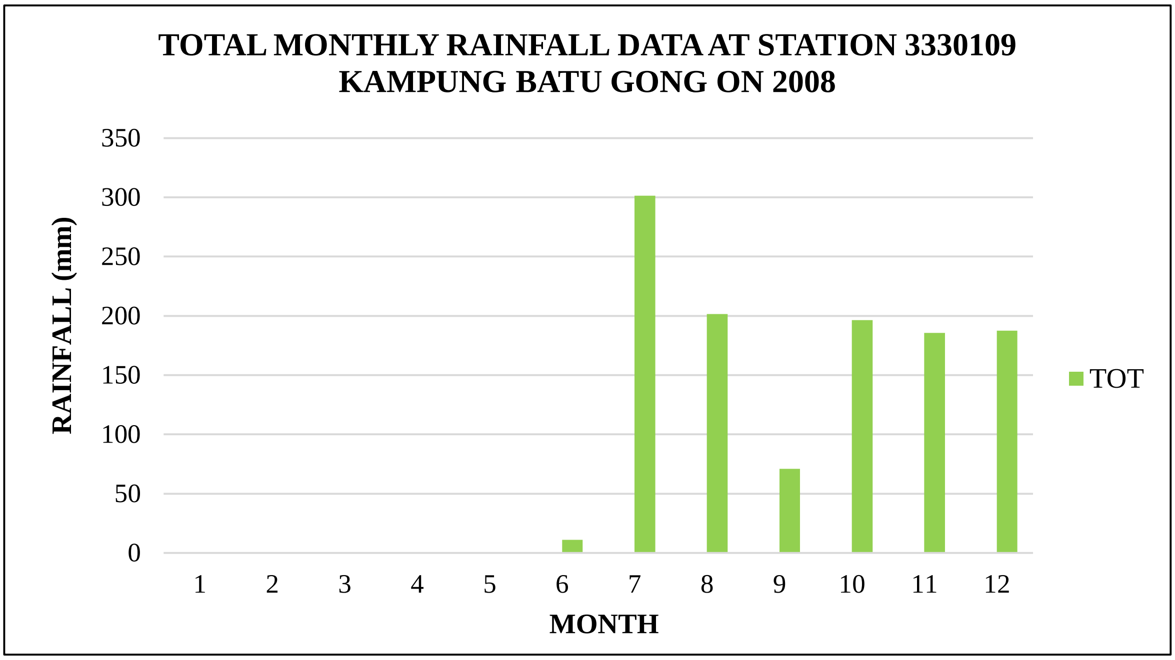


Chart 3.7.2 Rainfall pattern at Station Kampung Batu Gong on 2008.

3.8 Available Data from Department of Irrigation and Drainage (D.I.D)

Rainfall intensity data was provided by the Department of Irrigation and Drainage (DID) centre in Kuantan, Pahang. The nearest hydrological station located to Tasik Chini are Kampung Batu Gong, Paya Membang and Kampung Salong with station number 3330109, 3430097 and 3429096 respectively. The available data provided by Department of Irrigation and Drainage (DID) Centre in Kuantan, Pahang from 2008 until 2017 for analysis IDF curve and 9 years from 2008 to 2016 for develop temporal rainfall pattern

3.9 Intensity Duration Frequency (IDF) Curve

IDF is actually Intensity Duration frequency. Intensity, duration and frequency are important to plot the graph of IDF curves. IDF curves is created with rainfall records collected from a specific monitoring location

IDF Curves is used to show or characterizes an area of rainfall pattern. Statistic about rainfall event or reoccurrences can be determined using various standard return periods as stated in MSMA 2011 by analysing past rainfall event. Normally ARI used in IDF curve are 2 years, 5 years, 10 years, 25 years, 50 years and 100 years. Assumption of past rainfall statistics continue to represent rainfall statistic into future can be shown by these curve. IDF curve is the average rainfall depth that falls per time increment.

In Malaysia, rainfall intensity is stated in mm/hour. The purposes of IDF curve often to be used to find intensity or to find the frequency for a measured storm event.

3.9.1 Rainfall Intensity Duration Frequency Relationship

According to MSMA 2nd Edition rainfall depth can be converted into rainfall intensity where (intensity = depth/duration) which will be presented in IDF curve. IDF curve is beneficial in storm water drainage design because many calculation procedures required rainfall input in the form of average rainfall intensity. The three variables, frequency, intensity and duration are related to each other. Typically the curve is displaying two of variables, intensity and duration in a range of frequency. These data will be used as the input in storm water design processes.

3.9.2 Developing an IDF curve

IDF curve is developed by analysing years of rainfall records. The longer year of data will be needed to achieve a better quality of statistical analysis. Rainfall data record analysis will start with Cumulative Frequency Analysis. Cumulative Frequency Analysis is used for the analysis. The intervals of events with a certain magnitude process are determined for a range of metrics within the rainfall record. For example, the 5 minutes storm with greatest quantity of rainfall that occurred in 50 years. In MSMA 2nd Edition the IDF development procedures involve the steps as shown in Figure 3.9.2.

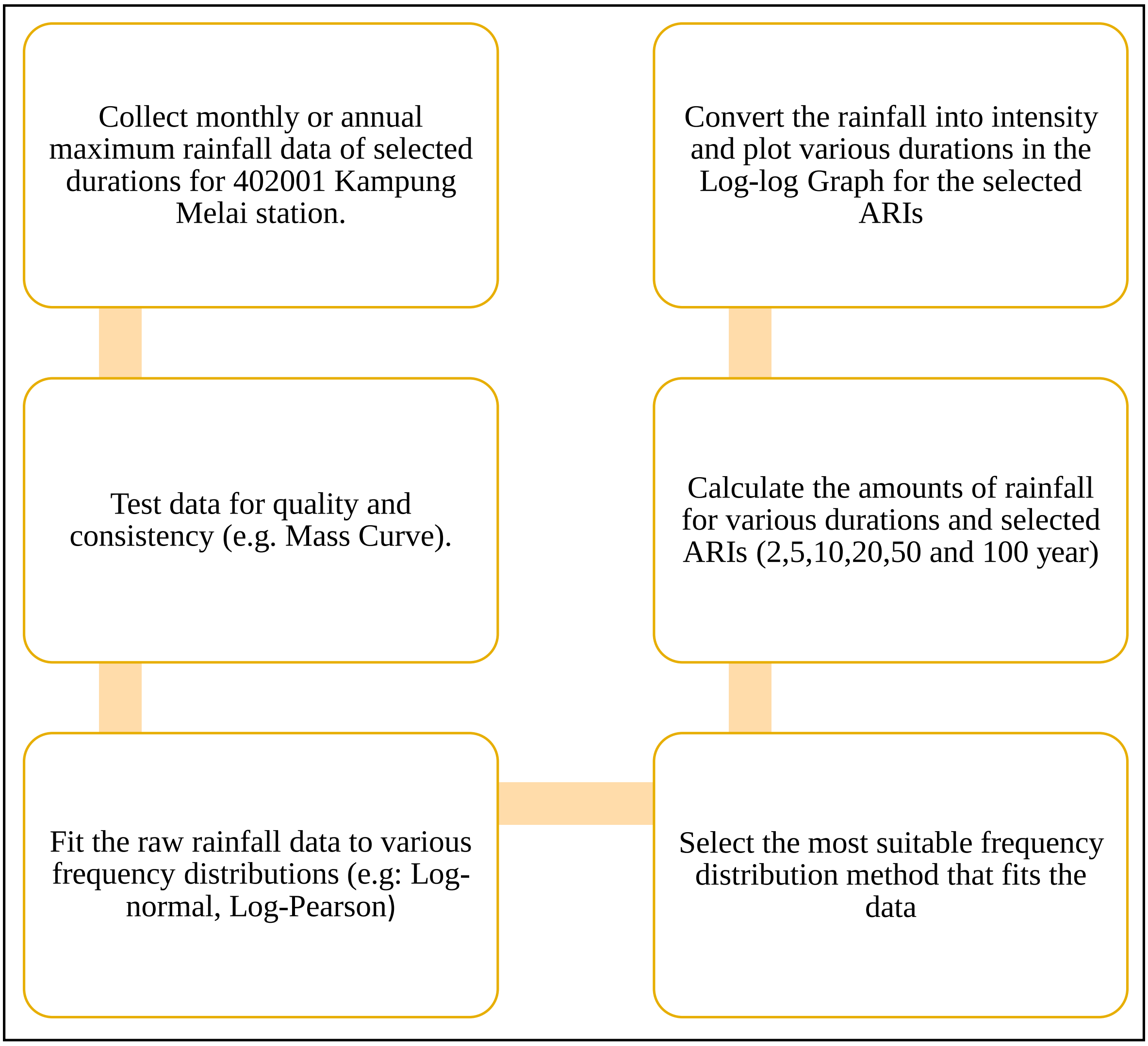


Figure 3.9.2 *Steps to develop IDF curves*
Source: *MASMA 2nd Edition*

3.10 Temporal Rainfall Pattern

This study focuses on the Sungai Jemberau and Sungai Chini (Navigation Lock). The nearest station to Sungai Jemberau is Kampung Melai station. 5 minutes interval rainfall data collected from the Department of Irrigation and Drainage (DID).

It is important to emphasise that the rainfall temporal patterns are intended for use in hydrograph generation design storms. They should not be confused with the real rainfall data in historical storms, which is usually required to calibrate and validate hydrological and hydraulic simulation results.

The standard time intervals recommended for urban storm water modelling are listed in Table 3.10.

Table 3.10 Recommended intervals for design temporal rainfall pattern

Storm duration(minutes)	**Time interval (minutes)**
Less than 60	5
60-120	10
121-360	15
Greater than 360	30

Source: (2012) *MSMA 2nd Edition*

The duration for this study are 10 minutes, 15 minutes, 20 minutes, 25 minutes, 30 minutes, 60 minutes and 135 minutes duration. The temporal rainfall pattern for each of the duration is developed by using Average Variability Method (AVM) following Australian Rainfall and Runoff (AR &R). The procedure taken to develop temporal rainfall pattern for Kampung Melai station by using the AVM based on MSMA 2nd Edition as below:

1. From the data extraction, the most 10 most intense bursts events were selected. This study only had durations of 10 minutes, 15 minutes, 20 minutes, 25 minutes, 30 minutes, 60 minutes, and 135 minutes rainfall.
2. The burst then divide into the respective time interval to give amount of rain in each rainfall period.
3. Assign rank for each interval based on the rainfall amount. The same amounts of rainfall in more than one period, the average rank to be use.

4. Determine the percentage of rain occurred in each interval and listed in order of magnitude.
5. The average value for rank of each period’s rainfall is obtained and given assigned ranks based on these average values. This is for the determination of chronological order of the average heaviest period until less heaviest period.
6. The average value for the percentage of rain in period of each rank also calculated. These average percentages of rainfall are a reasonable estimate of the percentages that would occur in the periods of the burst of rainfall of average variability.
7. The chronological sequence of the periods is the determined. This is by considering that the most intense rainfall within the storm should be assigned to the period whose average rank is the lowest.

The procedure involves the steps in MSMA 2nd Edition has been summarized as shown in Figure 3.10.

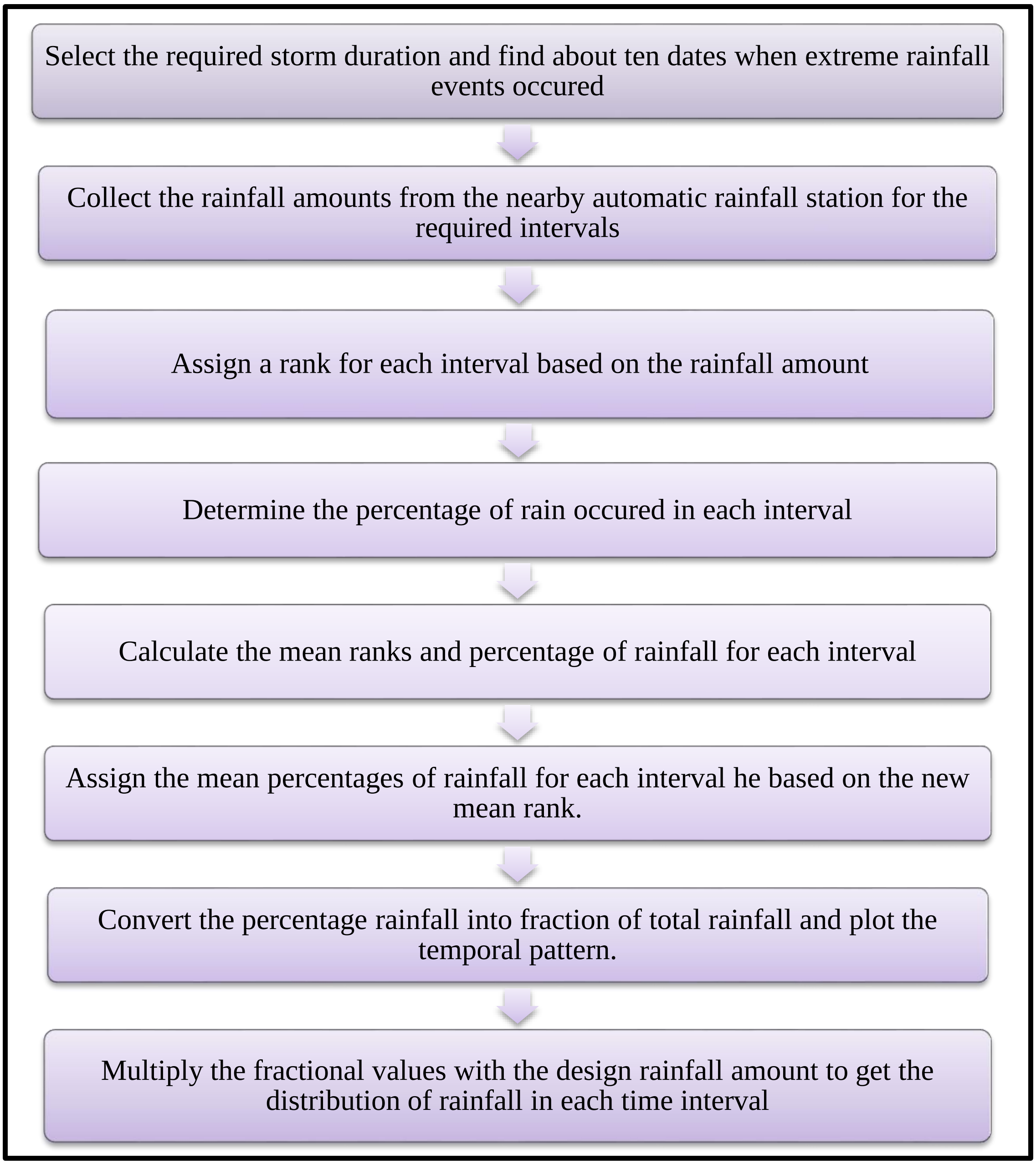


Figure 3.10 *Steps for the development design rainfall temporal pattern*
Source: *MSMA 2nd Edition (2012)*

3.11 River Flow Measurement

In order to calculate the flow for each station, an average or mean velocities must be determined. Since is not practical to measure the velocity of each layer, a method have been developed by follow the procedure in order to measure the velocities for the river stream. The mean velocity can be estimate from velocity measurement taken at a number of position in the flow.

3.11.1 River Flow Equipment

Flow measurement equipment which used in this study are state below. This equipment help to make the result more accurate:

a) Propeller current meter.

Figure 3.11.1 (a) *Propeller current meter*

b) Laser Distance.

Figure 3.11.1 (b) *Laser distance*

c) Water Depth Sensor

Figure 3.11.1 (c) *Water depth sensor*

As known, the current metre used to measure the velocity for each point. In this study, Propeller Current Meter is propose because the values for velocity are accurate. To measure the length of cross section for this study area, laser distance was used. It is because, the laser is more accurate compared to measuring tape. Then, to measure the river depth, water depth sensor were used.

3.11.2 Cross Sectional Area

The cross sectional area of the flow is determined from a level measurement by using the water depth sensor. It is important to do the level measurement and the flow measurement and the flow measurement must be at the same point.

3.11.3 Cross-Sectional Area Procedure

These propose of the procedure to determine the flow rate for every station. It is important to do the three times measurement of current velocity at different depth in order to get average. This is complete by dividing the stream cross section into polygon. In this study, the flow rate was measure by using Mid-Section Method. The velocity and the depth of the river will be getting from the current meter and depth measurement. All the data are important to calculate the flow stream of the water.

Initially, the width of the river is measure exactly perpendicular to the flow direction. The location should be chosen based on flow of the water. The cross sectional area should be no obstruction, backwater and the flow of water must be straight direction.

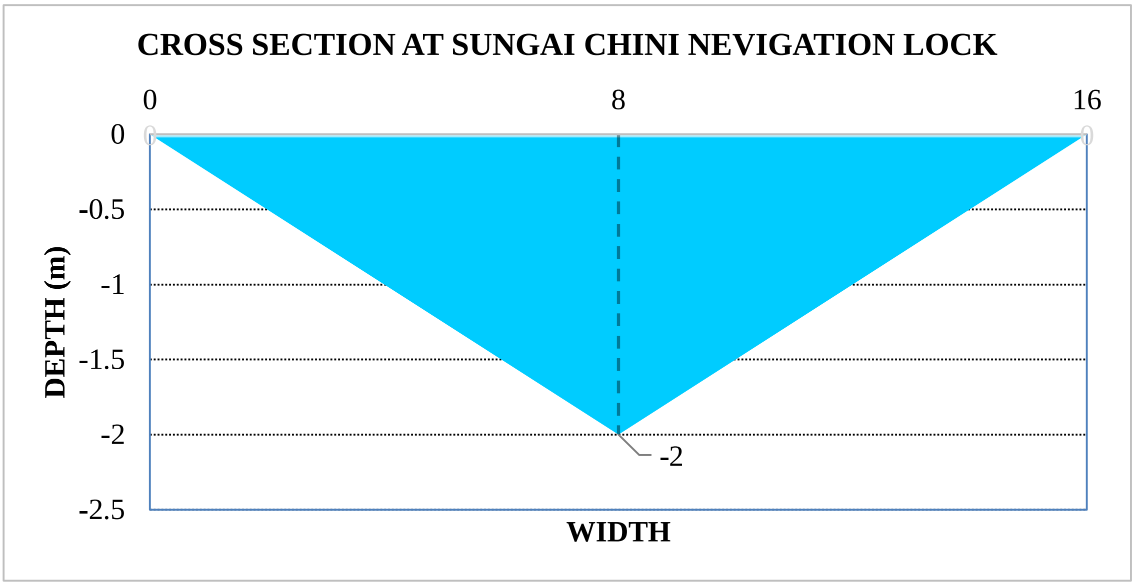


Figure 3.11.3 (a) *Cross section at Sungai Chini (Navigation Lock)*

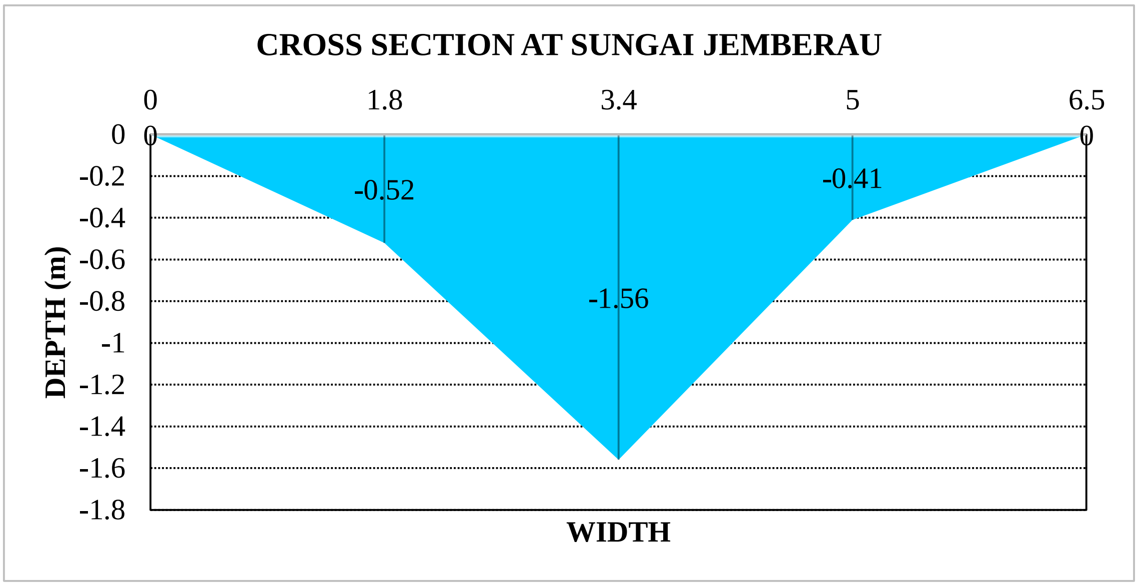


Figure 3.11.3 (b) *Cross section at Sungai Jemberau*

Each velocity measurement is not directed to the depth of the river. Before want to take the reading, the position of the propeller based on the depth of the river. If the depth of the river is less than 1 meter, the depth should be multiply with 0.4. So, that sum is the position of the propeller. That different for the depth above than 1m, it should be multiply with 0.6m and sum is the position of the propeller. Figure 3.11.3 (a) and Figure 3.11.3 (b) shown the cross section of river at Sungai Chini (Navigation Lock) and Sungai Jemberau.

Figure 3.11.3 (c) *Measuring velocities by using current meter*

During take the velocity measurement, some precautions must be alert in order to get precise reading. Firstly, the position of the propeller should be faced the flow of the stream flow.

All units are converted to the meters and the velocity in the interval is multiplied by the depth and lastly by the width of the downstream. All calculation for flow downstream is using Mid-Section Method. The calculation need to divide the cross section to 4 intervals. Then, take the average of the depth and the velocity and lastly the mean depth should multiply by the depth and the width. The total flow rate for the section is the sum of the four intervals.

Table 3.11.3 Calculation of river flow by using Mid- Section Method

DISTANCE FROM BANK LEFT BANK (m)	WATER DEPTH , d (m)	VELOCITY, V (m/s)	WIDTH , b (m)	DISCHARGE , Q (m3/s)	AVERAGE DISCHARGE, Qavg (m3/s)
0.0	0.00	0.000	0.0	0.000	0.104
1.8	0.52	0.068	1.8	0.064	
3.4	1.56	0.081	1.6	0.202	
5.0	0.41	0.069	1.6	0.045	
6.5	0.00	0.000	1.5	0.000	

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Introduction

The most common form of design rainfall data required for use in peak discharge estimation is from relationship represented by the Intensity duration frequency (IDF) curves. The IDF curve can be developed from the historical data and they are available for most geographical areas in Malaysia.

Recognizing that the rainfall data used to derive IDF are subjected to some interpolation and smoothing, it is desirable to develop IDF curves directly from local rain gauge records, if these records are sufficiently long and reliable.

4.2 Total Rainfall

Rainfall data is from Jabatan Pengairan Saliran Malaysia, JPS at 3 stations in Kuantan. The year of data is 10 years which is from 2008 until 2017. The total rainfall data for 3 stations hydrology will show the highest total rainfall result in Kuantan. The highest total rainfall in Kuantan is at Station 3330109 Kampung Batu Gong with 3141.5 mm. Table 4.2 (a) and Chart 4.2(a) show the annual rainfall from January to December from 2008 until 2016.

Table 4.2 (a) Total annual rainfall at station 3330109 on 2008 -2017.

BIL.	STATION	YEAR	MIN	MAX	TOTAL
1	3330109	2008	0	75.5	1154.5
2	3330109	2009	0	105.5	2244
3	3330109	2010	0	100	2259.5
4	3330109	2011	0	214.5	3141.5
5	3330109	2012	0	84	2528.5
6	3330109	2013	0	286.5	2923.5
7	3330109	2014	0	245.5	2803.5
8	3330109	2015	0	64.5	1346
9	3330109	2016	0	133	1441.5

Chart 4.2 (a): Total annual rainfall at station 3330109 on 2008 - 2017

From the Table 4.2 (b) and Chart 4.2 (b) below, show the total monthly rainfall for station 3330109 from January to December on 2008 until 2017. The maximum total value rainfall at station 3330109 is 3919.5 mm which is on December. While, the minimum total value rainfall is 990.5 mm which on February.

Table 4.2 (b) Total monthly rainfall for station 3330109 on 2008 - 2017.

JAN	FEB	MAR	APR	MEI	JUNE	JUL	AUG	SEP	OCT	NOV	DIS
1476	854.5	1468	989.5	1804	1078	1423	1446	1584	1997.5	2973	3765.5

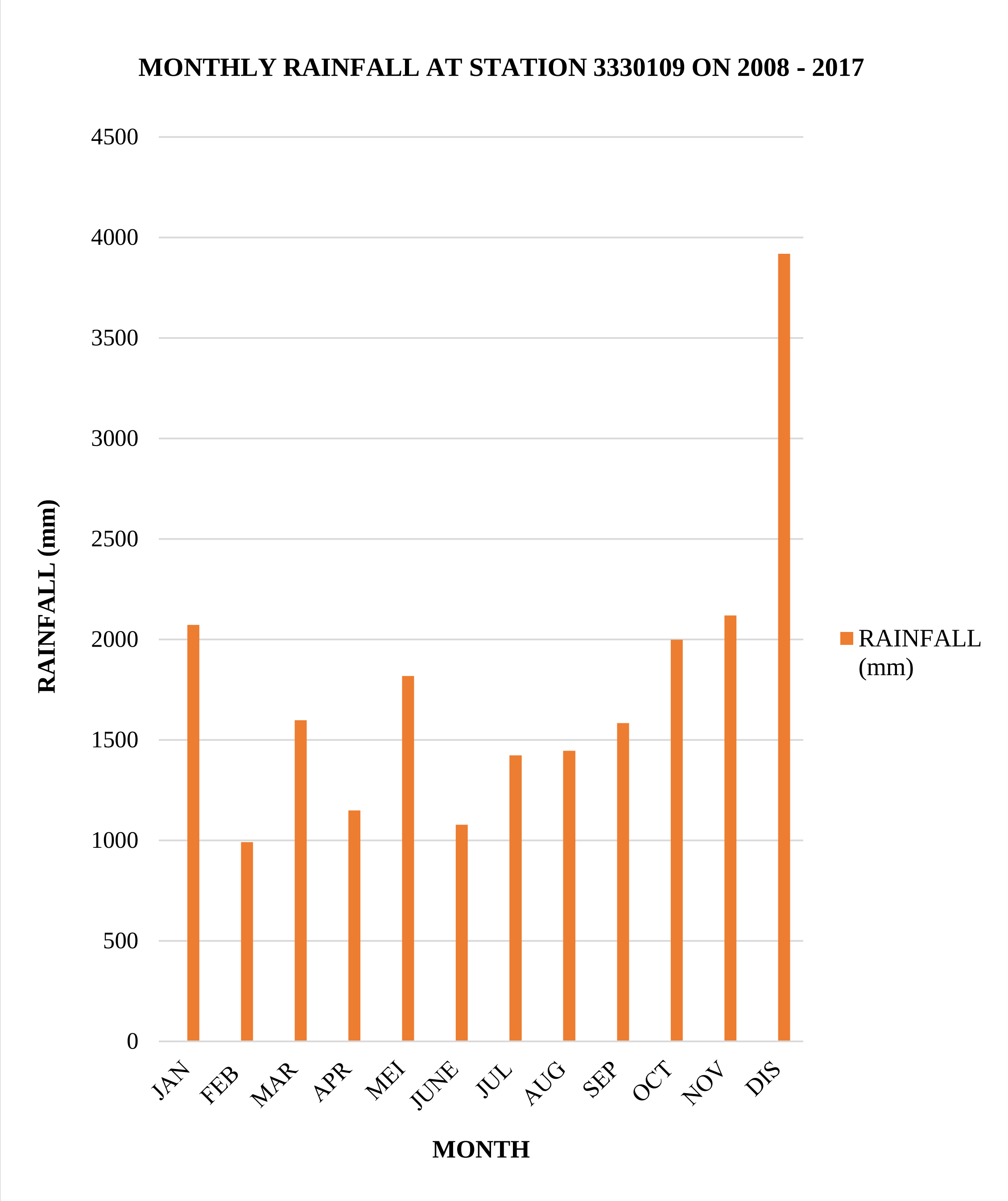


Chart 4.2 (b): Total monthly rainfall for station 3330109 on 2008 until 2017

4.3 Monthly Rainfall for Station 3330109 on 2008-2017)

4.3.1 Monthly Rainfall Data for Station 3330109 on 2008

From Table 4.3.1 there is some data were missing on 2008. Which are from January until May. Then, the minimum value of monthly rainfall for station 3330109 is 0.0 mm while the maximum 75.5 mm in July. Table 4.3.1 and Chart 4.3.1 shows the monthly rainfall data for 2008.

Table 4.3.1 Monthly rainfall data for station 3330109 on 2008

MONTH	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DIS	
MIN	?	?	?	?	?	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOT	?	?	?	?	?	11.0	301.5	201.5	71.0	196.5	185.5	187.5	1154.5
MAX	?	?	?	?	?	7.5	75.5	52	14.5	28	75.5	49.5	75.5
NO>0.0	0	0	0	0	0	2	14	14	13	14	16	13	86

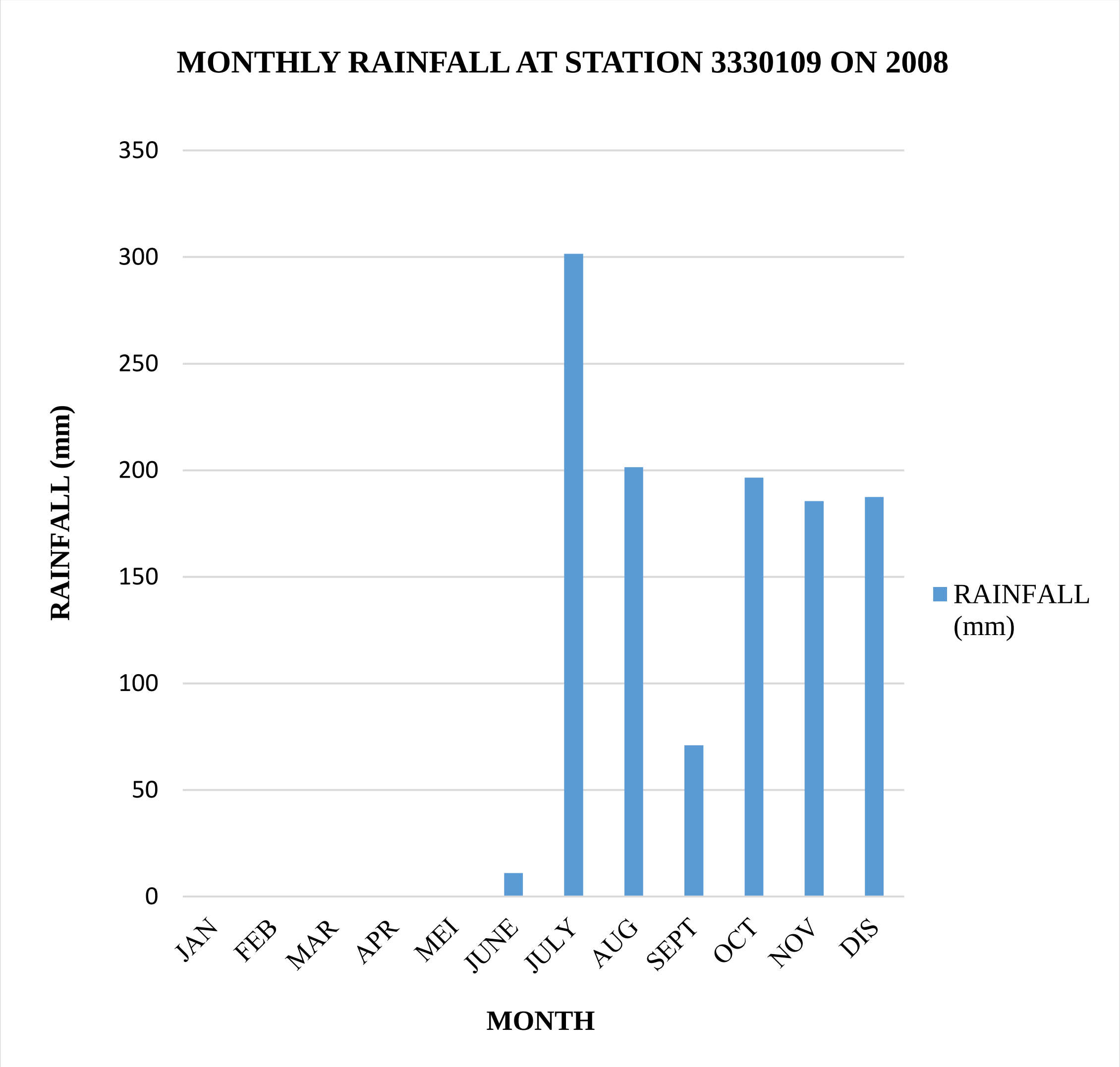


Chart 4.3.1: Monthly rainfall data for station 3330109 on 2008

4.3.2 Monthly Rainfall Data for Station 3330109 on 2009

From Table 4.3.2 there is no missing data on 2009. Then, the minimum value of monthly rainfall for station 3330109 is 0.0 mm while the maximum 105.5 mm in August. Table 4.3.2 and Chart 4.3.2 shows the monthly rainfall data for 2009.

Table 4.3.2 Monthly rainfall data for station 3330109 on 2009

MONTH	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DIS	

MIN	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
TOT	174.0	60.0	310.0	86.0	147.0	105.0	56.0	275.5	114.0	335.5	195.0	386.0	2244.0
MAX	88.5	59.0	46.0	16.5	81.5	30.0	12.0	105.5	20.5	67.0	35.0	104.0	105.5
NO>0.0	7	3	19	15	15	14	9	16	15	21	22	23	179

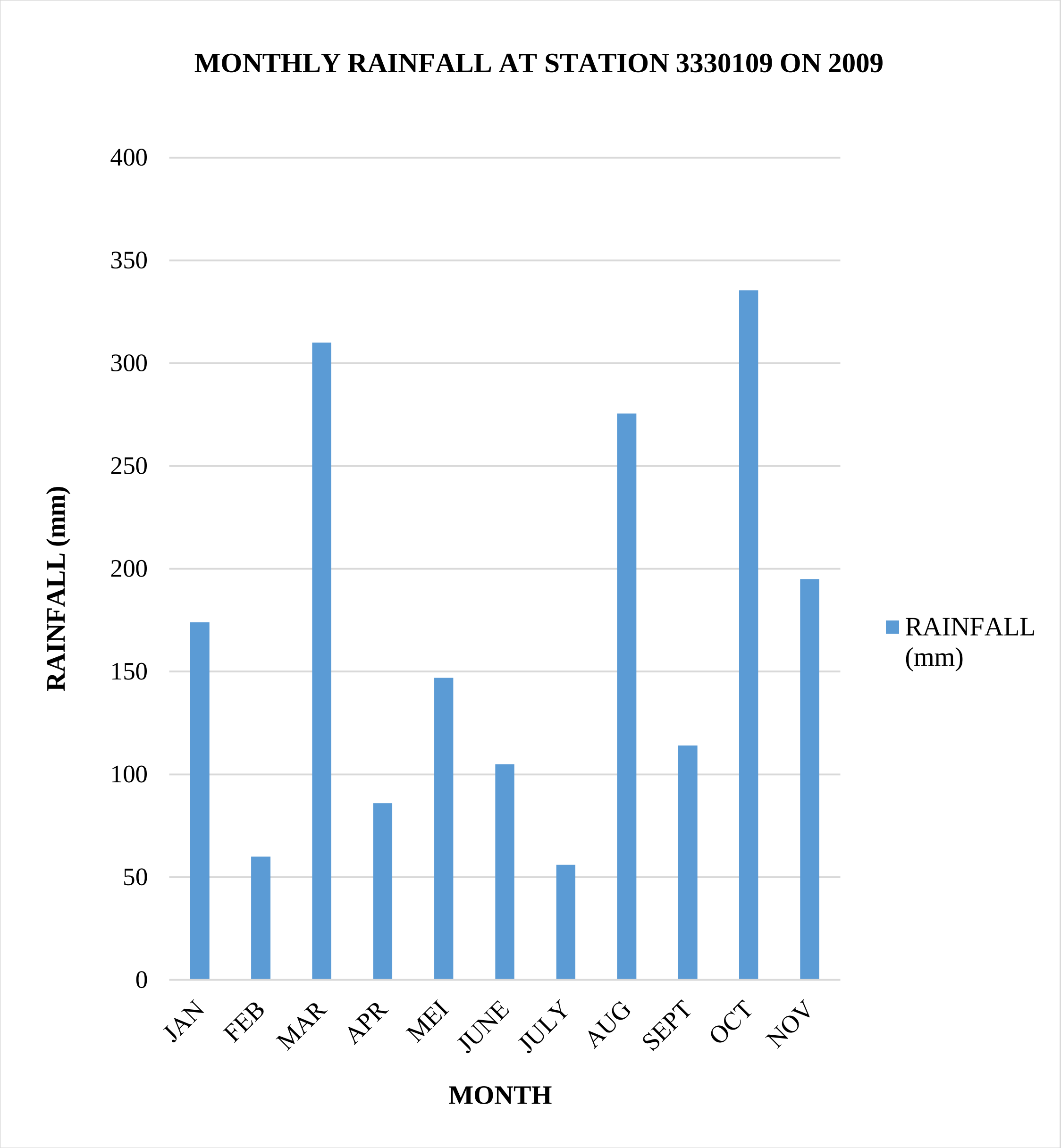


Chart 4.3.2: Monthly rainfall data for station 3330109 on 2009

4.3.3 Monthly Rainfall Data for Station 3330109 on 2010

From Table 4.3.3 there is no missing data on 2010. Then, the minimum value of monthly rainfall for station 3330109 is 0.0 mm while the maximum 100.0 mm in May. Table 4.3.3 and Chart 4.3.3 shows the monthly rainfall data for 2010.

Table 4.3.3 Monthly rainfall data for station 3330109 on 2010

MONTH	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DIS	
MIN	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
TOT	112.5	4.0	140.5	153.0	166.0	252.0	262.0	148.5	226.5	169.5	312.5	312.5	2259.5
MAX	45.5	2.5	63.5	58.5	100.0	82.5	79.5	31.5	51.5	47.0	76.5	58.0	100.0
NO>0.0	10	3	9	16	11	15	12	16	21	16	21	22	172

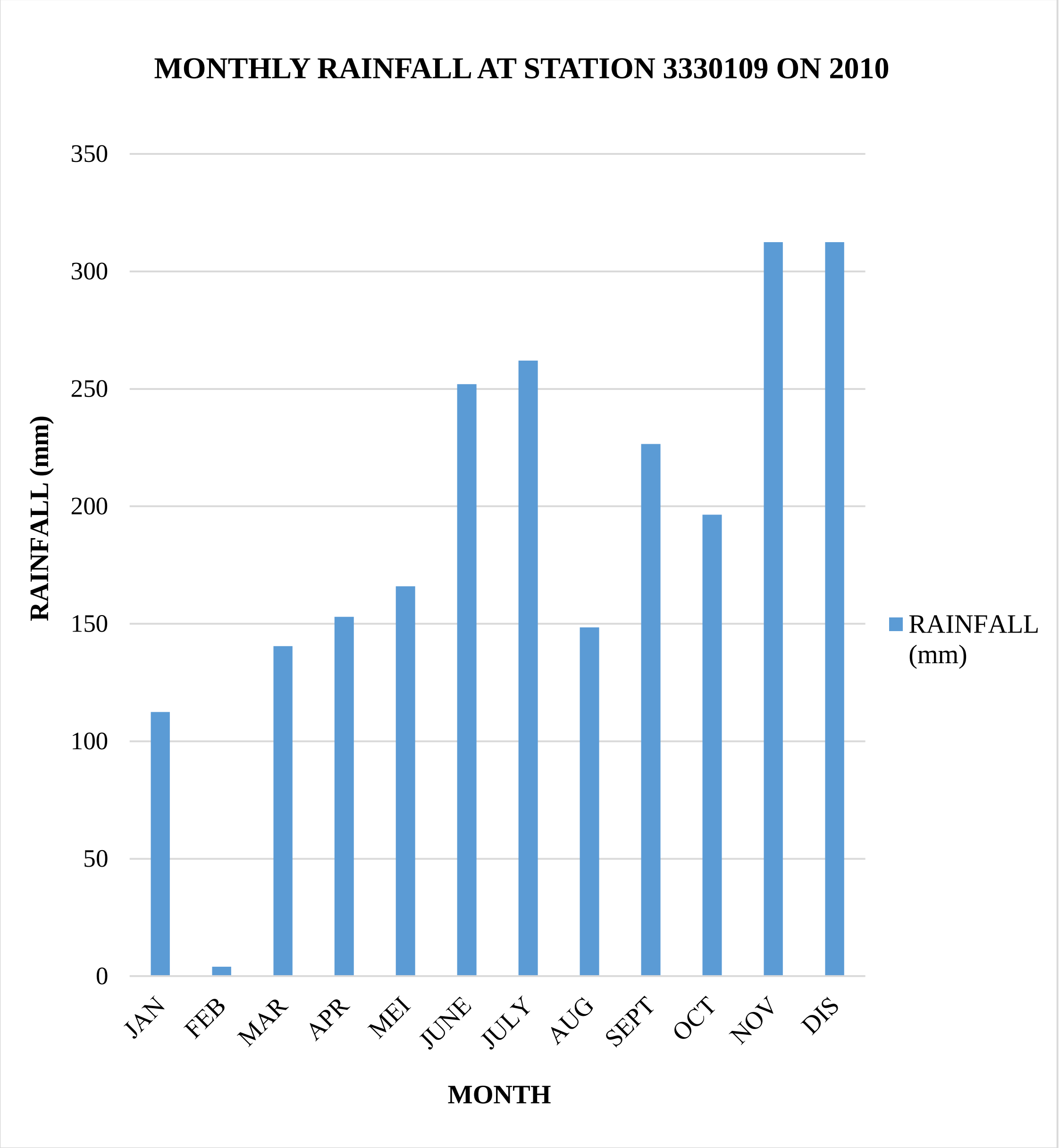


Chart 4.3.3: Monthly rainfall data for station 3330109 on 2010

4.3.4 Monthly Rainfall Data for Station 3330109 on 2011

From Table 4.3.4 there is no missing data on 2011. Then, the minimum value of monthly rainfall for station 3330109 is 0.0 mm while the maximum 214.5 mm in March. Table 4.3.4 and Chart 4.3.4 shows the monthly rainfall data for 2011.

Table 4.3.4 Monthly rainfall data for station 3330109 on 2011

MONTH	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DIS	
MIN	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
TOT	499.0	36.5	530.0	115.0	113.0	172.5	78.5	102.0	307.5	275.5	302.5	609.5	3141.5
MAX	94.5	29.5	214.5	27.5	33.5	48.0	27.5	53.5	43.5	88.0	148.0	185.5	214.5
NO>0.0	18	7	18	11	17	12	11	10	20	22	16	20	182

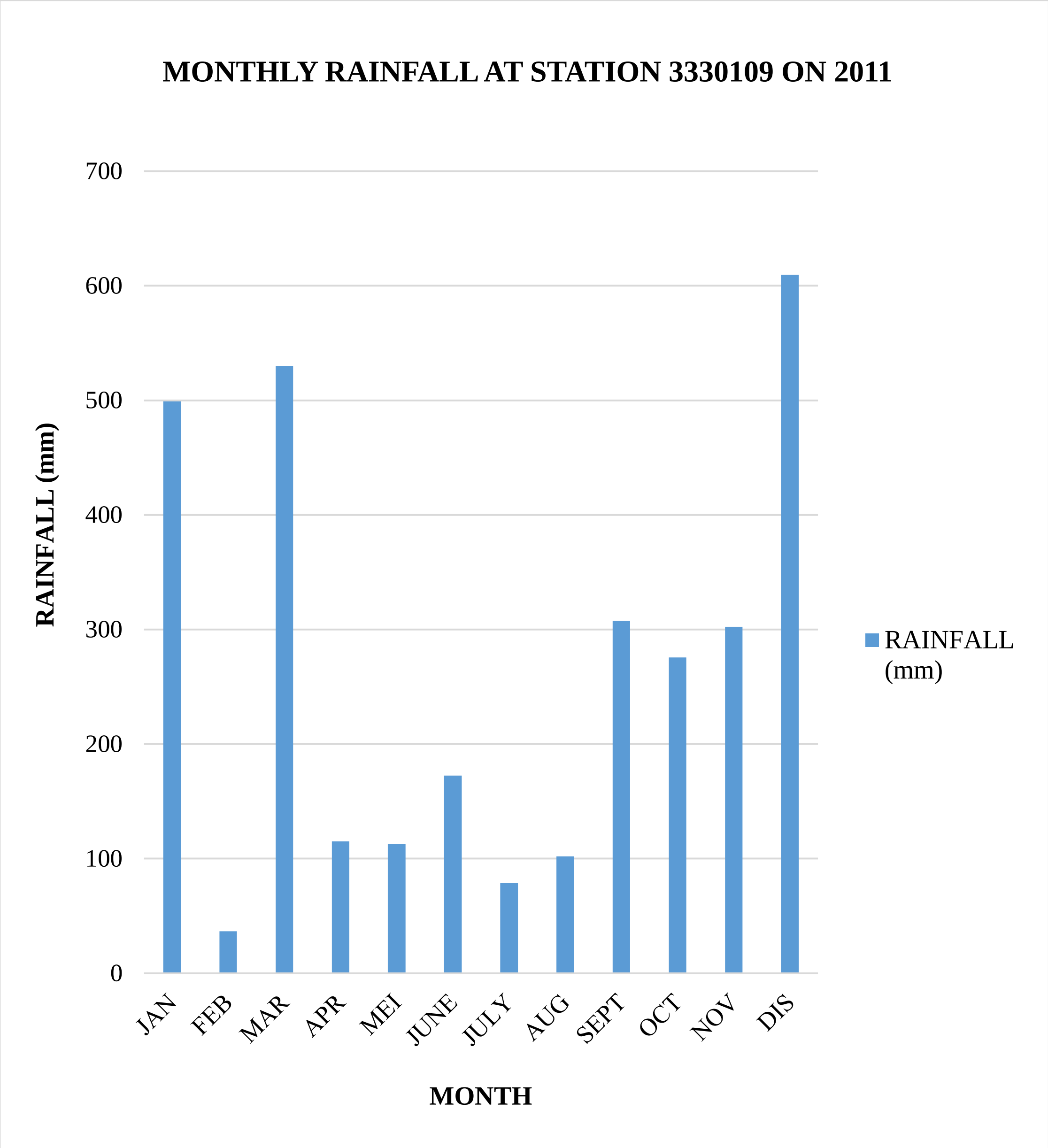


Chart 4.3.4: Monthly rainfall data for station 3330109 on 2011

4.3.5 Monthly Rainfall Data for Station 3330109 on 2012

From Figure 4.3.5 there is no missing data on 2012. Then, the minimum value of monthly rainfall for station 3330109 is 0.0 mm while the maximum 84.0 mm in April. Table 4.3.5 and Chart 4.3.5 shows the monthly rainfall data for 2012.

Table 4.3.5 Monthly rainfall data for station 3330109 on 2012

MONTH	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DIS	
MIN	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
TOT	227.0	119.0	221.5	235.5	222.5	106.0	102.5	153.0	272.5	165.5	311.0	392.5	2528.5
MAX	73.5	44.5	37.0	84.0	77.0	40.0	33.5	42.5	50.0	59.0	57.0	65.0	84.0
NO>0.0	16	14	22	16	13	9	10	10	14	17	24	21	186

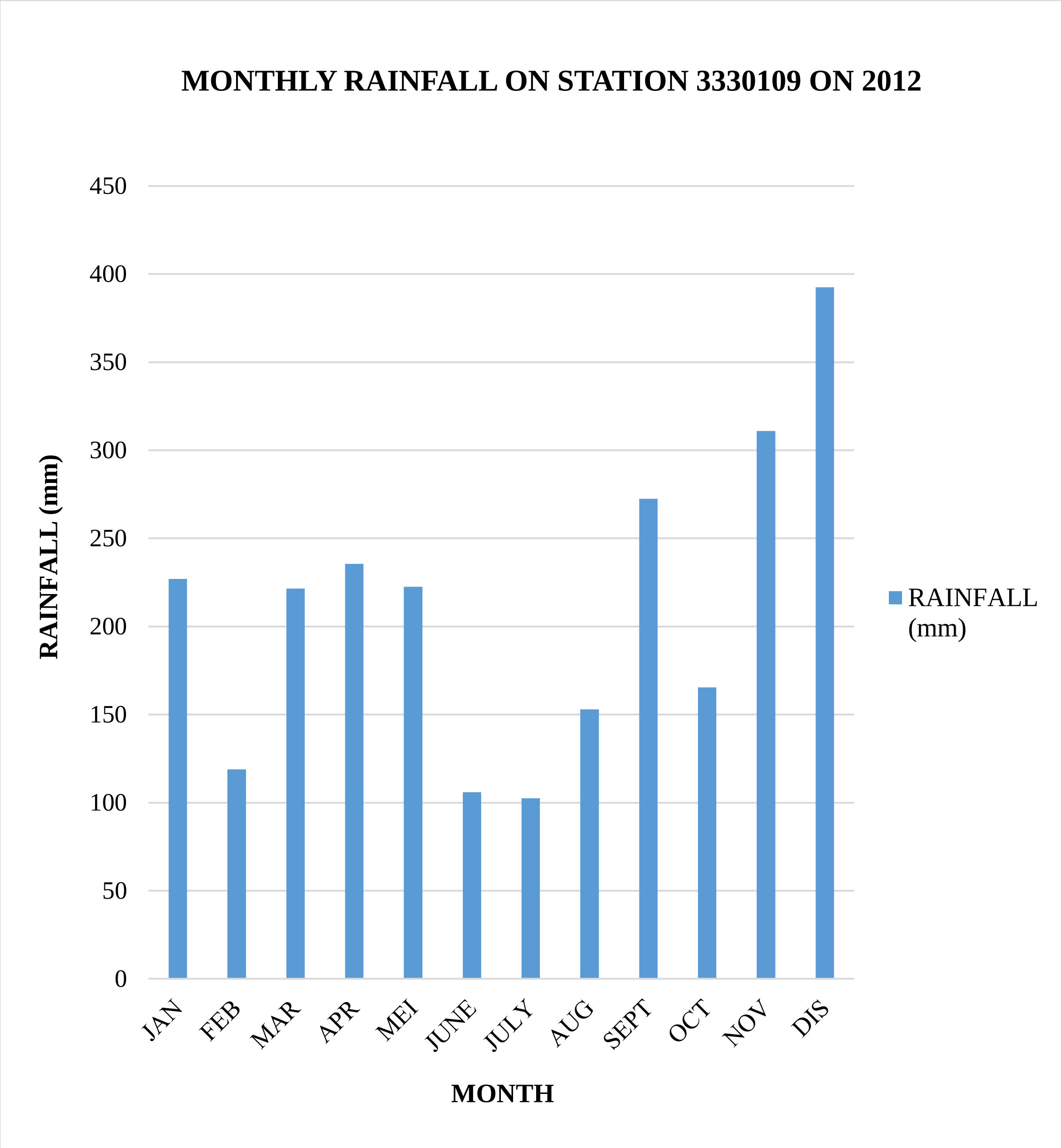


Chart 4.3.5: Monthly rainfall data for station 3330109 on 2012

4.3.6 Monthly Rainfall Data for Station 3330109 on 2013

From Table 4.3.6 there is some missing data on December 2013. Then, the minimum value of monthly rainfall for station 3330109 is 0.0 mm while the maximum

286.5 mm in December. Table 4.3.6 and Chart 4.3.6 shows the monthly rainfall data for 2013.

Table 4.3.6 Monthly rainfall data for station 3330109 on 2013

MONTH	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DIS	
MIN	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
TOT	162	433	71.5	232	413.5	100	151	130.5	194.5	289.5	124	622	2923.5
MAX	37	121	52.5	46	73.5	45.5	49.5	57.5	67.5	82	36.5	286.5	286.5
NO>0.0	12	18	9	20	21	9	13	12	17	20	17	10	178

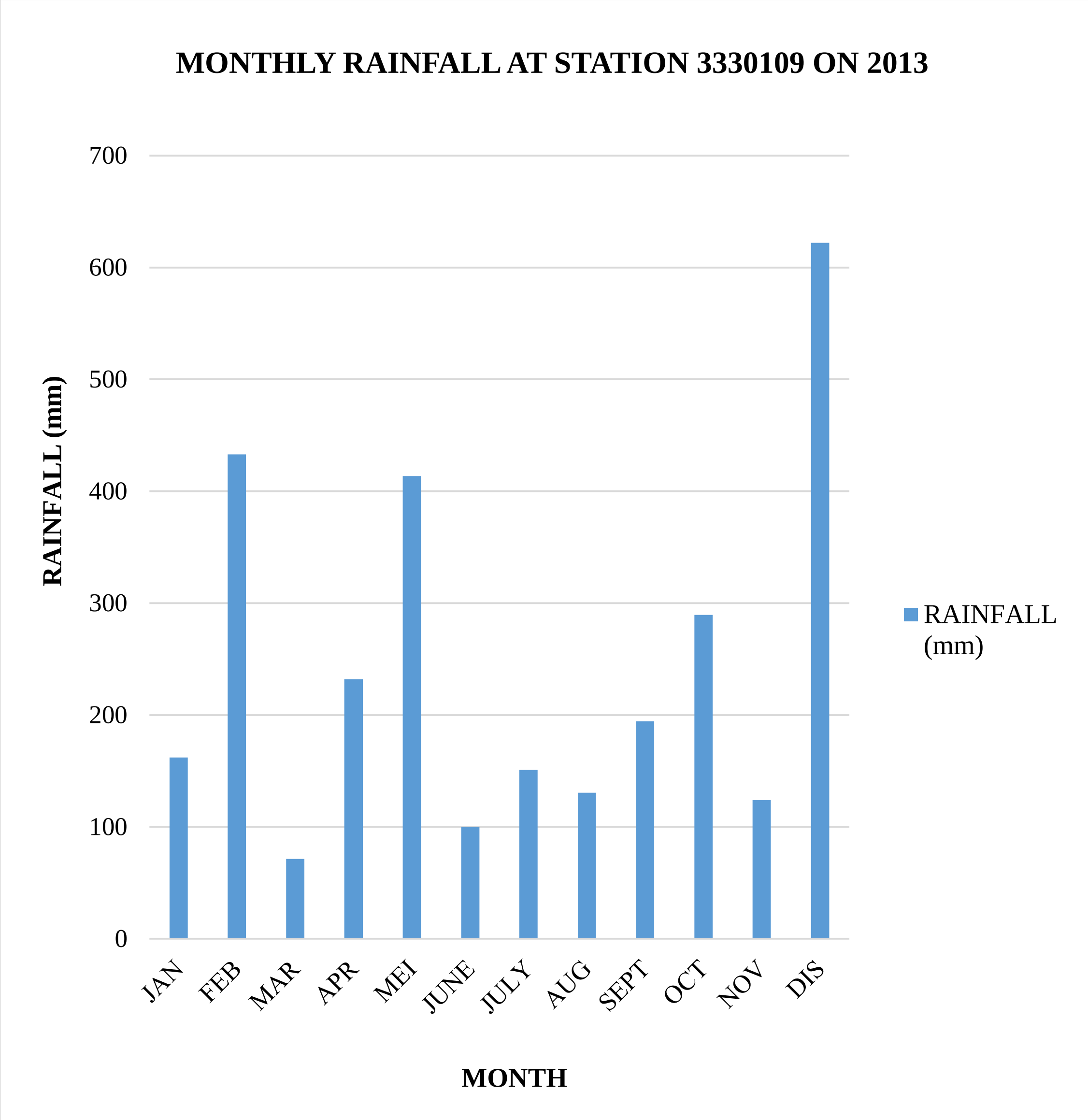


Chart 4.3.6: Monthly rainfall data for station 3330109 on 2013

4.3.7 Monthly Rainfall Data for Station 3330109 on 2014

From Table 4.3.7 there is some missing data on January 2014. Then, the minimum value of monthly rainfall for station 3330109 is 0.0 mm while the maximum 245.5 mm in December. Table 4.3.7 and Chart 4.3.7 shows the monthly rainfall data for 2014.

Table 4.3.7 Monthly rainfall data for station 3330109 on 2014

MONTH	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DIS	
MIN	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
TOT	0.0	0.0	122.5	60.5	488.0	72.0	215.0	174.0	143.5	245.5	301.5	981.0	2803.5
MAX	0.0	0.0	66.5	18.5	112.5	59.0	59.5	40.0	41.0	68.0	88.0	245.5	245.5
NO>0.0	0	0	7	8	18	6	10	17	11	14	19	22	132

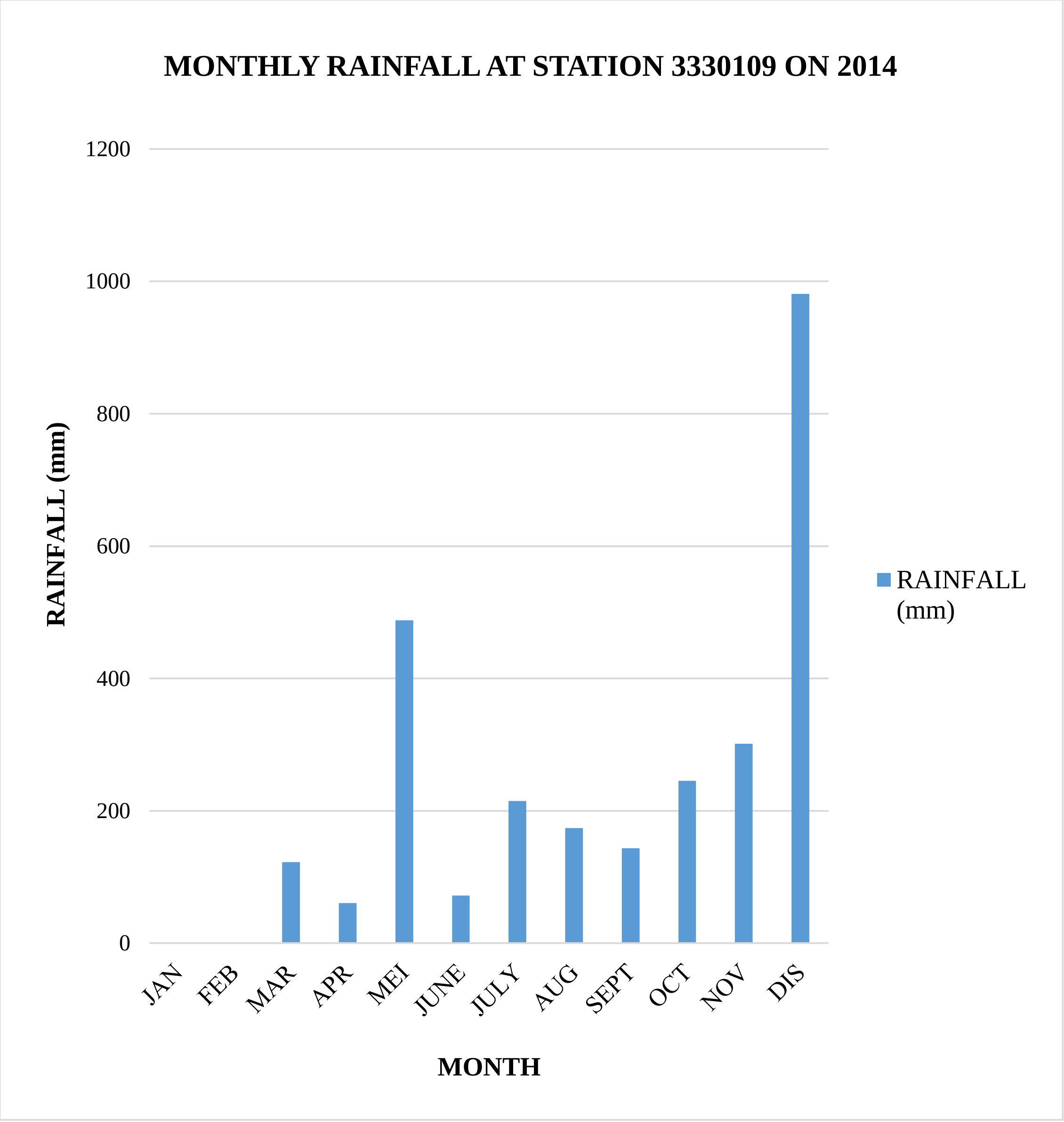


Chart 4.3.7: Monthly rainfall data for station 3330109 on 2014

4.3.8 Monthly Rainfall Data for Station 3330109 on 2015

From Table 4.3.8 there is some missing data on June and July 2015. Then, the minimum value of monthly rainfall for station 3330109 is 0.0 mm while the maximum 64.5 mm in December. Table 4.3.8 and Chart 4.3.8 shows the monthly rainfall data for 2015.

Table 4.3.8 Monthly rainfall data for station 3330109 on 2015

MONTH	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DIS	
MIN	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
TOT	151.5	17.0	41.5	63.0	178.5	31.5	78.0	137.5	93.5	65.5	214.0	274.5	1346.0
MAX	60.0	8.5	19.5	25.0	63.0	21	49.5	50.5	27.5	20.0	42.5	64.5	64.5
NO>0.0	8	5	6	10	13	3	6	15	8	10	20	16	120

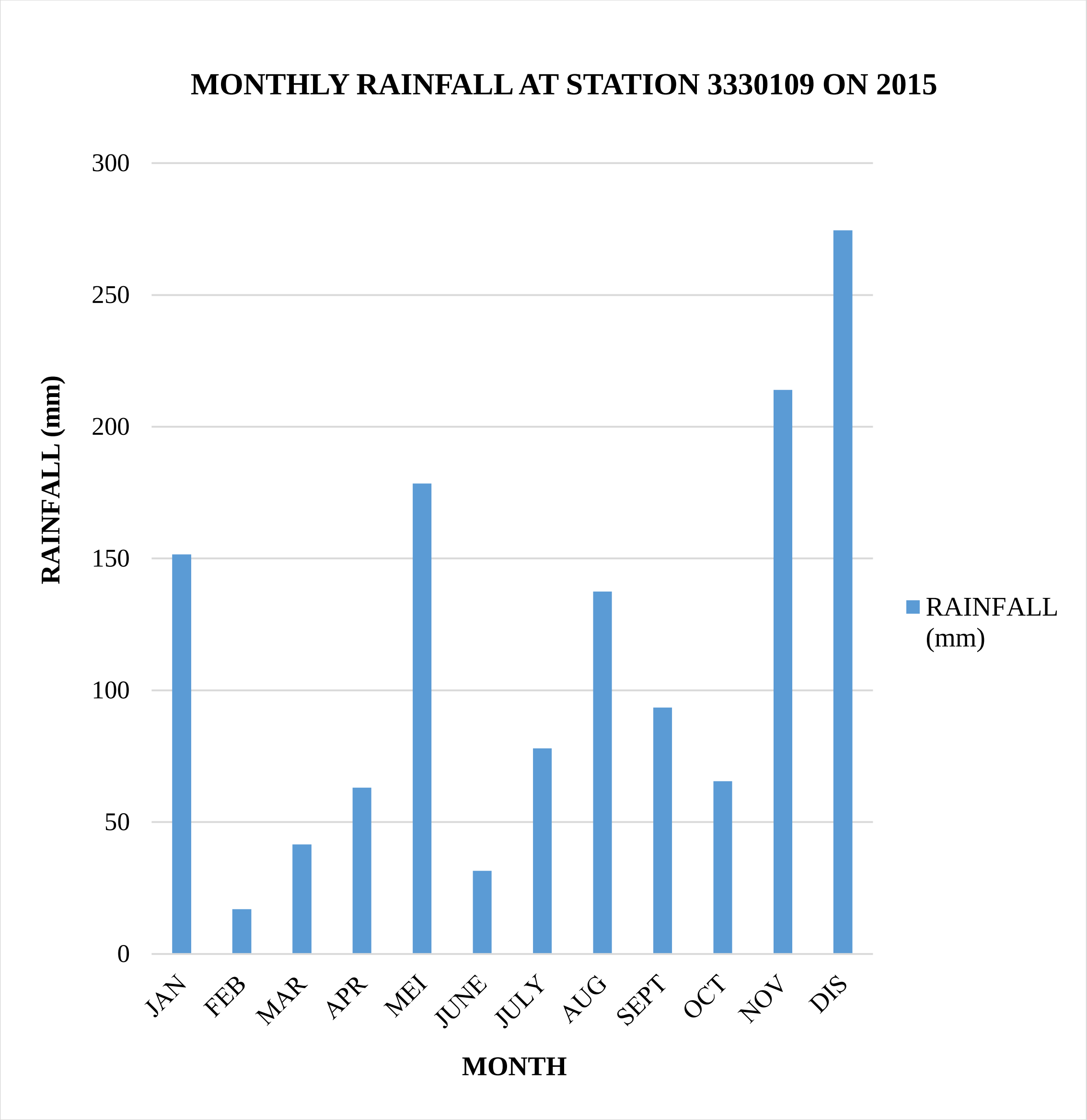


Chart 4.3.8: Monthly rainfall data for station 3330109 on 2015

4.3.9 Monthly Rainfall Data for Station 3330109 on 2016

From Table 4.3.9 there is some missing data on October until December 2016. Then, the minimum value of monthly rainfall for station 3330109 is 0.0 mm while the maximum 133.0 mm in June. Table 4.3.9 and Chart 4.3.9 shows the monthly rainfall data for 2016.

Table 4.3.9 Monthly rainfall data for station 3330109 on 2016

MONTH	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DIS	
MIN	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
TOT	150.0	185.0	30.5	44.5	75.5	228.0	178.5	123.5	161.0	227.5	173.5	154	1731.5
MAX	51.5	42.5	28.0	34.0	26.5	133.0	57.0	40.5	37.0	79.5	45.0	49.5	133.0
NO>0.0	12	11	4	3	14	11	13	11	18	18	5	0	120

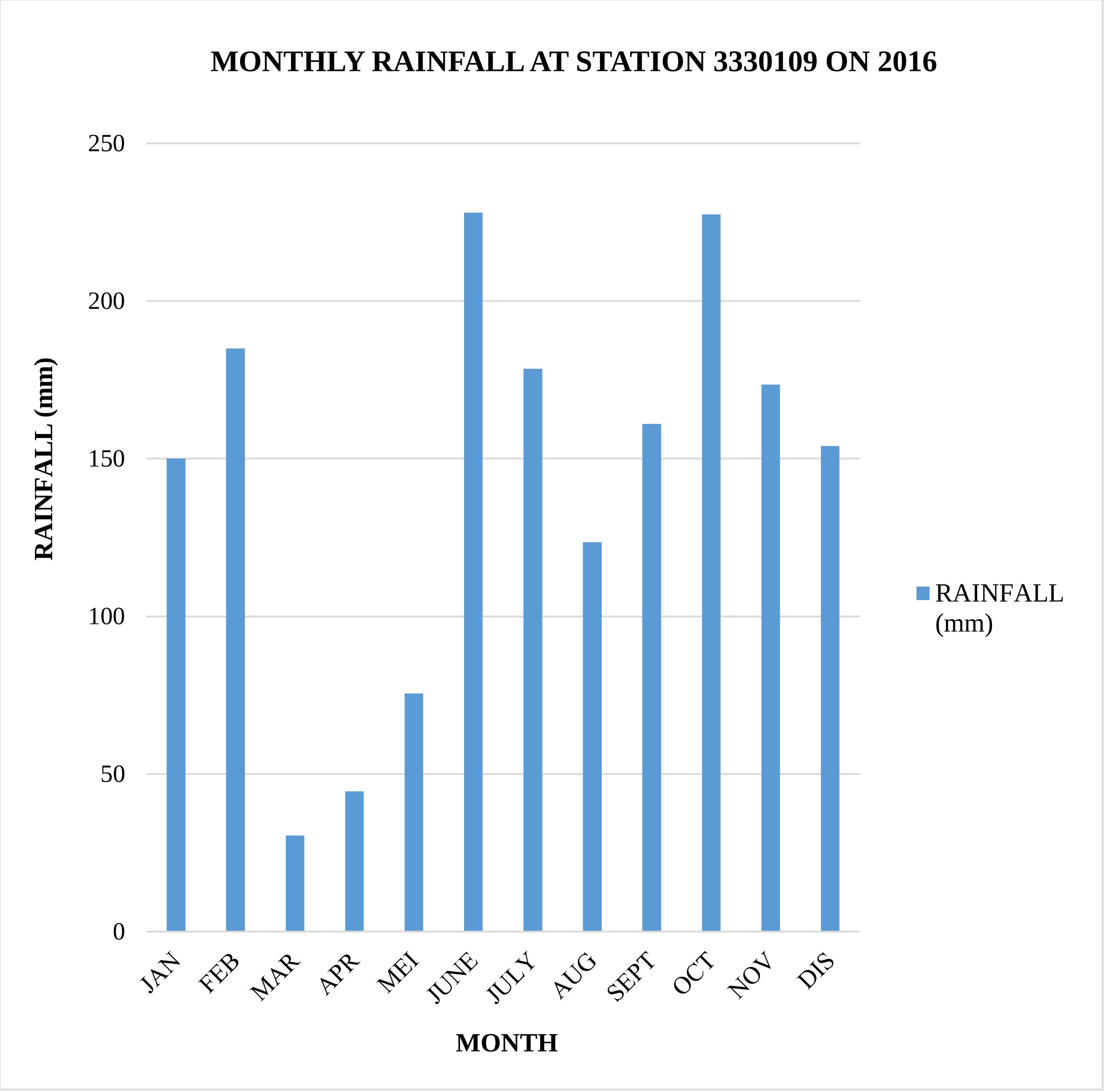


Chart 4.3.9: Monthly rainfall data for station 3330109 on 2016

4.3.10 Monthly Rainfall Data for Station 3330109 on 2017

From Table 4.3.10 there is some missing data from January until April 2017. Buts, on May 2017, the data it is not complete yet. It because the data, will collect on early of next month. So, the minimum value of monthly rainfall for station 3330109 is 0.0 mm while the maximum 192.0 mm in February. Table 4.3.10 and Chart 4.3.10 shows the monthly rainfall data for 2017.

Table 4.3.10 Monthly rainfall data for station 3330109 on 2017

MONTH	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DIS	
MIN	0.0	0.0	0.0	0.0	0.0	?	?	?	?	?	?	?	0.0
TOT	596.0	138.0	130.0	158.5	13.5	?	?	?	?	?	?	?	1034.0
MAX	192.0	91.0	49.0	71.5	11.5	?	?	?	?	?	?	?	192.0
NO>0.0	20	13	5	12	2	?	?	?	?	?	?	?	52

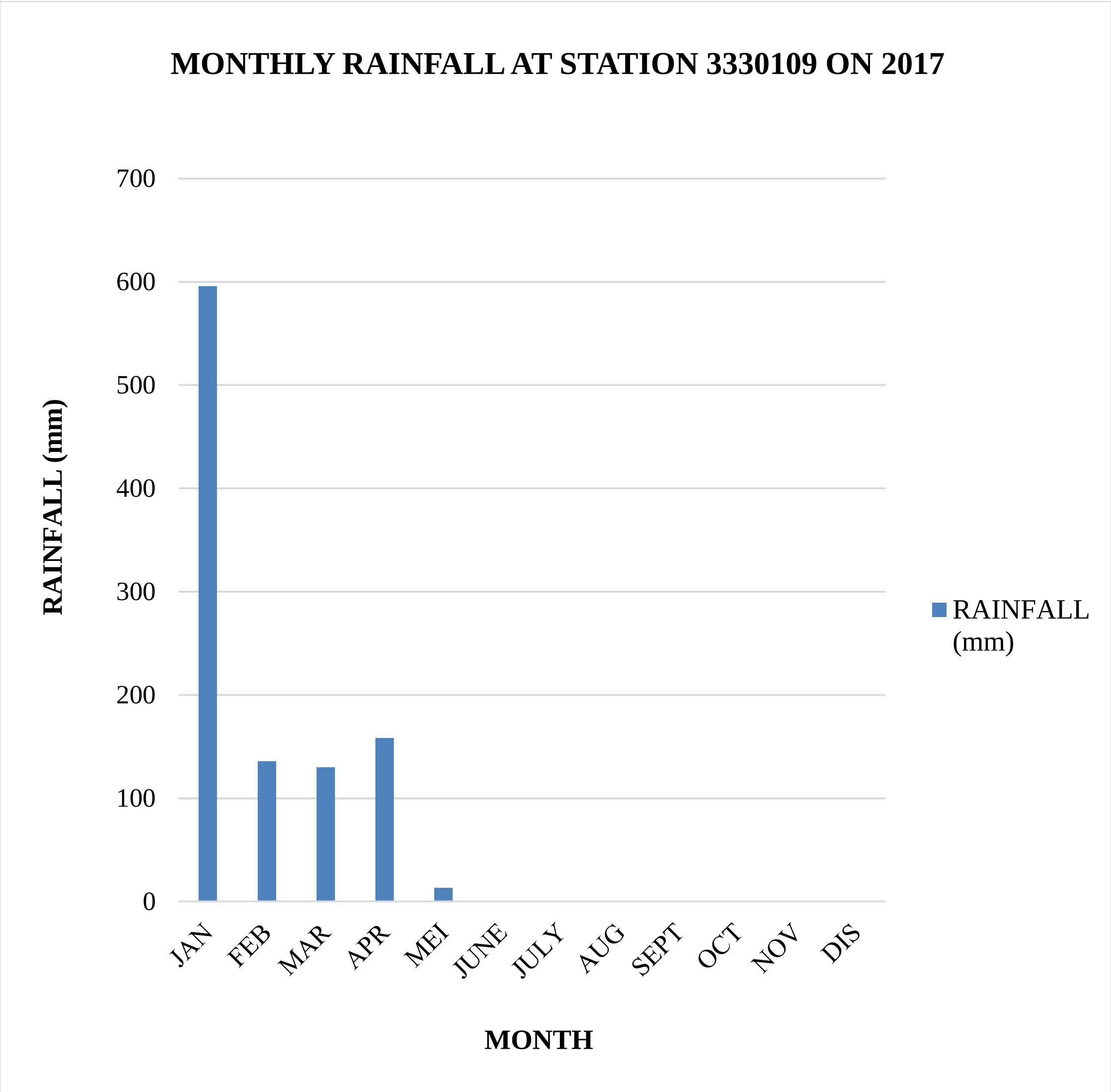


Chart 4.3.10: Monthly rainfall data for station 3330109 on 2017

4.4 Monthly Rainfall for Station 3430097 on 2012-2017

4.4.1 Total Monthly Rainfall for Station 3430097 on 2012 -2017

From the Table 4.4.1 and Chart 4.4.1 below, show the total monthly rainfall for station 3430097 from January to December on 2012 until 2017. The maximum total value rainfall at station 3430097 is 2720.5 mm which is on December. While, the minimum total value rainfall is 265.0 mm which on March.

Table 4.4.1 Total monthly rainfall for station 3430097 on 2008 -2017.

JAN	FEB	MAR	APR	MEI	JUN	JUL	AUG	SEP	OCT	NOV	DIS
554	661	265	784	867.5	386	489	881.5	694.5	684.5	921.5	2720.5

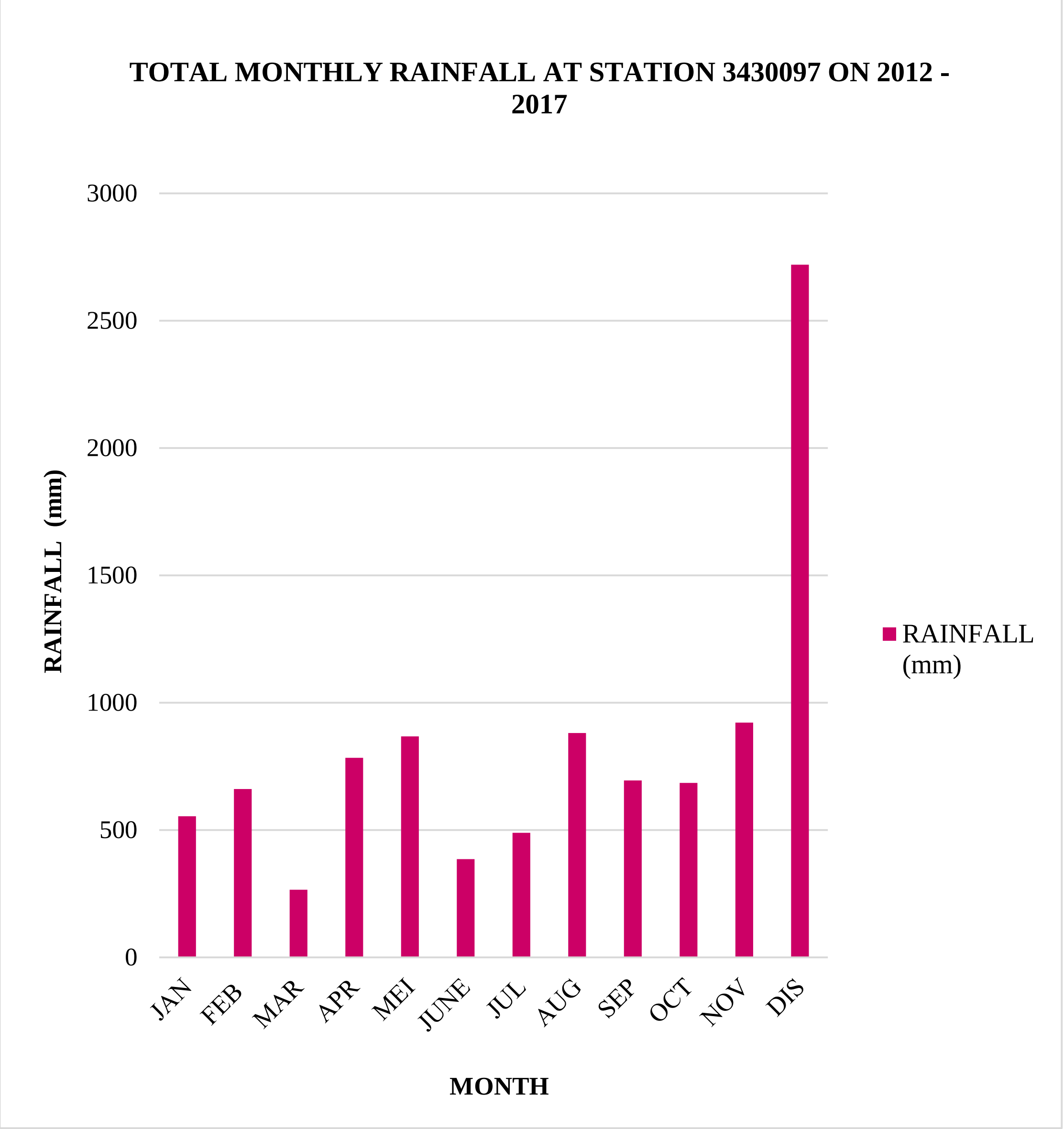


Chart 4.4.1: Total monthly rainfall for station 3430097 on 2008 - 2017

4.4.2 Monthly Rainfall Data for Station 3430097 on 2012

From Table 4.4.2 there is some missing data on January until August 2012. Then, the minimum value of monthly rainfall for station 3430097 is 0.0 mm while the maximum 79.5 mm in December. Table 4.4.2 and Chart 4.4.2 shows the monthly rainfall data for 2012.

Table 4.4.2 Monthly rainfall data for station 3430097 on 2012

MONTH	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DIS	
MIN	?	?	?	?	?	?	?	0.0	0.0	0.0	0.0	0.0	0.0
TOT	?	?	?	?	?	?	?	208.5	123.5	167.5	355.0	553.5	1408.0
MAX	?	?	?	?	?	?	?	76.0	28.5	59.5	71.5	79.5	79.5
NO>0.0	0	0	0	0	0	0	0	10	11	19	19	22	81

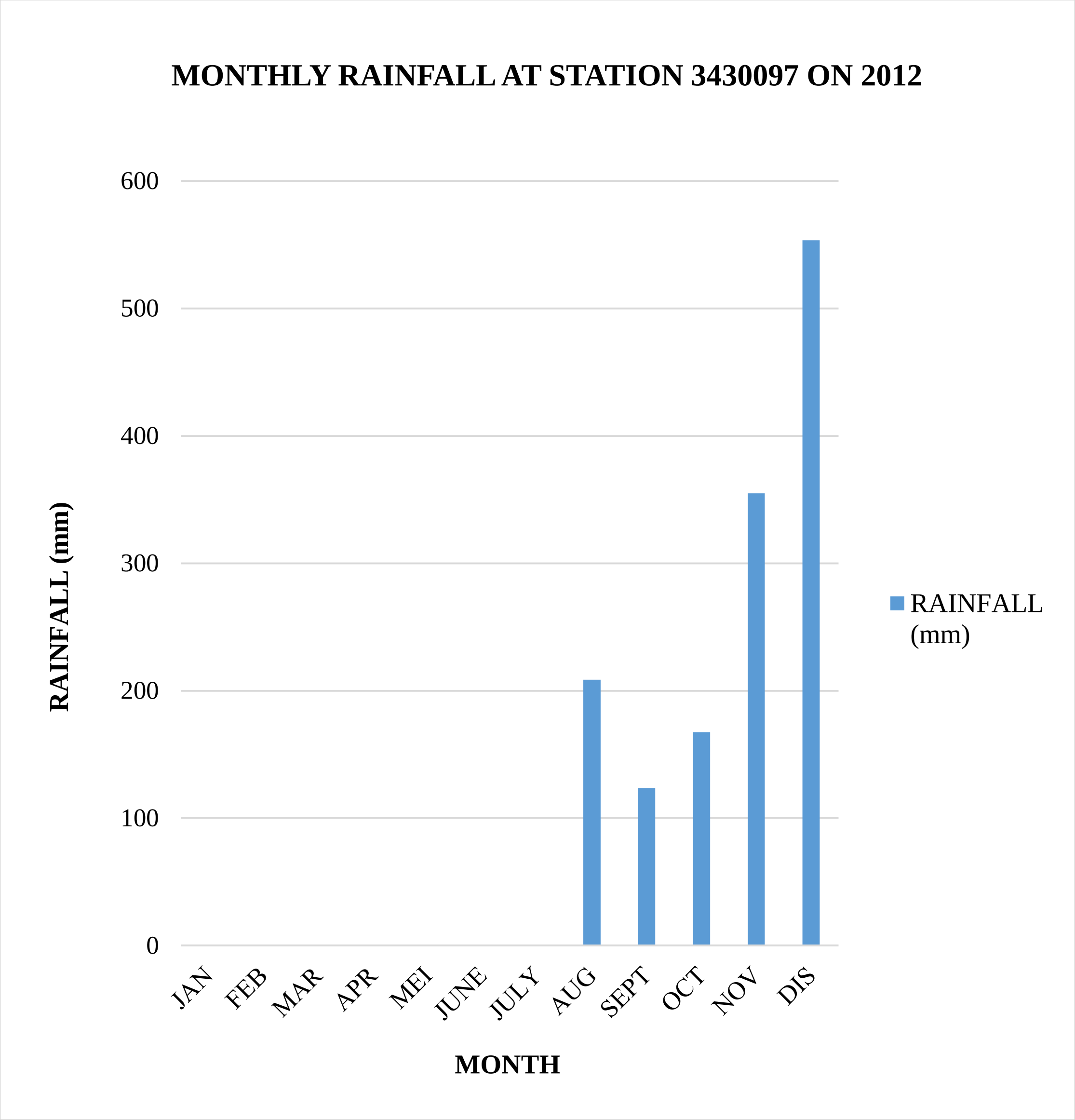


Chart 4.4.2: Monthly Rainfall Data for station 3430097 on 2012

4.4.3 Monthly Rainfall Data for Station 3430097 on 2013

From Table 4.4.3 there is no missing data on 2013. Then, the minimum value of monthly rainfall for station. Then, the minimum value of monthly rainfall for station 3430097 is 0.0 mm while the maximum 268.5 mm in December. Table 4.4.3 and Chart 4.4.3 shows the monthly rainfall data for 2013.

Table 4.4.3 Monthly rainfall data for station 3430097 on 2013

MONTH	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DIS	
MIN	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
TOT	153.0	235.0	28.0	248.5	235.0	87.5	141.0	166.5	139.0	196.5	127.5	782.0	2539.5
MAX	40.0	64.0	10.5	61.5	51.5	25.0	38.5	70.0	33.0	106.0	30.0	268.5	268.5
NO>0.0	12	18	7	14	19	10	11	11	16	14	18	16	166

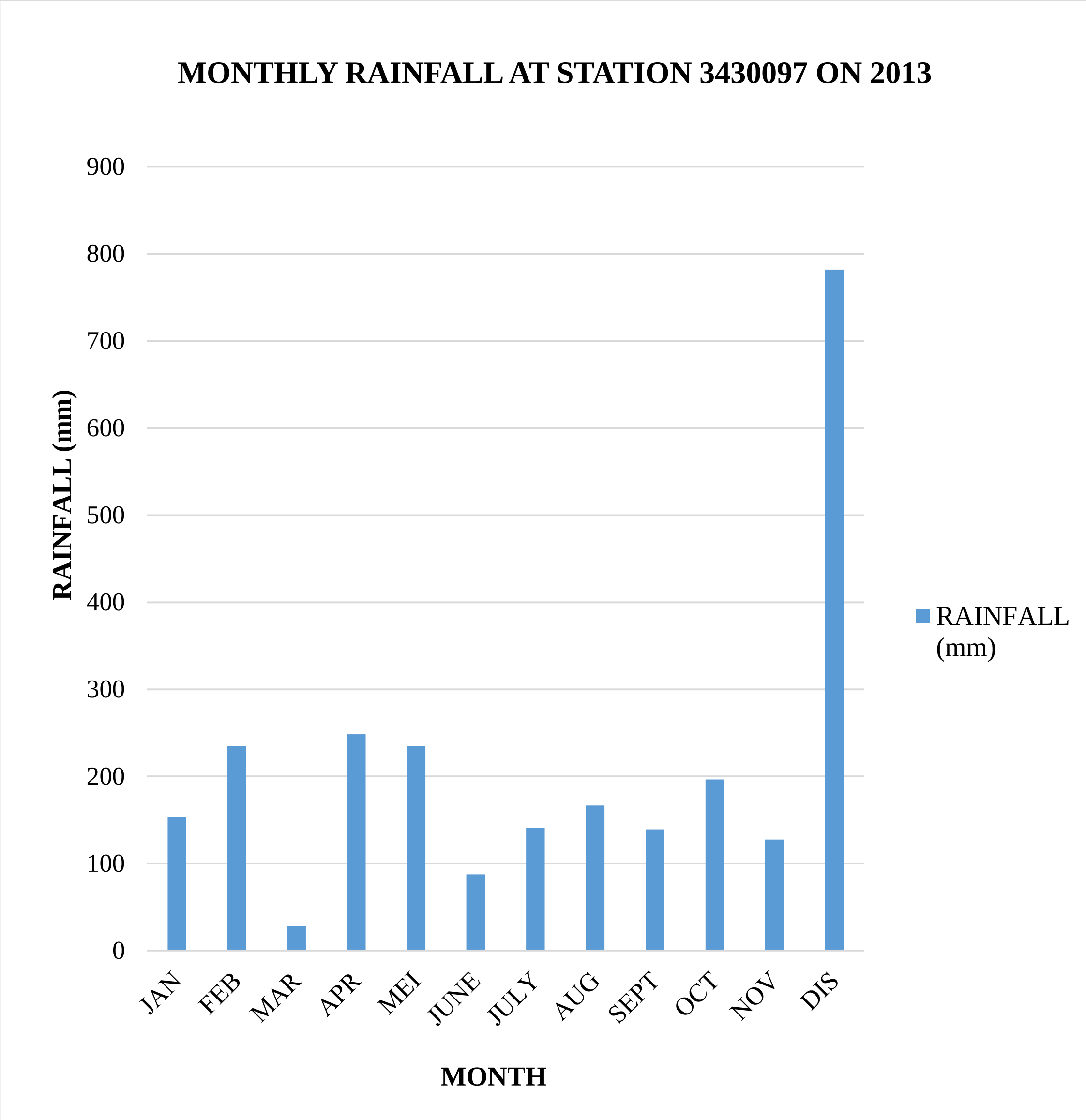


Chart 4.4.3: Monthly rainfall data for station 3430097 on 2013

4.4.4 Monthly Rainfall Data for Station 3430097 on 2014

From Table 4.4.4 there is no missing data on 2014. Then, the minimum value of monthly rainfall for station 3430097 is 0.0 mm while the maximum 234.0 mm in December. Table 4.4.4 and Chart 4.4.4 shows the monthly rainfall data for 2014.

Table 4.4.4 Monthly rainfall data for station 3430097 on 2014

MONTH	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DIS	
MIN	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
TOT	251.0	7.0	75.0	209.5	242.5	128.5	122.5	195.5	94.0	171.5	108.0	1097.0	2702.0
MAX	155.5	6.5	32.5	65.0	79.0	64.5	48.5	58.0	29.0	47.5	16.5	234.0	234.0
NO>0.0	8	2	8	12	15	9	8	16	10	16	17	22	143

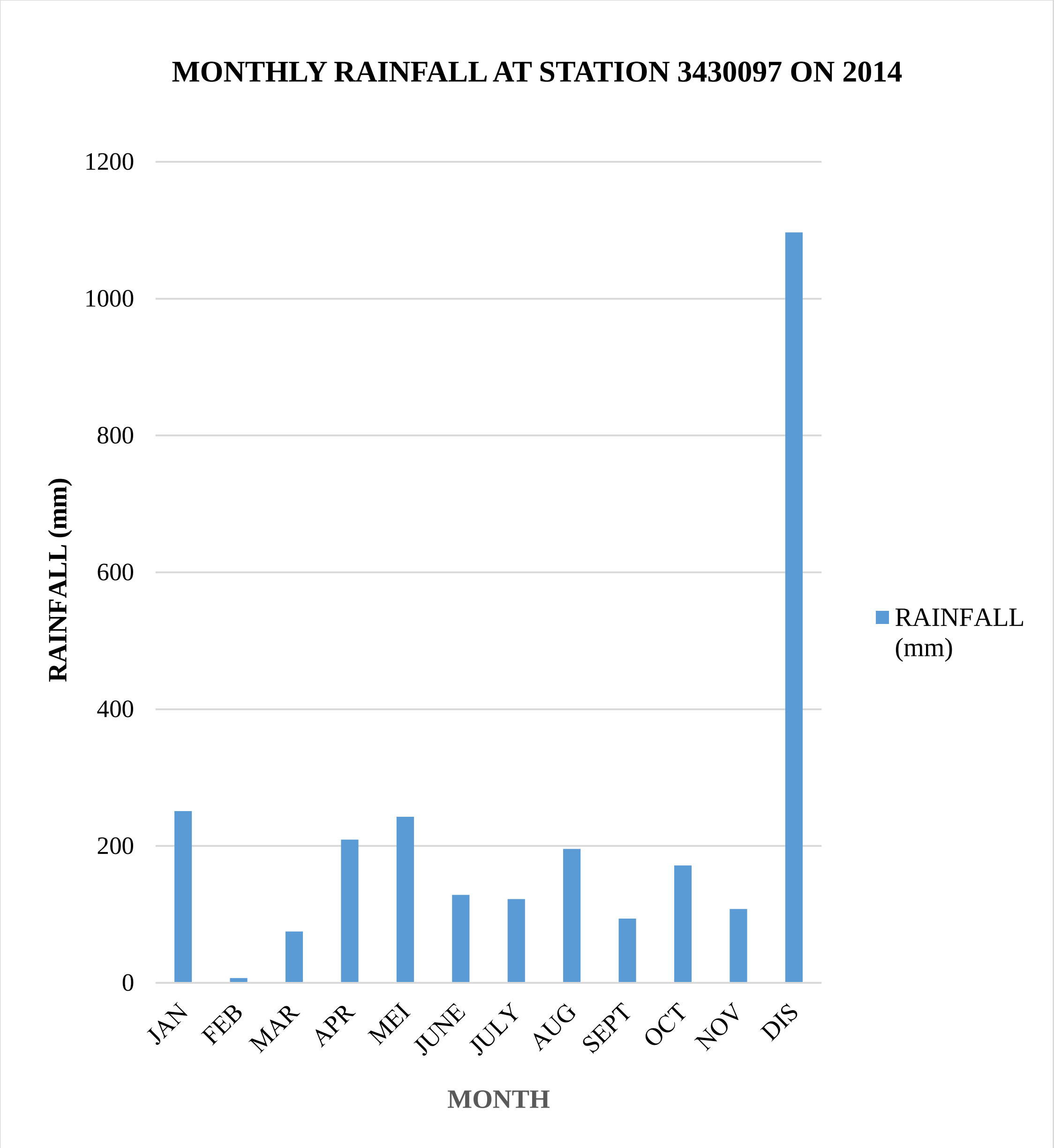


Chart 4.4.4: Monthly rainfall data for station 3430097 on 2014

4.4.5 Monthly Rainfall Data for Station 3430097 on 2015

From Table 4.4.5 there is some missing data on December 2015. Then, the minimum value of monthly rainfall for station 3430097 is 0.0 mm while the maximum 77.0 mm in April. Table 4.4.5 and Chart 4.4.5 shows the monthly rainfall data for 2015.

Table 4.4.5 Monthly rainfall data for station 3430097 on 2015

MONTH	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DIS	
MIN	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
TOT	23.5	20.5	1.5	120.0	140.0	68.0	64.0	110.0	129.5	77.0	267.0	9.0	1030.0
MAX	18.5	9.0	1.0	77.0	48.0	25.5	31.0	25.0	52.0	31.5	54.0	4.0	77.0
NO>0.0	6	4	2	8	16	6	9	10	8	10	19	5	103

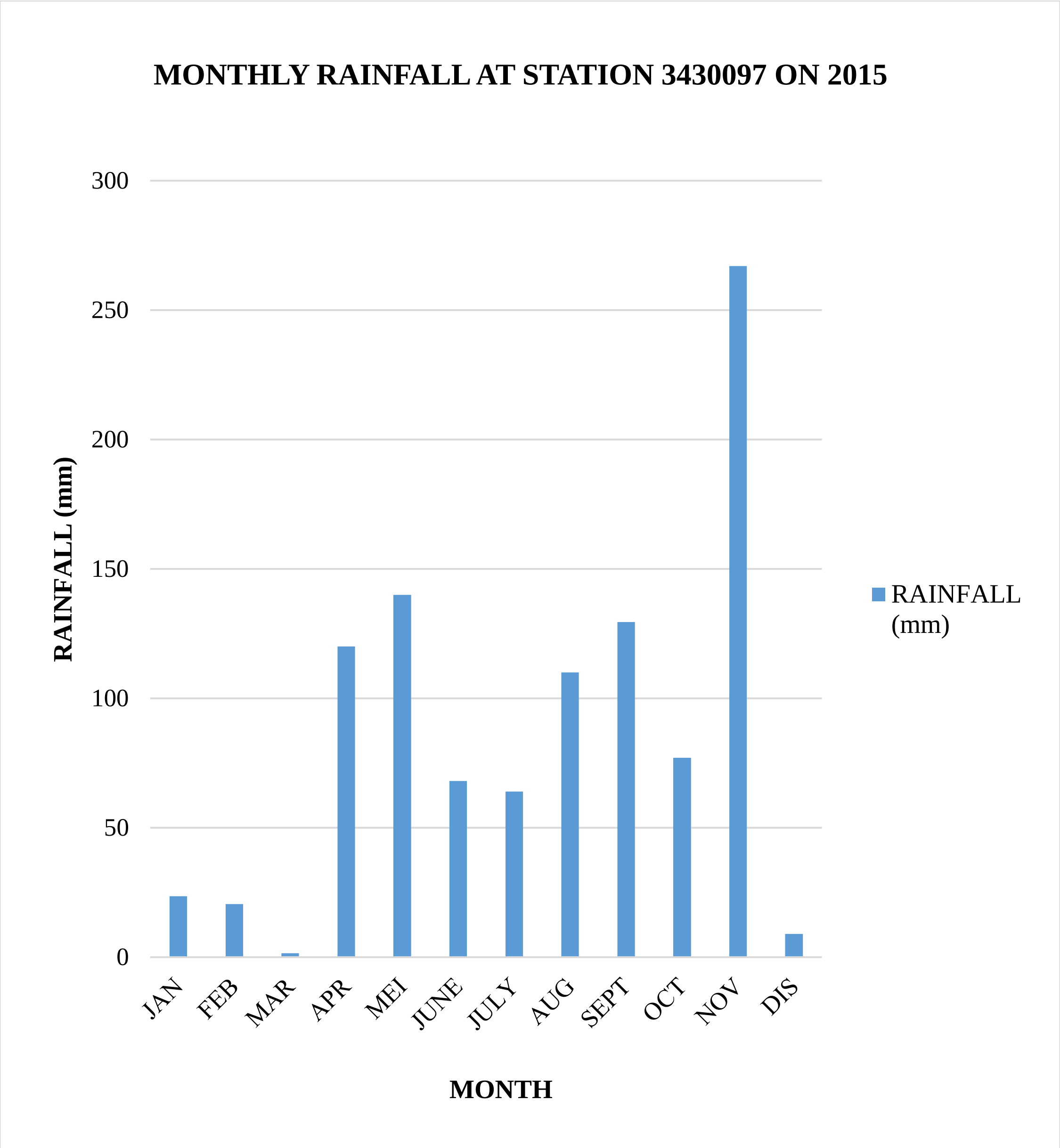


Chart 4.4.5: Monthly rainfall data for station 3430097 on 2015

4.4.6 Monthly Rainfall Data for Station 3430097 on 2016

From Table 4.4.6 there is some missing data on January, November and December 2016. Then, the minimum value of monthly rainfall for station 3430097 is 0.0 mm while the maximum 105.0 mm in May. Table 4.4.6 and Chart 4.4.6 shows the monthly rainfall data for 2016.

Table 4.4.6 Monthly rainfall data for station 3430097 on 2016

MONTH	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DIS	
MIN	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
TOT	51.0	175.5	23.5	18.5	223.0	102.0	161.5	201.0	208.5	72.0	64.0	279.0	1237.5
MAX	20.0	41.5	10.0	7.5	105.0	57.5	51.0	43.5	42.0	19.5	33.5	62.0	105.0
NO>0.0	6	16	6	4	14	9	13	10	17	11	10	14	108

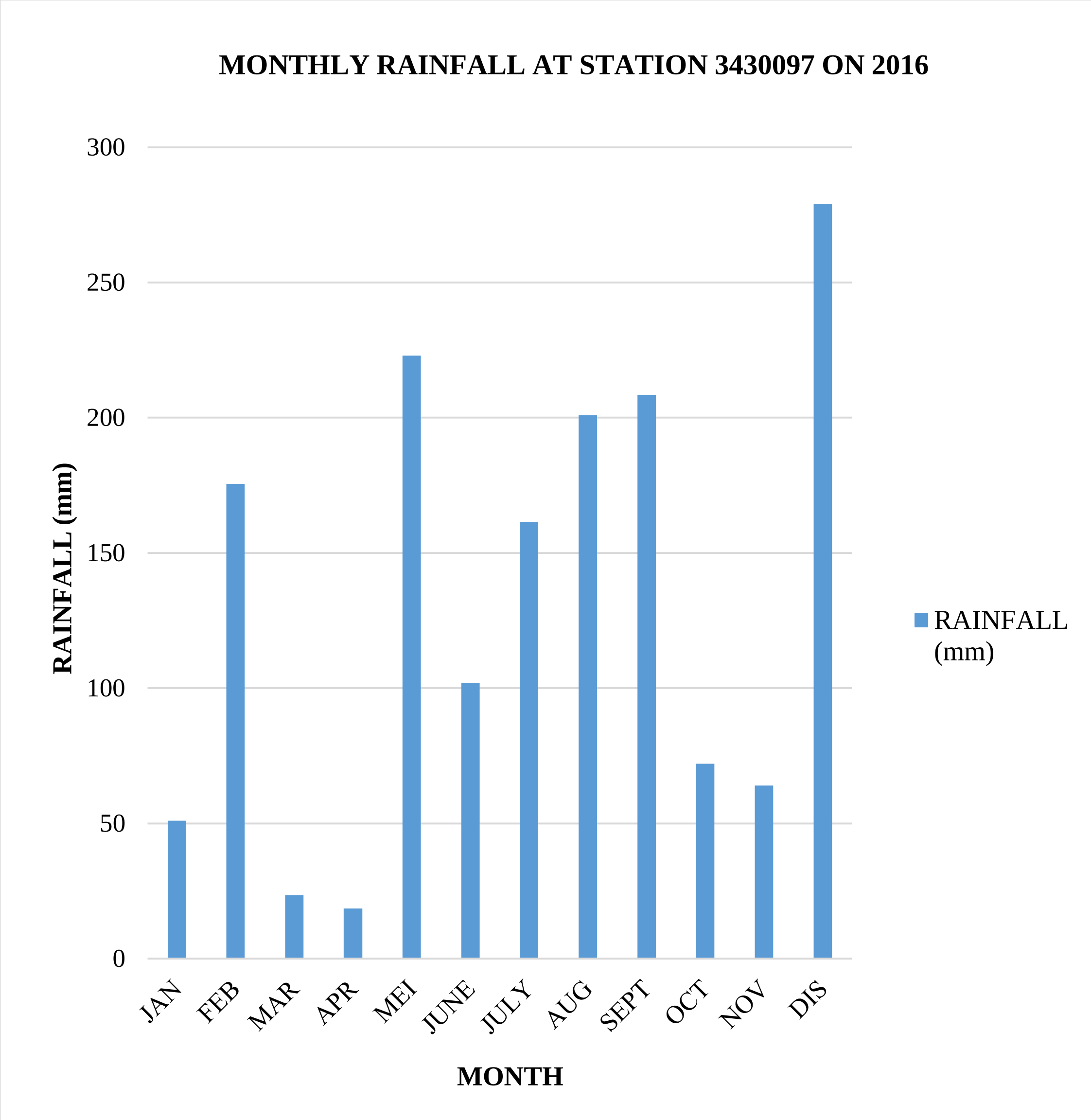


Chart 4.4.6: Monthly rainfall data for station 3430097 on 2016

4.4.7 Monthly Rainfall Data for Station 3430097 on 2017

From Table 4.4.7 there is some missing data from January until April 2017. Buts, on May 2017, the data it is not complete yet. It because the data, will collect on early of next month. So, the minimum value of monthly rainfall for station 3430097 is 0.0 mm while the maximum 132.0 mm in February. Table 4.4.7 and Chart 4.4.7 shows the monthly rainfall data for 2017.

Table 4.4.7 Monthly rainfall at for station 3430097 on 2017

MONTH	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DIS	
MIN	0.0	0.0	0.0	0.0	0.0	?	?	?	?	?	?	?	0.0
TOT	75.5	223.0	137.0	187.5	27.0	?	?	?	?	?	?	?	650.0
MAX	15.0	132.0	89.5	76.0	21.5	?	?	?	?	?	?	?	132.0
NO>0.0	23	13	13	16	2	?	?	?	?	?	?	?	67

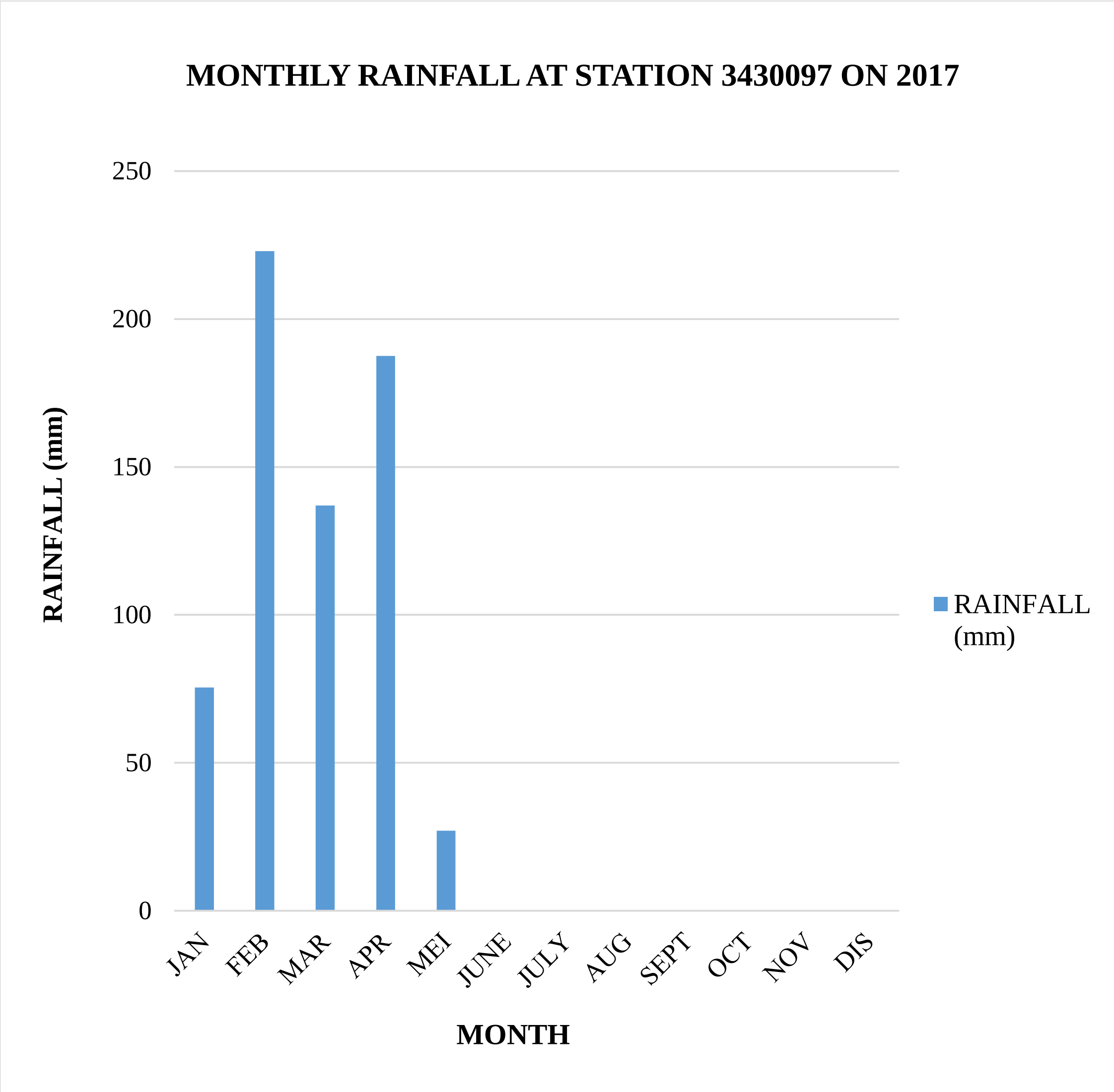


Chart 4.4.7**:** Monthly rainfall data for station 3430097 on 2017

4.5 Monthly Rainfall for Station 3429096 on 2012-2017

4.5.1 Total Monthly Rainfall for Station 3429096 on 2012 -2017

From the Table 4.5.1 and Chart 4.5.1 below, show the total monthly rainfall for station 3429096 from January to December on 2012 until 2017. The maximum total value rainfall at station 3429096 is 2726.5 mm which is on December. While, the minimum total value rainfall is 52.0 mm which on March.

Table 4.5.1 Total monthly rainfall for station 3429096 from 2012 until 2017.

JAN	FEB	MAR	APR	MEI	JUNE	JUL	AUG	SEP	OCT	NOV	DIS
1030	739	269.5	449	974	462	696	1047	846.5	1052	1414.5	2726.5

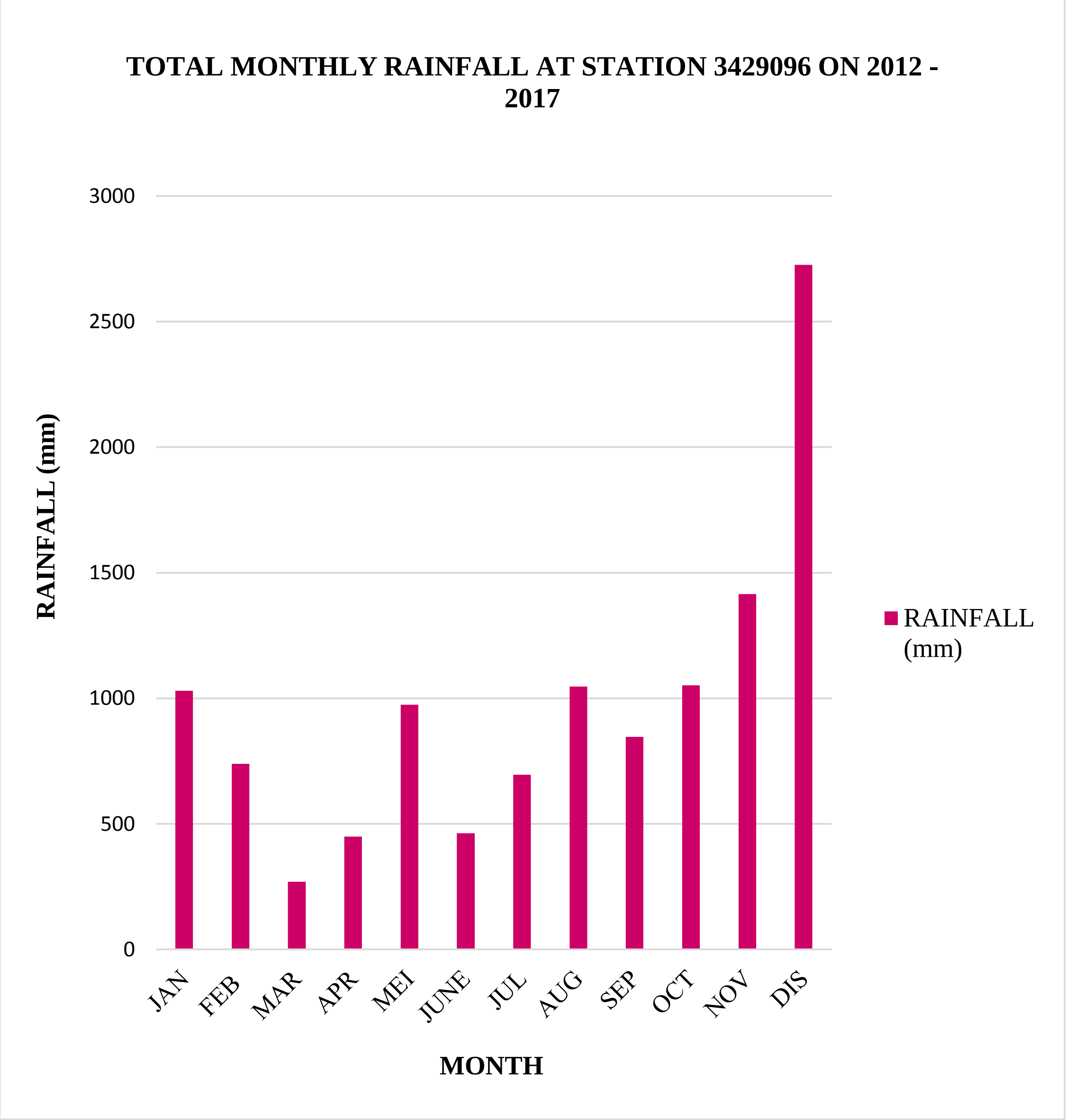


Chart 4.5.1: Total monthly rainfall for station 3429096 on 2012 until 2017

4.5.2 Monthly Rainfall Data for Station 3429096 on 2012

From Table 4.5.2 there is some missing data on January until August 2012. Then, the minimum value of monthly rainfall for station 3429096 is 0.0 mm while the maximum 94.0 mm in August. Table 4.5.2 and Chart 4.5.2 shows the monthly rainfall data for 2012.

Table 4.5.2 Monthly rainfall data for station 3429096 on 2012

MONTH	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DIS	
MIN	?	?	?	?	?	?	?	0.0	0.0	0.0	0.0	0.0	0.0
TOT	?	?	?	?	?	?	?	300.0	176.5	252.0	357.0	416.5	1502.0
MAX	?	?	?	?	?	?	?	94.0	57.5	86.5	71.0	81.5	94.0
NO>0.0	0	0	0	0	0	0	0	11	14	19	22	23	89

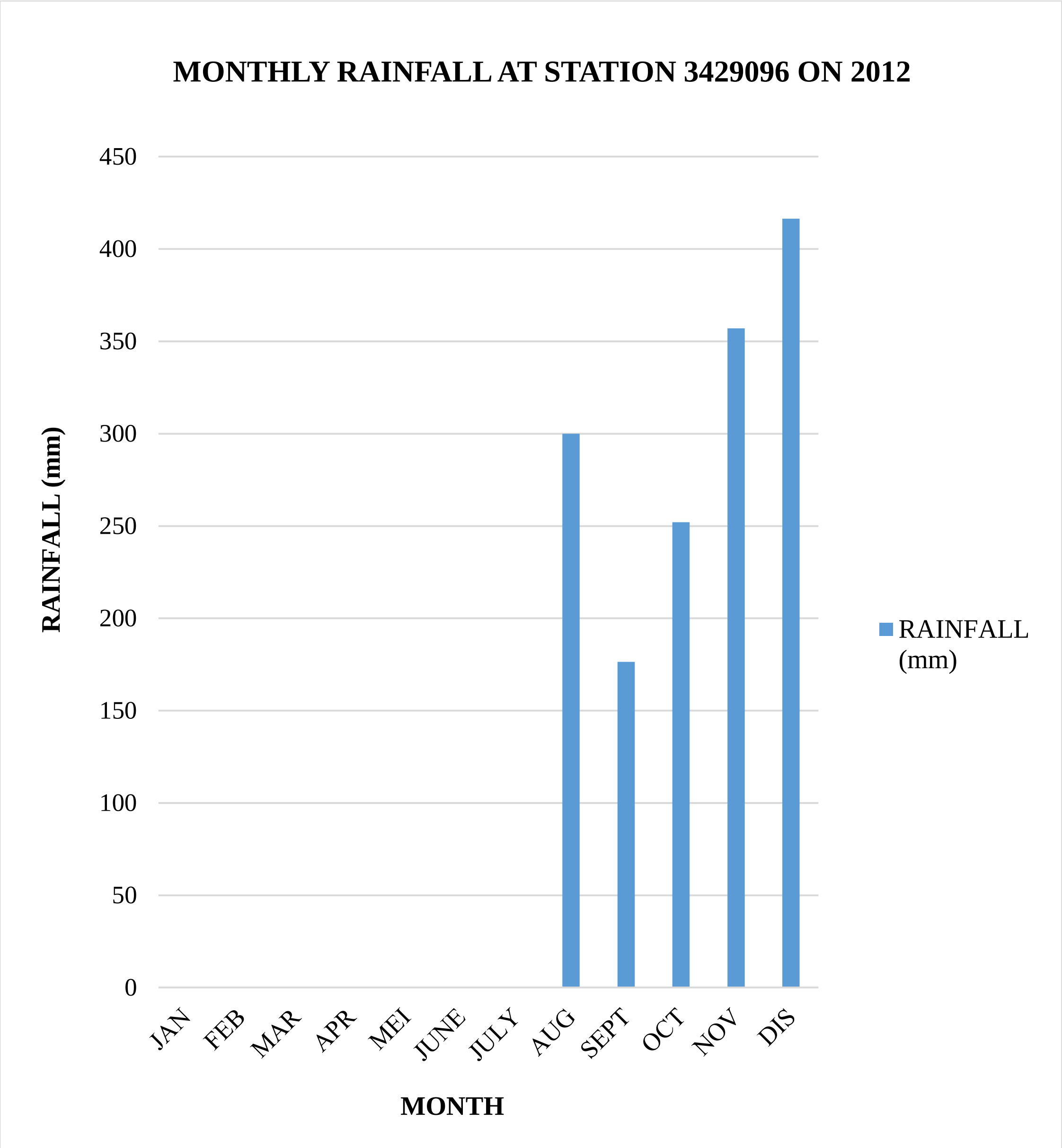


Chart 4.5.2: Monthly rainfall data for station 3429096 on 2012

4.5.3 Monthly Rainfall Data for Station 3429096 on 2013

From Table 4.5.3 there is some missing data on July 2013. Then, the minimum value of monthly rainfall for station 3429096 is 0.0 mm while the maximum 217.5 mm in December. Table 4.5.3 and Chart 4.5.3 shows the monthly rainfall data for 2013.

Table 4.5.3 Monthly rainfall data for station 3429096 on 2013

MONTH	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DIS	
MIN	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
TOT	157.0	353.5	14.5	78.0	236.0	106.0	0.0	163.0	170.5	228.5	148.0	659.5	2314.5
MAX	27.5	133.5	5.5	32.5	45.0	33.5	0.0	53.0	40.5	63.5	45.5	217.5	217.5
NO>0.0	14	19	5	18	18	11	0	14	20	22	16	17	174

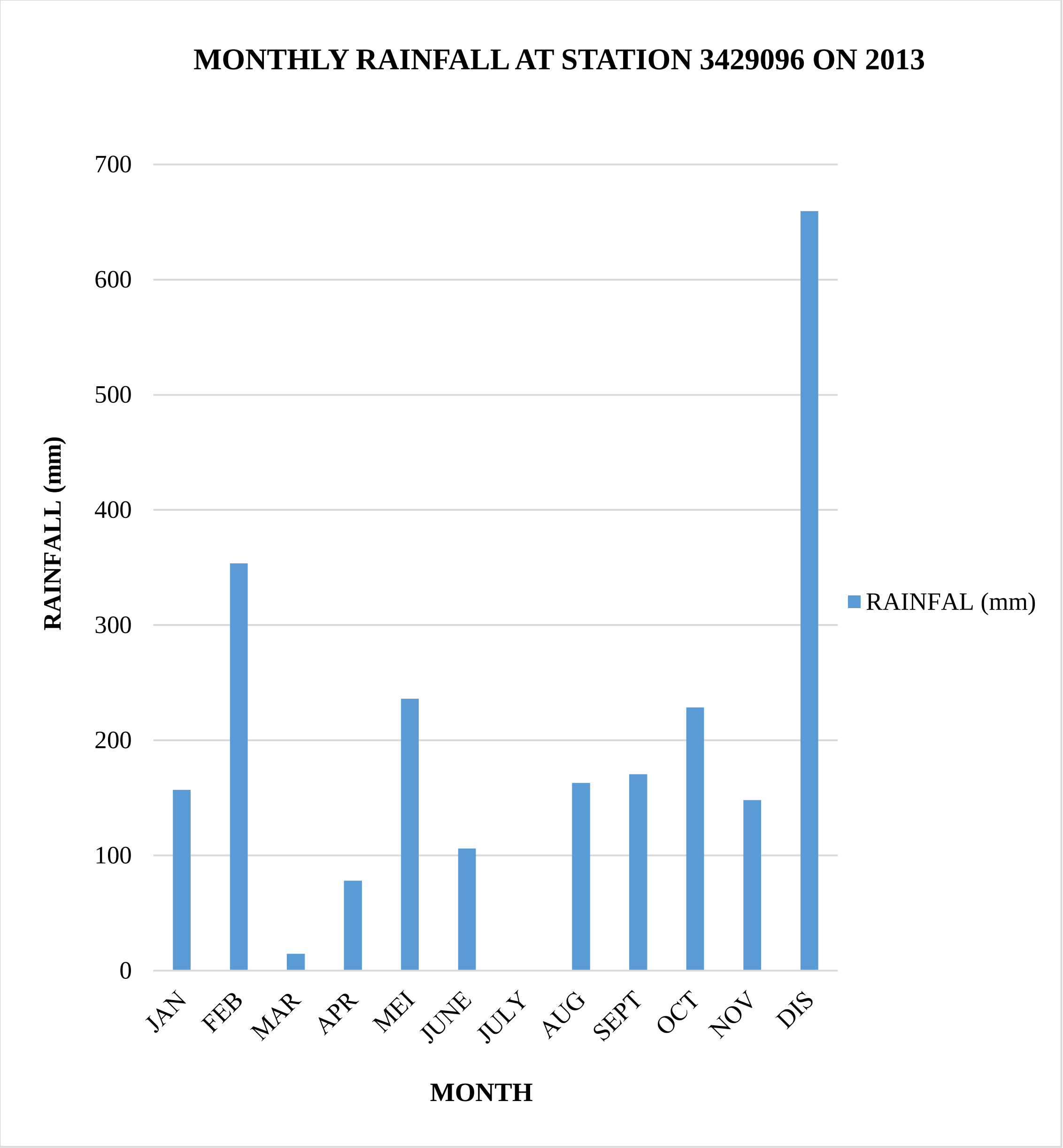


Chart 4.5.3: Monthly rainfall data for station 3429096 on 2013

4.5.4 Monthly Rainfall Data for 2014 at Station 3429096

From Table 4.5.4 there is some missing data on February and March 2014. Then, the minimum value of monthly rainfall for station 3429096 is 0.0 mm while the maximum 235.0 mm in December. Table 4.5.4 and Chart 4.5.4 shows the monthly rainfall data for 2014.

Table 4.5.4 Monthly rainfall data for station 3429096 2014

MONTH	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DIS	
MIN	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
TOT	157.5	2.5	20.0	62.5	260.0	148.0	262.5	285.0	165.5	248.5	237.5	920.5	2770.0
MAX	76.5	1.0	10.0	25.0	75.0	42.5	98.5	115.5	65.0	63.5	81.5	235.0	235.0
NO>0.0	11	3	2	9	17	11	17	15	9	18	19	24	155

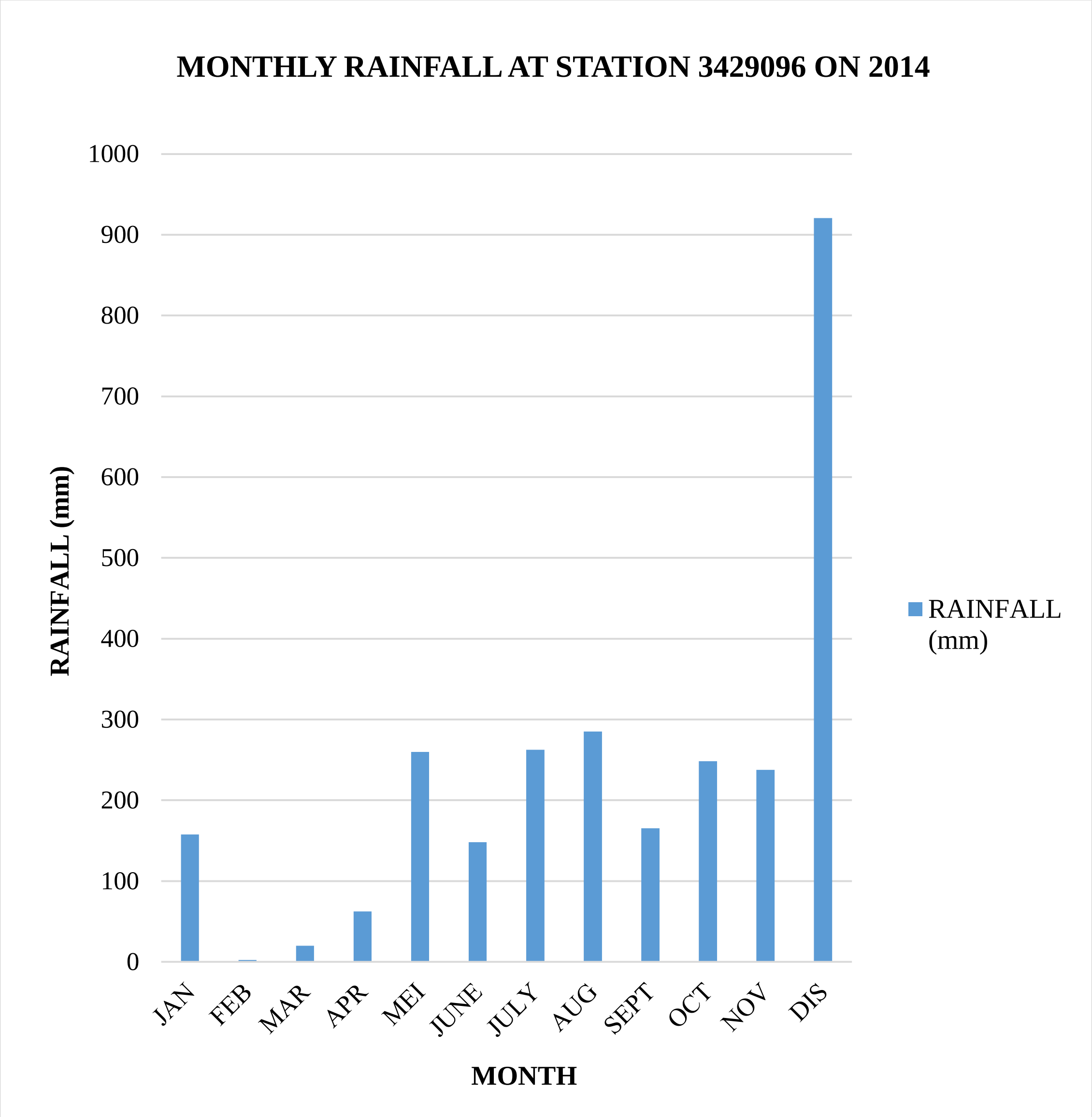


Chart 4.5.4: Monthly rainfall data for station 3429096 on 2014

4.5.5 Monthly Rainfall Data for Station 3429096 on 2015

From Table 4.5.5 there is some missing data on October 2015. Then, the minimum value of monthly rainfall for station 3429096 is 0.0 mm while the maximum 113.0 mm in November. Table 4.5.5 and Chart 4.5.5 shows the monthly rainfall data for 2015.

Table 4.5.5 Monthly rainfall data for station 3429096 on 2015

MONTH	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DIS	
MIN	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
TOT	151.0	9.0	7.0	84.0	217.0	56.5	209.5	124.0	148.0	66.0	358.0	199.5	1629.5
MAX	52.5	7.0	5.0	24.5	56.5	16.6	61.0	22.0	72.0	19.0	113.0	37.0	113.0
NO>0.0	10	3	4	11	18	11	9	18	12	11	24	15	146

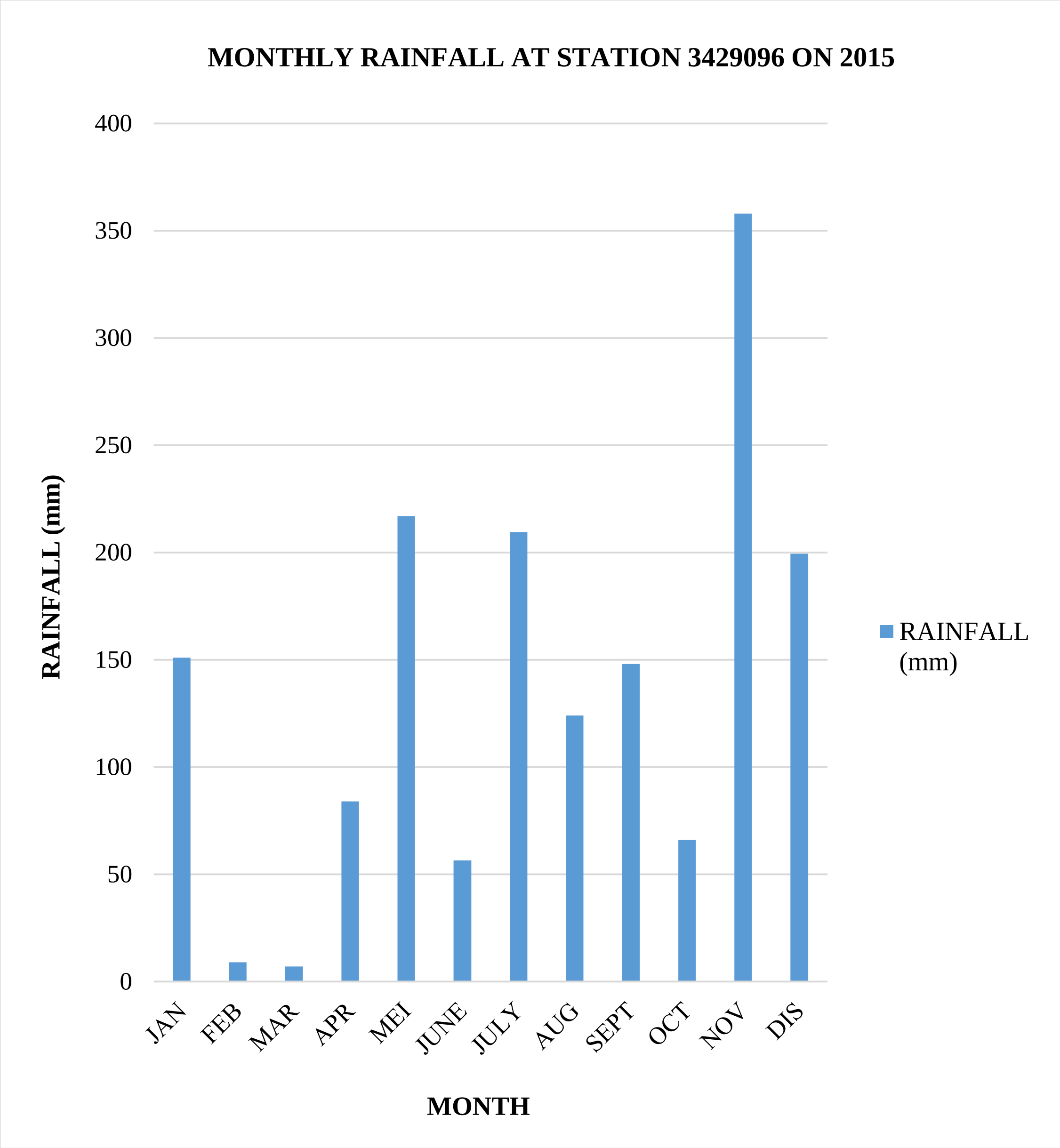


Chart 4.5.5**:** Monthly rainfall data for station 3429096 on 2015

4.5.6 Monthly Rainfall Data for Station 3429096 on 2016

From Table 4.5.5 there is some missing data on November and December 2016. Then, the minimum value of monthly rainfall for station 3429096 is 0.0 mm while the maximum 110.0 mm in December. Table 4.5.6 and Chart 4.5.6 shows the monthly rainfall data for 2016.

Table 4.5.6 Monthly rainfall data for station 3429096 on 2016

MONTH	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DIS	
MIN	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
TOT	111.0	134.0	10.5	24.5	261.0	151,5	224.0	175.0	186.0	257.0	314.0	530.5	2379.0
MAX	39.0	33.0	6.0	8.5	74.0	53.5	57.0	64.0	46.0	60.5	55.5	110	110.0
NO>0.0	12	14	3	8	14	9	17	9	14	19	23	19	161

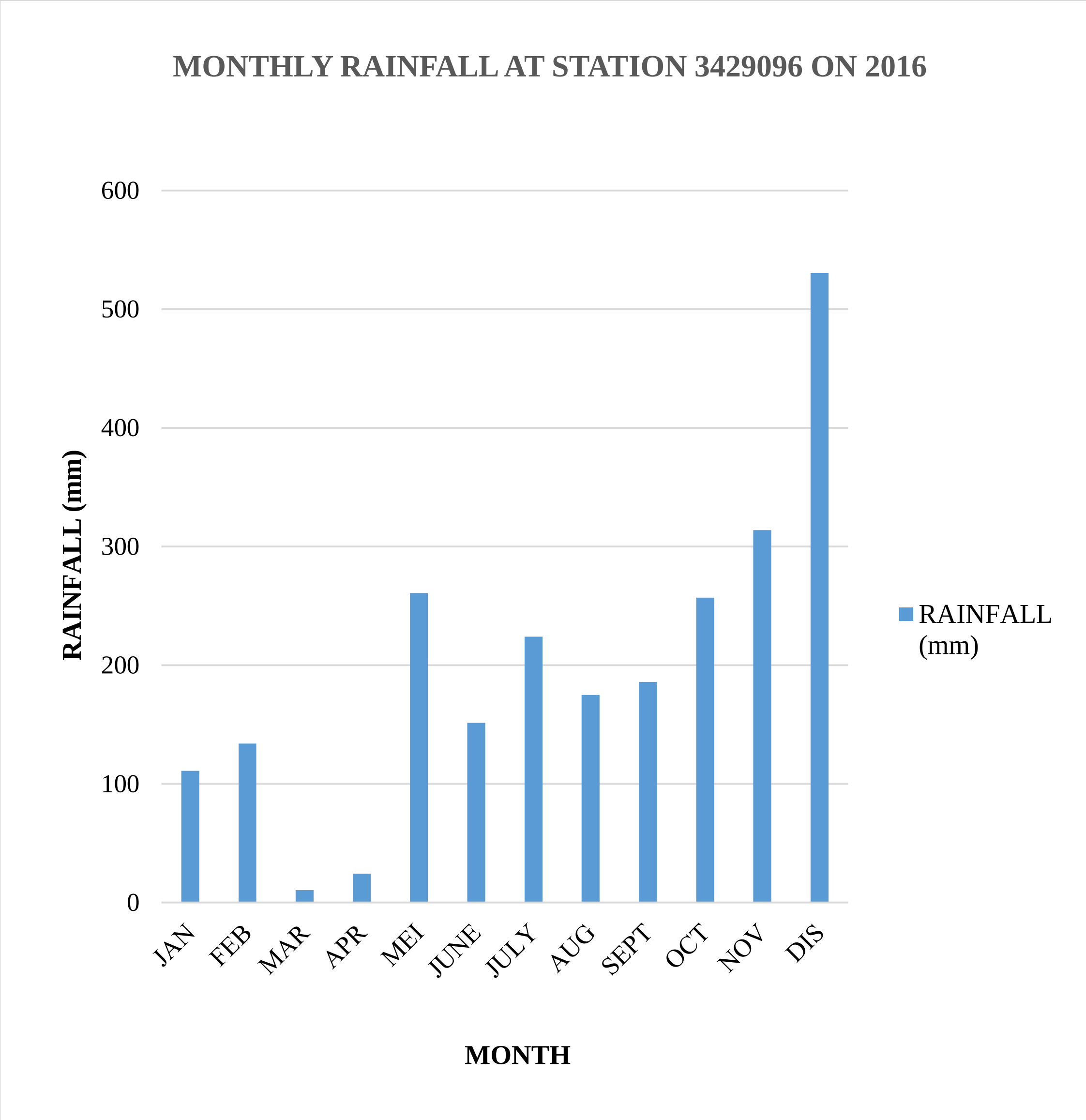


Chart 4.5.6: Monthly rainfall data for station 3429096 on 2016

4.5.7 Monthly Rainfall Data for Station 3430097 on 2017

From Table 4.5.7 there is some missing data from January until April 2017. Buts, on May 2017, the data it is not complete yet. It because the data, will collect on early of next month. So, the minimum value of monthly rainfall for station 3430097 is 0.0 mm while the maximum 192.0 mm in January. Table 4.5.7 and Chart 4.5.7 shows the monthly rainfall data for 2017.

Table 4.5.7 Monthly rainfall data for station 3429097 on 2017

MONTH	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DIS	
MIN	0.0	0.0	0.0	0.0	0.0	?	?	?	?	?	?	?	0.0
TOT	453.0	240.0	217.5	200.0	11.5	?	?	?	?	?	?	?	1122.5.0
MAX	192.0	138.5	58.5	84.5	11.5	?	?	?	?	?	?	?	192.0
NO>0.0	19	12	13	13	1	0	0	0	0	0	0	0	58

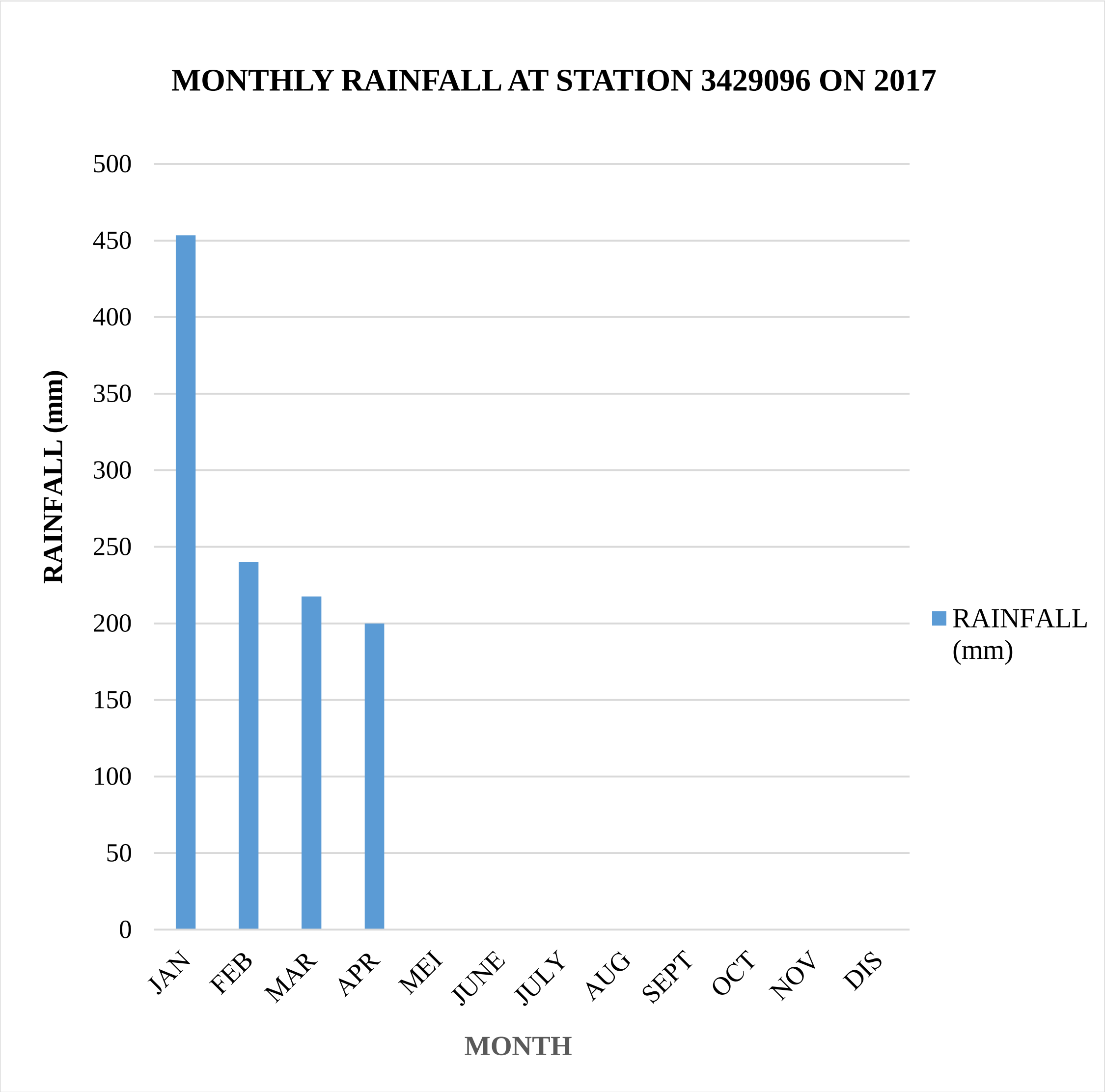


Chart 4.5.7: Monthly rainfall data for station 3429096 on 2017

4.6 Monthly Rainfall for Station Kampung Melai on 2016-2017

4.6.1 Monthly Rainfall Data for Station Kampung Melai on 2016

For 2016 there is some data were missing. Which are from January until August. It is because of the rain gauge was setup on September. Then, the minimum value of monthly rainfall for station Kampung Melai is 0.0 mm while the maximum 73.4 mm in December. Table 4.6.1 and Chart 4.6.1 shown the monthly rainfall for station Kampung Melai on 2016.

Table 4.6.1 Monthly rainfall for station Kampung Melai on 2016

MONTH	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DIS	
MIN	?	?	?	?	?	?	?	?	0.0	0.0	0.0	0.0	0.0
TOT	?	?	?	?	?	?	?	?	127.8	193.0	221.0	280.6	822
MAX	?	?	?	?	?	?	?	?	52.8	52.8	31.8	73.4	73.4
NO>0.0	0	0	0	0	0	0	0	0	14	19	22	25	80

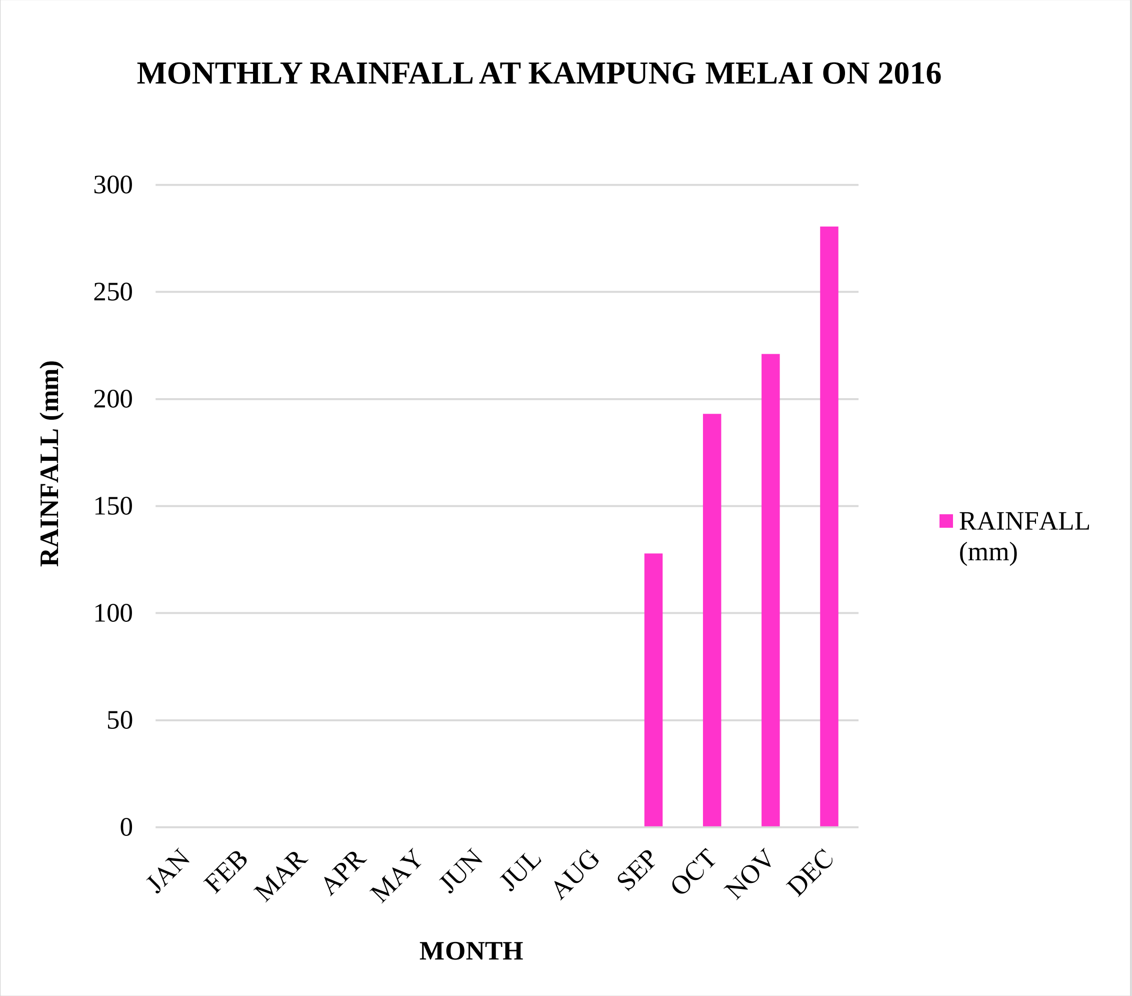


Chart 4.6.1: Monthly rainfall for station Kampung Melai on 2016

4.6.2 Monthly Rainfall Data for 2017 at Station Kampung Melai

For 2017 there is some data were missing. Which is on February. It is because of the equipment error. Then, the minimum value of monthly rainfall for station Kampung Melai is 0.0 mm while the maximum 173.2 mm in January. Table 4.6.2 and Chart 4.6.2 shown the total monthly rainfall for Station Kampung Melai on 2017.

Table 4.6.2 Total monthly rainfall for station Kampung Melai on 2017

MONTH	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DIS	
MIN	0.0	?	0.0	0.0	0.0	?	?	?	?	?	?	?	0.0
TOT	435.4	?	198.4	248.0	111.4	?	?	?	?	?	?	?	993.2
MAX	173.2	?	88.0	63.8	24.8	?	?	?	?	?	?	?	173.2
NO>0.0	12	?	13	17	13	?	?	?	?	?	?	?	55

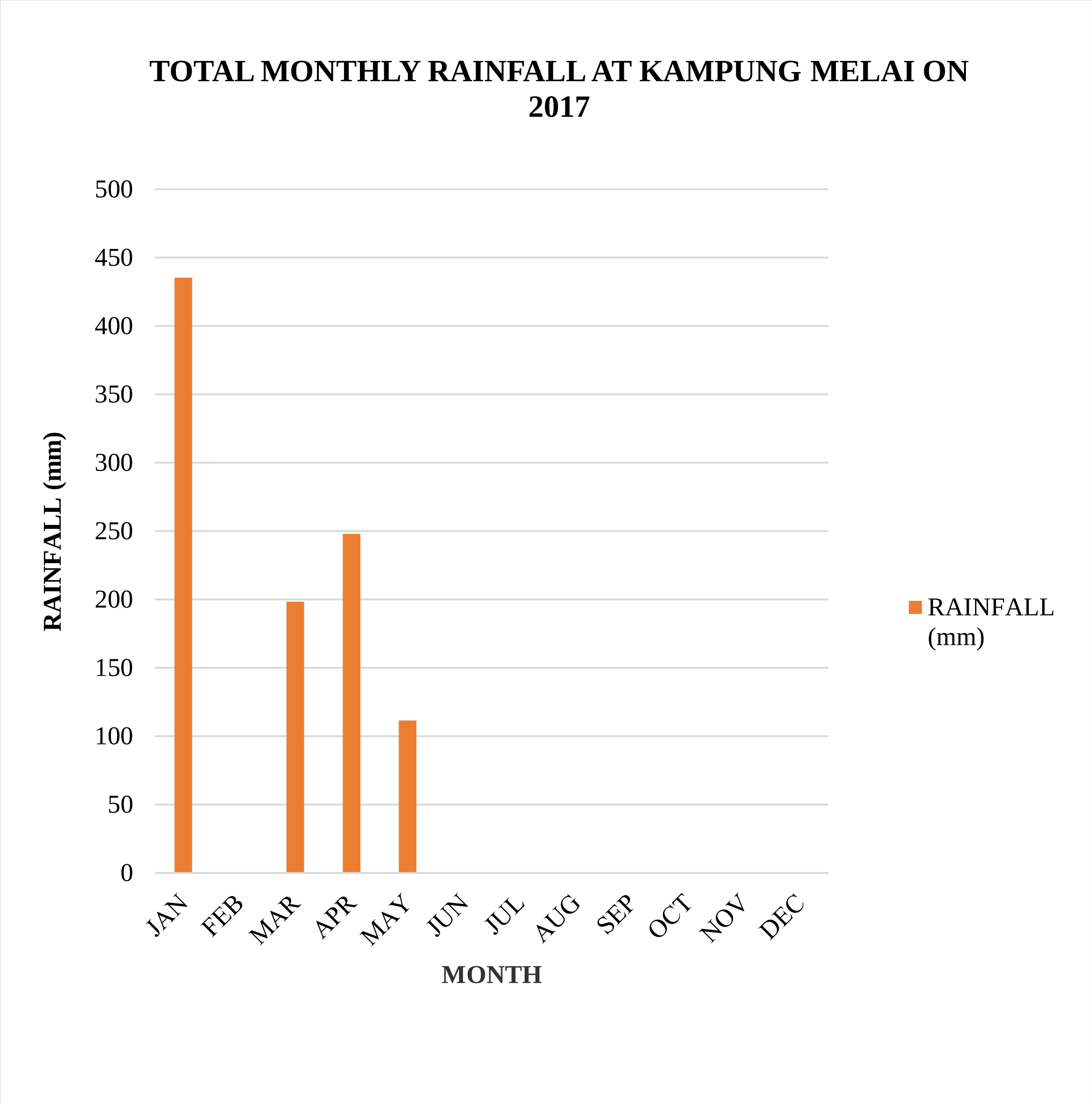


Chart 4.6.2: Total monthly rainfall for station Kampung Melai on 2017

4.7 Comparison Total Annual Rainfall for Nearest Station at Tasik Chini on 2008-2017

4.7.1 Total Annual Rainfall for Nearest Station at Tasik Chini on 2008

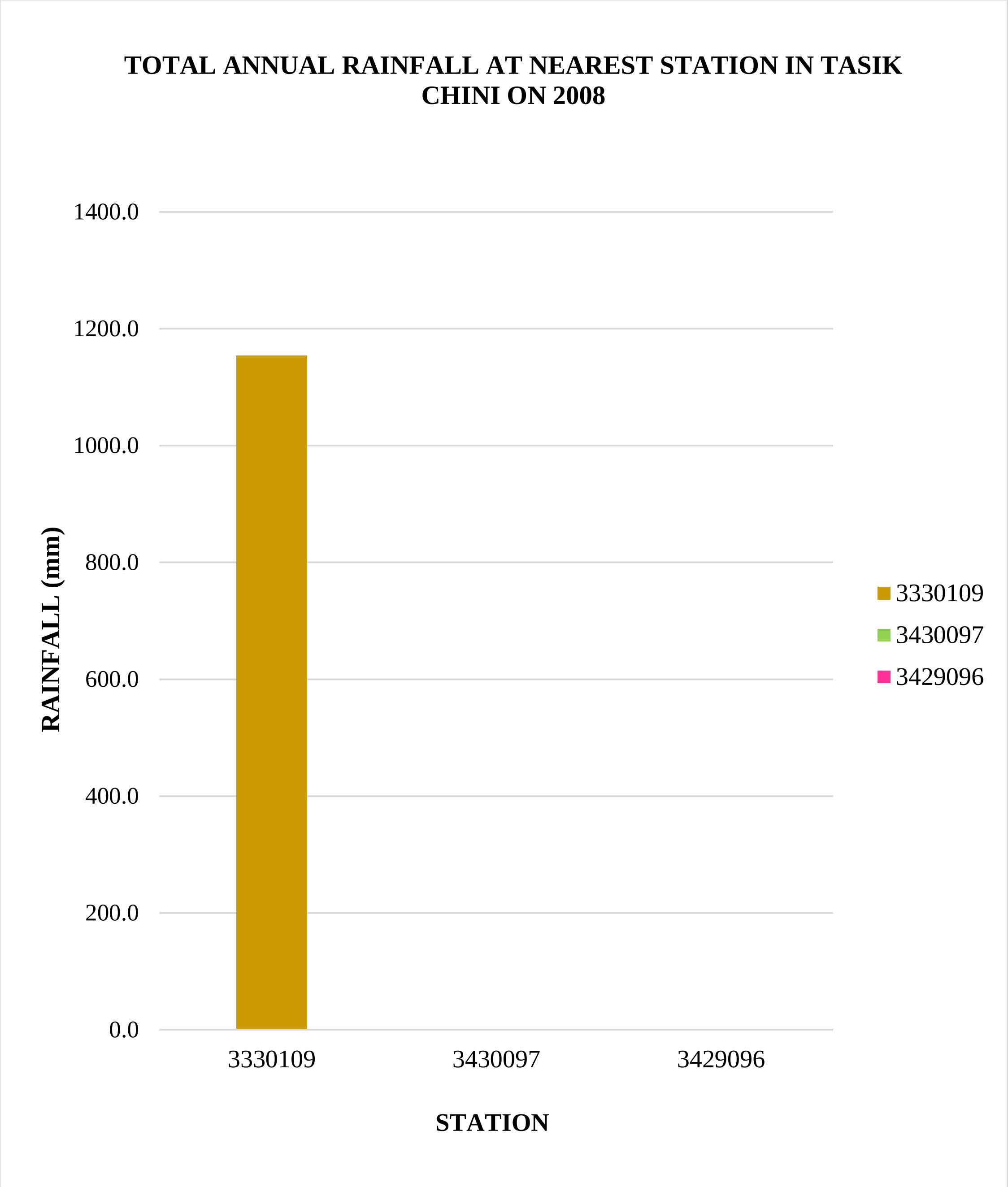


Chart 4.7.1: Total annual rainfall for nearest station at Tasik Chini on 2008

From Chart 4.7.1, it was shown the maximum total annual rainfall for nearest station at Tasik Chini on 2008 is Kampung Batu Gong Station (3330109). Which is the value is 1154.5 mm. While, there are no data for Paya Membang Station and Kampung Salong Station. It is because the rain gauge was does not set up yet at both of station.

4.7.2 Total Annual Rainfall for Nearest Station at Tasik Chini on 2009

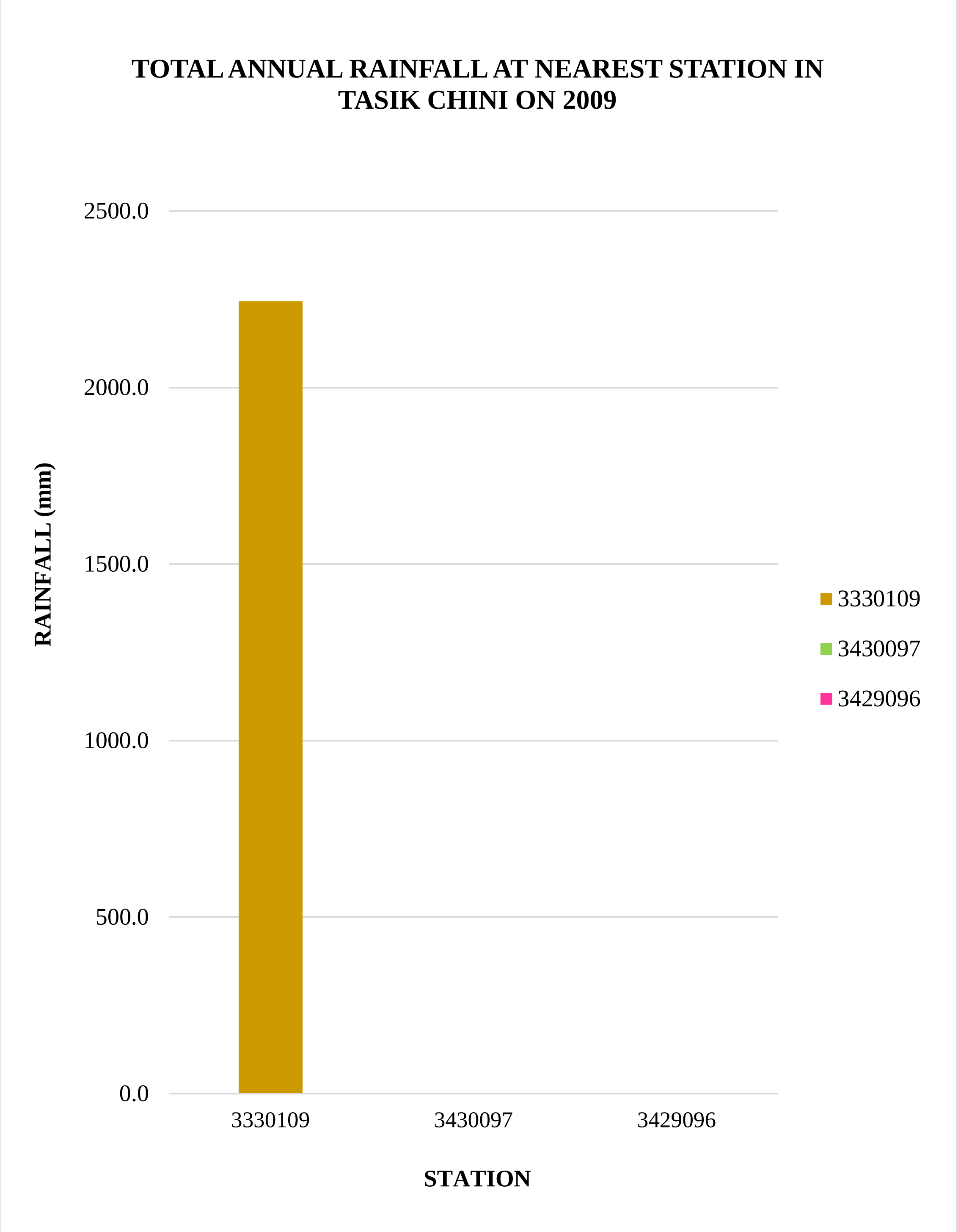


Chart 4.7.2: Total annual rainfall for nearest station at Tasik Chini on 2009

From Chart 4.7.2, it was shown the maximum total annual rainfall for nearest station at Tasik Chini on 2009 is Kampung Batu Gong Station (3330109). Which is the value is 2244.0 mm. While, there are no data for Paya Membang Station and Kampung Salong Station. It is because the rain gauge was does not set up yet at both of station.

4.7.3 Total Annual Rainfall for Nearest Station at Tasik Chini on 2010

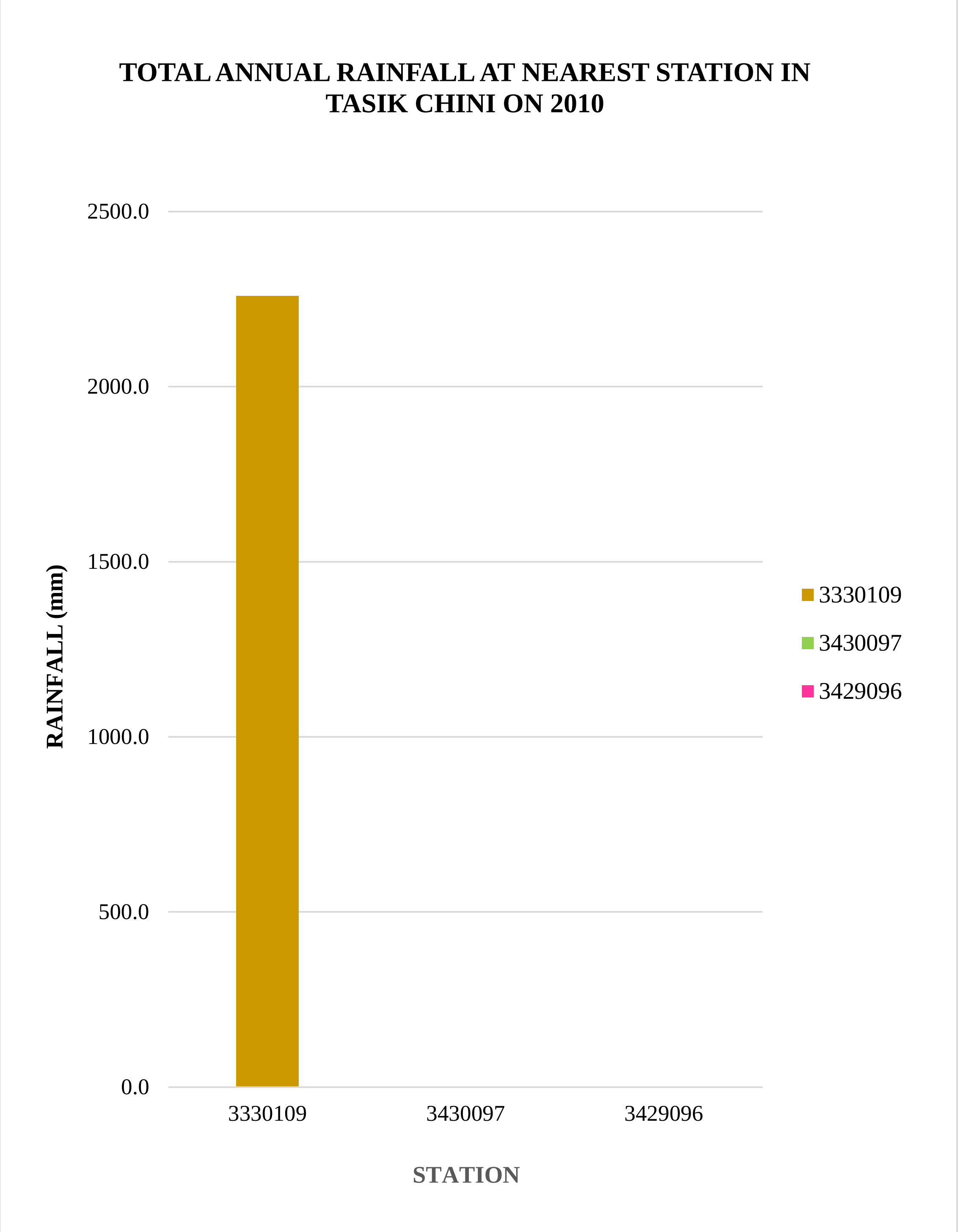


Chart 4.7.3: Total annual rainfall for nearest station at Tasik Chini on 2010

From Chart 4.7.3, it was shown the maximum total annual rainfall for nearest station at Tasik Chini on 2010 is Kampung Batu Gong Station (3330109). Which is the value is 2259.5.0 mm. While, there are no data for Paya Membang Station and Kampung Salong Station. It is because the rain gauge was does not set up yet at both of station.

4.7.4 Total Annual Rainfall for Nearest Station at Tasik Chini on 2011

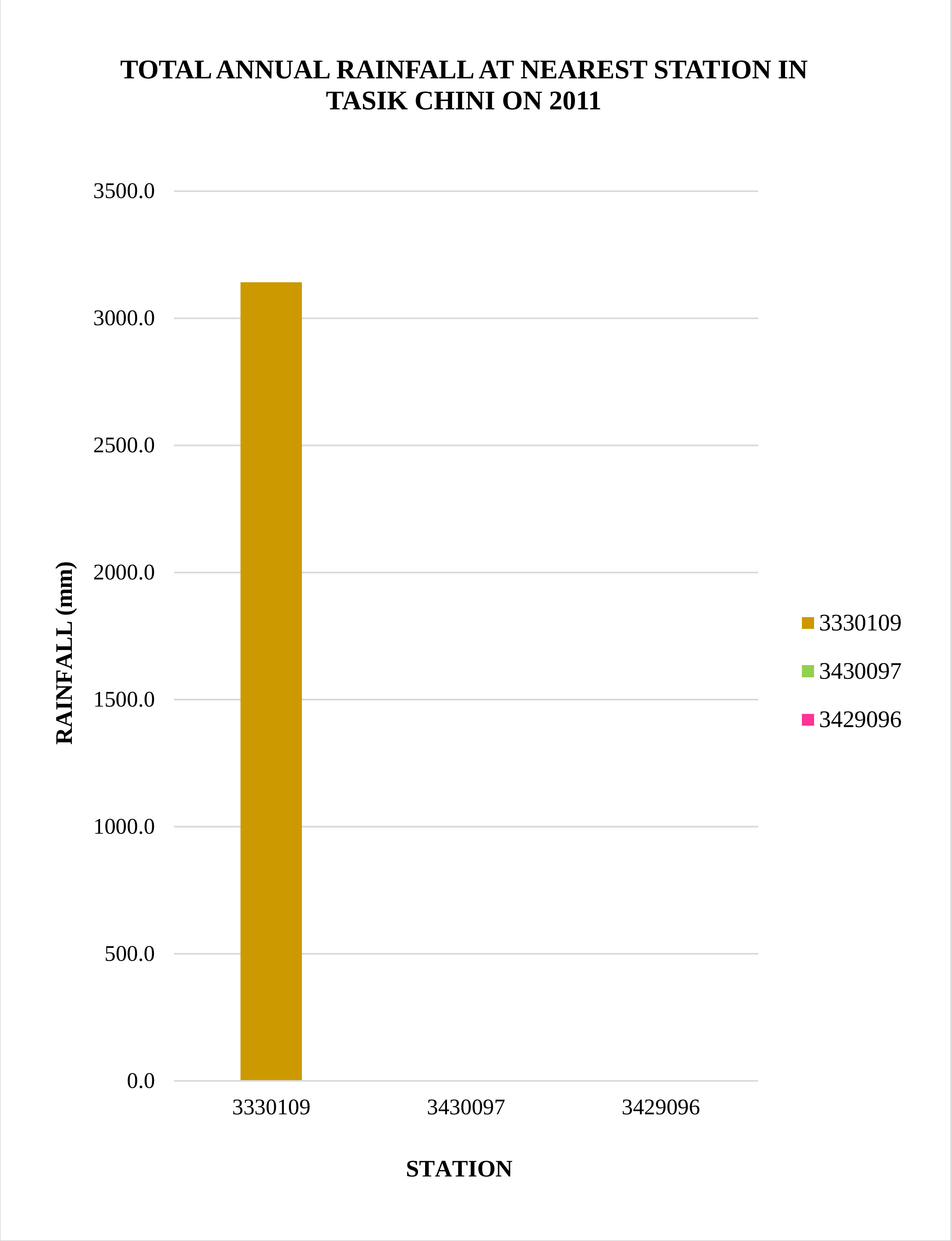


Chart 4.7.4: Total annual rainfall for nearest station at Tasik Chini on 2011

From Chart 4.7.4, it was shown the maximum total annual rainfall for nearest station at Tasik Chini on 2011 is Kampung Batu Gong Station (3330109). Which is the value is 3141.5 mm. While, there are no data for Paya Membang Station and Kampung Salong Station. It is because the rain gauge was does not set up yet at both of station.

4.7.5 Total Annual Rainfall for Nearest Station at Tasik Chini on 2012

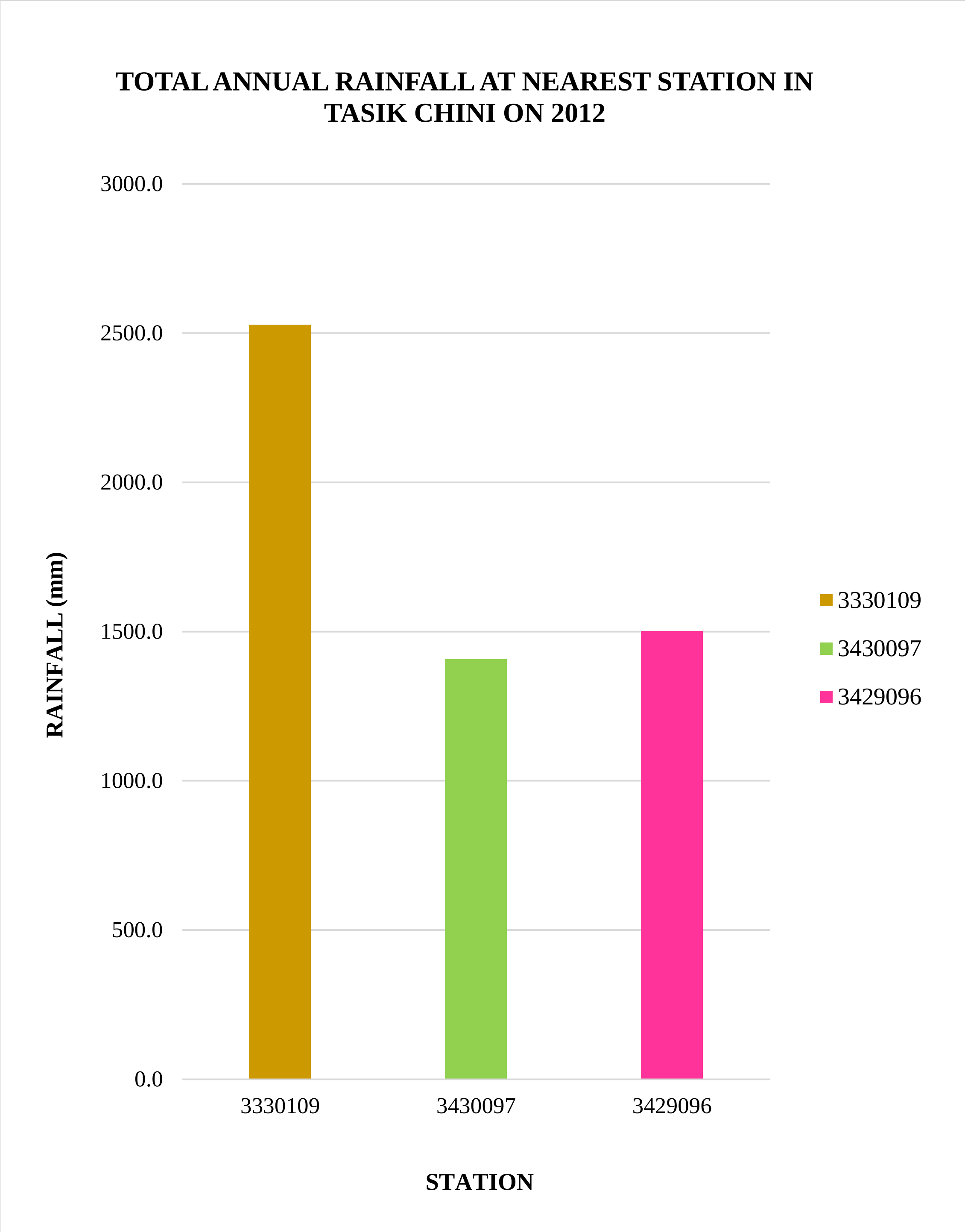


Chart 4.7.5: Total annual rainfall for nearest station at Tasik Chini on 2012

From Chart 4.7.5, it was shown the maximum total annual rainfall for nearest station at Tasik Chini on 2012 is Kampung Batu Gong Station (3330109). Which is the value is 2528.5 mm. While, the minimum total rainfall is 1408.0 mm. Which is at Paya Membang Station.

4.7.6 Total Annual Rainfall for Nearest Station at Tasik Chini on 2013

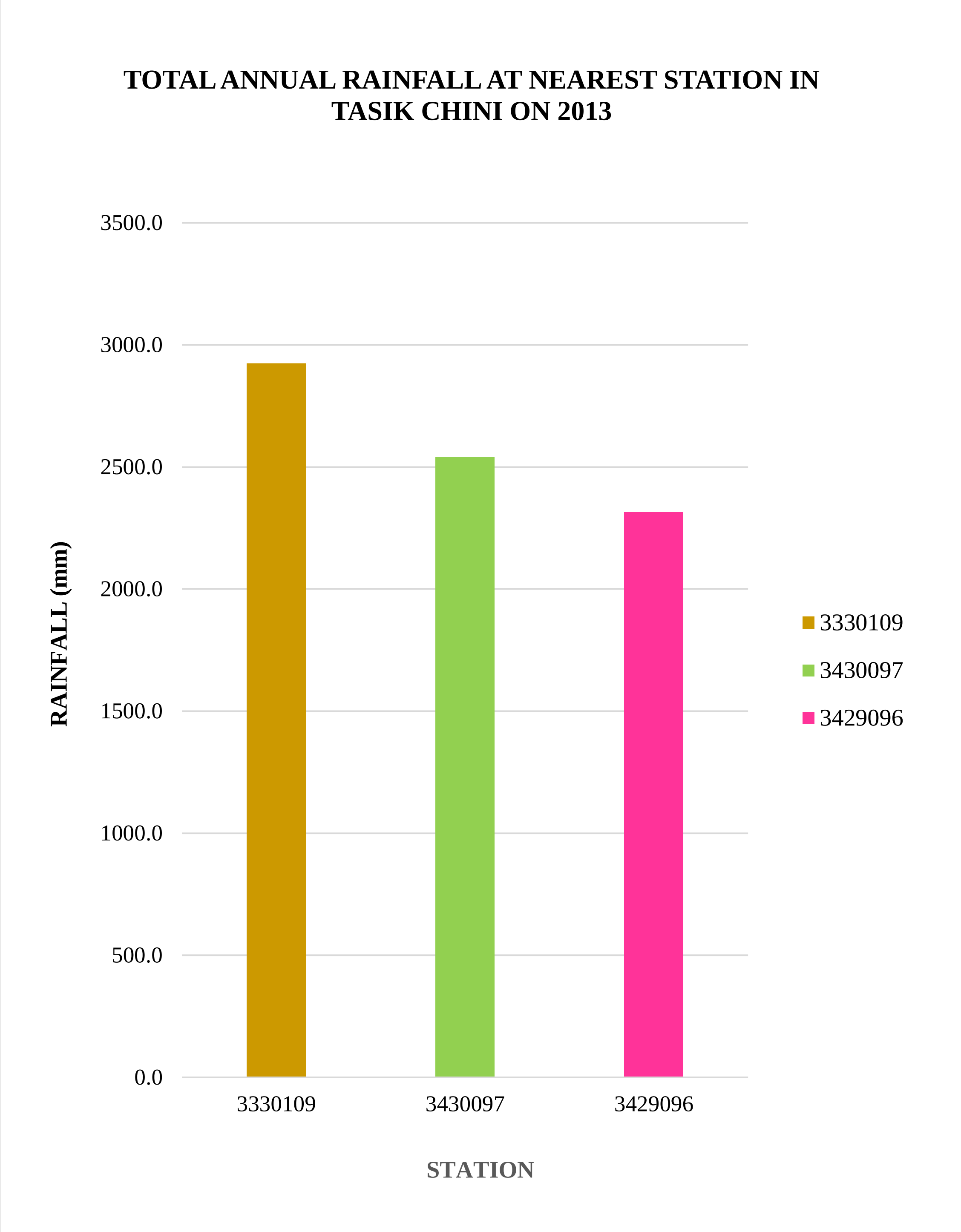


Chart 4.7.6: Total annual rainfall for nearest station at Tasik Chini on 2013

From Chart 4.7.6, it was shown the maximum total annual rainfall for nearest station at Tasik Chini on 2013 is Kampung Batu Gong Station (3330109). Which is the value is 2923.5 mm. While, the minimum total rainfall is 2314.5 mm. Which is at Kampung Salong Station.

4.7.7 Total Annual Rainfall for Nearest Station at Tasik Chini on 2014

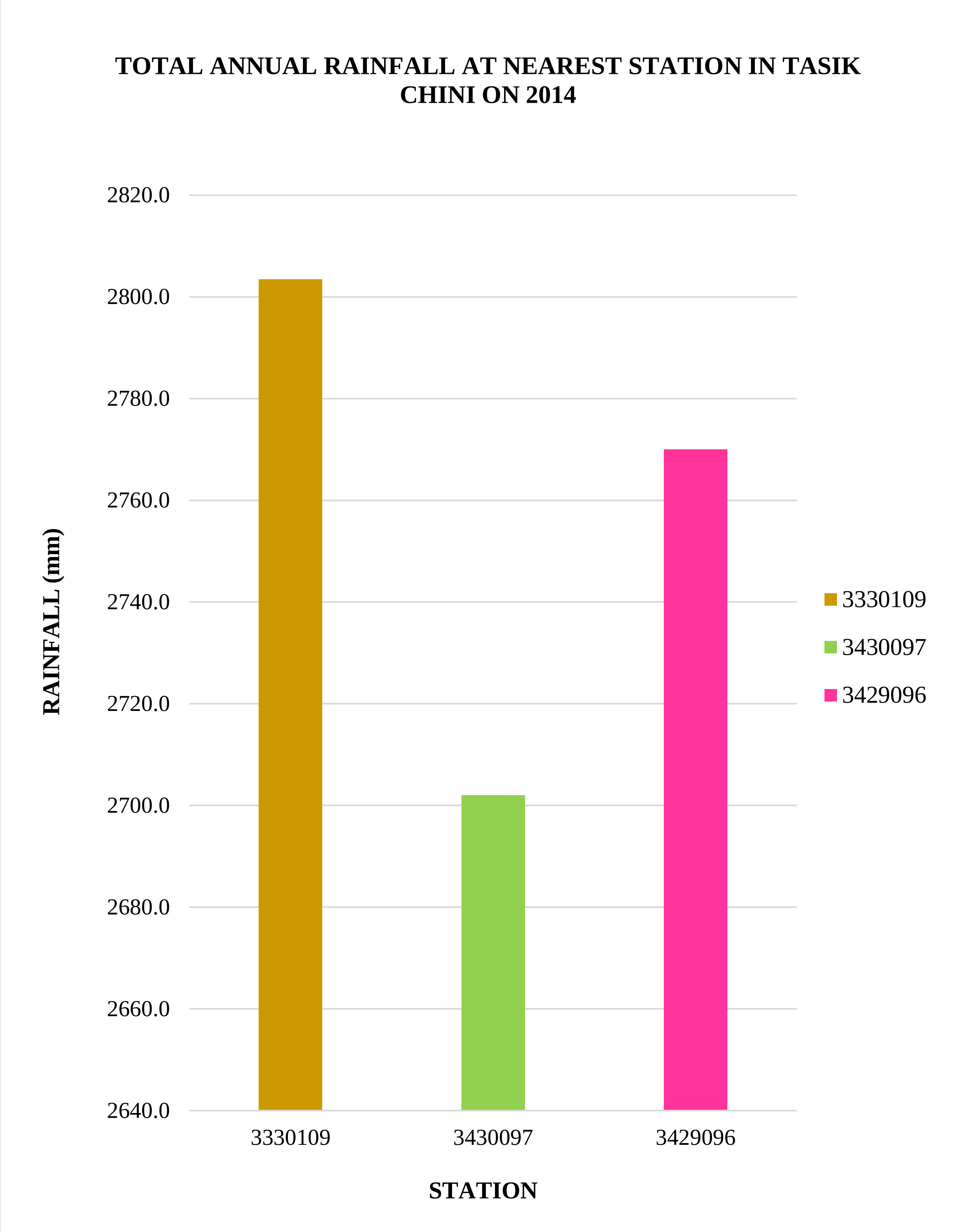


Chart 4.7.7: Total annual rainfall for nearest station at Tasik Chini on 2014

From Chart 4.7.7, it was shown the maximum total annual rainfall for nearest station at Tasik Chini on 2014 is Kampung Batu Gong Station (3330109). Which is the value is 2803.5 mm. While, the minimum total rainfall is 2702.0 mm. Which is at Paya Membang Station.

4.7.8 Total Annual Rainfall for Nearest Station at Tasik Chini on 2015

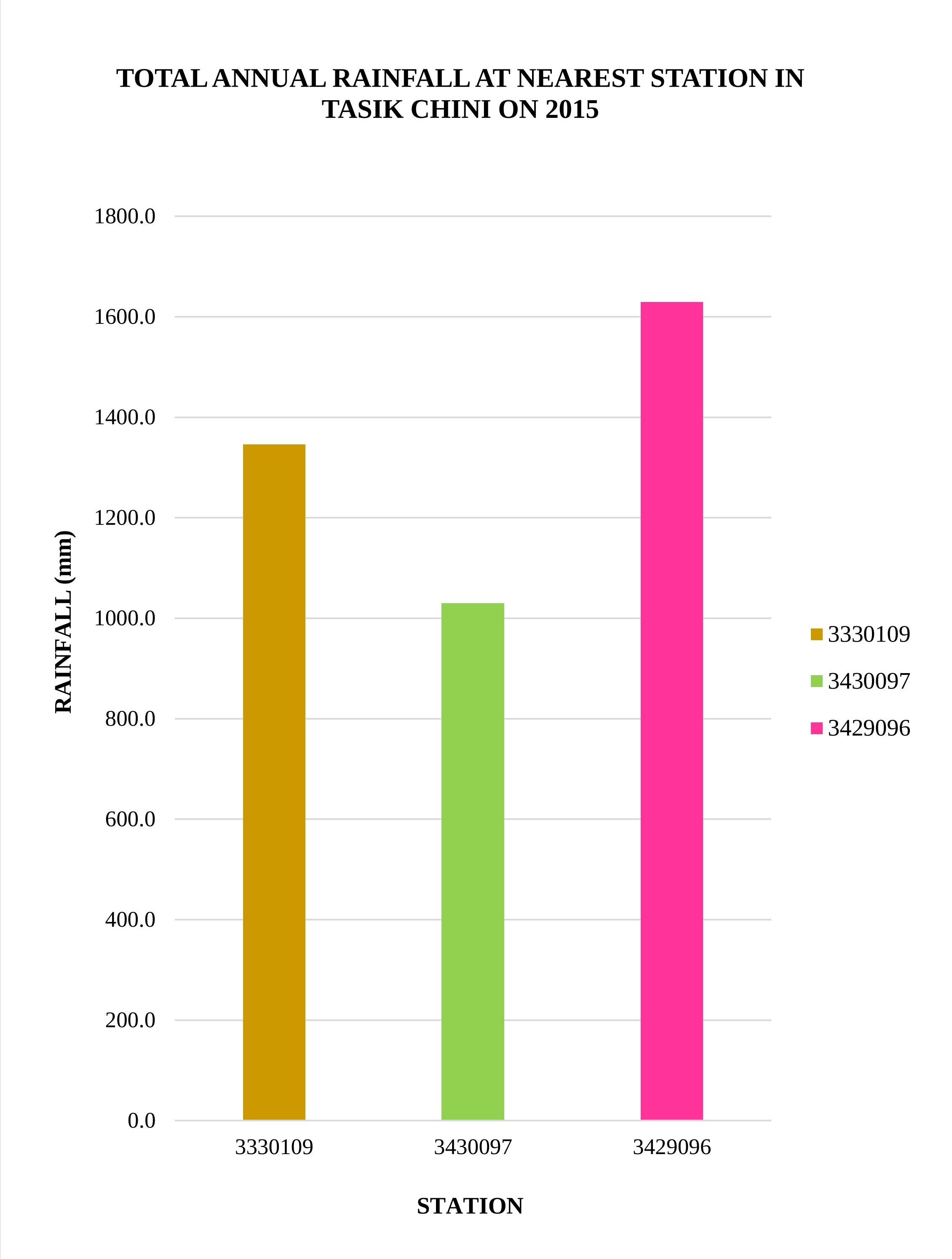


Chart 4.7.8: Total annual rainfall for nearest station at Tasik Chini on 2015

From Chart 4.7.8, it was shown the maximum total annual rainfall for nearest station at Tasik Chini on 2015 is Kampung Salong. Which is the value is 1629.5 mm. While, the minimum total rainfall is 1030.0 mm. Which is at Paya Membang Station.

4.7.9 Total Annual Rainfall for Nearest Station at Tasik Chini on 2016

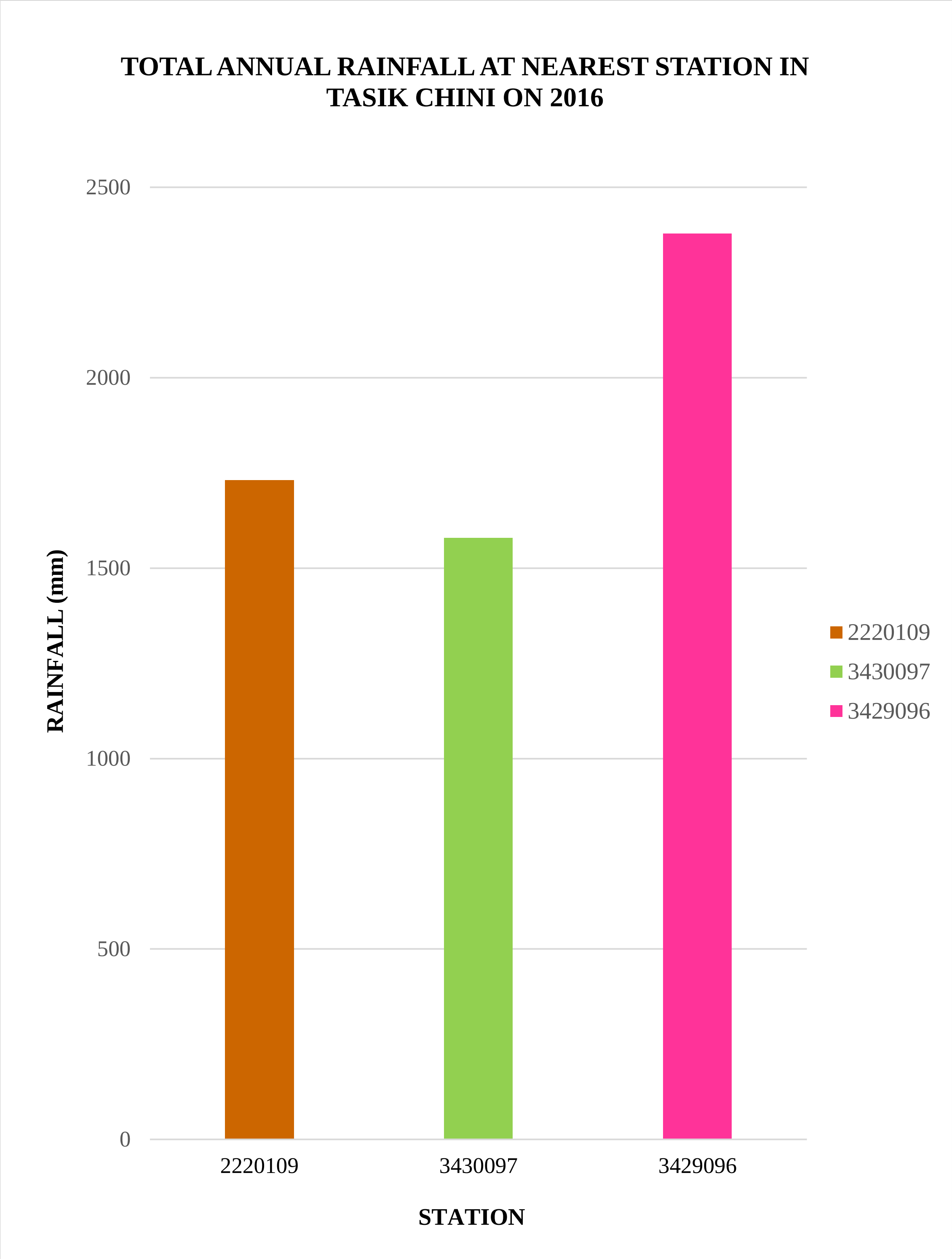


Chart 4.7.9: Total annual rainfall for nearest station at Tasik Chini on 2016

From Chart 4.7.9, it was shown the maximum total annual rainfall for nearest station at Tasik Chini on 2016 is Kampung Salong. Which is the value is 2379.0 mm. While, the minimum total rainfall is 1579.5 mm. Which is at Paya Membang Station.

4.7.10 Total Annual Rainfall for Nearest Station at Tasik Chini on 2017

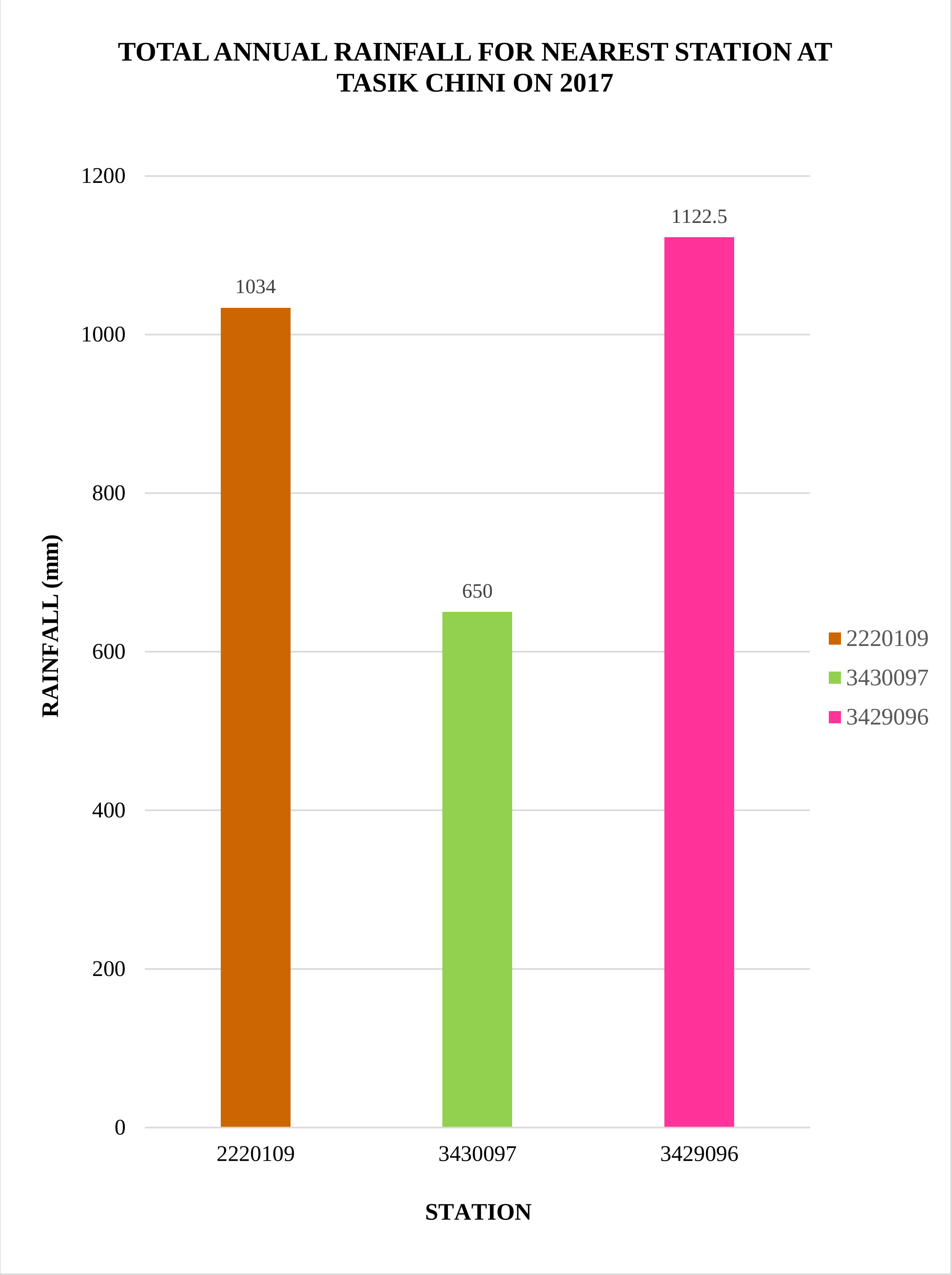


Chart 4.7.10: Total annual rainfall for nearest station at Tasik Chini on 2017

From Chart 4.7.10, it was shown the maximum total annual rainfall for nearest station at Tasik Chini on 2017 is Kampung Salong. Which is the value is 1122.5 mm. While, the minimum total rainfall is 650.0 mm. Which is at Paya Membang Station.

4.7.11 Annual Rainfall for Nearest Hydrological Station at Tasik Chini on 2008 – 2017

From Table 4.7.11 and Chart 4.7.11 shown total annual rainfall for nearest hydrological station at Tasik Chini on 2008 - 2017. There is no rainfall reading at Station 3430097 and 3429096 on 2008 - 2011. For station 3330109 the maximum rainfall reading was occurred on 2011. While, the minimum rainfall reading for was occurred on 2017. Compare with station 3430097. The maximum rainfall reading for this station is on 2014. Same like station 3429096, the maximum rainfall reading also occurred on 2014. Then, the minimum rainfall reading for station 3430097 is 650 mm which is on 2017. Buts, it is not consider as complete data. It is because the data was collected until third of May. It is same as station 3330109 and station 3430097.

Table 4.7.11 Annual rainfall for nearest hydrological station at Tasik Chini on 2008 - 2017

YEAR	STATION		
	3330109	3430097	3429096
2008	1154.5	NO DATA	NO DATA
2009	2244.0	NO DATA	NO DATA
2010	2259.5	NO DATA	NO DATA
2011	3141.5	NO DATA	NO DATA
2012	2528.5	1408.0	1502.0
2013	2923.5	2539.5	2314.5
2014	2803.5	2702.0	2770.0
2015	1346.0	1030.0	1629.5
2016	1441.5	1237.5	1575.0
2017	1034	650	1122.5

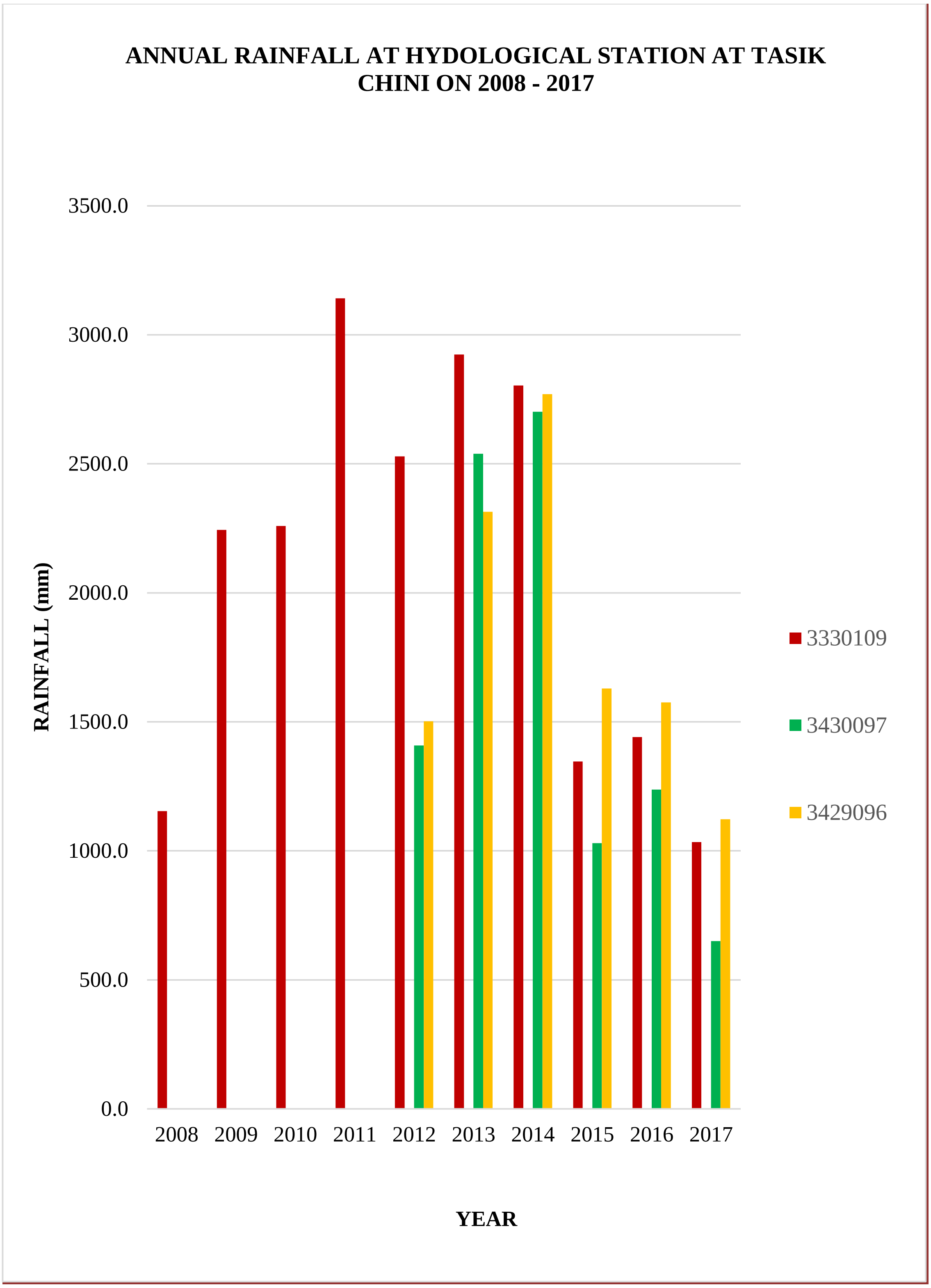


Chart 4.7.11: Total annual rainfall for nearest hydrological station at Tasik Chini on 2008 – 2017

4.7.12 Average Monthly Rainfall at Nearest Hydrological Station at Tasik Chini on 2008 – 2017

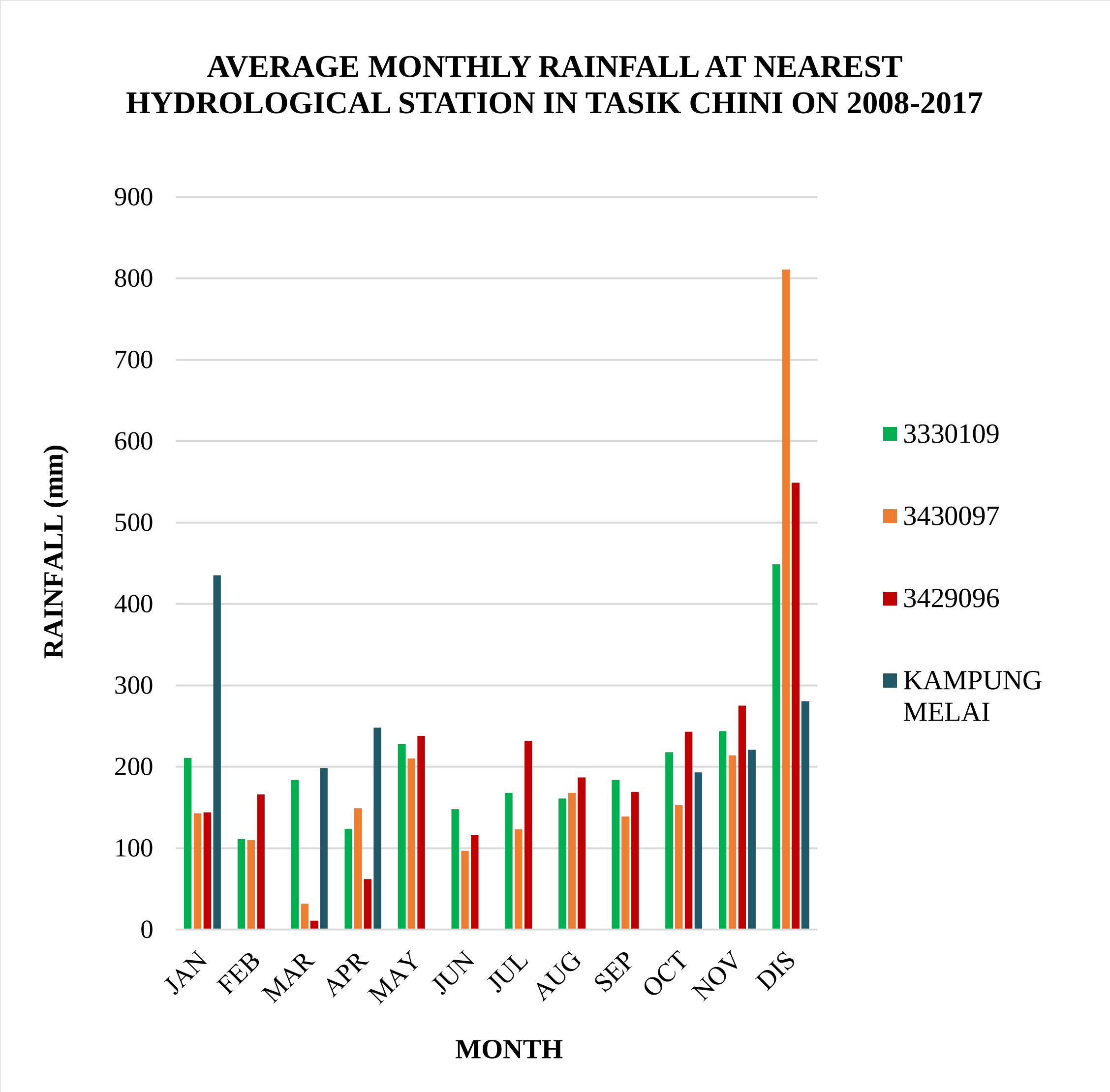


Chart 4.7.12: Average monthly rainfall at hydrological nearest station in Tasik Chini on 2008 - 2017

From Chart 4.7.12 shown average monthly rainfall for nearest hydrological station at Tasik Chini on 2008 - 2017. The maximum rainfall readings surrounding Tasik Chini were occurred in December. For Station 3330109, the highest rainfall reading is about 449 mm. While, the lowest rainfall reading for this station is about 111 mm. Compare with station 3430097, the maximum rainfall reading for this station is 811 mm. Buts, the minimum rainfall reading for this station is 32 mm. From the chart above, at Station at Kampung Melai, there is no rainfall reading on May until September. It is in these months the reading are not complete yet.

4.7.13 Maximum Average Daily Rainfall at Nearest Station in Tasik Chini on 2008 - 2017

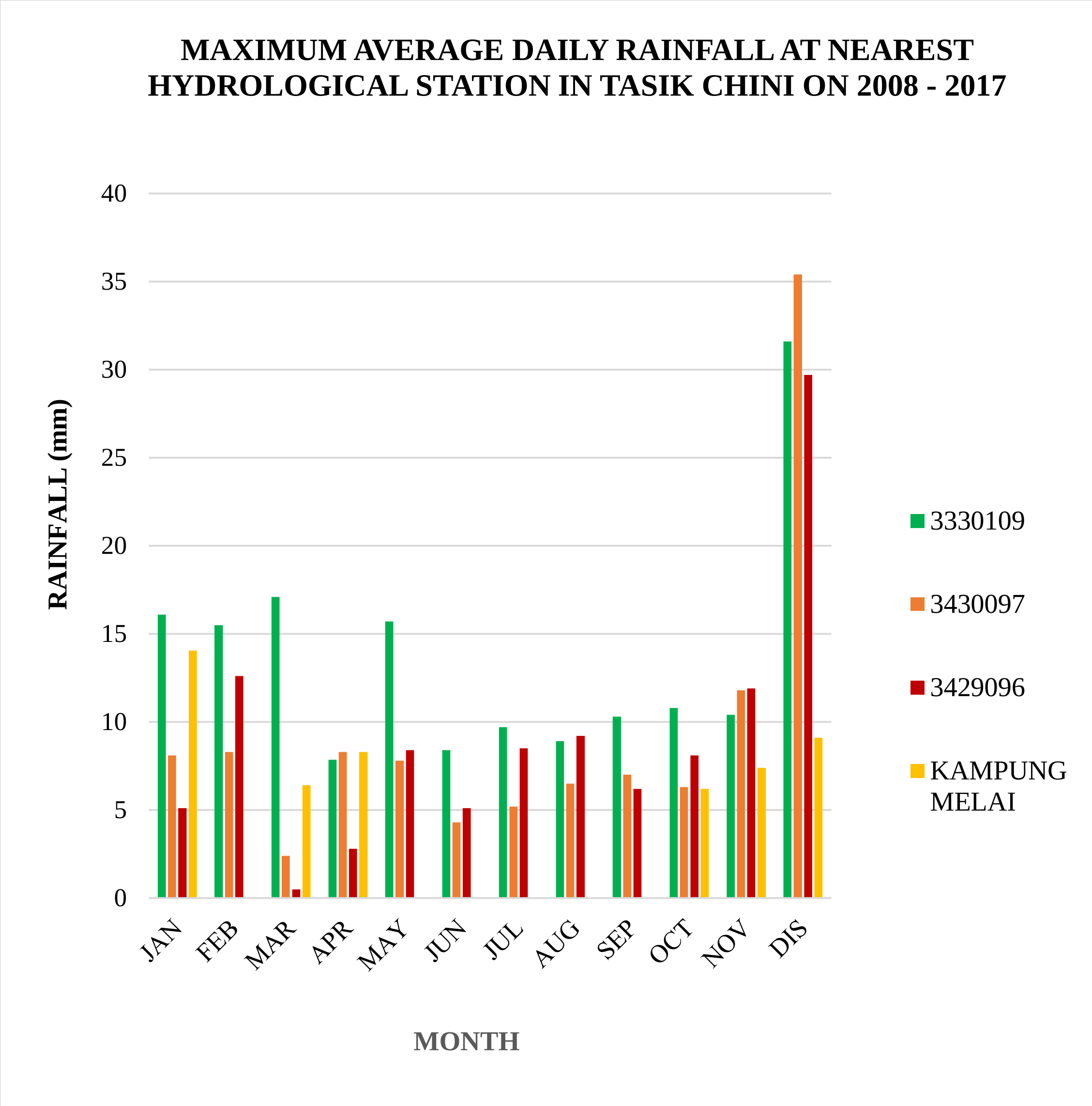


Chart 4.7.13: Maximum average daily rainfall at nearest hydrological station at Tasik Chini on 2008 - 2017

From Chart 4.7.13 shown maximum average daily rainfall for nearest hydrological station at Tasik Chini on 2008 - 2017. The maximum rainfall readings surrounding Tasik Chini were occurred in December. For Station 3330109, the highest rainfall reading is about 31.6 mm/day. While, the lowest rainfall reading for this station is about 7.85 mm/day. Compare with station 3430097, the maximum rainfall reading for this station is 35.4 mm/day. Buts, the minimum rainfall reading for this station is 0.5 mm/day. From the chart above, at Station at Kampung Melai, there is no rainfall reading on May until September. It is in these months the reading are not complete yet.

4.8 Comparison between Rainfall Data from D.I.D and Station Kampung Melai at Tasik Chini on 2008 - 2017

4.8.1 Monthly Rainfall for Nearest Station at Tasik Chini on 2008

From Table 4.8.1 and Chart 4.8.1 shown monthly rainfall for nearest station at Tasik Chini on 2008. There is no rainfall reading at Station 3430097, 3429096 and Kampung Melai. Buts, for Station 3330109 only June until December were recorded for this year. The maximum rainfall for this station is on July, which is 301.5 mm. While, the minimum rainfall reading is on June, which is only 11.00 mm. It was occur because some missing reading for this month.

Table 4.8.1 Monthly rainfall for nearest station at Tasik Chini on 2008

MONTH	STATION			
	3330109	3430097	3429096	KG. MELAI
JAN	N/A	N/A	N/A	N/A
FEB	N/A	N/A	N/A	N/A
MAR	N/A	N/A	N/A	N/A
APR	N/A	N/A	N/A	N/A
MAY	N/A	N/A	N/A	N/A
JUN	11.0	N/A	N/A	N/A
JUL	301.5	N/A	N/A	N/A
AUG	201.5	N/A	N/A	N/A
SEP	71.0	N/A	N/A	N/A
OCT	196.5	N/A	N/A	N/A
NOV	185.5	N/A	N/A	N/A
DEC	187.5	N/A	N/A	N/A

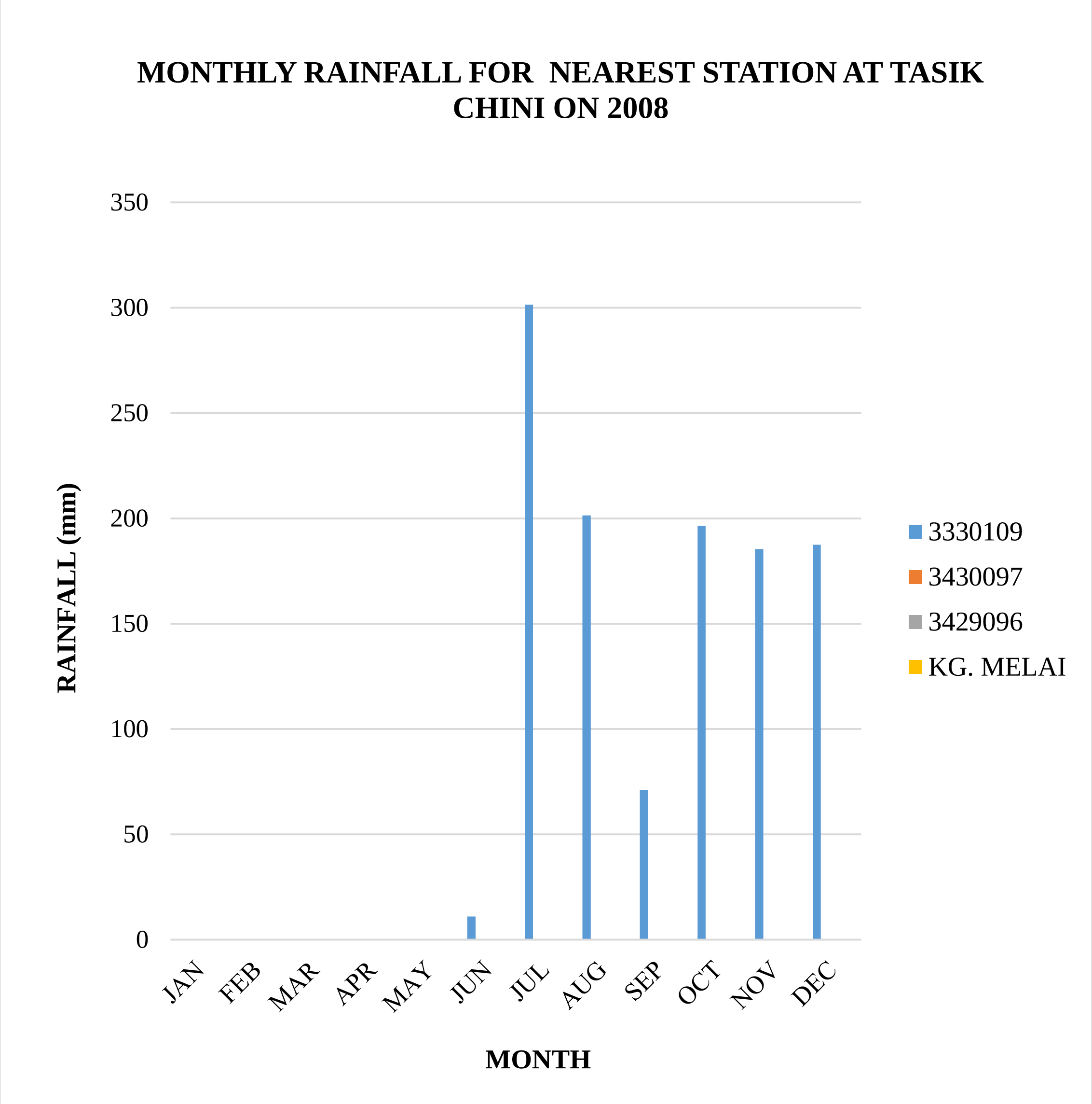


Chart 4.8.1: Monthly rainfall for nearest station at Tasik Chini on 2008

4.8.2 Monthly Rainfall for Nearest Station at Tasik Chini on 2009

From Table 4.8.2 and Chart 4.8.2 shown monthly rainfall for nearest station at Tasik Chini on 2009. There is no rainfall reading at Station 3430097, 3429096 and Kampung Melai. The maximum rainfall for this station is on December, which is 386.0 mm. While, the minimum rainfall reading is on July, which is only 56.0 mm.

Table 4.8.2 Monthly rainfall for nearest station at Tasik Chini on 2009

MONTH	STATION			
	3330109	3430097	3429096	KG. MELAI
JAN	174.0	N/A	N/A	N/A
FEB	60.0	N/A	N/A	N/A
MAR	310.0	N/A	N/A	N/A
APR	86.0	N/A	N/A	N/A
MAY	147.0	N/A	N/A	N/A
JUN	105.0	N/A	N/A	N/A
JUL	56.0	N/A	N/A	N/A
AUG	275.5	N/A	N/A	N/A
SEP	114.0	N/A	N/A	N/A
OCT	335.5	N/A	N/A	N/A
NOV	195.0	N/A	N/A	N/A
DEC	386.0	N/A	N/A	N/A

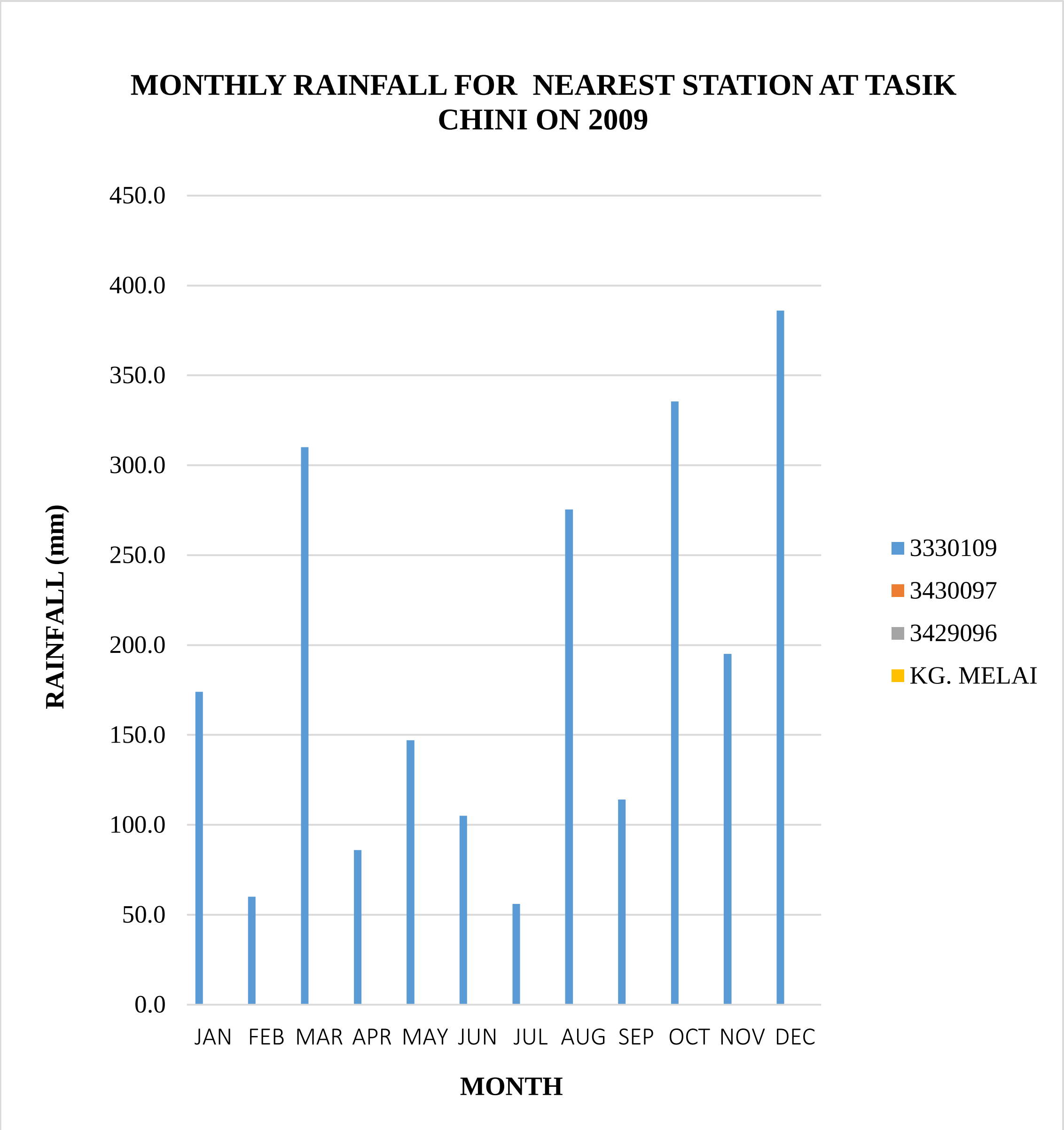


Chart 4.8.2: Monthly rainfall for nearest station at Tasik Chini on 2009

4.8.3 Monthly Rainfall for Nearest Station at Tasik Chini on 2010

From Table 4.8.3 and Chart 4.8.3 shown monthly rainfall for nearest station at Tasik Chini on 2010. There is no rainfall reading at Station 3430097, 3429096 and Kampung Melai. The maximum rainfall for this station is on November and December, which is 312.5 mm. While, the minimum rainfall reading is on February, which is only 4.0 mm.

Table 4.8.3 Monthly rainfall for nearest station at Tasik Chini on 2010

MONTH	STATION			
	3330109	3430097	3429096	KG. MELAI
JAN	112.5	N/A	N/A	N/A
FEB	4.0	N/A	N/A	N/A
MAR	140.5	N/A	N/A	N/A
APR	153.0	N/A	N/A	N/A
MAY	166.0	N/A	N/A	N/A
JUN	252.0	N/A	N/A	N/A
JUL	262.0	N/A	N/A	N/A
AUG	148.5	N/A	N/A	N/A
SEP	226.5	N/A	N/A	N/A
OCT	196.5	N/A	N/A	N/A
NOV	312.5	N/A	N/A	N/A
DEC	312.5	N/A	N/A	N/A

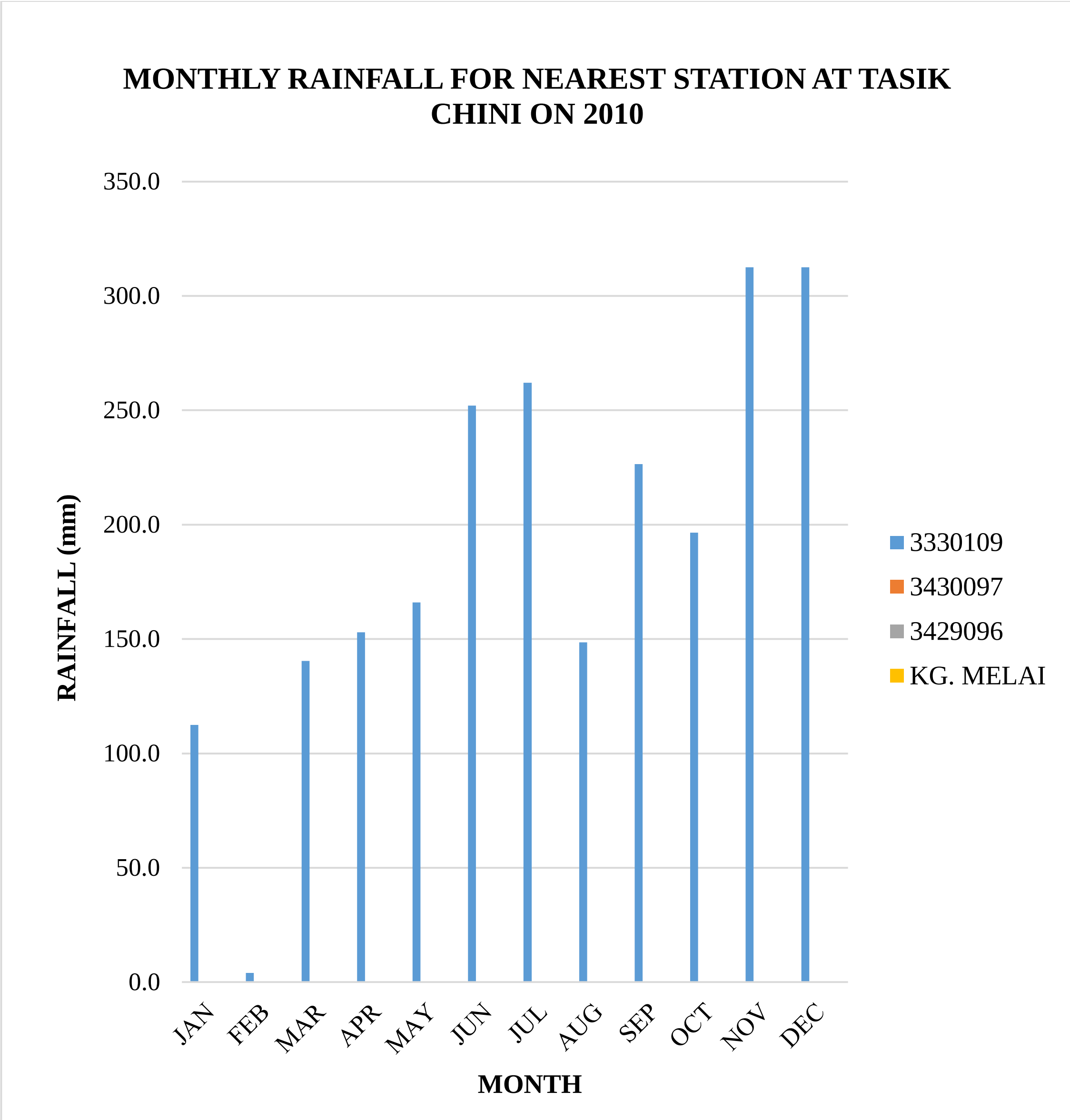


Chart 4.8.3: Monthly rainfall for nearest station at Tasik Chini on 2010

4.8.4 Monthly Rainfall for Nearest Station at Tasik Chini on 2011

From Table 4.8.4 and Chart 4.8.4 shown monthly rainfall for nearest station at Tasik Chini on 2011. There is no rainfall reading at Station 3430097, 3429096 and Kampung Melai. The maximum rainfall for this station is on December, which is 609.5 mm. While, the minimum rainfall reading is on February, which is only 36.5 mm.

Table 4.8.4 Monthly rainfall for nearest station at Tasik Chini on 2011

MONTH	STATION			
	3330109	3430097	3429096	KG. MELAI
JAN	499.0	N/A	N/A	N/A
FEB	36.5	N/A	N/A	N/A
MAR	530.0	N/A	N/A	N/A
APR	115.0	N/A	N/A	N/A
MAY	113.0	N/A	N/A	N/A
JUN	172.5	N/A	N/A	N/A
JUL	78.5	N/A	N/A	N/A
AUG	102.0	N/A	N/A	N/A
SEP	307.5	N/A	N/A	N/A
OCT	275.5	N/A	N/A	N/A
NOV	302.5	N/A	N/A	N/A
DEC	609.5	N/A	N/A	N/A

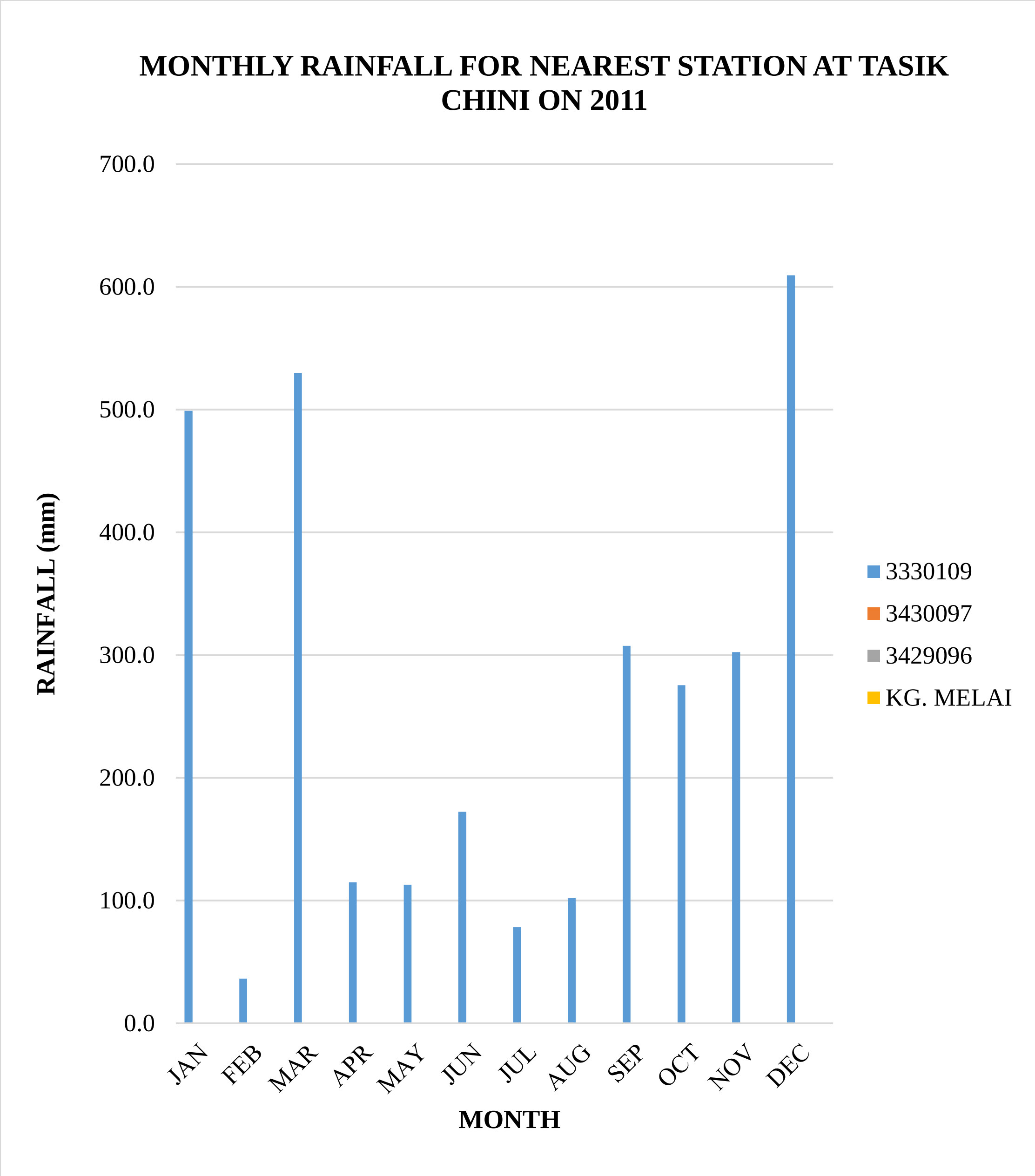


Chart 4.8.4: Monthly rainfall for nearest station at Tasik Chini on 2011

4.8.5 Monthly Rainfall for Nearest Station at Tasik Chini on 2012

From Table 4.8.5 and Chart 4.8.5 shown monthly rainfall for nearest hydrological station at Tasik Chini on 2012. There is no rainfall reading at Station Kampung Melai. The maximum rainfall for this year is at Station 3430097, which is on December with reading 553.5 mm. While, the minimum rainfall reading for this station is on September, which is only 123.5mm. Buts, the minimum rainfall for this year is at station 3330109 which is about 119.0 mm. It was occur on February.

Table 4.8.5 Monthly rainfall for nearest hydrological station at Tasik Chini on 2012

MONTH	STATION			
	3330109	3430097	3429096	KG. MELAI
JAN	227.0	N/A	N/A	N/A
FEB	119.0	N/A	N/A	N/A
MAR	221.5	N/A	N/A	N/A
APR	235.5	N/A	N/A	N/A
MAY	222.5	N/A	N/A	N/A
JUN	106.0	N/A	N/A	N/A
JUL	102.5	N/A	N/A	N/A
AUG	153.0	208.5	300.0	N/A
SEP	272.5	123.5	176.5	N/A
OCT	165.5	167.5	252.0	N/A
NOV	311.0	355.0	357.0	N/A
DEC	392.5	553.5	416.5	N/A

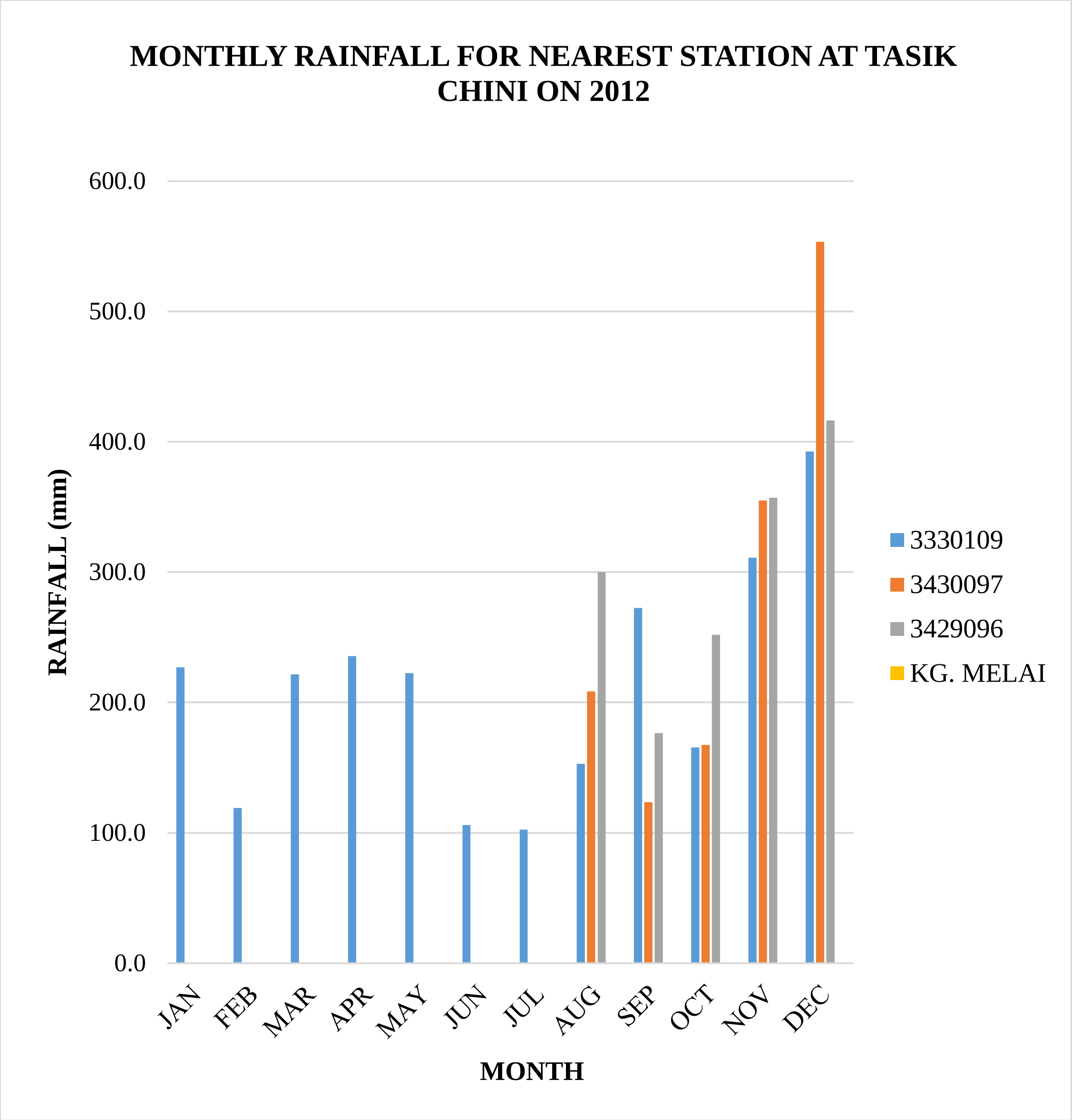


Chart 4.8.5: Monthly rainfall for nearest station at Tasik Chini on 2012

4.8.6 Monthly Rainfall for Nearest Station at Tasik Chini on 2013

From Table 4.8.6 and Chart 4.8.6 shown monthly rainfall for nearest hydrological station at Tasik Chini on 2013. There is no rainfall reading at Station Kampung Melai. The maximum rainfall for this year is at Station 3430097, which is on December with reading 782.0 mm. While, the minimum rainfall reading for this station is on March, which is only 28.0 mm. Buts, the minimum rainfall for this year is at station 3429096 which is about 0.0 mm. It was occur on July.

Table 4.8.6 Monthly rainfall for nearest station at Tasik Chini on 2013

MONTH	STATION			
	3330109	3430097	3429096	KG. MELAI
JAN	162.0	153.0	157.0	N/A
FEB	433.0	235.0	353.5	N/A
MAR	71.5	28.0	14.5	N/A
APR	232.0	248.5	78.0	N/A
MAY	413.5	235.0	236.0	N/A
JUN	100.0	87.5	106.0	N/A
JUL	151.0	141.0	0.0	N/A
AUG	130.5	166.5	163.0	N/A
SEP	194.5	139.0	170.5	N/A
OCT	289.5	196.5	228.5	N/A
NOV	124.0	127.5	148.0	N/A
DEC	622.0	782.0	659.5	N/A

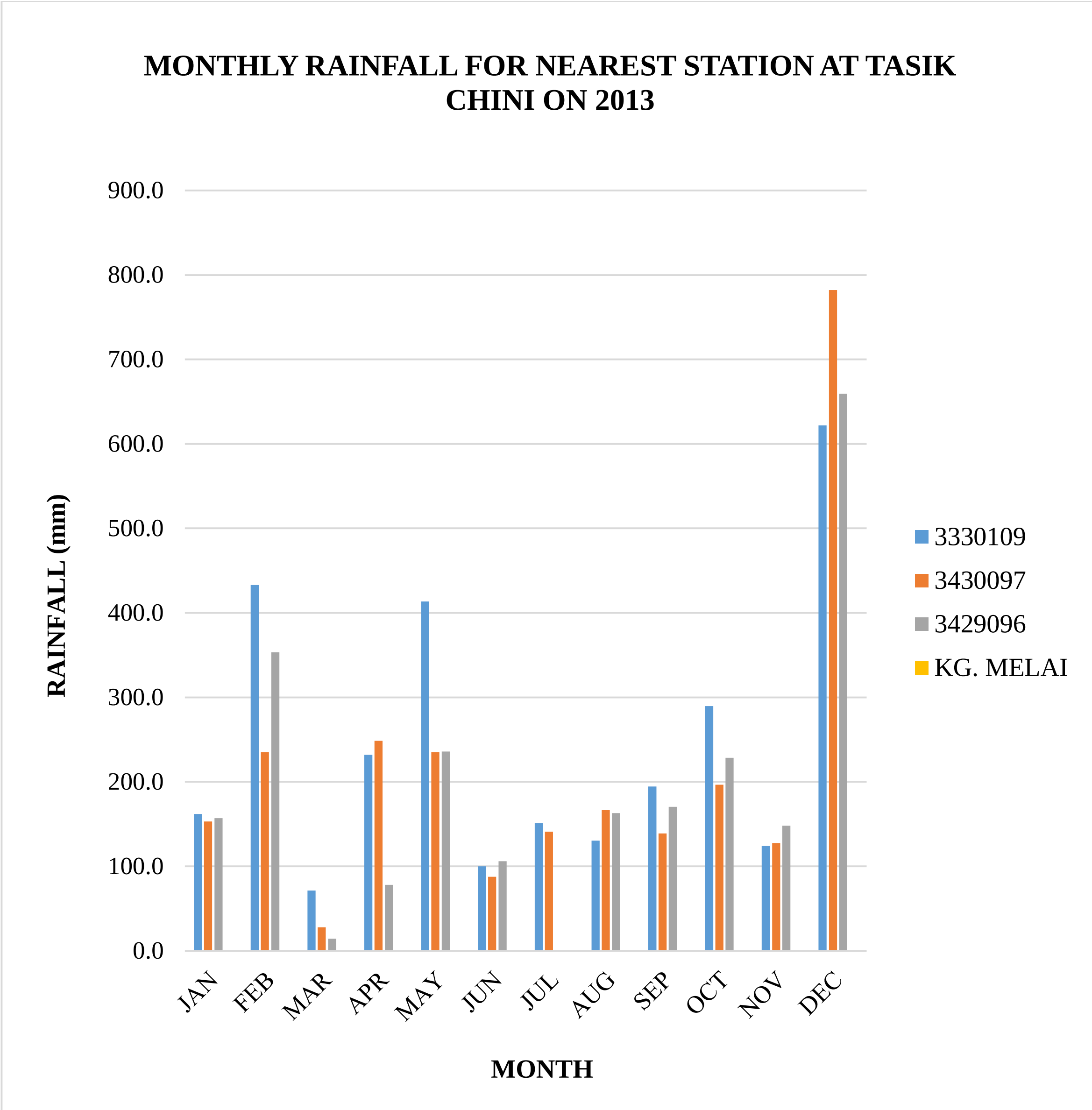


Chart 4.8.6: Monthly rainfall for nearest station at Tasik Chini on 2013

4.8.7 Monthly Rainfall for Nearest Station at Tasik Chini on 2014

From Table 4.8.7 and Chart 4.8.7 shown monthly rainfall for nearest hydrological station at Tasik Chini on 2014. There is no rainfall reading at Station Kampung Melai. The maximum rainfall for this year is at Station 3430097, which is on December with reading 1097.0 mm. While, the minimum rainfall reading for this station is on March, which is only 7.0 mm. Buts, the minimum rainfall for this year is at station 3330109 and 3429096 which is about 0.0 mm respectively. It were occur on February.

Table 4.8.7 Monthly rainfall for nearest station at Tasik Chini on 2014

MONTH	STATION			
	3330109	3430097	3429096	KG. MELAI
JAN	0.0	251.0	157.5	N/A
FEB	0.0	7.0	2.5	N/A
MAR	122.5	75.0	20.0	N/A
APR	60.5	209.5	62.5	N/A
MAY	488.0	242.5	260.0	N/A
JUN	72.0	128.5	148.0	N/A
JUL	215.0	122.5	262.5	N/A
AUG	174.0	195.5	285.0	N/A
SEP	143.5	94.0	165.5	N/A
OCT	245.5	171.5	248.5	N/A
NOV	301.5	108.0	237.5	N/A
DEC	981.0	1097.0	920.5	N/A

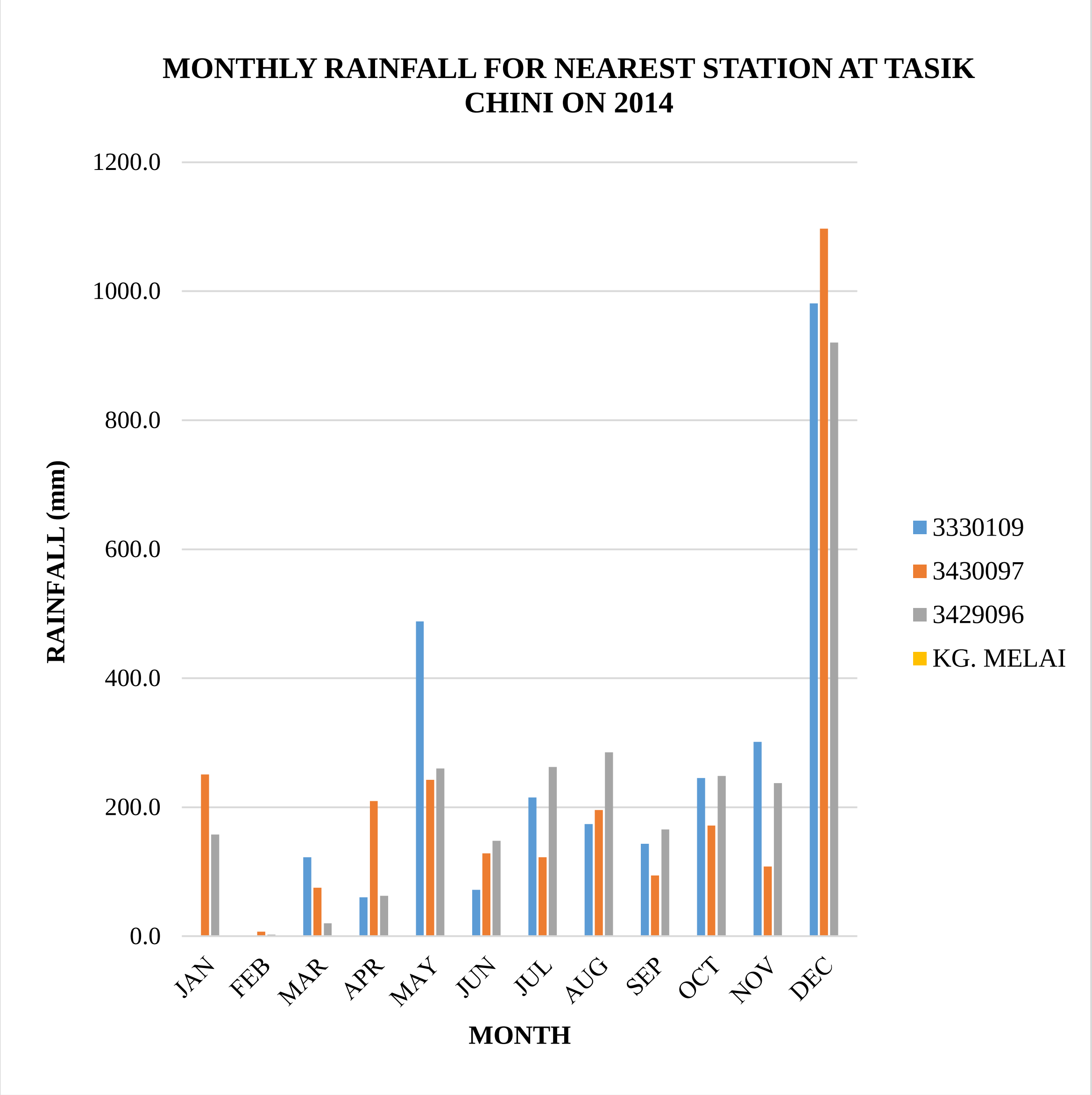


Chart 4.8.7: Monthly rainfall for nearest station at Tasik Chini on 2014

4.8.8 Monthly Rainfall for Nearest Station at Tasik Chini on 2015

From Table 4.8.8 and Chart 4.8.8 shown monthly rainfall for nearest hydrological station at Tasik Chini on 2015. There is no rainfall reading at Station Kampung Melai. The maximum rainfall for this year is at Station 3429096, which is on November with reading 358.0 mm. While, the minimum rainfall reading for this station is on March, which is only 7.0 mm. Buts, the minimum rainfall for this year is at station 3430097 which is about 0.0 mm. It were occur on March.

Table 4.8.8 Monthly rainfall for nearest station at Tasik Chini on 2015

MONTH	STATION			
	3330109	3430097	3429096	KG. MELAI
JAN	151.5	23.5	151.0	N/A
FEB	17.0	20.5	9.0	N/A
MAR	41.5	1.5	7.0	N/A
APR	63.0	120.0	84.0	N/A
MAY	178.5	140.0	217.0	N/A
JUN	31.5	68.0	56.5	N/A
JUL	78.0	64.0	209.5	N/A
AUG	137.5	110.0	124.0	N/A
SEP	93.5	129.5	148.0	N/A
OCT	65.5	77.0	66.0	N/A
NOV	214.0	267.0	358.0	N/A
DEC	274.5	9.0	199.5	N/A

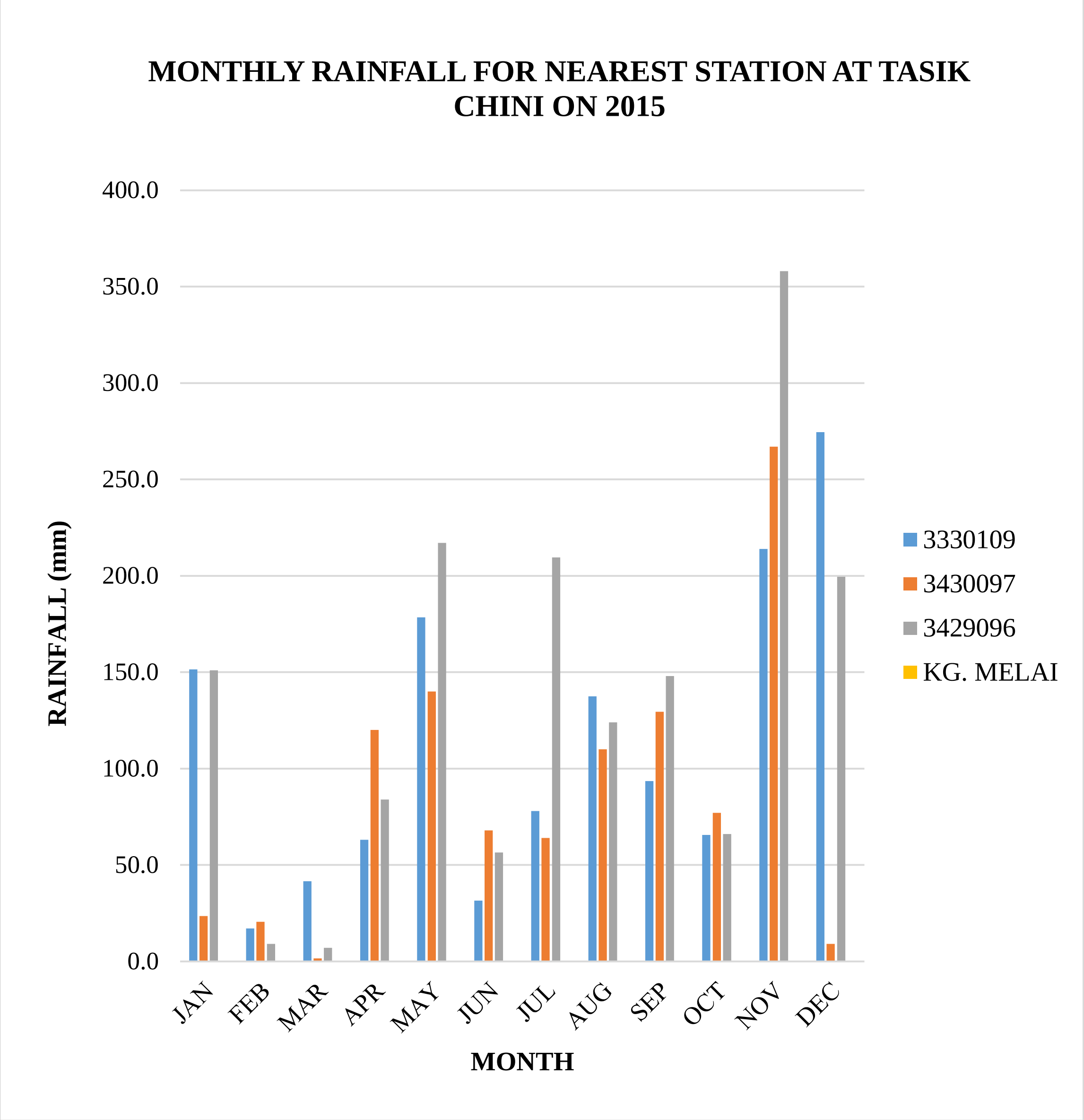


Chart 4.8.8: Monthly rainfall for nearest station at Tasik Chini on 2015

4.8.9 Monthly Rainfall for Nearest Station at Tasik Chini on 2016

From Table 4.8.9 and Chart 4.8.9 shown monthly rainfall for nearest hydrological station at Tasik Chini on 2016. The maximum rainfall for this year is at Station 3429096, which is on December with reading 530.5 mm. While, the minimum rainfall reading for this station is on March, which is only 10.5 mm. Buts, the minimum rainfall for this year is at station 3430097 which is about 1.0 mm. It were occur on November.

Table 4.8.9 Monthly rainfall for nearest station at Tasik Chini on 2016

MONTH	STATION			
	3330109	3430097	3429096	KG. MELAI
JAN	150.0	51.0	111.0	N/A
FEB	185.0	175.5	134.0	N/A
MAR	30.5	23.5	10.5	N/A
APR	44.5	18.5	24.5	N/A
MAY	75.5	223.0	261.0	N/A
JUN	228.0	102.0	151.5	N/A
JUL	178.5	161.5	224.0	N/A
AUG	123.5	201.0	175.0	N/A
SEP	161.0	208.5	186.0	127.8
OCT	227.5	72.0	257.0	193
NOV	37.5	1.0	40.5	221
DEC	N/A	N/A	N/A	280.6

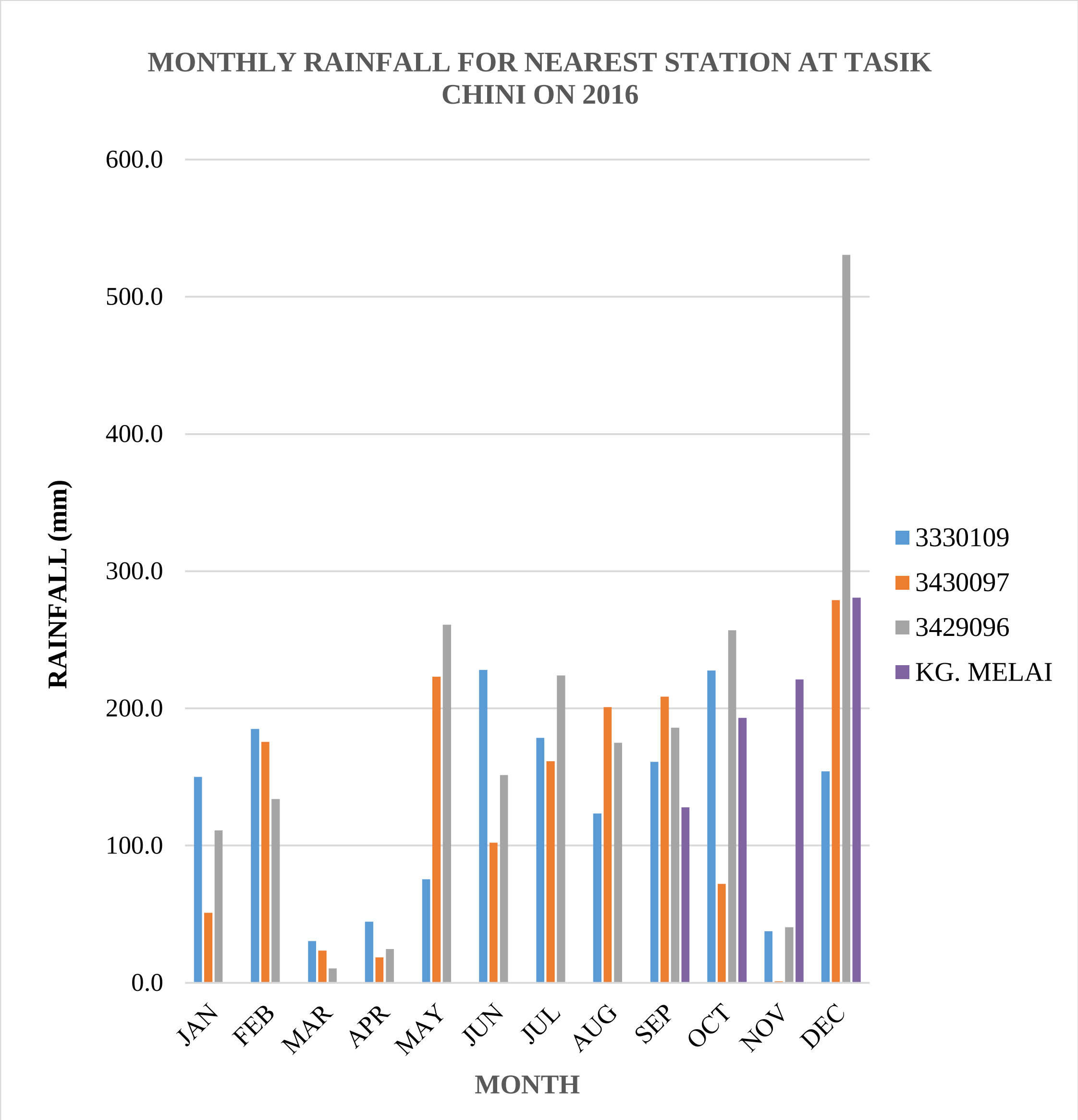


Chart 4.8.9: Monthly rainfall for nearest station at Tasik Chini on 2016

4.8.10 Monthly Rainfall for Nearest Station at Tasik Chini on 2017

From Table 4.8.10 and Chart 4.8.10 shown monthly rainfall for nearest hydrological station at Tasik Chini on 2017. There is no rainfall reading from June until Dec for station 3330109, station 3430097, station 3429096 and station at Kampung Melai. It is because the data are not complete yet. The maximum rainfall for this year is at Station 3330109, which is on January with reading 596.0 mm. While, the minimum rainfall reading for this year also at this which is on May with only 13.5 mm.

Table 4.8.10 Monthly rainfall for nearest station at Tasik Chini on 2017

MONTH	STATION			
	3330109	3430097	3429096	KG. MELAI
JAN	596.0	75.5	453.5	435.4
FEB	36.0	223.0	240.0	N/A
MAR	130.0	137.0	217.5	435.4
APR	158.5	187.5	200.0	248
MAY	13.5	27.0	11.5	111.4
JUN	N/A	N/A	N/A	N/A
JUL	N/A	N/A	N/A	N/A
AUG	N/A	N/A	N/A	N/A
SEP	N/A	N/A	N/A	N/A
OCT	N/A	N/A	N/A	N/A
NOV	N/A	N/A	N/A	N/A
DEC	N/A	N/A	N/A	N/A

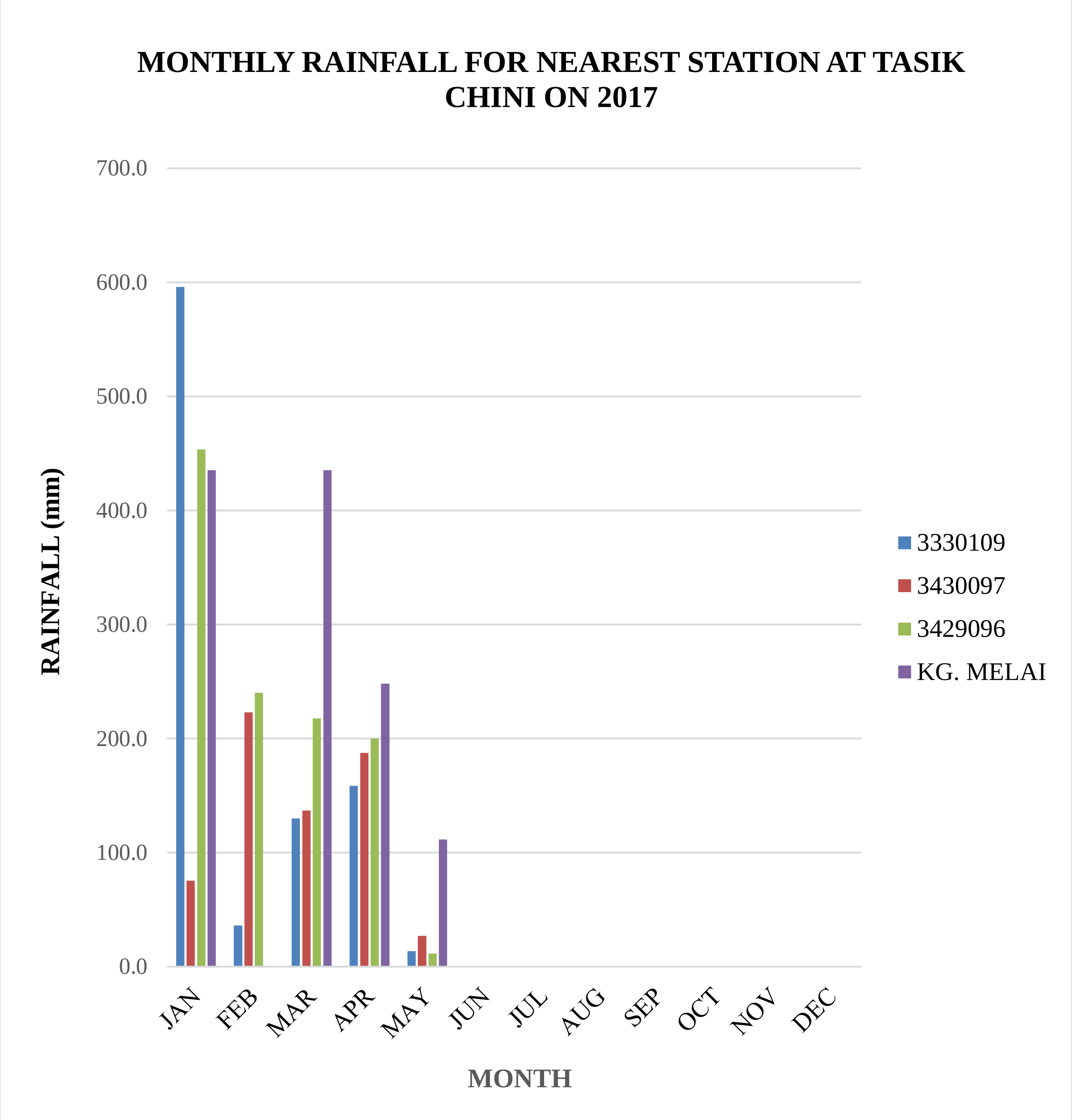


Chart 4.8.10: Monthly rainfall for nearest station at Tasik Chini on 2017

4.9 Maximum Monthly Rainfall for Nearest Stations at Tasik Chini on 2008 - 2017

From Table 4.9 and Chart 4.9 show the maximum total monthly rainfall for nearest hydrological stations at Tasik Chini. The maximum total monthly rainfall for station 3330109 was occurred in month of August with reading 1445.5 mm. Then, for station 3430097 was occurred in September with reading 694.5 mm. In Tasik Chini the maximum total monthly rainfall for new hydrological station is in January with reading 435.4 mm. For this station, the maximum total monthly rainfall was occurred only year.

Table 4.9 Maximum total monthly rainfall for nearest stations at Tasik Chini on 2008 -2017

NO.	STATION	MAX. TOTAL MONTHLY RAINFALL (mm)	REMARK
1	3330109	1445.50	• August (2008 – 2016) (no missing data) • Jan – Jul & Sep – Dec (2008 – 2017) (missing data)
2	3430097	694.5	• September (2012 – 2016) (no missing data) • Jan – Aug & Oct – Dec (2008 – 2017) (missing data)
3	3429096	846.5	• September (2012 – 2016) (no missing data) • Jan – Aug & Oct – Dec (2008 – 2017) (missing data)
4	KAMPUNG MELAI	435.4	• January 2017

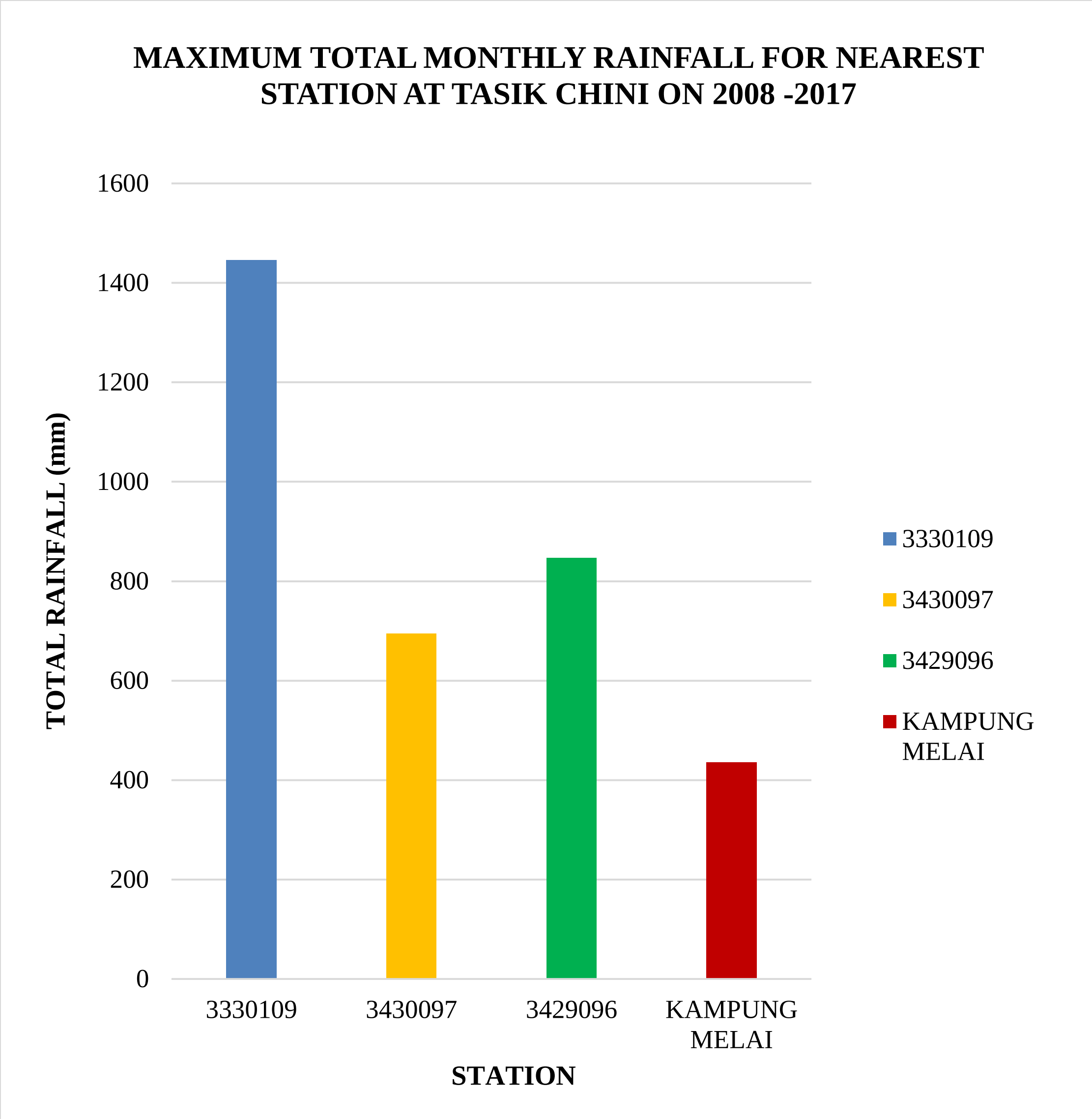


Chart 4.9: Maximum total monthly rainfall for nearest stations at Tasik Chini on 2008 - 2017

4.10 Total Rainfall of 10 Years Duration for Nearest Station at Tasik Chini on 2008-2017

From the Table 4.10 and Chart 4.10, it is show the result of total rainfall for 9 years duration for 4 Hydrological Station in Tasik Chini. Then, the highest total annual rainfall from the result show is at station 3330109 at Tasik Chini with 19842.5 mm.

Table 4.10 Maximum total annual rainfall of 10 years duration for nearest stations at Tasik Chini on 2008 -2017

NO.	STATION	MAX. TOTAL ANNUAL RAINFALL (mm)	REMARK
1	3330109	19842.5	2008 - 2017
2	3430097	8917.0	2012 -2017
3	3429096	9791.0	2012 -2017
4	KAMPUNG MELAI	1384.8	2016 -2017

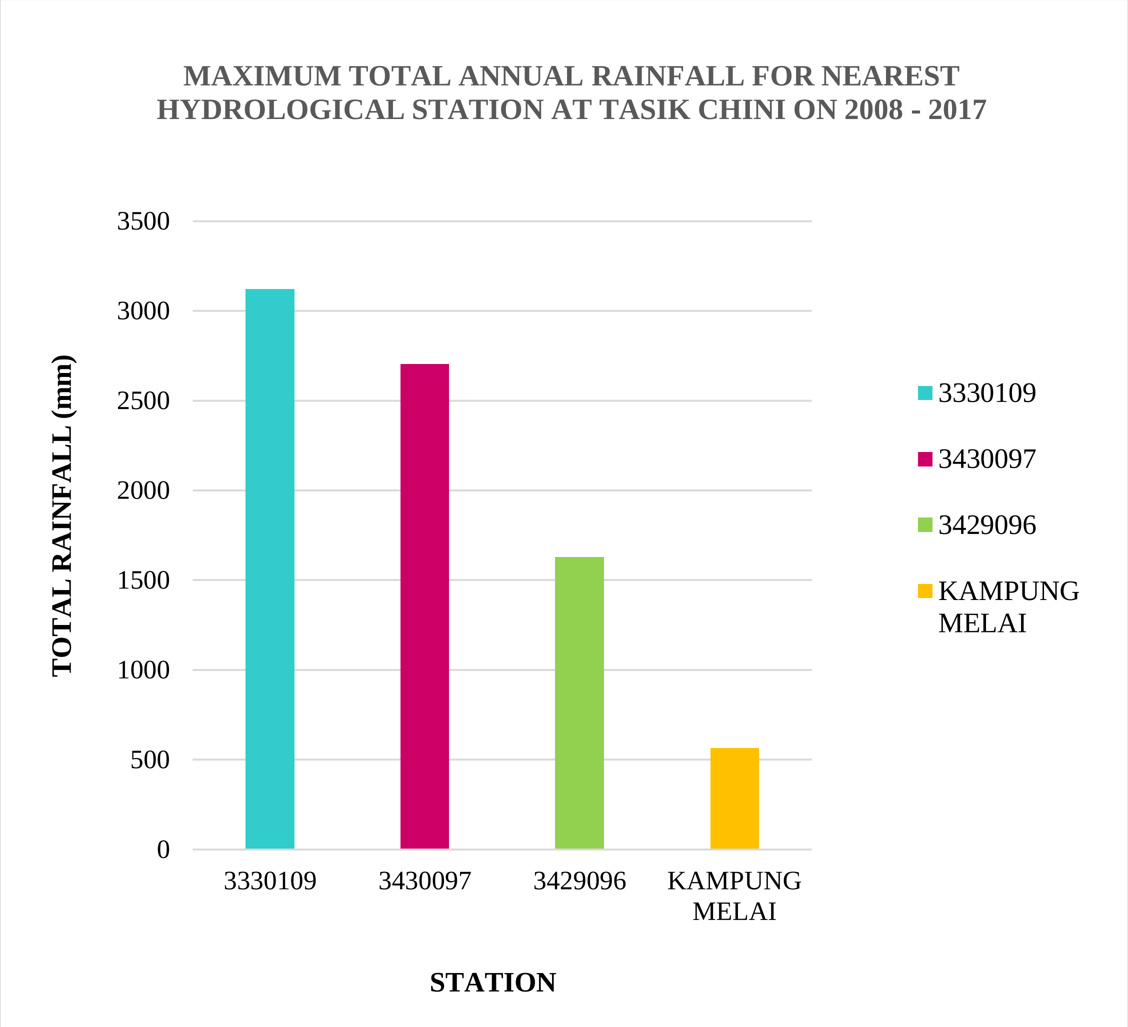


Table 4.10: Maximum total annual rainfall of 10 years duration for nearest stations at Tasik Chini on 2008 -2017

4.11 Rainfall Intensity for Station 3330109

From data collected that get from JPS Kuantan, data will be analyze by using procedure in MSMA2 method Rainfall Intensity. The steps start with identify the highest total rainfall station which is at station 3330109 Kampung Batu Gong. Then the next step is chooses the Hydrology Station in MSMA2 that have been list to the Station 3330109 Kampung Batu Gong. The selection of the station can be applied by using Hydrological Stations Map in Pekan. After finish choose the station, make calculation step by step similar to MSMA2 procedure to get rainfall intensity and lastly draw the graph for rainfall intensity by the storm duration. The purpose of calculation rainfall intensity is to get the value of rainfall intensity and comparison between the total rainfalls that had been analysis with rainfall intensity get at Station 3330109 Kampung Batu Gong. The Storm Duration is from 5 minutes to 1440 minutes for 2-years ARI, 5-years ARI, 20-years ARI, 50-years ARI and 100-years.

Tables 4.11 (a) Rainfall Intensity for 2-years ARI

λ	**T**	**k**	**d**	**θ**	**η**	**i**
58.483	2	0.212	0.0833	0.197	0.586	142.7384
58.483	2	0.212	0.1667	0.197	0.586	122.5328
58.483	2	0.212	0.25	0.197	0.586	108.5845
58.483	2	0.212	0.5	0.197	0.586	83.6977
58.483	2	0.212	1	0.197	0.586	60.9656
58.483	2	0.212	3	0.197	0.586	34.2822
58.483	2	0.212	9	0.197	0.586	18.4566
58.483	2	0.212	12	0.197	0.586	15.6424
58.483	2	0.212	15	0.197	0.586	13.7511
58.483	2	0.212	18	0.197	0.586	12.3734
58.483	2	0.212	24	0.197	0.586	10.4704

Table 4.11 (a) show the result of rainfall intensity for storm duration start with 5 minutes until 1440 minutes and Average Rainfall Intensity for 2-years. From the result for first storm duration which is 5 minutes early the rainfall intensity is 142.7384 mm/hr. While for the last storm duration with 1440 minutes the rainfall intensity value is 10.4704 mm/hr. It is show the rainfall intensity decrease by the follow minutes.

Tables 4.11 (b) Rainfall Intensity for 5-years ARI

λ	**T**	**k**	**d**	**θ**	**η**	**i**
58.483	5	0.212	0.0833	0.197	0.586	173.3421
58.483	5	0.212	0.1667	0.197	0.586	148.8044
58.483	5	0.212	0.25	0.197	0.586	131.8655
58.483	5	0.212	0.5	0.197	0.586	101.6429
58.483	5	0.212	1	0.197	0.586	74.0369
58.483	5	0.212	3	0.197	0.586	41.6325
58.483	5	0.212	9	0.197	0.586	22.4138
58.483	5	0.212	12	0.197	0.586	18.9962
58.483	5	0.212	15	0.197	0.586	16.6994
58.483	5	0.212	18	0.197	0.586	15.0263
58.483	5	0.212	24	0.197	0.586	12.7153

Table 4.11(b) show the result of rainfall intensity for storm duration start with 5 minutes until 1440 minutes and Average Rainfall Intensity for 5-years. From the result for first storm duration which is 5 minutes early the rainfall intensity is 173.3421 mm/hr. While for the last storm duration with 1440 minutes the rainfall intensity value is 12.7153 mm/hr. It is show the rainfall intensity decrease by the follow minutes.

Tables 4.11 (c) Rainfall Intensity for 20-years ARI

λ	**T**	**k**	**d**	**θ**	**η**	**i**
58.483	20	0.212	0.0833	0.197	0.586	232.5631
58.483	20	0.212	0.1667	0.197	0.586	199.6422
58.483	20	0.212	0.25	0.197	0.586	176.9163
58.483	20	0.212	0.5	0.197	0.586	136.3684
58.483	20	0.212	1	0.197	0.586	99.3310
58.483	20	0.212	3	0.197	0.586	55.8559
58.483	20	0.212	9	0.197	0.586	30.0712
58.483	20	0.212	12	0.197	0.586	25.4861
58.483	20	0.212	15	0.197	0.586	22.4046
58.483	20	0.212	18	0.197	0.586	20.1599
58.483	20	0.212	24	0.197	0.586	17.0594

Table 4.11(c) show the result of rainfall intensity for storm duration start with 5 minutes until 1440 minutes and Average Rainfall Intensity for 20-years. From the result for first storm duration which is 5 minutes early the rainfall intensity is 232.5631 mm/hr. While for the last storm duration with 1440 minutes the rainfall intensity value is 17.0594 mm/hr. It is show the rainfall intensity decrease by the follow minutes.

Tables 4.11 (d) Rainfall Intensity for 50-years ARI

ʎ	**T**	**k**	**d**	**θ**	**η**	**i**
58.483	50	0.212	0.0833	0.197	0.586	282.4257
58.483	50	0.212	0.1667	0.197	0.586	242.4464
58.483	50	0.212	0.25	0.197	0.586	214.8479
58.483	50	0.212	0.5	0.197	0.586	165.6063
58.483	50	0.212	1	0.197	0.586	120.6280
58.483	50	0.212	3	0.197	0.586	67.8316
58.483	50	0.212	9	0.197	0.586	36.5186
58.483	50	0.212	12	0.197	0.586	30.9505
58.483	50	0.212	15	0.197	0.586	27.2083
58.483	50	0.212	18	0.197	0.586	24.4823
58.483	50	0.212	24	0.197	0.586	20.7170

Table 4.11 (d) show the result of rainfall intensity for storm duration start with 5minutes until 1440 minutes and Average Rainfall Intensity for 50-years. From the result for first storm duration which is 5minutes early the rainfall intensity is 282.4257 mm/hr. While for the last storm duration with 1440 minutes the rainfall intensity value is 20.7170 mm/hr. It is show the rainfall intensity decrease by the follow minutes.

Tables 4.11 (e) Rainfall Intensity for 100-years ARI

λ	**T**	**k**	**d**	**θ**	**η**	**i**
58.483	100	0.212	0.0833	0.197	0.586	327.1316
58.483	100	0.212	0.1667	0.197	0.586	280.8239
58.483	100	0.212	0.25	0.197	0.586	248.8568
58.483	100	0.212	0.5	0.197	0.586	191.8206
58.483	100	0.212	1	0.197	0.586	139.7225
58.483	100	0.212	3	0.197	0.586	78.5689
58.483	100	0.212	9	0.197	0.586	42.2993
58.483	100	0.212	12	0.197	0.586	35.8497
58.483	100	0.212	15	0.197	0.586	31.5152
58.483	100	0.212	18	0.197	0.586	28.3576
58.483	100	0.212	24	0.197	0.586	23.9964

Table 4.11 (e) show the result of rainfall intensity for storm duration start with 5minutes until 1440 minutes and Average Rainfall Intensity for 100-years. From the result for first storm duration which is 5minutes early the rainfall intensity is 327.1316 mm/hr. While for the last storm duration with 1440 minutes the rainfall intensity value is 23.9964 mm/hr. It is show the rainfall intensity decrease by the follow minutes.

Table 4.11 (f) Result of Rainfall Intensity

RAINFALL INTENSITY(mm/hr)					
storm duration (minute)	2-yr ARI	5-yr ARI	20-yr ARI	50-yr ARI	100-yr ARI
5	142.7384	173.3421	232.5631	282.4257	327.1316
10	122.5328	148.8044	199.6422	242.4464	280.8239
15	108.5845	131.8655	176.9163	214.8479	248.8568
30	83.6977	101.6429	136.3684	165.6063	191.8206
60	60.9656	74.0369	99.3310	120.6280	139.7225
180	34.2822	41.6325	55.8559	67.8316	78.5689
540	18.4566	22.4138	30.0712	36.5186	42.2993
720	15.6424	18.9962	25.4861	30.9505	35.8497
900	13.7511	16.6994	22.4046	27.2083	31.5152
1080	12.3734	15.0263	20.1599	24.4823	28.3576
1440	10.4704	12.7153	17.0594	20.7170	23.9964

Table 4.11(f) shown the result for Rainfall Intensity. For 2-Year ARI, 5-Year ARI, 20-year ARI, 50-Year ARI and 100 -Year ARI. From the result, for 100-year ARI have the highest Rainfall Intensities with 327.1316 mm/hr for 5 minute.

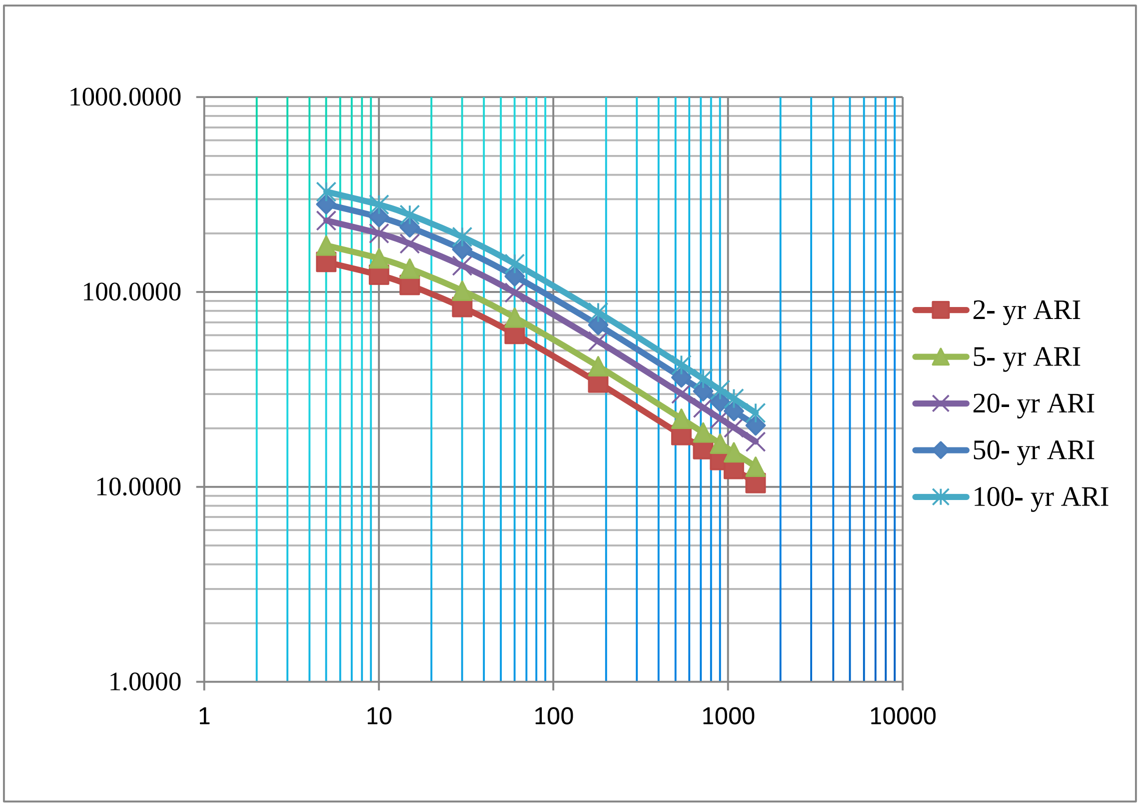


Chart 4.11 (f): Scatter of rainfall intensity for 5 type year of ARI versus storm duration

4.12 Flow Rate at Tasik Chini

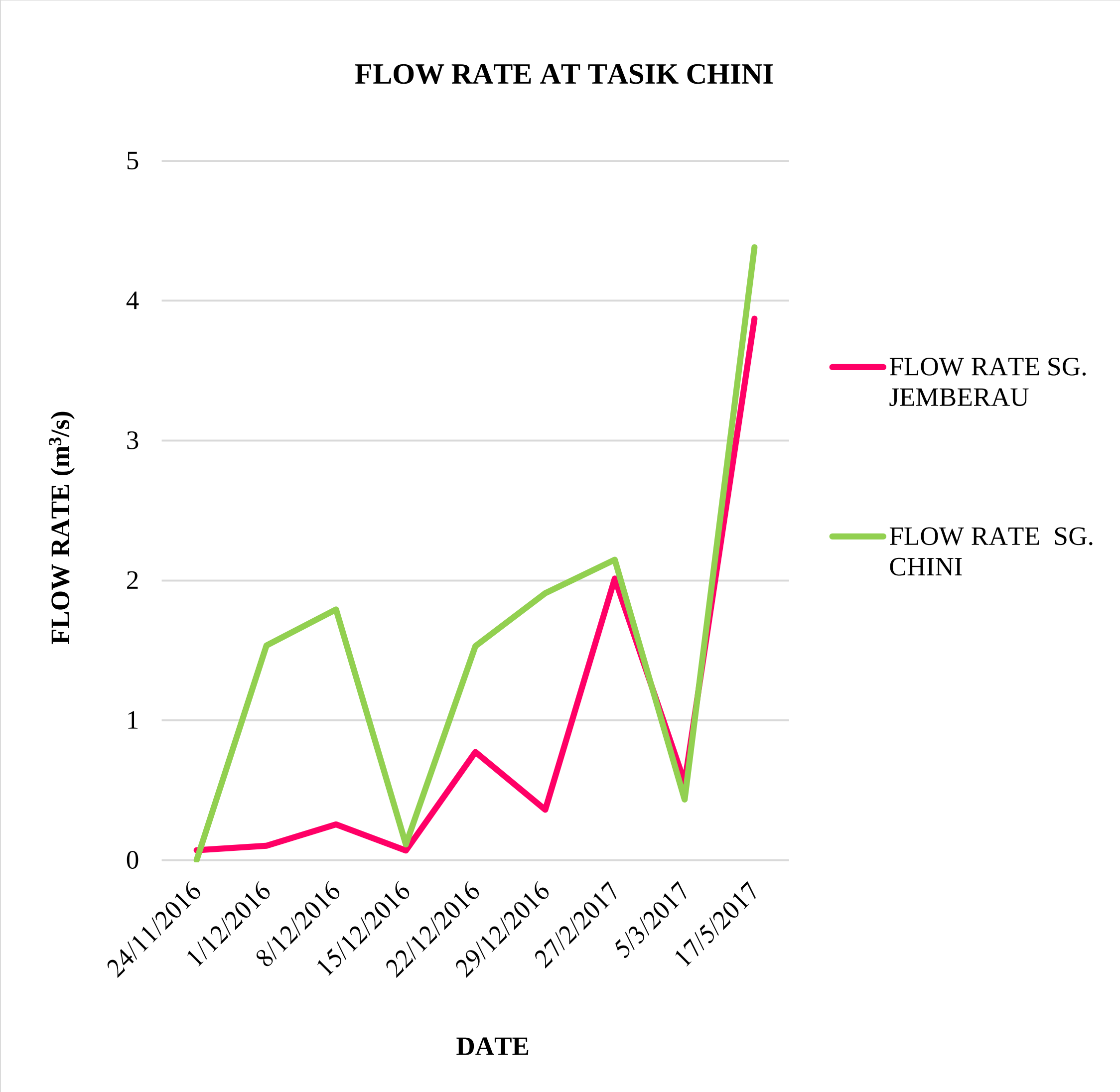


Chart 4.12: Flow rate at Tasik Chini

From Chart 4.12 above the highest flow rate is 4.382 m^3/s which is at Sungai Chini (Navigation Lock) which is on 17th of May 2017. While, the lowest flow rate also at Sungai Chini (Navigation Lock) with 0.0 m^3/s which is on 24th of November 2016. On 15th of December 2016, the flow rate were decreased dramatically at both of the river. While on 5th of March 2017, the flow rate were increased dramatically at both of the river.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

The main objectives of the research have been successfully achieved. The first objective of the study is achieved by collecting rainfall data from Jabatan Pengairan dan Saliran, JPS. After done collecting data, all the data had been analysis by their maximum and total average monthly of rainfall for 10 years duration for each station. After that, the comparison data between the calculation of Rainfall Intensity and the maximum of rainfall data from JPS was made to know the between of the value of rainfall either in large different or not much different. Besides that from the analysis of the data, the highest Station with 21166 mm of total annual rainfall is in Station 3330109 Kampung Batu Gong. The data had been analysis from 2008 until 2017 with 10 years duration at 3 rainfall hydrology stations. Then, the additional analysis is achieved by analyse the rainfall intensity for the nearest hydrology station with Station 3330109 Kampung Batu Gong, then the data was be analyse by using procedure in MSMA2 method for rainfall intensity for Storm Duration and Average Rainfall Intensity result.

Later, the second objective of the study is to determine analysis flow rate and rainfall at Sungai Chini (Navigation Lock) and Sungai Jemberau. From the analysis the highest flow rate is 4.382 m^3/s which is at Sungai Chini (Navigation Lock). While, the lowest flow rate also at Sungai Chini (Navigation Lock) with 0.0 m^3/s. Refer chart from previous chapter, From Chart 4.12 above the highest flow rate is 4.382 m^3/s which is at Sungai Chini (Navigation Lock) which is on 17th of May 2017. While, the lowest flow rate also at Sungai Chini (Navigation Lock) with 0.0 m^3/s which is on 24th of November 2016.

5.2 Recommendation

The recommendations of this study are further research need to be conducted in order to get more precise result to get more reliable results, the following actions are proposed:

1. Collect more on maximum rainfall data for selected intervals until latest year and develop IDF curve for every 10 years based on the raw data that collected.

2. Compare the all IDF curve that develop for 10 years based on the shape of IDF curve and intensity value that obtain from calculation.

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APPENDIX A

RAINFALL DATA AT STATION 3330109

Station 3330109 2008

Daily totals Year 2008 site 3330109 KG. BATU GONG at PAHANG
Rain mm

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	?	?	?	?	?	?	2.0	0.0	0.0	0.0	0.0	0.0
2	?	?	?	?	?	?	0.5	0.0	9.5	0.0	75.5	0.0
3	?	?	?	?	?	?	0.0	0.0	1.5	20.0	2.5	0.0
4	?	?	?	?	?	?	29.5	0.0	8.0	8.0	0.0	1.5
5	?	?	?	?	?	?	0.5	0.0	6.0	25.0	0.0	0.0
6	?	?	?	?	?	?	0.0	0.0	12.5	0.0	14.5	0.5
7	?	?	?	?	?	?	0.0	0.0	0.0	0.0	0.0	5.5
8	?	?	?	?	?	?	0.0	28.0	0.0	0.0	0.0	49.5
9	?	?	?	?	?	?	2.0	0.0	0.0	0.0	2.5	41.0
10	?	?	?	?	?	?	19.0	18.5	0.0	11.5	0.0	0.0
11	?	?	?	?	?	?	22.0	0.5	0.0	0.0	1.0	0.0
12	?	?	?	?	?	?	0.0	7.5	0.0	0.0	0.0	0.0
13	?	?	?	?	?	?	0.0	1.0	0.0	28.0	0.5	0.0
14	?	?	?	?	?	?	28.0	0.0	2.0	0.0	0.0	1.0
15	?	?	?	?	?	?	0.0	3.0	0.5	0.5	3.0	3.0
16	?	?	?	?	?	?	0.0	4.0	14.5	0.0	6.5	0.0
17	?	?	?	?	?	?	0.0	1.5	0.5	13.5	0.0	0.0
18	?	?	?	?	?	?	0.0	31.0	0.0	0.0	1.0	0.0
19	?	?	?	?	?	?	8.0	52.0	5.0	19.0	2.5	0.0
20	?	?	?	?	?	?	11.5	0.0	1.5	13.0	30.5	0.0
21	?	?	?	?	?	?	0.0	0.0	0.0	0.5	6.0	0.0
22	?	?	?	?	?	?	0.0	0.0	0.0	18.5	0.0	0.0
23	?	?	?	?	?	?	56.0	0.0	0.0	22.5	0.0	0.0
24	?	?	?	?	?	?	10.5	15.5	0.0	15.0	5.5	0.0
25	?	?	?	?	?	?	0.0	5.0	0.0	0.0	2.5	0.0
26	?	?	?	?	?	0.0	75.5	0.0	0.0	0.0	30.0	0.5
27	?	?	?	?	?	0.0	36.5	0.0	6.0	1.5	1.5	4.0
28	?	?	?	?	?	0.0	0.0	32.0	0.0	0.0	0.0	16.0
29	?	?	?	?	?	7.5	0.0	0.0	0.0	0.0	0.0	39.0
30	?		?	?	?	3.5	0.0	0.0	3.5	0.0	0.0	0.5
31	?		?		?		0.0	2.0		0.0		25.5

Station 3330109 2009

Daily totals Year 2009 site 3330109 KG. BATU GONG at PAHANG
Rain mm

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	2.0	0.0	38.5	0.5	20.5	0.0	0.0	0.0	13.5	15.0	0.0	2.0
2	88.5	0.0	2.5	0.0	0.0	0.0	0.0	0.0	3.0	3.5	0.0	3.5
3	16.0	0.0	2.5	0.0	1.0	1.0	0.0	0.0	0.0	23.0	0.5	2.5
4	60.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	35.5
5	0.0	0.0	6.0	8.0	0.0	0.0	3.5	0.0	3.5	0.5	35.0	104.0
6	1.0	0.0	14.0	0.0	0.0	3.0	6.5	55.0	6.0	1.0	24.0	21.5
7	0.0	0.0	5.5	0.0	0.0	0.0	0.0	0.0	0.0	17.5	4.5	0.5
8	0.0	0.0	42.5	0.5	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0
9	0.0	0.0	22.5	0.5	81.5	0.0	0.0	0.0	19.5	0.0	15.0	1.0
10	0.0	0.0	22.5	5.0	0.5	0.0	0.0	3.0	0.0	0.0	5.5	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0	3.0	46.5	20.5	1.0	0.5	0.0
12	0.0	0.0	0.0	0.5	0.5	8.5	0.0	0.0	1.0	9.5	0.0	0.0
13	0.0	0.0	0.0	0.5	0.0	2.5	0.0	1.0	0.0	12.0	18.5	0.0
14	0.0	0.0	1.5	0.0	0.0	7.0	0.0	0.0	17.5	20.0	12.0	0.0
15	0.0	59.0	2.5	16.5	0.0	1.5	0.0	0.0	0.0	0.0	1.5	1.5
16	0.5	0.0	20.5	5.0	0.0	1.0	0.0	1.0	0.0	21.0	0.0	0.5
17	0.0	0.0	0.0	0.0	4.0	0.5	0.0	2.0	0.5	33.0	2.0	7.0
18	0.0	0.0	0.0	0.0	20.0	0.0	0.0	0.0	8.0	13.0	0.0	3.0
19	0.0	0.0	0.0	0.5	0.0	0.0	0.0	2.0	0.0	0.5	0.0	59.0
20	0.0	0.0	0.0	7.0	0.0	0.0	0.0	0.0	6.0	0.0	8.5	42.0
21	0.0	0.0	46.0	13.0	0.0	0.0	0.0	12.0	11.0	0.0	9.5	31.5
22	0.0	0.0	0.0	0.0	1.5	0.0	12.0	3.5	0.0	0.0	14.5	7.0
23	0.0	0.0	0.0	0.0	3.5	0.5	0.0	105.5	0.0	0.0	3.0	9.0
24	0.0	0.5	0.0	0.0	0.5	12.5	0.0	24.5	1.0	1.5	1.5	1.0
25	0.0	0.5	27.5	13.0	0.0	15.0	0.0	1.0	0.0	24.5	10.5	2.0
26	6.0	0.0	0.0	0.0	0.5	0.0	12.0	2.0	0.0	0.5	9.5	2.5
27	0.0	0.0	17.5	0.0	1.5	0.0	1.5	2.5	0.0	8.0	12.5	45.5
28	0.0	0.0	7.5	13.5	0.0	30.0	8.0	13.5	2.5	67.0	0.5	3.5
29	0.0		17.5	2.0	8.5	1.5	4.5	0.5	0.0	62.5	5.5	0.5
30	0.0		4.5	0.0	2.5	20.5	5.0	0.0	0.0	0.0	0.5	0.0
31	0.0		8.5		0.5		0.0	0.0		0.0		0.0

Station 3330109 2010

Daily totals Year 2010 site 3330109 KG. BATU GONG at PAHANG
Rain mm

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	23.5	0.0	4.0	0.0	0.5
2	16.5	0.0	0.0	1.5	0.0	0.0	4.5	0.0	0.0	1.5	0.0	0.5
3	45.5	0.0	0.0	0.5	0.0	0.0	2.0	0.5	1.5	10.5	2.0	3.0
4	13.5	0.0	0.0	0.0	0.0	0.0	79.5	15.5	0.0	0.0	0.0	5.0
5	1.0	0.0	0.0	1.5	0.0	2.0	0.0	0.5	2.5	7.0	0.5	17.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	37.5	58.0
7	4.5	0.0	0.0	3.0	0.0	16.0	0.0	0.0	21.5	33.5	17.5	26.0
8	0.5	0.0	0.0	0.0	0.0	0.0	4.5	0.0	27.0	0.0	2.0	0.0
9	0.0	0.0	0.0	6.0	0.0	2.0	6.5	0.0	0.5	6.5	0.0	0.5
10	0.0	0.0	0.0	0.5	0.5	5.0	19.5	0.0	6.0	8.5	1.0	0.0
11	0.0	0.0	3.5	0.5	0.0	0.0	0.0	0.0	0.5	0.5	0.5	0.0
12	0.0	0.0	6.0	0.0	0.0	0.0	10.0	1.0	0.0	0.0	8.0	0.0
13	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.5	0.0
14	0.0	0.0	21.5	0.0	2.0	0.0	0.0	2.5	0.5	0.0	22.0	8.5
15	2.0	0.0	0.0	0.0	2.5	27.0	0.0	0.0	41.5	0.5	0.0	1.5
16	0.5	0.0	0.0	0.0	0.0	0.5	0.0	1.0	0.5	0.0	0.0	45.0
17	0.0	0.0	0.0	0.0	100.0	0.5	0.0	31.5	51.5	0.0	0.0	9.0
18	0.0	2.5	0.5	58.5	0.0	0.0	0.0	0.0	10.0	0.0	0.0	7.0
19	0.0	0.5	12.0	0.0	1.5	0.0	2.5	23.5	22.0	0.0	0.0	1.0
20	0.0	0.0	63.5	44.0	1.0	1.0	0.0	0.0	1.5	0.0	76.5	32.0
21	0.0	1.0	12.5	3.0	0.0	52.0	0.0	0.0	0.5	0.0	2.0	6.5
22	0.0	0.0	0.0	4.5	0.0	6.0	0.0	0.0	0.0	4.5	23.0	3.0
23	0.0	0.0	0.0	0.0	37.5	12.5	23.5	7.5	0.0	0.0	0.5	0.0
24	0.0	0.0	20.5	0.0	0.0	0.0	0.0	15.5	0.0	0.0	72.0	6.0
25	0.0	0.0	0.0	0.5	0.0	21.5	0.0	0.0	9.5	47.0	3.0	0.0
26	0.0	0.0	0.0	4.0	0.0	0.0	58.5	0.0	0.0	0.5	3.5	0.0
27	28.0	0.0	0.0	2.5	8.5	23.0	0.0	22.0	4.5	0.0	1.5	0.0
28	0.0	0.0	0.0	14.5	0.0	0.0	0.0	1.5	1.0	10.0	5.0	4.5
29	0.5		0.0	0.0	9.0	0.5	0.0	0.0	2.0	31.0	16.5	17.5
30	0.0		0.0	8.0	2.5	82.5	50.5	1.5	21.5	3.5	17.5	44.5
31	0.0		0.0		1.0		0.5	0.5		0.5		16.0

Station 3330109 2011

Daily totals Year 2011 site 3330109 KG. BATU GONG at PAHANG
Rain mm

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	58.5	29.5	0.0	23.5	10.5	39.5	0.0	0.0	0.0	9.0	0.0	0.5
2	94.5	1.0	0.0	0.5	33.5	0.5	0.0	0.0	2.5	3.5	0.0	0.5
3	23.5	1.0	0.0	0.5	10.5	0.5	1.5	0.0	4.5	1.0	0.4	0.0
4	6.5	0.5	0.0	0.5	3.5	0.0	0.4	0.0	0.0	14.5	0.6	0.0
5	0.0	0.0	0.0	1.5	3.0	9.5	4.1	0.0	0.0	0.0	16.5	15.5
6	3.5	0.0	11.0	0.0	0.0	0.0	0.0	0.0	1.0	3.0	0.0	0.5
7	32.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.5
8	5.0	0.0	30.0	0.0	0.0	0.0	6.0	0.0	19.5	88.0	0.0	0.5
9	0.0	0.0	5.5	0.0	0.0	44.0	0.0	2.0	2.0	0.0	0.0	0.0
10	2.0	0.0	35.5	0.0	0.0	0.0	0.0	17.0	17.0	14.0	0.0	0.0
11	8.5	0.0	33.0	11.0	0.0	9.0	0.0	3.5	8.0	1.5	0.0	84.0
12	0.0	0.0	214.5	0.0	0.0	0.0	0.0	0.0	0.5	0.5	0.0	86.0
13	1.0	0.0	4.0	0.0	0.0	10.0	0.0	0.0	39.0	0.0	12.5	2.0
14	0.0	0.0	0.0	0.0	1.5	0.5	0.0	0.0	0.5	0.0	2.5	0.0
15	7.0	0.0	6.5	0.0	7.0	0.0	0.0	0.0	5.0	0.0	0.0	0.0
16	0.0	3.5	1.0	0.0	0.5	48.0	27.5	0.0	36.5	0.0	0.0	0.0
17	0.0	0.0	0.0	26.5	3.5	0.0	0.0	0.5	2.5	14.5	0.0	31.5
18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	31.0	9.5	0.5	41.0
19	0.0	0.5	1.0	8.5	4.0	0.0	0.0	0.0	15.0	4.5	0.0	70.5
20	0.0	0.5	12.5	3.5	2.5	0.0	0.0	0.0	38.0	36.0	0.0	6.0
21	0.0	0.0	61.0	11.5	0.5	0.0	0.0	17.0	12.5	2.0	23.0	2.5
22	0.0	0.0	0.0	0.0	2.5	0.0	0.5	0.0	16.0	12.0	4.0	37.5
23	0.0	0.0	5.0	0.0	0.5	9.5	10.0	5.5	0.0	4.0	148.0	185.5
24	0.0	0.0	0.0	0.0	0.0	0.0	2.5	0.0	0.0	3.0	27.5	23.0
25	12.5	0.0	0.0	0.0	19.0	0.0	25.0	1.0	0.0	4.5	46.5	19.0
26	36.5	0.0	1.5	0.0	0.5	0.0	0.0	1.5	0.0	1.0	0.0	1.5
27	19.5	0.0	0.0	0.0	0.0	0.5	0.0	0.5	43.5	23.5	3.0	0.0
28	67.5	0.0	59.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	6.0	0.0
29	10.0		41.0	27.5	10.0	0.0	0.5	53.5	0.0	22.0	10.5	1.5
30	77.0		7.5	0.0	0.0	1.0	0.0	0.0	13.0	4.0	0.5	0.0
31	34.0		0.5		0.0		0.0	0.0		0.0		0.0

Station 3330109 2012

Daily totals Year 2012 site 3330109 KG. BATU GONG at PAHANG
Rain mm

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	57.0	2.0	10.0	0.5	0.0	8.5	0.0	0.0	0.0	15.5	27.0	0.0
2	0.5	3.0	0.5	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	73.5	4.0	21.0	2.5	77.0	18.5	12.0	0.5	0.0	0.0	3.5	4.0
4	0.5	44.5	19.5	12.0	0.0	40.0	0.5	0.0	36.0	0.0	18.0	6.0
5	0.0	0.0	0.0	0.0	48.5	0.0	0.0	0.0	0.0	3.0	4.5	5.5
6	0.0	0.0	0.5	0.0	0.0	3.0	0.0	18.0	0.0	0.5	26.5	0.0
7	0.0	0.5	5.5	47.0	25.5	0.5	0.5	0.0	0.0	14.0	0.5	0.0
8	0.5	0.0	8.5	0.0	8.0	0.5	33.5	0.0	32.0	22.5	0.0	0.5
9	1.5	0.0	35.5	0.5	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0
10	0.5	0.0	2.5	12.0	0.0	0.0	16.5	0.0	33.0	0.0	0.5	0.0
11	4.5	0.0	1.0	2.5	0.0	0.0	4.0	0.0	0.0	0.0	30.0	65.0
12	1.5	0.0	1.5	1.5	4.5	0.0	0.0	0.0	50.0	3.0	28.5	0.0
13	44.5	2.5	10.5	1.5	0.5	0.0	0.0	0.0	7.5	5.5	15.0	13.5
14	4.5	4.5	10.5	84.0	0.0	0.0	0.0	0.0	0.0	6.0	1.5	1.0
15	5.0	0.0	0.5	0.0	8.0	0.0	0.0	0.0	0.0	59.0	0.0	15.5
16	0.0	0.0	13.0	4.0	0.0	0.0	9.5	2.5	0.0	2.0	1.0	28.5
17	0.0	21.0	0.0	29.0	6.5	0.0	6.0	0.0	24.0	2.5	0.0	4.5
18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0	5.0	5.0	3.0	41.5
19	0.0	16.0	0.0	0.0	0.0	0.0	0.0	17.0	0.5	0.5	0.5	23.5
20	2.5	0.5	8.0	0.0	0.0	0.0	19.5	0.0	0.0	0.0	44.0	0.0
21	26.5	0.0	0.0	1.0	25.5	0.0	0.0	42.5	18.5	3.5	0.5	3.0
22	0.0	1.5	5.5	0.0	0.0	0.0	0.0	0.0	30.5	20.0	0.0	8.5
23	0.0	0.0	0.5	5.0	5.0	0.0	0.0	0.0	25.5	2.5	21.5	0.0
24	0.0	0.0	11.5	0.0	0.0	0.0	0.0	0.0	0.5	0.0	57.0	23.0
25	0.0	7.0	0.0	0.0	0.0	7.0	0.0	0.0	9.0	0.0	20.5	56.5
26	0.0	0.0	0.0	0.0	0.0	27.5	0.0	0.0	0.5	0.0	0.5	30.5
27	0.5	0.0	0.0	31.5	0.5	0.5	0.0	12.0	0.0	0.0	0.5	6.5
28	3.5	11.5	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	18.0
29	0.0	0.5	0.0	0.0	5.5	0.0	0.0	1.0	0.0	0.0	5.5	5.5
30	0.0		17.5	0.0	7.5	0.0	0.0	25.5	0.0	0.0	0.5	0.0
31	0.0		37.0		0.0		0.0	30.0		0.5		32.0

Station 3330109 2013

Daily totals Year 2013 site 3330109 KG. BATU GONG at PAHANG
Rain mm

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	16.5	0.0	7.0	0.0	30.0	6.5	1.5	0.0	1.5	0.5	0.5	65.0
2	0.0	0.0	0.5	0.0	7.5	0.0	0.0	0.0	1.0	3.5	0.0	68.0
3	5.5	7.5	0.0	0.0	0.5	5.0	0.0	0.0	0.0	0.0	0.0	286.5
4	0.0	42.0	0.0	14.0	24.5	0.0	22.5	0.0	0.5	20.0	0.0	74.0
5	0.0	121.0	0.0	2.0	9.0	45.5	49.5	0.0	0.5	2.5	0.0	7.5
6	0.5	19.5	1.5	25.5	0.0	3.0	0.0	3.0	0.0	0.0	6.0	22.0
7	0.0	0.5	6.0	30.0	0.5	0.0	0.0	6.5	67.5	0.0	0.0	64.0
8	0.0	0.0	0.5	0.0	30.0	7.5	0.0	0.0	4.5	0.0	0.0	33.0
9	0.0	3.5	0.0	12.5	1.0	0.0	6.0	11.0	17.0	2.5	3.0	1.0
10	1.5	0.5	2.5	25.5	0.5	5.5	0.0	0.0	0.0	25.5	0.0	0.0
11	0.5	23.0	0.5	2.5	30.0	0.0	0.0	0.0	7.0	0.0	36.5	1.0
12	0.0	0.0	0.0	6.5	0.0	10.5	0.5	0.0	2.0	82.0	1.0	?
13	0.0	33.0	0.0	0.5	0.0	0.0	0.0	0.0	0.5	35.0	0.0	?
14	16.5	25.0	0.0	1.0	0.0	0.0	1.0	0.0	37.0	7.5	0.0	?
15	0.0	49.5	0.0	4.0	22.0	0.0	0.0	0.0	6.5	2.5	0.0	?
16	0.0	18.5	0.0	0.5	24.0	0.0	0.0	6.5	0.0	0.0	0.0	?
17	0.0	38.0	0.0	0.0	0.0	0.0	1.0	36.0	0.5	0.0	6.0	?
18	0.0	14.0	0.0	0.0	20.5	0.0	49.5	0.5	16.0	0.0	0.0	?
19	37.0	0.0	0.0	12.0	0.0	0.0	0.5	0.5	0.0	0.5	1.5	?
20	15.5	0.0	0.0	4.0	73.5	0.0	0.0	0.5	31.0	26.0	9.0	?
21	31.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.5	1.5	?
22	24.0	0.0	0.0	30.0	0.5	0.0	0.0	0.0	0.0	15.0	0.0	?
23	9.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	1.0	13.5	?
24	4.5	0.0	0.0	0.0	3.0	0.0	0.0	0.0	0.0	0.0	10.5	?
25	0.0	0.5	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	1.0	?
26	0.0	1.0	52.5	9.5	55.0	0.0	6.5	0.0	0.0	5.0	13.0	?
27	0.0	22.5	0.5	0.0	36.0	0.0	0.5	5.5	0.0	0.0	0.5	?
28	0.0	13.5	0.0	46.0	22.5	0.0	0.0	1.5	0.0	2.5	12.5	?
29	0.0		0.0	1.5	22.5	1.5	0.0	57.5	1.0	9.0	4.0	?
30	0.0		0.0	4.0	0.0	15.0	11.5	1.5	0.5	1.0	4.0	?
31	0.0		0.0		0.0		0.5	0.0		43.5		?

Station 3330109 2014

Daily totals Year 2014 site 3330109 KG. BATU GONG at PAHANG
Rain mm

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	?	0.0	0.0	0.0	26.5	0.0	59.5	0.5	0.5	21.0	88.0	5.5
2	?	0.0	0.0	0.0	0.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0
3	?	0.0	0.0	0.0	40.0	0.0	32.5	11.5	0.0	0.0	0.0	1.5
4	?	0.0	0.0	7.0	0.0	0.0	0.0	0.5	0.0	68.0	0.5	14.0
5	?	0.0	0.0	10.0	0.0	59.0	0.0	0.0	14.0	9.5	0.0	0.0
6	?	0.0	0.0	0.0	2.5	0.5	0.0	0.0	6.5	0.0	0.0	38.0
7	?	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.5	0.0	36.0	0.0
8	?	0.0	0.0	0.0	23.0	0.0	0.0	8.5	0.0	28.5	20.5	28.0
9	?	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.0	0.5
10	?	0.0	0.0	3.0	1.0	0.0	0.0	0.0	0.0	0.0	14.0	0.0
11	?	0.0	0.0	3.0	15.0	1.0	24.0	0.0	18.5	3.0	2.0	0.0
12	?	0.0	0.0	0.0	18.0	5.5	20.0	0.0	4.5	62.0	0.0	0.0
13	?	0.0	0.0	0.0	45.5	0.0	0.0	1.0	37.0	0.0	0.5	0.0
14	?	0.0	0.0	0.0	0.0	0.0	0.0	13.5	0.0	0.5	11.5	0.0
15	?	0.0	0.0	0.0	0.0	0.0	0.0	36.0	0.0	0.0	1.5	0.5
16	?	0.0	8.5	0.0	92.0	0.0	2.5	0.5	0.0	0.0	18.5	9.5
17	?	0.0	36.0	0.0	60.0	0.0	0.0	15.5	0.0	0.0	8.0	70.5
18	?	0.0	1.5	0.0	28.0	0.0	0.0	0.0	0.0	0.0	3.0	30.5
19	?	0.0	6.0	18.5	1.0	0.0	0.0	5.0	0.0	16.5	13.5	9.5
20	?	0.0	0.0	0.0	9.0	0.0	0.0	40.0	15.5	0.0	0.0	15.0
21	?	0.0	3.0	12.0	3.5	0.0	0.0	25.0	5.0	2.5	0.0	4.0
22	?	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	3.5	0.0	52.0
23	?	0.0	0.0	0.0	112.5	0.0	40.5	0.0	0.0	6.5	0.0	245.5
24	?	0.0	0.0	0.0	0.0	0.0	0.0	8.0	0.0	0.0	3.5	119.0
25	?	0.0	1.0	0.0	0.0	0.0	0.0	6.0	0.0	0.0	0.5	41.0
26	0.0	0.0	0.0	0.0	1.0	0.0	0.0	1.5	41.0	1.0	0.0	33.0
27	0.0	0.0	0.0	6.0	0.0	0.0	1.5	0.0	0.0	6.5	72.5	78.5
28	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	16.5	0.0	0.0
29	0.0		0.0	0.0	5.5	0.0	6.5	0.0	?	0.0	0.5	102.0
30	0.0		66.5	1.0	0.0	1.0	27.5	0.0	?	0.0	1.0	82.5
31	0.0		0.0		4.0		0.5	0.0		0.0		0.5

Station 3330109 2015

Daily totals Year 2015 site 3330109 KG. BATU GONG at PAHANG
Rain mm

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0.0	0.0	0.0	25.0	10.0	0.0	?	5.5	0.0	0.0	2.0	0.5
2	0.0	0.0	0.0	0.5	0.0	0.0	?	0.0	0.0	0.0	22.5	0.0
3	0.0	0.0	0.0	3.5	47.0	0.0	?	7.5	0.0	5.0	0.0	8.0
4	0.0	6.5	0.0	0.0	0.0	0.0	?	7.0	0.0	0.0	0.0	0.0
5	0.0	8.5	0.0	0.0	15.5	1.5	?	0.0	0.0	0.0	13.0	22.0
6	0.5	0.5	0.0	0.0	0.0	0.0	?	2.0	0.0	0.0	14.5	29.5
7	6.0	1.0	0.0	0.0	0.0	0.0	?	9.0	0.0	2.0	42.5	8.0
8	60.0	0.0	0.0	0.0	0.0	0.0	?	0.0	1.5	0.0	0.0	26.5
9	40.0	0.0	0.0	0.0	0.5	21.0	0.0	0.0	1.0	0.0	9.0	39.0
10	23.5	0.0	0.0	2.5	63.0	9.0	0.0	0.0	27.5	0.0	0.0	1.5
11	2.0	0.0	0.0	0.0	1.5	0.0	0.0	11.5	0.0	0.0	0.5	0.0
12	2.0	0.0	0.0	0.0	0.0	?	0.0	50.5	0.0	0.0	2.0	13.5
13	0.0	0.0	0.0	0.0	0.0	?	0.0	0.5	0.0	0.0	0.0	23.0
14	0.0	0.0	0.0	0.0	0.0	?	0.0	0.0	2.0	0.0	1.5	0.5
15	0.0	0.0	0.0	0.0	0.0	?	0.0	0.0	0.0	0.0	12.5	0.0
16	0.0	0.0	0.0	0.0	0.0	?	0.0	0.0	0.0	0.0	7.0	0.0
17	0.0	0.0	0.0	0.0	0.0	?	49.5	0.0	6.0	0.0	7.5	0.0
18	0.0	0.0	0.0	0.0	7.5	?	1.0	2.0	5.5	0.0	0.0	6.0
19	0.0	0.0	0.0	0.0	0.0	?	0.0	0.0	0.0	20.0	0.0	3.0
20	0.0	0.5	0.0	1.0	24.5	?	0.5	0.0	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0	?	0.0	0.0	0.0	0.0	7.0	0.0
22	0.0	0.0	0.5	16.5	0.0	?	18.5	0.0	23.5	0.0	0.0	0.0
23	0.0	0.0	0.0	0.5	0.5	?	0.0	19.5	26.5	0.0	18.0	0.0
24	0.0	0.0	0.0	0.0	0.0	?	0.0	4.0	0.0	0.0	18.0	0.5
25	0.0	0.0	0.0	3.5	0.0	?	0.0	8.5	0.0	3.0	0.0	0.0
26	0.0	0.0	19.5	0.0	0.0	?	0.0	0.0	0.0	2.0	6.0	0.0
27	0.0	0.0	0.5	6.0	1.0	?	0.5	5.5	0.0	17.5	12.0	0.0
28	0.0	0.0	7.5	4.0	0.0	?	8.0	1.0	0.0	1.0	3.5	28.5
29	0.0		0.0	0.0	6.5	?	0.0	0.0	0.0	1.5	6.0	64.5
30	17.5		1.0	0.0	0.5	?	0.0	0.0	0.0	0.5	9.0	0.0
31	0.0		12.5		0.5		0.0	3.5		13.0		0.0

Station 3330109 2016

Daily totals　　Year 2016　　site 3330109 KG. BATU GONG at PAHANG
Rain mm

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	51.5	0.0	0.5	0.0	0.0	0.5	29.5	0.0	1.0	4.0	0.0	1.5
2	26.5	0.0	0.0	0.0	0.0	0.5	0.0	0.0	1.0	0.0	0.0	1.0
3	3.5	15.5	0.0	0.0	1.0	0.0	0.0	0.0	1.0	0.0	4.5	1.0
4	0.0	10.5	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.5
5	0.0	40.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	22.0	1.0
6	0.0	42.5	1.5	0.0	26.5	0.0	10.0	0.0	0.5	44.5	3.5	0.5
7	0.0	24.0	0.0	0.0	0.0	6.0	0.0	0.5	0.0	1.5	7.0	1.0
8	0.0	7.0	0.0	0.0	0.0	0.0	0.0	5.5	0.5	0.0	0.5	?
9	0.0	0.0	0.0	0.0	9.5	0.0	0.0	0.0	21.5	0.0	?	49.5
10	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	3.0	45.0	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	2.5	27.5	6.5	9.5
12	0.0	0.0	0.0	0.0	11.0	133.0	0.0	0.0	2.5	?	1.0	0.0
13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.0	0.0	0.0
14	0.0	0.0	0.0	34.0	11.0	0.0	0.0	0.0	12.0	0.0	0.0	0.0
15	0.5	0.0	0.0	0.0	0.0	51.0	4.5	0.0	0.0	0.0	34.5	14.0
16	12.0	4.0	0.0	0.5	11.5	0.5	18.0	0.0	4.5	0.5	0.5	0.0
17	0.0	0.0	0.0	0.0	0.0	8.5	3.5	0.0	0.0	2.5	0.0	0.5
18	0.0	3.0	0.0	0.0	0.0	0.0	6.5	0.0	1.0	0.0	0.5	0.0
19	0.0	8.5	0.0	0.0	0.0	2.5	0.0	0.0	0.0	0.0	0.5	0.5
20	0.0	23.5	0.0	0.0	0.0	0.0	34.5	40.5	0.0	2.0	14.5	2.0
21	0.0	0.0	0.0	0.0	0.0	0.0	57.0	35.5	0.0	0.0	20.0	19.5
22	25.0	0.0	0.0	0.0	1.0	13.0	0.0	2.0	1.5	0.5	1.5	0.0
23	5.0	0.0	0.0	0.0	1.0	0.5	0.0	1.0	0.0	1.0	1.5	0.0
24	6.0	0.0	0.0	0.0	0.5	0.0	0.0	2.0	14.0	79.5	1.0	14.5
25	2.5	0.0	0.0	0.0	0.5	12.0	8.0	0.0	37.0	0.0	2.0	1.5
26	11.0	0.0	0.0	10.0	0.5	0.0	0.0	11.5	0.0	7.5	2.0	34.5
27	5.5	0.0	0.0	0.0	0.5	0.0	2.5	0.0	31.0	2.5	1.5	0.5
28	1.0	0.0	0.0	0.0	0.5	0.0	0.5	0.0	28.5	2.5	1.5	1.0
29	0.0	6.5	28.0	0.0	0.0	0.0	0.0	6.5	0.0	15.0	1.0	0.0
30	0.0		0.5	0.0	0.5	0.0	0.0	15.0	0.0	12.5	1.0	0.0
31	0.0		0.0		0.0		0.0	3.5		1.0		0.0

Station 3330109 2017

Daily totals Year 2017 site 3330109 KG. BATU GONG at PAHANG
Rain mm

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	6.5	0.0	22.5	?	2.0	?	?	?	?	?	?	?
2	17.5	0.0	34.0	?	11.5	?	?	?	?	?	?	?
3	26.0	0.0	24.0	?	0.0	?	?	?	?	?	?	?
4	0.0	0.0	49.0	?	0.0	?	?	?	?	?	?	?
5	0.0	2.5	0.5	?	?	?	?	?	?	?	?	?
6	6.5	14.0	0.0	?	?	?	?	?	?	?	?	?
7	2.5	0.0	0.0	?	?	?	?	?	?	?	?	?
8	8.0	0.0	?	?	?	?	?	?	?	?	?	?
9	0.0	?	?	?	?	?	?	?	?	?	?	?
10	?	0.5	0.0	?	?	?	?	?	?	?	?	?
11	0.0	0.0	0.0	1.5	?	?	?	?	?	?	?	?
12	4.0	0.0	0.0	0.0	?	?	?	?	?	?	?	?
13	0.0	6.5	0.0	0.0	?	?	?	?	?	?	?	?
14	0.5	3.0	0.0	2.0	?	?	?	?	?	?	?	?
15	9.0	5.0	0.0	6.0	?	?	?	?	?	?	?	?
16	44.0	2.0	?	0.0	?	?	?	?	?	?	?	?
17	0.0	9.0	?	0.0	?	?	?	?	?	?	?	?
18	12.0	1.0	?	0.0	?	?	?	?	?	?	?	?
19	4.5	0.0	?	0.5	?	?	?	?	?	?	?	?
20	0.0	0.5	?	71.5	?	?	?	?	?	?	?	?
21	27.0	0.0	?	2.0	?	?	?	?	?	?	?	?
22	19.5	0.0	?	27.5	?	?	?	?	?	?	?	?
23	20.5	0.5	?	1.0	?	?	?	?	?	?	?	?
24	134.0	0.0	?	5.0	?	?	?	?	?	?	?	?
25	192.0	0.0	?	29.0	?	?	?	?	?	?	?	?
26	30.0	0.0	?	10.0	?	?	?	?	?	?	?	?
27	27.0	0.5	?	0.0	?	?	?	?	?	?	?	?
28	5.0	91.0	?	0.0	?	?	?	?	?	?	?	?
29	0.0		?	2.5	?	?	?	?	?	?	?	?
30	0.0		?	0.0	?	?	?	?	?	?	?	?
31	0.0		?		?		?	?		?		?

APPENDIX B

RAINFALL DATA AT STATION 3430097

Station 3430097 2012

Daily totals   Year 2012   site 3430097 PAYA MEMBANG at PAHANG
Rain mm

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	?	?	?	?	?	?	?	?	0.0	18.0	22.0	0.0
2	?	?	?	?	?	?	?	?	0.0	0.0	0.0	0.0
3	?	?	?	?	?	?	?	6.0	0.0	0.0	2.5	23.5
4	?	?	?	?	?	?	?	0.0	0.0	0.5	22.5	8.0
5	?	?	?	?	?	?	?	0.0	0.0	5.0	8.5	2.5
6	?	?	?	?	?	?	?	25.5	0.0	2.0	10.0	0.0
7	?	?	?	?	?	?	?	0.0	0.0	8.0	0.5	8.5
8	?	?	?	?	?	?	?	0.0	0.0	4.5	0.0	0.0
9	?	?	?	?	?	?	?	0.0	0.0	0.0	0.0	0.0
10	?	?	?	?	?	?	?	0.0	4.5	0.0	0.0	0.0
11	?	?	?	?	?	?	?	0.0	0.0	0.0	13.0	11.0
12	?	?	?	?	?	?	?	0.0	18.0	7.5	53.0	0.0
13	?	?	?	?	?	?	?	0.0	0.0	16.5	12.5	1.5
14	?	?	?	?	?	?	?	0.0	9.5	26.0	0.0	0.5
15	?	?	?	?	?	?	?	11.5	0.0	59.5	0.0	18.5
16	?	?	?	?	?	?	?	0.0	0.0	0.5	0.5	19.5
17	?	?	?	?	?	?	?	0.0	3.0	2.0	0.0	21.0
18	?	?	?	?	?	?	?	0.0	28.5	0.5	0.0	79.5
19	?	?	?	?	?	?	?	47.5	0.5	0.5	0.0	76.0
20	?	?	?	?	?	?	?	0.0	0.0	0.0	18.0	1.0
21	?	?	?	?	?	?	?	76.0	26.5	5.5	0.0	7.0
22	?	?	?	?	?	?	?	0.0	4.5	7.0	0.0	16.5
23	?	?	?	?	?	?	?	6.0	7.0	2.5	51.5	0.0
24	?	?	?	?	?	?	?	15.0	0.0	0.0	71.5	27.0
25	?	?	?	?	?	?	?	0.0	12.5	0.0	39.0	78.0
26	?	?	?	?	?	?	?	0.0	9.0	0.0	0.5	41.5
27	?	?	?	?	?	?	?	0.0	0.0	1.0	7.5	21.0
28	?	?	?	?	?	?	?	0.5	0.0	0.0	6.0	3.5
29	?	?	?	?	?	?	?	1.0	0.0	0.0	1.0	18.0
30	?		?	?	?	?	?	0.0	0.0	0.0	15.0	0.0
31	?		?		?		?	19.5		0.5		70.0

Station 3430097 2013

Daily totals Year 2013 site 3430097 PAYA MEMBANG at PAHANG
Rain mm

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	22.5	0.0	10.5	0.0	2.0	6.0	1.5	0.0	2.0	0.0	0.5	128.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	78.0
3	15.0	4.0	0.0	0.0	13.0	21.0	0.0	0.0	0.0	0.5	0.0	268.5
4	0.0	2.5	0.0	4.0	0.0	1.5	13.5	0.0	0.5	14.5	5.0	77.5
5	0.0	0.5	0.0	0.0	6.5	1.0	38.5	0.0	15.0	9.5	3.5	11.5
6	3.0	1.0	0.5	33.0	1.5	6.0	0.0	3.0	1.0	0.0	7.0	63.0
7	0.0	1.0	9.5	10.5	3.0	0.0	0.0	1.5	30.0	0.0	0.0	60.0
8	0.0	0.5	6.0	0.0	12.0	1.0	0.0	0.0	3.5	0.0	2.0	47.5
9	0.0	22.0	0.5	0.0	0.0	0.0	8.5	5.5	33.0	4.0	5.5	1.0
10	9.5	0.0	0.0	30.5	3.0	3.0	0.0	0.0	0.0	8.5	0.0	0.0
11	0.0	26.0	0.0	1.5	11.5	0.0	0.0	15.5	0.0	1.0	12.5	6.0
12	0.0	1.0	0.0	36.0	0.0	25.0	0.5	0.0	6.0	106.0	0.0	0.0
13	0.0	64.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	1.5	0.0	0.0
14	1.0	24.5	0.0	12.0	0.0	0.0	2.0	0.0	29.5	12.5	0.0	0.0
15	0.0	10.5	0.0	2.0	30.5	0.0	0.0	0.0	0.5	0.0	0.0	0.0
16	1.0	13.0	0.0	0.0	23.0	0.0	0.0	5.5	0.0	0.0	0.0	14.5
17	0.0	16.5	0.0	0.0	0.0	0.0	0.5	70.0	0.0	0.0	3.5	0.0
18	0.0	6.0	0.0	11.0	2.5	0.0	37.0	0.0	0.0	0.0	1.0	0.0
19	35.5	0.0	0.0	5.5	0.0	0.0	0.0	9.5	0.0	6.5	2.5	6.5
20	8.5	0.0	0.0	0.0	4.5	0.0	0.0	0.0	2.0	5.5	5.0	15.0
21	7.5	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.5	0.0
22	40.0	0.0	0.5	61.5	1.7	0.0	0.0	0.0	0.0	10.5	0.0	0.0
23	9.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30.0	0.5
24	0.5	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.5	0.0
26	0.0	2.5	0.5	32.5	51.5	0.0	33.5	0.0	0.0	13.0	19.5	0.0
27	0.0	23.5	0.0	0.0	7.0	0.5	0.0	0.0	11.0	0.0	0.0	4.0
28	0.0	16.0	0.0	0.0	49.0	0.0	0.0	0.5	0.0	0.0	12.5	0.5
29	0.0		0.0	8.0	12.0	0.0	0.0	21.5	1.0	0.0	4.0	0.0
30	0.0		0.0	0.0	0.0	22.5	0.5	17.0	1.5	0.0	12.5	0.0
31	0.0		0.0		0.0		5.0	17.0		3.0		0.0

Station 3430097 2014

Daily totals Year 2014 site 3430097 PAYA MEMBANG at PAHANG
Rain mm

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0.5	0.0	0.5	0.0	5.0	0.0	48.5	0.5	0.0	8.5	0.0	2.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.5	0.0	0.0	0.0	0.0	0.0	45.0	17.5	0.0	0.0	0.0	2.5
4	11.0	0.0	0.0	43.5	0.0	1.5	0.0	5.0	0.0	47.5	0.5	14.5
5	0.0	0.0	0.0	65.0	0.0	64.5	0.0	0.0	12.0	9.0	0.0	0.0
6	2.0	0.0	0.0	0.0	17.5	0.5	0.0	0.0	1.5	0.0	0.0	25.5
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.5	0.5	0.0	12.0	0.0
8	0.0	0.0	0.0	0.0	6.0	0.0	0.0	17.5	0.0	16.0	0.0	37.0
9	0.0	0.0	0.0	0.0	0.0	0.0	1.5	0.0	0.0	0.0	6.0	9.0
10	72.5	6.5	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	15.5	0.0
11	155.5	0.0	0.0	8.5	21.5	0.0	0.0	0.0	1.0	3.5	15.5	0.0
12	0.0	0.0	0.0	2.5	0.0	0.0	0.0	0.0	5.0	17.5	0.0	0.0
13	4.0	0.0	0.0	0.0	27.0	5.5	0.0	0.0	25.0	0.0	1.0	0.0
14	5.0	0.0	0.0	0.0	0.0	0.0	0.0	7.0	0.0	0.0	12.5	0.0
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	3.0	2.5
16	0.0	0.0	16.0	0.0	1.5	0.0	0.0	5.5	0.0	3.5	0.5	4.5
17	0.0	0.0	32.5	2.5	79.0	0.0	0.4	0.0	0.0	0.0	6.0	69.0
18	0.0	0.0	4.5	0.5	0.5	1.5	0.1	0.0	0.0	0.0	5.0	43.5
19	0.0	0.0	2.5	21.5	2.0	0.0	0.0	3.5	0.0	9.0	16.5	12.5
20	0.0	0.0	0.0	0.0	1.0	0.0	0.0	48.0	0.0	5.0	0.0	4.5
21	0.0	0.0	0.5	45.5	13.0	0.0	0.0	58.0	18.0	1.5	0.0	6.5
22	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.5	0.0	66.5
23	0.0	0.0	0.0	0.0	11.0	0.0	9.0	0.0	0.0	4.5	0.0	234.0
24	0.0	0.0	0.0	0.0	7.0	0.0	0.0	2.5	0.0	0.0	2.0	201.0
25	0.0	0.0	7.0	0.0	0.0	0.0	0.0	13.0	0.0	0.0	0.0	36.0
26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.5	29.0	3.0	0.5	46.0
27	0.0	0.0	0.0	4.5	0.0	14.5	9.0	2.0	0.5	26.5	7.0	79.0
28	0.0	0.0	0.0	9.0	0.0	5.0	0.0	5.5	0.0	0.0	0.0	0.5
29	0.0		0.0	0.0	20.0	22.0	9.0	0.0	0.0	0.0	3.0	118.5
30	0.0		11.5	6.0	0.0	13.5	0.0	0.0	1.5	0.5	1.5	82.0
31	0.0		0.0		30.5		0.0	0.0		10.5		0.0

Station 3430097 2015

Daily totals Year 2015 site 3430097 PAYA MEMBANG at PAHANG
Rain mm

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0.0	0.0	0.0	1.0	14.0	0.0	0.0	8.5	0.0	0.0	2.0	4.0
2	0.0	0.0	0.0	0.0	1.5	0.0	0.0	0.0	0.0	0.0	13.0	3.5
3	0.0	0.0	0.0	0.0	17.0	0.0	0.0	21.5	0.0	6.5	0.0	0.5
4	0.0	9.0	0.0	0.0	0.0	0.0	12.0	17.0	0.0	0.0	0.0	0.0
5	0.0	7.0	0.0	0.0	2.0	14.5	0.0	0.0	0.0	0.0	1.0	0.5
6	0.0	3.5	0.0	0.0	0.0	0.0	0.0	2.5	0.0	0.0	14.5	0.5
7	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	13.0	?
8	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	?
9	2.0	0.0	0.0	0.0	0.0	2.5	0.5	5.0	5.0	0.0	12.0	?
10	1.0	0.0	0.0	0.0	5.5	19.0	0.0	0.0	0.0	0.0	0.0	?
11	0.5	0.0	1.0	9.0	0.0	0.0	0.5	0.0	1.0	0.0	0.0	?
12	0.0	0.0	0.0	0.0	0.5	0.5	0.0	25.0	0.0	0.0	1.5	?
13	0.0	0.0	0.0	0.0	18.5	0.0	4.5	0.0	13.5	1.0	0.0	?
14	0.0	0.0	0.0	0.0	0.0	25.5	0.0	0.0	0.0	0.0	15.0	?
15	0.0	0.0	0.0	0.0	2.5	0.0	0.0	0.0	0.0	0.0	21.5	?
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.0	?
17	0.0	0.0	0.0	0.0	0.0	6.0	31.0	0.0	13.0	0.0	8.5	?
18	0.0	0.0	0.0	0.0	1.5	0.0	1.0	0.0	7.0	0.0	0.0	?
19	0.0	0.0	0.0	0.0	3.5	0.0	0.0	0.0	0.0	5.0	0.0	?
20	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	?
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24.5	?
22	0.0	0.0	0.0	77.0	2.0	0.0	10.5	0.0	52.0	0.0	2.0	?
23	0.0	0.0	0.0	0.0	14.5	0.0	1.0	0.0	37.0	0.0	54.0	?
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.5	0.0	?
25	0.0	0.0	0.0	7.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0	?
26	0.0	0.0	0.5	0.5	0.0	0.0	0.0	0.0	0.0	2.0	5.5	?
27	0.0	0.0	0.0	14.0	6.0	0.0	0.0	3.5	0.0	0.0	18.5	?
28	0.0	0.0	0.0	0.0	1.0	0.0	0.0	2.0	0.0	0.0	4.0	?
29	0.0		0.0	11.0	48.0	0.0	0.0	0.0	0.0	15.0	17.5	?
30	18.5		0.0	0.0	2.0	0.0	3.0	0.5	0.0	0.5	32.0	?
31	0.5		0.0		0.0		0.0	24.5		31.5		?

Station 3430097 2016

Daily totals Year 2016 site 3430097 PAYA MEMBANG at PAHANG
Rain mm

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	?	0.0	0.5	0.0	0.5	0.0	0.5	0.0	0.5	10.0	0.0	0.0
2	?	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.0	0.0	0.0	27.0
3	?	9.0	0.0	0.0	18.5	0.0	0.0	0.0	0.0	0.0	0.0	62.0
4	?	0.5	0.0	0.0	0.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0
5	?	41.5	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0
6	?	29.5	4.0	0.0	3.0	0.0	3.0	0.5	0.0	4.5	0.5	0.0
7	?	18.5	0.0	0.0	0.5	10.5	8.5	0.0	10.5	0.0	0.5	0.0
8	0.0	3.5	0.5	0.0	0.0	0.0	4.0	0.5	0.0	0.0	0.0	2.5
9	0.0	0.0	0.0	0.0	11.5	0.0	0.0	0.0	25.5	0.0	?	?
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.5	0.0	2.5	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	8.0	15.0	0.0	14.0
12	0.0	0.5	0.0	0.0	3.0	57.5	0.0	0.0	4.0	10.0	0.0	0.0
13	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	?	0.0	0.0
14	0.0	7.5	0.0	5.5	6.0	0.0	0.0	0.0	19.0	5.5	0.0	0.5
15	0.0	0.0	0.0	0.0	0.0	14.5	2.0	0.0	1.5	0.0	0.0	51.5
16	4.0	2.0	0.0	0.5	0.0	0.0	0.5	0.0	1.5	19.5	0.0	0.0
17	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	2.0	3.0	0.0	2.5
18	0.0	2.0	0.0	0.0	0.0	0.0	8.0	29.5	0.0	0.0	0.0	0.0
19	0.0	15.0	0.0	0.0	0.0	4.0	0.0	0.0	5.0	0.0	0.0	6.0
20	0.0	26.5	0.0	5.0	0.0	0.0	46.0	33.5	0.0	0.0	0.0	1.5
21	0.0	0.0	0.0	0.0	18.0	0.0	34.5	35.5	0.0	1.0	0.5	44.5
22	13.5	0.0	0.0	0.0	2.5	12.5	0.0	25.0	1.5	0.0	0.0	0.0
23	5.5	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.5	0.0	0.5	0.0
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5	26.0
25	3.0	10.0	0.0	0.0	0.0	0.5	51.0	0.0	38.5	0.0	33.5	1.0
26	20.0	0.0	0.0	7.5	2.0	0.0	0.0	43.5	0.5	0.0	0.0	39.5
27	5.0	2.5	1.5	0.0	0.0	0.0	2.5	0.0	40.0	0.0	3.0	0.0
28	0.0	0.5	10.0	0.0	9.5	0.0	0.0	0.0	42.0	0.5	1.0	0.5
29	0.0	6.5	7.0	0.0	0.0	0.0	0.0	18.5	0.0	0.5	1.0	0.0
30	0.0		0.0	0.0	105.0	0.0	0.0	0.0	0.0	0.0	22.0	0.0
31	0.0		0.0		42.5		0.0	7.0		0.0		0.0

Station 3430097 2017

Daily totals Year 2017 site 3430097 PAYA MEMBANG at PAHANG
Rain mm

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	6.5	0.5	3.0	0.5	21.5	?	?	?	?	?	?	?
2	9.0	0.5	89.5	21.0	5.5	?	?	?	?	?	?	?
3	15.0	0.0	16.0	1.0	0.0	?	?	?	?	?	?	?
4	0.0	0.5	1.5	2.5	0.0	?	?	?	?	?	?	?
5	0.0	0.5	0.0	0.0	?	?	?	?	?	?	?	?
6	0.5	0.0	0.0	0.5	?	?	?	?	?	?	?	?
7	9.5	?	0.0	0.0	?	?	?	?	?	?	?	?
8	0.0	0.5	?	0.0	?	?	?	?	?	?	?	?
9	0.0	0.0	0.0	76.0	?	?	?	?	?	?	?	?
10	?	0.0	0.0	?	?	?	?	?	?	?	?	?
11	0.0	0.0	0.0	0.0	?	?	?	?	?	?	?	?
12	12.5	0.0	0.0	0.0	?	?	?	?	?	?	?	?
13	0.5	8.0	0.0	0.0	?	?	?	?	?	?	?	?
14	0.0	20.5	0.0	5.0	?	?	?	?	?	?	?	?
15	0.0	5.0	0.0	0.0	?	?	?	?	?	?	?	?
16	1.0	9.5	0.0	0.0	?	?	?	?	?	?	?	?
17	2.5	0.0	10.5	0.0	?	?	?	?	?	?	?	?
18	1.0	0.0	3.5	0.0	?	?	?	?	?	?	?	?
19	1.5	0.0	0.0	1.0	?	?	?	?	?	?	?	?
20	1.0	3.0	1.0	40.5	?	?	?	?	?	?	?	?
21	1.5	0.0	2.5	0.5	?	?	?	?	?	?	?	?
22	1.0	0.0	0.0	20.5	?	?	?	?	?	?	?	?
23	1.5	0.0	0.0	0.5	?	?	?	?	?	?	?	?
24	1.5	0.0	0.0	0.0	?	?	?	?	?	?	?	?
25	1.5	35.0	0.0	5.0	?	?	?	?	?	?	?	?
26	1.5	0.0	0.0	2.0	?	?	?	?	?	?	?	?
27	1.5	132.0	1.0	8.5	?	?	?	?	?	?	?	?
28	1.5	7.5	0.5	0.0	?	?	?	?	?	?	?	?
29	1.5		6.0	2.5	?	?	?	?	?	?	?	?
30	1.0		1.5	0.0	?	?	?	?	?	?	?	?
31	1.0		0.5		?		?	?		?		?

APPENDIX C

RAINFALL DATA AT STATION 3429096

Station 3429096 2012

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~~~ NIWA Tideda ~~~ JPS Ampang                              21-NOV-2016 15:35
~~~ PDAY ~~~  VER 1.9
Source is F:\datatideda\MINILOG.mtd
24 hour periods ending at 8:00:00am each day.
Daily totals        Year 2012        site 3429096 KG. SALONG at PAHANG
Rain mm
```

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	?	?	?	?	?	?	?	?	0.0	19.5	11.0	7.0
2	?	?	?	?	?	?	?	?	0.0	0.0	0.0	0.0
3	?	?	?	?	?	?	?	?	0.0	0.0	13.5	1.5
4	?	?	?	?	?	?	?	?	0.5	0.0	13.0	5.5
5	?	?	?	?	?	?	?	?	7.5	4.0	3.5	2.0
6	?	?	?	?	?	?	?	?	4.0	2.0	20.0	0.0
7	?	?	?	?	?	?	?	?	0.0	3.5	0.5	0.5
8	?	?	?	?	?	?	?	?	12.5	3.5	0.0	0.0
9	?	?	?	?	?	?	?	?	0.0	0.0	8.5	0.0
10	?	?	?	?	?	?	?	?	0.5	0.0	0.0	0.0
11	?	?	?	?	?	?	?	?	0.0	25.5	20.0	2.5
12	?	?	?	?	?	?	?	?	18.0	1.0	1.0	0.0
13	?	?	?	?	?	?	?	?	0.0	13.0	32.0	7.5
14	?	?	?	?	?	?	?	0.0	0.0	25.0	20.5	13.0
15	?	?	?	?	?	?	?	22.0	0.0	86.5	0.0	42.0
16	?	?	?	?	?	?	?	0.0	7.0	0.5	0.5	38.0
17	?	?	?	?	?	?	?	0.0	0.5	0.5	0.0	9.5
18	?	?	?	?	?	?	?	0.0	13.5	48.5	24.0	43.0
19	?	?	?	?	?	?	?	38.5	0.0	0.5	0.0	42.5
20	?	?	?	?	?	?	?	0.0	0.0	0.0	36.0	0.5
21	?	?	?	?	?	?	?	71.5	57.5	5.0	0.5	0.5
22	?	?	?	?	?	?	?	5.5	8.0	10.0	0.0	7.5
23	?	?	?	?	?	?	?	94.0	22.0	2.0	71.0	0.0
24	?	?	?	?	?	?	?	0.5	8.5	0.0	4.5	11.0
25	?	?	?	?	?	?	?	0.5	0.0	0.0	9.0	37.0
26	?	?	?	?	?	?	?	0.0	16.5	0.0	43.0	47.0
27	?	?	?	?	?	?	?	0.0	0.0	1.0	0.5	10.0
28	?	?	?	?	?	?	?	18.5	0.0	0.0	16.5	4.0
29	?	?	?	?	?	?	?	2.5	0.0	0.0	0.0	3.0
30	?		?	?	?	?	?	16.5	0.0	0.0	8.0	0.0
31	?		?		?		?	30.0		0.5		81.5

Station 3429096 2013

Daily totals   Year 2013   site 3429096 KG. SALONG at PAHANG
Rain mm

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	24.5	0.0	0.0	0.0	6.5	7.5	?	0.0	2.0	0.5	0.5	108.0
2	0.5	0.0	0.0	0.0	0.5	0.0	?	0.0	0.5	0.0	2.0	34.0
3	12.0	1.5	0.0	0.0	0.0	7.0	?	0.0	0.5	2.0	0.0	217.5
4	0.0	29.0	0.0	32.5	1.0	0.0	?	0.0	0.0	27.0	2.5	65.0
5	0.0	133.5	0.0	16.5	0.0	33.5	?	0.0	30.0	0.5	4.0	12.0
6	0.5	18.0	2.0	10.5	0.0	12.0	?	3.0	5.5	0.0	5.5	49.5
7	0.0	0.0	5.5	11.0	3.5	0.0	?	1.5	40.5	2.5	0.0	67.5
8	0.0	1.0	1.5	0.5	5.0	8.0	?	0.0	3.0	0.5	0.0	24.5
9	0.0	4.0	4.5	0.0	1.5	2.5	?	12.5	6.0	0.5	22.0	0.5
10	23.5	0.0	1.0	0.5	27.5	2.0	?	0.0	27.0	63.5	0.0	1.0
11	0.0	21.0	0.0	0.0	26.5	0.0	?	0.5	0.0	1.0	12.5	0.0
12	5.5	1.0	0.0	0.5	0.0	4.5	?	0.0	0.5	21.0	0.0	0.0
13	5.0	16.5	0.0	0.5	0.0	0.0	?	0.0	8.0	1.5	0.0	1.0
14	17.5	36.0	0.0	1.0	0.0	1.5	?	0.0	14.0	5.0	0.0	0.0
15	0.0	27.0	0.0	0.0	16.0	0.0	?	0.5	8.0	0.0	13.0	0.0
16	1.0	12.5	0.0	0.5	4.0	0.0	?	0.5	0.5	0.0	0.0	41.5
17	0.0	27.5	0.0	0.5	1.0	0.0	?	24.0	0.0	0.0	1.5	0.0
18	0.0	6.5	0.0	0.0	6.5	0.0	?	0.0	0.0	0.5	0.5	0.5
19	27.5	0.5	0.0	0.0	0.0	0.0	?	53.0	0.0	0.0	0.0	7.5
20	1.5	4.0	0.0	0.5	17.0	0.0	?	0.0	2.5	0.5	7.0	18.0
21	8.5	0.0	0.0	0.5	0.0	0.0	?	0.0	0.5	1.5	1.0	10.0
22	26.5	0.0	0.0	0.0	0.0	0.0	?	4.0	0.0	60.0	0.0	0.0
23	3.0	0.0	0.0	0.5	0.0	0.0	?	0.0	0.0	8.0	13.5	0.0
24	0.0	0.0	0.0	0.5	1.0	0.0	?	0.0	0.0	0.0	0.0	0.0
25	0.0	0.0	0.0	0.0	0.0	0.0	?	0.0	0.5	2.0	0.0	0.0
26	0.0	0.5	0.0	0.5	18.5	0.0	?	5.0	0.0	16.0	0.0	0.0
27	0.0	4.5	0.0	0.0	19.0	0.0	?	12.5	0.0	0.0	0.0	1.5
28	0.0	9.0	0.0	0.0	36.0	0.0	?	0.0	9.0	0.0	45.5	0.0
29	0.0		0.0	0.5	45.0	15.5	?	7.0	0.5	7.5	1.5	0.0
30	0.0		0.0	0.5	0.0	12.0	?	4.0	11.5	0.5	15.5	0.0
31	0.0		0.0		0.0		0.0	35.0		6.5		0.0

Station 3429096 2014

Daily totals   Year 2014   site 3429096 KG. SALONG at PAHANG
Rain mm

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	2.0	0.0	?	0.0	12.0	0.5	30.5	0.0	0.0	2.0	0.0	1.0
2	0.0	0.0	?	0.0	0.0	6.0	0.0	0.0	0.0	0.5	25.0	0.0
3	1.0	0.0	?	0.0	2.5	0.0	98.5	13.5	0.0	0.0	0.0	20.0
4	1.0	0.0	?	24.0	0.0	24.0	4.0	1.5	0.0	63.5	0.0	3.5
5	0.5	0.0	?	25.0	0.0	5.0	3.0	0.0	36.5	24.5	0.0	0.0
6	2.5	0.0	?	0.5	0.0	0.0	0.5	0.0	0.0	0.0	0.0	9.5
7	4.0	0.0	?	0.0	0.0	0.0	0.0	16.0	1.5	0.0	11.0	0.5
8	0.0	0.0	?	0.0	41.5	0.0	0.0	3.0	0.0	24.0	23.5	4.5
9	0.0	0.0	?	0.0	0.0	1.5	4.5	0.0	0.0	1.0	22.5	15.0
10	76.5	0.0	?	0.5	0.0	0.0	0.0	0.0	0.0	0.5	0.5	1.0
11	68.5	0.0	?	0.0	34.0	0.5	20.0	0.0	0.0	2.5	0.0	0.0
12	0.5	0.0	?	0.0	0.0	0.5	20.0	0.0	4.5	43.0	81.5	0.0
13	0.5	0.0	?	0.0	8.0	42.5	0.0	1.0	7.5	0.0	0.0	0.0
14	0.5	0.0	?	0.0	0.5	0.0	0.0	56.5	0.5	0.5	5.0	0.0
15	0.0	0.0	?	0.0	6.0	0.0	0.0	0.0	0.0	0.0	5.0	4.0
16	0.0	1.0	?	0.0	10.0	0.0	34.5	0.5	0.0	25.0	1.0	2.5
17	0.0	0.0	?	0.0	2.0	0.0	0.0	0.0	0.0	0.0	6.0	63.5
18	0.0	0.0	?	2.0	25.0	0.0	6.5	0.0	0.0	0.0	3.0	27.5
19	0.0	0.0	?	3.5	1.5	0.0	0.5	20.5	0.0	21.5	9.5	8.5
20	0.0	0.0	?	0.0	6.5	0.0	0.0	10.0	0.0	9.0	0.5	1.5
21	0.0	0.0	10.0	5.5	15.0	0.0	0.0	115.5	65.0	0.5	0.0	4.0
22	0.0	0.5	0.0	0.0	2.0	0.0	0.0	0.0	0.0	1.5	0.0	58.0
23	0.0	1.0	0.0	0.0	13.5	0.0	1.5	0.0	0.0	1.0	1.5	235.0
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.5	0.0	20.5	1.0	144.0
25	0.0	?	0.0	0.0	0.0	0.0	25.0	31.0	0.0	0.0	8.0	19.5
26	0.0	?	0.0	0.0	?	0.0	0.5	5.0	12.5	0.0	0.0	71.5
27	0.0	?	0.0	1.0	?	41.0	7.0	0.5	0.5	0.0	18.0	67.5
28	0.0	?	0.0	0.5	0.0	23.0	0.5	0.0	0.0	7.5	13.5	0.5
29	0.0		0.0	0.0	75.0	3.5	0.0	0.0	0.0	0.0	0.0	100.5
30	0.0		10.0	0.0	0.0	0.0	5.5	0.0	37.0	0.0	1.5	57.5
31	0.0		0.0		5.0		0.0	7.0		0.0		0.0

Station 3429096 2015

Daily totals   Year 2015   site 3429096 KG. SALONG at PAHANG
Rain mm

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	1.5	0.0	0.0	24.5	5.0	0.0	0.0	4.5	0.5	0.0	1.0	0.0
2	0.0	0.0	0.0	0.0	2.5	0.5	0.0	2.5	0.0	4.5	11.0	4.0
3	0.0	0.0	0.0	1.0	2.5	0.0	0.0	13.5	0.0	5.0	0.0	4.0
4	0.0	7.0	0.0	0.0	0.0	0.0	3.0	11.0	0.0	0.0	0.4	0.0
5	0.0	0.5	0.0	0.0	36.5	0.0	0.0	0.0	2.5	0.0	42.6	30.0
6	19.0	1.5	0.0	7.5	0.0	0.0	0.0	16.0	0.0	0.0	113.0	2.0
7	3.5	0.0	0.0	0.5	0.0	0.0	0.0	0.5	0.0	1.0	3.5	17.5
8	52.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.5	0.5	4.5
9	31.0	0.0	0.0	0.0	3.0	3.5	0.0	22.0	23.0	0.0	10.5	17.5
10	16.5	0.0	0.5	7.5	0.0	0.5	0.0	0.5	1.0	0.0	0.0	0.0
11	5.5	0.0	0.0	6.5	0.5	0.5	0.0	3.0	1.0	0.0	4.5	0.0
12	2.0	0.0	0.0	10.0	0.5	7.9	0.0	13.5	0.0	?	17.5	11.5
13	0.0	0.0	0.0	0.0	8.0	16.6	0.0	0.5	0.0	?	0.0	30.0
14	0.0	0.0	0.0	0.0	0.0	9.5	0.0	0.0	0.0	0.0	17.5	0.5
15	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0	0.0	2.5	0.0
16	0.0	0.0	0.0	0.0	0.0	15.5	0.0	0.0	0.0	0.0	6.5	0.0
17	0.0	0.0	0.0	0.0	5.5	1.0	60.5	0.0	0.5	0.0	8.5	0.0
18	0.0	0.0	0.0	0.0	14.5	0.0	2.0	0.0	1.5	0.0	0.5	0.0
19	0.0	0.0	0.0	0.0	12.5	0.5	0.0	0.0	0.0	12.0	0.0	0.0
20	0.0	0.0	0.0	0.0	9.5	0.5	0.0	0.0	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.5	0.0	9.5	0.0	0.0	0.0	9.0	0.0
22	0.0	0.0	0.0	9.0	0.0	0.0	8.0	2.5	13.5	0.0	0.0	0.0
23	0.0	0.0	0.0	0.0	1.0	0.0	0.0	4.5	25.5	0.0	39.0	6.5
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0	0.0	12.5	6.0	0.0
25	0.0	0.0	0.0	0.0	0.0	0.0	21.5	10.0	0.0	7.0	1.0	0.0
26	0.0	0.0	0.0	6.0	46.0	0.0	0.0	0.0	0.0	0.0	13.0	0.5
27	0.0	0.0	5.0	0.0	0.0	0.0	42.0	1.5	0.0	2.5	22.0	0.0
28	0.0	0.0	0.0	11.0	56.5	0.0	61.0	0.5	0.0	0.0	3.0	37.0
29	0.0		0.0	0.5	9.0	0.0	0.0	0.0	0.0	1.0	15.5	33.5
30	18.0		1.0	0.0	3.5	0.0	2.0	0.0	72.0	1.0	9.5	0.5
31	0.0		0.5		0.0		0.0	13.5		19.0		0.0

Station 3429096 2016

Daily totals   Year 2016   site 3429096 KG. SALONG at PAHANG
Rain mm

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	39.0	11.5	0.0	0.0	0.0	0.0	18.5	0.0	0.5	3.0	1.0	?
2	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.5	0.0	0.5	?
3	0.0	9.0	0.0	0.0	4.0	0.0	0.0	0.0	0.0	0.0	2.5	?
4	0.0	5.5	0.0	0.0	0.0	53.5	0.0	0.0	0.0	0.0	0.0	?
5	0.0	33.0	0.0	0.0	0.0	0.0	0.0	0.0	8.5	1.5	10.5	?
6	0.0	26.0	0.0	0.0	0.0	0.0	7.5	0.0	10.5	14.0	13.5	?
7	0.0	11.5	1.5	0.0	0.0	25.0	7.0	0.5	0.0	8.5	12.5	?
8	0.0	8.0	0.0	0.0	0.0	0.0	9.0	0.0	0.0	0.0	0.0	?
9	0.0	0.0	0.0	0.0	1.5	8.0	0.0	0.0	3.0	0.0	?	?
10	0.0	0.0	0.0	0.0	0.0	0.0	3.5	0.0	0.0	12.5	?	?
11	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	?	?
12	0.0	0.0	0.0	2.5	16.5	18.5	0.0	30.0	0.0	20.0	?	?
13	0.0	0.0	0.0	5.0	39.5	0.0	12.5	0.0	0.0	?	?	?
14	0.5	2.0	0.0	2.5	2.0	0.0	0.0	0.0	0.0	11.5	?	?
15	0.0	0.0	0.0	8.5	0.0	7.0	0.0	0.0	15.5	0.0	?	?
16	31.0	0.5	0.0	1.0	5.0	0.5	3.5	0.0	0.0	12.5	?	?
17	0.5	0.0	0.0	0.0	0.5	26.5	0.5	0.0	4.5	0.5	?	?
18	0.0	0.0	0.0	0.0	0.0	0.0	21.0	0.0	9.5	0.0	?	?
19	0.0	8.0	0.0	0.0	0.0	3.0	2.5	0.0	10.0	0.0	?	?
20	0.0	6.0	0.0	0.0	13.5	0.0	41.0	13.5	0.0	0.0	?	?
21	0.0	0.0	0.0	0.0	53.5	0.0	57.0	64.0	0.0	0.0	?	?
22	15.0	0.0	0.0	0.0	3.0	9.5	0.0	39.0	3.0	1.0	?	?
23	4.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	?	?
24	0.5	0.0	0.0	2.5	0.0	0.0	0.0	0.0	0.0	60.5	?	?
25	6.0	0.5	0.0	0.0	0.0	0.0	1.0	0.0	46.0	0.5	?	?
26	3.5	0.0	0.0	0.0	11.0	0.0	0.0	3.0	0.5	29.5	?	?
27	8.0	0.5	0.0	0.5	0.0	0.0	24.0	0.0	10.5	16.0	?	?
28	0.0	0.0	3.0	0.0	22.5	0.0	14.5	0.0	43.5	3.5	?	?
29	0.0	12.0	6.0	0.0	0.0	0.0	0.5	5.5	0.0	32.5	?	?
30	0.0		0.0	2.0	74.0	0.0	0.0	0.5	0.0	13.5	?	?
31	0.5		0.0		14.5		0.0	19.0		15.0		?

Station 3429096 2017

Daily totals Year 2017 site 3429096 KG. SALONG at PAHANG
Rain mm

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	5.5	0.0	8.0	3.5	11.5	?	?	?	?	?	?	?
2	17.0	0.0	48.5	8.0	0.0	?	?	?	?	?	?	?
3	20.5	0.5	22.5	0.0	0.0	?	?	?	?	?	?	?
4	0.0	0.0	2.5	0.0	?	?	?	?	?	?	?	?
5	0.0	0.0	0.0	0.0	?	?	?	?	?	?	?	?
6	0.0	40.5	0.0	0.0	?	?	?	?	?	?	?	?
7	0.5	?	0.0	0.5	?	?	?	?	?	?	?	?
8	3.5	0.5	?	0.0	?	?	?	?	?	?	?	?
9	0.0	0.0	0.5	26.5	?	?	?	?	?	?	?	?
10	?	0.0	0.0	1.0	?	?	?	?	?	?	?	?
11	0.0	0.0	0.0	?	?	?	?	?	?	?	?	?
12	16.5	0.0	0.0	0.0	?	?	?	?	?	?	?	?
13	0.0	3.0	0.0	0.0	?	?	?	?	?	?	?	?
14	0.0	19.0	0.0	26.5	?	?	?	?	?	?	?	?
15	7.0	3.5	0.0	0.0	?	?	?	?	?	?	?	?
16	8.5	5.0	0.0	0.0	?	?	?	?	?	?	?	?
17	0.0	0.5	11.5	0.0	?	?	?	?	?	?	?	?
18	5.5	0.0	12.5	0.0	?	?	?	?	?	?	?	?
19	41.0	0.0	0.0	1.5	?	?	?	?	?	?	?	?
20	4.0	0.0	0.0	84.5	?	?	?	?	?	?	?	?
21	15.0	0.0	58.5	2.5	?	?	?	?	?	?	?	?
22	18.5	0.0	0.5	20.0	?	?	?	?	?	?	?	?
23	7.0	0.0	0.5	1.0	?	?	?	?	?	?	?	?
24	53.0	0.0	0.0	0.0	?	?	?	?	?	?	?	?
25	192.0	12.5	0.0	22.0	?	?	?	?	?	?	?	?
26	13.5	0.5	0.0	0.0	?	?	?	?	?	?	?	?
27	7.5	138.5	1.0	2.5	?	?	?	?	?	?	?	?
28	17.5	16.0	0.0	0.0	?	?	?	?	?	?	?	?
29	0.0		5.0	0.0	?	?	?	?	?	?	?	?
30	0.0		0.0	0.0	?	?	?	?	?	?	?	?
31	0.0		46.0		?		?	?		?		?

APPENDIX D

MAP OF TASIK CHINI