

# Capacity Development to Support National Drought Management Policies



## MALAYSIA

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FRIM



DID Malaysia



MetMalaysia



A UN-WATER INITIATIVE ORGANIZED BY:



Convention on Biological Diversity



# MALAYSIA

## Introduction

- Climate : Equatorial with uniform temperature, high humidity & abundant rainfall
- Spatial variability : Pen. Malaysia :2,400 mm, Sarawak: 3,600 mm & Sabah: 2,500mm
- Temporal Variability : 60% falls during the northeast monsoon (Nov – Feb) especially east coast of Pen. Malaysia

## Water Resource Management

- Federal Constitution : Article 74 provide for separation of jurisdiction and responsibility between federal, state and concurrent.
- Natural resources management including water is under the state jurisdiction
- Forestry and Agriculture : State responsibility
- Federal Govt. to provide technical advise, collect information and data, set up monitoring stations and conduct surveys
- Disaster Management : Public Health -> Concurrent list
- Water Services : Concurrent list

# Drought Management - SOP

- Drought disaster in Malaysia is managed according to the standard operating procedure (SOP) - led by the National Security Council of the Prime Minister Ministry.
- Published and circulated in December 2011.
- Formulated following several drought events that had happened in Malaysia particularly the one in 1992 and 1998.
- Classification of drought
- Responsible agencies to monitor drought : MetMalaysia/DID Malaysia & Minerals and Geosains Department Malaysia
- Severity of drought – Alert, Warning, Emergency and Termination
- Line of communication
- Roles and responsibility and mitigation measures
- The recent drought event which lasted approximately 2 months from mid-January 2014 to mid-March 2014 was the first time the SOP was put into practice.

# MetMalaysia



- MetMalaysia responsible for issuing drought early warning if there is possibility of drought base on some criteria such as weather and climate forecasting tools including numerical modeling and related index which indicate early signs drought resulted like El-Nino phenomena.
- MetMalaysia used the Standard Precipitation Index and rainfall anomalies to reflect the drought severity in Malaysia

# METEOROLOGICAL DROUGHT MONITORING

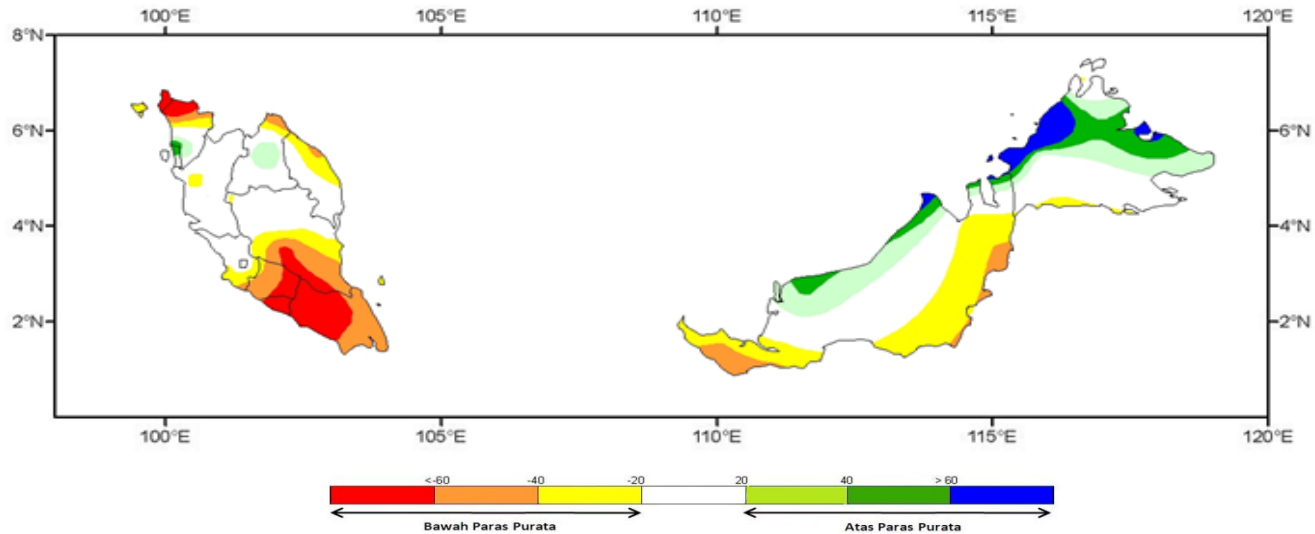
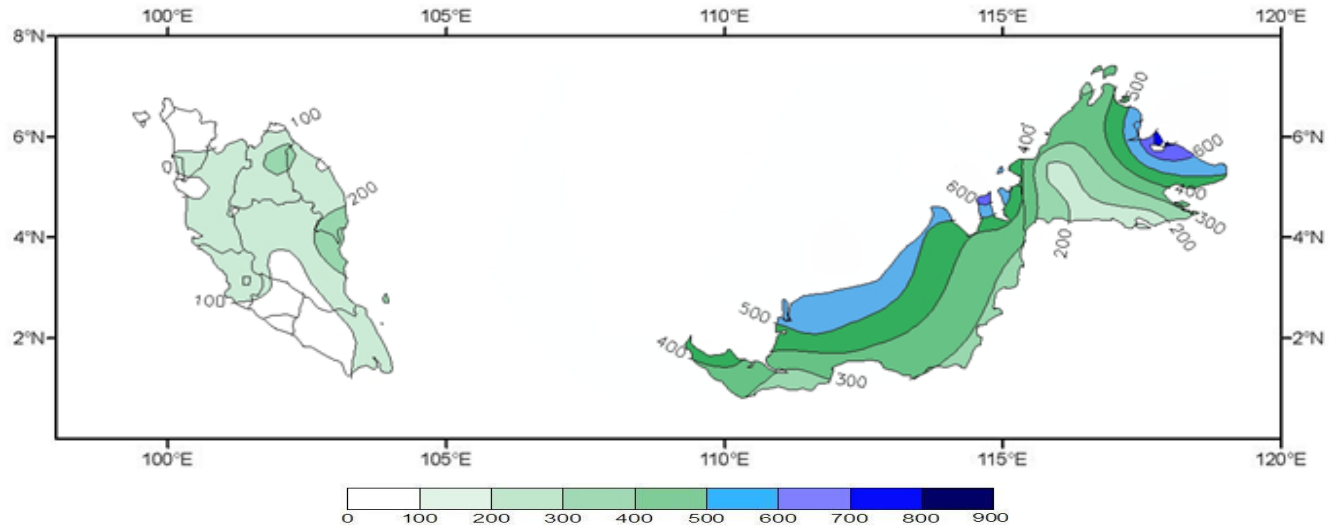
Issuing drought early warning IF:

| <b>LEVEL</b>             | <b>MONITORING STATUS</b>   |
|--------------------------|--|
| LEVEL 1:<br>ALERT        | Deficit for total rainfall for at least 3 consecutive months above 35% from normal and the latest SPI index is less than -1.5, OR the deficit for 6 consecutive months above 35% and latest SPI index is less than -1.5. |
| LEVEL 2 :<br>WARNING     | Deficit for total rainfall for at least 3 and 6 consecutive months above 35% from normal and the latest 3 months SPI index is less than -1.5, and drought ALERT level declared before.                                   |
| LEVEL 3 :<br>EMERGENCY   | Deficit for total rainfall for at least 3 and 6 consecutive months above 35% from normal and the latest 3 months SPI index is less than -2.5, and drought WARNING level has been declared before.                        |
| LEVEL 4 :<br>TERMINATION | SPI index become positive and/or total rainfall for the current month above normal.  |



# Weather Malaysia – Last Drought Episode

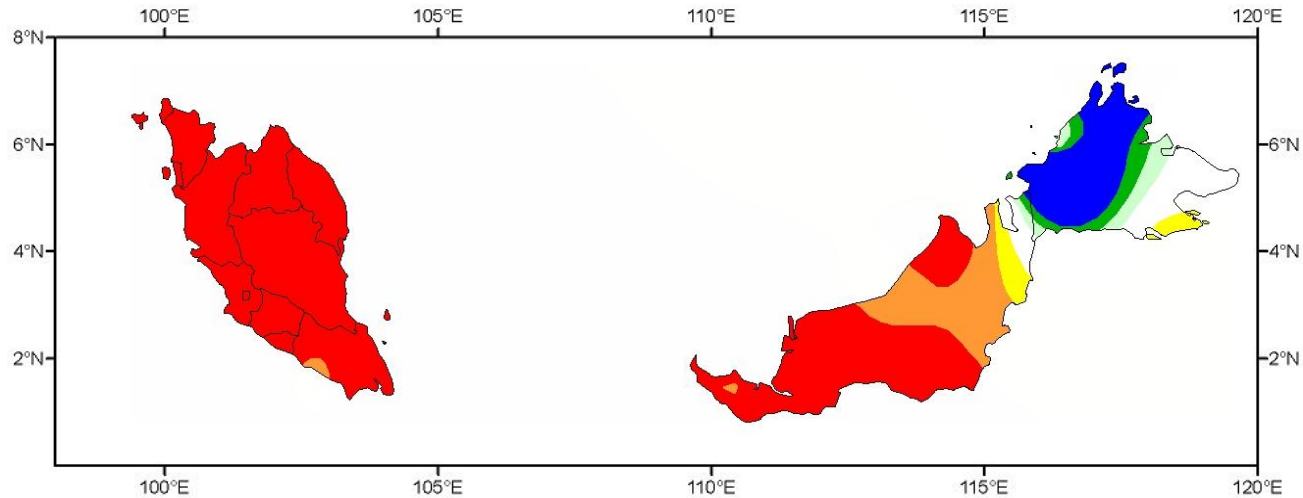
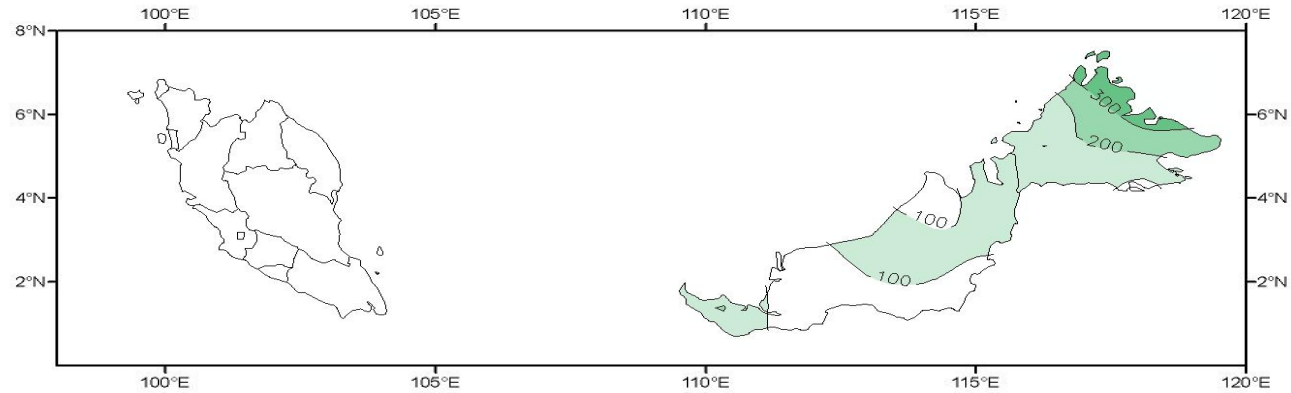
## Rainfall January 2014





# Weather Malaysia – Last Drought Episode

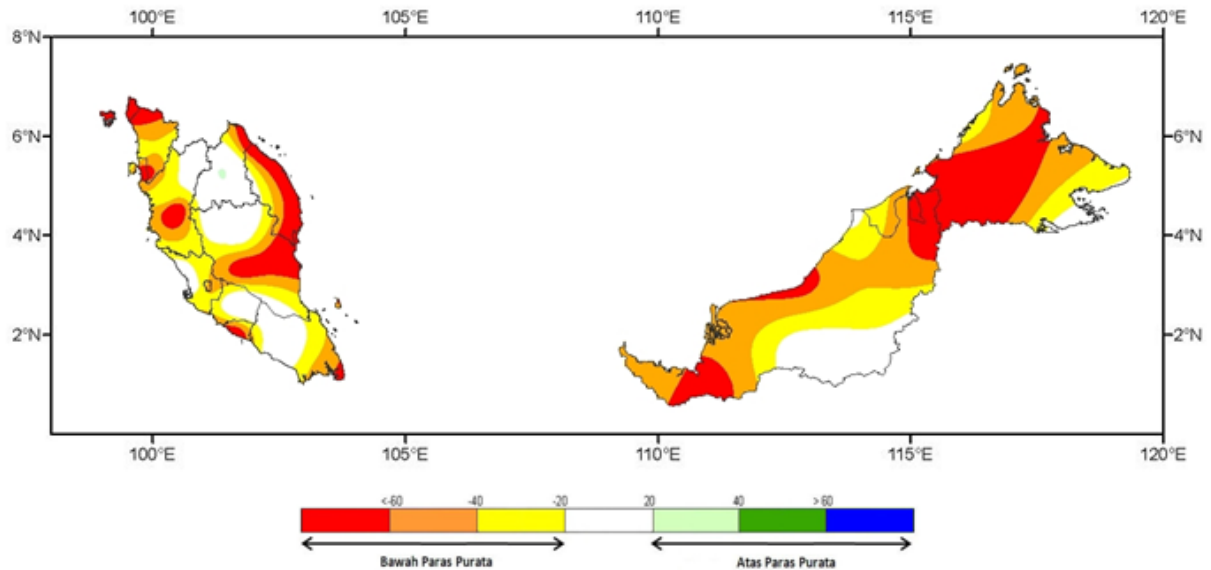
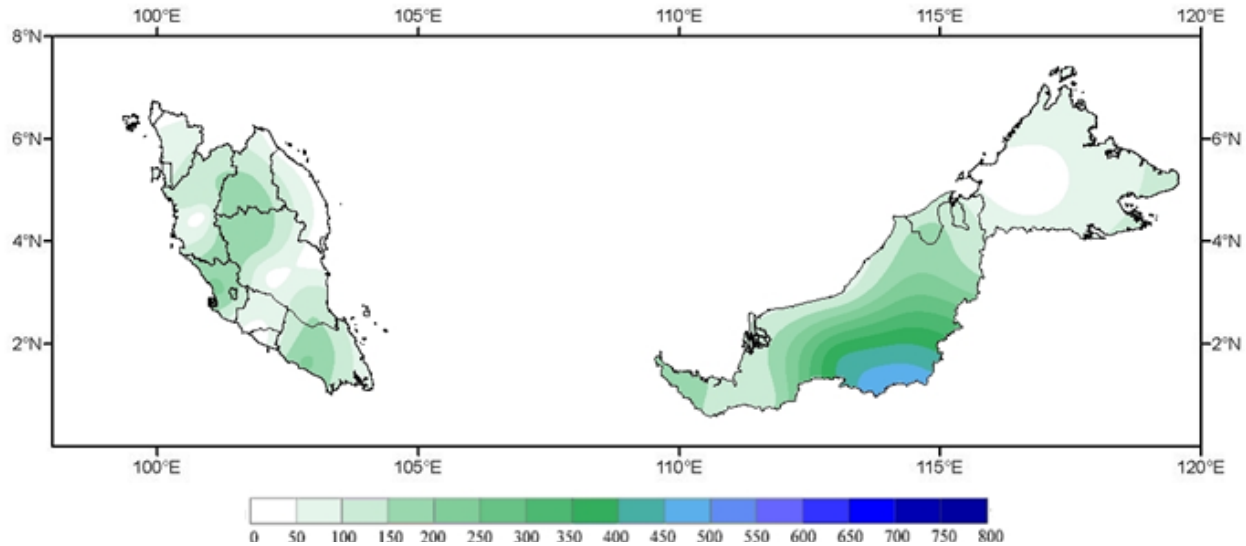
## Rainfall February 2014





# Weather Malaysia

## Rainfall March 2014

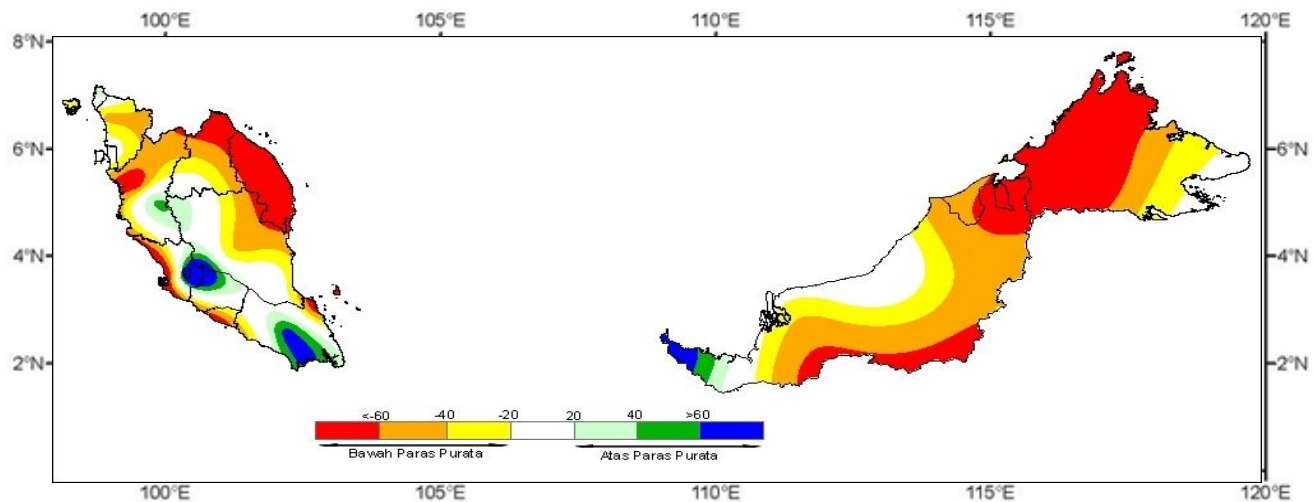
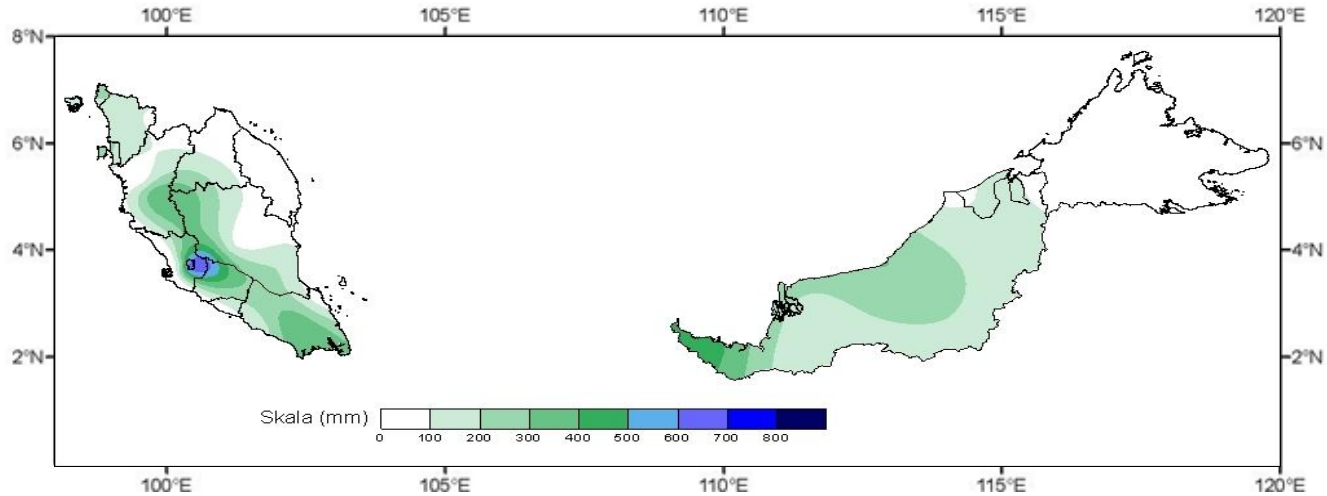




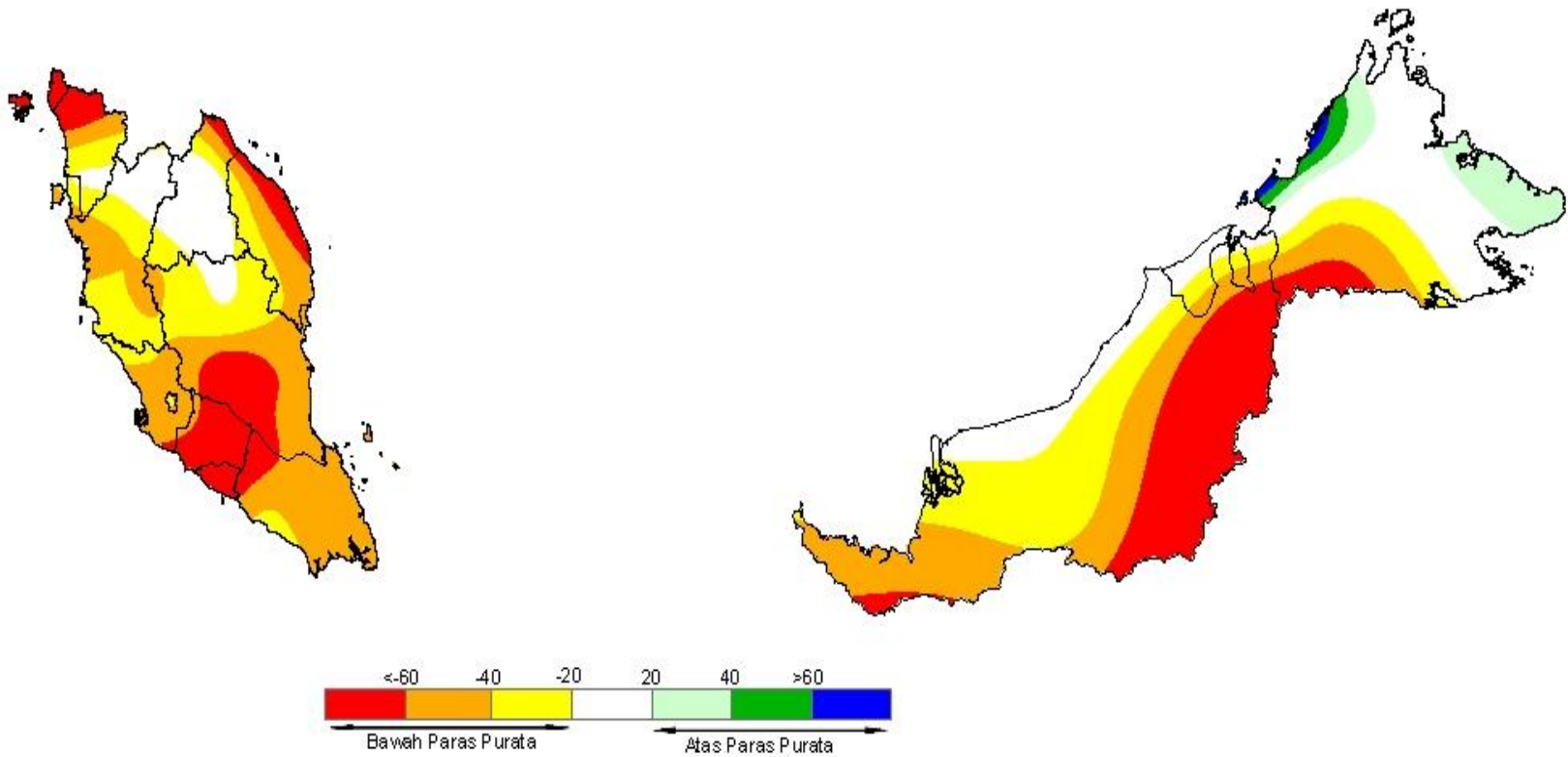


# Weather Malaysia

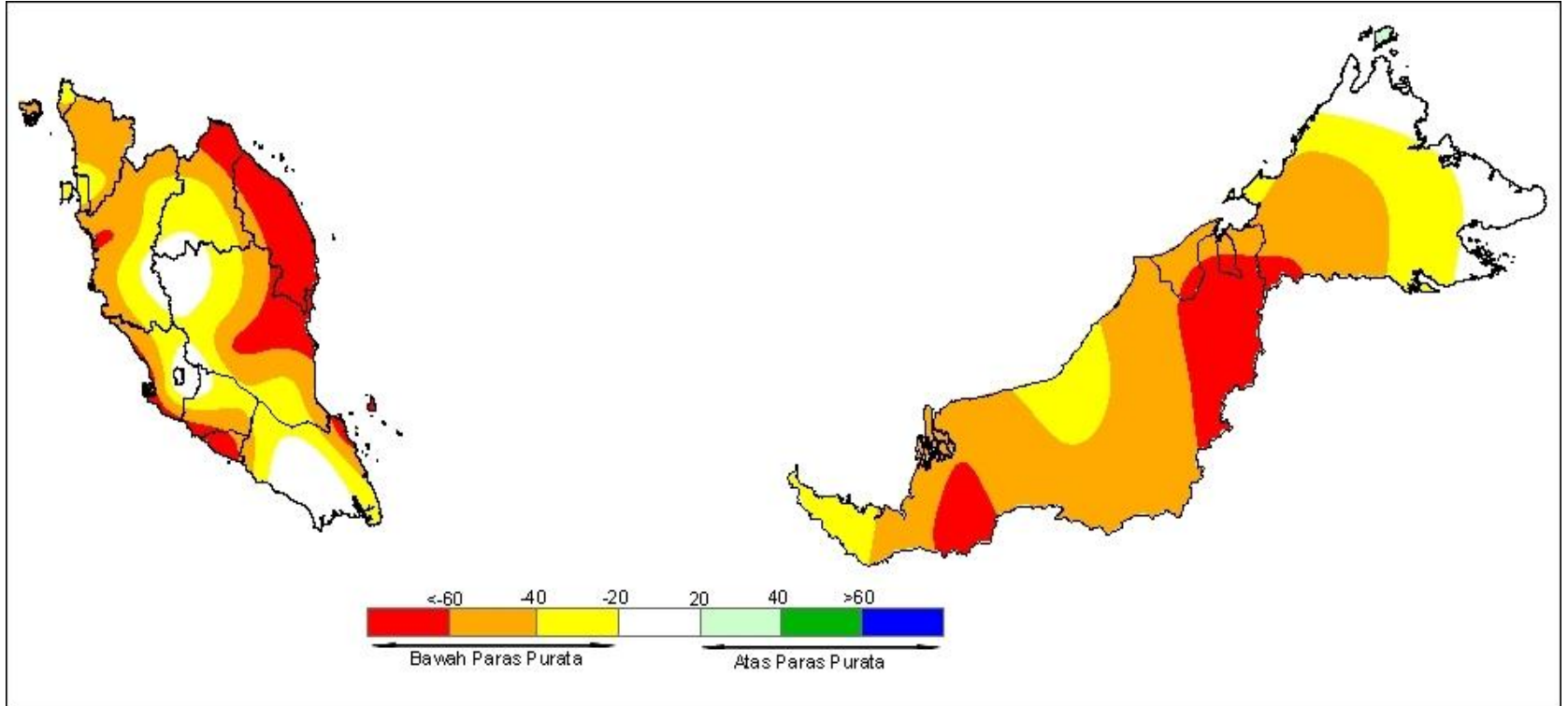
## Rainfall April 2014



# Rainfall Anomaly (Jan – Mar 2014)



# Rainfall Anomaly (Feb – Apr 2014)



**DROUGHT MONITORING FOR MALAYSIA**  
**(SPI Index)**  
**MARCH 2014**

| Stn Name      | Stn No | Lat | Lon   | 1m   | 2m   | 3m   | 4m   | 5m   | 6m   |
|---------------|--------|-----|-------|------|------|------|------|------|------|
| Langkawi      | 48600  | 6.3 | 99.7  | -1.1 | -1.4 | -1.3 | -1.3 | -0.7 | -0.4 |
| Bayan Lepas   | 48601  | 5.3 | 100.3 | -0.5 | -1.4 | -1.4 | -1.5 | -1.1 | -0.3 |
| Butterworth   | 48602  | 5.5 | 100.4 | -0.7 | -1.7 | -0.5 | -1.0 | -1.1 | -0.3 |
| Alor Setar    | 48603  | 6.2 | 100.4 | -0.9 | -1.6 | -1.7 | -1.3 | -1.6 | -0.6 |
| Chuping       | 48604  | 6.5 | 100.3 | -1.6 | -2.2 | -2.1 | -1.9 | -1.7 | -1.8 |
| Kota Bharu    | 48615  | 6.2 | 102.3 | -0.5 | -1.1 | -1.1 | -1.2 | -1.3 | -1.4 |
| K.Krai        | 48616  | 5.5 | 102.2 | 0.3  | -0.5 | 0.1  | 0.2  | -0.2 | -0.3 |
| Gong Kedak    | 48617  | 5.8 | 102.5 | -1.0 | -1.4 | -1.2 | -1.4 | -1.7 | -1.4 |
| K. Terengganu | 48618  | 5.4 | 103.1 | -1.0 | -1.5 | -1.4 | -0.9 | -0.4 | -0.4 |
| Sitiawan      | 48620  | 4.2 | 100.7 | -0.7 | -1.6 | -0.7 | -0.4 | -0.6 | 0.3  |
| Lubok Merbau  | 48623  | 4.8 | 100.9 | -0.2 | -1.3 | -1.4 | -1.8 | -1.7 | -1.5 |
| Ipoh          | 48625  | 4.6 | 101.1 | -2.4 | -2.4 | -1.2 | -1.5 | -1.5 | -0.9 |
| Cameron       | 48632  | 4.5 | 101.4 | -0.9 | -1.3 | -1.1 | -0.7 | -0.6 | -0.4 |
| Batu Embun    | 48642  | 4.0 | 102.4 | 0.0  | -0.7 | -0.6 | -0.2 | -0.2 | -0.1 |
| Subang        | 48647  | 3.1 | 101.6 | -0.6 | -2.0 | -1.7 | -0.9 | -0.2 | -0.6 |
| PJ            | 48648  | 3.1 | 101.7 | -0.9 | -2.3 | -1.5 | 0.0  | -0.2 | 0.0  |
| Muadzam       | 48649  | 3.1 | 103.1 | -0.3 | -1.3 | -1.6 | -0.1 | -0.6 | -0.5 |
| KLIA          | 48650  | 2.7 | 101.7 | -0.6 | -1.7 | -1.4 | -1.3 | -1.0 | -1.2 |
| Temerloh      | 48653  | 3.5 | 102.4 | -1.5 | -2.1 | -2.3 | -0.7 | -0.7 | -0.7 |
| Kuantan       | 48657  | 3.8 | 103.2 | -1.2 | -1.9 | -0.9 | 0.4  | 0.0  | -0.1 |
| Melaka        | 48665  | 2.3 | 102.3 | -1.8 | -2.6 | -2.6 | -2.2 | -1.5 | -1.7 |
| Batu Pahat    | 48670  | 1.9 | 103.0 | 0.2  | -0.3 | -1.0 | -0.4 | -0.1 | -0.1 |
| Kluang        | 48672  | 2.0 | 103.3 | 0.1  | -0.9 | -1.5 | -0.7 | -0.7 | -0.8 |
| Mersing       | 48674  | 2.5 | 103.8 | -0.2 | -1.4 | -1.1 | -0.8 | -1.4 | -1.5 |
| Senai         | 48679  | 1.6 | 103.7 | -0.6 | -1.5 | -1.5 | -0.5 | -0.6 | -0.7 |
| Kuching       | 96413  | 1.5 | 110.3 | -1.7 | -2.1 | -2.2 | -1.3 | -1.4 | -1.1 |
| Sri Aman      | 96418  | 1.2 | 111.5 | -1.7 | -2.1 | -2.3 | -1.3 | -1.3 | -1.5 |
| Sibu          | 96421  | 2.3 | 111.8 | -1.4 | -3.0 | -0.9 | -0.3 | -0.4 | -0.6 |
| Bintulu       | 96441  | 3.2 | 113.0 | -1.6 | -1.6 | -0.3 | 0.6  | 0.4  | 0.0  |
| Miri          | 96449  | 4.3 | 114.0 | -0.1 | -0.8 | 0.3  | 1.0  | 0.8  | 0.7  |
| Labuan        | 96465  | 5.3 | 115.3 | -0.8 | 0.2  | 1.0  | 1.0  | 1.0  | 0.7  |
| K.Kinabalu    | 96471  | 5.9 | 116.1 | 0.0  | 0.2  | 1.0  | 1.3  | 1.2  | 1.3  |
| Kudat         | 96477  | 6.9 | 116.8 | 0.0  | 0.3  | 0.0  | -0.2 | -0.2 | -0.2 |
| Tawau         | 96481  | 4.3 | 117.9 | 0.0  | -0.2 | -0.3 | -0.4 | 0.3  | 0.5  |
| Sandakan      | 96491  | 5.9 | 118.1 | -0.7 | 0.1  | 0.7  | 0.3  | 0.2  | 0.1  |

**How to use**

**2.0 and above : Extremely wet**  
**1.5 to 1.99 : Very wet**  
**1.0 to 1.49 : Moderately wet**  
**-0.99 to 0.99 : Normal**

**-1.0 to -1.49 : Moderately dry**  
**-1.5 to -1.99 : Severely dry**  
**-2.0 or less : Extremely dry**

## Drought Monitoring For Malaysia (SPI Index) (APRIL 2014)

| Station Name  | 1 Month | 2 Month | 3 Month | 4 Month | 5 Month | 6 Month |
|---------------|---------|---------|---------|---------|---------|---------|
| Langkawi      | -0.8    | -1.14   | -1.33   | -1.3    | -1.36   | -0.9    |
| Bayan Lepas   | 0.18    | -0.45   | -1.01   | -1.08   | -1.21   | -1.01   |
| Butterworth   | 0.23    | -0.27   | -0.89   | -0.27   | -0.65   | -0.85   |
| Alor Setar    | -0.66   | -1.2    | -1.69   | -1.73   | -1.39   | -1.63   |
| Chuping       | 0.49    | -0.41   | -0.9    | -0.93   | -1.07   | -1.11   |
| Kota Bharu    | -2.64   | -1.45   | -1.78   | -1.54   | -1.49   | -1.54   |
| K.Krai        | -1.1    | -0.37   | -0.8    | -0.19   | 0.06    | -0.36   |
| Gong Kedak    | -1.37   | -1.32   | -1.64   | -1.34   | -1.49   | -1.68   |
| K. Terengganu | -2.9    | -1.61   | -1.92   | -1.69   | -1.2    | -0.64   |
| Sitiawan      | -0.6    | -1.07   | -1.83   | -1.09   | -0.71   | -0.88   |
| Lubok Merbau  | -1.97   | -1.55   | -2.15   | -2.28   | -2.34   | -2.31   |
| Ipoh          | 0.85    | -0.58   | -1.04   | -0.58   | -1.00   | -1.12   |
| Cameron       | 0.89    | 0.17    | -0.31   | -0.35   | -0.15   | -0.12   |
| Batu Embun    | -0.58   | -0.46   | -0.96   | -0.81   | -0.43   | -0.4    |
| Subang        | 0.01    | -0.48   | -1.56   | -1.43   | -0.81   | -0.18   |
| Petaling Jaya | 1.75    | 0.75    | -0.16   | -0.07   | 0.73    | 0.45    |
| Muadzam       | 0.22    | -0.24   | -0.8    | -1.25   | -0.05   | -0.53   |
| KLIA          | -0.25   | -0.76   | -1.76   | -1.68   | -1.5    | -1.24   |
| Temerloh      | -0.33   | -1.35   | -1.63   | -1.95   | -0.78   | -0.83   |
| Kuantan       | -0.67   | -1.27   | -1.63   | -1.06   | 0.21    | -0.14   |
| Melaka        | -1.54   | -2.18   | -2.6    | -2.9    | -2.65   | -2.01   |
| Batu Pahat    | 0.13    | 0.08    | -0.37   | -1.09   | -0.47   | -0.08   |
| Kluang        | 1.3     | 0.85    | 0.23    | -0.46   | -0.09   | -0.15   |
| Mersing       | -1.53   | -0.97   | -1.85   | -1.41   | -1.06   | -1.74   |
| Senai         | 1.51    | 0.52    | -0.06   | -0.49   | 0.09    | -0.02   |
| Kuching       | 1.24    | -0.22   | -1.22   | -1.69   | -0.95   | -1.08   |
| Sri Aman      | -1.5    | -2.1    | -2.34   | -2.51   | -1.56   | -1.59   |
| Sibu          | -1.06   | -2.07   | -2.96   | -1.19   | -0.58   | -0.68   |
| Bintulu       | 0.51    | -0.78   | -1.13   | -0.21   | 0.66    | 0.52    |
| Miri          | -0.74   | -0.81   | -1.34   | 0.04    | 0.84    | 0.68    |
| Labuan        | -1.06   | -1.51   | -0.49   | 0.69    | 0.71    | 0.69    |
| K.Kinabalu    | -0.71   | -0.62   | -0.36   | 0.68    | 1.05    | 0.94    |
| Kudat         | -1.55   | -0.46   | 0.04    | -0.14   | -0.27   | -0.24   |
| Tawau         | -0.21   | -0.21   | -0.36   | -0.36   | -0.44   | 0.15    |
| Sandakan      | 0.73    | -0.05   | 0.26    | 0.69    | 0.39    | 0.28    |

- **How to use**

- 2.0 and above :Extremely wet
- 1.5 to 1.99 : Very wet
- 1.0 to 1.49 : Moderately wet
- -0.99 to 0.99 : Normal
- -1.0 to -1.49 : Moderately dry
- -1.5 to -1.99 : Severely dry
- -2.0 or less : Extremely dry

| Stesen           | SPI Mac 2014 | Nilai purata jangka panjang 3 bulan (mm) | Jumlah hujan kumulatif 3 bulan (mm) | Peratus perbezaan daripada nilai normal |
|------------------|--------------|--|-------------------------------------|---|
|                  |              | (Dec-Feb) - A                            | (Dec-Feb)-B                         | (B-A)/A                                 |
| Alor Setar       | -0.87        | 230.0                                    | 61.0                                | 27                                      |
| Batu Embun       | 0.00         | 410.3                                    | 296.4                               | 72                                      |
| Batu Pahat       | 0.16         | 499.0                                    | 333.4                               | 67                                      |
| Bayan Lepas      | -0.49        | 306.9                                    | 150.2                               | 49                                      |
| Bintulu          | -1.64        | 981.7                                    | 840.8                               | 86                                      |
| Butterworth      | -0.72        | 288.1                                    | 219.2                               | 76                                      |
| Cameron          | -0.91        | 476.4                                    | 262.0                               | 55                                      |
| Chuping          | -1.55        | 220.7                                    | 25.2                                | 11                                      |
| Gong Kedak       | -1.00        | 661.6                                    | 276.8                               | 42                                      |
| Ipoh             | -2.42        | 526.5                                    | 316.8                               | 60                                      |
| KLIA             | -0.62        | 439.8                                    | 183.6                               | 42                                      |
| Kluang           | 0.09         | 470.0                                    | 210.8                               | 45                                      |
| Kota Bharu       | -0.49        | 327.6                                    | 92.4                                | 28                                      |
| Kota Kinabalu    | 0.00         | 287.9                                    | 499.8                               | 174                                     |
| Kuala Krai       | 0.26         | 386.1                                    | 365.2                               | 95                                      |
| Kuala Terengganu | -0.97        | 407.5                                    | 107.8                               | 26                                      |
| Kuantan          | -1.22        | 652.7                                    | 331.0                               | 51                                      |
| Kuching          | -1.65        | 1522.5                                   | 777.2                               | 51                                      |
| Kudat            | -0.03        | 682.0                                    | 711.4                               | 104                                     |
| Labuan           | -0.75        | 471.9                                    | 789.2                               | 167                                     |
| Lubok Merbau     | -0.22        | 389.1                                    | 206.2                               | 53                                      |
| Melaka           | -1.82        | 328.7                                    | 72.0                                | 22                                      |
| Mersing          | -0.21        | 627.8                                    | 291.2                               | 46                                      |
| Miri             | -0.07        | 615.5                                    | 661.2                               | 107                                     |
| Muadzam          | -0.33        | 591.2                                    | 257.8                               | 44                                      |
| Petaling Jaya    | -0.94        | 714.9                                    | 438.4                               | 61                                      |
| Pulau Langkawi   | -1.06        | 171.0                                    | 49.4                                | 29                                      |
| Sandakan         | -0.68        | 931.0                                    | 1211.9                              | 130                                     |
| Senai            | -0.64        | 542.4                                    | 269.0                               | 50                                      |
| Sibu             | -1.39        | 999.3                                    | 761.2                               | 76                                      |
| Sitiawan         | -0.66        | 404.7                                    | 279.4                               | 69                                      |
| Sri Aman         | -1.70        | 901.4                                    | 404.8                               | 45                                      |
| Subang           | -0.56        | 610.8                                    | 345.2                               | 57                                      |
| Tawau            | 0.02         | 359.0                                    | 280.4                               | 78                                      |
| Temerloh         | -1.54        | 388.5                                    | 83.6                                | 22                                      |

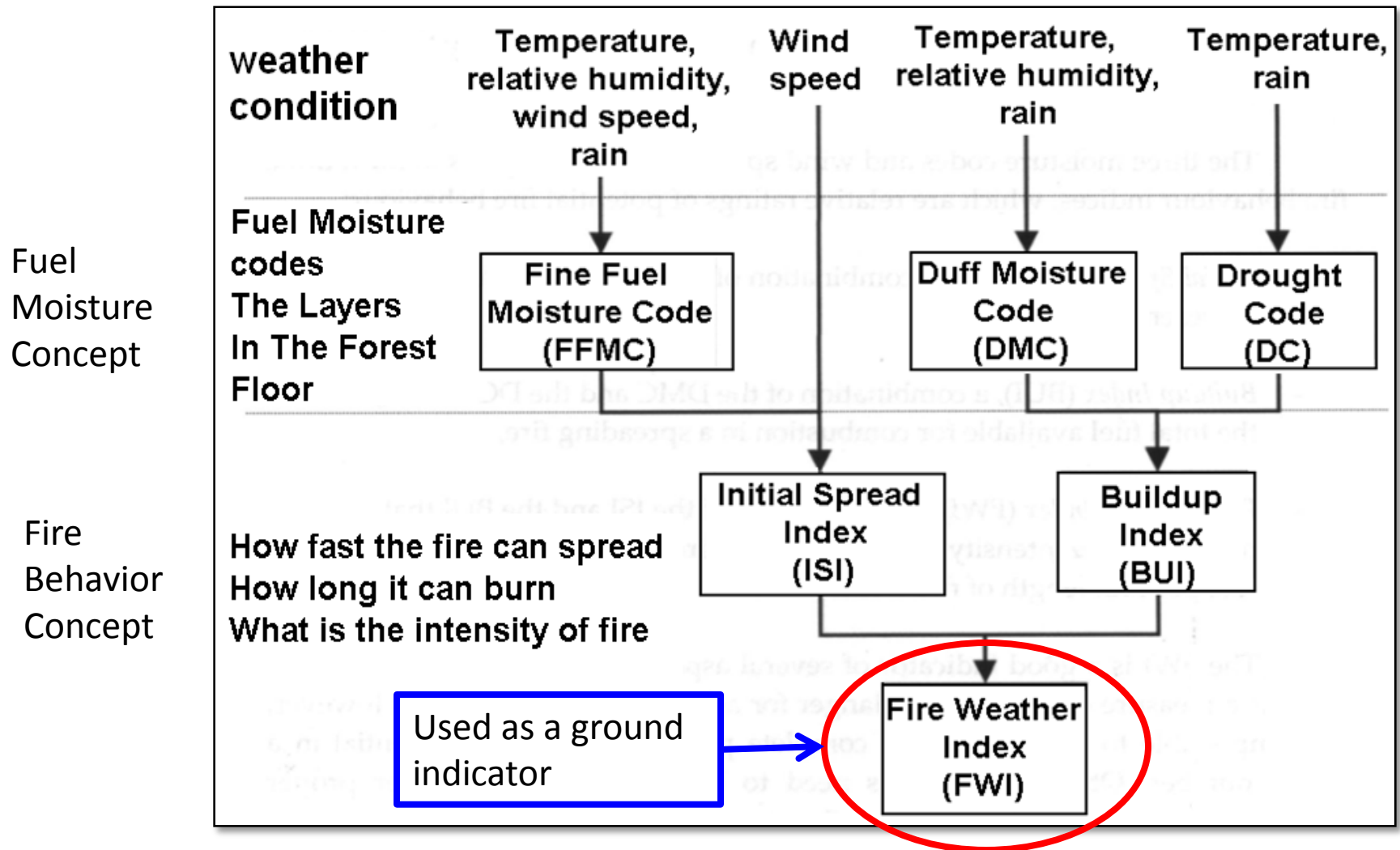
Nota

|  |   |
|--|---|
|  | Nilai SPI kurang dari -1.5              |
|  | Nilai Defisit melebihi -35%             |
|  | Stesen yang memenuhi kedua-dua kriteria |

# FIRE DANGER RATING SYSTEM (FDRS)

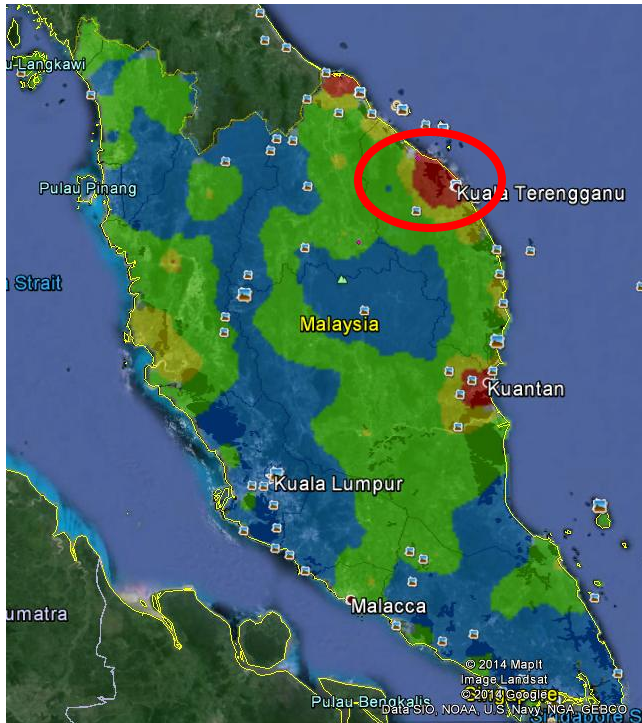
- Fire danger rating is the evaluation of meteorological factors that influence fire danger (**Fire Danger** is the ability of a fire to start, spread and do damage)
- A system that monitors forest/vegetation fires risk and supplies information that assists in fire prevention and management
- To predict possible fire occurrence and behaviour
- A guide to policy-makers in developing mitigation actions to protect life, property and the environment

# Basic Structure of FDRS System

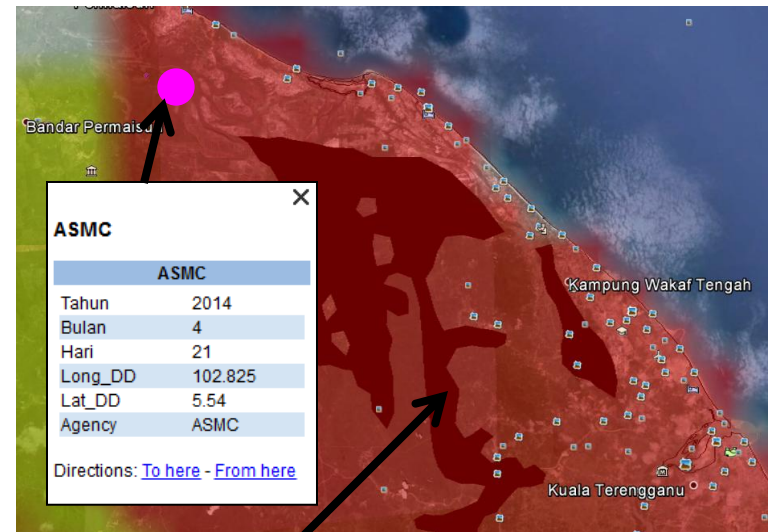
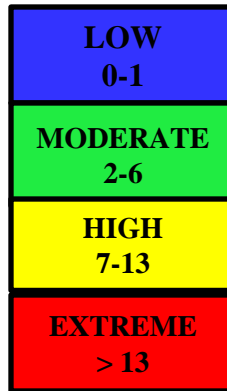




# FWI index



## Color level



- Google Earth maps
- Zoom in to the red area
- The black shaded area is a peat land
- Hot spot Information (●)
- Update color level on FWI cart at the ground, by a forest ranger



# Drought Management – DID Malaysia

- **HYDROLOGICAL DROUGHT MONITORING**

For DID Malaysia, its drought monitoring program was initiated since 2001

Among its first initiative was to establish a website wholly focusing on drought monitoring.

Its objective is to assist relevant agencies to make early preparation to face drought events.

In this web site, 20 water level stations were set up to monitor reservoirs level and another 23 stations for rivers

# INFOKEMARAU

infokemarau.water.gov.my

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## INFO KEMARAU

Department of Irrigation and Drainage  
Ministry of Natural Resources and Environment

HOME STANDARD PRECIPITATION INDEX (SPI) STORAGE DAM RIVER FLOW RAINFALL & WATER LEVEL REPORTS

### ABOUT INFOKEMARAU

**Drought Information Website**  
Drought monitoring program was initiated since early 2001.

**Methodology**  
Close relationship between water resources status and current rainfall amount received. Therefore, in this program rainfall data of 41 selected stations are used in the analysis to reflect the water resources status of Peninsular Malaysia. In this case the percentage of deviation from the long term mean (LTM) value of 3 monthly moving rainfall totals is used as indicator of the water catchments condition. A negative deviation from the LTM value indicates that the particular region is experiencing a dryer than normal condition and vice versa.

[More...](#)

### ADMIN LOGIN

LOGIN  
Username :   
Password :

### STATE LOGIN

LOGIN  
Username :   
Password :

### STATISTICS

21,254 Visitors  
Since December 10, 2013

Kuala Lumpur

4:37:38 pm

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**InfoKemarau** @InfoKemarau 1 Apr  
DIMAKLUMKAN KAWASAN TELAH MULA/BEBERAPA HARI MENERIMA HUJAN (01/04/14) oleh JMM (METMalaysia): Pahang (Daerah Temerloh, Pekan dan Rompin)

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# RESERVOIR STORAGE

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### Drought Monitoring by Dam Levels

| No. | Dam Name                 | State (Storage Curve)    | StationID | Purpose / Agency | Last Update      | Normal Level (m) | Minimum Level (m) | Maximum Level (m) | Dam Level (m) (Real Time) | Storage (MCM) | Storage (% MCM) |
|-----|--------------------------|--------------------------|-----------|------------------|------------------|------------------|-------------------|-------------------|---------------------------|---------------|-----------------|
| 1   | EMPANGAN MACHAP          | <a href="#">JOHOR</a>    | 1832480   | W/F (DID)        | 04/04/2014-16:00 | 15.85            | 13.10             | 19.40             | 14.29                     | 3.44          | 32.44           |
| 2   | EMPANGAN SEMBRONG        | <a href="#">JOHOR</a>    | 1931480   | W/F (DID)        | 04/04/2014-16:00 | 10.00            | 6.00              | 13.80             | 8.65                      | 19.50         | 63.88           |
| 3   | EMPANGAN BEKOK           | <a href="#">JOHOR</a>    | 2030481   | W/F (DID)        | 04/04/2014-16:00 | 15.50            | 8.70              | 22.00             | 13.68                     | 36.60         | 59.88           |
| 5   | EMPANGAN PADANG SAGA     | <a href="#">KEDAH</a>    | 6397405   | I/W/F (DID)      | 04/04/2014-16:00 | 21.20            | 18.50             | 22.60             | 18.17                     | 0.06          | 37.49           |
| 6   | EMPANGAN BERIS           | <a href="#">KEDAH</a>    | 5907401   | I/W/F (DID)      | 03/04/2014-17:00 | 84.00            | 68.00             | 86.40             | 77.53                     | 53.88         | 44.86           |
| 7   | EMPANGAN BUKIT KWONG     | <a href="#">KELANTAN</a> | 5919403   | I/W (DID)        | 04/04/2014-16:01 | 16.76            | 12.20             | 17.72             | 14.53                     | 5.42          | 39.32           |
| 8   | EMPANGAN AHNING          | <a href="#">MADA</a>     | 6307480   | I/W(MADA)        | 04/04/2014-16:00 | 113.00           | 73.00             | 114.00            | 102.43                    | 167.71        | 60.97           |
| 9   | EMPANGAN MUDA            | <a href="#">MADA</a>     | 6108480   | I/W(MADA)        | 04/04/2014-15:00 | 100.60           | 82.30             | 103.30            | 92.29                     | 53.05         | 34.33           |
| 11  | EMPANGAN TIMAH TASOH     | <a href="#">PERLIS</a>   | 6602481   | I/W/F (DID)      | 04/04/2014-16:30 | 29.10            | 25.30             | 30.10             | 27.26                     | 13.06         | 39.64           |
| 13  | EMPANGAN BUKIT MERAH     | <a href="#">PERAK</a>    | 5006401   | W/F (DID)        | 04/04/2014-16:00 | 8.70             | 6.40              | 9.80              | 6.57                      | 21.48         | 27.17           |
| 14  | EMPANGAN LANGAT          | <a href="#">SELANGOR</a> | 0000000   | W(LUAS)          | 04/04/2014-08:00 | 220.96           | 204.21            | 220.96            | 211.42                    | 16.00         | 49.35           |
| 15  | EMPANGAN SUNGAI SELANGOR | <a href="#">SELANGOR</a> | 0000000   | W(LUAS)          | 04/04/2014-08:00 | 220.00           | 184.63            | 220.00            | 189.85                    | 84.00         | 36.88           |
| 16  | EMPANGAN TASIK SUBANG    | <a href="#">SELANGOR</a> | 0000000   | W(LUAS)          | 04/04/2014-08:00 | 37.87            | 34.75             | 37.87             | 37.74                     | 3.00          | 88.16           |
| 17  | EMPANGAN SUNGAI TINGGI   | <a href="#">SELANGOR</a> | 0000000   | W(LUAS)          | 04/04/2014-08:00 | 59.50            | 49.00             | 59.50             | 52.98                     | 69.00         | 60.97           |
| 18  | EMPANGAN SEMENYIH        | <a href="#">SELANGOR</a> | 3018402   | W (ABASS)        | 03/04/2014-17:00 | 111.00           | 84.30             | 111.00            | 106.08                    | 42.26         | 59.82           |
| 19  | EMPANGAN BATU            | <a href="#">WLH</a>      | 3216490   | W/F (DID)        | 04/04/2014-16:00 | 102.70           | 79.00             | 107.30            | 99.27                     | 24.98         | 78.14           |
| 20  | EMPANGAN KLANG GATE      | <a href="#">WLH</a>      | 3217435   | W/F (PNSB)       | 04/04/2014-15:45 | 94.00            | 84.00             | 98.00             | 89.90                     | 16.06         | 57.76           |

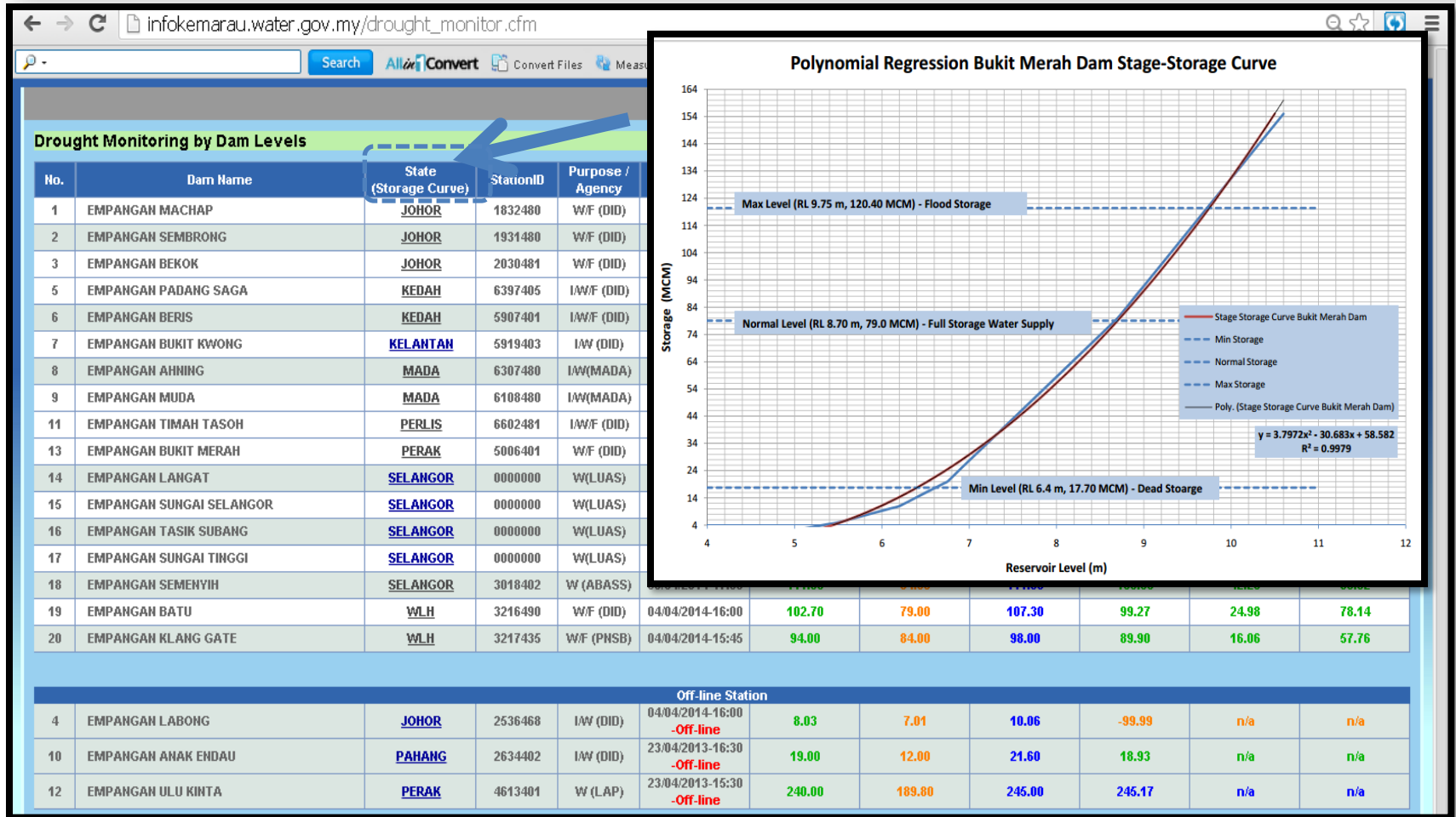
  

| Off-line Station |                     |                        |         |           |                               |        |        |        |        |     |     |
|------------------|---------------------|------------------------|---------|-----------|-------------------------------|--------|--------|--------|--------|-----|-----|
| 4                | EMPANGAN LABONG     | <a href="#">JOHOR</a>  | 2536468 | I/W (DID) | 04/04/2014-16:00<br>-Off-line | 8.03   | 7.01   | 10.06  | -99.99 | n/a | n/a |
| 10               | EMPANGAN ANAK ENDAU | <a href="#">PAHANG</a> | 2634402 | I/W (DID) | 23/04/2013-16:30<br>-Off-line | 19.00  | 12.00  | 21.60  | 18.93  | n/a | n/a |
| 12               | EMPANGAN ULU KINTA  | <a href="#">PERAK</a>  | 4613401 | W (LAP)   | 23/04/2013-15:30<br>-Off-line | 240.00 | 189.80 | 245.00 | 245.17 | n/a | n/a |



20 reservoir levels are monitored daily

# STORAGE VOLUME



# LOW FLOW ANALYSIS

| No. | Station ID<br>(Flow Duration Graph ) | Station Name<br>(Graph)            | State<br>(Rating Curve) | Last Update      | Normal Level<br>(m) | Water Level<br>(m)<br>(Real-time) | River Flow<br>(m <sup>3</sup> /s) | Drought Flow For Various Return Periods<br>For 7 Days Low Flow<br>(m <sup>3</sup> /s) |        |         |         |
|-----|--------------------------------------|------------------------------------|-------------------------|------------------|---------------------|-----------------------------------|-----------------------------------|---|--------|---------|---------|
|     |                                      |                                    |                         |                  |                     |                                   |                                   | 2-year  | 5-year | 10-year | 20-year |
| 1   | 2527411                              | SG.MUAR DI BULOH KASAP             | JOHOR                   | 04/04/2014-16:00 | 15.5                | 4.79                              | 15.74                             | 8.05  | 5.05   | 4.2     | 3.2     |
| 2   | 2030401                              | SG.BEKOK DI BT.77 JLN Y.P          | JOHOR                   | 04/04/2014-16:00 | 5.94                | 3.04                              | 0.53                              | 1.88  | 0.73   | 0.35    | 0.14    |
| 3   | 1737451                              | SG. JOHOR AT RANTAU PANJANG        | JOHOR                   | 04/04/2014-16:00 | 4                   | 3.01                              | 24.39                             | 8.14  | 4.79   | 3.15    | 1.9     |
| 4   | 5606410                              | SG. MUDA AT JAMBATAN SYED OMAR     | KEDAH                   | 04/04/2014-16:00 | 8                   | 6.42                              | 26.65                             | 17.6  | 10.96  | 9.33    | 8.6     |
| 5   | 5721442                              | SG.KELANTAN DI KUSIAL              | KELANTAN                | 04/04/2014-16:01 | 10                  | 8.29                              | 135.61                            | 155.4   | 98.9   | 70.5    | 48.5    |
| 6   | 5320443                              | SG.GALAS DI DABONG                 | KELANTAN                | 04/04/2014-16:01 | 28                  | 26.89                             | 283.01                            | 195.13  | 101.74 | 61.48   | 33.74   |
| 7   | 2519421                              | SG. LINGGI AT SUA BETONG           | NEGERI<br>SEMBILAN      | 04/04/2014-05:00 | 5                   | 4.01                              | 0.00                              | 3.47  | 1.73   | 1.07    | 0.65    |
| 8   | 3519426                              | SG.BENTONG DI KUALA MARONG         | PAHANG                  | 04/04/2014-16:00 | 86                  | 85.82                             | 11.46                             | 2.77  | 1.64   | 1.16    | 0.83    |
| 9   | 4023412                              | SG.PAHANG DI SUNGAI YAP            | PAHANG                  | 04/04/2014-10:02 | 44                  | 44.20                             | 459.82                            | 104.52  | 51.78  | 32.16   | 20.05   |
| 10  | 3224433                              | SG.TRIANG DI JAM.KERETAPI          | PAHANG                  | 04/04/2014-16:08 | 31                  | 30.22                             | 3.41                              | 18.11   | 7.31   | 3.33    | 0.9     |
| 11  | 3424411                              | SG.PAHANG DI TEMERLOH (LUBUK PASU) | PAHANG                  | 04/04/2014-15:00 | 26                  | 24.35                             | 267.24                            | 165.43  | 110.86 | 90.75   | 78.44   |
| 12  | 5505412                              | SG.MUDA DI LADANG VICTORIA         | PULAU PINANG            | 04/04/2014-16:30 | 3.5                 | 2.55                              | 22.00                             | 15.75   | 9.83   | 8.2     | 7.39    |
| 13  | 4911445                              | SG.PLUS DI KG.LINTANG              | PERAK                   | 04/04/2014-16:00 | 52                  | 51.90                             | 2.83                              | 13.3  | 9.29   | 7.41    | 6.03    |
| 14  | 4809443                              | SG.PERAK DI ISKANDAR BRIDGE        | PERAK                   | 04/04/2014-16:00 | 32                  | 31.77                             | 133.00                            | 122.65  | 68.94  | 45.49   | 29.16   |
| 15  | 5206432                              | SG. KERIAN DI SELAMA               | PERAK                   | 04/04/2014-15:45 | 10                  | 7.63                              | 4.74                              | 10.13   | 6.09   | 4.21    | 2.84    |
| 16  | 2816441                              | SG.LANGAT DI DENGKIL               | SELANGOR                | 04/04/2014-16:00 | 4                   | 3.87                              | 54.69                             | 7.29  | 4.31   | 3.15    | 2.41    |
| 17  | 3813411                              | SG.BERNAM DI JAMBATAN SKC          | SELANGOR                | 04/04/2014-16:00 | 16.5                | 17.21                             | 71.43                             | 15.79   | 12.17  | 10.88   | 10.12   |
| 18  | 3615412                              | SG.BERNAM DI TANJUNG MALIM         | SELANGOR                | 04/04/2014-16:00 | 38.5                | 36.68                             | 3.32                              | 3.27  | 2.28   | 1.97    | 1.81    |
| 19  | 2917401                              | SG.LANGAT DI KAJANG                | SELANGOR                | 04/04/2014-16:15 | 22.89               | 22.45                             | 9.62                              | 2.29  | 1.13   | 0.79    | 0.61    |
| 20  | 3414421                              | SG.SELANGOR DI RANTAU PANJANG      | SELANGOR                | 04/04/2014-16:30 | 5                   | 5.23                              | 57.22                             | 18.87   | 13.07  | 9.95    | 7.4     |
| 21  | 3118445                              | SG.LUI DI KG. SG. LUI              | SELANGOR                | 04/04/2014-16:30 | 77                  | 74.54                             | 6.27                              | 0.65  | 0.37   | 0.24    | 0.16    |
| 22  | 2918401                              | SG.SEMENYIH DI RINCHING            | SELANGOR                | 04/04/2014-16:00 | 22                  | 20.39                             | 3.26                              | 1.93  | 1.14   | 0.96    | 0.88    |
| 23  | 4832441                              | SG.DUNGUN DI JAM.JERANGAU          | TERENGGANU              | 04/04/2014-16:00 | 7                   | 4.44                              | 1.12                              | 26.84   | 12.81  | 6.12    | 1.14    |

Off-line Station



## 23 River Discharge Stations

# LOW FLOW ANALYSIS

| No. | Station ID<br>(Flow Duration Graph) | Station Name<br>(Graph)            | State<br>(Rating Curve) | Last Update      | Normal Level<br>(m) | Water Level<br>(m)<br>(Real-time) | River Flow<br>(m <sup>3</sup> /s) | Drought Flow For Various Return Periods<br>For 7 Days Low Flow<br>(m <sup>3</sup> /s) |        |         |         |
|-----|-------------------------------------|------------------------------------|-------------------------|------------------|---------------------|-----------------------------------|-----------------------------------|---|--------|---------|---------|
|     |                                     |                                    |                         |                  |                     |                                   |                                   | 2-year  | 5-year | 10-year | 20-year |
| 1   | 2527411                             | SG.MUAR DI BULOH KASAP             | JOHOR                   | 04/04/2014-16:00 | 15.5                | 4.79                              | 15.74                             | 8.05  | 5.05   | 4.2     | 3.2     |
| 2   | 2030401                             | SG.BEKOK DI BT.77 JLN Y.P          | JOHOR                   | 04/04/2014-16:00 |                     |                                   |                                   |   |        |         | 0.14    |
| 3   | 1737451                             | SG.JOHOR AT RANTAU PANJANG         | JOHOR                   | 04/04/2014-16:00 |                     |                                   |                                   |   |        |         | 1.9     |
| 4   | 5606410                             | SG.MUDA AT JAMBATAN SYED OMAR      | KEDAH                   | 04/04/2014-16:00 |                     |                                   |                                   |   |        |         | 8.6     |
| 5   | 5721442                             | SG.KELANTAN DI KUSIAL              | KELANTAN                | 04/04/2014-16:00 |                     |                                   |                                   |   |        |         | 48.5    |
| 6   | 5320443                             | SG.GALAS DI DABONG                 | KELANTAN                | 04/04/2014-16:00 |                     |                                   |                                   |   |        |         | 33.74   |
| 7   | 2519421                             | SG.LINGGI AT SUA BETONG            | NEGERI SEMBILAN         | 04/04/2014-09:00 |                     |                                   |                                   |   |        |         | 0.65    |
| 8   | 3519426                             | SG.BENTONG DI KUALA MARONG         | PAHANG                  | 04/04/2014-16:00 |                     |                                   |                                   |   |        |         | 0.83    |
| 9   | 4023412                             | SG.PAHANG DI SUNGAI YAP            | PAHANG                  | 04/04/2014-10:00 |                     |                                   |                                   |   |        |         | 20.05   |
| 10  | 3224433                             | SG.TRIANG DI JAM.KERETAPI          | PAHANG                  | 04/04/2014-16:00 |                     |                                   |                                   |   |        |         | 0.9     |
| 11  | 3424411                             | SG.PAHANG DI TEMERLOH (LUBUK PASU) | PAHANG                  | 04/04/2014-15:00 |                     |                                   |                                   |   |        |         | 78.44   |
| 12  | 5505412                             | SG.MUDA DI LADANG VICTORIA         | PULAU PINANG            | 04/04/2014-16:00 |                     |                                   |                                   |   |        |         | 7.39    |
| 13  | 4911445                             | SG.PLUS DI KG.LINTANG              | PERAK                   | 04/04/2014-16:00 |                     |                                   |                                   |   |        |         | 6.03    |
| 14  | 4809443                             | SG.PERAK DI ISKANDAR BRIDGE        | PERAK                   | 04/04/2014-16:00 |                     |                                   |                                   |   |        |         | 29.16   |
| 15  | 5206432                             | SG.KERIAN DI SELAMA                | PERAK                   | 04/04/2014-15:00 |                     |                                   |                                   |   |        |         | 2.84    |
| 16  | 2816441                             | SG.LANGAT DI DENGKIL               | SELANGOR                | 04/04/2014-16:00 |                     |                                   |                                   |   |        |         | 2.41    |
| 17  | 3813411                             | SG.BERNAM DI JAMBATAN SKC          | SELANGOR                | 04/04/2014-16:00 |                     |                                   |                                   |   |        |         | 10.12   |
| 18  | 3615412                             | SG.BERNAM DI TANJUNG MALIM         | SELANGOR                | 04/04/2014-16:00 |                     |                                   |                                   |   |        |         | 1.81    |
| 19  | 2917401                             | SG.LANGAT DI KAJANG                | SELANGOR                | 04/04/2014-16:00 |                     |                                   |                                   |   |        |         | 0.61    |
| 20  | 3414421                             | SG.SELANGOR DI RANTAU PANJANG      | SELANGOR                | 04/04/2014-16:00 |                     |                                   |                                   |   |        |         | 7.4     |
| 21  | 3118445                             | SG.LUI DI KG. SG. LUI              | SELANGOR                | 04/04/2014-16:00 |                     |                                   |                                   |   |        |         | 0.16    |
| 22  | 2918401                             | SG.SEMENYIH DI RINCHING            | SELANGOR                | 04/04/2014-16:00 |                     |                                   |                                   |   |        |         | 0.88    |
| 23  | 4832441                             | SG.DUNGUN DI JAM.JERANGAU          | TERENGGANU              | 04/04/2014-16:00 |                     | 4.44                              | 1.12                              | 26.04   | 12.01  | 6.12    | 1.14    |

**RATING TABLE AT Site 2527411 Sg Muar at Buloh Kasap at 31122009 24000**  
FLOW (m3/s)

| Water level<br>(m) | Discharge (m <sup>3</sup> /s) |        |        |        |        |        |        |        |        |        |
|--------------------|-------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
|                    | 0                             | 0.1    | 0.2    | 0.3    | 0.4    | 0.5    | 0.6    | 0.7    | 0.8    | 0.9    |
| 3                  | 0.00                          | 0.07   | 0.44   | 0.80   | 1.17   | 1.53   | 2.31   | 3.08   | 3.85   | 4.62   |
| 4                  | 5.40                          | 6.56   | 7.72   | 8.88   | 10.04  | 11.20  | 12.71  | 14.22  | 15.74  | 17.25  |
| 5                  | 18.76                         | 20.60  | 22.45  | 24.29  | 26.14  | 27.98  | 30.14  | 32.30  | 34.46  | 36.62  |
| 6                  | 38.78                         | 41.24  | 43.70  | 46.16  | 48.62  | 51.08  | 54.06  | 57.05  | 60.03  | 63.02  |
| 7                  | 66.00                         | 69.61  | 73.21  | 76.82  | 80.42  | 84.03  | 88.51  | 92.99  | 97.47  | 101.95 |
| 8                  | 106.43                        | 111.53 | 116.63 | 121.72 | 126.82 | 131.91 | 137.62 | 143.33 | 149.04 | 154.75 |
| 9                  | 160.46                        | 166.79 | 173.11 | 179.44 | 185.77 | 192.09 | 199.03 | 205.98 | 212.92 | 219.86 |
| 10                 | 226.80                        | 234.36 | 241.91 | 249.47 | 257.03 | 264.58 | 273.15 | 281.72 | 290.29 | 298.87 |
| 11                 | 307.44                        | 316.01 | 324.58 | 333.15 | 341.72 | 350.29 | 358.86 | 367.43 |        |        |

**Rating Curve Sg Muar di Buloh Kasap, Johor**

$y = -6E-05x^2 + 0.0438x + 3.8627$   
 $R^2 = 0.9727$



The Malaysian participants wishes to thank the organizers for inviting us to participate  
in the workshop and to impart knowledge on drought management  
and  
Thank you for your kind attention

**Thank You**