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Dr.Quek's Tips on MSMA
Application of
Time-Area Method
Presented By: Ir. Dr. Quek Keng Hong

WELOME TO

"10 Common Mistakes by Engineers in Applying MSMA"

Video 5- Application of the Time-Area Method

Presented by: Ir. Dr. Quek Keng Hong



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Topics Covered in Dr. Quek's Video on "10 Common Mistakes by Engineers in Applying MSMA" Series:

1. Choice of Design Storm- Where to get up-to-date design storm data?
2. Choice of Peak Discharge- What limitations of various computation methods?
3. Hydrological Procedures- Which can still be applied for rural catchments?
4. Rational Method- What limitation to catchment size?
5. Time-Area Method- How to apply Time-Area Method correctly?

Topics Covered in Dr. Quek's Video on "10 Common Mistakes by Engineers in Applying MSMA" Series (Continued):

6. Runoff Routing Method- Which free software can be used and what data required?

7. Detention- Detention Basin or On-Site Detention (OSD)?

8. On-Site Detention (OSD)- How to optimize the required SSR (Site Storage Requirement)?

9. Detention Basin- How to optimize the required detention storage?

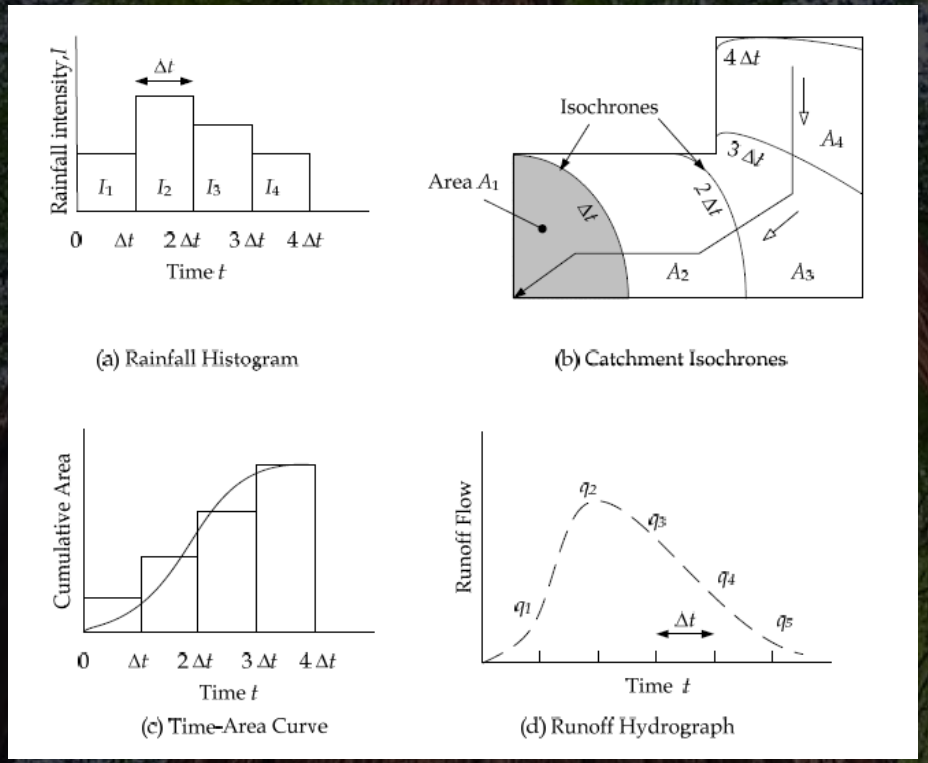
10. Erosion and Sediment Control Plan (ESCP)- How to apply ESCP Correctly?

- **How to Correctly Apply the Time-Area Method in MSMA?**

1. When to apply the Time-Area Method in MSMA?

For area < 80 ha use the Rational Method
For area > 80 ha use the Time-Area Method

- 2. Time-Area Method is convolution of the rainfall excess hyetograph with a time-area diagram



- 3. The convolution procedure

The convolution procedure can be represented by:

$$q_i = I_i \cdot A_1 + I_{i-1} \cdot A_2 + ... + I_1 \cdot A_i$$

where
qi = the flow hydrograph ordinates (m3/s)
Ii = excess rainfall hyetograph ordinates (m/s)
Ai = time-area histogram ordinates (m2)
i = number of isochrone area contributing to the outlet.

- 4. The convolution procedure

The convolution procedure can be expanded as follows:

$$q_1 = I_1 \cdot A_1$$

$$q_2 = I_2 \cdot A_1 + I_1 \cdot A_2$$

$$q_3 = I_3 \cdot A_1 + I_2 \cdot A_2 + I_1 \cdot A_3$$

$$q_4 = I_4 \cdot A_1 + I_3 \cdot A_2 + I_2 \cdot A_3 + I_1 \cdot A_4$$

$$q_5 = I_5 \cdot A_1 + I_4 \cdot A_2 + I_3 \cdot A_3 + I_2 \cdot A_4 + I_1 \cdot A_5$$

- 5. Loss Model for the Time-Area Method in MSMA (2011)

Table 2.6 in MSMA (2011) gives the recommended loss models for used in the Time-Area Method.

Catchment Condition	Initial loss (mm)	Continuous Loss (mm/hr)
Impervious	1.5	0
Pervious	10	• Sandy Soil: 10-25 mm/hr • Loam Soil: 3-10 mm/hr • Clay Soil: 0.5-3 mm/hr

6. The Time-Area Method as compared to the Rational Method:

Advantages:

Area > 80 ha.

Uneven temporal distribution of rainfall.

Effect of temporary catchment storage.

Disadvantages:

More difficult to apply than the Rational Method.

Prone to errors due to wrong application.

7. Differences between the Time-Area Method and the Rational Method

Need to derive the Time-Area diagram.

Need to input the rainfall temporal pattern.

Need to determine the loss rate.

Need to perform the convolution process.

8. Common Mistakes in Applying the Time-Area Method

a. Using too many isochrones.

b. Applying to too large catchment.

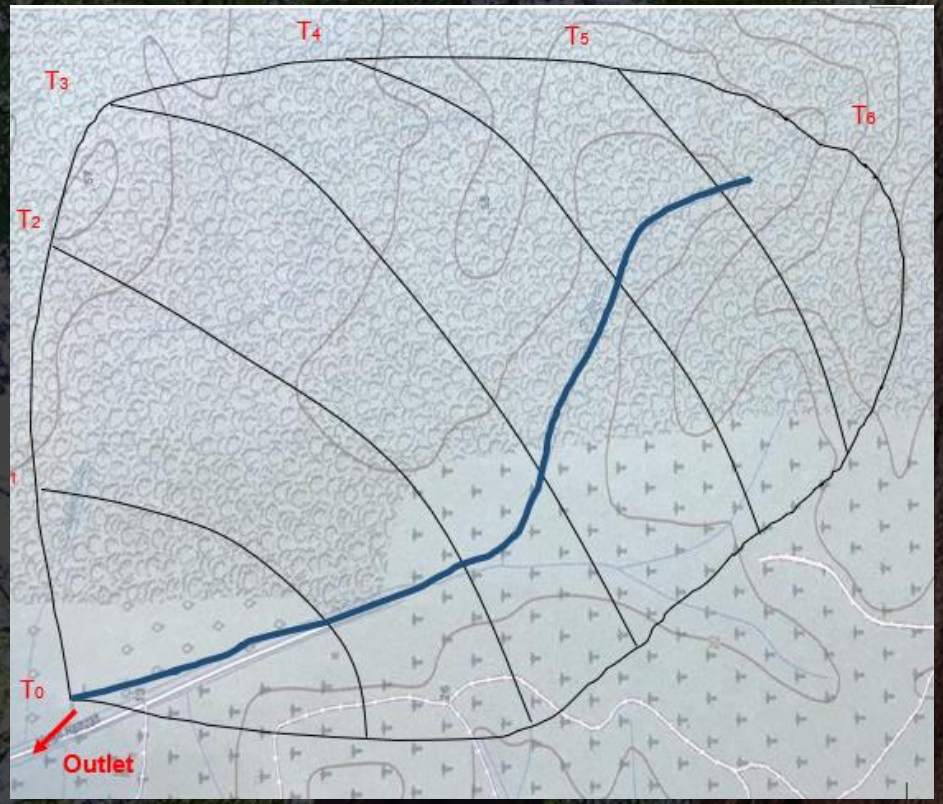
c. Input wrong storm and temporal patterns- HP1/26 rec over MSMA

d. Input wrong loss rate- MSMA (2011) recommends Table 2.6.

e. Error in applying the convolution process- see my spreadsheet.

f. Mistakes in deriving the Time-Area diagram- pre & post development scenario.

9. Pre and Post-Development Scenarios





10. Case Study- Apply the Time-Area Method to compute the peak discharge with Design Storm based on HP1 (2021) & MSMA (2011):

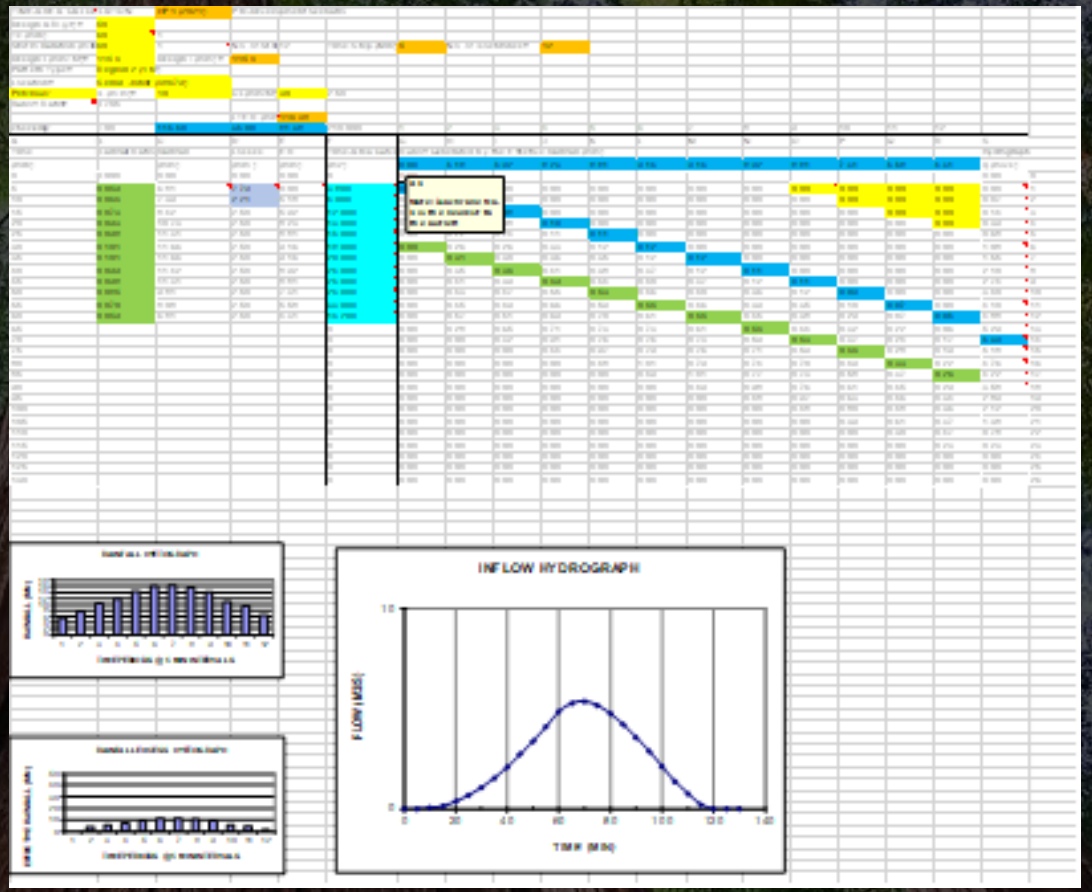
Worked Example 4.3- HP1 (2021)
Worked Example 4.4- MSMA (2011)

Pre-Development
Area = 21 ha
Time Area Curve:
3800,4000,12000,13000,15000,18000,20000,24000,25000,26000,33000,16200

Storm duration= 60 min
Tc = 60 min
Station Name: Senai, Johor

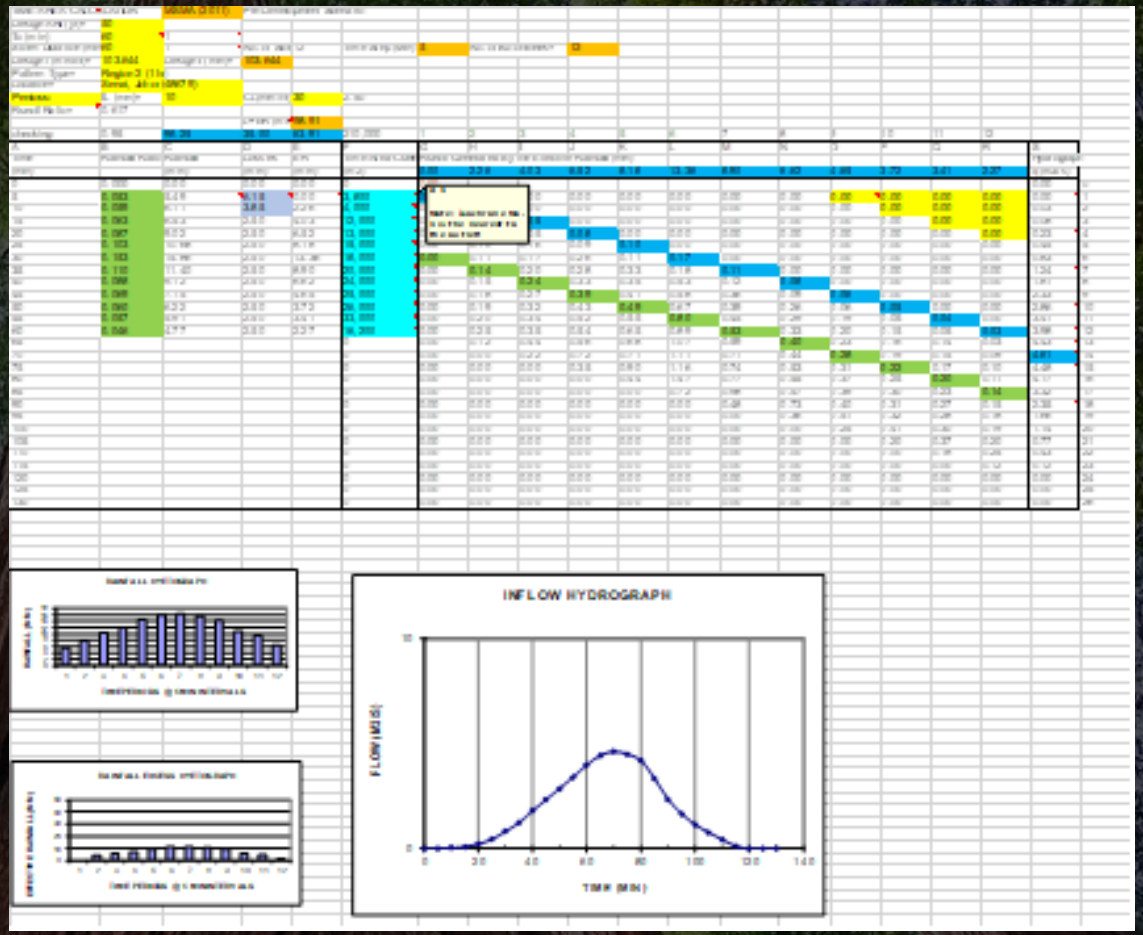
11. Worked Example 4.3- Computed design discharge from Time-Area Method using design storm based on HP1 (2021):

Qp= 5.39 m3/s



12. Worked Example 4.4 - Computed design discharge from Time-Area Method using design storm based on MSMA (2011):

Qp= 4.61 m3/s

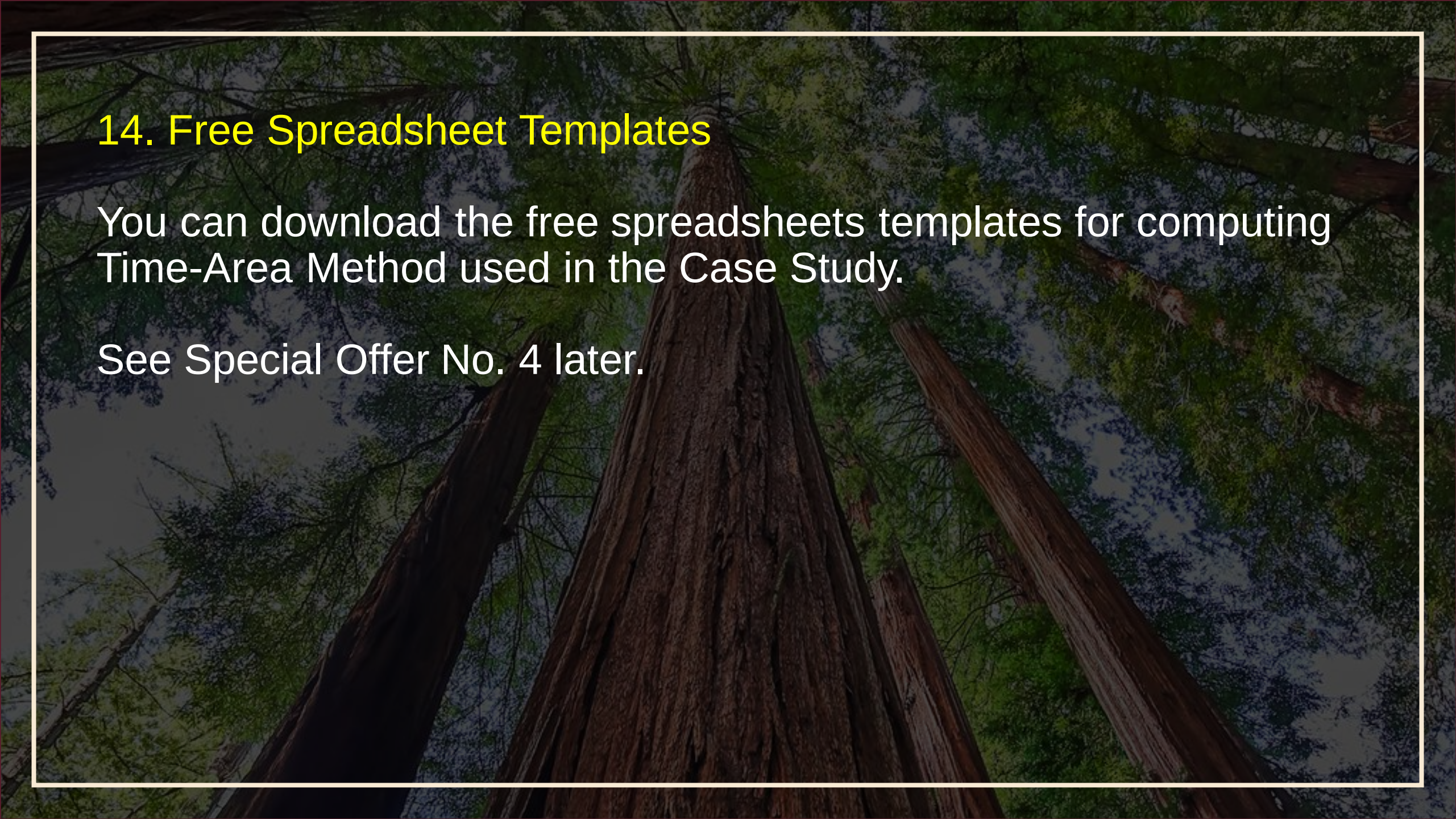


13. Conclusions:

HP1 (2021), intensity i= 115.40 mm/hr (A)
MSMA (2011), intensity i= 98.25 mm/hr (B)
The ratio of A/B = 1.17

HP1 (2021), Qp = 5.39 m3/s (A)
MSMA (2011), Qp = 4.61 m3/s (B)
The ratio of A/B = 1.17

Hence HP1 gives higher estimates of the peak discharge hydrograph in Time-Area Method.



14. Free Spreadsheet Templates

You can download the free spreadsheets templates for computing Time-Area Method used in the Case Study.

See Special Offer No. 4 later.

SPECIAL OFFER 1:



You can Signup MSMAware for free now:

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http://welcomeVideo.msmaware.com

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Download Free Spreadsheet Templates:

Free spreadsheet templates (Storm, Rational Method, Time-Area Method, OSD) for the first 88 requests each month at:

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Can I contact Dr. Quek if I have any question?

Answer: **YES!**

Email: workshops@msmam.com

Call/WhatsApp: (6) 012-2812590

Please check our Facebook page at: http://fb.msmam.com

Benefits of Attending MSMA Workshops:

1. Practical hands-on training workshops using spreadsheet templates and real case studies.

2. Conducted by a trainer with 3 decades of experience as a consultant in drainage design and hydrology.

3. Compliance with authority's requirements on MSMA.

Benefits of Attending MSMA Workshops (Continued):

4. Learn to optimise your design of drainage structures while complying with MSMA.

5. Receive valuable spreadsheet templates which you can bring back for your work.

6. Bonuses- spreadsheet templates, software and resource material on MSMA.

Benefits of Attending MSMA Workshops (Continued):

7. Free signup of MSMAware Free Version.

8. Lifetime access to gDrive to download resource material, worked examples, tools and spreadsheets on MSMA.

9. Sign up for Facebook page- http://fb.msmam.com - like it and you will receive future posts on MSMA.

Benefits of Attending MSMA Workshops (Continued):

10. New material will be uploaded to the shared gDrive folder at regular intervals. This will be announced on Facebook page or via emails.

11. Workshops accredited by BEM- Gain up to 7 CPD Hours per day for PE renewal.

12. Workshops accredited by HRD Corp and are claimable from HRD Corp.

How to Contact Us?

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