Drainage Effects Of Sangkuriang Indah Residential Area On Condition Existing Drainage System in Water Shed Borang River Palembang City

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Abstract—Palembang city is largely lowlands areas. potentially rapid development occurs land use change and condition of the area is vulnerable to flooding, such as in the urban area. Sangkuriang Indah Residential including one of experiencing flooding problems, especially if rainfall is high intensity. The purpose of this study are to analyze the flood in the area of Sangkuriang Indah Residential, evaluate existing channel dimensions and discharge planning an ideal channel dimensions.

The methodology are used : 1) The collection of both primary and secondary data. 2) Hydrological analysis for the identification of flooding. 3) Analyzing the discharge channel dimensions are by using SWMM-5 program. 4) Preparation of Reports. The collection of primary data such as survey conditions existing used questionnaires and interviews, GPS elevation surveys while collecting data such as search data GIS Map, Satellite Imagery and Data Hydrology.

The condition of existing Sangkuriang Indah Residential are located in low topography and dimensions of drainage inadequate and water flows less smoothly. In the simulation of existing conditions on drainage in the residential Sangkuriang Indah obtained that the channel inadequate C8, C9 and C13 channels with dimensions of 20 cm x20 cm. Using a rational method, C8 channel dimensions = 25 cm x 53 cm, C9 channels = 25 cm x 40 cm,C13 channels = 25 cm x 35 cm. The simulation results obtained SWMM-5, C8 channel dimensions = 25 cm x 40 cm, C9 channels = 25 cm x 40 cm, C13 channels = 25 cm x 30 cm. So, the results of dimension channel calculation used SWMM-5 program more economic than rational method. inundation that occurred due to the dimensions of the channel, the construction of homes that do not meet the standards, land conversion and tides (climate change).

Keywords— Floods, Rainfall, Drainage, Residential.

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I. Introduction

FLOOD is a very popular word in Indonesia, especially in the rainy season, considering almost all cities in Indonesia suffered catastrophic flooding. These events repeated nearly every year, but the issue until now have not been resolved, and even tends to increase, both its frequency, its range, depth, and duration.

Palembang city is one big cities in Indonesia are often experienced flooding problems. As a developing city with a variety of existing urban infrastructure, the topography has the potential to experience flooding especially during the rainy season. It is also in perparah with the changes and shifts in land use functions.

In the city of Palembang, especially wetlands has been a lot intended for construction of one residential area in District Sako located in Sub watershed accreditation form. Sangkuriang Indah Residential including one of the housing in the area that experienced flooding problems, especially if high-intensity rainfall. Channel dimensions will lead to inadequate capacity of small and not ideal channel conditions will inhibit the flow rate so that the water should flow into the overflow discharge channel exceeds the channel.

II. Fundamental Theory

A. Drainage

Drainage can be generally defined as a technical act to reduce excess water, well water comes from rain, seepage, and excess irrigation water from an area / land, so that the function of the area / land is not disturbed (suripin, 2003).

From another point of view, drainage is one of the elements of public infrastructure needs of urban society in the context of city life into a safe, comfortable, clean, and healthy. Drainage infrastructure here serves to drain surface water into water bodies (surface and bottom water sources) and or building infiltration. It also serves as a control surface water needs with actions to improve the area muddy, standing water and flooding.

Method of disposal or distribution of water to the drainage system should not cause damage to the soil surface shape, for example due to water erosion and deposits. In principle, a good drainage plan will pay attention to the main terms of the planned area in the end free from flooding and drainage channels to drain any sediment and concentration of particles in a short time.

B. Flooding

Flooding is the event setting the mainland because of increased water volume or flow / stagnant water which is due to the surge-surge in the area on the right or left side of the river / channel due to flow of the river does not have enough capacity for flow rates through (Sudjarwadi 1987).

Floods are frequently influenced by several factors, among others:

a. The small capacity of the drainage
b. The bottom slopes gently sloping drainage channel.
c. Influenced by tidal
d. The topography in some places a relatively flat.
e. High rainfall that run off which happens quite large.
f. Sedimentation of rivers and household waste

C. Rainfall

Rainfall is needed for the design of water utilization is the average rainfall throughout the region. Observer stations scattered rain in a watershed can be considered as a point. Purpose of finding the average rainfall is changing to rain rain point territory or looking for a value that can be represented in a watershed. Broadly There are 3 (three) ways to calculate the average rainfall is way average Algebra, Thissen Polygons way, way Ishoyet.

Frequency Analysis

Frequency analysis is used to determine the amount of rain or a debit when rainfall (return period) specified. This scale is a scale flooding (or rain / design rainfall) which will average equaled or exceeded once in T years. T (year) is called when the reset (return period). Frequency analysis can be done for the series of data obtained from the data whether the data recording rainfall / discharge.

Frequency analysis is used to determine the amount of rain or a debit Frequency Re-Rain Periods

Rain forecasts plan carried out by frequency analysis of annual maximum rainfall data (annual series). There are several kinds of distribution in statistics and a frequency commonly used in the analysis there are 4 (four) types:

1). Normal Distribution;
2). Log Normal Distribution;
3). Gumbel distribution;
4). Log Pearson Type III distribution.

D. Distribution Testing

In order to obtain the best frequency distribution, data were analyzed using the method of distributions to the frequency analysis. Selection of the type of distribution method that will be worn, carried out with due regard to the amount of rain and statistical data for comparison of all types of distributions were tested compatibility with the Kolmogorov-Smirnov method. If the quantities of rain did not show any statistical data on the use of certain types of distribution methods, selected the type of distribution method that gives a maximum deviation of the empirical distribution of the theoretical minimum.

E. Rain Intensity

Rain intensity is high or rain water depth per time unit. Stating the amount of rainfall intensity rainfall in the short term that gives an overview rain per hour. To process data into rainfall intensity rainfall statistics used means of observational data the duration of rainfall that occurred can be used various methods, including:

- Van Breen Method
- Tanimoto Method
- Hasper and Verduwen Method

F. Selection of Rain Intensity Analysis Method

After doing the processing of rainfall data with statistical methods is the selection of analytical methods the intensity of rainfall. According Suripin (2003) The amount of rainfall intensity is different due to the rainfall duration or frequency of occurrence. The relationship between intensity, duration and frequency of rain usually expressed in the curved Intensity-Duration-Frequency

Intensity-Duration-Frequency Curve (IDF). Necessary short-term rainfall data for example 5 minutes, 10 minutes, 30 minutes, 60 minutes and the hours fatherly IDF curved shape. Furthermore, based on these short-term rainfall data IDF curve can be made with one of the following equation:

- Talbot Method (1881)
- Sherman Method (1905)
- Ishiguro Method (1953)
- Mononobe Method

G. Runoff Coefficient

Reduced water that made it through the mouth of the basin caused by the flow retained by the roots and leaves of plants, and are suspended between grass or dense undergrowth.

Water seeped into the soil layer retained in the form of a puddle of water, when the uneven flow of surface area and a lot of infiltration basins is stored in the wells that are constructed by the inhabitants of the city, so that rain water eventually seeped into the ground. Runoff coefficient also depends on soil properties and Events. However, in practice there are many different types of mixed land uses within a watershed. Therefore, to obtain a combined drainage coefficient, Cw should use the following composite formula:

$$C_w = \frac{A_1C_1 + A_2C_2 + A_nC_n}{A_1 + A_2 + A_n} \quad (1)$$

where :

C_w = the coefficient of the combined drainage;
A_1, A_2, A_n = the area of Regional stream n fruit, with a land use different;
C_1, C_2, C_n = coefficient of the drainage basin of n, with different land use.

H. Time of Concentration

Time of concentration is the time required by the rain water that falls to flow from farthest point to the point of control after the soil becomes saturated and small deprsei deprsei-met (Suripin, 2003). In this case it is assumed that if the duration of rainfall equal to the time of concentration. One method to determine the total concentration is the formula developed by Kirpich (1940), which can be written as follows

$$t_c = \left(\frac{0{,}87\ L^2}{1000\ S}\right)^{0{,}385} \quad (2)$$

Where tc is the time of concentration in hours, L the length of the main channel from upstream to drain in Km and S main channel slope in m.

I. Debit Flood Plan

To plan a channel dimensions must be known actual flood discharge. This aims to avoid the puddles. To meet this goal lines should be made sufficiently in accordance with the flood discharge. Flood discharge is very important in planning the drainage system. If one dala determine discharge plans, then the unused drainage system will not function properly. Discharge of water that must be channeled taken on a large flood discharge plan, as the basis for the calculation of the size of the planned buildings. This aims to avoid damage to the building and surrounding area as a result of excessive water discharge, is also planning a building needs to be created that is

economical, the following are factors - factors that determine how many high-standing water is allowed so as not to cause harm are:
a. How much area will be flooded (up to the permitted height limit).
b. The duration of inundation occurred

Rasional Method

This method is the oldest in calculating the discharge, the way is based on a formula;

$$Q = 0.002778\ C.I.A \qquad (3)$$

When used according to metric units (Kensaku Takeda, 2006), then the formula becomes rational.

$$Q = 0,278\ C.I.A\ (m^3/det) \qquad (4)$$

where :

Q = Debit (m^3/s)
C = Number drainage
I = Intensity of rainfall maximum during the same time the length of time of concentration (mm/ h).

III. METHODS

A. Study Site

Palembang city lies between 2°52' to 3°5'LS and 104°37' till 104°52' E with an average height of 8 meters from the sea surface. The city of Palembang in 2007 divided 16 districts and 107 sub-districts, and based on PP.No 23 in 1998 Palembang area is 400.61 km^2 or 40,061 ha. Consists of 19 watersheds with their respective administrative boundaries.

In geographical boundaries of the region of Palembang are as follows:

- South Boundary: Regency Ogan Ilir and Muaraenim
- North: District Banyuasin
- East : District Banyuasin
- West : DistricBanyuasin

The study focused on the drainage area of housing in the city of Palembang.

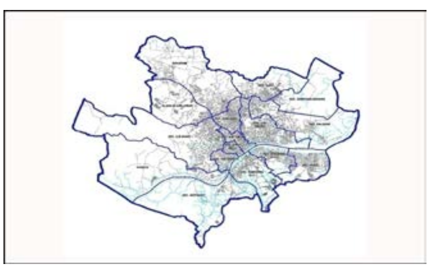

Fig 1. Map of site study

B. Data Processing

Having conducted a review of field and data collection, data processing can be performed the following:

a) Data processing of the survey maps of GPS (Global Positioning System).
b) Calculation of rainfall intensity.
c) Determining the method of distribution of rainfall with the Kolmogorov-Smirnov test.
d) Calculation of flood discharge plan with the rational method.
e) Analysis of rainfall units with units hidrograf.
f) Analysis of discharge channel capacity modeling with SWMM program-5 (Storm Water Management Model 5). From the data processing, the output obtained from the modeling. After data analysis it can be done.

Drainage network Sangkuriang Indah Residential modeled using SWMM5 program. The first step in doing that is inputting the data modeling, simulation afterwards. Modeling and simulation results show the high water drainage when it rains occur and which channels melimpas, the capacity is not enough to accommodate the discharge, and the next step is the analysis of simulation results.

The data needed to perform the modeling and simulation are:
a. Map of the area of housing and residential drainage network
b. Condition of existing channels (channel dimensions)
c. Hyetograph rain ABM design methods, and initial and boundary conditions of the simulation.
d. Tidal

IV. RESULT AND DISCUSSION

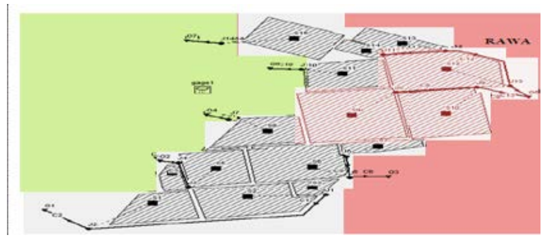

Fig 2. Regional channels are flooded

In the process of simulation results (existing conditions) is done checking in each channel (Junctions, Conduits, outfalls). After analyzing simulated flooded areas found in Conduits 8, 9 and Conduits Conduits 13.

- C8 is a secondary channel that connects J8-J9 and serve S9, channels, measuring 20x20cm.
- C9 is a primary channel that connects J9 to O5 and serve S9, channels, measuring 20x20cm.
- C13 is the primary channel that connects J13 to the O5 and serve S12, channels, measuring 20x25cm.

Flood simulation

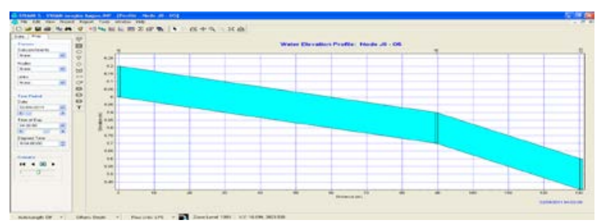

Fig 3. Flood simulation C8 and C9

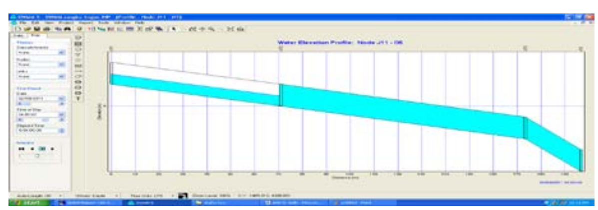

Fig 4. Flood simulation C13

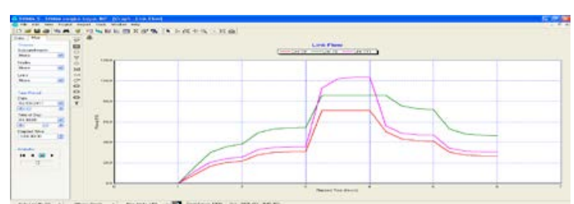

Fig 5. Grafik *link flow* C8, C9, C13

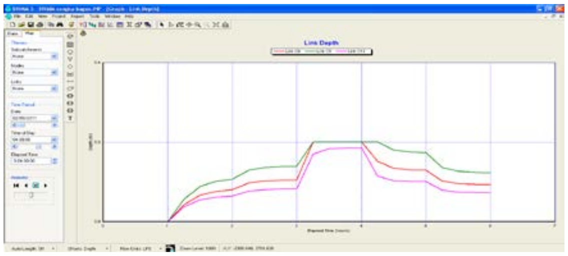

Fig 6. Grafik *link depth* C8, C9, C13

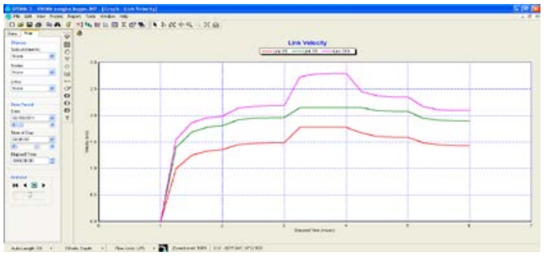

Fig 7. Grafik *link velocity* C8, C9, C13

Conduits 8 (J8-J9)

From the results of simulation with SWMM-5 program found that the C8 (J8 to J9) experienced flooding. Melimpas water to the surface occurred at the 3 through 15 minutes and take place for 1 hour. Where the value of the peak occurs at a depth of 4 is equal to 0.20 cm with a flow of 70.92 LPS and velocity of 1.77 m / sec.

Conduits 9 (J9-O5)

From the simulation results with the program found that the SWMM-5 C9 (J9 to O5) experienced flooding. Melimpas water to the surface occurred at the 3 through 15 minutes and take place for 1 hour and 15 minutes, resulting in stagnant flow and overflow channel limit. Where the depth of the peak value occurs at the amount of 0.20 to 5 cm with a flow of 85.73 LPS and velocity of 2.14 m / sec

Conduits 13 (J13-O5)

From the results of simulation with SWMM-5 program found that the C13 (J13 to O5) experienced flooding. Melimpas water to the surface occurred at the 3 through 30 minutes and take place for 30 minutes, resulting in stagnant flow and overflow channel limit. Where the depth of the peak value occurs at the rate of 0.25 to 4 cm with the flow and velocity of 101.99 LPS at 2.78 m / s.

Scenario Modelling Channel Dimension Settlement Against Flooding

Planning dimensions of Line Ideal Wasters

From the results of simulation and modeling of existing conditions, there are 3 channels that are not able to accommodate the discharge that C8, C9 and C13. Where is the flooding that occurred in the area of channel capacity can result from a small addition that also changes in land use that causes loss of catchment areas.

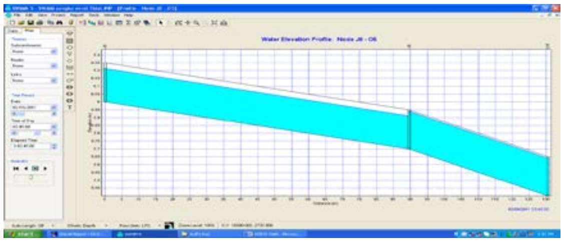

Fig 8. Simulation of flood channels in the C8 and C9 replacement

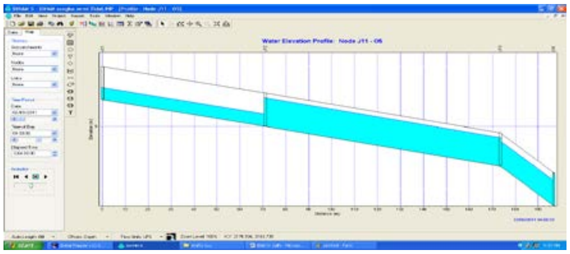

Fig. 9

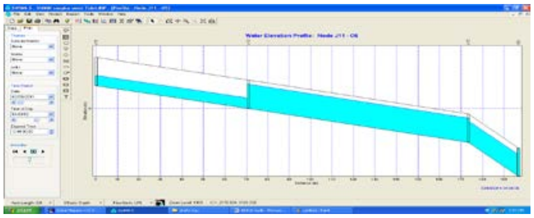

Fig 10. Simulation replacement in C13 flood channel

From the analysis of flood simulation and the simulation results in Table C8, C9 and C13 with a replacement channel, channel capacities appear sufficient substitute, so there is no flooding and the water does not overflow beyond looks channels.

Method of trial and error SWMM-5

From the calculation of rational methods and results of simulation modeling with SWMM-5 obtained ideal discharge channel dimensions which can accommodate a capacity of Debir water. But it's good to plan drainage economic aspects are taken into account (effectively and efficiently), and therefore tried the method of trial error.

Conduits 8

Rational calculation results obtained from the channel dimension 25x53. To get the effective and efficient method of trial and error try, try measuring 25x40 cm channel and simulated by SWMM-5 program got the result that is still able to accommodate the dimensions of the discharge capacity.

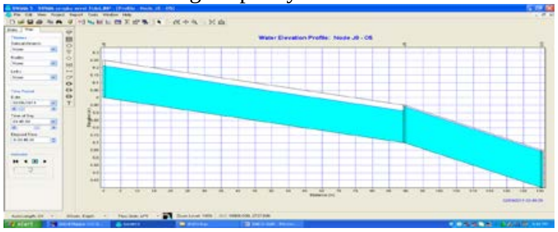

Fig 11. Hasil simulasi *trial error* pada C8

Conduits 9

Rational calculation results obtained from channel dimensions 25x40 cm, denganmetode trial error, try channel measuring 25x35 cm and simulated by SWMM-5 program, but we got the result that the dimensions are not able to accommodate the discharge capacity. Then remained on the channel dimensions 25x40 cm.

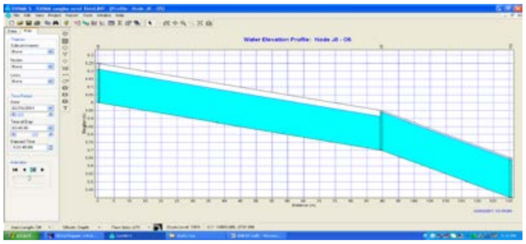

Fig 12. Hasil simulasi *trial error* pada C9

Conduits 13

Rational calculation results obtained from channel dimensions 25x35 cm, with the method of trial and error, try channel measuring 25x30 cm and simulated by SWMM-5 program got the result that is still able to accommodate the dimensions of the discharge capacity.

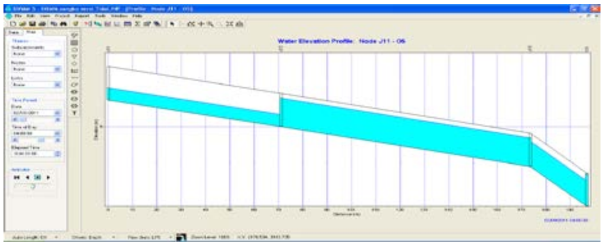

Fig 13. The simulation results of trial error in C13

Recapitulation Table Dimension Line

TABLE 1. RECAPITULATION OF EXISTING DRAINAGE CONDITIONS SIMULATION SWMM-5

SWMM Simulation (Existing Conditions)				
Channel	Dimension		Caption	Max depth (cm)
	Height (cm)	Width (cm)		
C 8	20	20	Overflow	>20
C 9	20	20	overflow	>20
C 13	25	20	overflow	>20

TABLE 2. RECAPITULATION DRAINAGE CALCULATION RATIONAL METHOD SIMULATION SWMM-5

SWMM Simulation (Rasional calculation)				
Channel	Dimension		Caption	Max depth (cm)
	Height (cm)	Width (cm)		
C 8	25	53	unoverflow	0.16
C 9	25	40	unoverflow	0.24
C 13	25	35	unoverflow	0.15

TABLE 3. RECAPITULATION DRAINAGE TRIAL ERROR SIMULATION SWMM-5 METHOD

SWMM Simulation (Trial Error SWMM-5)				
Channel	Dimension		Caption	Max depth (cm)
	Height (cm)	Width (cm)		
C 8	25	40	unoverflow	0.21
C 9	25	40	unoverflow	0.24
C 13	25	30	unoverflow	0.17

V. CONCLUSION

1. In the simulation of existing conditions in the housing on channel Sangkuriang Indah using SWMM 5.0 program found that the channel is a channel inadequate C8, C9 and C13 channels with dimensions of 20x25cm.
2. Based on the rational calculation and simulation models obtained SWMM5 dimensional channel dimensions Sangkuriang Beautiful adequate housing as follows:

Saluran8 (C8)
- Rational Method = 25 cm (height) x 53 cm (width)
- SWMM5 = 25 cm (height) x 40 cm (width)

Saluran9 (C9)
- Rational Method = 25 cm (height) x 40 cm (width)
- SWMM5 = 25 cm (height) x 40 cm (width)

Saluran13 (C13)
- Rational Method = 25 cm (height) x 35 cm (width)
- SWMM5 = 25 cm (height) x 30 cm (width)

3. Comparison of the results of the calculation of the dimensions of the channel using the rational method to program SWMM-5 simulation results obtained with SWMM-5 program can generate more economic dimensions.
4. In residential inundation occurs due to the low capacity of the channel capacity, infiltration areas that converted it working, low topographic location, land use change, climate change.
5. Dimensional channel model simulation results SWMM5 more efficient than the dimensions of the calculation of the rational method

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