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Urban Planning of Drainage in BTN Hamzy of Makassar City

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Abstract

Drainage is generally defined as a technical measure to remove excess water which is not desirable in an area, as well as ways of overcoming consequences caused by excess water, so that the function of the area/land is not disturbed. Drainage problems in the BTN Hamzy of Makassar City, caused by a lack of ability to accommodate drainage discharge the water, there is also a channel that does not connect/disconnected with other channels, also less maintained and not maintaining the drainage channels. Location of study is on Housing Complex BTN Hamzy of Makassar City. The study discusses the causes of inundation occurred in the area due to lack of ability to accommodate drainage water discharge and less optimal catcher called inlet channels in capturing the existing water discharge. The analysis shows that there are 4 blocks of housing that have lower altitudes than the surrounding blocks, i.e., Block P, P1, Q, Q1, R, R1 and S, but the existing channels are not capable of removing water from the puddle. The method used is a channel dimension planning useful for normalizing existing channels and re-planning of inlet tracts and making absorption wells in the area.

Keywords: Drainage; Urban; Makassar

Introduction

Urban drainage is one of the vital infrastructures for the region. Which serves to drain the air? Where drainage systems are not well designed will be environmental degradation, economic losses and degradation of residential quality such as flood puddles, floods, damaged existing infrastructure [1]. This contributes to the disruption of urban functions, the inhibition of human mobility and the emergence of various diseases [2].

City growth and development of the development sector have a significant impact on changes in the value of surface runoff, with further impacts on the drainage system [3]. Increasing residential areas and their facilities led to the use of previously open land that serves as a recharge area, turned into a closed area of pavement and is waterproof so as to reduce its function as a recharge area. Besides, land use change also causes land criticality, so that the existing land will be easily eroded [4].

Changes in land use that do not pay attention to the environmental aspects can increase the runoff of the surface water which also causes the erosion process, thus increasing the peak flood discharge in the rainy season and vice versa will reduce the flow of the river in the dry season due to the diminution of the pervasive water [5]. Besides, during the rainy season erosion materials will also be carried by the runoff discharge.

One of the problems related to the development of housing in Makassar, especially in BTN Hamzy, has an impact on the inadequate drainage function of the city, so that every rainy season comes, some of the area is flooded or flooded with sand, mud and garbage [6-8]. This condition is considered not good for the people of the city and seems to make the image of BTN Hamzy become less healthy. Therefore it is necessary to plan a system to overcome the puddle of water that occurs, namely by making the appropriate drainage system and environmentally sound. While the drainage planning concept that currently exist is often contradictory to the concept of environmental conservation because it philosophizes that the region should be immediately free from waterlogging by pulling it into the network system and flowing into the next river to the sea without regard to environmental sustainability.

Current condition BTN Hamzy has a water channel that has not been fully utilized as a city drainage channel. The channel conditions are generally relatively shallow with a depth of ± 0.5 meters and the width of the cross section is also relatively small at 0.5-0.75 meters [7]. In the planning has not illustrated in detail the drainage well plan the direction of water flow, channel dimensions, patterns of drainage systems used, and so forth.

Research Methods

Study location

Makassar city is the capital of South Sulawesi Province is a district located in the west coast and tropical climate. Makassar City consists of 14 sub-districts namely Makassar District, Mariso Sub-district, Wajo Sub-district, Mamajang Sub-district, Rappocini Sub-district, Maggala Sub-District, Biringkanaya Sub-district, Panakkukang Sub-District, Ujung Tana Subdistrict and Tamalanrea Sub-district, total area 157,77 km^2 and population end of 2017 1.653.386 inhabitants (Figure 1).

Necessary data

Data used in this research consists of two kinds, namely spatial data (spatial) and non-spatial. The following data is used:

1. Topographic map.
2. Scheme of drainage network.
3. Rainfall data.
4. High runoff data on channel.
5. Existing drainage channel data.
6. Population data.

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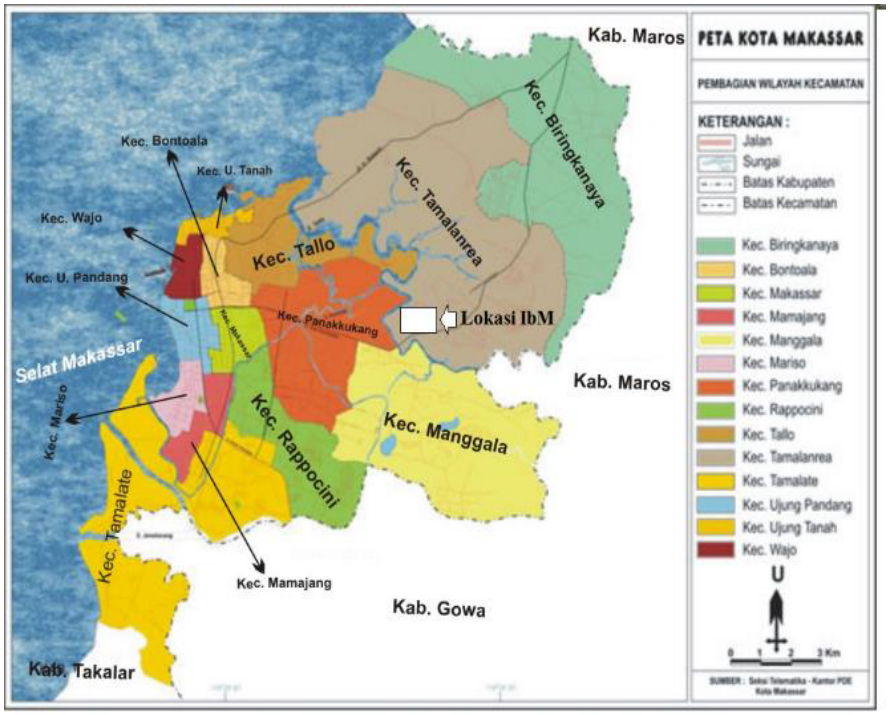

Figure 1: Location map of Makassar City [9].

Stages of study work

Stages of study work can be explained as follows [8,9]:

1. Looking for maximum annual daily rainfall from 2008-2017 at Antang rain station.
2. Determine the intensity of rainfall with the formula Mononobe.
3. Determining the area of the drainage area.
4. Determine the coefficient of drainage (C) based on the existing land around the road in BTN Hamzy.
5. Determine the capacity of existing drainage channels.
6. Evaluate the capacity of the existing drainage capacity with the flood discharge at the time of the 5th anniversary, Evaluation of the causes and handling of inundation.

Calculation

Daily rainfall data for hydrological treatment is obtained from Antang rainfall station located in Manggala sub district where the rain data is Tamalanrea Sub district [10]. The stations and rainfall analysis are shown in Table 1.

The consisitance test is required to test the truth of field data that is not affected by errors during delivery or during measurement; the data should illustrate the hydrological phenomenon as is true in the field [11].

From the analysis results in the above table will be used in the calculation of rainfall design by using the log Pearson type III method (Table 2). The table below is the result of the calculation of rainfall design using the log Pearson type III method [11].

Test calculation of conformity of projection method using correlation coefficient number. From the calculation of correlation coefficient on Geometry method, Arithmetic, Ekponensial, the results obtained that Geometric method has the largest correlation coefficient and close to +1. Thus the method chosen for population projection

Year	Maximum Daily Rainfall
	Tamalanrea Sub-district
2008	145.0
2009	73.6
2010	143.6
2011	220.0
2012	140.0
2013	133.0
2014	170.0
2015	145.0
2016	150.0
2017	88.0

Table 1: Daily mean rain data.

S. No	Tahun	Curah Hujan	Sk	(sk)	Dy^2	Sk	(sk)
1	2008	145	55,58	55.68	280,489	-,680	1,680
2	2009	73.6	-29,98	29,98	81,719	-,906	0,906
3	2010	143.6	-29,98	29,98	81,719	-,906	0,906
4	2011	220	-13,58	13,58	16,770	-0,411	0,411
5	2012	140	-9,38	9,38	8,002	-,284	0,284
6	2013	133	6,42	6,42	3,745	0,194	0,194
7	2014	170	6,42	6,42	3,745	0,194	0,194
8	2015	145	11,42	11,42	11,852	0,345	0,345
9	2016	150	11,42	11,42	11,852	0,345	0,345
10	2017	88	26,42	26,42	63,447	0,799	0,799
11	2008	145	76,42	76,42	530,885	2,310	2,310
Rerata		0		5,061	0		
Jumlah		1553.2			1,094,225		

Table 2: Homogeneity test of rainfall.

until 2027 is the Geometry Method because it approaches the actual population development [11].

The existing drainage capacity calculation aims to determine the ability of the drainage channel to accommodate the existing discharge, as well as to determine the volume of runoff reduced by the drainage channel. The drainage channel at BTN Hamzy has a trapezoidal channel shape with a plastering type [12].

The channel at the study site has a bottom width (b1) of 0.40 m, a top width (b2) of 0.75 m, a height (h) of 0.75 m, a slope of talud (m) 0.085 m and a channel slope of 0.005. The dimension of the channel can be seen in Figure 2.

Evaluation of causes and combating puddles

There are several factors that cause the occurrence of inundation in the study location, namely, the dimensions of drainage channels located in small study sites, the condition of the channel is disconnected, so it cannot accommodate the runoff water that resulted in large pools, then the number of sediments and garbage resulting in blockage of drainage channels runoff water cannot be accommodated [13].

From the factors that because the occurrence of inundation in the location it is necessary to do an action that is to increase the dimensions of the channel to be able to accommodate the rainwater runoff and the need for channel normalization due to sediment and garbage for drainage channel can work optimally.

Recommendations for drainage and water supply channel improvement

From the data obtained, it turns out that the blocks P, Q, R, and S have a lower altitude than surrounding settlement with 30 cm difference, resulting in puddle throughout the year. Community landfill activities have not been able to solve the problem of inundation, on the other hand the development carried out by the government by increasing the height of the road, resulting in the house getting drowned [14].

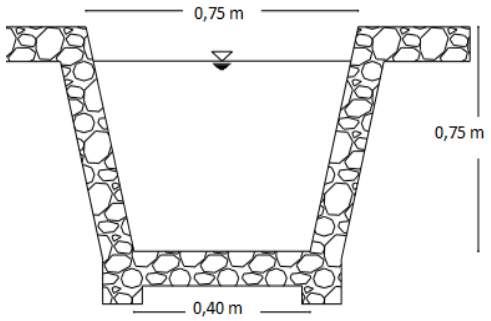

Figure 2: Dimension of water channel source: (Dinas PU Kota Makassar).

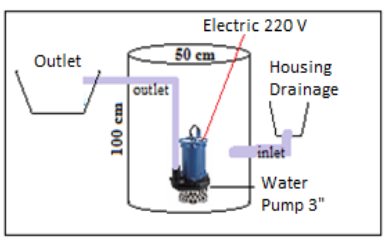

Figure 3: Drainage well plan.

The use of drainage wells is helpful to drain puddles. At the bottom of the well is a submersible water pump installed 3 "to drain the water in 4 hours, working automatically so that if the well is filled with water then the pump will drain the water in the well then forwarded to the outlet channel [15]. Drainage wells as in Figure 3.

Conclusions and Recommendations

Conclusions

1. Alternative problem solving inundation in the Study Site due to the inability of drainage channel to accommodate the existing discharge, the channel also disconnected from each other and altitude problems using drainage well pump.
2. By normalizing the drainage channels on the road and re-dimensioning as well as determining the most effective position spacing reduces the puddle. In addition to paying attention to the effectiveness of the catcher channel to the water flow in the road body, the type of catcher channel should also pay attention to the convenience of the road users.

Recommendations

1. In order to avoid puddles during the rainy season should pay attention to the importance of drainage channels. Before planning the channel should take into account the discharge that will enter the drainage channel.
2. Taking into account the condition of existing channels to maintain and maintain existing channels by not littering the trash.
3. Noting the existence of existing catcher channels (inlet) by not covering with garbage. And the importance of maintaining the condition of the channel by not littering and routinely doing excavation of channels and catcher channels (inlet).

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