ST-13
FLOODING AND LANDSLIDE POTENTIAL MAPPING OF PUBLIC HOUSING AFTER LANDUSED CHANGE

Ferry Hermawan[1*] , Eva Sulistyaningrum[2], Jihan Alda Afchori[3], Rudi Yuniarto[4] , Arif Hidayat[5], Frida Kistiani[6], Moch. Agung Wibowo[7] dan Jati Utomo Dwi Hatmoko[8]

[1]Program Studi Teknik Sipil, Universitas Diponegoro, Jl. Prof. Soedarto No.13, Semarang*
e-mail: ferry.hermawan@live.undip.ac.id
[2] Program Studi Teknik Sipil, Universitas Diponegoro, Jl. Prof. Soedarto No.13, Semarang
e-mail: evasulistya@students.undip.ac.id
[3] Program Studi Teknik Sipil, Universitas Diponegoro, Jl. Prof. Soedarto No.13, Semarang
e-mail: jihanaldaa@students.undip.ac.id
[4] Program Studi Teknik Sipil, Universitas Diponegoro, Jl. Prof. Soedarto No.13, Semarang
e-mail: rudiyuniartoadi@lecturer.undip.ac.id
[5] Program Studi Teknik Sipil, Universitas Diponegoro, Jl. Prof. Soedarto No.13, Semarang
e-mail: arifdedi1@gmail.com
[6] Program Studi Teknik Sipil, Universitas Diponegoro, Jl. Prof. Soedarto No.13, Semarang
e-mail: fridakistiani1@gmail.com
[7] Program Studi Teknik Sipil, Universitas Diponegoro, Jl. Prof. Soedarto No.13, Semarang
e-mail: agungwibowo360@gmail.com
[8] Program Studi Teknik Sipil, Universitas Diponegoro, Jl. Prof. Soedarto No.13, Semarang
e-mail: jati.hatmoko@ft.undip.ac.id

ABSTRAK

Semarang City, the capital of Central Java Province, is divided into three parts based on its topography: hills, lowlands, and coastal areas. As a result, the city is at risk of natural disasters. According to BNPB data from 2014 to 2023, Semarang City has the second-highest disaster history in Central Java Province, with 741 disaster events recorded. Floods and landslides are the most common disasters in the area. Permata Jangli Housing is located in the hills, where changes in land use have transformed the surrounding forest into road infrastructure. An analysis of hydrological data and soil characteristics at the site indicates that these changes have led to increased surface flow, resulting in an increased flood discharge. This is one of the reasons for the high potential for disaster. Therefore, it is essential to map the disaster potential in Permata Jangli Housing. Factors such as land use, rainfall intensity, soil texture, slope, and soil elevation affect flooding disasters, while rainfall intensity, slope, soil texture, and land use affect landslides. To assess and map the potential for disasters, we used overlay techniques with the QGIS application. Our findings indicate that Permata Jangli Residential area has a moderate potential for flooding, covering 68% of the area or 1.1 ha, and a high potential of 32% or 0.5 ha. In contrast, the potential for landslides in Permata Jangli is medium, covering 74% or 1.2 ha of the area, and high potential of 26% or 0.4 ha. In conclusion, our study emphasizes the importance of mapping disaster potential in areas with a history of natural disasters. By doing so, we can take preventive measures and mitigate the impact of disasters in the future.

Keywords: disaster, potential, map, landslide, flood.

INTRODUCTION

Background

According to data from the National Disaster Management Agency (BNPB) from 2014 to 2023, Semarang City in Central Java Province is ranked second for having experienced 741 disasters. Among the nine types of disasters that occurred in Indonesia, floods and landslides have been the most frequent disasters in Semarang City, with 431 and 117 events respectively. These disasters are caused by various factors such as topography, climatology, hydrology, vegetation and land use, geology, and anthropogenic factors (Youssef et al., 2022). Disasters can be classified into three types based on their causes: natural disasters, non-natural disasters, and social disasters. Natural disasters are caused by events or series of events caused by nature, including earthquakes, tsunamis, erupting mountains, floods, droughts, typhoons, and landslides (according to Law 24/2007 on Disaster Management). However, natural disasters do not always occur due to natural factors as many important factors caused by humans can turn natural hazards into disasters (Bosher & Chmutina, 2017). An example of this is the Permata Jangli Residential in Semarang City, Central Java, Indonesia, where the upstream area was changed by road development, leading to potential disaster risks. The location of Permata Jangli Housing is in a hilly area, and the road infrastructure with its asphalt pavement has altered the run-off characteristics, flood discharge, and watershed. This research aims to demonstrate a potential risk map for floods and landslides in residential areas that are influenced by land use change in the upstream area.

LITERATURE REVIEW

Law No. 24/2007 on Disaster Management defines disasters as events or series of events that threaten and disrupt the lives and livelihoods of the community. These events can be caused by natural or non-natural factors, or human factors, and can result in human casualties, environmental damage, property losses, and psychological impacts. In English, disasters are referred to as disasters, while threats or dangers are called hazards. Hazards are natural events that can endanger humans and the environment, while disasters are the impacts caused by them (Adiyoso, 2018: 27). Landslide and flood disasters are the two most frequent disasters in hilly areas. A landslide is a mass of soil and/or rock that detaches from a slope and moves downward due to gravity. According to BNPB (2011), landslides are one type of movement of soil or rock masses or a mixture of both, down or out of the slope due to disruption of the stability of the soil or rocks that make up the slope. The types of landslides are translational avalanches, rotational avalanches, block movement, rock collapse, soil crawling, and the flow of robbery materials. Flooding is river runoff that exceeds the water level and causes inundation around the river area. Indonesia is one of the countries that is prone to flooding because it has 5,590 main rivers, 600 of which have the potential to cause floods. The flood-prone area covered by the main rivers reaches 1.4 million hectares (Bappenas, 2008). In general, the causes of flooding can be summarized into three categories: human activities that affect spatial changes and have an impact on changes in environmental conditions, natural events (high rainfall, sea level rise, storms, etc.), and environmental degradation (such as changes in land use functions, sedimentation in rivers, narrowing of rivers, etc.). There are three types of floods: lightning floods, flood overflow, and coastal flooding. This research aims to demonstrate the potential disaster map of landslide and flood in a residential area located in a hilly area that has been affected by land use changes.

RESEARCH METHOD

Disaster Potential Assessment is a crucial step in preparing for a disaster management plan. The assessment evaluates the possibility and magnitude of losses caused by existing threats to reduce disaster risks. To determine the threat value, factors that trigger disasters are scored and weighed. This involves assigning values to the parameters that cause disasters and calculating the significant factors that contribute to them. It is important to note that each disaster has different trigger factors. Mapping is carried out using QGIS software by conducting an overlay analysis of the potential factors for floods and landslides. An overlay is a technique that combines graphics from one map with another map and its attributes to produce a combined map that has attribute information from both. The detail scoring of potential disaster of flood and landslide are presented in Table 1 and Table 2.

Table 1. Scoring the Potential for Flood Disaster

No	Variable	Class	Information	Score	Weight (%)	Total
1	Land Cover		Forest	1	25	0.25
2			Mixed Garden	2		0.50
3			Settlement	3		0.75
4			Paddy	4		1.00

No	Variable	Class	Information	Score	Weight (%)	Total
5			Ponds / Water Bodies	5		1.25
1		2000 - 2500 mm/year		1		0.25
2	Rainfall	2500 - 3000 mm/year		3	25	0.75
3		> 3000 mm/year		5		1.25
1			Very Smooth	5		0.625
2			Soft	4		0.50
3	Soil Texture		Keep	3	12.5	0.375
4			Rough	2		0.25
5			Very rude	1		0.125
1		0 – 8 %	Flat	5		1.25
2		8 – 15 %	Ramps	4		1.00
3	Slope slope	15 – 25 %	A bit steep	3	25	0.75
4		25 – 45 %	Steep	2		0.50
5		> 45 %	Very Steep/ Upright	1		0.25
1		> 100		1		0.25
2		75 – 100		2		0.50
3	Land Elevation	50 – 75		3	12.5	0.375
4		25 – 50		4		0.50
5		0 – 25		5		0.625

(Source: Ariyora et al., 2015)

Table 2. Scoring the Potential for Landslide Disaster

No	Variable	Class Interval	Land use	Score	Weight (%)	Total
1			Forest	1		0.2
2			Mixed Forest	2		0.4
3	Land Cover		Mixed Garden	3	20	0.6
4			Rice fields, shrubs	4		0.8
5			Settlement	5		1.0
1		< 1000 mm/year	Very dry	1		0.3
2		1000–2000 mm/year	Dry	2		0.6
3	Rainfall	2000 - 3000 mm/year	Being/ Damp	3	30	0.9
4		3000 - 4000 mm/year	Wet	4		1.2
5		> 4000 mm/year	Very wet	5		1.5
1			Very Smooth	5		0.5
2			Soft	4		0.4
3	Soil Texture		Keep	3	10	0.3
4			Rough	2		0.2
5			Very rude	1		0.1
1		0 – 8 %	Flat	1		0.4
2		8 – 15 %	Ramps	2		0.8
3	Slope slope	15 – 25 %	A bit steep	3	40	1.2
4		25 – 45 %	Steep	4		1.6
5		> 45 %	Very Steep/ Upright	5		2.0

(Source: modified from Hadmoko et al., 2010 dan Sari et al., 2017)

RESULTS AND DISCUSSION

Photogrammetric Data Analysis

The land use in watershed areas was analyzed through photogrammetric data analysis using QGIS software. The results of the analysis showed that an area of 4.3 hectares, which was originally a forest, has been converted into a road with flexible pavement made of asphalt. This represents 3.4% of the watershed area. As a result, the runoff coefficient has increased from 0.62 to 0.64. The value of the runoff coefficient is now close to 1.0, indicating that rainwater flows as surface runoff.

Hydrology Analysis

From the rainfall data analysis using aprob 4.1 *software*, the Log Pearson III distribution method was employed. Table 3 presents the comparison of the distribution data assessment.

Table 3. Comparison Assessment of Rainfall Data Distribution

Types of Distribution	Condition	Result	Conclusion
Normal	Cs ≈ 0	1.885	Non-Compliant
	Ck ≈ 3	3.513	Non-Compliant
Gumbel	Cs ≈ 1,1396	1.885	Non-Compliant
	Ck ≈ 5,4002	3.513	Non-Compliant
Log Pearson III	Cs ≠ 0	1.034	Compliant
	Ck ≈ 3,07706	1.101	Compliant
Log Normal	Cs = 3 Cv + Cv3	1.034	Non-Compliant
	Ck ≈ 0	1.101	Non-Compliant

The suitability of the observations of the Pearson III log distribution to the theoretical distribution was tested through goodness and fit test, as presented in Table 4.

Table 4. Goodness and Fit test theoretical data distribution

Fit Test	Gumbel	Log Normal	Log *Pearson* III	Normal
Smirnov-Kolmogorov	pass	pass	pass	pass
Maximum difference	0,196	0,182	0,121	0,266
Chi-square	pass	pass	pass	fail
Chi-square maximum	6,7	4,3	4,3	10,2

The assigned return period (Tr) is 5 years, with a design rainfall of 151 mm. Based on the calculation results, the river's length is 2.8 km, with a slope of 0.04 and an area of 1.271 km2. According to the Kirpich formula, the concentration time is 0.501 hours. To determine the intensity of rain, the Mononobe formula is used.

$$I = \frac{R_{5\,year}}{24}\left[\frac{24}{tc}\right]^{2/3}$$

Where, I = Rainfall intensity, R = Design rainfall, tc = concentration time in hours. The results of rainfall intensity are shown in the following table.

Table 5. Rainfall Intensity

t (hours)	Return Period				
	2	5	10	20	50
0.5	56.683	83.099	105.662	132.627	176.103
1.0	35.708	52.349	66.563	83.550	110.938
1.5	27.250	39.950	50.797	63.761	84.661
2.0	22.495	32.978	41.932	52.633	69.886
2.5	19.385	28.419	36.136	45.358	60.226

t (hours)	Return Period				
	2	5	10	20	50
3.0	17.167	25.167	32.000	40.167	53.333
3.5	15.490	22.709	28.875	36.244	48.125
4.0	14.171	20.775	26.415	33.157	44.026
4.5	13.101	19.206	24.421	30.653	40.701
5.0	12.212	17.903	22.764	28.574	37.940
5.5	11.460	16.801	21.363	26.815	35.604
6.0	10.814	15.854	20.159	25.303	33.598

The intensity of rain was obtained at 83,041 mm/hour. The flood discharge is obtained using the Rational equation $= 0{,}278\ C\ I\ A$, where Q = Maximum discharge (m^3/s), C = Runoff coefficient, I = Rain intensity with rain duration equal to concentration time (mm/hour), and A = Watershed area (km^2). The initial rain intensity resulted in a flood discharge of 17.993 m^3/s, while the final intensity led to 18.595 m^3/s. The rainfall intensity increased by 3.3% to 0.602 m^3/s.

River capacity analysis

The analysis of river capacity is conducted through stages in the HEC-RAS software, which involves a simulation run with steady flow. This process helps to produce the shape of the river cross-section, water level, and river capacity. The results obtained from the HEC-RAS simulation are presented in Figure 2 and Table 6.

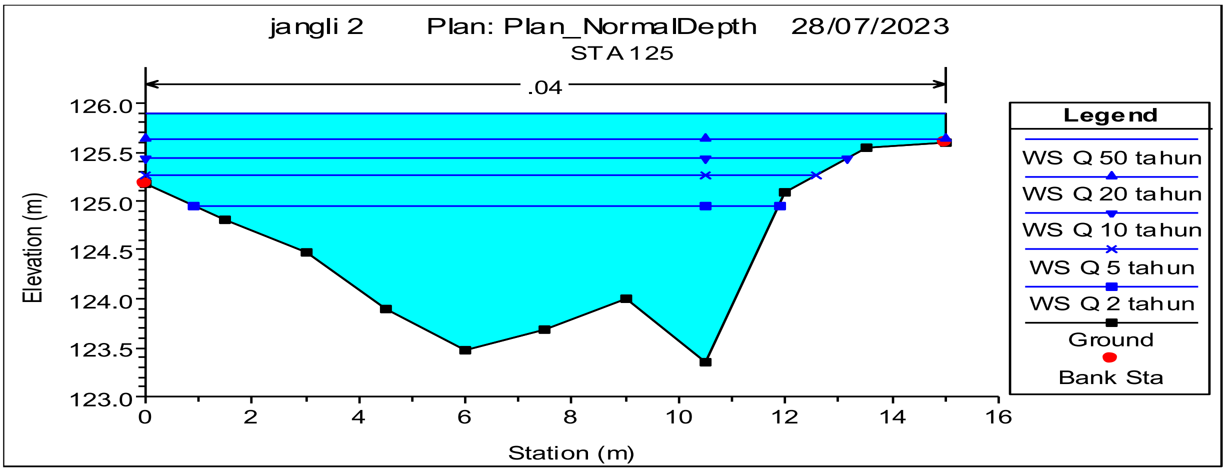

Figure 2. The output of existing HEC-RAS against flood discharge at STA 125

The results of *running* the HEC-RAS are shown in the following table.

Table 5. HEC-RAS output at 50, 20, 10, 5, and 2 years Return Period (Tr)

STA	Return Period	Discharge	Water Level Elevation	Water Level Elevation	Flow Speed	Channel Width
		m^3/s	m	m	m/s	m
0	50 Year	39.41	119.85	121.67	3.48	9.28
	20 Year	29.68	119.85	121.44	3.23	8.67
	10 Year	23.64	119.85	121.27	3.04	8.23
	5 Year	18.6	119.85	121.1	2.87	7.81
	2 Year	12.68	119.85	120.9	2.59	7.19
50	50 Year	39.41	121.35	123.46	3.39	9.94
	20 Year	29.68	121.35	123.16	3.31	8.15

STA	Return Period	Discharge	Water Level Elevation	Water Level Elevation	Flow Speed	Channel Width
		m^3/s	m	m	m/s	m
	10 Year	23.64	121.35	122.97	3.17	7.38
	5 Year	18.6	121.35	122.78	3.03	6.65
	2 Year	12.68	121.35	122.55	2.69	5.81
100	50 Year	39.41	122.93	125.18	3.33	10.5
	20 Year	29.68	122.93	124.95	3.11	9.82
	10 Year	23.64	122.93	124.8	2.92	9.36
	5 Year	18.6	122.93	124.66	2.74	8.9
	2 Year	12.68	122.93	124.32	2.89	5.19
150	50 Year	39.41	123.89	125.96	2.08	15
	20 Year	29.68	123.89	125.71	1.95	14.45
	10 Year	23.64	123.89	125.51	1.89	13.51
	5 Year	18.6	123.89	125.31	1.87	11.53
	2 Year	12.68	123.89	125.01	1.83	9.15
200	50 Year	39.41	124.78	126.7	2.86	14.65
	20 Year	29.68	124.78	126.54	2.59	13.7
	10 Year	23.64	124.78	126.38	2.51	12.79
	5 Year	18.6	124.78	126.08	2.82	7.3
	2 Year	12.68	124.78	125.89	2.42	6.71
250	50 Year	39.41	127.29	128.89	2.89	12.31
	20 Year	29.68	127.29	128.7	2.61	12.06
	10 Year	23.64	127.29	128.57	2.41	11.77
	5 Year	18.6	127.29	128.45	2.22	11.45
	2 Year	12.68	127.29	128.28	1.96	10.45
300	50 Year	39.41	127.8	129.83	3.68	7.77
	20 Year	29.68	127.8	129.56	3.43	7.3
	10 Year	23.64	127.8	129.37	3.23	6.99
	5 Year	18.6	127.8	129.2	3.03	6.69
	2 Year	12.68	127.8	128.95	2.79	5.81
350	50 Year	39.41	130.95	132.99	3.41	9.76
	20 Year	29.68	130.95	132.77	3.15	9.55
	10 Year	23.64	130.95	132.62	2.95	9.01
	5 Year	18.6	130.95	132.39	3	6.82
	2 Year	12.68	130.95	132.13	2.78	5.83
400	50 Year	39.41	135.19	137.38	3.29	11.07
	20 Year	29.68	135.19	137.18	3.02	10.76
	10 Year	23.64	135.19	137.04	2.82	10.55
	5 Year	18.6	135.19	136.92	2.63	10.41
	2 Year	12.68	135.19	136.65	2.63	6.88
450	50 Year	39.41	137.62	142.5	0.77	15
	20 Year	29.68	137.62	142.13	0.65	15
	10 Year	23.64	137.62	141.86	0.57	15
	5 Year	18.6	137.62	141.6	0.5	15
	2 Year	12.68	137.62	141.24	0.4	14.68
500	50 Year	39.41	140.3	142.42	2.22	11.83

STA	Return Period	Discharge	Water Level Elevation	Water Level Elevation	Flow Speed	Channel Width
		m^3/s	m	m	m/s	m
	20 Year	29.68	140.3	142.06	2.17	10.56
	10 Year	23.64	140.3	141.79	2.16	9.78
	5 Year	18.6	140.3	141.53	2.18	9.08
	2 Year	12.68	140.3	141.17	2.33	8.12

The HEC-RAS analysis concluded that the water level is a linear function, meaning that as the return period increases, the water level also increases. The flood discharge simulation results revealed that the river's capacity is insufficient to hold water, and the water level should not exceed the cross-sectional capacity.

Analysis of soil characteristics

The analysis of bore log data for soil characteristics revealed that soil types at a depth of 0-5m were primarily clay, which is conducive to floods. On the other hand, soil types at a depth of more than 10m were found to be silt clay, which is more prone to landslides. To validate the results of soil characteristics obtained from the borelog analysis, a grain accumulation graph analysis was conducted. The soil composition at depths of -4.50 and -10.00 in two drill points were studied, and the results are as presented in Table 6.

Table 6. Soil composition and classification by texture

No	Drill Point	Depth (m)	Grain Analysis	Accumulated Results
1	BH5	4,50 -5,00	32% (Clay) 68% (Silt)	A mixture of silted clay and clay
2		14,50-15,00	25% (Clay) 53% (Silt) 22% (Fine Sand)	Silted Clay
3	BH6	4,50 -5,00	38% (Clay) 62% (Silt)	A mixture of silted clay and clay
4		14,50-15,00	2% (Clay)` 30% (Silt) 20% (Fine Sand) 38% (Coarse) 10% (Gravel)	Sandy Clay

The results of soil composition analysis using grain analysis charts show that soil characteristics are in accordance with the results of *bore log analysis.*

Mapping potential floods and landslides

QGIS software is utilized to perform a comprehensive analysis of the factors that may cause flood disasters. This involves mapping out potential flood hazards and assessing the variables listed in Table 7 to determine the likelihood of such disasters occurring.

Table 7. Results of the assessment of potential flood disasters

No	Variable	Class	Land use	Score	Weight (%)	Total
1	Land Cover	-	Settlement	3	25	0.75
2		-	Ponds / Water Bodies	5		1.25
1	Rainfall	2000 - 2500 mm/year		1	25	0.25
1	Soil Texture	-	Very Smooth	5	12,5	0.625

1	Slope	0 – 8 %	Flat	5	25	1.25
2		8 – 15 %	Ramps	4		1
3		15 – 25 %	A bit steep	3		0.75
1	Land Elevation	> 100		1	12,5	0.25
2		75 – 100		2		0.5

After analyzing the factors that could trigger a potential flood disaster, we overlay the mapping results onto QGIS software to create a map displaying the potential flood-prone areas (see Figure 3).

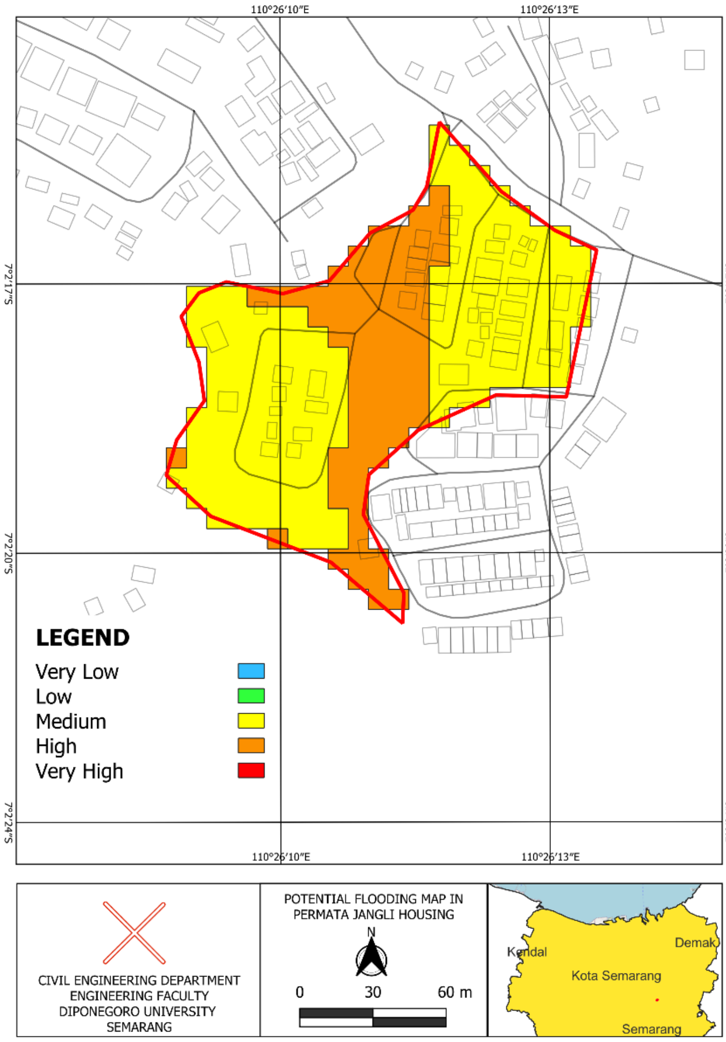

Figure 3. Map of potential flood disasters

In order to assess the factors that contribute to landslide disasters, QGIS software is utilized to map their potential, as detailed in Table 8.

Table 8. Results of the assessment of the potential for landslides

No	Variable	Class	Information	Score	Weight (%)	Total
1	Land Cover		Rice fields, shrubs	4	20	0.8
2			Settlement	5		1
1	Rainfall	2000 - 3000 mm/year	Sedang/ Lembab	3	30	0.9
1	Soil Texture		Soft	4	10	0.4
1	Slope	0 – 8 %	Flat	1	40	0.4

2	8 – 15 %	Ramps	2	0.8
3	15 – 25 %	Agak Curam	3	1.2

Once the analysis of factors that may lead to potential landslides is complete, the resulting mapping data is overlaid onto QGIS software. The data is then used to produce maps that display the areas that are most vulnerable to potential landslide disasters (see Figure 4).

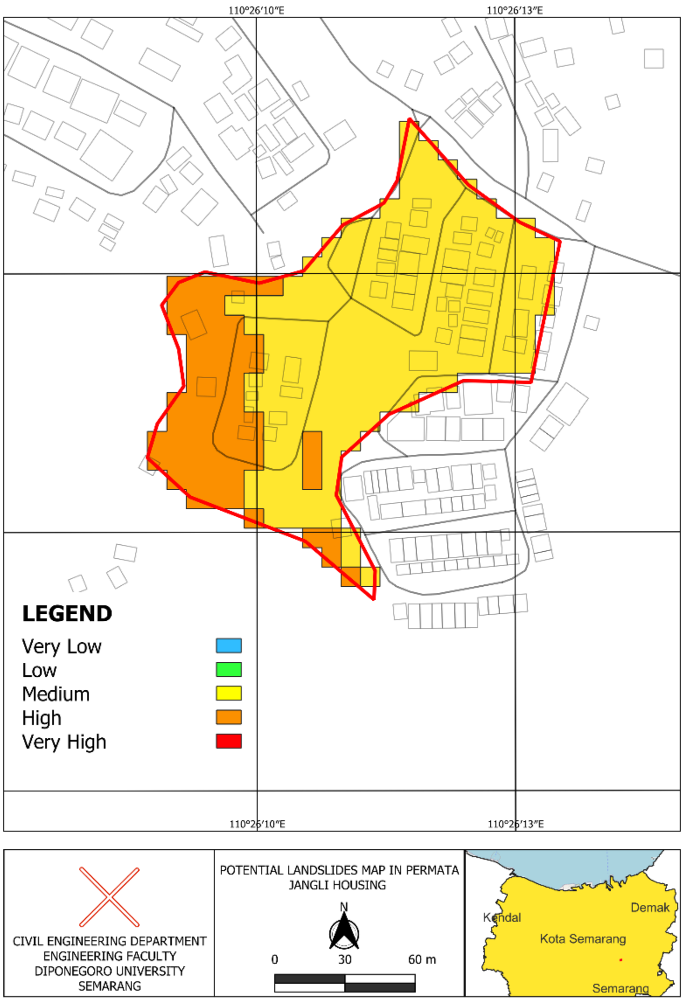

Figure 4. Map of potential landslides

Land use changes from forest areas to road infrastructure with flexible pavements covering an area of 4.34 ha, resulting in an increase in flood discharge. The increase in flood discharge affects the potential for floods and landslides at the study site because of the condition of the soil. The potential for flood disasters at the study location has two classes of potential flood disasters with, namely medium class covering an area of 1.1 ha or 68% of the total residential area and high class covering 0.5 ha or 32% of the total residential area While the potential for disaster shows that the potential for landslides with medium class covering an area of 1.2 ha or 74% of the total area of the study location and high class covering an area of 0.4 ha or 26% of the total residential area.

CONCLUSION

When it comes to mapping out potential risk hazards for floods and landslides, there are a variety of conditions that need to be taken into account. As such, the approach for managing these situations must be tailored to the specific area affected. This study has shown that when dealing with soil as a medium affected by an increase in flood discharge, a systematic approach is necessary to anticipate the potential impact. It is critical to be prepared for such situations because when this study was conducted, the disaster caused harm to the surrounding population due to some technical oversights. This highlights the need to take a proactive approach to mitigate future disasters by addressing the root causes and types of impacts that are most likely to occur.

Thank you to all parties who have supported this research, the Semarang City Fire Department and the construction management laboratory assistants, Department of Civil Engineering, Diponegoro University. The researchers also expressed their gratitude to LPPM UNDIP through the support of the Research International Publication Grant (RPI) for the Second Year of Contract No. 569-143/UN7. D2/PP/V/2023 and Community Service Grant Batch I-2023-Civil Engineering Department, Contract No. 073/B1/Sipil/2/UN7.F3/PP/III/2023.

REFERENCES

Adiyoso, W. (2018). Manajemen Bencana: Pengantar & Isu-Isu Strategis. Bumi Aksara, Jakarta

Ariyora, Y. K. S., Budisusanto, Y., & Prasasti, I. (2015). “Pemanfaatan data Penginderaan Jauh dan SIG untuk Analisa Banjir (Studi Kasus : Banjir Provinsi DKI Jakarta)”. GEOID, Vol. 10, No. 2, 137-146

Bappenas. (2008). Penilaian Kerusakan dan Kerugian. Badan Perencanaan Pembangungan Nasional, Jakarta

BNPB. (2011). Peraturan Kepala Badan Nasional Penanggulangan Bencana Nomor 8 Tahun 2011 Tentang Standardisasi Data Kebencanaan. Badan Nasional Penanggulangan Bencana, Jakarta

Bosher, L., & Chmutina, K. (2017). Disaster Risk Reduction for The Built Environment. John Wiley & Sons, Chicester

Das, B. M. (1995). Mekanika Tanah (Prinsip-prinsip Rekayasa Geoteknis). Erlangga, Jakarta

Haribulan, R., Gosal, P. H., & Karongkong, H. H. (2019). “Kajian Kerentanan Fisik Bencana Longsor di Kecamatan Tomohon Utara”. Jurnal Spasial, Vol 6, No. 3

Hadmoko, D. S., Lavigne, F., Sartohadi, J., Hadi, P., & Winaryo. (2010). “Landslide hazard and risk assessment and their application in risk management and landuse planning in eastern flank of Menoreh Mountains, Yogyakarta Province, Indonesia.” Natural Hazards, 54(3), 623–642.

Roccati, A., Paliaga, G., Luino, F., Faccini, F., & Turconi, L. (2021). “Gis-based landslide susceptibility mapping for land use planning and risk assessment”. Land, 10(2), 1–28.

Sari, D. A. P., Innaqa, S., & Safrilah. (2017). “Hazard, Vulnerability and Capacity Mapping for Landslides Risk Analysis using Geographic Information System (GIS)”. IOP Conference Series: Materials Science and Engineering, 209(1).

Suripin. (2003). Sistem Drainase Kota Yang Berkelanjutan. Penerbit Andi, Yogyakarta

UNDP. (1992). Disaster Management Program: Introduction of Hazard. Geneva

Pemerintah Pusat. (2007). Undang Undang Republik Indonesia Nomor 24 Tahun 2007 Tentang Penanggulangan Bencana. Jakarta

Youssef, A. M., Mahdi, A. J., Al-Katheri, M. M., Pouyan, S., Keesstra, S. (2022). “Multi-hazards Modeling Using Machine Learning Algorithms In Southwestern Saudi Arabia.”