Study of Urban Riverbank Area Development (Case Study: Bah Bolon River, Pematang Siantar City)

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Abstract
The Bah Bolon watershed divides Pematang Siantar City for + 12 km from east to west of Kota Pematang Siantar with an average width of 20 - 25 meters. There are nine other rivers that divide the city area, namely: Bah Kapul, Bah Banai, Bah Sigulanggulang, Bah Hapal, Bah Kada, Bah Sorma, Bah Silulu, and Bah Biak. In addition to the ten rivers, there are several other tributaries. The total length of all rivers that are included in the administrative area of Pematang Siantar City is ± 105.64 km. The areas along the rivers present public open space areas (within the river boundaries) to be developed into riverbank areas to present inclusive, adaptive, and sustainable public spaces. The current condition in most river boundary areas, there are residential buildings that utilize the river boundary area as a building site with an orientation facing away from the river flow. In addition, there is a lack of communal space and green open areas that can be used as activity spaces and social interactions. The research method used in this study is descriptive qualitative, where data is obtained through interview/questionnaire methods and field observations by directly observing the behavior and daily activities of residents in the research area in order to obtain a physical picture of the existing conditions. The results of the analysis are used as a basis for regional development in the form of re-arranging the area that can increase the value of the area in terms of ecology, social, culture, and economy.

Keyword: River Side, Area Planning, Bah Bolon River

Introduction

Riverbank areas, especially in urban areas, are spaces that have strategic value in terms of ecology, social, culture, and economy. Playing an important role in the structure and dynamics of city development, this area is a connecting corridor between the environment and people's lives. In the context of increasingly rapid urbanization, the development of riverbank areas is a challenge as well as an opportunity in planning city development to present inclusive, adaptive, and sustainable public spaces. However, many riverbank areas are faced with problems such as environmental degradation, flooding, slums, and uncontrolled land conversion. Therefore, the development of riverbank areas should not only focus on aesthetic or commercial aspects, but more than that, it must pay attention to environmental carrying capacity, preservation of local culture, and the needs of the people living around it.

Good riverbank area development can improve the quality of life, while poor management can cause problems such as flooding, environmental damage, and the inability to access water resources optimally. The study of riverbank area development is an analysis and planning that focuses on the use of land along the river for various interests, both economic, social, and environmental. This study aims to create a balance between development and nature conservation, as well as optimizing the potential of natural resources along the riverbank. In the context of city planning, the study of riverbank area development is very important, especially because many urban areas grow and develop along rivers. Rivers not only function as natural resources, but also as central elements in the social and economic structure of the city.

Pematang Siantar City is the second largest city in the North Sumatra Province after Medan City as the provincial capital. Located close to the equator which has an impact on the tropical climate of the region. The land contour tends to be flat with a moderate climate. This flat land contour is very ideal as a residential area. On this basis, the colonial government also determined (municipal code) 'Kampung Siantar' to be a municipality (gemeente). The Bah Bolon Watershed divides Pematang Siantar City along + 12 km from east to west into two parts (colonial era). One part, namely on the east side, is a native settlement (inlander) and on the west side has been a gemeente area since 1917.

he term ‘siantar’ has been used as a word to indicate a location (area) long before the colonial era in 1885. This term comes from the Simalungun language which means ‘located between’, namely between two vast waters of the ‘sea of cycles’ (Lake Toba) to the south and the Strait of Malacca to the east. Its territory is in the middle of the Main Village (partuanon) of the Siantar Kingdom, namely Sipolha and Sidamanik to the south, Marihat to the east, Nagahuta to the west and Dolog Marlawan, Bandar, Padang City and Tanjungkasau to the north.

The phenomenon of high population growth rates in general has an impact on the problems faced by cities in Indonesia, including Pematang Siantar City. This condition causes an increase in demand for housing. Especially for development activities carried out by the non-formal sector, resulting in the emergence of dense and irregular slum housing environments, and do not have environmental facilities and infrastructure that meet technical and health standards (Yudohusodo 1991: 331). Referring to the problem of slum settlements, a strategy is needed that is able to reduce or even eliminate slums in residential environments including settlements on riverbank areas (waterfront).

The government's program to improve national transportation routes in the form of the construction of the Trans Sumatra route in the form of toll roads has had an impact on decreasing economic activity in areas along the national road. Several areas have felt the impact, including Deli Serdang Regency, Serdang Bedagai Regency, and Tebing Tinggi City. Since the operation of the Kutepat Toll Road (Kuala Namu - Tebing Tinggi - Parapat),

at the end of 2024, the areas mentioned above have experienced a drastic decrease in visitors. This will of course have an impact on the community's economy. Until this article was written, Pematang Siantar City was still the final destination of the Kutepat Toll Road. It is believed that when this route reaches the Parapat area (Simalungun Regency), it is very possible that this obstacle will also be felt by the second largest city in North Sumatra. One anticipation that can be done is to create interesting destinations. So that the public's enthusiasm to continue to come to visit will always be there. Of course this will have an impact on the economy.

One possible way is through efforts to develop the Bah Bolon waterfront area as a recreational area as a form of concern in increasing the economic and ecological value around the area. One of the potentials that makes this possible is that the river channel has so far been used as a white water rafting recreation route. Both the river route in the administrative area of Pematang Siantar City, and in the administrative areas of other regencies that it crosses. Another potential is that this area has superior sectors in the form of agriculture and fisheries. Therefore, Pematang Siantar City requires infrastructure development and design of waterfront areas that can accommodate activities from the community in this area and can also increase regional economic income.

Geographically, Pematang Siantar City is located at 2053'20"-300'00" N and 9900'0"-9906'35" E. Located in the middle of Simalungun Regency. The land area of Pematang Siantar City is 79,971 km2 at an altitude of 400-500 meters above sea level. Based on the area by sub-district, the largest sub-district is Siantar Sitalasari Sub-district with an area of 23,723 km2 or equal to 28.41 percent of the total area of Pematang Siantar City. Pematang Siantar City consists of 8 sub-districts and 53 villages/wards. Administratively, Pematang Siantar City has administrative boundaries:

a. North Side : Simalungun Regency
b. South Side : Simalungun Regency
c. East Side : Simalungun Regency
d. West Side : Simalungun Regency

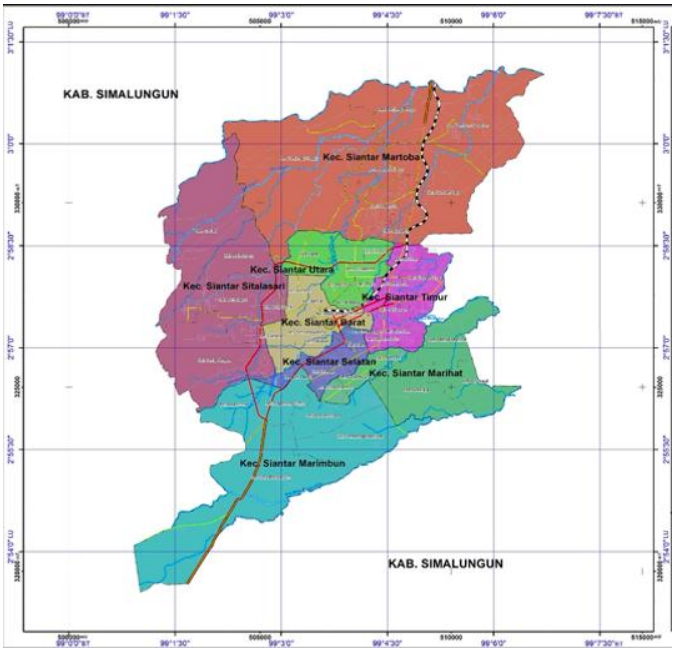

Figure 1. Administrative Map of Pematang Siantar City
(source : BAPPEDA Pematang Siantar City, 2017)

Bah Bolon Watershed located in Pematang Siantar City with a length of + 12 KM and divides two areas of the city from east to west with an average river width of 20 - 25 meters. Crosses several sub-districts, namely:

a. East Siantar District,
b. West Siantar District,
c. South Siantar District,
d. Siantar Sitalasari District, and
e. Siantar Marimbun District.

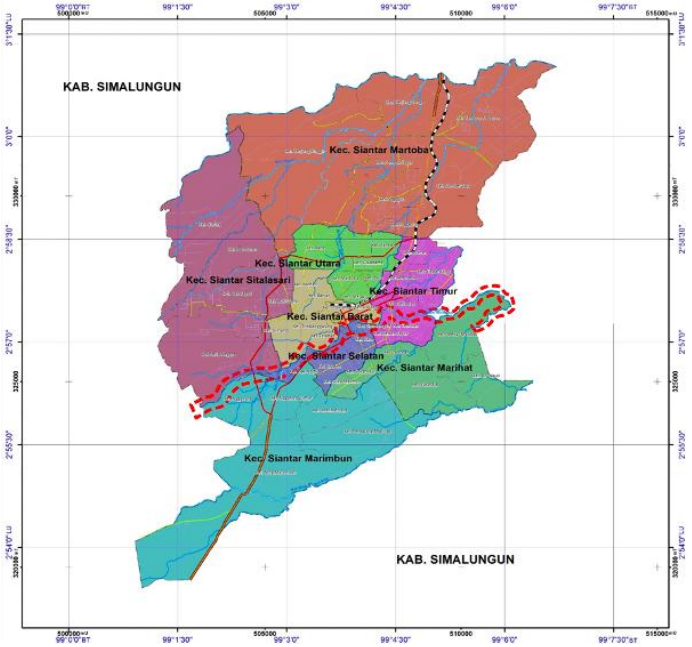

Figure 2. Map of the Bah Bolon River Basin Route in Pematang Siantar City (source : BAPPEDA Pematang Siantar City, 2017)

It is with almost all other urban areas throughout Indonesia that have watersheds that divide the city, areas along rivers, especially riverbank areas, face serious problems in their management, such as high building density with minimal environmental infrastructure, visual quality that appears shabby, vulnerability to flooding and landslides, and household waste disposal.

Figure 3. River Boundary Conditions in the Bah Bolon River Basin

Based on the identification of the problem, it was found that the limited condition of urban land caused the increasing density of buildings with uneven distribution areas. This causes pressure on the surrounding area, especially on the banks of the Bah Bolon River. Inappropriate land distribution, with buildings along the right and left banks of the river that utilize the waterfront area as a built-up area/residential housing for residents.

Another potential that needs to be explored is the existence of several community groups that utilize the river route as a means of recreation/sports, namely rafting activities. Even the Pematang Siantar City Government through the Tourism Office, places the Bah Bolon River as a mainstay tourist destination for rafting activities. Of course, this activity must be supported by supporting facilities and infrastructure.

Figure 4. Rafting Activities in the Bah Bolon River Basin
(source: medanmerdeka.com)

Literature Review

A. Spatial Planning of Waterfront Areas

Spatial planning of waterfront areas is an area bounded by water from its community which in its development is able to include human values, namely the need for public space and natural values (Carr, 1992). Spatial planning of waterfront areas is a strategic issue in regional development, especially in facing the challenges of urbanization, climate change, and environmental degradation. Problems that often arise in the management of waterfront areas include environmental degradation, uncontrolled land conversion, low public accessibility, and conflicts between conservation and development interests. Therefore, spatial planning of waterfront areas requires a comprehensive, cross-sectoral, and community-based planning approach.

B. Elements of Urban Design

Urban design elements are the main components that form the physical, functional and visual quality of a city. In planning and designing waterfront areas, understanding these elements is essential to create a comfortable, efficient and sustainable environment. Urban design elements are based on normative studies of applicable theories, standards and laws and regulations. According to Hamid Sirvani (1985: pages 7-8) urban design elements are divided into 8 (eight) components, namely land use, building form and mass layout, parking circulation, open space, pedestrian paths, activity support, information layout and preservation.

C. Land Use

In principle, land use is the regulation of land use to determine land use in determining the best choice for allocating certain functions, so that in general it can provide an overall picture of how an area in a region should function.

D. Building Form and Massing

The shape and mass of a building are not solely determined by the height or size of the building, the appearance or configuration of the building mass, but are also determined by:

a. Size of the building;
b. Building intensity;
c. Building height;
d. Building boundaries;

e. Facade;
f. Scale;
g. Material;
h. Texture; and
i. Color.

E. Parking and Circulation

The problem of circulation in urban areas is a problem that requires fundamental thinking, between the available road infrastructure, the form of the city structure, public service facilities and the increasing number of motorized vehicles.

F. Open Space

Open spaces can involve landscaping, hard elements (hardscape) which include: roads, sidewalks, and so on, as well as soft elements (softscape) in the form of parks and recreational spaces in urban areas.

G. Pedestrian Area

A good pedestrian system will reduce vehicle attachment in the city center area, improve environmental quality through a humane design system, create more street vendor activities and ultimately help the air quality in the area.

H. Signage

Road signs, directions to a certain area will make the atmosphere of the city environment even more lively.

I. Activity Support

Supporting activities are all building functions and activities that support the public space of a city area. The form, location and character of an area that has special characteristics will affect the function, land use and its activities.

J. Concervation

Conservation/protection of buildings must always be linked to the whole city. The concept of urban conservation takes into account aspects: single buildings, architectural structures and styles, matters relating to the utility, general building or building suitability.

a. Slums

In its development, the growth of slum settlements can be caused by several factors. According to **Constantinos A. Doxiadis (1968)**, it is stated that the growth of slum settlements is influenced by several factors, one of which is the growth of density (population growth), namely with the increase in the number of residents, namely from births and the increase in the number of families, it will bring new problems. Humanly, they want to occupy their own homes. Thus, the increasing number of dwellings in the residential area causes the growth of residential housing.

The characteristics of slums are settlements with very high levels of occupancy and building density, irregular buildings, very low quality houses. In addition, there is inadequate basic infrastructure and facilities such as drinking water, roads, waste water and garbage **(Sinulingga, 2005)**.

b. Riverside Slum

Riverbank slums are slums located outside the River Boundary Line (GSS). These riverbank slums can be divided into 2 (two) types. The first type is if the river in

question has a dam, then in Peraturan Pemerintah No. 47 Tahun 1997 regarding the National Spatial Planning, the intended residential environment is at least 5 (five) meters along the foot of the embankment, while for unbanked rivers, the intended settlement is located outside the river boundary whose width is determined by the local government. Likewise, settlements for embanked and unbanked rivers, which are located in urban areas, the intended settlement is located outside the river boundary whose width is determined by the local government (Hidayat et al, 2023; Hartini et al, 2023; Nasution et al, 2025).

Discussion and Result

A. Overview of Research Area

The Bah Bolon Watershed, which divides two areas of Pematang Siantar City, crosses 5 (five) sub-districts, including East Siantar District (Papua Village, Tomuan Village, and Kebun Sayur Village), West Siantar District (Dwikora Village, Timbang Galung Village, and Teladan Village), South Siantar District (Simalungun Village, Karo Village, Kristen Village, and Aek Nauli Village, Siantar Sitalasari District (Setia Negara Village), and Siantar Marimbun District (Nagakuhuta Village). From the entire area crossed by the Bah Bolon Watershed, it is necessary to determine priority areas that will be used as research areas. The main basis for determining this is the identification of areas that need immediate handling. The handling in question is mainly related to the existence of slum areas in the area. In addition, similarities in environmental characteristics and the amount of development potential are also the basis for determining the research area

Based on the identification conducted, 3 areas were determined as research locations, namely in the Setia Negara Village, Siantar Sitalasari District, Teladan Village and Timbang Galung Village, West Siantar District, and Simalungun Village, South Siantar District. Of the four village areas, the areas located on the river boundaries include the following areas:

a. The Rindam area in Setia Negara Village, Siantar Sitalasari District;
b. The area of Diponegoro St.- Sudirman St.- Kapt. M.H. Sitorus St in Teladan Village and Timbang Galung Village, West Siantar District; and
c. The area of Dewi Quan in Temple in Simalungun Village, South Siantar District.

a. Delineation of Research Area

This is the process of determining the borders or boundaries of the research area for the three selected areas based on geographical criteria, land use, administrative function, regional socio-economics.

Table 1. Delineation of Research Area

Numb.	Area Name	Width (Ha)
1.	Area of Rindam Kodam I/BB	16,43
2.	Area of Diponegoro St. - Sudirman St. - M.H. Sitorus St.	24,88
3.	Area of Dewi Quan In Temple	7,47

Source: BAPPEDA Pematang Siantar City

Figure 5. Delineasi Kawasan Rindam

Most of the area of this region is included in the area of the Regional Military Main Regiment (Resimen Induk Daerah Militer/RINDAM) Kodam I/BB. Some of the potentials that support this area to be developed include the existence of public open spaces such as the Rindam Triangle Beo Park managed by the Pematang Siantar City Government, and the RINDAM 1/BB Park managed by RINDAM I/BB itself. So this area has indeed become one of the tourist destinations in Pematang Siantar City. Likewise with the Dewi Quan In Temple Area, which is an artificial tourist destination. While the Diponegoro St. - Sudirman St. - M.H. Sitorus St., is an area in the city center that is advantageous in terms of access to reach.

Figure 6. Delineation of the Area of Diponegoro St. - Sudirman St. - M.H. Sitorus St.

Figure 7. Delineation of Dewi Quan in Temple Area

b. Reginal Problems

Based on the results of the survey and identification in the field, it was identified that there were several problems that occurred in the 3 areas. For the problems, they are grouped into 2 main problems, namely:

a. The condition of the borders is not well organized and its use is unclear; and
b. River boundaries that are used as settlements (houses) or trade (kiosks).

Table 2. The Problems

Numb	Area Name	Sitution Photos
1.	Area of Rindam Kodam I/BB Problems: The condition of the borders is not well organized and its use is unclear. Handling Concept: Arrangement of the area to be more organized with clear utilization (public use)	
2.	Area of Diponegoro St. - Sudirman St. - M.H. Sitorus St. Problems: River boundaries used as settlements (houses) or trade (kiosks) Handling Concepts: Reorganization (rehabilitation) of river boundaries for public use (parks/green open space)	 
3.	Area of Dewi Quan in Temple Problems: River boundaries used as settlements (houses) or trade (kiosks) Handling Concepts: Reorganization (rehabilitation) of river boundaries for public use (parks/green open space)	

c. Land Use Recommendation Concept

Based on the inventory of existing problems, there are several buildings that are included in the river boundary area, then the existing buildings will be arranged, and if possible will be relocated to an area that is still empty. Some of the plans that are carried out include riverbank plazas, green open spaces, open spaces (playgrounds), water recreation facilities, culinary areas, docks, settlements, tourist information centers, learning studios, fishing areas, commercial complexes, shophouses, and souvenir shops.

Tabel 3. Land Use Recomendation

Name of Area	Program	Volume	Etc.
Area of Rindam Kodam I/BB	Construction of Main Gate of Area and Parking Area	1124 m^2	
	Amphiteathre Construction	1843 m^2	
	Bridge Construction	90 m^1	
	Rafting Station Construction	250 m^2	
	Gazebo Construction	75 m^2	
	Area Identity Construction	600 m^2	
	Rest Area Construction	200 m^2	
	Pavement	1000 m^2	
	Trees Planting	500 m^2	
	Parking Area Construction	1200 m^2	
	Retaining Wall Construction	1500 m^1	
	Trash Cans Provision	100 loct.	
Area of Sudirman St. - Diponegoro St. - M.H. Sitorus St.	Development of Core Zone Area	1400 m^2	
	Pavements	3600 m^2	
	Trees Planting	1000 m^2	
	Retaining Wall Construction	1000 m^1	
	Garden Light Provision	72 loct.	
	Trash Cans Provision	150 loct.	
Kawasan Kuil Dewi Quan In	Amphiteathre Construction	850 m^2	
	Rafting Station Construction	250 m^2	
	Gazebo Construction	75 m^2	
	Bridge Construction	90 m^1	
	Rest Area Construction	115 m^2	
	Parking Area Construction	1500 m^2	
	Open Space Construction	300 m^2	
	Pavement	8000 m^2	
	Trees Planting	450 m^2	
	Retaining Wall Construction	1000 m^1	
	Garden Light Provision	160 loct.	
	Trash Cans Provision	400 loct.	

Source: Analysis Result, 2025

d. Recommendation Concept for Building Form and Mass Aspects (Building Orientation)

In the spatial pattern plan, the area of Pematang Siantar City is divided into several spatial pattern units which are divided into two large groups, namely: Protected Areas and Cultivation Areas. The determination of the designated areas is adjusted to Permen PU No. 17/PRT/M/2009 regarding Guidelines for the Preparation of City Spatial Planning Plans.

The definition of protected areas here is an area designated with the main function of protecting the sustainability of the environment which includes natural resources and artificial resources. While the definition of cultivation areas is an area designated with the

main function to be cultivated based on the condition and potential of natural resources, human resources and artificial resources.

The rules related to the Bah Bolon River contained in the Pematang Sianar City Spatial Plan are regarding river boundaries. The rules for river boundaries include:

a. Embanked river borders are at least 3 (three) meters from the outer edge of the embankment along the river channel; and
b. River borders that are not embanked are at least 10 (ten) meters from the left and right edges of the riverbed along the river channel.

Meanwhile, for permitted activities, they include: b. Unbanked river boundaries must be at least 10 (ten) meters from the left and right edges of the riverbed along the river channel.

a. Activities on river banks for parks or recreation areas equipped with play areas, seating, jogging tracks, garden furniture and/or sports facilities;
b. Transportation activities for inspection roads;
c. Wetland farming activities, dryland farming, animal husbandry, and plantations; and
d. Green Open Space activity.

Activities that are permitted with conditions include activities for main infrastructure buildings and buildings that do not interfere with the function of river boundaries. While activities that are not permitted include:

a. Activities that disrupt the landscape, fertility and durability of the soil;
b. Activities that disrupt hydrological and hydraulic functions, the preservation of flora and fauna and the preservation of environmental functions; and
c. Activities that damage the quality of river water, the physical condition of the river and riverbed and disrupt water flow..

General provisions for the intensity of space utilization include:

a. Maximum Basic Building Coeficient is 10% (ten percents);
b. Maximum Basic Floor Building is 0,1; and
c. Minimum Green Base Coeficient is 80% (eighty percents).

Provision of minimum infrastructure and facilities, including:

a. Provision of public green open space;
b. Public Transportation Facilities;
c. Places of worship and parking facilities; and
d. Food Facilities.

The concept of building orientation recommendations at the research location is to rearrange buildings that previously faced the river to building directions facing the river. According to the concept of a waterfront city, the building mass, especially the direction of the building, needs to be arranged facing the river because the specialness of the building's existence lies not only in the building itself but also in its placement. Physically, there is a relationship between the river and the buildings on its banks. The direction of orientation and position of the building towards the river, where the distance between the river and the building is only separated by a road.

e. Circulation and Parking Recommendation Concept

Circulation is an element of urban design that can directly shape and control the pattern of urban activities, as is the case with the existence of a transportation system of public roads, pedestrian ways, and interconnected transit points that will shape movement.

Parking systems in Indonesia can be divided into two types, namely: on-street parking and off-street parking. Parking in the yard consists of two, namely parking buildings and underground parking (Fais et al., 2014). Vehicle parking patterns located on local roads

and main roads at the research location tend to use the concept of perpendicular parking and parallel parking.

f. Open Space Recommendation Concept

Based on Undang - Undang Nomor 26 Tahun 2007 on Spatial Planning and Regulations of Public Works Ministry No.05/PRT/M/2008 regarding Guidelines for the Provision and Utilization of Green Open Space in Urban Areas is stated that the definition of Green Open Space (RTH) is an elongated area/path and/or grouped area, the use of which is more open, a place for plants to grow, both those that grow naturally and those that are planted intentionally. Based on UU No. 26 Tahun 2007, specifically mandates the need for the provision and utilization of green open space, the proportion of which is set at least 30 (thirty) percent of the city area.

g. Pavement Area Recommendation Concept

A good pavement system will reduce vehicle attachment in the city center area, improve environmental quality through a humane design system, create more street vendor activities and ultimately help the air quality in the area. The concept that will be carried out is to revitalize damaged pedestrian ways.

h. Signage Aspect Recommendation Concept

The signage referred to here includes the creation of a gate as a location marker. Other markers that will be placed at certain points include: danger signs on riverbank areas, no-waste markers, assembly point area markers, evacuation route markers, building markers and places to carry out certain activities, and other markers.

Conclusion

Based on the results of the research and discussion, the Bah Bolon Riverbank Development Study in Pematang Siantar City, can be concluded as follows:

a. The riverbank area covers 5 (five) sub-districts. Of all the sub-districts, there are 3 (three) potential areas to be developed. These three areas were selected based on the similarity of the character of the area, the urgency of handling, and the potential of the area.
b. The development area includes the RINDAM KODAM I/BB area located in Setia Negara Village, Siantar Sitalasari District, covering an area of + 16.43 Ha, the Jalan Sutomo - Jalan Diponegoro - Jalan M.H. Sitorus area located in Teladan Village and Timbang Galung Village, West Siantar District, covering an area of + 24.88 Ha, and the Dewi Quan In Temple area in Simalungun Village, West Siantar District, covering an area of + 7.47 Ha.
c. The orientation and layout of the building mass (houses and businesses) are not in accordance with existing provisions. Almost all building orientations are facing away from the DAS. Many buildings are located in the river boundary area. For this reason, it is necessary to organize and relocate buildings into multi-residential buildings (rusunawa).
d. In the research area, handling will be carried out in the form of rearranging the three existing areas, in the form of land use planning including the arrangement of riverbank plazas, green open spaces, rafting activity terminals/stations, public toilets, green open spaces, amphitheatres, water recreation facilities, gazebos, culinary areas, art studios, souvenir sales places, tourist information centers, places of worship, health service buildings, pedestrian (jogging tracks), vehicle parking areas, public vehicle stopping places (bus stops), lighting, sanitation systems, and other supporting facilities..

e. Circulation and vehicle parking aspects are planned in such a way that they differentiate circulation patterns for motorized vehicles, bicycles, and pedestrians, including circulation for people with disabilities.
f. The development concept implemented is sustainable development (continuing development) by involving the active role of the community.

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