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# Flood Management Solutions at Panca Budi School in Medan

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**ABSTRACT**

Flooding is one of the problems that often occurs in the Panca Budi School in Medan, especially during the rainy season. This problem is caused by poor drainage systems, low soil absorption due to reduced green open space, and suboptimal waste management. This study aims to analyze the factors that cause flooding in the school environment and design solutions based on a sustainable approach to overcome these problems. The research method used is qualitative descriptive with data collection techniques through observation, interviews, and literature studies. The results showed that high rainfall intensity, inadequate drainage system, and low environmental awareness were the main causes of flooding at Panca Budi School in Medan. The solutions offered include improving the drainage system through the construction of larger and closed channels, the implementation of green infrastructure such as infiltration wells and bio-retention parks, rainwater management with rainwater harvesting systems, and education and involvement of the school community to maintain environmental cleanliness. The implementation of this solution also emphasizes sustainability by ensuring regular evaluation of the effectiveness of the measures that have been implemented. This research is expected to be a guide in overcoming flood problems in the school environment, creating safe and comfortable learning spaces, and contributing to better environmental management.

**Keyword : Flood, Drainage, Green Infrastructure, Rainwater Management, Sustainability.**



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## INTRODUCTION

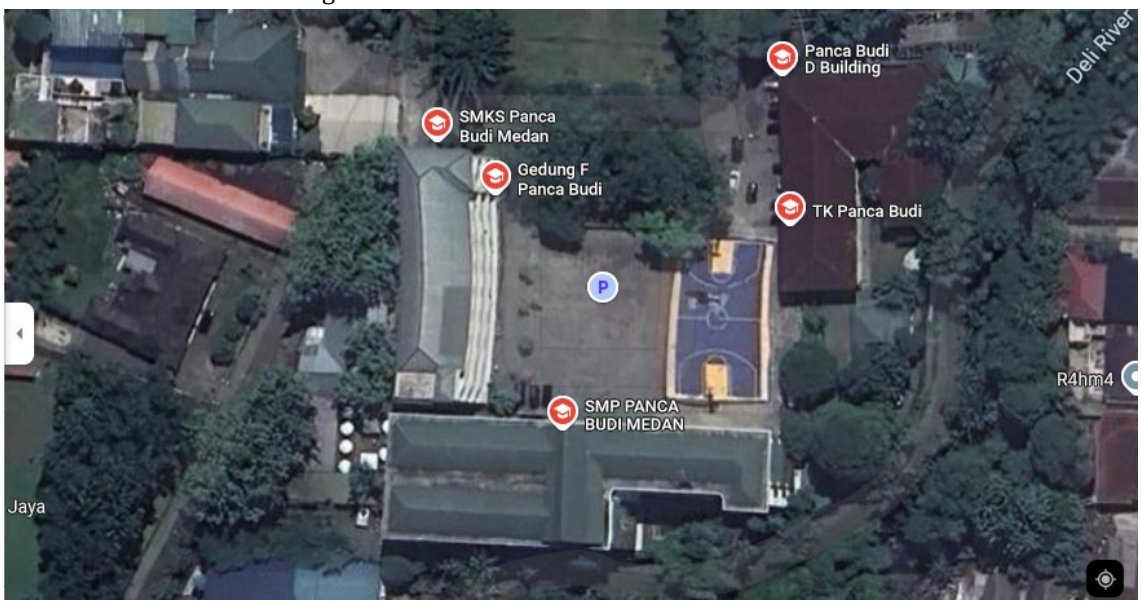
Floods are one of the main problems that often occur in urban areas, including in the city of Medan, which results in damage to infrastructure, disrupts daily activities, and damages the environment. The campus and the area around Sekolah Panca Budi Medan are also inseparable from the impact of this natural disaster, especially in the rainy season. Some of the factors that cause flooding around this campus include the condition of inadequate drainage channels, the influence of rapid urbanization, and the lack of green open space that can accommodate rainwater. This problem becomes more complex when lecture activities and other activities are hampered due to waterlogging that occurs in the area around the campus. Therefore, handling the flood problem at Panca Budi Medan School is very important. The study aims to identify the causes of flooding and formulate solutions that can be applied to prevent and reduce its impact, by utilizing the principles of sustainable water management and appropriate technology.

Figure .1.1 Location Plan of Panca Budi Medan School

The main causes of flooding around Panca Budi Medan School can be seen from several factors, both natural and artificial. One of the main factors is population density and rapid development in the area around the campus, which leads to changes in land use. Many areas that were previously green open land have now been converted into buildings or parking, which reduces the soil's ability to absorb rainwater. As a result, rainwater cannot be absorbed optimally and flows into inadequate drainage channels. Drainage channels in the area around the Panca Budi campus are also the main contributors to flooding. Some existing waterways are blocked due to garbage, building materials, or even the construction of new infrastructure that blocks the flow of water. This poor drainage causes rainwater that falls to the ground to stagnate and it is difficult to flow smoothly, causing flooding.

In addition, another factor that affects the occurrence of floods is the lack of green open spaces (RTH) that function as shelters and rainwater catchments. RTH around campus is relatively limited, and this reduces the environment's ability to manage rainwater naturally. In fact, areas that have a lot of green open space can help slow down the flow of rainwater and reduce the volume of water flowing into drainage channels.

Figure 1.2 Front View of Panca Budi Medan School




Climate change is also a factor that worsens flood conditions. The increase in extreme rain intensity in recent years has further increased the frequency of flooding in various areas, including around Panca Budi School. With the increasing frequency of heavy rains accompanied by strong winds,

the existing drainage system has become ineffective enough to handle large volumes of water. Floods that occur in the school environment not only have an impact on physical damage, but also interfere with teaching and learning activities. Student activities and teaching carried out in classrooms are often disrupted due to puddles that enter the school area. The road to school can also be hampered, so many students arrive late. Therefore, handling the flood problem at Panca Budi Medan School is very important to maintain the smooth running of educational activities and create a safe and comfortable environment.

Flood management in this school area requires a comprehensive solution, considering that the flood problems faced are quite complex. Therefore, this study aims to identify the root causes of flooding, as well as formulate effective solutions in overcoming the problem by using sustainable approaches, such as water management concepts based on environmentally friendly technologies and green infrastructure. Thus, the importance of rainwater management and the preparation of an effective drainage system are part of the steps to overcome and prevent flooding in the Panca Budi Medan School environment, so that the impact of this natural disaster can be minimized and the campus environment remains safe and comfortable for the entire academic community. Overall, the main problems faced in flood management at Panca Budi Medan School are related to inadequate drainage systems, lack of green open space, development density, and lack of understanding and participation in water management. Solutions to address these issues require a holistic approach, which includes improving drainage infrastructure, increasing green open spaces, and implementing sustainable water management technologies and policies.

## LITERATURE REVIEW

### Definition of Flood

Flooding is a natural phenomenon that occurs when the volume of water flowing at the ground level exceeds the capacity of existing drainage channels or reservoirs, thereby inundating certain areas. Floods can be caused by various factors, both natural factors such as heavy rainfall, and artificial factors such as inadequate drainage channels, land changes, or development patterns that do not pay attention to environmental aspects. According to Kusumawati (2019), floods often occur due to an imbalance between the amount of rainwater that falls and the capacity of the environment to hold or drain the water.

### Causes of Floods

Some of the causes of flooding in urban areas such as Sekolah Panca Budi Medan include:

1. High Rainfall High rainfall can cause very large volumes of water that must be channeled through drainage channels. If the drainage channel is unable to accommodate the water discharge, the water will overflow and inundate the ground surface.
2. Inadequate Drainage System Poor or clogged drainage systems are a major factor causing flooding in many urban areas. Narrow, clogged with garbage, or poorly maintained channels will cause rainwater to not flow smoothly.
3. Land Use Change Conversion of open land into building land or roads that cannot absorb rainwater causes water to flow faster into drainage channels. This results in faster waterlogging, especially in areas with high population density.
4. Lack of Green Open Space (RTH) The existence of RTH is crucial in rainwater management, as plants and open ground can absorb most of the rainwater. Losing RTH due to urbanization exacerbates this problem.

### Rainwater Drainage and Management System

According to Tama (2019), effective rainwater management is one of the main keys in flood prevention in urban areas. One of the systems that can be applied is *Sustainable Drainage Systems* (SuDS) or sustainable drainage systems that aim to handle rainwater in an environmentally friendly way, such as using infiltration wells, bioretention, and rainwater catchment to prevent excessive water runoff.

Integrated Drainage *Systems* is an approach to designing and managing drainage channels that not only drain water, but also utilize rainwater for other needs, such as watering plants or recharging groundwater. Syarifuddin (2019) in his research stated that the use of integrated and sustainable

drainage channels can reduce flood risk, improve water quality, and reduce the negative impact of urban development.

## METHOD APPROACH

This study uses a descriptive qualitative approach to analyze flood problems in Panca Budi Medan School and find appropriate handling solutions. According to Sugiyono (2019), the descriptive qualitative approach aims to provide an in-depth description of the phenomenon that occurs, in this case the problem of flooding that often occurs in school areas. This approach allows researchers to dig into more detailed information from a variety of sources, such as direct observations, interviews with related parties, and literature studies.

This research is a case study research, which focuses on solving the flood problem that occurred at Panca Budi School Medan. Case study research is perfect for analyzing a problem or phenomenon that occurs in a specific place, to then find relevant solutions. Yin (2019) explained that case studies are an effective method to understand complex problems in certain contexts, such as flood management in urban areas affected by various environmental factors.

Data collection is carried out by several methods as follows: Field Observation Field observations are carried out to directly identify problems that exist at the research site. Researchers will monitor drainage channels, the physical condition of areas that are often flooded, and infrastructure related to water management. Moleong (2019) stated that field observation provides a real picture of conditions in the field and helps researchers to see problems directly. Interviews Interviews will be conducted with parties who have relevant information, such as school principals, environmental management staff, and local residents. This interview technique will explore their opinions and experiences related to the problem of flooding in schools and solutions that have been implemented before. Creswell (2019) states that in-depth interviews can provide more complete and in-depth data about the problem being researched.

Data obtained from observations, interviews, and documentation studies will be analyzed using qualitative analysis with an inductive approach. According to Miles & Huberman (2019), qualitative analysis aims to organize and group data based on emerging themes or categories, so that patterns related to the causes and impacts of floods in Sekolah Panca Budi Medan can be found.

Once the data was collected, the analysis was carried out using analytical descriptive techniques that linked the factors causing flooding to the proposed solutions. The data will be analyzed in depth to find relationships between variables that affect flood management, such as drainage capacity, land use change, and environmental policies.

## DISCUSSION

### What are the factors that cause flooding around Panca Budi School in Medan

The factors that cause flooding around Panca Budi Medan School can be influenced by various aspects, both natural and man-made. The following is a detailed discussion of the factors that cause flooding in the area:

One of the main factors causing flooding is high rainfall in a short period of time. Medan, as one of the cities in Indonesia, has a tropical climate that tends to experience heavy rain in the rainy season. As the intensity of rain increases, the volume of water falling above the ground level also increases. If the drainage channel cannot accommodate a large volume of water, then the water will overflow and inundate the surrounding area. Heavy rains that occur during the rainy season are often the main cause of flooding in urban areas, including around Panca Budi School in Medan.

One of the causes of floods that are often found in urban areas is an inadequate or damaged drainage system. Poor drainage can be caused by several factors:

a. Narrow or clogged drainage channels: Drainage channels that are not large enough or clogged with garbage or soil can cause water to not flow smoothly, resulting in considerable puddles. This often happens in densely populated areas that do not have good waterway management.

b. Lack of maintenance of drainage channels: Many drainage channels are not properly maintained, so they cannot function optimally. Piles of garbage and leaves that are not cleaned will worsen the flow of water.

Around Panca Budi School, suboptimal drainage channels can be one of the main causes of flooding. If there is no regular maintenance and increased drainage capacity, waterlogging will get worse when there is heavy rain.

Rapid urbanization and land use changes around campuses can worsen drainage conditions and increase flood risk. Some of the land use changes that occurred were:

a. Conversion of open land to built land: The number of buildings, roads, and other facilities is reducing the amount of green open space (RTH) that serves to absorb rainwater. Soil covered with concrete or asphalt cannot absorb water, so rainwater flows faster into drainage channels and causes waterlogging.
b. Changes in water flow: Developments that do not pay attention to natural water flow can divert the path of rainwater flow, causing water to pool in improper locations.

Panca Budi School, which is located in a rapidly growing area, faces challenges related to land use change. Without good spatial planning, water absorption becomes limited, increasing the likelihood of flooding.

Green open spaces (RTH) are essential for managing rainwater, as plants and open ground can absorb rainwater well. However, with the increasingly dense development around Panca Budi School, the existence of RTH has become limited. The loss of green open land that should be used to absorb water causes rainwater to flow faster into drainage channels and cause flooding. Without the planting of trees or land that can absorb water, this area becomes very vulnerable to flooding, especially during high rainfall. Therefore, the addition of RTH around the campus is an important solution in reducing the potential for flooding.

The process of erosion and deterioration of soil quality that occurs in the area around the campus can also exacerbate the problem of flooding. Erosion causes a decrease in the soil's ability to absorb rainwater, so more water flows into drainage channels and causes flooding. Soil eroded by erosion is no longer able to hold water, and this can lead to greater runoff when it rains. Erosion can occur in areas that do not have sufficient vegetation cover, or in areas that frequently experience development activities that damage soil structures. Therefore, maintaining soil quality and planting proper vegetation is essential to prevent erosion and reduce the risk of flooding.

Water management systems that are not integrated between surface drainage and groundwater management can exacerbate flood problems. Without integrated management, rainwater flowing from the ground level often flows into drainage channels without any arrangement to direct water to the right area, such as infiltration wells or water reservoirs. The factors that cause flooding around Panca Budi Medan School involve various aspects, both natural such as high rainfall, as well as artificial factors such as poor drainage systems, changes in land use, lack of green open space, inadequate waste management, and soil erosion. A combination of these factors exacerbates flood conditions in the region. Therefore, a comprehensive approach is needed in dealing with flood problems, starting from improving drainage infrastructure, increasing public awareness of the importance of cleanliness, to the application of nature-based solutions such as green open spaces and infiltration wells.

**What is the drainage system in the current school environment**

The drainage system in the Panca Budi Medan School environment has a very important role in preventing waterlogging or flooding during the rainy season. Effective drainage will drain rainwater to a safe place and prevent it from flooding the school area, which can interfere with teaching and learning activities and damage school facilities. The following is a detailed discussion of the drainage system in the current school environment.

The drainage system in the Panca Budi Medan School environment consists of several main drainage channels and small drainage channels that drain rainwater from various points within the

school area to the main channels along the highway. These drainage channels are generally in the form of open ditches or pipelines that drain water to shelters or larger waterways around schools.

a. Open Drainage Channels: Some parts around the school still use open drainage channels in the form of ditches along paths or field areas. Although these open channels allow for greater water flow, they are often clogged with garbage, foliage, or soil, causing water to overflow and stagnate.
b. Pipelines: Some drainage channels are also in the form of pipes that drain water into the sewers. However, these pipelines are sometimes not large enough to accommodate high volumes of water, especially during heavy rains. In addition, several pipelines have experienced blockages due to suboptimal waste management.

One of the main problems faced in the drainage system in the Panca Budi School environment is the lack of regular maintenance of drainage channels. Channels that are not cleaned regularly can clog the flow of water. Dry leaves, garbage, and soil material that enter the canal become an obstacle to the flow of water, which causes water to get trapped and eventually inundate the school area. The lack of awareness to clean drainage channels and the lack of facilities for waste management cause drainage channels around schools to often be blocked. Therefore, even though the existing drainage system is well built, its performance is not optimal due to inadequate maintenance factors.

The drainage capacity around Panca Budi School is still inadequate to accommodate rainwater that falls with high intensity. In the rainy season with very heavy rainfall, the existing drainage channels often cannot accommodate large volumes of water, so the water overflows and inundates certain parts of the school, such as the yard, parking lot, or the road to the classroom. The limited capacity of drainage channels is also due to the design of the channels that do not take into account the potential for extreme rainfall that can occur. In addition, there is an increasingly dense construction around schools, which reduces green open space and soil absorption, further deteriorating drainage capacity to handle rainwater.

The drainage channels around Panca Budi School are also often not located in the optimal position to drain rainwater to the main channel. Some existing channels may not be directly connected to larger drainage channels outside the school environment, so water tends to be trapped inside the school area and cause inundation. In addition, at certain points, such as around field areas or classrooms, drainage channels are located higher than ground level, resulting in water not being able to flow smoothly. The improper arrangement of the position and flow direction of the drainage channel also exacerbates the flood problem.

In addition to internal problems related to drainage, changes in land use around schools also affect the existing drainage system. With the ever-increasing development around the school area, more surfaces are covered by concrete or asphalt, which reduces the ability of the soil to absorb rainwater. During heavy rains, water that cannot be absorbed by the soil will flow into the drainage channel. However, if the drainage is unable to accommodate a larger volume of water due to land use change, waterlogging will occur in the school area. This change further worsens the existing drainage conditions. The drainage system in the Panca Budi Medan School environment currently has several obstacles, especially in terms of capacity and maintenance. Although there are several drainage channels built, these channels are often unable to hold high volumes of rainwater, and poor maintenance problems worsen their performance. Therefore, better drainage improvements and management, such as routine maintenance, capacity building, and rearrangement of drainage channels, are needed to prevent flooding and waterlogging in schools.

**What are the solutions that can be applied to overcome flooding at Panca Budi Medan School**

To overcome the flood problem at Panca Budi School Medan, various solutions need to be implemented in an integrated and sustainable manner. These solutions include approaches based on more efficient water management, improvement of drainage infrastructure, and prevention and mitigation efforts. Here are some solutions that can be applied to overcome flooding around Panca Budi Medan School in detail:

1. Drainage System Improvement
   One of the main solutions to overcome flooding is to increase the capacity and quality of the existing drainage system. A good and adequate drainage system will help drain rainwater quickly and efficiently to a safe drain, thus preventing waterlogging.
   a. Routine Cleaning of Drainage Channels: Regular cleaning of drainage channels from garbage, leaves, and other materials that can obstruct the flow of water. This activity needs to be carried out by school officials by involving the academic community such as students and teachers to maintain the cleanliness of the environment.
   b. Increased Drainage Capacity: Enlarging drainage channels or replacing damaged and clogged channels with larger ones. Larger drainage channels will be able to hold more water, especially during heavy rains. The construction of infiltration wells can also be an alternative to reduce the load on drainage channels.
   c. Installation of Closed Drainage Systems (Pipes): To solve the problem of standing water in field areas or school yards, closed drainage systems such as pipes can be installed to drain water faster and safer. This system can also be installed in flood-prone locations around school buildings.
2. Waste Management and Environmental Awareness
   Garbage that accumulates and clogs drainage channels is one of the main causes of flooding in urban areas, including in school environments. Therefore, good waste management and environmental awareness are essential to reduce flood risk.
   a. School Community Counseling and Education: Educate students, teachers, and school staff on the importance of maintaining cleanliness and not littering. This cleanliness awareness campaign can be carried out through various media, such as posters, seminars, and mutual cooperation activities.
   b. Adequate Waste Management Facilities: Provide garbage cans in every corner of the school and regulate organic and inorganic waste separation systems. Properly managed waste will reduce the risk of clogged waste in drainage channels.
   c. Periodic Channel Cleaning: Prepare a drainage cleaning schedule periodically, especially before the rainy season, to ensure that the drains are not blocked by garbage and other debris.
3. Green Open Space Development (RTH)
   Tree planting and the construction of green open spaces (RTH) can be one of the effective solutions to overcome flooding in school areas. RTH serves as an area for rainwater absorption and a reduction in the flow of water flowing into drainage channels.
   a. Tree Planting and Vegetation: Increasing the number of trees and vegetation around the school environment will help increase the soil's absorption of rainwater. Trees can also reduce the rate of surface water flow that risks causing flooding.
   b. Construction of Parks or Catchment Areas: Creating parks or catchment areas in certain parts of schools that have not yet been built. This area can be a place to absorb rainwater and reduce the volume of water flowing into the drainage.
   c. Use of Plants That Absorb a Lot of Water: Plants such as elephant grass, rice, or other plants that are able to absorb rainwater quickly can be planted around schools to help absorb water more effectively.
4. Construction and Optimization of Infiltration Wells
   Infiltration wells are one of the effective nature-based solutions in dealing with flood problems, especially in urban areas that are mostly made of concrete. Infiltration wells function to absorb rainwater into the soil, thereby reducing waterlogging on the surface.
   a. Construction of Infiltration Wells at Strategic Points: Building infiltration wells in flood-prone areas or in places where there is not too much construction, such as in school yards or fields. With infiltration wells, rainwater can be channeled directly into the ground, reducing the potential for flooding at the surface.

b. Infiltration Well Capacity Increase: In order to improve the efficiency of infiltration wells, the capacity of the well can be enlarged according to needs. With a larger capacity, infiltration wells can absorb more water, thereby reducing inundation and potential flooding.

5. Integrated Rainwater Management
   The application of the concept of integrated water management in the school environment, such as the IWRM (Integrated Water Resources Management) system, can help manage rainwater more effectively.
   a. Rainwater Collection for Alternative Use: Collects rainwater that falls on the roof of a school building to be used in daily activities, such as watering plants, toilets, or other purposes. That way, the need for clean water can be reduced, while the use of rainwater can be maximized.
   b. Rainwater Treatment System Application: Filtering and treating rainwater collected through natural filtration systems (e.g., by using sand, stone, or gravel) to reduce contaminants, so that the water can be used for cleaner purposes.
6. Planning and Improvement of Environmental Infrastructure
   Better and sustainable infrastructure development is essential in preventing flooding. This includes better spatial planning, improved road infrastructure, and better water flow management.
   a. Redesign of Drainage Ducts Connected to Main Drains: Make improvements to existing drainage systems by connecting them directly to the main sewer outside the school environment. A better design will reduce the risk of water getting trapped and inundating the school area.
   b. Construction of Flood-Resistant Roads and Parking Lots: Changing the design of roads and parking lots by using environmentally friendly and water-absorbing materials, such as permeable paving blocks. This will help rainwater seep into the soil and reduce water flow into drainage channels.
7. Routine Monitoring and Evaluation
   To ensure that the solutions implemented run well, it is important for schools to monitor and evaluate regularly.
   a. Monitoring the Effectiveness of Implemented Solutions: Periodically assess whether the solutions that have been implemented, such as increasing drainage capacity or building infiltration wells, are really effective in overcoming flooding.
   b. Evaluation of Rainwater and Waste Management Systems: Evaluate rainwater and waste management to see the extent to which environmental awareness has been applied among students and school staff.

The solutions implemented to overcome flooding at Panca Budi Medan School include improving drainage systems, good waste management, building green open spaces, and implementing an integrated water management system. With the consistent and comprehensive implementation of these solutions, it is hoped that the problem of flooding in the school environment can be minimized, so that teaching and learning activities are not disrupted and school facilities are well maintained.

**CONCLUSION**

From the results of research and discussion on flood management solutions at Panca Budi School in Medan, it can be concluded that the flood problem in the school environment is caused by various factors, such as inadequate drainage systems, low soil absorption capacity due to land conversion, and poor waste management. In addition, the high intensity of rainfall in Medan City further aggravates this condition.

To effectively and sustainably address the flood problem, the designed solution needs to include several integrated steps, namely:

1. Drainage System Improvement Improve and increase the capacity of existing drainage channels to drain rainwater more efficiently, as well as ensure that channels are not clogged with garbage.

2. Implementation of Green Infrastructure Build infiltration wells, infiltration parks, and green open spaces (RTH) to increase soil absorption, reduce surface water runoff, and help improve groundwater quality.
3. Integrated Rainwater Management Utilizing rainwater through *rainwater harvesting* systems, such as rainwater collection and filtration for non-potable needs, thereby reducing the risk of waterlogging.
4. Good Waste Management Educates the school community about the importance of maintaining environmental cleanliness, along with the provision of waste sorting facilities and regular cleaning of waterways.
5. Community Awareness and Participation: Increase the awareness of all school residents and involve the surrounding community in maintaining environmental cleanliness and supporting the implementation of anti-flood solutions.

The implementation of this solution not only focuses on handling the current flood problem, but also on long-term prevention by improving the ecosystem of the school environment and its surroundings. This approach is expected to create a safe, comfortable, and sustainable learning environment at Sekolah Panca Budi Medan. The success of the solution requires a joint commitment from schools, students, teachers, the community, and the government to implement and maintain the sustainability of the flood mitigation measures that have been designed.

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