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An Assessment of Retention Pond Conditions in Housing Area at Batu Pahat, Johor

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Abstract

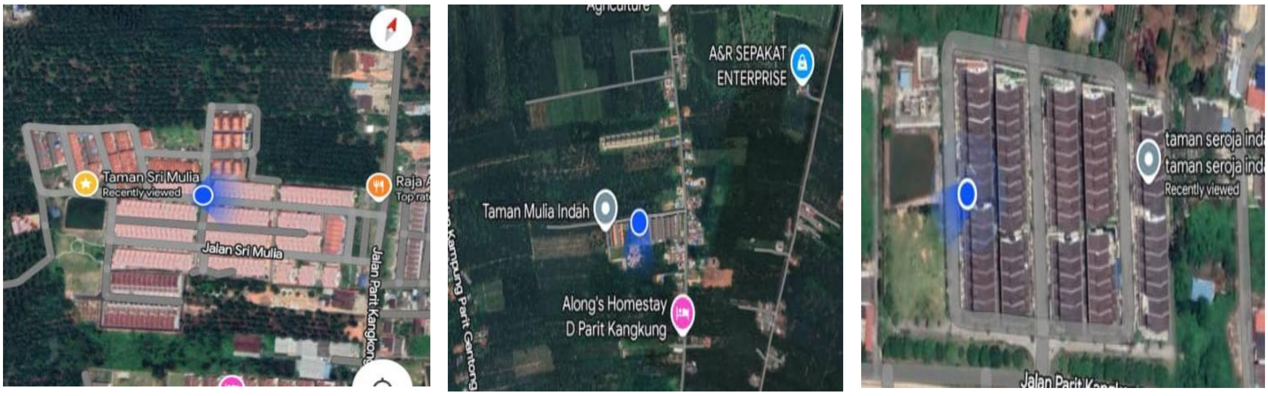
The rapid urbanization and climate change have been known to disrupt natural hydro systems in Malaysia deeply by causing inefficient management of stormwater management and urban flooding in the case of regular urban developments. With these problems in place, the proposed study sought to assess the status of retention ponds in five residential sections of the town of Batu Pahat, the state of Johor, taking into consideration the guidelines of the Urban Stormwater Management Manual of Malaysia (MSMA) and Sustainable Drainage Systems (SuDS). The assessment was done through on-site observation, photo observations, and use of a structured evaluation checklist based on important categories: design and structure, integration of the environment, maintenance and safety, and fit within the community. The performance of each retention pond according to a Likert-scale rubric has shown that there is a lot of variation in the performance. The best pond (Taman Permata) obtained the overall score of 87%, which shows that it was well designed and rather well maintained. The worst site (Taman Seroja Indah) scored only 59%, which means that it was poorly designed and maintained in the of environmental integration and was poorly developed in terms of safety features. The results reveal design discrepancies, care work, and coordination with urban planning. Retention ponds play a crucial role in flood mitigation and water quality enhancement, which should be taken into consideration in residential places, and depend on regular maintenance, or design by MSMA, and embedding in urban sustainability systems.

1. Introduction

Malaysia's Stormwater management has been largely disturbed by urbanization and climate change, especially in suburban areas of housing by developers, such as in Batu Pahat, Johor, where conventional drainage systems are no longer able to cope with the rising levels of runoff due to the frequency and volume of storms. As indicated in the literature, the conventional systems do not support the concept of environmental sustainability and flood resiliency, thereby noting that the concept of sustainable urban drainage systems (SuDS) is required, particularly in the form of retention ponds that can support floods, enhance water quality, as well as biodiversity (DID, 2012; Ahmad Khairi, 2024). Nevertheless, even with the guidelines of the MSMA 2 nd Edition, the condition of retention ponds in Malaysia remains badly maintained, irregularly designed, and low data are available regarding the working capability of the ponds in the field. In reaction to this, the project evaluated the requirements and performance of five retention ponds in residential neighbourhoods in Batu Pahat, employing a systematic evaluation checklist on the basis of the principles of MSMA and SuDS. The study found different degrees of performance using site visits and visual inspections of the sites, and it showed that there is a high need for standardized design, proper maintenance performs and implementation of the policies in order to have more resiliency and sustainability in regards to flood management strategies in urban planning design.

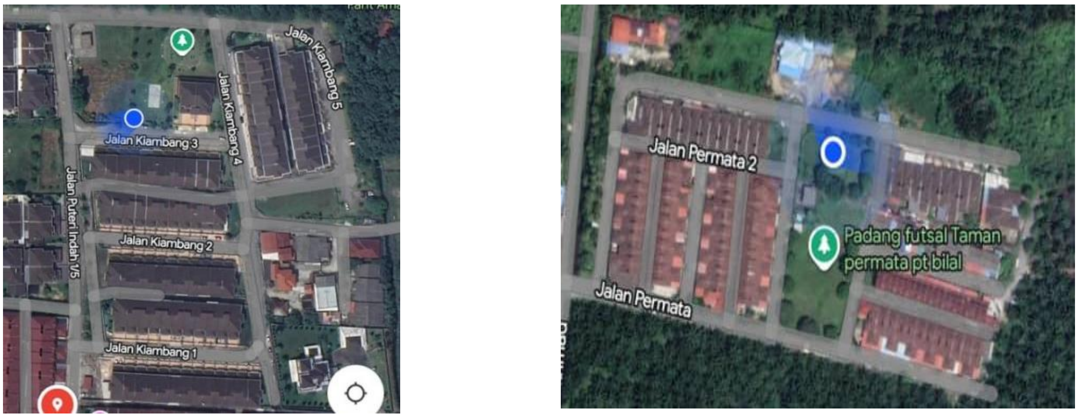
2. Methodology

This study utilized a methodology based on a structured field-based assessment to assess the level of retention ponds within five residential areas in Batu Pahat, Johor. Site visits, visual observations, and photographic records were the main approaches used to collect primary data, during which the physical appearance, maintenance conditions, and the inclusion of the ponds in the environment were recorded. The custom evaluation checklist was created according to fundamental criteria obtained by the Urban Stormwater Management Manual for Malaysia (MSMA) 2 nd Edition and the Sustainable Drainage Systems (SuDS) concepts. The categories that were included in the checklist are the design and structure, environmental integration, maintenance and safety, and compatibility with surrounding communities. Scores were assessed with a Likert-scale scoring rubric to make it consistent and recognized to make cross-site comparison. This methodology has given us a uniform model to show how effective and compliant the retention ponds are in line with national standards in stormwater.



(a) **(b)** **(c)**

Fig. 2 *Housing areas (a) Taman Sri Mulia, (b) Taman Mulia Indah, (c) Taman Seroja Indah*



(d) **(e)**

Fig. 3 *Housing areas (d) Taman Kiambang (e) Taman Permata*

The evaluation checklist was prepared with the help of literature on stormwater management, MSMA guidelines, and sustainable drainage design best practices. It was the main tool in the field observations and the data collection by means of this checklist. The ponds were evaluated based on a few-point criteria, such as physical design, hydrological role, ecological integration, urban accessibility, and maintenance.

Place:..

CATEGORY	ITEM	SCORE
1. Design & Structure	Pond Type	
	Storage Volume Capacity	
	Outlet & Inlet Structure	
	Side Slope Gradient	
2. Environmental Function	Ecological Landscaping	
	Water Quality Function	
	Sediment Control	
3. Maintenance & Safety	Access for Maintenance	
	Safety Features	
	Regular Inspection/Maintenance	
4. Community & Urban Fit	Location	
	Aesthetic Value	
	Impact on Neighbors	

Fig. 4 *Evaluation Checklist*

Direct site observations and photographs were used to collect field data. A Likert-scale rating was applied to the checklist to quantify results and make uniform evaluations and comparisons between the various sites. Significant design characteristics, such as inlet and outlet structures, vegetation, sedimentation rates, and maintenance indicators, were identified and logged.

Rubric Checklist

ITEM \ SCORE	1 (Very Poor)	2 (Poor)	3 (Fair)	4 (Good)	5 (Excellent)
Pond Type	Pond type is inappropriate or not functioning as a retention pond (e.g., dry with no stormwater purpose).	Pond exists but does not meet basic stormwater retention standards.	Pond type is acceptable but could be improved for efficiency or function.	Suitable pond type with effective retention characteristics.	Optimal pond type specifically designed for effective flood mitigation and sustainability.
Storage Volume Capacity	Severely inadequate; cannot hold expected stormwater volume.	Low capacity; frequent overflow during storms.	Meets minimum required capacity but not robust.	Sufficient volume to handle standard storm events.	High capacity; exceeds design standards and ensures flood control.
Outlet & Inlet Structures	Damaged, blocked, or non-functional inlet/outlet.	Inadequate design causing water flow problems.	Functional but needs improvement for flow control.	Well-designed with good flow regulation.	Excellent design with durable and efficient flow mechanisms.

(a)

Side Slope Gradient	Dangerous, steep, or eroded slope.	Slopes are unstable or too steep for safety.	Average stability; could benefit from reinforcement.	Stable and moderately sloped for safety and maintenance access.	Ideally graded, safe, and conforms to engineering best practices.
Ecological Landscaping	No vegetation or completely degraded landscape.	Sparse, non-native or unmaintained vegetation.	Some ecological landscaping but lacks variety or health.	Good mix of native plants, contributing to biodiversity.	Rich ecological landscaping with native species, well-maintained, and supports habitat.
Water Quality Function	Pond has visibly polluted or stagnant water.	Minimal treatment features; poor water clarity.	Average water quality; limited filtering or settling functions.	Good water quality through proper filtration and vegetation.	Excellent natural treatment system maintaining clean, clear water.
Sediment Control	Excessive sediment accumulation, affecting pond capacity.	Some sediment control exists but is poorly managed.	Moderate sediment control with occasional clogging.	Functional sediment traps or basins with minimal buildup.	Effective, well-maintained sediment control system in place.

(b)

Access for Maintenance	No access; maintenance impossible	Limited access with difficulty for equipment or personnel.	Some access paths available, but not ideal.	Good access for periodic maintenance activities.	Excellent access with safe, designated maintenance routes.
Safety Features	No safety measures; high risk to public.	Inadequate safety features like broken fencing or signs.	Some safety features exist but need repair or improvement.	Proper safety features in place (fencing, signage, slopes).	Comprehensive safety system protecting public and workers.
Regular Inspection/Maintenance	No inspection or maintenance activities observed.	Irregular maintenance with visible issues.	Some maintenance done occasionally, but inconsistent.	Regular and recorded inspection/maintenance performed.	Routine, well-documented maintenance with excellent condition.
Location	Pond is poorly located, causing obstruction, flooding, or isolation; disconnected from the community.	Pond is placed in an inconvenient area, with limited benefit or accessibility to the public.	Acceptable location, but with some issues (e.g., minor access problems, or low visibility).	Well-placed with good integration into the surrounding area; easily accessible and functional.	Strategically located for maximum flood control and community accessibility; enhances connectivity.

(c)

Aesthetic Value	No aesthetic effort; pond is an eyesore, with trash or overgrowth.	Minimal landscaping or visual value; appears neglected.	Some visual appeal, but design is basic or inconsistently maintained.	Visually pleasant with landscaping and clean surroundings.	Beautifully integrated into urban design with high aesthetic and recreational value.
Impact on Neighbors	Creates negative effects like odors, flooding, or mosquito breeding; strongly opposed by residents.	Some disturbance to nearby residents, with complaints or concerns.	Neutral impact; no major complaints, but not actively beneficial either.	Generally positive impact; contributes to local environment and community satisfaction.	Highly beneficial to residents; promotes safety, education, or recreation with strong community support.

(d)

Fig. 5 *Rubric Checklist*

A standardized rubric would enable objectivity, consistency, and transparency in the comparative analysis of stormwater pond systems. Along with the clear definition of performance indicators and scoring criteria, e.g., pond type, storage volume, safety, aesthetics, the rubric reduces subjectivity and bias, even under the circumstance of having multiple evaluators or different site provisions. To illustrate, a value of 1 might reveal that storage is so miserably low; a value of 5 would signify that flood control is at its best. This organized method helps to consistently benchmark all sites and improve the data interpretation, allowing the stakeholders to point out places for improvement and take evidence-based decisions that are paramount in engineering, urban planning, and the environment.

Options	Scale
Very Poor	1
Poor	2
Fair	3
Good	4
Excellent	5

Fig. 6 *Likert Scale To Rate (Likert R., 1932)*

The approach provided in this analysis allowed a complex assessment of the suitability of these retention ponds to the principles of Sustainable Drainage Systems (SuDS) and the MSMA Second Edition standards. The methods used, which included both qualitative and quantitative techniques, meant a clearer comprehension of how well these ponds mitigated flood risk and aided sustainable urban drainage.

3. Results

The research consisted of assessing five retention ponds in residential premises around Batu Pahat, Johor, which included Taman Seroja Indah, Taman Sri Mulia, Taman Mulia Indah, Taman Kiambang, and Taman Permata. The ponds were rated against five major categories: design suitability, hydrological performance, environmental integration, maintenance condition, and urban compatibility, by a structured checklist and on-site observation. The Likert scale was used to record the results, and the findings are represented by comparative tables and bar charts to ease understanding.

3.1 Design & Structure

The evaluation of stormwater ponds across five Tamans revealed a mix of strengths and weaknesses in design and performance. Both Taman Sri Mulia and Taman Mulia Indah scored lowest (1) in pond type, indicating poor functionality in stormwater retention, though Sri Mulia showed strength in outlet/inlet structures and slopes, while Mulia Indah excelled only in storage volume. Taman Seroja Indah performed moderately, with good storage and functional flow structures, but had issues with pond type and unsafe slope gradients. Taman Permata and Taman Kiambang both had ineffective pond types and low storage capacity (scores of 2), but stood out with high-performing outlet/inlet structures and moderate slope stability. Overall, while most ponds had effective water flow systems, widespread issues with pond type and volume limit their stormwater management efficiency.

↓	C1-T	C2	C3	C4	C5
	Housing Area	Pond Type	Storage Volume Capacity	Outlet & Inlet Structures	Side Slope Gradient
1	Taman Sri Mulia	1	3	4	4
2	Taman Mulia Indah	1	4	1	3
3	Taman Seroja Indah	2	4	3	2
4	Taman Permata	2	2	4	3
5	Taman Kiambang	2	2	4	3

Fig. 7 *Design & Structure*

3.2 Environmental Integration

The environmental performance of stormwater ponds across the five Tamans varies significantly. Taman Sri Mulia showed strong ecological landscaping (score 4) but weak water quality and sediment control (score 2), limiting its overall effectiveness. Taman Mulia Indah had moderate landscaping (score 3) but poor water treatment (score 2) and very weak sediment control (score 1), indicating the need for major improvements. Taman Seroja Indah performed well in landscaping and water quality (both scored 4), though its sediment control remained weak (score 2). Taman Permata showed the poorest results, scoring 1 across all indicators, pointing to a need for urgent rehabilitation. Taman Kiambang had moderate ecological landscaping (score 3), strong water quality (score 4), but weak sediment control (score 2). Overall, while some ponds support biodiversity and water clarity, most suffer from inadequate sediment control, affecting long-term environmental sustainability.

	Housing Area	Ecological Landscaping_1	Water Quality Function_1	Sediment Control
1	Taman Sri Mulia	4	2	2
2	Taman Mulia Indah	3	2	1
3	Taman Seroja Indah	4	4	2
4	Taman Permata	1	1	1
5	Taman Kiambang	3	4	2

Fig. 8 *Environmental Integration*

3.3 Maintenance & Safety

The maintenance and safety evaluation of the stormwater ponds reveals varying levels of performance across the Taman. Taman Sri Mulia and Taman Kiambang both scored high in access (score 5), allowing easy maintenance, but lacked safety measures and regular inspections (scores 1–2), posing risks. Taman Mulia Indah performed the worst overall, with scores of 1 in all aspects, indicating poor access, safety, and maintenance. Taman Seroja Indah showed strong access (5) and good safety features (4), but lacked consistent maintenance (2), while Taman Permata had moderate access (3) but failed in safety and inspection (1). Overall, while access is adequate in some areas, consistent safety infrastructure and structured maintenance schedules are lacking, threatening long-term pond effectiveness and public safety.

	Housing Area	Access for Maintenance	Safety Features	Regular Inspection/Maintenance
1	Taman Sri Mulia	5	2	1
2	Taman Mulia Indah	1	1	1
3	Taman Seroja Indah	5	4	2
4	Taman Permata	3	1	1
5	Taman Kiambang	5	1	2

Fig. 9 *Maintenance & Safety*

3.4 Community & Urban Fit

The community integration and urban fit of the stormwater ponds show mixed results across the five towns. Taman Sri Mulia is fairly well-integrated, with a good location (score 4), moderate aesthetics (3), but limited positive impact on neighbours (2), suggesting room for improvement. Taman Mulia Indah performs poorly overall, with low scores in aesthetics (2) and neighbour impact (1), indicating community dissatisfaction. Taman Seroja Indah stands out with excellent location (5), moderate aesthetics (3), and neutral to slightly positive neighbour feedback (3), showing strong integration. Taman Permata also has a good location (4) but suffers from low aesthetic value (2) and negative neighbour impact (1), reducing its appeal. Taman Kiambang is well-located (5) but lacks aesthetic development (2) and is viewed negatively by residents (1), highlighting poor community engagement. Overall, while many ponds are well-situated, visual quality and social acceptance remain major weaknesses.

	Housing Area	Location_1	Aesthetic Value	Impact on Neighbors
1	Taman Sri Mulia	4	3	2
2	Taman Mulia Indah	3	2	1
3	Taman Seroja Indah	5	3	3
4	Taman Permata	4	2	1
5	Taman Kiambang	5	2	0

Fig. 10 *Community & Urban Fit*

Out of the five sites, both Taman Seroja Indah and Taman Sri Mulia were identified to be the most effective ponds. These ponds had a satisfactory performance with regard to the MSMA guidelines, mainly in managing peak water flows, proper in and outlet structures, good maintenance direction, and general clarity. The fact that they are near important aspects to the people, like roads and recreational parks, also makes them easily accessible and visible, making them well-maintained.

Taman Mulia Indah and Taman Permata, on the other hand, registered poor performance. Such locations had obvious evidence of sedimentation, blocked or absent drainage systems, and lacked fencing or other protective measures that are both dangerous to the surrounding communities and expose them to the dangers of flooding. These were also not subjected to regular maintenance practices, with vegetation growth and the buildup of garbage in and around the pond sites.

Taman Kiambang received an average rating and demonstrated partial conformity to the design principles, yet had minor maintenance-related flaws and poor environmental connection.

The most general problems that arose in the majority of ponds were:

- Deposition of the sediment and debris.

- Failure to maintain according to the routine.
- Poor implementations like fences and signage.
- Limited accessibility in certain places, especially the places that are distant from the community and public sites.

Such findings reflect the inconsistency of retention pond conditions and indicate the necessity of unified enforcement and regular maintenance, as well as design modifications to improve the overall efficiency of retention ponds in stormwater management processes and flood prevention.

4. Discussion

There was a significant variation in the state and functionality of retention ponds in five residential regions in Batu Pahat; some of the ponds, like Taman Permata, achieved as high as 87 percent because of good design and maintenance, whilst others like Taman Seroja Indah scored only 59 percent because of poor environmental integration, urgent provision of safety measures. Such variations indicate that there is no standardisation, poor maintenance planning, and poor alignment of the provisions with the concepts explained in the MSMA and Sustainable Drainage Systems guides. On comparison with international case studies such as community based systems with an example of United Kingdom, ecologically enhanced and well maintained ponds in Netherlands, as well as Singapore ABC Waters Programme, it is evident that successful storm waters solutions are generally characterized by clear regulatory systems, coordinated maintenance strategy, mature community engagement, and considerate integration in green infrastructure of a city. The local planners and authorities in Malaysia would benefit by learning the things they can do with retention ponds that are both functional, long-lasting, and acceptable to their populations, at least based on the experiences of these international practices. Doing so would help them develop more resilient and caring developments with regard to the natural environment, and made possible by the rich lessons that international practices have to offer.

5. Conclusion

An assessment of the condition and performance of retention ponds within five residential areas in Batu Pahat, Johor, was carried out with a structured checklist that was developed through the MSMA and SuDS principles. The results indicated a high level of uniformity with certain ponds that were well-designed and maintained, and others that had flaws in their level of solution to places in the environment, safety hazards, and maintenance. The findings of these studies are an indication of the opinion that retention ponds are critical components of managing stormwater and floods, as well as it may only be effective when the design standards are maintained at the same level, whenever maintenance is carried out consistently, and incorporated in the urban planning. The study suggests that better implementation of the MSMA guidelines, the involvement of more stakeholders, and awareness of the population are the key to improving the long-term trends of such systems. It is also suggested that local governments assume the application of standardized methods of assessment, provision of adequate resources for maintenance, and the upholding of designs of multifunctional ponds (those that provide ecological and community functions as well). Nevertheless, the investigation had certain limitations, such as its localized geographic areas of study, the absence of quantitative measures in terms of qualitative visual observatory, and the non-inclusion of the additional SuDS like bioswales or green roofs implying that future studies can explore the geographical area as well as consider hydrological modelling, the survey of stakeholders, and comparisons of different regions to obtain a more complete picture.

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