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ENGINEERING AND TECHNOLOGY
COLLOQUIUM



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PREFACE

Welcome to the 2nd International Science, Engineering and Technology Colloquium 2025 (ISETC 2025)!

It is with great pleasure that we present this year's colloquium, a distinguished gathering of scholars, researchers, and professionals dedicated to the advancement of applied sciences. Held virtually on 9th July 2025, ISETC 2025 serves as a platform to highlight cutting-edge research, foster meaningful networking, encourage collaborations, and explore innovative solutions to global challenges.

This year's theme, "The Power of Scientific Innovation: Intelligent Solutions for a Sustainable World" highlights our shared goal to solve global challenges through applied science. It celebrates innovation as a key to building a more sustainable and resilient future. We're proud to feature keynote speakers and presenters who bring fresh insights, bold ideas, and breakthroughs shaping tomorrow's world.

We would like to extend our heartfelt appreciation to the Faculty of Applied Sciences, Universiti Teknologi MARA, Perak Branch, Tapah Campus, for their outstanding support and assistance throughout the planning and execution of the event. Their dedication has been instrumental to the success of this colloquium. We would like to sincerely thank all participants and researchers for their valuable contributions. We also appreciate the reviewers for their careful evaluations and helpful feedback. Your hard work and support mean a lot to us.

As editors, we are proud to present this collection of proceedings. It is an honour to bring together the interesting and meaningful work of our speakers and authors. We hope the ideas shared will lead to new discoveries, encourage more research, and help solve global challenges through science and innovation.

Warm regards,

Dr. Emi Norzehan Mohamad Mahbob

Dr. Saiyidah Nafisah Hashim

Ms. Lili Widarti Zainuddin

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ISETC 2025 Proceedings Editors

RECREATIONAL WATER QUALITY IN A FOREST RESERVE: A STUDY FROM TAMAN RIMBA TELUK BAHANG

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Abstract: This study evaluated the recreational water quality in Taman Rimba Teluk Bahang, Penang, a popular natural park featuring artificial pools fed by flowing freshwater. Water samples were collected monthly over three months (November 2023 to January 2024) at three stations (upstream, midstream, and downstream) to assess selected physicochemical parameters. Parameters included water temperature, pH, dissolved oxygen, conductivity, total dissolved solids (TDS), water transparency, turbidity, total suspended solids (TSS), nitrite, ammonia, orthophosphate, and chlorophyll-a. Most parameters met Malaysia's National Water Quality Standards (NWQS) for Water Class IIB, except for pH at midstream and downstream stations, which recorded values below pH 6, possibly due to natural or anthropogenic influences. Station 1 (upstream), where recreational activities were observed, remained within acceptable limits, although pH declined slightly during peak visitor periods. Significant correlations were found between conductivity and TDS ($\rho = 0.942$, $p < 0.01$), and between temperature and transparency ($\rho = -0.722$, $p < 0.01$). Elevated ammonia and conductivity at Station 3 suggested contamination from a nearby wastewater outlet. Overall, the upstream pool was safe for recreational use, but further monitoring and investigation are recommended, particularly regarding pH variation and the influence of human activity on water quality.

Keywords: *Recreational, water quality, Taman Rimba, Teluk Bahang, physicochemical parameters*

INTRODUCTION

Public pools are artificial basins filled with clean water that are open for all people to carry out recreational water activities, such as swimming or bathing, which may require an entrance fee or free admission. Taman Rimba Teluk Bahang in Penang is a natural park within Teluk Bahang Forest Reserve which was established and utilized for recreational and eco-tourism purposes to raise the consciousness of the public about forestry and nature appreciation (Jusoh et al., 2011). It provides artificial communal pools and mini waterfalls with natural water flowing through them for people to swim and bathe, and other recreational activities can be carried out around the pools, such as picnics and camping. Therefore, the recreational water in Taman Rimba is susceptible to contamination by environmental factors and anthropogenic activities since it is an open area enclosed by a forest that welcomes many visitors daily.

The recreational water quality of the pools is crucial for the public health and safety of activities like swimming and bathing. Poor recreational water quality of the pools or the surrounding environment would cause the users to be more susceptible to physical risks such as drowning or injuries, biological risks such as diseases caused by pathogenic microorganisms, and chemical risks due to chemical contamination (WHO, 2006). There is very little online information about Taman Rimba Teluk Bahang. Most of the resources online related to Taman Rimba Teluk Bahang are reviews or blogs written by visitors who travelled to Taman Rimba. No official data or related research about the recreational water quality in Taman Rimba Teluk Bahang is available online. Since the public pools are mainly used for recreational activities by visitors, it is important to know about the recreational water quality in Taman Rimba Teluk Bahang. This research aimed to evaluate the recreational water quality in Taman Rimba Teluk Bahang based on the selected physicochemical parameters.

MATERIALS AND METHODS

The selected study site was Taman Rimba Teluk Bahang, Penang (Coordinates: 5°26'47.3"N, 100°13'01.7"E; Figure 1). It is also known as Hutan Lipur Teluk Bahang and was established in 1974 for recreational activities, eco-tourism and for the public to be conscious of the importance of forests and cherish nature. There are five units of recreational

pools built in Taman Rimba Teluk Bahang. The water flows into the pools as natural freshwater, continuously flowing from upstream to downstream (Jabatan Perhutanan Negeri Pulau Pinang, 2015b).

Three sampling stations were set up in this study. The sampling stations were established at the upstream pool, the middle stream and the downstream. The physicochemical parameters were measured at each station, and the water samples were collected with three replicates each for later analysis of ex-situ parameters in the laboratory. Water sampling was conducted once a month in the morning for three consecutive months, starting from November 2023 until January 2024. At each sampling station, three replicates of water samples with a volume of about 500 ml for each replicate were collected. The multiparameter model YSI 556 MPS was used to measure the in-situ parameters including water temperature, dissolved oxygen (DO), conductivity and total dissolved solid (TDS). On the other hand, turbidity was measured using Vernier LabQuest® 2 with turbidity sensor (TRB-BTA), while pH was measured using pH meter. Water transparency was measured using a Secchi disc tied with a rope. Water samples collected in the field were brought back to the laboratory to analyze ex-situ parameters, including total suspended solids (TSS), nitrite, ammonia, orthophosphate, and chlorophyll-a concentration.



Figure 1. Sampling stations at Taman Rimba Teluk Bahang
(Source: The Layout Plan Board in Taman Rimba Teluk Bahang)

RESULTS AND DISCUSSION

The study at Taman Rimba Teluk Bahang investigated various water quality parameters over three months across three stations (Table 1). Among these, water temperature, pH, conductivity, total dissolved solids (TDS), transparency, total suspended solids (TSS), nitrite, ammonia, orthophosphate, and chlorophyll-a showed clear patterns or ecological relevance.

Table 1. Variation of water quality parameters in Taman Rimba Teluk Bahang (November 2023 – January 2024)

Parameters	Minimum – Maximum, Mean $\pm$ SE		
	Station 1	Station 2	Station 3
Temperature ($^{\circ}$ C)	25.55 – 25.87, 25.73 $\pm$ 0.01	26.14 – 26.40, 26.23 $\pm$ 0.01	26.10 – 26.35, 26.24 $\pm$ 0.01
DO (mg/L)	5.38 – 7.19, 6.45 $\pm$ 0.44	6.00 – 6.89, 6.39 $\pm$ 0.18	5.80 – 7.22, 6.75 $\pm$ 0.29
Conductivity (μ S/cm)	21.00 – 27.00, 24.44 $\pm$ 0.97	22.00 – 29.00, 25.44 $\pm$ 0.85	23.00 – 28.00, 26.22 $\pm$ 0.33
TDS (mg/L)	14.00 – 17.00, 16.00 $\pm$ 0.41	14.00 – 18.00, 16.00 $\pm$ 0.38	15.00 – 18.00, 16.78 $\pm$ 0.33
pH	5.65 – 6.87, 6.06 $\pm$ 0.16	5.10 – 6.38, 5.60 $\pm$ 0.10	4.74 – 6.30, 5.35 $\pm$ 0.05
Transparency (cm)	112.00 – 123.00, 118.44 $\pm$ 1.75	40.00 – 47.00, 44.00 $\pm$ 1.05	22.00 – 35.00, 28.61 $\pm$ 1.31
Turbidity (NTU)	22.30 – 29.40, 26.90 $\pm$ 0.52	21.80 – 30.80, 24.67 $\pm$ 0.94	23.80 – 29.40, 26.26 $\pm$ 0.93
TSS (mg/L)	0.40 – 18.00, 7.11 $\pm$ 1.04	2.00 – 16.80, 9.02 $\pm$ 1.12	2.80 – 14.00, 7.11 $\pm$ 0.81
Chl. <i>a</i> (μ g/L)	0.01 – 0.47, 0.22 $\pm$ 0.10	0.01 – 11.66, 2.67 $\pm$ 1.68	0.00 – 2.18, 0.69 $\pm$ 0.38
PO ₄ -P (mg/L)	0.01 - 0.03, 0.02 $\pm$ 0.00	0.01 – 0.04, 0.02 $\pm$ 0.00	0.01 – 0.03, 0.02 $\pm$ 0.00
NH ₄ -N (mg/L)	0.00 – 0.12, 0.05 $\pm$ 0.01	0.01 – 0.08, 0.04 $\pm$ 0.00	0.04 – 0.15, 0.10 $\pm$ 0.01
NO ₂ -N (mg/L)	0.00 – 0.01, 0.01 $\pm$ 0.00	0.00 – 0.01, 0.01 $\pm$ 0.00	0.00 – 0.01, 0.01 $\pm$ 0.00

Water temperature ranged from 25.5 °C to 26.4 °C, remaining within the Malaysian water quality standard for Class II (DOE Malaysia, NWQS). Station 1 (upstream) had the lowest temperature, likely due to deeper water and tree shading. Transparency was highest at this station, with a strong negative correlation between water temperature and transparency ($\rho = -0.722$, $p < 0.01$). This suggests deeper and clearer water can help maintain cooler temperatures, contributing to a more stable aquatic environment. The pH values at Station 1 were mostly within the Class IIB standard (pH 6–9), except in December (5.81), when visitor numbers peaked. In contrast, Stations 2 and 3 consistently recorded pH values below 6, with Station 3 reaching as low as 4.74, making them unsuitable for recreational use (DOE Malaysia, NWQS). The low pH at these stations may be influenced by natural or anthropogenic factors that need further investigation.

Conductivity values (22–29 $\mu\text{S}/\text{cm}$) and TDS (15–18 mg/L) were low and fell under Class I standards ($<1,000 \mu\text{S}/\text{cm}$ and $<500 \text{ mg}/\text{L}$, respectively). Station 3 consistently showed the highest values, potentially due to wastewater discharge from nearby toilets (Yap, 2013). A strong positive correlation was found between conductivity and TDS ($\rho = 0.942$, $p < 0.01$), consistent with findings from Rusydi (2018) and Zhang et al. (2017), indicating the presence of dissolved ions from pollution sources. TSS levels were low overall ($<16 \text{ mg}/\text{L}$) and met Class I standards. Station 2 had the highest TSS in November, though no consistent link to bather density was found. Variability may be due to sediment resuspension during sampling (Bhateria & Jain, 2016; Zhang et al., 2017). Previous studies showed bather activity could affect TSS (Butler et al., 2021; Tyagi et al., 2013), but this was not confirmed here.

Nitrite concentrations were well below the 0.4 mg/L limit (max 0.0103 mg/L), though highest in November. Nitrite may originate from recent contamination, including bather-related waste such as saliva (Hillestad et al., 2009; WHO, 2016). Ammonia levels also remained below the 0.4 mg/L limit but were highest at Station 3, likely due to toilet wastewater and bather activity (Bhatnagar et al., 2016; Devi et al., 2019; Tyagi et al., 2013). Orthophosphate levels were low (max 0.0368 mg/L), under the 0.2 mg/L standard. While not statistically significant, a slight increase in phosphate was observed during higher visitor months, suggesting potential links to human activity (Butler et al., 2021). Chlorophyll-a levels were low (0–11.66 $\mu\text{g}/\text{L}$), indicating oligotrophic conditions and good water quality (Sallam & Elsayed, 2018). Station 2 showed slightly higher levels, possibly due to green algae growth and sample handling.

CONCLUSIONS

Overall, most water quality parameters at Taman Rimba Teluk Bahang met the standards of Malaysia's Water Class IIB, except for pH. Station 1 (upstream), where recreational activities occurred, was generally safe for body contact, though pH dropped slightly during peak visitor periods. Stations 2 and 3 had lower pH levels but were not used for recreation, so the impact was minimal. However, the causes of low pH at these stations need further investigation. Some parameters like pH, conductivity, TDS, ammonia, and orthophosphate showed significant variation by month and location, likely influenced by human activity and a wastewater outlet near Station 3. Strong correlations were found between conductivity and TDS, and between water temperature and transparency. To improve accuracy and understanding, more samples and a wider range of water quality parameters including biological ones, it should be analysed in future studies to better assess recreational water safety in the area.

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Prof. Madya Dr. Nur Hisham Ibrahim
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Kelulusan daripada pihak tuan dalam perkara ini amat dihargai.

Sekian, terima kasih.

"BERKHIDMAT UNTUK NEGARA"

Saya yang menjalankan amanah,

Setuju.

27.1.2023

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PROF. MADYA DR. NUR HISHAM IBRAHIM
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