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WELCOME SPEECH FROM THE CHAIRMAN

RISM 17th International Surveying Conference for Undergraduates (ISCU 2025)

بسم الله الرحمن الرحيم السلام

عليكم ورحمة الله وبركاته

Greetings to all,

It is with great pleasure that I welcome you to the 17th RISM International Surveying Conference for Undergraduates (ISCU 2025), themed *“Embracing Construction Revolution 4.0: Transforming Malaysia’s Built Environment.”* On behalf of the Royal Institution of Surveyors Malaysia (RISM), I also wish to express our sincere appreciation to Universiti Teknologi MARA (UiTM), Perak Campus, for graciously hosting this significant event.

As we navigate the era of the Fourth Industrial Revolution (IR4.0)—or in our context, Construction Revolution 4.0 (CR4.0)—we are witnessing transformative advancements across the global construction sector. Technologies such as Building Information Modelling (BIM), the Internet of Things (IoT), artificial intelligence (AI), robotics, big data analytics, and cloud computing are redefining the way we build, manage, and interact with our built environment. For Malaysia, embracing CR4.0 is a strategic imperative to achieve our socio-economic and environmental goals.

This conference serves as a vital platform to unite surveying undergraduates from various disciplines, fostering critical dialogue on industry challenges, enhancing professional networking, and preparing a new generation of talent for the rapidly evolving construction landscape. It is also an opportunity for employers to engage with and inspire our future professionals.

I would like to extend my heartfelt thanks to all industry speakers, paper presenters, judges, and participants for their time, contributions, and support in making ISCU 2025 a success. I also commend the organising committee for curating a meaningful and dynamic conference experience.

May the knowledge gained, connections formed, and ideas exchanged during this event inspire all participants to lead and innovate in their future endeavours.

Wishing everyone a productive and memorable conference.

Prof. Ts Sr Dr. Adi Irfan Bin Che Ani'
Chairman, Universities’ Partnering Committee
RISM Session 2024/2025
May 2025

WELCOME SPEECH FROM CO-CHAIRMAN

RISM 17th International Surveying Conference for Undergraduates (ISCU 2025)

Bismillahirrahmanirrahim.

السلام عليكم ورحمة الله وبركاته and greetings to all.

It is my great pleasure to welcome everyone to the 17th International Surveyor Conference for Undergraduates (ISCU 2025), proudly hosted by Universiti Teknologi MARA (UiTM) Perak Branch in collaboration with the Royal Institution of Surveyors Malaysia (RISM). This event is a meaningful platform for students in the built environment to share ideas, showcase innovations, and build professional networks. We are honoured by your presence and enthusiastic participation, with 135 accepted papers and 78 poster presentations this year.

UiTM Perak, home to the College of Built Environment, has long been a hub for academic excellence in architecture, planning, and surveying. Our commitment remains strong in nurturing competent graduates who meet industry demands and contribute to nation-building.

While you're here, we invite you to experience the heritage and culture of Perak Tengah from the architectural richness of Rumah Kutai to the historical towns of Pasir Salak, Bota, and Kampung Gajah.

To all presenters and winners, congratulations on your achievements. Let your work today be a catalyst for future success and academic growth. We hope this conference will inspire you to explore new ideas, foster collaboration, and make lasting memories.

My deepest thanks to the Royal Institution of Surveyors Malaysia (RISM) and the organising committee for making this event a success.

We hope your experience here will be rewarding and unforgettable.

Thank you. Selamat datang dan selamat berjaya.

Associates Professor Dr. Nur Hisham Ibrahim, *PMP*
Co-Chairman, Universities' Partnering Committee
RISM Session 2024/2025
May 2025

WELCOME SPEECH FROM THE PROJECT DIRECTOR

RISM 17th International Surveying Conference for Undergraduates 2025

Alhamdulillah, all praise to Allah S.W.T. for His guidance and blessings in making the RISM 17th International Surveying Conference for Undergraduates (ISCU) 2025 a reality.

It is with great honour and gratitude that I welcome all participants, guests, academicians, and industry professionals to this prestigious event, proudly organized under the Royal Institution of Surveyors Malaysia (RISM). This 17th edition of ISCU stands as a proud testament to our collective dedication toward academic excellence, professional collaboration, and youth empowerment in the field of surveying.

I extend my heartfelt appreciation to RISM for its unwavering support, to the hardworking ISCU 2025 Organising Committee, and to all 16 partnering universities across Malaysia for their commitment and contributions. Your efforts have shaped this conference into a dynamic platform for knowledge exchange, innovation, and professional growth.

To the academicians and practitioners present, your insights are invaluable in bridging the gap between academic theory and real-world practice. To our undergraduate participants, your passion, curiosity, and commitment are the very foundation of our future. May this conference not only deepen your academic journey but also ignite a spirit of leadership, integrity, and sustainable thinking.

Let this gathering serve as more than an academic milestone. May it foster lifelong networks, inspire transformative ideas, and chart new directions in our shared professional journey.

Wishing everyone a rewarding and inspiring conference experience.

Sr Dr. Nurul Fadzila Zahari
Project Director
RISM 17th ISCU 2025

UNRAVELING SEDIMENT TRANSPORT DYNAMICS: INSIGHTS FOR COASTAL AND PORT MANAGEMENT

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ABSTRACT

Sedimentation poses a persistent challenge to coastal and port operations, affecting navigational safety, operational efficiency and environmental sustainability. This case study investigates the sediment distribution via Multibeam Echo Sounder (MBES) technology for precise and detailed data acquisition at Westports Malaysia for a six month duration after the post-dredging activities. The study specifically focuses on sediment volume and spatial distribution to determine movement patterns and accumulation dynamics within the post-dredging context. By leveraging the MBES technology, high-resolution bathymetric depth and backscatter data are collected, yielding critical insights into sediment dynamics. Key challenges in sediment monitoring, including environmental factors and data processing are addressed, demonstrating MBES as a reliable equipment in hydrographic surveying. The findings help to optimize maintenance dredging strategies, enhancing resource allocation and refining sediment monitoring practices. Furthermore, the innovative application of MBES technology highlights its potential to inform decision-making in sustainable port management. This study not only enriches our understanding of sediment composition and behaviour, but it also advocates environmentally responsible practices in maritime operations. By promoting operational efficiency, minimizing environmental impacts, and supporting the long-term development of port infrastructure, this research demonstrates the integration of cutting-edge technology with targeted analytical approaches in addressing sedimentation challenges across the coastal and port regions.

Keywords: Post-Dredging Analysis, Sediment Distribution, Multibeam Echo Sounder

I. INTRODUCTION

Sedimentation is a common challenge in coastal and port environments such as Westports Malaysia, significantly affecting navigability and port operations. This natural process, influenced by factors including river flow, tidal action, and stormwater runoff, leads to the accumulation of materials such as sand, silt, and clay within port areas. Over time, this accumulation obstructs navigation channels, reduces water depth, and disrupts port activities, necessitating regular dredging to maintain safe and navigable waterways (Zhang et al., 2012). Ensuring an efficient and sustainable dredging strategy is critical to port management, as excessive sedimentation can lead to increased maintenance costs and operational inefficiencies. This issue is particularly significant, requiring frequent dredging to maintain safe water depths and ensure smooth shipping operations.

While dredging is necessary to maintain port functionality, it raises concerns regarding environmental sustainability and economic feasibility. Dredging activities can contribute to water pollution and disrupt marine ecosystems, highlighting the need for a balance between operational requirements and environmental responsibility (Fan et al., 2019). Post-dredging monitoring plays a crucial role in evaluating dredging effectiveness and understanding sediment redistribution patterns over time. However, conventional sediment monitoring methods, such as manual surveys and point-based water sampling, often lack precision, are time consuming, and result in data gaps that limit effective decision-making (Patmont et al., 2018). The reliance on outdated monitoring techniques leads to inefficiencies, as frequent but unnecessary dredging cycles can increase operational costs without fully addressing sedimentation challenges.

To overcome these limitations, the application of Multibeam Echo Sounder (MBES) technology has gained prominence in hydrographic surveys due to its ability to generate high-resolution, three-dimensional bathymetric maps of the seafloor. MBES provides accurate and detailed sediment distribution data, enabling port authorities to monitor sediment movement and optimize dredging schedules (Wu et al., 2018). This technology enhances sediment monitoring precision by offering continuous and extensive coverage compared to traditional survey methods. Despite its advantages, the use of MBES for post-dredging sediment assessment remains underexplored, particularly in analyzing sediment redistribution over specific periods. A more comprehensive understanding of how sediments behave post-dredging is essential for improving long-term sediment management strategies.

In the case of Westports Malaysia, where sedimentation is a recurrent issue, integrating MBES technology into post-dredging assessments presents an opportunity to enhance port maintenance practices. By providing detailed insights into sediment characteristics and movement, MBES can aid in optimizing dredging activities, minimizing environmental impacts, and reducing overall operational costs (Manap et al., 2019). The adoption of advanced monitoring technologies is crucial for ensuring sustainable port operations while addressing the continuous challenge of sedimentation (Song et al., 2011).

This study aims to evaluate the effectiveness of MBES technology in post-dredging monitoring by analyzing sediment redistribution patterns in Westports Malaysia. The findings of this research will provide valuable insights into sediment dynamics, contributing to the development of more efficient and sustainable sediment management practices in port environments. By leveraging high-resolution hydrographic data, this study seeks to improve decision-making for future dredging strategies, balancing operational efficiency with environmental sustainability. To better understand the available methods and justify the use of MBES, this chapter will review relevant sediment monitoring technologies and their effectiveness in post-dredging environments.

XI. LITERATURE REVIEW ON SEDIMENT MONITORING TECHNOLOGIES

Sedimentation monitoring is essential for assessing seabed conditions after dredging. This review highlights both conventional and advanced methods, with emphasis on their suitability for post-dredging studies.

A. *Conventional Methods for Sediment Monitoring*

Several studies have explored bathymetric survey techniques for sediment monitoring, particularly in post-dredging environments. Traditional approaches such as Single-beam Echo Sounder (SBES) have been widely used in hydrographic surveying due to its simplicity and cost-effectiveness. SBES operates by emitting a single acoustic pulse to measure water depth, making it suitable for small-scale surveys. However, its single-point data acquisition limits spatial coverage, rendering it less effective for detailed sediment mapping in complex marine environments (Grall et al., 2020). Consequently, SBES is gradually being replaced by more advanced technologies that provide higher resolution and broader coverage for post-dredging assessments.

Manual sampling instruments, such as grab samplers, sediment traps, and core samplers, are also commonly employed to collect physical seabed samples, which are then analyzed in laboratories to determine grain size distribution, composition, and organic content. While these methods provide direct and reliable data, they are constrained by their point-based nature, labor-intensive procedures, and the potential for sample disturbance during retrieval.

B. *Advanced Acoustic Methods for Sediment Monitoring*

To overcome the limitations of conventional methods, advanced acoustic technologies have emerged as more reliable alternatives for sediment monitoring. MBES represents a major advancement in acoustic survey technology, capable of emitting multiple beams across a wide swath of the seabed. This not only increases spatial coverage but also allows for higher-resolution mapping, making MBES ideal for applications that require precise seabed characterization, such as dredging, environmental monitoring, and sediment management (Che Hasan et al., 2014; Stephens & Diesing, 2015).

In addition to bathymetric data, MBES captures backscatter intensity, which provides information on sediment texture and composition. This dual functionality enables the classification of seafloor materials and the detection of sediment movement patterns based on acoustic reflectivity. Such methods offer insights into sediment types, accumulation zones, and potential navigational risks. With advanced processing techniques, MBES data can be used to extract sediment distribution trends over time, making it essential for long-term monitoring and maintenance planning. Overall, the use of acoustic-based methods like MBES and backscatter analysis provide a more comprehensive and efficient approach to post-dredging sediment monitoring compared to conventional techniques (Brown et al., 2019).

XII. MATERIAL AND AREA OF STUDY

A. *Research Location*

The study was conducted at Westports Malaysia, a major port located on Pulau Indah, Klang, Selangor. Strategically positioned along the Straits of Malacca, Westports serves as a crucial hub for international shipping and trade. The study focused on several berths within the ports, covering a survey length of approximately 268 meters. Due to high rate of siltation, regular dredging and sediment monitoring are necessary to ensure safe navigation and maintain operational efficiency. The study area is directly influenced by tidal flows from Selat Klang Selatan and sediment transport from Pulau Che Mat Zin, which contribute to continuous seabed changes, as shown in Figure 1.0. The bathymetric characteristics of the study area exhibit considerable variation, with depth changes influenced by natural sedimentation and dredging activities. Given these dynamic conditions, the surveyed berths and surrounding areas require continuous monitoring to maintain safe navigation depths, ensuring efficient port operations and minimizing disruptions caused by sediment accumulation.

Figure 1.0 Study Area at Westports Malaysia

B. *Research Stages*

To ensure high-precision data collection, a structed research methodology was adopted, integrating bathymetric mapping, tidal corrections, and sediment sampling. Figure 2.0 illustrates the research workflow, outlining each step from survey planning to data analysis. The methodology involved the use of the Kongsberg EM 2040C Multibeam Echo Sounder (MBES) for seabed mapping, a tide gauge for vertical corrections, and a Van Veen grab sampler for sediment analysis, ensuring comprehensive of the study area.

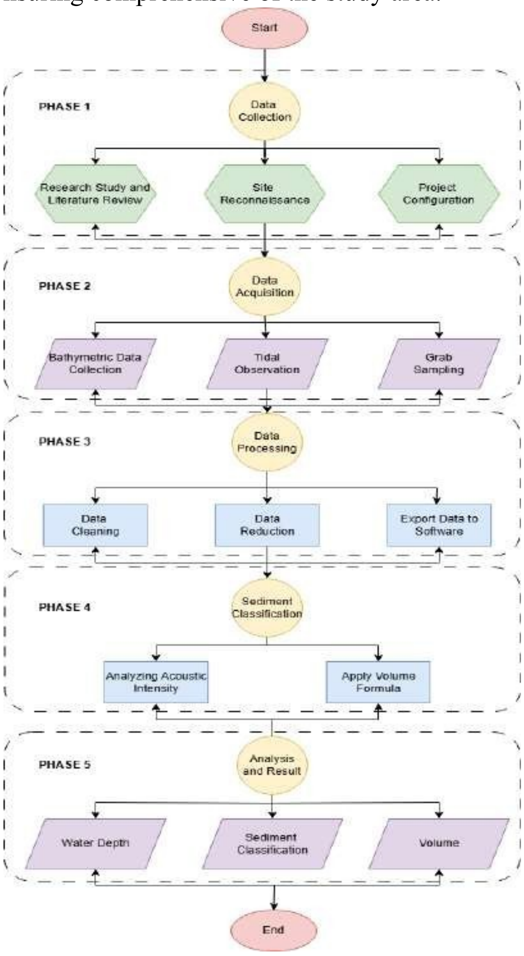


Figure 2.0 Research Workflow

The research methodology was structured into five phases to ensure systematic data collection, processing, and analysis. Phase 1 focused on data collection that involved planning and preparation, ensuring that all instruments and methodologies were properly configured before field deployment. The study area and scope were clearly defined. Calibration of the Kongsberg EM 2040C Multibeam Echo Sounder (MBES) and supporting instruments was conducted to ensure measurement accuracy. Additionally, Malaysia Tide Table 2023 was reviewed to establish a consistent vertical reference using Chart Datum (CD). Survey transects were pre-planned for complete seabed coverage, and sediment sampling locations were strategically selected for later analysis. Post-dredging sediment monitoring was conducted through six surveys between June and November 2023 to track sediment accumulation and redistribution. The survey schedule is summarized in Table 1.0.

Table 1.0 Post-dredge Monitoring Surveys Conducted in 2023

No.	Monitoring Survey	Date
1	First	12th June 2023
2	Second	10th July 2023
3	Third	16th August 2023
4	Fourth	06th September 2023
5	Fifth	09th October 2023
6	Sixth	06th November 2023

In Phase 2, data acquisition was conducted using MBES for bathymetric surveys with overlapping swaths to ensure full seabed coverage. The system, mounted on a survey vessel, was supported by real-time motion compensation to minimize errors. Tidal observations were continuously recorded using a tide gauge, providing essential water level variations for depth correction. Sediment sampling was performed using a Van Veen grab sampler at 10 designated stations to analyze post-dredging sediment characteristics. Figure 3.0 provides examples of the collected bed sediment samples, illustrating their composition. A GNSS system was integrated for precise georeferencing, ensuring spatial accuracy.

Figure 3.0 Examples of Collected Bed Sediment Samples

Phase 3 involved data processing using QPS Qimera software, where data cleaning removed noise, tidal corrections standardized depth measurements relative to Chart Datum, and data reduction optimized datasets for analysis. The processed bathymetric data was then exported for visualization and interpretation. In Phase 4, sediment characterization was performed to assess seabed conditions and post-dredging sedimentation patterns. Backscatter intensity analysis from MBES was used to classify seabed materials, distinguishing between fine sediments (silt, mud) and coarser materials (sand, gravel). Volume computation was carried out to estimate sediment accumulation or loss, aiding in the assessment of dredging effectiveness and sediment transport dynamics.

Finally, Phase 5 involved analysis and results interpretation, where water depth analysis identified variations in seabed elevation caused by natural sedimentation and dredging activities. Sediment classification results provided a detailed understanding of seabed composition and distribution using QPS FMGT software. Volume estimation helped quantify post-dredging sedimentation, supporting future dredging planning and monitoring strategies using ArcMap software. The study successfully achieved its objective of assessing post-dredging sediment distribution at Westports Malaysia to ensure that navigation depths are maintained efficiently for port operations.

XIII. RESULTS

This section presents the results of the backscatter data obtained from six monitoring sessions, with a focus on Monitoring 1 (initial survey) and Monitoring 6 (final survey). The analysis highlights change in seabed characteristics due to sediment buildup over time, identifying specific areas where significant differences are observed. Figure 4.0 provides an overview of the area surveyed, showing overlapping seabed layers and highlighting key regions of interest. As illustrated in Figure 4.0, the backscatter intensity from the Multibeam Echo Sounder (MBES) offers valuable insights into seabed composition and sediment distribution.

Figure 4.0 Overview of the Regions of Interest

Sediment volume calculations confirm this trend, showing and confirm an increase of 8885500 m³ between Monitoring 1 (4920200 m³) and Monitoring 3 (13805700 m³), indicating significant sediment accumulation. The presence of coarser materials in some areas suggests hydrodynamic influence, leading to resuspension and selective deposition. Sediment transport patterns show a progressive build-up in low-energy zones, likely due to reduced current velocities that allow finer particles to settle (Muhamad et al., 2023). By Monitoring 5 (11403700 m³) and Monitoring 6 (11626600 m³), sediment volume appears to have stabilized, suggesting a decrease in deposition rates or an approach toward equilibrium. Backscatter imagery supports this trend, identifying sediment accumulation in low-energy zones where silt and clay settle, while coarser sediments persist areas with stronger hydrodynamic activity (Hunt et al., 2020a).

A comparison of sediment volume from Monitoring 3 to Monitoring 5 reveals a decline from 13805700 m³ to 11403700 m³, suggesting potential sediment redistribution due to tidal currents, hydrodynamic forces, or vessel movements. Figure 5.0 illustrates the sedimentation trend, particularly along offshore edges of berth pockets, where sediment may have collapsed from relatively steep side slopes following maintenance dredging. This is further supported by a decrease in bed level along these offshore edges. Post-dredge and sixth monitoring survey data confirm that sedimentation corresponds to bed level reductions, whereas erosion is indicated by elevation increases. Extracted cross-section profiles reinforce these findings. Sediment accumulation is primarily driven by hydrodynamic conditions, post-dredging redistribution, and natural seabed evolution, with finer sediments gradually settling over time.

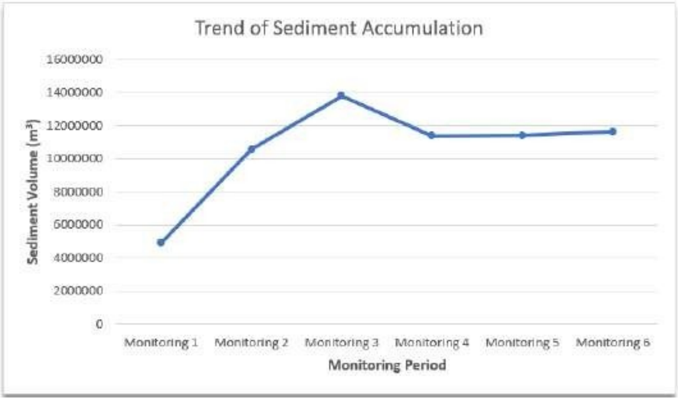


Figure 5.0 Trend of Sediment Accumulation

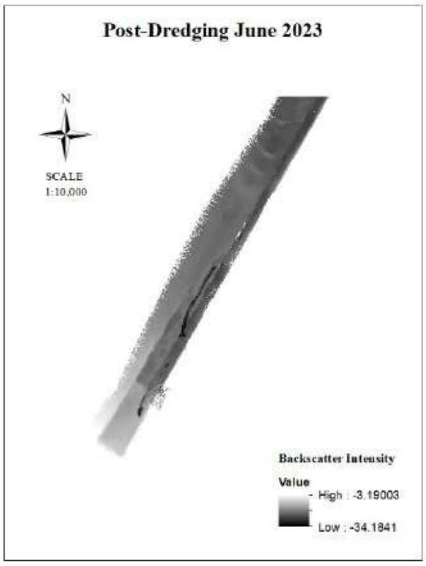
The volume estimation of sediment was a crucial step in planning dredging activities. By highlighting increases in sediment volume across identified hotspots, the study provided insights into sedimentation trends. This data was essential for optimizing dredging plans, ensuring that high-accumulation areas were prioritized to maintain safe navigation depths. Given that each berth has a maximum allowable dredging depth, understanding sediment buildup helped prevent potential ship grounding incidents. Targeted sediment management strategies were developed based on these findings to enhance operational efficiency and reduce unnecessary dredging in stable areas (Elnabwy et al., 2024).

Bed sediment sampling was conducted across the survey area, covering multiple stations. However, this report focuses on the highlighted area, specifically Stations G1 and G2, as they are relevant to the study. The results from these stations, as shown in Table 2.0, indicate differences in sediment composition, with G1 classified as silt (D_{50} = 0.0502 mm, located at 101° 16' 49.66" E, 2° 54' 42.87" N) and G2 as fine sand (D_{50} = 0.2255 mm, located at 101° 16' 28.07" E, 2° 53' 57.19" N). These findings help in understanding sediment transport and deposition in the targeted area.

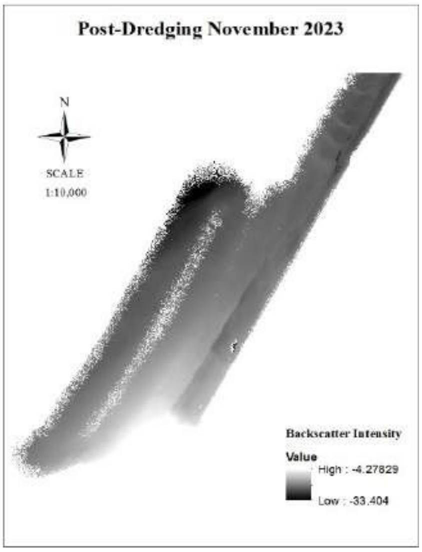
Table 2.0 Backscatter Intensity and Sediment Type

Location	Particle Size Distribution (%)				D_{50} (mm)	Soil Classification
	Clay	Silt	Sand	Gravel		
G1	16	47	37	0	0.0502	Silt
G2	11	21	64	1	0.2255	Fine Sand

The analyzed bed sediment samples indicate that the sediments in the study area consist of silt and fine sand. The average D_{50} for both stations falls under the fine sand category based on the Wentworth Size Class. To quantify sediment changes, a quantitative analysis was conducted by calculating the mean backscatter intensity for specific regions using data from Monitoring 1 and Monitoring 6. This analysis supports the interpretation of sediment distribution patterns and confirms the trends observed in the volume measurements. As shown in Figure 6.0(a), the post-dredging backscatter image from June 2023 illustrates changes in seabed composition, while Figure 6.0(b) presents the conditions observed in November 2023. Increased sedimentation alters seabed morphology, impacting navigation safety and marine ecosystem stability. Areas with coarse sediments (higher backscatter values, typically -20 to -25 dB) likely experience strong hydrodynamic forces that prevent excessive deposition, whereas fine sediments (lower backscatter values, typically -30 to -35 dB) tend to accumulate in low- energy zones (Amanda et al., 2024).



(a)



(b)

Figure 6.0 Backscatter Image: (a) Post-Dredging June 2023, (b) Post-Dredging November 2023

XIV. DISCUSSION

The sediment analysis based on Multibeam Echo Sonder (MBES) data reveals spatial variations in seabed composition, allowing classification into three main categories: coarse-grained (sand and gravel), medium-grained (sandy silt), and fine-grained (clay and silt). Results show that approximately 65-70% of the accumulated sediment in the study area falls into the fine-grained category. This explains the low backscatter intensity observed in most zones, as finer particles tend to absorb more acoustic energy and reflect less, compared to coarser materials.

The dominance of fine sediments, particularly silt and fine sand suggests ongoing sedimentation that may pose navigational challenges. While sediment accumulation in non-critical areas could naturally stabilize the seabed, buildup within navigation routes or dredged zones increases the risk of channel obstruction, requiring more frequent dredging operations. Despite the analysis being limited to two stations, the uniformity of sediment composition across the surveyed region indicates consistent sediment transport processes affecting the area.

Further, the temporal monitoring between six observation periods showed a notable decline in backscatter intensity. This trend is consistent with gradual sediment accumulation post-dredging. These findings align with Hunt et al., who emphasized that sustained low backscatter values are indicative of fine sediment deposition and active redistribution processes. Such insights are critical for port authorities in determining the most effective timing and location for maintenance dredging (Hunt et al., 2020b).

The results also underscore the value of using MBES technology for continuous post-dredging assessment. The ability to detect and classify seabed composition in detail provides strategic advantages in managing sedimentation risks. Specifically, it supports optimization of dredging schedules, minimizes redundant operations, and improves long-term planning for port maintenance and infrastructure stability.

In addition, these findings have broader implications for sustainable coastal and offshore development. Incorporating hydrodynamic modelling alongside MBES data could enhance predictive capabilities, allowing for better management of sediment transport pathways. This approach supports sustainable sediment management in alignment with the United Nations Sustainable Development Goals (SDG 9 – Industry, Innovation, and Infrastructure and SDG 14 -Life Below Water). With consistent monitoring and data-driven decision making, stakeholders can achieve a balance between maritime development and environmental stewardship.

CONCLUSION

This study has successfully demonstrated the applicability of Multibeam Echo Sounder (MBES) technology in post-dredging sediment monitoring at Westports Malaysia. Over a six-month period, MBES data revealed localized sedimentation patterns influenced by tidal movements and vessel traffic, offering reliable insights for navigation safety and infrastructure planning. The integration of bathymetric data and sediment sampling enabled a comprehensive assessment of seabed morphology and sediment characteristics.

The findings offer a localized framework for port authorities to optimize maintenance dredging schedules, improve operational efficiency, and reduce environmental impacts. Beyond operational value, this research contributes to the academic domain by addressing a critical gap in long-term sediment monitoring in tropical port environments.

Furthermore, the approach aligns with Sustainable Development Goals (SDGs) related to infrastructure resilience and marine ecosystem protection. It reinforces the role of marine geospatial technology in promoting Built Environment Sustainability and Conservation, especially in the context of sustainable coastal development and Construction Revolution 4.0 (CR4.0) Future studies may consider extended monitoring periods, seasonal variation analyses, or real-time sediment tracking using AI-based seabed classification techniques. This study reaffirms MBES as a reliable instrument for informed sediment management in modern port ecosystems.

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The author would like to express sincere gratitude to my supervisor for their invaluable guidance and support throughout this study. I also extend my appreciation to those who provided assistance and encouragement in completing this research. Special thanks to the UiTM Perak Branch for the opportunity to present this work, and to THS Geoscience Sdn. Bhd. for providing the QPS Qimera software that supported data processing.

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