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عنوان البحث

أثر تطبيق ضبط الرواسب على أداء مشاريع الإنشاء في ولاية كوينزلاند

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Research Title

**The impact of Sediment Control implementation on the
performance of construction projects in Queensland**

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حقوق الطباعة

حقوق الطباعة تمتلكها جامعة ميدأوشن. حيث إن جميع المواد والمحتويات الواردة في هذا البحث

هي

ملك للجامعة، ولا يجوز استخدامها أو إعادة نشرها أو توزيعها بدون إذن مسبق من جامعة

ميدأوشن

الباحث

الملخص

تلعب صناعة البناء دورًا محوريًا في ولاية كوينزلاند - أستراليا، إلا أن هذه المشاريع قد تواجه العديد من التحديات البيئية مثل جريان الرواسب وتآكل التربة نتيجة للظروف البيئية المختلفة. تهدف هذه الدراسة إلى تحليل تأثير تطبيق ضوابط الرواسب على الأداء العام لمشاريع البناء من حيث التكلفة والوقت والجودة والفوائد طويلة الأمد والتخطيط والإدارة في كوينزلاند.

سيتم استخدام منهجية البحث المزدوج (الكمّي والنوعي) في هذه الدراسة لتحليل كيفية تأثير التشريعات والمتطلبات الخاصة بضوابط الرواسب على أداء مشاريع البناء، من خلال استبيان كمّي ومقابلات ومناقشات نوعية مع المختصين في المجال.

ستُبرز النتائج التحديات المحتملة التي قد تواجه مشاريع البناء أثناء الالتزام بالتشريعات الخاصة بضوابط الرواسب في ولاية كوينزلاند، بالإضافة إلى توضيح تأثيرها على التكلفة والوقت والجودة والفوائد طويلة الأمد والتخطيط والإدارة.

ونظرًا لندرة الدراسات التي تناولت هذه الجوانب، تسعى هذه الدراسة إلى تقديم فهم واضح لهذه التحديات لجميع العاملين في قطاع البناء، مثل المهندسين ومديري المشاريع والمقاولين.

الكلمات المفتاحية: ضوابط الرواسب، مشاريع البناء، أداء المشاريع، التحديات البيئية، كوينزلاند

Abstract:

Construction industry plays a pivot role in Queensland, Australia, but these projects may face multiple environmental challenges such as sediment runoff and erosion due to environmental circumstances. This research will investigate the effect of sediment control implementation on the key performance of construction projects cost, time, quality and long-term benefits and planning and management in Queensland. A mixed-methods approach will be used in this research to study how sediment control legislations and requirements impact the performance of construction projects, through conducting quantitative survey and qualitative interviews and discussions.

The findings will outline the potential challenges that might occur during construction projects while complying with the state of Queensland's sediment control legislations. In addition to highlight the changes on cost, time, quality and long-term benefits and planning and management of construction projects.

There are limited studies discussing these issues and challenges, however, this research will provide a clear understanding to these challenges for everyone involved in the construction industry such as, engineers, project managers and contractors.

Keywords: Sediment control, construction projects, project performance, environmental challenges, Queensland.

Acknowledgement

This work is dedicated to the people who have been the foundation of my strength and the reason behind my perseverance.

To my beloved parents, whose unconditional love, guidance, and prayers have accompanied me through every stage of my life. Your sacrifices and constant encouragement have been the light that guided my path, and your belief in me has inspired me to keep moving forward, even when the road was difficult. Everything I have achieved reflects your love and support.

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And to my precious son, who fills my life with joy and purpose. You are my greatest inspiration and the reason I strive to be better every day. May this achievement remind you that dedication, faith, and hard work can turn dreams into reality.

Finally, I dedicate this research to my faculty members who have been sharing experience and knowledge with us during the entire journey.

Researcher

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List of terminology

Term	Definition (according to PMI and PMBOK® Guide)
Cost overrun	The amount by which actual project costs exceed the planned or budgeted costs.
Environmental control	Measures and processes used to minimize or eliminate environmental impacts from project activities, ensuring compliance with environmental standards.
Erosion	The process by which soil and rock are removed from the earth's surface by wind, water, or human activity and transported elsewhere.
Inspection	A technique that involves examining or measuring project work to verify whether it meets established requirements and standards.
Legislations	A body of laws or regulations enacted by a government to guide and control activities such as environmental protection or construction practices.
Long-term benefits	Outcomes that extend beyond the project's completion, providing continued value or sustainability over time.
Project cost	The total financial resources required to complete a project, including labour, materials, equipment, and overheads.
Project life cycle	The series of phases that a project passes through from initiation to closure.
Project performance	The measurement of how effectively a project achieves its objectives in terms of cost, time, quality, and scope.
Queensland	A state in northeastern Australia known for its tropical climate, where environmental factors such as heavy rainfall influence construction practices.
Runoff	Water that flows over land surfaces and can carry sediments, pollutants, or debris into nearby water bodies.
Sediment	Solid material, typically soil or organic matter, that is transported and deposited by water, wind, or gravity.
Sediment control	Practices designed to prevent sediment from leaving construction sites and entering drainage systems or waterways.
Stakeholder	Any individual, group, or organization that may affect or be affected by a project's decisions, activities, or outcomes.
Stormwater traps	Structures designed to capture sediment, debris, or pollutants from stormwater before it enters drainage or natural water systems.
Sustainable	Meeting present needs without compromising the ability of future generations to meet their own needs; ensuring environmental, social, and economic balance.
Time delay	A deviation from the planned project schedule that results in tasks or milestones being completed later than intended.
Topsoil	The uppermost layer of soil, rich in organic material, which is crucial for vegetation growth and often disturbed during construction.
Vegetation	Plant life or ground cover that helps stabilize soil and reduce erosion on construction sites.
Woven sediment fence	A temporary barrier made of woven geotextile fabric used to capture sediment and control runoff on construction sites.

Chapter one
Introduction

1.1. Introduction:

Queensland is a large state and considered as the second largest state in Australia with a total area of approximately 1,729,742 km². The estimated resident population of Queensland on 31 March 2025, the preliminary estimate was 5,647,468 persons, representing about 20.5% of Australia's total population. (Australian Bureau of Statistics).



Figure 1.1.1: Queensland, Australia map
(Worldatlas graphic maps)

With large land area and a significant population, construction projects and infrastructure development represent a huge sector in the state of Queensland, Australia, and there are continuous future plans and ongoing expansion in this field. According to the Australian Infrastructure Budget Monitor 2024-25, Queensland ranked fifth among Australian states and territories for its proportion of government spending on infrastructure, with 14.6% of its budget allocated for 2024-25. However, Queensland is known for its tropical climate and experiences a wet season with heavy rainfall through out the year. This can result in water pollution, as the uncontrolled movement of sediments can run off into rivers, waterways, creeks, and drainage systems, causing contamination, harming aquatic life, and generating considerable economic costs.

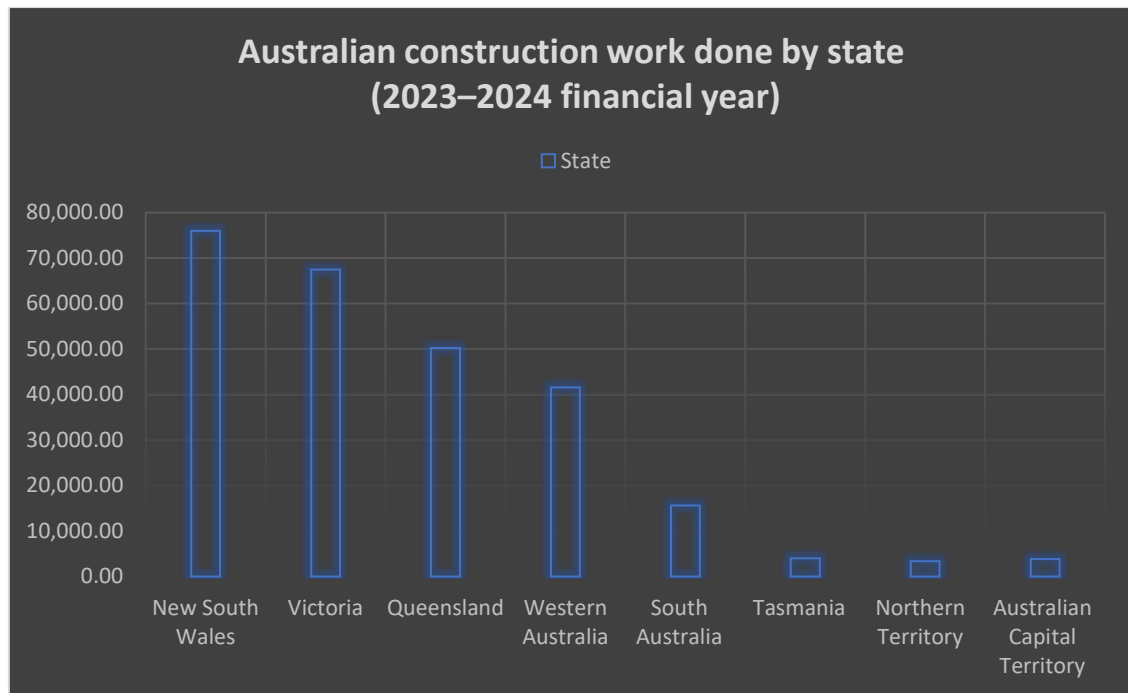


Figure 1.1.2: Total construction spending figures for the 2023–2024 financial year (Australian Bureau of Statistics ABS,2024)

The Queensland Government has adopted a strict regulatory approach to addressing this issue and has enforced specific requirements on construction projects. The **IECA Best Practice Erosion and Sediment Control Guidelines (2008)** serve as the primary reference for all regulations related to sediment control on construction sites. Sediment control focus on minimizing the entrance of polluted material to the water ways to protect the environment from any possible damage that could happen due to construction activities. This shall be under the Queensland sediment control guidelines and regulations. For example, to do that, it is common in Queensland to use the Woven sediment fence in buildings construction sites to trap the sediment and allow water through, or the stormwater inlet traps which used in large duty and infrastructure construction sites.

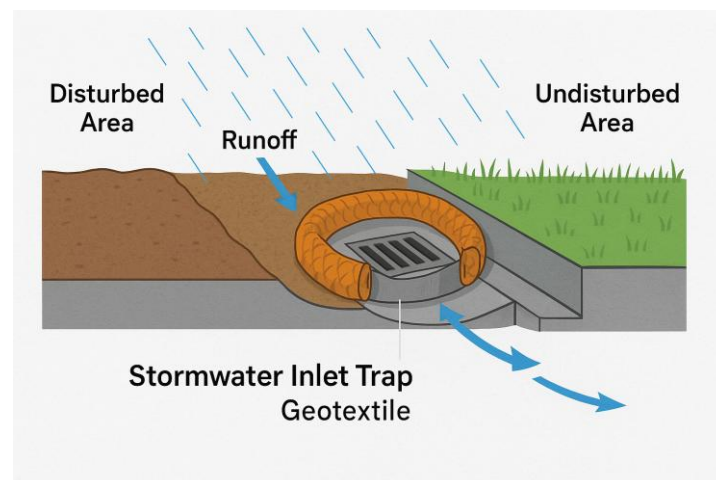


Figure 1.1.3: Stormwater Inlet Trap

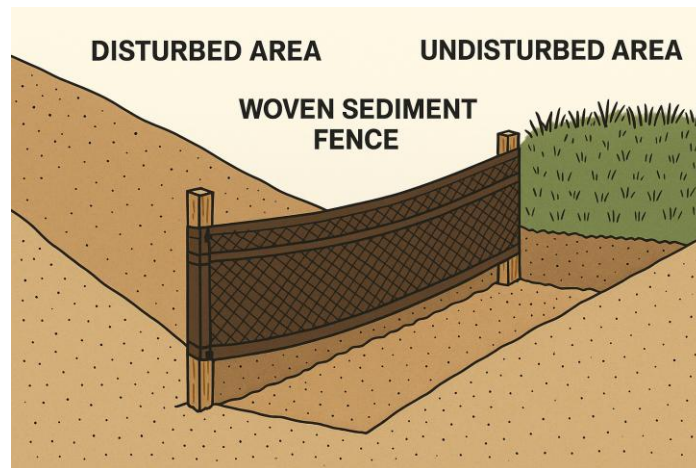


Figure 1.1.4: Woven sediment fence

Furthermore, construction project performance is often challenged when complying with sediment control plans and Queensland regulations. Cost is one of the most critical concerns for clients, stakeholders, engineers, and contractors, and adherence to the state's regulations for sediment control can significantly increase the cost of projects. Potential and unexpected delays may occur throughout the project timeline while attempting to implement and maintain the sediment control plan.

The management plan of any construction project is crucial and may be considered the most important foundation before commencing work. However, construction activities cannot begin before obtaining an approved sediment control plan from the authorities. Additionally, site opening or project commencement can be paused or require modifications. Typically, pre-rain and post-rain inspections are carried out by the Department of Environment, Tourism, Science and Innovation, and missing such inspections for any reason can create disruptions in the project's management plan.

There is no doubt that such environmental control practices aim to promote more sustainable future and improve environmental outcomes, not only but also, contributes in long-term durability of infrastructure development. However, in the construction field, these practices may also negatively influence the delivery quality of projects, as some environmental requirements can lead to rushed rework or delays in certain structural activities to comply with environmental regulations.



Figure 1.1.5: Construction Project key performance

This research aims to examine and investigate the potential challenges that may arise during construction projects as a result of complying with the state of Queensland's sediment control regulations, and to highlight the issues associated with their implementation on the key performance of construction projects.

1.2. Problem Statement:

Construction projects play a major role in the economic growth of Queensland, but they can also cause harm and damage to topsoil and natural vegetation areas, especially during the wet season. The uncontrolled movement of sediments, silt, cement, mud, or other pollutants may be washed away from construction sites and carried through external and stormwater drainage systems, causing pollution to rivers, creeks, wetlands, and waterways. Therefore, the Queensland Government and local councils have implemented strict regulations to control such substances and minimize the risk of environmental pollution, based on the IECA Best Practice Erosion and Sediment Control Guidelines (2008).

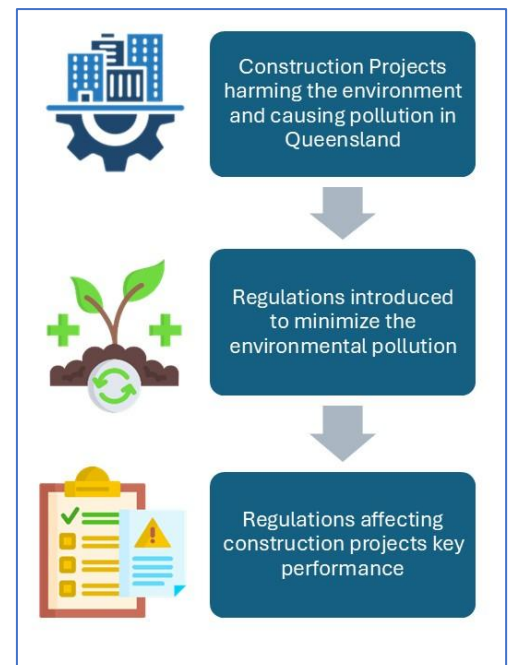


Figure 1.2.1: Problem statement

While these regulations are essential to ensure a sustainable working environment, they have created significant challenges for the engineering community by impacting the performance factors of construction project delivery. Upholding the standards of sediment

control may increase project costs, cause unexpected delays, and affect the quality and sequencing of work. The management and planning of construction projects may become more complex due to the need to coordinate approvals, inspections, and sediment control activities alongside other environmental requirements.

This research seeks to address the lack of understanding of how sediment control regulations affect the performance factors of construction projects, namely cost, time, quality and long-term benefits, and project planning and management. Despite the importance of sediment control in the construction field, there is limited academic research exploring these impacts, and this study aims to highlight and address that gap.

1.3. Significance of the research:

This research is important because it bridges a critical gap in both the academic and practical understanding of how applying sediment control plans and regulations affects the performance factors of construction projects in Queensland, Australia. Despite the importance of sediment control in achieving sustainable outcomes and protecting both the environment and structural elements in the long term, there are limited studies addressing its effect on performance factors such as cost, time, quality, long-term benefits, and project planning and management.

By presenting this research, valuable and relevant concepts will be explored. Understanding how sediment control measures influence project performance will enable engineers and stakeholders to improve project planning, enhance quality, produce more accurate cost and time estimations, and strengthen overall project management. Furthermore, this research will support local authorities and councils in reviewing their environmental regulations and guidelines to ensure they are more achievable and practical without compromising the quality of project delivery. Overall, the study aims to support the protection of Queensland's natural ecosystems while sustaining the growth of infrastructure development.

1.3.1 Academic Significance:

- 1- Highlights the impact of sediment control on the performance of construction projects specifically cost, time, quality, and planning and management in Queensland, providing a foundation for future research as very few studies currently address this topic.
- 2- Contributes to both project management and environmental engineering by linking theories of project delivery quality with sustainable construction outcomes.
- 3- Gather and present potential challenges in applying sediment control on construction projects to support future academic studies.

1.3.2 Practical Significance:

- 1- Support the infrastructure industry involving engineers, contractors and project managers by presenting the most common problems and challenges during the

implementation of sediment control, to help avoid them in future projects and enable better planning.

- 2- Provides a clearer understanding of how complying with sediment regulations can increase project costs or cause unexpected delays, letting stakeholder plan projects more effectively.
- 3- Offer local authorities and councils, ideas that may lead to adjustments in some rules and regulations of sediment control to achieve better quality in construction projects.

1.4. Objectives of the study:

The aim of this study is to investigate how implementing sediment control regulations can impact construction projects in Queensland, by studying the cost, time, quality and project management.

1- Cost

- Analysing how far will the sediment control increase the cost of construction projects by comparing the cost of the project with and without applying these regulations.
- Presenting the cost overrun in construction projects due to sediment control applications by comparing the planned cost vs the actual cost of construction projects.

2- Time

- Evaluating how sediment control affects construction projects schedules by highlighting the unexpected delays causing schedule disruptions.

3- Quality and long-term benefits

- Measuring the quality of performing structural activities such as task orders or rushed work during the project while applying sediment control.
- Exploring how sediment control activities such as protecting the subgrade in construction projects contributes to long-term infrastructure development and protecting structural elements.

4- Project planning and management

- Presenting how sediment control takes a part in planning and managing the project before starting construction by initiating approvals and regulatory documentation.
- Investigating the increase in complexity in construction projects due sediment control hold points.

1.5. Research questions:

The main question of this research is how sediment control regulations affect the performance factors of construction projects in Queensland, Australia, namely cost, time, quality and long-term benefits, and project planning and management. The following are some questions that will be answered and discussed in this research.

- How far does implementing sediment control raise up the cost of construction projects in Queensland?
- How does the cost differ between the planned and actual in construction projects that apply sediment control?
- How will the difference between the planned and actual cost cause cost overrun in construction projects?
- What is the direct cost of implementing sediment control to construction projects in Queensland?
- What is the indirect cost of implementing sediment control to construction projects in Queensland?
- What are the challenges that stakeholders face in Queensland while scheduling construction projects?
- How will applying sediment control cause unexpected delays and schedule disruptions in construction projects in Queensland?
- How many working days should stakeholders allow for sediment control implication?
- How to measure the quality of performing structural activities along with applying sediment control in construction projects in Queensland?
- How sediment control contributes to long-term infrastructure development and protecting structural elements in construction projects in Queensland?
- What are the short-term benefits of sediment control?
- What are the long-term benefits of sediment control?
- How can the sediment control affect the plan and management of construction projects?
- To what extent may the sediment control regulation increase the complexity of construction projects in Queensland?
- Is planning for sediment control to be implemented at construction site considered complicated?

1.6. Research Hypotheses:

This research has multiple hypotheses that are listed as follows:

1- Cost:

- The total cost of construction projects in Queensland will be higher by 10% to 15% after applying sediment control compared to projects that do not apply these measures.
- Planned and actual cost will differ in construction projects after implementing sediment control regulations.

2- Time:

- The implementation of sediment control regulations will cause unexpected delays and disruptions in the schedule of construction projects in Queensland.

3- Quality and Long-Term Benefits:

- The quality of some structural and civil activities in construction projects will be lower by following sediment control rules and regulations which cause interruptions and rushed civil tasks.
- The long-term durability of structural elements will improve by applying proper sediment and control plan in construction projects.

4- Project Planning and Management:

- A lot of effort must be done while initiating the management plan of construction projects with sediment control.
- The execution of sediment control requirements raises up the construction projects' complexity due to the significant number of approvals and inspections needed throughout the project's life cycle.

1.7. Theoretical Model:

To ensure the accuracy of the research hypothesis, I generated a model of measuring the effect of sediment control implementation on the key performance of construction projects, which are cost, time, quality and planning.

The main areas that the research will be covering are as follows:

- 1- Cost.
- 2- Time.
- 3- Quality and long-term benefits.
- 4- Project planning and management.

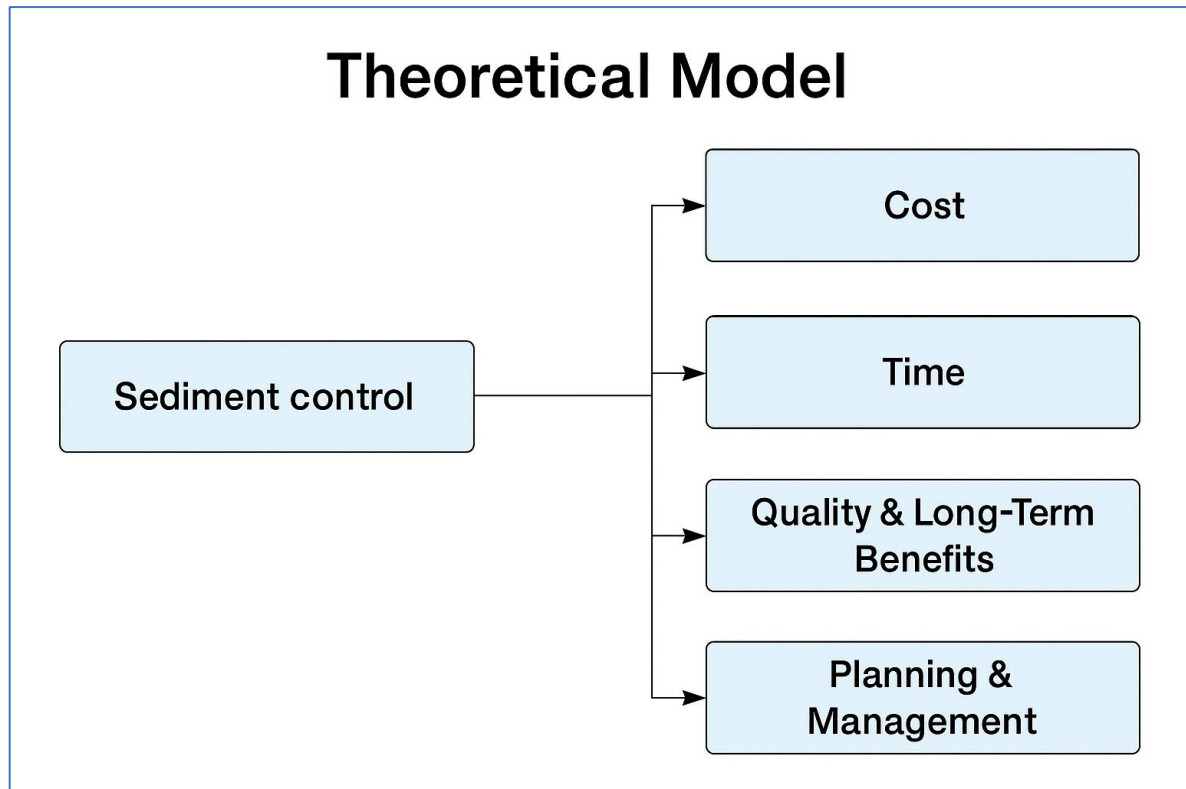


Figure 1.7.1: Theoretical research areas

Despite the challenges and obstacles that the research is discussing, yet it isn't enough to explain all the aspects related to the effect of sediment control on construction projects' key performance. But it might be a start to further research and studies to other researchers and engineering professions. It is crucial to mention that the researcher has worked in construction projects and currently working in one of the local government councils in Queensland, which means that this research is reflecting a personal professional experience, such as deep understanding to the obstacles happening in construction projects due to environmental control.

1.8. Conclusion:

In this chapter, the general ideas of this research are presented to give a picture of the aim of this research and reasons for choosing this title. Also, the research problem among with the hypothesis and questions were discussed briefly with some figures to presents the model of this study and its significance to the construction industry.

Chapter two: **Literature Review**

2.1. Introduction

Despite the rareness of the studies discussing the effect of sediment control implementation on the construction project performance in Queensland, there are some studies that investigated general environmental control and its effect on key performance elements separately. Also, there are some studies that focused on certain areas within Queensland due to weather circumstances in these areas.

This research is summarizing these studies and highlighting the relevant aspects to sediment control effect. However, the results of some literature reviews may differ from my findings depending on the approach.

It is important for the reader to know that the data was gathered from multiple construction project with different scope of work, thus the finding might not be reliable as needed compared to officially published studies and statistics.

2.2. Literature Review:

1- The Economic Cost of Erosion and Sediment Loss from Construction Sites in South East Queensland. (Griffith University & IECA Australasia, 2015)

This study is discussing a main source of water pollution which is sedimentation cause by construction activities and unfollowed environmental regulations. It is also highlighting the cost of sediment loss and benefits gained from applying sediment and erosion control during construction activities like cost savings. The study presented accurate statistics gathered from governmental sectors resources about the annual sediment contribution form construction activities in Queensland and other states. For instance, one of the discussed problems was the blocked stormwater drainage due to sediment which could have been avoided and costed nothing if sediment control was followed earlier during construction process. The following tables are presenting an example of the costs for cleaning up drainage infrastructure.

Sediment impacting drainage infrastructure assets	Cost (\$)	Source/Reference
Average sediment removal from stormwater infrastructure by one SEQ Council that can potentially be avoided. (estimated cost (\$250-500/tonne)	\$1.46 Million per annum	Healthy Land and Water (QLD) 2019
Cleaning and maintaining stormwater infrastructure by one SEQ Council that can potentially be avoided (closed stormwater infrastructure and stormwater quality treatment devices).	\$820,000 per annum (estimated cost)	Healthy Land and Water (QLD) 2019

Figure 2.2.1: (From source) Examples of cleaning-up costs (sediment impacting drainage infrastructure assets)

Sediment impacting drainage infrastructure assets and waterways	Cost (\$)	Source/Reference
Removing sediment from open drains and creeks SEQ wide – costs that can potentially be avoided.	\$375/tonne per annum (estimated cost)	Healthy Land and Water (QLD) 2019

Figure 2.2.2: (From source) Examples of cleaning-up costs (sediment impacting drainage infrastructure assets and waterways)

2- Review of Erosion and Sediment Control in South East Queensland. (Water by Design, 2023) — research/discussion paper synthesizing recent findings and practice in SEQ.

This research is comparing the previous and current compliances to the implementation of sediment and erosion regulations in construction sites. Also, it discussed that the rates of applying sediment and erosion control previously were very low which caused significant pollution to the waterways due to construction activities in the area of South East Queensland. The main goal from this research was to determine whether the construction industry related to lands development was applying and practicing environmental control efficiently to minimize the harm of sediments on waterways.

In 2013, Healthy land & Water initiated six local governments areas (LGAs) for urban development industry, this was done to investigate whether construction sites are following the sediment and erosion control legislations or not in South East Queensland. The following figure was taken from this study presenting the results of an examination of 57 sites, detailing the percentages to which these sites were applying erosion and sediment control across South East Queensland.

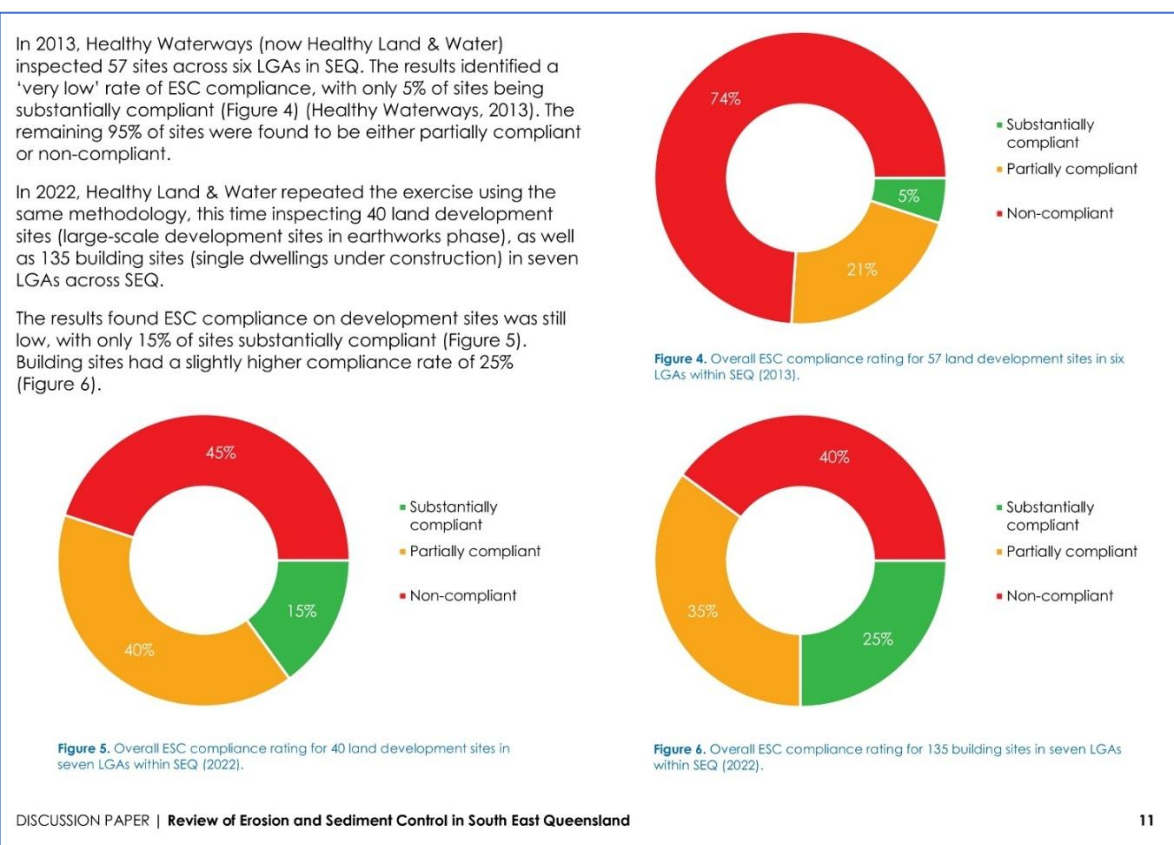


Figure 2.2.3: (From source) Overall ESC compliance rating for multiple sites in seven LGAs with SEQ for the years 2013 and 2022

Additionally, the study mentioned the reasons of having such low percentage in applying sediment and erosion control legislation across multiple urban and construction industries after spending a decade gathering information from stakeholders and other involved parties through workshops, surveys, interviews and other methods. The study mentioned that main

reason was due “the lack of enforcement action taken by regulatory authorities”. Not only but also, the lack of consistency among applying the erosion and sediment control between the local governments areas which caused confusion in the construction industry. The study was concluded by suggesting multiple recommendations and suggestions to improve the erosions and sediment planning phase as follows.

- Mandate in policy and development conditions that all ESC plans be prepared by a suitably qualified person, such as a CPESC (at least for sites over a certain area or risk level).
- Resource an experienced local government officer to review plans.
- Standardise Erosion Hazard Assessment forms.
- Standardise conditions for development approvals. For example, conditions should:
 - Allow ESC plans to adapt to various development stages whilst ensuring best practice measures are implemented and maintained.
 - Reference compliance with the most up-to-date State Planning Policy 2017 Stormwater Management Design Objectives (SMDO's), the International Erosion Control Association's Best Practice Erosion & Sediment Control (IECA, 2008), DES Procedural Guides and other relevant documents.
 - Include performance-based conditions, such as discharge water quality objectives (50mg/L) as per the State Planning Policy 2017 SMDOs.
 - Require the involvement of a suitably qualified independent third party to plan, implement/oversee, monitor, report and adapt ESC on development sites.

3- Sediment Basin Water Quality on a Large Highway Construction Project. (IECA Australasia Conference Paper, 2023) — monitored turbidity/TSS under different basin management approaches.

This study is discussing a very efficient procedure in sediment control implications during highway construction which is the sedimentation basis. It presented how this procedure helps capturing tones of sediments that might be washed into the waterways because of highway construction activities. Usually, highway construction causes a significant amount of pollution to the waterways due to the exposed soil and land layers. The study showed a water experiment that is done by collecting water samples from the basin inlets and outlets to check the number of polluted particles due to construction activities.

4- Turf for Erosion and Sediment Control -Construction of an Australian National Demonstration Facility. (International Turfgrass Society Research Journal, 12. Holborn, S. & Pearce, W. 2013).

This study discussed a natural solution that controls sediment and erosion designed and operated by Queensland based demonstration facility. The facility studied and tested the turf's efficiency and its ability to give the soil more stability compared to the regular

sediment and erosion control like fences and blankets during rainfall. As mentioned in the study, four main areas were examined as follows:

- Hydraulic roughness of different turfgrass types.
- Measurement of the sediment trapping capability of Turfgrass.
- Assessment of the ability of higher flows to tunnel under turf sod of differing establishment age.
- Rates of root development, including seasonal effects on root development.

5- Bungles, Blowouts and Boondoggles: Why Australia’s infrastructure projects cost more than they should. (The center for independent studies, 2023)

This report is focusing on showing how infrastructure projects in Australia are recently costing more due to several factors like labours, poor planning, and strict environmental and safety regulations to follow. The study documented how environmental legislations contributes to higher cost in the construction industry across Australia compared to the USA. It was mentioned in the study, “Australia has robust environmental regulations to protect the natural environment and biodiversity. Compliance with these regulations can involve additional assessments, mitigation measures, and monitoring”. Even though these standards are costing more in the construction field, they are serving an important purpose which is achieving environmental control and sustainability.

6- Erosion and sediment control — WSUD during the construction phase. In Sustainable Urban Water Blueprints (pp. 145–166). (Rowlands, L. 2019)

This study is examining how much sediment control is taking a place in the construction industry especially the land development phase compared to other phases, also how insufficient sediment control practices can affect the environment and infrastructure projects. It also highlights how environmental sediment control practices align with WSUD principles during the planning phase of construction projects results achieving sediment control efficiently.

7- Quantifying sediment export from an urban development site: Heron Park, western Australia. (Oldham, C.E., Eynon, F., & Ocampo, C.J. 2020)

This study is discussing the approach of developing solutions that will prevent sediment runoff from building sites activities in Heron Park, Western Australia. The aim of the study was to quantify the amount of sediment particles that leave the construction sites and how can the implementation of sediment and erosion control help reduce it. The research was based on using field monitoring, sediment samples and hydrological analysis to see the movement of the runoff and to quantify sediment concentration to evaluate the efficiency of basins and drainage systems. The following figure shows the monitoring approach for the project.

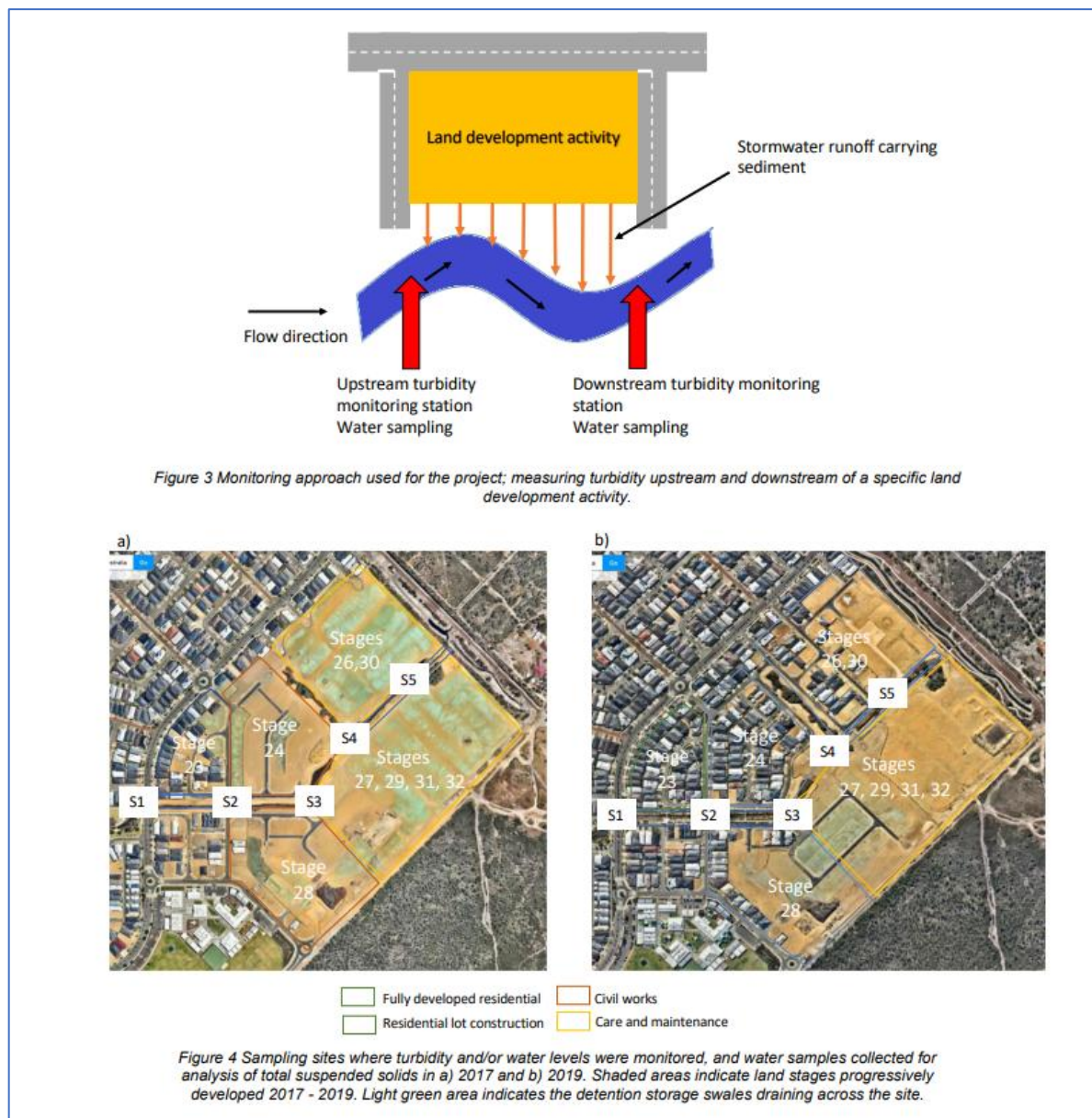


Figure 2.2.4: Field monitoring

The findings of this study showed that the major reason of sediment pollution is caused by construction sites and infrastructural developments, especially during rainfall and storm events. And because of the low efficiency of some drainage systems and maintenance, large amount of fine sediments are being moved to waterways and pollute them, which was higher than recommended in the best-practice ESC guidelines. In addition, the study showed that the sediment control procedures were effective when taking the soil type, rainfall density and construction staging into consideration. The following figure is showing one location in two-time frames (2017 and 2019) for the concentration of sediment loads.

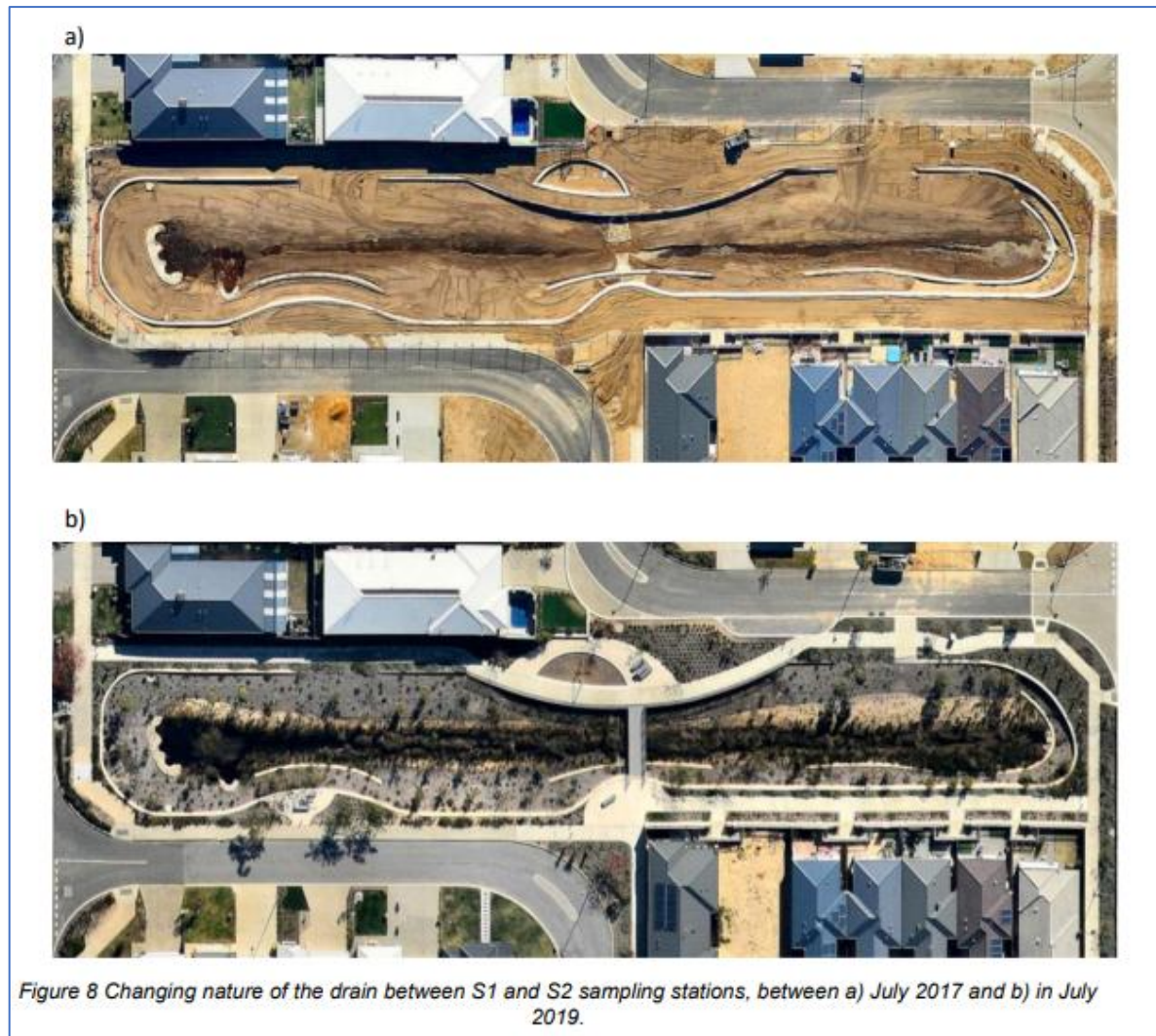


Figure 2.2.5: Sampling stations

2.2.1 Conclusion from Previous Studies:

- 1- The sediment control regulations play a pivot role in Queensland government sectors.
- 2- The government updates the regulations of environmental control all the time which creates conflicts and confusion among stakeholders in construction sites.
- 3- There are different sediment control procedures to follow depending on the construction type.
- 4- Failing to follow compliances to the implementation of sediment and erosion regulations in construction sites may cost the government a fortune to maintain the polluted areas and waterways.
- 5- It is more common now to follow environmental control legislation than before which can reduce harm to the environment as well as saving money.
- 6- There plenty of sufficient natural environmental control solutions that help trapping sediment life turfgrass which proved to be a better solution than the old fashion ones on the long-term side.

7- a lot of standards and requirements in the safety and environmental control are the reason why infrastructure projects are costing more and more, however, achieving these standards is giving more sustainable future in the construction field.

8- A lot of waterways pollution could be minimized through following the correct procedure in applying sediment control such as a proper installation of drainage system.

2.2.2 Recommendations based on Previous Studies:

1- Engineers and project managers should focus on achieving sediment control efficiently through integrating sediment control into early cost planning and scheduling during construction projects.

2- More natural sediment control solutions are worth to consider due to its long-term efficiency and lower future maintenance cost.

3- Applying sediment control procedures will save money and cut the expenses paid on fixing the topsoil by the government.

4- The local authorities and councils should be more precise and consistent during the inspections and approvals for any environmental control plan to avoid confusion among stakeholders.

5- Minimising the exposed areas during infrastructure projects result in having less disturbance in the soil which will reduce the sedimentation and any environmental practices.

6- The government might consider updating the environmental control and have a discussion with all construction parties to set consistent standards for future projects.

7- All parties involved in construction project should work on strengthening the early stages for planning sediment or environmental control.

8- The gap between the government environmental team and engineers should be filled with coordination among both teams.

9- Perhaps adding more trainings and webinar to the construction team will help avoid common problems related to sediment control implementation.

10- Focus on adding digital tools that will help in setting inspections and obtaining approvals.

2.3. Research Theoretical Framework:

This research is discussing different theoretical perspectives in the construction management, sediment control, regulations and rules compliance and the keys of construction project's performance. The main goal of this theoretical framework is to create an academic and conceptual foundations which will explain the impact of sediment control on the performance of construction projects in the state of Queensland in Australia, targeting cost, time, quality and long term benefits, and project planning and management. It will also synthesise theories, principles and findings to establish a model that summarise the relationships between both independent and dependent variables in this research.

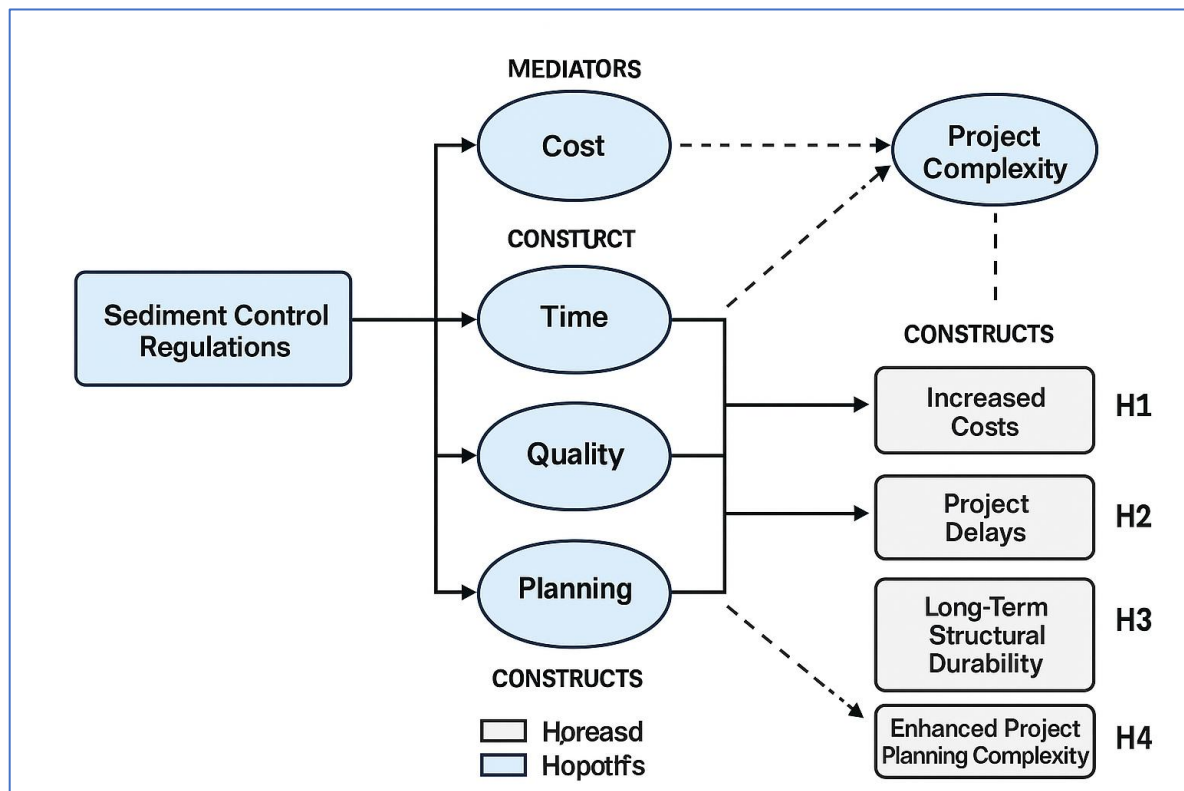


Figure 2.3: Research theoretical framework summary diagram

2.3.1 Sediment Control as a Regulatory and Environmental Framework

The sediment control requirements were established under Queensland environmental legislation which included three main regulations that will form the independent variable of this research as follows:

- Environmental Protection Act (1994).
- Local government development conditions.
- Best-practice guidelines (IECA, 2018).

The following theoretical basis assumptions align with Regulatory Compliance Theory, which explains that the more rules and regulations needed to be achieved in sediment control, the more administrative and operational burdens.

- More environmental and sediment legislation leads to higher compliance needs and requirements.
- Acquiescing affect construction activities, resources, project plan and overall project complexity.

- Increased environmental regulations will lead to more documentation, inspections and approvals in construction projects.

2.3.2 Cost overrun theory

The cost factor in construction projects key performance is addressed in the cost overrun theory, which means that any changes in sediment control requirements, environmental legislations, and hidden or conditions from the original budget of the project will often lead to cost overrun.

According to the literature and research hypotheses that were mentioned earlier, sediment control influences the cost of construction project through the following:

- Materials such as, geofabric, silt fencing and sediment basins.
- Manpower and equipment hire.
- Rework and additional structural activities due to failure in achieving environmental inspections.
- Temporary or additional work which was not included in project's tender.

The study (Rowlands, 2019; CIS, 2023) confirm that environmental compliance contributes to 10–18% secondary cost impacts which support the research hypothesis of planned and actual cost that may differ in construction projects after implementing sediment control regulations.

2.3.3 Time and delay theory

The time factor of the key performance aligns with Project Delay Theory that explains the time extension of the project's critical path due to additional environmental activities. The following points will explain the sediment control contribution to delays in construction projects:

- Additional activities such as installation.
- Work stops due to weather conditions or non-compliance.
- Additional time for work approvals or inspection's requests.

2.3.4 Quality and long-term benefits framework

The quality factor of the key performance is based on the Long-term Asset performance theory that reflects the improvements on the lifecycle and stability of the construction project due to sediment control implications. These implications enhance the quality factor through the following:

- Protecting the foundations from erosion.

- Keeping the drainage systems and retaining walls stable.
- Reduce sediment that may affect the quality of certain structural elements.
- More future jobs available in the engineering/environmental field.

On the other hand, there are some negative impacts that might happen in construction projects due to poor planning or lack of sediment control plan such as:

- Site access restrictions.
- Speeding up some structural activities to meet environmental control.

Therefore, there are mixed effects expected to be among negative impacts and long-term benefits.

2.3.5 Construction project planning and management theory

The planning side of this research is explained in Project Complexity Theory. This theory shows that the more documentation, tasks, approvals and inspections, the more challenging will be to coordinate and plan the project. The sediment control will increase the complexity of the project by the following:

- Plans and strategies to achieve sediment control under the state legislations.
- Regular inspections based on the type of the project.
- Obtaining documents and approvals.
- Filling the gap between the environmental team and project engineers.

2.3.6 Conceptual relationship

The proposal of the theoretical model for this research is as follows:

- Independent Variable which includes all the legislations and laws for sediment control implementation.
- Dependent Variable includes the four key performance of construction projects which are:
 1. Cost.
 2. Time.
 3. Quality and long-term benefits.
 4. Project planning and management.

Thus, the theoretical framework assumption is that sediment control rules and regulations will impact the four key performance of construction projects.

2.3.7 Theoretical contribution of this research

This research highlights a clear understanding of the effect of sediment control on construction projects through the following:

- Measuring the impact on the cost of the project.
- Addressing operational challenges and disruptions.
- Listing the long-term benefits and negative impacts on construction projects.
- Discussing the planning and managing disruptions and confusions.

The research is giving detailed understanding to these effects and highlighting all the aspects that could affect the key performance of construction projects.

2.4. Conclusion:

This chapter presented a comprehensive review of previous studies involving sediment control practices. Not only but also, presented the effect of their implication on construction projects in Queensland. It also discussed in detail the theoretical framework of the research. Illustrating the theories related to each element of the key performance of a construction project.

Chapter three:
Research Methodology

3.1. Introduction:

This research will be discussing the research methodology as well as research tools. The research methodology will include research design, data collection methods, population and sample and data analysis techniques. While the research tools will include the survey, conducted interviews, GIS and focus group discussions as follows.

3.2. Research Methodology:

3.2.1 Research Design:

This research uses a descriptive and analytical design to study the impact of sediment control implementation on the performance of construction projects in Queensland. The research will use a mixed-method approach which will combine quantitative data that is collected through surveys and qualitative data that is collected from interviews. The descriptive aspect in this study will be outlining the challenges in the construction field in terms of project performance factors during the implementation of sediment control while the analytical aspect will investigate to what extent these challenges affect the performance of the project. The design of this research will provide a significant understanding for all construction industry-related engineers, stakeholders, project managers and contractors across Queensland.

3.2.2 Research community:

The research community involved all relevant professions related to construction like engineers, project managers, positions related to environment and administrators in Queensland, Australia.

3.2.3 Data collection methods:

The data that will be collected in this research is collected using both qualitative and quantitative methods to provide clear and comprehensive understanding of sediment control implementation on construction project performance in Queensland. The qualitative data will be obtained through conducting some semi-structured interviews with experts in the construction industry to learn more about the challenges and obstacles that could affect the project's outcome during the implementation of sediment control. While the quantitative data will be gathered by a structured survey using the tool Google Forms that is distributed among engineers, contractors, project managers and some local council employees through social media, emails and direct contacts. This mixed methodology will highlight issues and challenges and make it easier to statistically analyse the data related to construction site performance during sediment control.

3.2.4 Population and Sample:

The research will target professionals who were involved in construction industry especially in infrastructure projects where sediment control was applied in Queensland. These professions will include office/site engineers, project managers, project officers, environmental inspectors and contractors. It will also target employees in the environmental control sector at local councils as they are directly

linked to construction project outcome and performance. The sampling size was 311 survey participants to ensure various aspects from different sides related to the implementation of sediment control in the construction industry in Queensland. However, the interviews were 4 interviews to collect quantitative data about the obstacles, cost issues, planning and managing challenges in the construction field resulting from the application of sediment control. The sample distribution as per demographic characteristics is described in the following table below:

Variable	Phrase	Quantity	Percentage
Age group	20 - 30	28	9.1%
	30 - 40	16	51.5%
	40 - 50	94	30.3%
	50+	28	9.1%
experience in construction	≤2 years	47	15.2%
	2–5 years	75	24.2%
	5–10 years	132	42.2%
	10+ years	57	18.2%
experience working in Queensland	≤2 years	169	54.5%
	2–5 years	85	27.3%
	5–10 years	28	9.1%
	10+ years	28	9.1%
current role	Engineer	198	63.6%
	Manager	85	27.3%
	Safety/Environmental position	19	6.1%
	Administration	9	3.0%
training on environmental controls	Yes	198	63.6%
	No	113	36.4%

Table 3.2.4.1: Sample distribution in the demographic characteristics

3.2.5 Data Analysis Techniques:

Quantitative: This part of the research will discuss the numerical section of how applying sediment control in construction projects affects cost, time, quality and project planning. It will analyse the survey data, which allows accurate predictions and comparisons among the construction project key performance after the implementation of sediment control in Queensland.

Qualitative: This part of the research will observe and explore the effect of sediment control application on construction projects in Queensland by studying and analysing the conducted interviews. It will focus on investigating the key performance of construction projects and the challenges that might occur during the project through the sediment control implementation. Additionally, a case study

related to the quality and complexity of construction projects while applying certain regulations related to sediment control will be discussed and analysed in detail.

3.3. Research Tools:

3.3.1 Structured Survey:

A well-prepared structured survey will gather data from several professionals involved in construction projects in Queensland. This survey will target office/site engineers, project managers, project officers, environmental inspectors, and contractors to explore their thoughts on the impact of sediment control implementation on construction projects.

3.3.2 Semi-structured interviews:

Semi-structured interviews will play a pivotal role in this research, discussing the impact of sediment control application on construction projects in Queensland with employees from various local councils. The interviews will focus on investigating the key performance indicators of construction projects and the challenges that might occur during the project due to the application of sediment control.

3.3.3 GIS and site-based observation:

GIS and site-based observation will serve as an analytical supporting tool to assess the relationship between the construction industry, especially infrastructure projects, and the implementation of sediment control across multiple construction sites and projects in Queensland. The GIS tool will help in determining the obstacles that affect project key performance indicators throughout the process of sediment control on construction sites. It is both a scientific and practical tool that will show how sediment control influences the cost, time, quality, and planning of construction projects across Queensland and add more accuracy to the research.

3.3.4 Focus Group:

This research will gather ideas and insights from a group of professionals, which will allow for the presentation of valuable points about how sediment control regulations affect the performance factors of construction projects, namely cost, time, quality and long-term benefits, and project planning and management. The process will involve collecting the points of view and opinions from a group of professionals in the construction industry (4 to 8 participants) regarding the implementation of sediment control regulations and its relevance to project performance and outcomes.

3.4. Research limitations:

Although many valuable points were discussed and highlighted in this research, there are multiple limitations that impact the findings and results. It is crucial to mention these limitations, as it helps in supporting the transparency of this research and increases the validity of the research outcomes.

3.4.1 Geographic and contextual limitation

This research is conducted, and all data collected are based on construction projects located only in Queensland. As mentioned earlier, it is a wet state with a tropical climate that follows strict rules and regulations in terms of environmental control, which makes it a perfect place to study sediment control-relevant strategies and issues. This is unlike other areas where climate conditions and environmental control vary, for example, Western Australia. Thus, this research is only valid within the context of Queensland's environmental control regulations.

3.4.2 Data availability and confidentiality

Conducting such research will involve seeking out multiple actual projects to compare several criteria, such as the actual cost and the planned cost after applying sediment control in the project, as well as the need to examine some schedules and plans for time delays, quality observation, and sediment control inspection details. This might be a struggle, as many construction organizations and local governments may prefer to maintain confidentiality over such criteria, which could lead the study to rely on estimations rather than records or actual data. This limitation can affect the data collected from surveys and interviews, for example, which will not guarantee the complete accuracy of the research.

3.4.3 Sample size and representation

It is very common in Australia to work DIDO (drive-in, drive-out) or FIFO (fly-in, fly-out), so the participants in the survey, interviews, and focus groups might not be located in Queensland. Additionally, since they are from multiple professions, such as engineers, project managers, and contractors, who might work in a hybrid capacity for both construction projects and local governments, this may result in various views regarding the implementation of sediment control in the construction industry affecting project key performance indicators.

3.4.4 Environmental and project variability

The construction industry has a wide range of projects that varies in size, budget, scope, locations, structures and environmental conditions. This may influence the implication of sediment control regulations for a particular project, for example small projects like homes and commercial buildings may have minor sediment control regulations to follow than the infrastructure projects like external/stormwater drainage and highways. Therefore, it might be hard to connect the relation between the sediment control framework and the key performance of construction projects.

3.4.5 Limited availability of previous studies

This research is seeking to study the effect of the implication of sediment control on construction project and study that influence on the cost, time, quality and long-term benefits and planning of the project. However, very limited resources and academic previous studies were available related, instead studies mostly focus on environmental outcomes. This makes it challenging to address the effect on construction key performance, thus the research will rely on collecting data from survey, interviews and focus group along with construction projects.

Chapter four:
Results and Recommendations

4.1. Introduction:

This chapter will present and discuss the results obtained from the survey, interviews, and focus group conducted to analyse the impact of sediment control implementation on construction project performance in Queensland. The findings are organized according to the four key performance indicators identified in the theoretical framework — cost, time, quality and long-term benefits, and project planning and management.

The analysis aims to determine how the enforcement of sediment control measures affects these aspects of project performance, highlighting both positive and negative implications. Quantitative results from the survey are complemented by qualitative insights gathered from interviews and focus group discussions to ensure a comprehensive understanding of the issue.

The chapter also provides interpretations of these findings in relation to the reviewed literature and theoretical model. Finally, recommendations are proposed based on the results to improve the implementation of sediment control practices while minimizing their negative effects on project performance and enhancing sustainability outcomes in Queensland's construction industry.

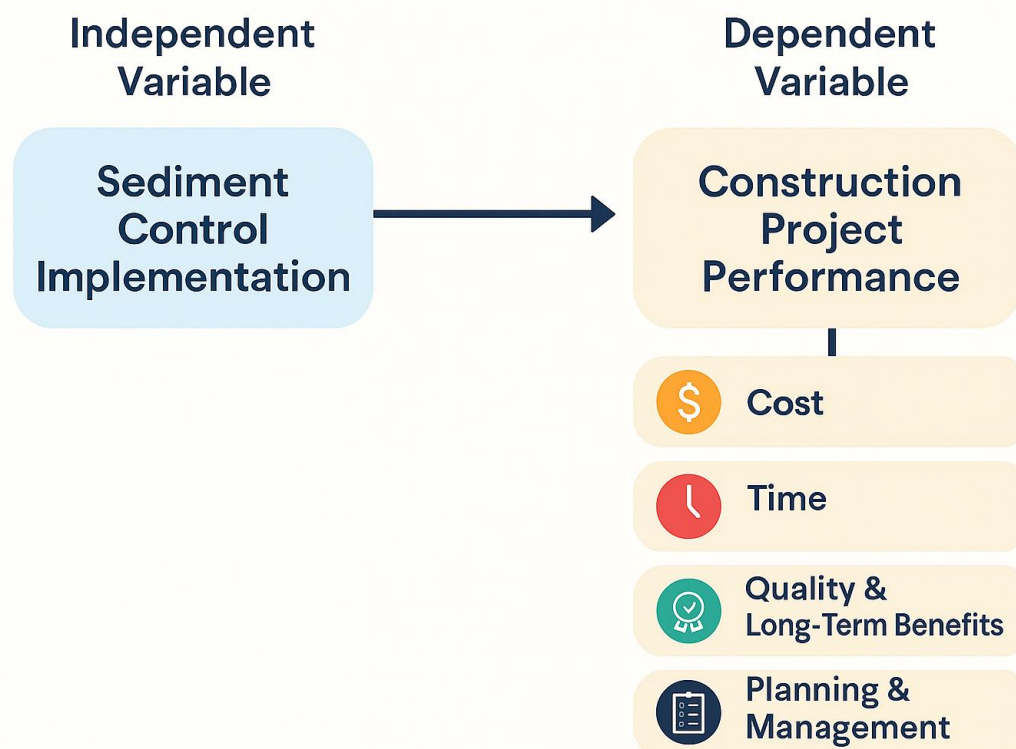


Figure 4.1.: Dependant and Independent variable

4.2. Results and discussions:

4.2.1 Respondent demographics

This section presents the demographic characteristics of the participants, which provide essential context for interpreting the findings of this study. Understanding the respondents' age groups, total years of experience in the construction industry, experience working specifically in Queensland, professional roles, and prior training in environmental controls helps establish the credibility and relevance of the collected data. These demographic variables ensure that the perspectives reflected in the survey come from individuals with appropriate professional backgrounds and practical exposure to sediment control practices. Additionally, analysing the diversity of respondents allows for stronger validation of the study's conclusions, as it demonstrates that insights regarding the impact of sediment control on project performance are informed by a broad and representative sample of industry professionals.

4.2.1.1 Age Group of Respondents – First question

Results:

A total of 311 participants completed the questionnaire. The age distribution shows that:

- 51.5% of respondents are between 30–40 years
- 30.3% are between 40–50 years
- 9.1% are 20–30 years
- 9.1% are 50 years and above

Thus, the majority of respondents fall within the 30–50-year age range.

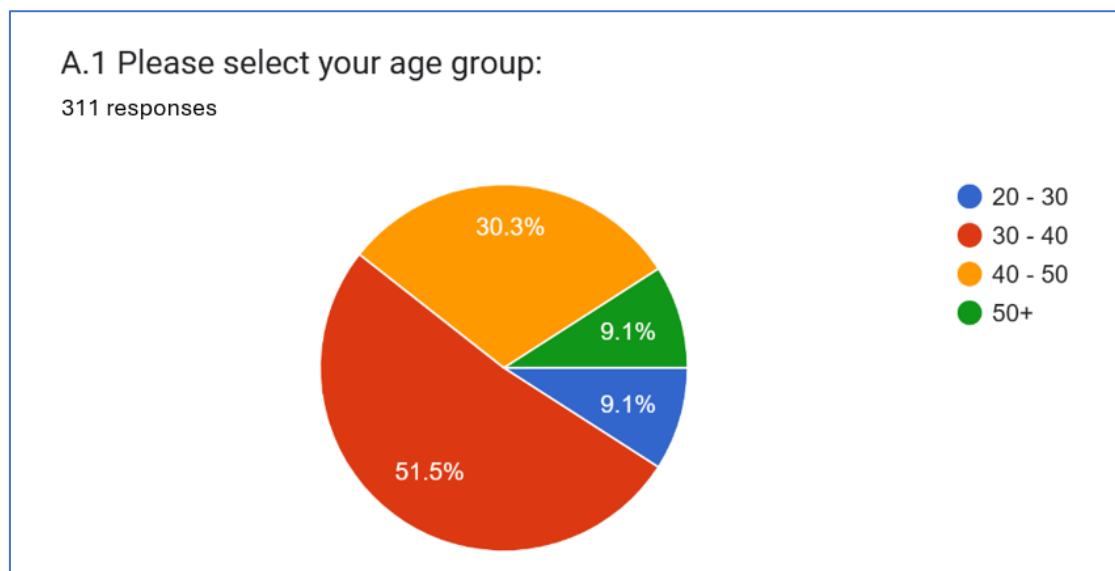


Figure 4.2.1.1: First question

Discussion:

1. Majority of respondents are mid-career construction professionals

The predominance of respondents aged 30–50 years indicates that most participants are likely to be in mid-career positions, such as, site engineers, project engineers, construction supervisors, project managers, and environmental compliance officers. These positions are

typically responsible for applying and managing sediment control procedures on construction sites. Their age profile aligns with the workforce segment most heavily involved in Queensland's project delivery activities.

2. Relevance to sediment control implementation

Professionals aged 30–50 usually possess enough technical knowledge and site-based exposure to understand:

- How sediment control requirements influence project cost.
- delays caused by weather events and environmental inspections impacts on quality and rework.
- Administrative pressure on project planning and management.

Therefore, their views directly support the research aim of evaluating how sediment control regulations affect construction project performance.

3. Alignment with construction industry demographics

Studies such as Rowlands (2019) note that the active construction workforce in Australia is concentrated within this same age range.

This means the sample is both representative and industry-relevant.

4. Summary

Overall, the age distribution reflects a sample composed largely of mid-career practitioners, ensuring that the results are informed by individuals who have substantial involvement in managing construction activities and complying with sediment control requirements in Queensland.

4.2.1.2 Total Years of Experience in Construction – Second question

Results

The distribution of respondents based on total construction industry experience is as follows:

- 42.4% have 10–20 years of experience
- 24.2% have 5–10 years
- 18.2% have more than 20 years
- 15.2% have 5 years or less

Most respondents (84.8%) have more than five years of experience in the construction field.

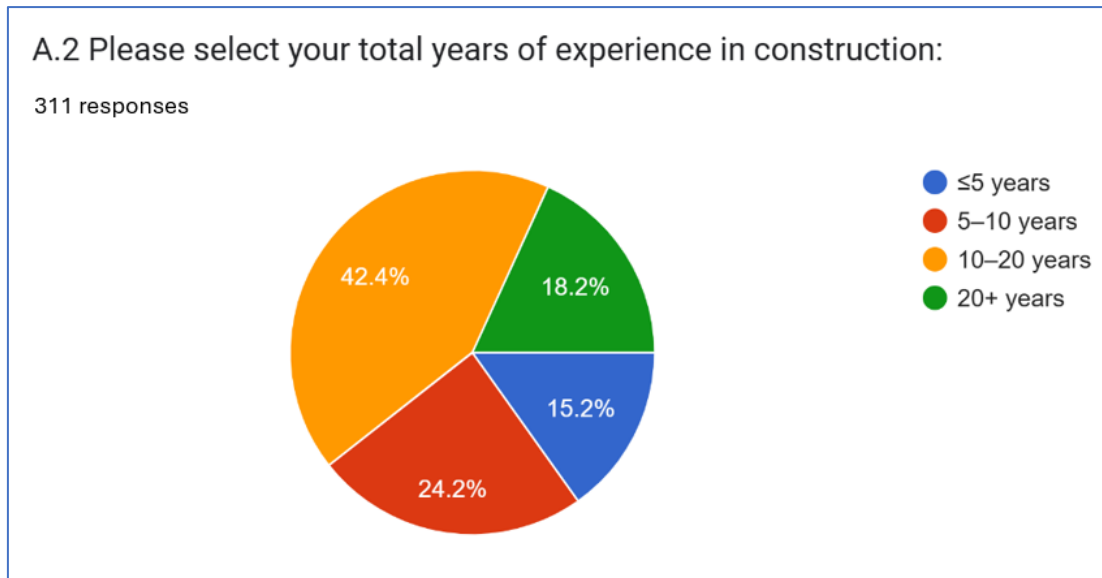


Figure 4.2.1.2: Second question

Discussion

1. Respondents possess strong and diverse construction experience

The large proportion of respondents with 10–20 years of experience indicates a highly knowledgeable sample.

These individuals typically occupy roles involving:

- project decision-making
- resource allocation
- environmental inspections
- construction sequencing
- cost estimation and project planning

Their extensive experience means they provide credible insights into how sediment control influences project performance.

2. Direct relevance to cost, time, quality and planning impacts

Experienced practitioners are better positioned to understand:

- how sediment control requirements contribute to cost increases.
- how compliance and wet-weather shutdowns affect project timelines the ways sediment control measures influence quality, rework, and long-term outcomes the management burden involved in approvals, documentation, and inspections.

Therefore, the high level of experience among respondents directly strengthens the analysis of the key performance indicators in this research.

3. Supports the accuracy of the research findings

Because these respondents have worked on multiple projects over many years, their insights:

- Are based on repeated patterns rather than isolated events.
- Represent industry reality.

- Align with previous studies that emphasise the importance of experience when evaluating sediment control challenges (Rowlands 2019; Belayutham et al., 2016)

4. Summary sentence

In summary, the strong representation of respondents with mid- to long-term construction experience enhances the reliability of the survey results, allowing for deeper understanding of how sediment control implementation affects cost, scheduling, quality, and project management in Queensland's construction industry.

4.2.1.3 Years of Experience Working in Queensland – Third question

For the question relating to participants' years of experience working specifically in Queensland, the results show that:

- 54.5% of respondents have ≤ 2 years of experience
- 27.3% have 2–5 years
- 9.1% have 5–10 years
- 9.1% have 10+ years

This means that more than half of the respondents are relatively new to working in Queensland's construction sector, even though many have substantial overall experience in construction.

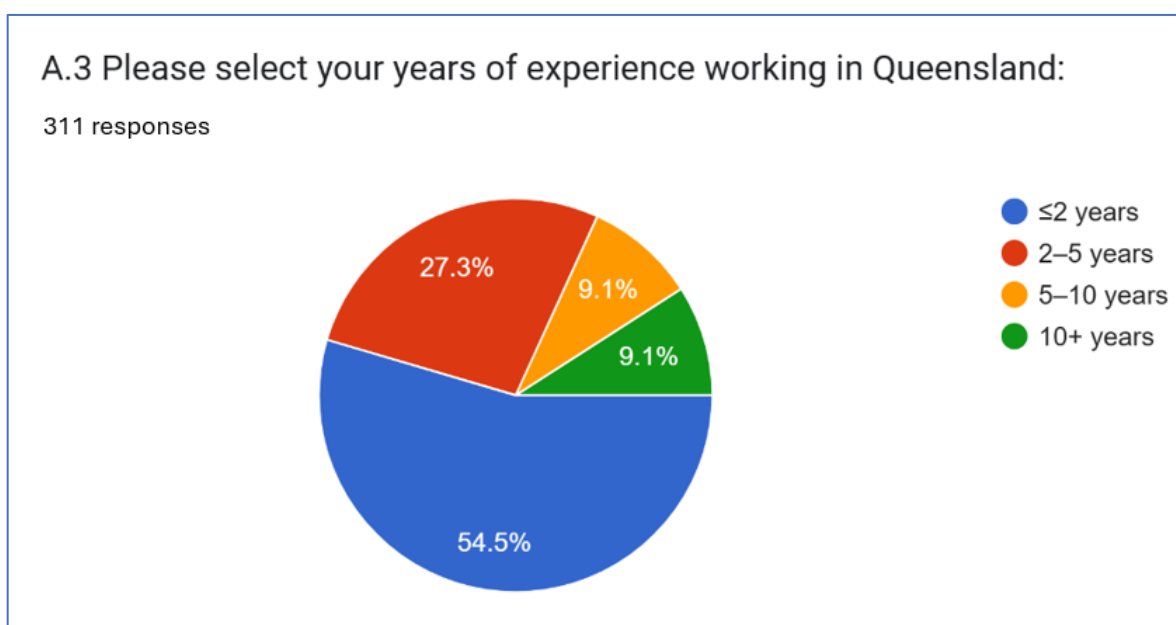


Figure 4.2.1.3: Third question

Discussion

1. High proportion of respondents newly exposed to Queensland regulations

The majority of participants (54.5%) have worked in Queensland for two years or less.

This is an important result because Queensland has unique environmental regulations, particularly relating to sediment control, wet-season management, stormwater protection, and the IECA 2008 Best Practice Guidelines.

Professionals new to Queensland are likely still adapting to:

- Strict sediment control requirements.
- Frequent inspections.
- Wet-weather shutdown rules.
- Council and state compliance expectations.

This may influence their perception of:

- Increased project cost.
- Additional time delays.
- Challenges in quality control.
- Complexities in planning and management.

These results help explain why some participants may feel that sediment control regulations create significant project pressure—because they are still adjusting to Queensland’s regulatory environment compared to other states.

2. Meaningful input from respondents familiar with Queensland conditions

Although most respondents are relatively new to Queensland, around 45.5% of participants have more than two years of experience.

This group provides valuable insights because they have had repeated exposure to the realities of:

- Wet season impacts.
- Erosion and sediment control audits.
- Hold points and compliance checks.
- Local council and DESI (Department of Environment, Science and Innovation) requirements.

Thus, the sample contains a balanced mix of:

- New professionals who may highlight adjustment challenges
- Experienced Queensland practitioners who can evaluate long-term project impacts

This diversity adds depth and credibility to the findings.

3. Relevance to the research topic

Sediment control implementation in Queensland is strongly influenced by local environmental conditions, especially heavy rainfall patterns and tropical climate zones. Because more than half the respondents are new to Queensland, they may perceive the regulations as more demanding compared to other states.

This links directly to the key research areas:

- Cost: newcomers may report higher cost impacts due to unfamiliar compliance tasks.
- Time: weather-driven delays may feel more significant to those unused to Queensland wet seasons.
- Quality: unfamiliarity with sediment control requirements can affect quality and rework.
- Planning & Management: the learning curve for local legislation adds administrative burden.

4. Summary sentence

In summary, although many respondents possess substantial construction experience overall, more than half are relatively new to Queensland's regulatory environment. This provides valuable insight into how sediment control implementation is perceived by both newcomers and experienced practitioners, adding depth to the analysis of its impact on cost, time, quality, and project management within the state.

4.2.1.4 Current Role of Respondents – Forth question

Participants were asked to select their current role within the construction industry. The results show that:

- 63.6% identified as Engineers
- 27.3% identified as Managers
- 6.1% held a Safety/Environmental position
- 3.0% worked in Administration

This demonstrates that the overwhelming majority of respondents are either engineers or managers, representing the core operational and decision-making workforce in construction projects.

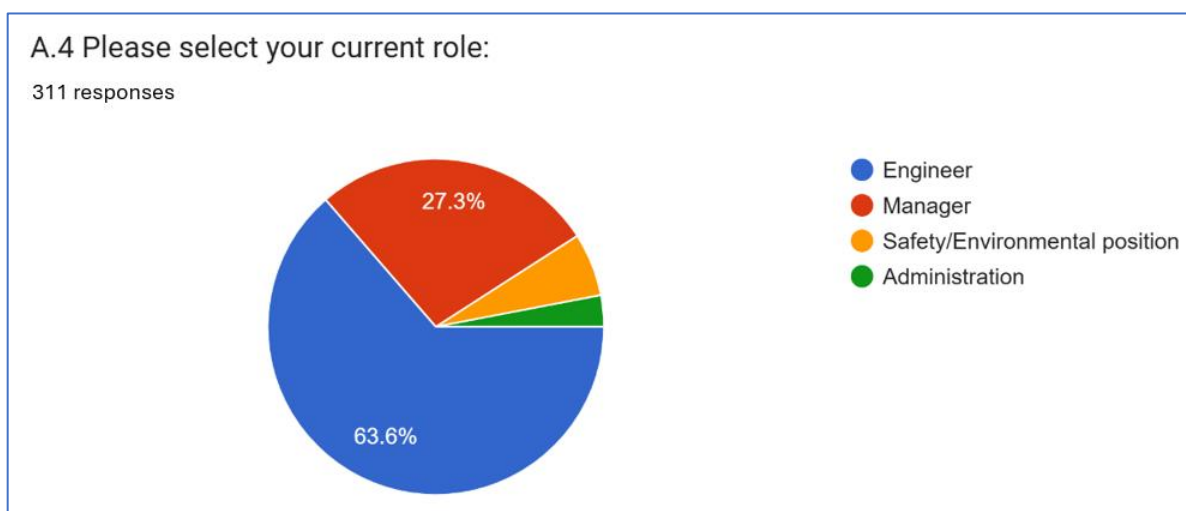


Figure 4.2.1.4: Forth question

Discussion

1. Strong representation of engineers directly involved in project delivery

With 63.6% engineers, the sample is heavily composed of those who are responsible for:

- Developing construction methodologies
- Coordinating site activities
- Implementing sediment control measures
- Ensuring compliance with Queensland environmental regulations
- Managing project resources, sequencing, and performance

Engineers are among the professionals most directly impacted by the introduction of sediment control requirements. Their perspectives therefore provide meaningful insights into the practical challenges associated with cost, time, quality, and planning impacts.

2. Managers add a strategic perspective on performance impacts

The 27.3% managers are likely to include:

- Project managers.
- Construction managers.
- Site managers.
- Operations managers.

These roles deal with:

- Budgeting and cost allocation.
- Schedule development and delay claims.
- Risk management.
- Compliance meetings and council communication.
- Approval processes for sediment and erosion control plans.

Their strategic view complements the engineers' operational experiences, strengthening the depth of the data collected.

3. Environmental and safety officers reinforce credibility for sediment control evaluation

Although a smaller group (6.1%), respondents in safety and environmental roles offer critical insight into:

- Erosion and sediment control inspections.
- Hold points.
- Non-compliance notices.
- Environmental risks during wet-season construction.
- Implementation of IECA Best Practice Guidelines.

This helps validate whether the challenges identified by engineers and managers align with actual regulatory practice.

4. Relevance to the research topic

This role distribution aligns strongly with the aims of the study.

Engineers and managers are the primary individuals affected by how sediment control implementation influences:

Cost: additional materials, labour, and compliance expenses.

Time: inspection delays, weather-related stoppages, and rework.

Quality: constraints on sequencing, rushed activities, or enhanced long-term outcomes.

Project Planning & Management: increased administrative load and coordination requirements.

Therefore, the makeup of the respondents directly supports the reliability and relevance of the findings.

5. Summary sentence

Overall, the high proportion of engineers and managers in the sample provides strong validity for the study, as these roles are central to implementing sediment control requirements and managing their impact on construction project performance in Queensland.

4.2.1.5 Environmental Control Training – Fifth question

Participants were asked whether they had previously received any formal training related to environmental controls, such as erosion and sediment control measures, environmental compliance procedures, or IECA guideline requirements.

The responses were as follows:

- 63.6% reported Yes, they have received training.
- 36.4% reported No, they have never received environmental control training.

This indicates that nearly two-thirds of respondents have some level of exposure to environmental practices relevant to construction activities in Queensland.

A.5 Have you ever received any training on environmental controls ?

311 responses

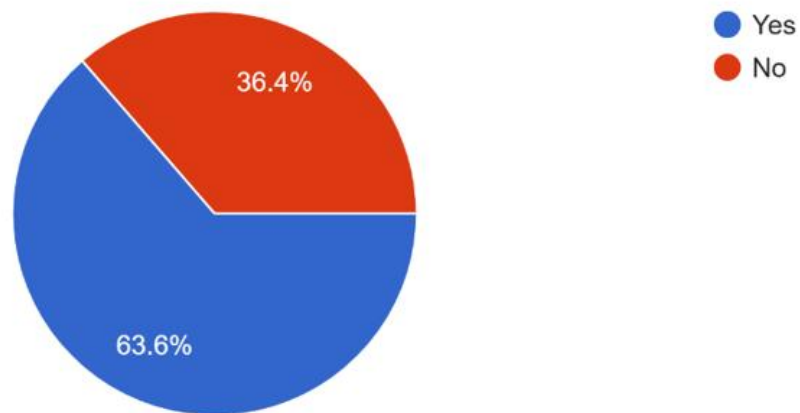


Figure 4.2.1.5: Fifth question

Discussion

1. Strong training presence improves reliability of responses

With 63.6% having received environmental control training, the majority of participants possess foundational knowledge on:

- Sediment control principles.
- Erosion risks and mitigation strategies.
- Regulatory expectations under the Queensland environmental framework.
- Hold points, inspections, and environmental obligations.
- Site-specific sediment and erosion control plans (ESCPs).

This enhances the credibility and depth of the survey results, as most participants understand how sediment control is implemented in real construction settings.

2. Lack of training among 36.4% highlights industry gaps

A significant proportion (over one-third) have never received formal training.

This indicates persistent challenges in the industry, such as:

- Uneven access to environmental education.
- Insufficient induction content on sediment control.
- Lack of obligation in some organisations to train staff.
- A gap between regulatory expectations and on-site awareness.

This supports the argument presented in previous studies that construction personnel often receive inconsistent environmental training, contributing to misunderstandings, non-compliances, and project delays.

3. Relevance to the research topic

This question is directly linked to the core focus of the research:
how sediment control implementation affects construction project performance.

Sediment control performance depends heavily on:

- Workers understanding environmental regulations.
- Correct installation of sediment fences, traps, stabilisation, and stormwater Protection.
- Proper sequencing of work during wet-weather periods.
- Timely identification of environmental risks.

The existence of a large untrained group may explain:

- Higher cost overruns due to rework, fines, or incorrect installations.
- Longer time delays caused by repeated inspections or non-compliance notices
- Reduced quality of sediment control measures.
- Increased managerial burden to supervise, educate, and coordinate compliance.

Thus, this variable serves as a contributing factor that may partially explain the performance issues identified in the study.

4. Implications for the industry

The results suggest strong opportunities for improvement:

- Expanding training programs across all experience levels.
- Standardising competency requirements for sediment control implementation.
- Improving awareness of the IECA (2008) Best Practice Guidelines.
- Encouraging councils and contractors to provide refresher training.
- Integrating environmental control modules in engineering curricula.

Improved training can help reduce inefficiencies, improve quality, and strengthen compliance across the industry.

5. Summary sentence

Overall, the results show that while a majority of construction professionals in Queensland have received environmental control training, a substantial minority have not, highlighting a critical gap that may contribute to cost, time, and quality challenges in sediment control implementation.

4.2.2 Financial impact of sediment control on construction projects performance

This section of the survey examines the cost-related implications of sediment control implementation in construction projects across Queensland. Understanding the financial impact is essential, as cost performance is one of the key indicators of project success and a major concern for contractors, engineers, and stakeholders. This section explores how

sediment control requirements influence project budgets, the frequency and magnitude of cost overruns, and the underlying causes contributing to these financial deviations. By analysing participants' responses, the research provides empirical evidence on whether sediment control increases project expenditure, how accurately these costs are predicted during planning, and which factors exert the greatest pressure on budgets. The results of this section directly support the study's objective of evaluating the economic consequences of environmental control measures and identifying areas where planning practices and regulatory clarity may be improved to minimise cost-related risks in future projects.

4.2.2.1 Cost allocation for sediment control in construction projects – First question

The results of Question B1 reveal that most participants reported allocating less than 5% of the total project cost to sediment control measures, representing 63.6% of all responses. A further 15.2% of participants indicated an allocation ranging between 5%–10%, while 18.2% reported higher allocations of 10%–15%. Only a small proportion of respondents (approximately 3%) selected allocations above 15%, indicating that allocations beyond this threshold are uncommon in typical construction projects.

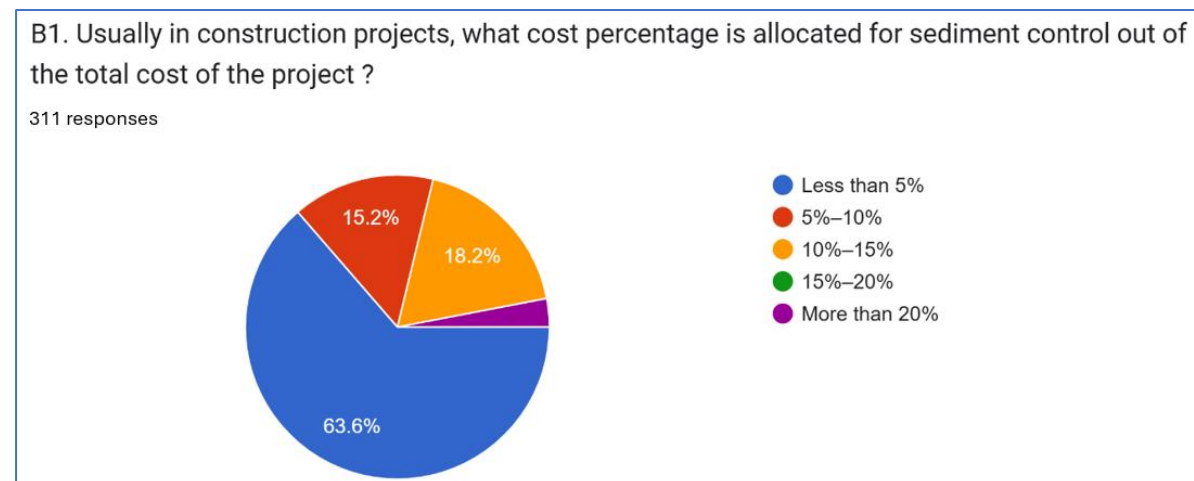


Figure 4.2.2.1: First question

These findings suggest that sediment control is generally viewed as a minor component of the overall project budget, at least during the planning phase. This aligns with common industry expectations, where sediment control is often underestimated compared to other cost elements such as materials, labour, and equipment. However, this perception contrasts with the widespread industry concerns—highlighted in previous studies—that sediment control frequently contributes to unplanned cost overruns due to unexpected environmental inspections, rework, site shutdowns, and the need for compliance upgrades.

The distribution of responses also indicates a disconnect between planned allocations and actual financial impact, which becomes more evident in later survey questions about cost overruns. While most respondents allocate less than 5% initially, subsequent responses suggest that actual project expenditures often exceed these planned values. This supports one of the core assumptions in this research: sediment control is budgeted as a small cost item but becomes a significant contributor to cost escalation when not managed effectively.

Overall, the results of B1 provide an important baseline for understanding typical budgeting practices in Queensland's construction industry and highlight a key issue relevant to this

research topic—underestimation of environmental control costs during project planning, which may lead to long-term financial and operational challenges.

4.2.2.2 Frequency of cost overrun caused by sediment control – second question

The responses to Question B2 demonstrate how often construction professionals experience cost overruns directly related to sediment control requirements. The results show that 57.6% of participants encounter cost overruns occasionally, while 27.3% reported that such overruns occur rarely. Only 15.2% indicated that cost overruns happen frequently during project execution.

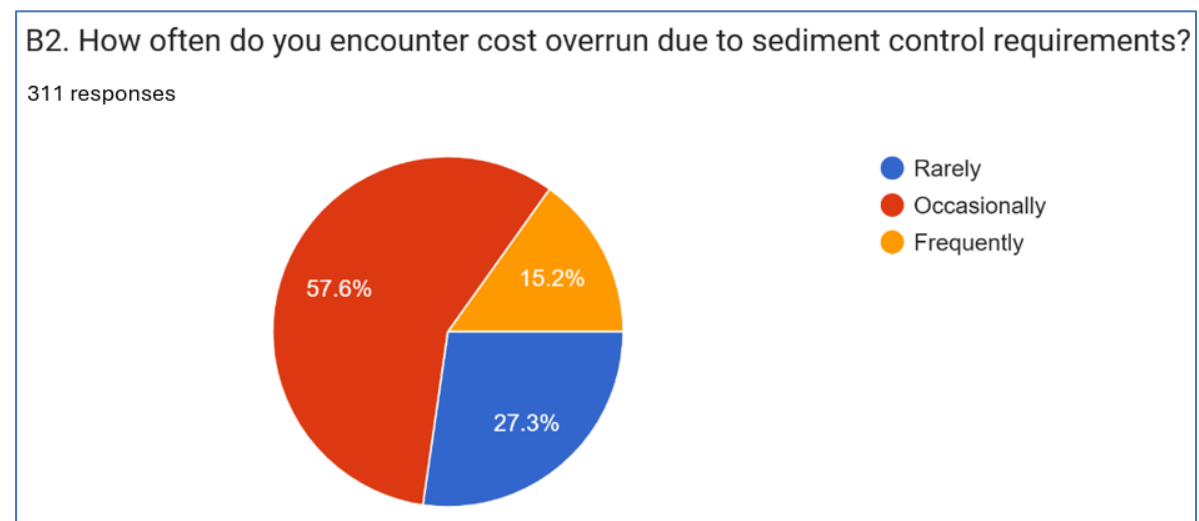


Figure 4.2.2.2: Second question

These findings indicate that although sediment control is generally budgeted as a minor cost component (as shown in B1), unexpected financial impacts occur in a considerable number of projects. The fact that more than half of respondents' experience cost overruns occasionally suggests that sediment control often introduces unplanned financial pressures, likely due to unforeseen site conditions, weather events, or additional compliance requirements enforced by Queensland regulations.

For this research, B2 provides clear evidence that sediment control contributes to cost variability within construction projects. This supports the study's hypothesis that environmental compliance, while beneficial for long-term sustainability, can pose practical challenges for project planning and budgeting. It also highlights a mismatch between initial cost expectations and actual expenditure, reinforcing the importance of improved forecasting and risk allocation in project management.

4.2.2.3 Cost overrun when sediment control implemented – Third question

The results of Question B3 provide clear evidence that sediment control implementation commonly leads to measurable cost overruns in construction projects across Queensland. Out of 311 respondents, nearly half (48.5%) reported that sediment control results in a 2%–4% cost increase beyond the original budget. This makes it the most frequently observed range and suggests that even moderate sediment control requirements exert a consistent financial impact on project delivery.

A further 21.2% of respondents indicated that the cost overrun is less than 2%, while another 21.2% indicated overruns between 4%–6%. A smaller portion of respondents (9.1%) reported experiencing cost overruns exceeding 6%, indicating that although major cost escalations are less common, they do occur in projects with more complex or demanding environmental conditions.

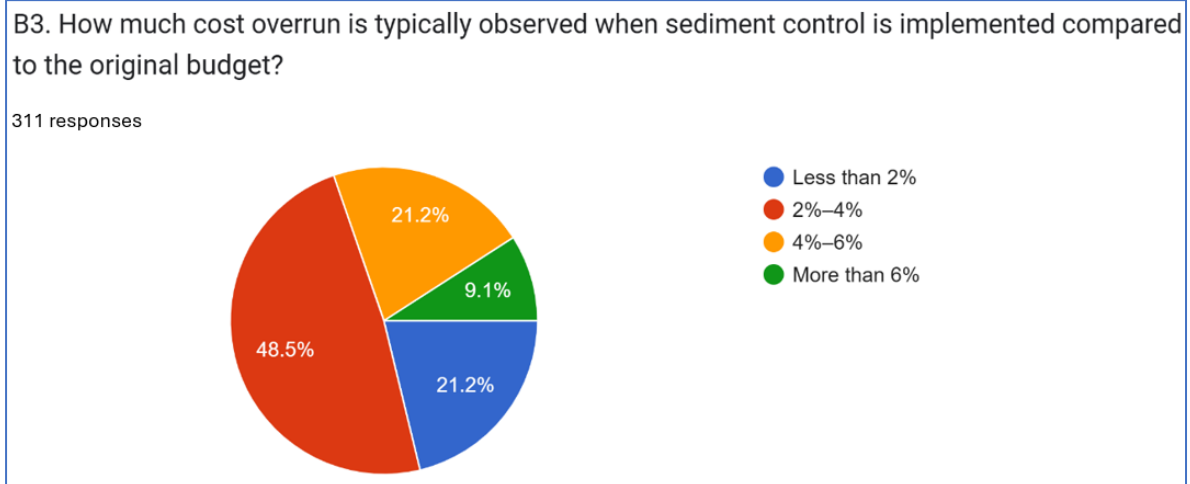


Figure 4.2.2.3: Third question

These findings demonstrate that sediment control is not only a mandatory compliance requirement but also a predictable driver of cost deviations in construction projects. When applied to large-scale infrastructure projects—where budgets can reach tens or hundreds of millions—even a 2–4% increase becomes financially significant. This aligns directly with the research objective of analysing the impact of sediment control on the cost performance of construction projects and reinforces observations from previous studies that environmental compliance can pose ongoing financial challenges for contractors and project managers.

Overall, this question provides empirical support for the notion that sediment control contributes to systematic, measurable, and often underestimated cost overruns, making it an essential factor to consider in cost planning, risk allocation, and budget contingency strategies.

4.2.2.4 Cause of cost overrun when sediment control implemented – Fourth question

The findings from Question B4 provide valuable insight into the primary drivers of cost overruns associated with sediment control implementation in Queensland construction projects. Among 311 respondents, the majority (48.5%) identified poor planning as the leading cause of cost increases. This indicates that inadequate preparation, insufficient pre-construction assessment, or failure to anticipate environmental requirements significantly contributes to budget deviations. This result aligns with existing literature emphasising that environmental controls must be embedded early in the planning phase to avoid unplanned expenses during execution.

A considerable portion of respondents (27.3%) attributed cost overruns to unclear legislation and specifications, highlighting the ongoing challenge posed by the interpretation of sediment control guidelines. This suggests that contractors and engineers may struggle to fully understand or predict regulatory expectations, resulting in redesigns, corrective work, or late adjustments that increase costs. This finding directly supports your project’s argument that current sediment control regulations may introduce complexity and uncertainty into project planning and delivery.

Additionally, 15.2% of participants cited material costs as a key contributor, reflecting the increasing expense of geofabrics, sediment fences, inlet protection devices, and other temporary environmental controls that must be maintained throughout the project lifecycle. A smaller group (9.1%) identified manpower/plants as the main cause, implying that although labour and machinery requirements do impact cost, their role is less significant compared to planning deficiencies and regulatory ambiguity.

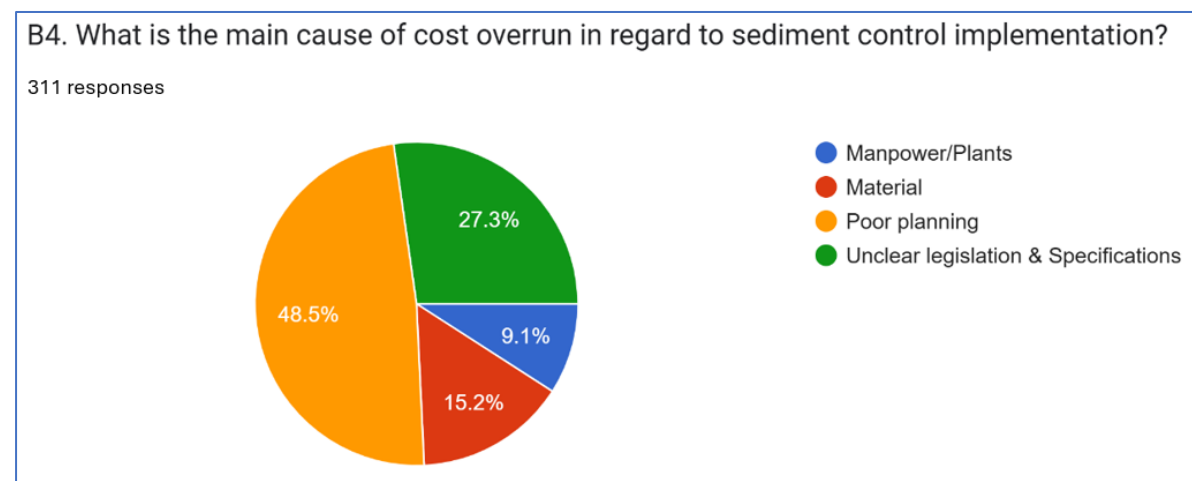


Figure 4.2.2.4: Fourth question

These results demonstrate that financial impacts are not solely due to the physical sediment control measures themselves, but also to broader organisational and regulatory issues. Ultimately, this question reinforces the research’s central theme: sediment control affects construction project performance through multiple pathways, including planning, compliance, material procurement, and workforce management.

4.2.3 Financial impact of sediment control on construction projects performance

This section of the survey focuses on assessing the impact of sediment control implementation on project timelines, a critical component of construction project performance. Time performance is especially important in Queensland, where environmental conditions—such as frequent rainfall and regulatory inspections—can influence construction sequencing and cause unexpected schedule disruptions. This section investigates how sediment control affects the duration of activities on the critical path, the extent of project delays, and the severity of various time-related contributing factors. By analysing participants’ responses, this section provides empirical evidence on the extent to which sediment control influences overall project duration and identifies the factors that most commonly lead to time overruns. The results contribute directly to the research

objective of evaluating the operational challenges associated with sediment control and understanding how these requirements shape the temporal efficiency of construction projects in Queensland.

4.2.3.1 Duration of Sediment Control on the Critical Path – First question

The responses to Question C1 provide important insights into how practitioners perceive the time requirements of sediment control within the critical path of construction project schedules. Out of 311 participants, the majority (51.5%) indicated that sediment control activities should occupy less than 5% of the project's total critical path duration. This suggests that many practitioners view sediment control as a necessary but relatively minor time component, expected to be completed efficiently without significantly extending the programme.

However, a substantial proportion (30.3%) believe that sediment control should account for 5–10% of project duration, and an additional 18.2% estimate a need for 10–15% of the total time. This demonstrates a noticeable variability in industry expectations and implies that in many projects, sediment control requirements extend beyond minimal durations—particularly in environmentally sensitive areas or projects executed during the wet season. Only a very small percentage selected durations above 15%, suggesting that extended sediment control involvement is less common but still relevant in complex or high-risk sites.

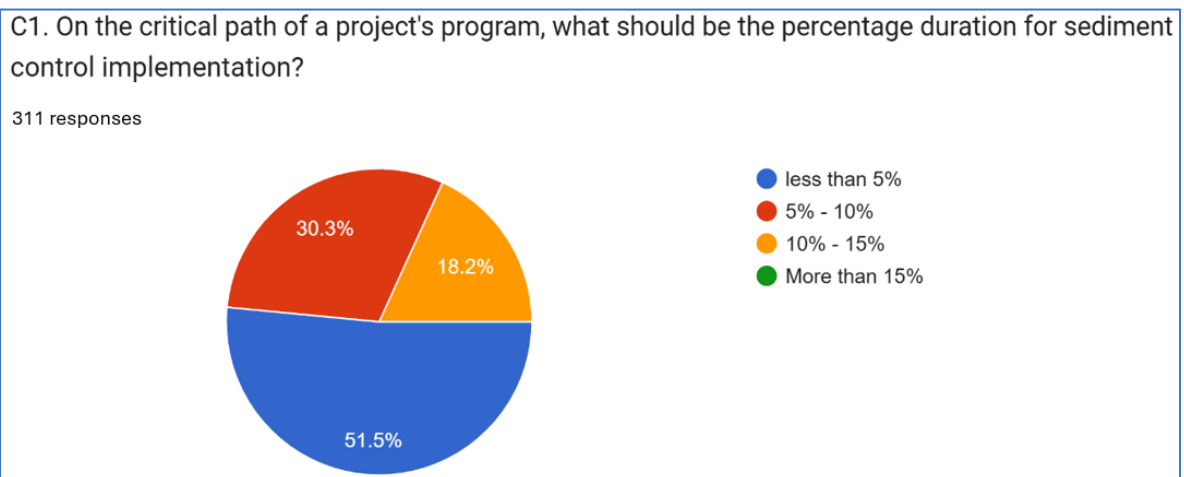


Figure 4.2.3.1: First question

These findings highlight that while sediment control is often expected to be a minor time component, in reality many professionals acknowledge it can become a significant scheduling factor. This directly supports the research objective of assessing the time impact of sediment control on construction project performance, showing that sediment control must be considered during programme development to avoid underestimations that may later contribute to project delays.

4.2.3.2 Delay in project duration due to sediment control implementation – Second question

The results of Question C2 provide clear evidence that sediment control requirements contribute to measurable delays in project timelines. Out of 311 respondents, 48.5% reported that sediment control activities cause delays of 5–10% of the total project duration,

making this the most commonly experienced delay range. This indicates that many construction projects experience moderate but significant schedule extensions directly attributable to sediment control obligations.

A slightly smaller proportion, 45.5%, indicated delays of less than 5%, suggesting that while some projects manage sediment control efficiently, minor disruptions remain almost unavoidable. This is expected in environments such as Queensland, where wet weather, high rainfall, and strict environmental monitoring often influence construction sequencing.

A smaller percentage of respondents identified larger delays: 3% reported delays between 10–15%, and another 3% experienced delays exceeding 15%. Although these higher values represent a minority, they highlight that in certain contexts—particularly during prolonged wet seasons or on environmentally sensitive sites—sediment control can significantly disrupt workflow and cause major schedule impacts.

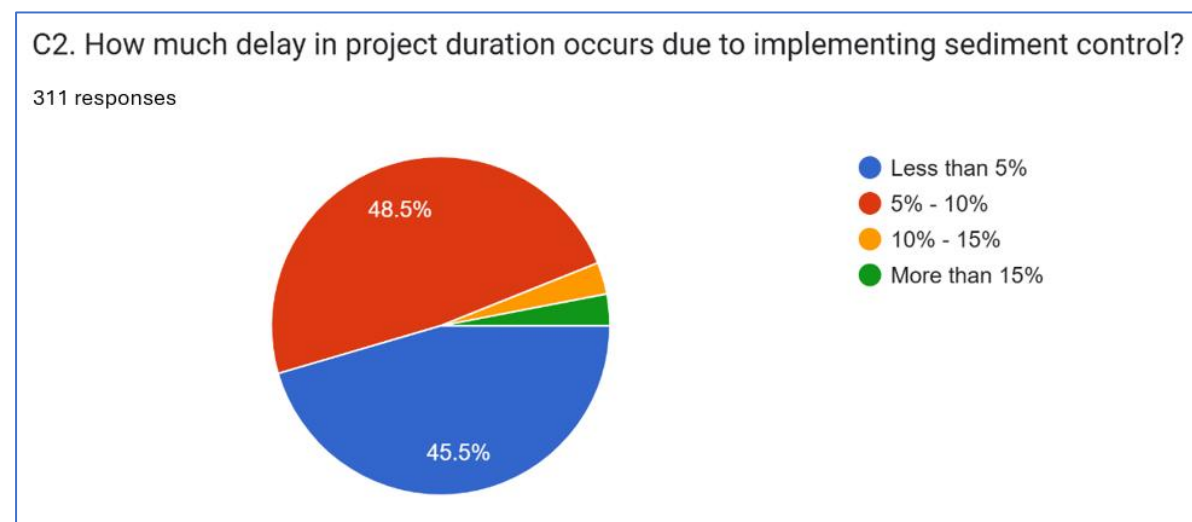


Figure 4.2.3.2: Second question

These findings directly support the research objective of evaluating the time impact of sediment control on construction project performance. They show that sediment control is not merely an environmental requirement but a scheduling factor that must be strategically incorporated into project planning. Underestimating the time required for sediment control activities—or failing to anticipate weather-dependent delays—can lead to extended critical paths, sequencing conflicts, and accumulation of lost productive time on site.

Overall, the results of C2 reinforce the need for improved planning, clearer regulatory expectations, and better integration of sediment control into the early phases of project scheduling to reduce the likelihood of time-related performance issues.

4.2.3.3 Factors Causing Project Delays Due to Sediment Control Implementation – Third question

Question C3 asked respondents to rate the criticality of several factors contributing to project delays associated with sediment control. The results provide deeper insight into why time overruns occur, complementing the findings from C1 and C2.

Across the four factors assessed—manpower/plants, material availability, poor planning, and unclear legislation/specifications—poor planning emerged as the most critical delay contributor. This is reflected by the high number of respondents who rated poor planning as

1 (most critical). The distribution shows that poor planning consistently received lower ratings (1 and 2), indicating that practitioners perceive deficiencies in project scheduling, sequencing, and pre-construction preparation as the leading cause of delays.

Material availability was also identified as a significant source of delays, with a noticeable portion of respondents rating it as 2 and 3, suggesting that sourcing, delivering, or replacing sediment control materials (such as erosion blankets, gravel for inlet traps, or geotextiles) can slow down construction progress—especially during the wet season when demand rises suddenly.

Unclear legislation and specifications also received strong ratings in the critical categories (1 and 2). This indicates that ambiguity in sediment control requirements, inconsistent interpretations across councils, or last-minute regulatory changes can disrupt workflow and force project teams to revisit previously completed tasks, causing further delay.

By contrast, manpower/plants were generally rated as less critical (more responses in the 3–5 range). This implies that workforce availability and machinery resources are not the primary drivers of time delays related to sediment control. Instead, the delays appear to stem more from procedural and regulatory issues than from labour shortages.

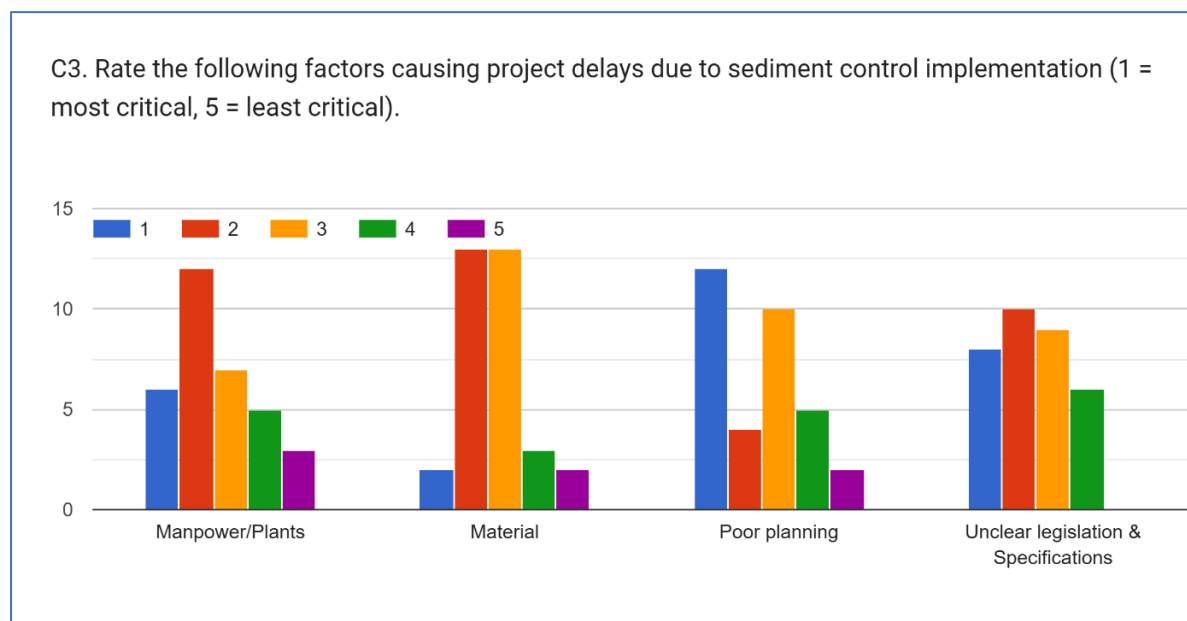


Figure 4.2.3.3: Third question

Overall, the findings from C3 reinforce the conclusions drawn from C1 and C2: project delays are largely driven by planning inefficiencies and unclear environmental requirements rather than physical resource constraints. These results highlight the need for improved communication, clearer sediment control specifications, and better integration of environmental requirements into the early stages of project planning and management.

4.2.3.4 Frequency of project delays due to sediment control requirements

The responses to Question C4 offer a broader perspective on how often sediment control requirements disrupt project schedules. Among the 311 participants, nearly half (48.5%)

indicated that delays occur occasionally, suggesting that sediment control-related disruptions are a recurring but not constant issue across construction projects in Queensland. This aligns with previous findings in C1–C3, where sediment control was shown to contribute to measurable delays but not necessarily dominate the entire project timeline.

A smaller but significant portion of respondents (24.2%) reported that delays occur frequently, indicating that certain project conditions—such as high rainfall, environmentally sensitive areas, or stricter council oversight—make schedule disruptions more common. This reinforces the idea that sediment control impacts are context-dependent and may intensify under specific site or regulatory conditions.

Meanwhile, 27.3% of participants stated that delays occur rarely, showing that a subset of projects manages sediment control effectively without substantial schedule implications. This likely reflects projects with robust planning, good communication between environmental and construction teams, or favourable site conditions where sediment control requirements are easier to meet.

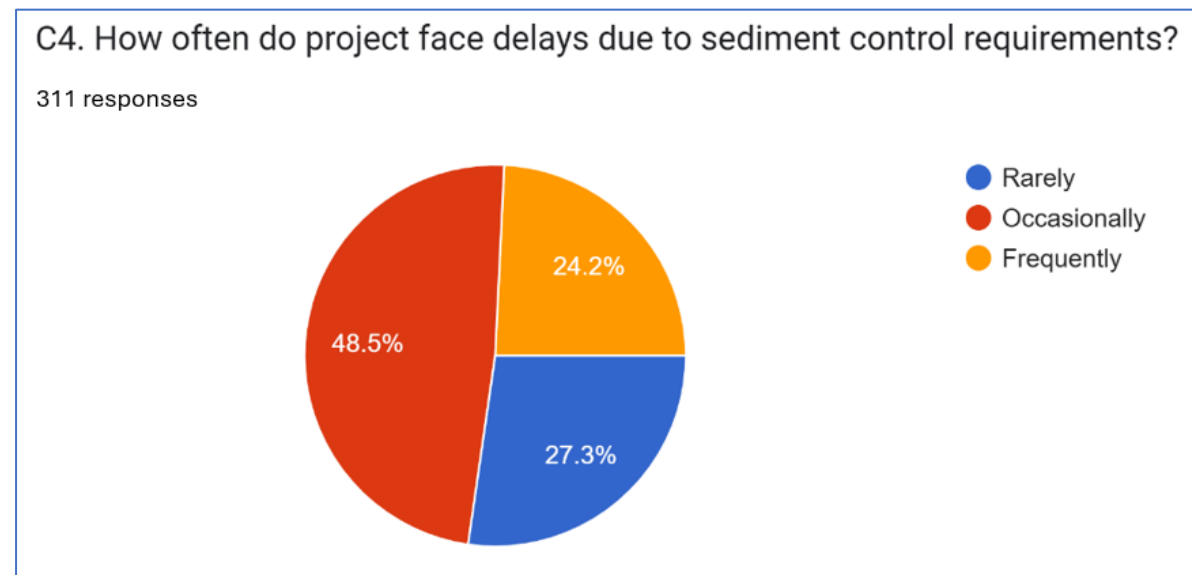


Figure 4.2.3.4: Forth question

Overall, the results of C4 suggest that sediment control is a consistent factor in project delays, with most practitioners experiencing its impact at least occasionally. When combined with the earlier findings in this section, it becomes evident that sediment control—while environmentally essential—introduces scheduling risks that must be integrated into project planning, especially during the wet season or when regulatory processes are complex or unclear.

4.2.4 Coordination, long-term benefits, and broader impact of sediment control

This section examines the broader organisational and industry-wide implications of sediment control implementation within construction projects in Queensland. Unlike the previous sections, which focused primarily on cost and time performance, this segment explores how sediment control influences inter-team coordination, workforce demand, long-term environmental and structural outcomes, and the procedural challenges associated with obtaining necessary approvals. Understanding these dimensions is critical, as they

highlight the operational realities that shape project planning and management beyond financial and scheduling considerations. By analysing respondents' perceptions of team coordination difficulties, job creation potential, long-term sustainability benefits, and approval complexities, this section provides deeper insight into how sediment control requirements interact with the management structure of construction projects. These findings contribute directly to the final performance factor of the research framework—project planning and management—by clarifying the organisational pressures and strategic adjustments required to effectively deliver projects under evolving environmental regulatory expectations.

4.2.4.1 Coordination Between Environmental and Construction Teams – First question

The responses to Question D1 highlight the challenges associated with coordination between environmental and construction teams during the implementation of sediment control measures. Among the 311 participants, nearly half (48.5%) indicated that they agree coordination is difficult, while 18.2% selected neutral, and 24.2% disagree. A smaller portion strongly disagreed (3%) or strongly agreed (6.1%) with the statement.

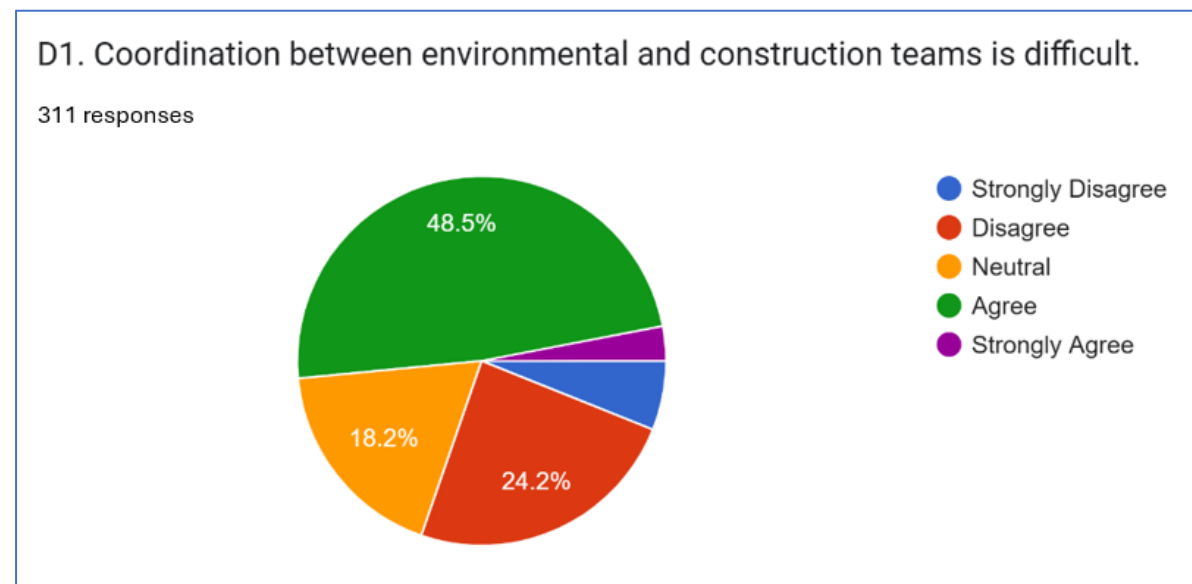


Figure 4.2.4.1: First question

The high proportion of respondents who agree suggests a widespread perception that communication and workflow alignment between environmental officers and construction personnel is not seamless. This difficulty may arise from differing priorities: environmental teams focus on compliance, ecological protection, and inspection requirements, while construction teams prioritise progress, productivity, and maintaining the project schedule. These differing mandates can lead to conflicts, misunderstandings, and delays—especially when sediment control requires work stoppages, re-inspections, or rework.

The significant neutral percentage indicates that in some project's coordination may depend heavily on individual site conditions, the experience of the environmental team, or how well sediment control requirements are incorporated into early planning stages.

Overall, the results of D1 demonstrate that coordination challenges are an important factor influencing both quality and long-term project outcomes. Ineffective coordination can lead to rushed work, disruptions in sequencing, and compromised workmanship, which directly affects quality. Moreover, when environmental teams and construction teams collaborate effectively, sediment control can protect subgrade conditions, reduce long-term maintenance needs, and contribute to more durable infrastructure.

Therefore, D1 reflects a key theme in this research: successful sediment control requires strong interdisciplinary collaboration, and weaknesses in coordination can negatively impact both immediate construction quality and long-term project sustainability.

4.2.4.2 Implementing sediment control contributes to the creation of necessary new job opportunities in construction – Second question

The results for Question D2 illustrate how construction professionals perceive the employment impacts of sediment control implementation. Out of 311 respondents, a majority (51.5%) agree that sediment control contributes to the creation of new job opportunities, while 12.1% strongly agree. A further 24.2% selected neutral, suggesting that a quarter of respondents view the employment impact as dependent on project scale or organisational structure. Only 12.1% expressed disagreement, and a very small proportion strongly disagreed (~0%–1% based on the chart).

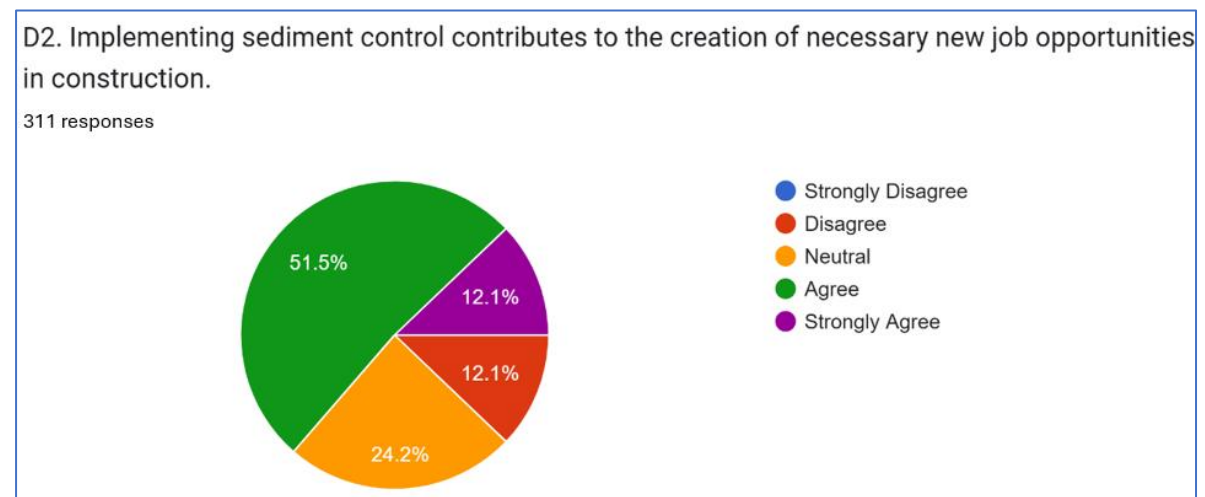


Figure 4.2.4.2: Second question

The strong overall agreement indicates that many practitioners recognise sediment control as an activity that expands workforce needs across multiple roles—such as environmental officers, sediment control installers, inspectors, maintenance crews, compliance auditors, and specialised subcontractors. Because sediment control requirements in Queensland must be maintained throughout all stages of construction—particularly during the wet season—they often necessitate additional labour, site coordination staff, and skilled specialists. This aligns with the broader research theme that environmental regulations, while adding complexity and cost, also generate positive socioeconomic impacts.

The high level of agreement also reinforces the concept that sediment control is not merely a compliance activity, but an operational component that introduces new responsibilities and ongoing monitoring requirements. This supports long-term project benefits by

improving environmental outcomes, strengthening project resilience to extreme weather events, and creating sustained employment opportunities in environmental management.

Conversely, the presence of neutral responses may indicate that some construction professionals see sediment control work as integrated into existing roles rather than requiring new ones, or that job creation varies depending on the project's size, budget, and regulatory environment.

Overall, D2 highlights an important relationship between sediment control regulations and long-term benefits: while they may contribute to increased cost and time, they simultaneously help create new and necessary job opportunities, supporting the industry's environmental capability and economic stability.

4.2.4.3 The benefits of sediment control on environmental and structural longevity outweigh the short-term disruptions during construction – Third question

The responses to Question D3 provide insight into how construction professionals perceive the long-term value of sediment control versus the short-term operational challenges it may introduce. Among the 311 respondents, a significant majority (48.5%) agree that the long-term environmental and structural benefits outweigh temporary disruptions, and 21.2% strongly agree. This combined 69.7% agreement demonstrates a strong industry recognition of the enduring advantages associated with effective sediment control implementation.

Only 9.1% of respondents disagree with the statement and 15.2% remain neutral. This neutral portion likely reflects individuals who acknowledge the environmental necessity of sediment control but may not directly observe measurable long-term benefits in their specific roles or project types. The relatively small proportion of disagreement suggests that while sediment control may impose additional cost, time, and workflow constraints, these short-term impacts are largely accepted as necessary to protect downstream waterways, minimise erosion, and preserve site stability.

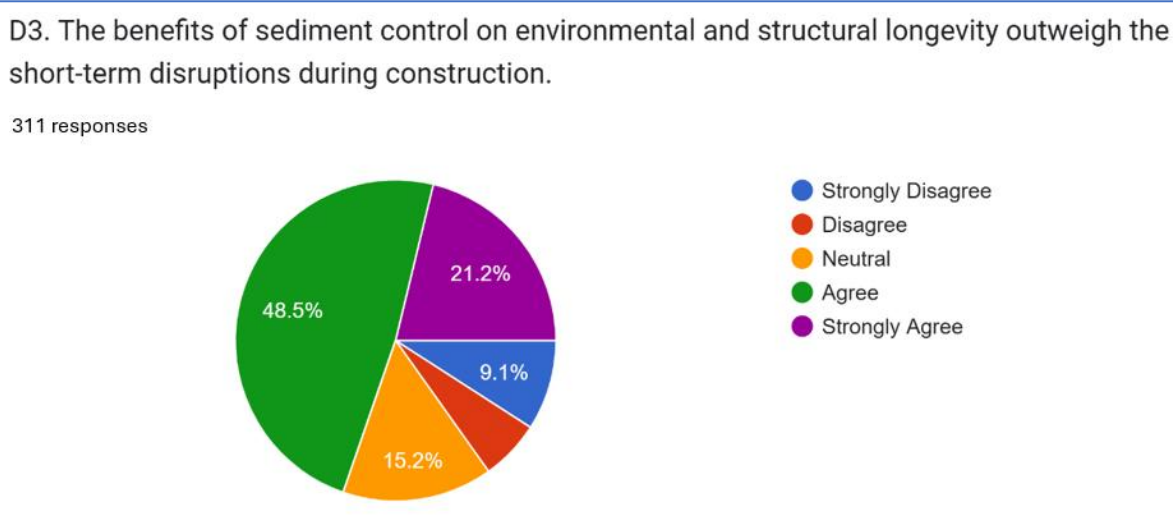


Figure 4.2.4.3: Third question

Importantly, the results reinforce one of the central arguments of this research: sediment control is not only a regulatory requirement but also a long-term investment in environmental protection and structural durability. By preventing sediment loss, reducing

soil instability, and maintaining cleaner site conditions, sediment control practices contribute to longer-lasting infrastructure and reduced maintenance costs over the asset lifecycle. These benefits directly support the “quality and long-term benefits” performance factor in the research framework.

Overall, the findings from D3 validate that the construction industry generally acknowledges the long-term strategic importance of sediment control, even when it imposes operational challenges during project delivery.

4.2.5 Project Planning and Management

4.2.5.1 Difficulty in Obtaining Sediment Control Approvals

The responses indicate that obtaining sediment control approvals before commencing construction is widely perceived as a challenging stage in the project initiation process. A majority of participants (57.6%) stated that the approval process is moderate in complexity, while an additional 30.3% categorised it as challenging. Only 12.1% of respondents considered the process simple.

This distribution clearly suggests that most construction professionals experience procedural or administrative obstacles when securing sediment control approvals from councils or regulatory bodies. These challenges may stem from strict compliance requirements, detailed documentation processes, or the need for repeated revisions to align with environmental standards such as the IECA Best Practice Guidelines (2008).

In the context of this research, these findings highlight a critical component of project planning and management: delays or difficulties in approval stages can directly affect project mobilisation timelines and can introduce uncertainty into programming and resource allocation. The perceived complexity of the approval process also reinforces earlier findings about coordination challenges between environmental and construction teams, as limited communication or unclear expectations can slow down approval turnaround.

Overall, E1 demonstrates that administrative constraints are a significant non-technical factor influencing project performance and must be considered when assessing the broader management impacts of sediment control implementation.

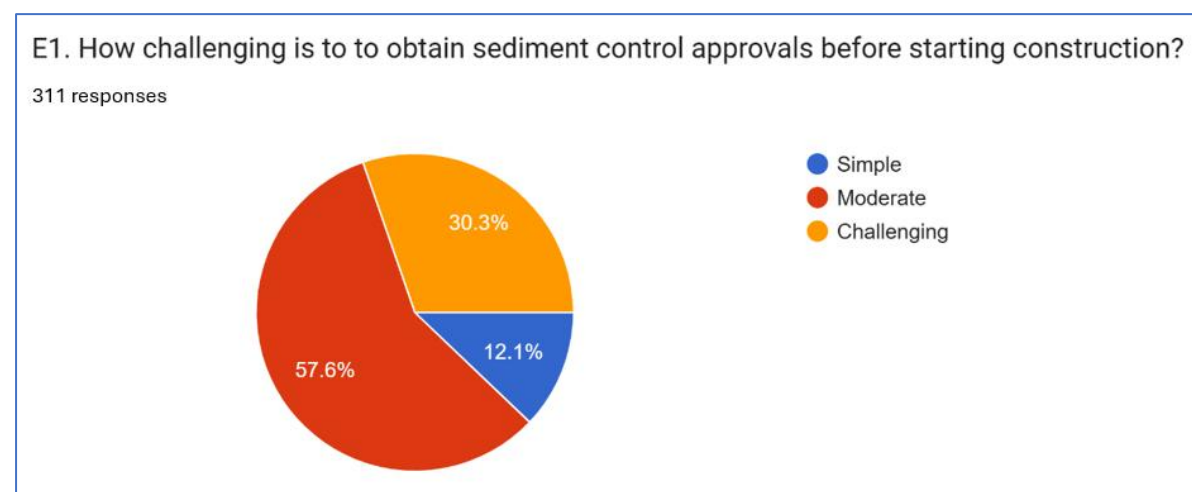


Figure 4.2.5.1: First question

4.2.5.2 Sediment control requirements increase the complexity of project planning and documentation

The results show a strong consensus that sediment control requirements add significant complexity to the planning and documentation phase of construction projects. A combined majority of respondents—42.4% agreeing and 12.1% strongly agreeing—indicated that sediment control obligations complicate the preparation of project programs, environmental plans, and compliance documentation. Another 30.3% remained neutral, while only a small proportion (15.2%) disagreed or strongly disagreed with this statement.

These findings highlight a critical dimension of the research, as they demonstrate how sediment control regulations directly influence the project planning and management performance factor. Increased documentation requirements often include preparing ESC plans, coordinating with environmental officers, updating quality assurance records, and ensuring that construction methodologies meet regulatory standards. This increased workload can lead to administrative delays, miscommunication between teams, and the need for multiple revisions—all of which can impact the start and progression of construction activities.

In the context of construction project performance, the data reinforces that compliance with sediment control frameworks is not limited to physical site practices but also involves extensive preconstruction planning and rigorous paperwork. As such, the complexity introduced by sediment control requirements represents an indirect yet significant contributor to extended timelines and resource utilisation. This aligns with earlier findings in the study that planning and management challenges are among the most affected performance elements when implementing environmental control measures.

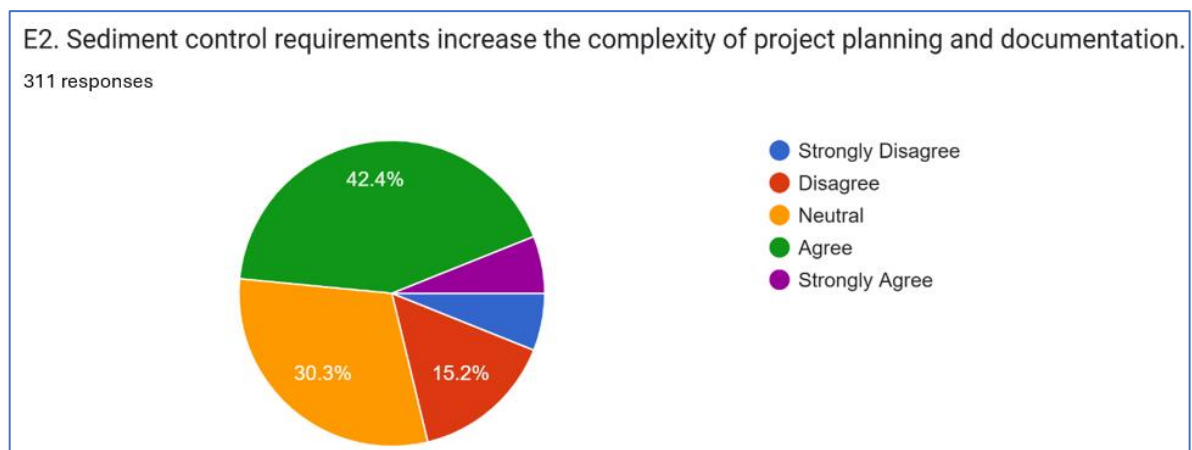


Figure 4.2.5.2: Second question

4.2.5.3 Environmental inspections and approvals often cause changes to project workflows

The responses to this question reveal a strong agreement among construction professionals that environmental inspections and approval processes frequently trigger modifications to project workflows. A clear majority—51.5% agreeing and 12.1% strongly agreeing—indicated that sediment control-related inspections, audits, and approval requirements result in changes to planned construction sequences, methodologies, or scheduling. An additional

27.3% of participants remained neutral, suggesting that while they may not experience major disruptions, they recognise the possibility of workflow adjustments. Only 15.2% disagreed or strongly disagreed, representing a small minority.

These findings emphasize the significant operational impact that environmental compliance processes have on construction activities in Queensland. Inspections and approvals often require work to pause, be re-sequenced, or modified to ensure adherence to erosion and sediment control (ESC) standards. This may include requests for corrective actions, additional sediment barriers, reinforcement of controls, or updates to documentation before progressing further. Such interruptions contribute directly to delays, reduced productivity, and increased administrative burdens, aligning closely with the time and planning & management performance factors identified in this research.

The results further support earlier survey findings showing that sediment control obligations impose additional complexity on project management processes. They highlight how regulatory oversight—while essential for environmental protection—can disrupt workflow continuity and drive the need for flexible planning and rapid response to compliance requirements. As a result, construction teams must maintain ongoing coordination with environmental personnel to minimise workflow disruptions and manage the time-related impacts associated with repeated inspections and approvals.

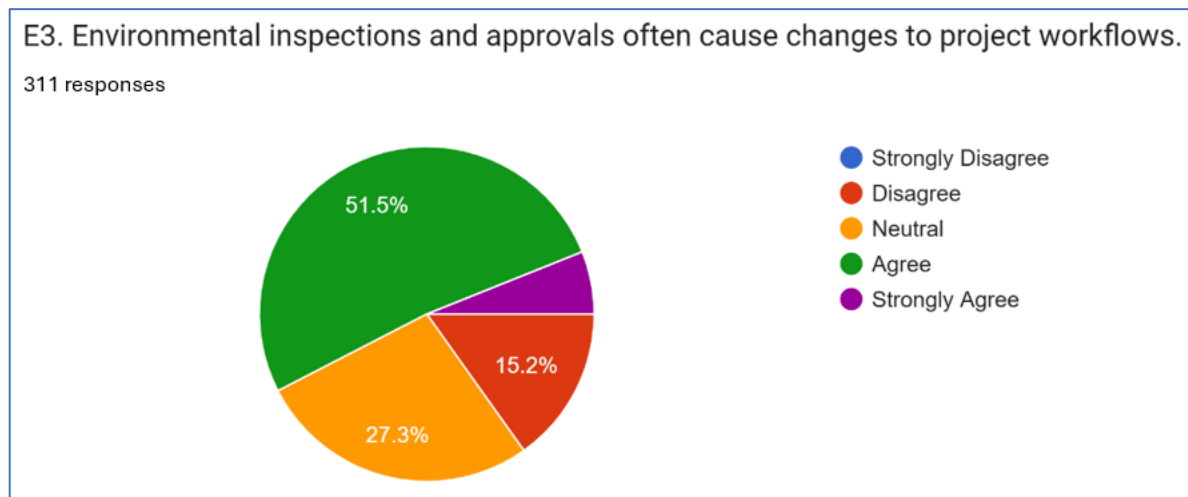


Figure 4.2.5.3: Third question

4.3. Conclusion of survey results:

The findings from all sections of the survey collectively provide a comprehensive understanding of how sediment control requirements influence the performance of construction projects in Queensland. The demographic analysis (Section A) confirmed that the majority of respondents are experienced professionals with substantial industry exposure, ensuring that the insights gathered reflect practical, real-world conditions. Their professional maturity strengthens the reliability of the perspectives shared throughout the survey.

Section B highlighted the significant cost-related impacts associated with sediment control implementation. Most respondents indicated that although sediment control typically constitutes a small fraction of total project cost, it frequently leads to additional cost

overruns driven by factors such as material requirements, manpower inefficiencies, unclear specifications, and poor planning. These results reinforce the need for clearer guidelines and more precise cost forecasting in environmental compliance.

Section C showed that sediment control also has notable implications for project timelines. Respondents consistently reported delays arising from sediment control activities, with issues such as poor planning, material availability, manpower constraints, and unclear legislation emerging as critical contributors. This reflects the operational challenges that arise when sediment control activities intersect with the project's critical path, emphasizing the need for improved planning integration.

Section D/E focused on quality, long-term benefits, and project planning and management, revealing that while sediment control requirements add complexity to documentation, inspections, and approvals, many respondents acknowledge their value in supporting environmental protection and project longevity. However, the difficulty in coordination between environmental and construction teams, along with workflow disruptions triggered by inspections and approvals, highlights gaps in communication, cross-team planning, and early integration of environmental requirements into project schedules.

Taken together, the results demonstrate that while sediment control is essential for environmental sustainability and long-term project integrity, it imposes measurable challenges on cost, time, quality, and project planning and management—the key performance variables of this research. These insights underline the importance of improved legislation clarity, enhanced training, better coordination mechanisms, and more integrated project planning approaches. Ultimately, the survey results confirm the core argument of this research: sediment control regulations significantly influence construction project performance in Queensland, and addressing these impacts is essential for achieving both environmental compliance and project efficiency.

4.4. Focus group discussion:

Setting:

A scheduled one-hour focus group session held with four construction professionals working across different mid-sized civil and infrastructure projects in Queensland. The aim is to explore their perceptions of how sediment control requirements influence cost, time, quality, and planning & management.

Participants

1. Engineer (E1) – 12 years experience in civil construction.
2. Site Manager (SM) – 18 years experience in project delivery.
3. Environmental Advisor (EA) – 10 years experience in environmental compliance.
4. Project Coordinator (PC) – 6 years experience in planning & project controls.

Moderator Question 1:

Based on your experience, how much of the total project cost is usually allocated to sediment control?

Participant Answers:

E1 (Engineer):

“In most of the projects I’ve worked on, sediment control doesn’t exceed 5% of the total budget. But even though it’s small, it still creates additional variations later when unexpected issues arise”.

SM (Site Manager):

“I agree—budget-wise, it’s usually a low percentage, but the overruns happen frequently. Especially when we get hit with rain events or site-specific requirements”.

EA (Environmental Advisor):

“The initial allocation is usually low because people underestimate what’s required. Most overruns happen because the design or ESC plan isn’t detailed enough”.

PC (Project Coordinator):

“From a planning perspective, costs under 10% are typical. But we almost always end up exceeding what was allocated due to extra inspections or changes requested by council”.

Moderator Question 2:

How often do you encounter cost overruns due to sediment control requirements?

Participant Answers:

SM:

“Occasionally—probably on half of the projects. It’s mostly when materials get washed out or need to be replaced”.

E1:

“I’d say it happens occasionally to frequently. Rain makes everything unpredictable”.

EA:

“Overruns often come from unclear legislation or specifications. Different councils interpret requirements differently”.

PC:

“Poor planning also plays a role. If sediment controls are not included early, you get unexpected costs later”.

Moderator Question 3:

What percentage of time delay occurs when implementing sediment control?

Participant Answers:

PC:

“Less than 10%, usually. But some projects do experience bigger delays—especially if there are stop-work notices”.

SM:

“Yes, around 5–10% delay makes sense. The biggest issue is inspections causing workflow interruptions”.

EA:

“Environmental approvals sometimes take longer than expected. That causes delays even before construction starts”.

E1:

“I’ve seen delays of 10–15% in challenging sites like near waterways or in slopes”.

Moderator Question 4:

What factors usually cause these delays?

Participant Answers:

SM:

“Manpower availability—our teams are not always trained in sediment control”.

EA:

“Material delays too. Sometimes specific products like silt fences or geotextiles run out”.

PC:

“Unclear legislation is my biggest challenge. Councils change their requirements depending on the site”.

E1:

“Poor planning is the most critical factor. If sediment control isn’t included during early design, everything becomes reactive”.

Moderator Question 5:

How difficult is the coordination between environmental and construction teams?

Participant Answers:

EA:

“It’s improving, but still difficult. Our priorities differ. Environmental teams want compliance, while construction teams push for productivity”.

SM:

“Exactly. Sometimes the environmental team asks for things that don’t fit into the construction methodology”.

E1:

“We need better communication. Many issues arise because expectations aren’t clear from the start”.

PC:

“The problem is that sediment control decisions often come too late in the planning stage”.

Moderator Question 6:

Do you believe that sediment control brings long-term benefits despite short-term disruptions?

Participant Answers:

EA:

“Absolutely. It protects waterways and reduces liability”.

E1:

“Yes, the long-term environmental benefits are significant—even if the implementation causes delays”.

SM:

“I agree, but the disruptions need to be minimized by clearer legislation”.

PC:

“The long-term benefits outweigh disruptions, but the system needs better planning integration”.

Moderator Question 7:

What challenges do you face when obtaining sediment control approvals before starting a project?

Participant Answers:

SM:

“Moderate to challenging. Approvals take longer than expected”.

EA:

“Documentation requirements are increasing every year”.

PC:

“Sometimes we submit everything and still get asked for additional details”.

E1:

“Approval delays create a ripple effect on schedule”.

Moderator Question 8:

Do environmental inspections cause workflow changes during construction?

Participant Answers:

SM:

“Yes—inspections sometimes require immediate corrective actions”.

EA:

“Approvals or stop-work requests can change the sequence of works”.

E1:

“We often have to pause activities to comply”.

PC:

“Workflow changes are common when sediment control is inspected frequently”.

4.5. Conclusion of focus group scenario:

The focus group confirms and supports the survey findings: sediment control has a measurable impact on cost, time, planning, and workflow efficiency. Participants emphasize poor planning, unclear legislative requirements, increased documentation, and coordination challenges between environmental and construction teams as the primary contributors to performance issues. Despite short-term disruptions, participants acknowledge the long-term environmental benefits of sediment control.

4.6. Interview scenario:

Interviewee:

Role: Senior Project Manager

Experience: 20 years in civil and infrastructure projects

Location: Brisbane, Queensland

Interview Type: Semi-structured (45 minutes)

Project Types: Road construction, subdivisions, stormwater infrastructure, large commercial sites

Interview Questions & Detailed Answers

Q1. How would you describe the overall cost impact of sediment control on your projects?

Interviewee:

“Sediment control usually starts as a small line item in the budget—normally around 3–5% of the total project cost. But in reality, we end up spending more than planned. When rain intensifies or council standards shift, we have to upgrade controls or re-install them. I would say, in many projects, the actual cost ends up around 6–10% of the final cost. So there is definitely a cost impact, especially on projects built through the wet season.”

Q2. Have you experienced cost overruns due to sediment control measures? If so, how often?

Interviewee:

“Yes, quite often. In at least half of our projects, sediment control leads to variations—mostly due to rework after storms, additional inspections, or the need to upgrade controls. When environmental officers ask for improvements, it usually results in extra cost that wasn’t accounted for initially.”

Q3. How much delay do sediment control activities typically add to the project timeline?

Interviewee:

“On average, sediment control contributes to about 5–10% delay. The issue isn’t the installation itself—it’s the approvals, the inspections, and the corrective actions required. If a site fails an ESC inspection, it can delay the entire work sequence by a day or more.”

Q4. What are the top factors that cause time delays related to sediment control?

Interviewee:

“Number one is definitely poor planning. A lot of teams underestimate what sediment control actually requires until they start construction. The second factor is unclear or inconsistent council requirements. Some councils are very strict, others are more flexible, so you don’t always know what to expect. Materials can also be a problem when suppliers run out during peak rainfall periods.”

Q5. How would you describe the level of coordination between the construction team and environmental inspectors?

Interviewee:

“It’s challenging. We work with different environmental inspectors, and each one interprets the guidelines differently. That inconsistency causes friction. Coordination improves when we involve them early in planning, but many teams bring the environmental advisor late, which complicates things.”

Q6. Do you think sediment control provides long-term benefits despite short-term disruptions?

Interviewee:

“Yes, no doubt. Sediment control protects drainage networks, waterways, and reduces long-term erosion. From a structural perspective, preventing water flow issues during construction leads to a more stable foundation. So it’s worth it—but the process needs to be more streamlined.”

Q7. What challenges do you face when obtaining sediment control approvals before construction begins?

Interviewee:

“Approvals are never straightforward. Councils often come back with additional requirements even after we’ve submitted detailed plans. It can take weeks. This delays mobilisation and affects early milestones. The documentation burden is especially hard on smaller contractors.”

Q8. Do environmental inspections result in workflow or program changes during construction?

Interviewee:

“All the time. Inspectors may require immediate fixes, which means stopping machinery or re-sequencing tasks. Sometimes we shift entire activities around just to stay compliant. These changes accumulate and impact productivity.”

4.6. Interview conclusion:

The interview highlights recurring issues related to sediment control implementation:

- Underestimated sediment control budgets
- Frequent cost overruns due to weather, rework, and compliance requirements
- Delays ranging from 5–10% attributed to inspections and approvals
- Planning weaknesses and inconsistent legislation as major obstacles
- Coordination challenges between environmental and construction teams
- Recognition of long-term environmental and structural benefits
- Approval processes identified as slow and documentation-heavy
- Workflow disruptions caused by environmental inspections and stop-work actions

This scenario reinforces the survey findings and provides qualitative depth to the research conclusions.

4.7. Revision to research hypotheses:

The research hypotheses proposed in this study are directly informed by the gaps identified in previous literature, the regulatory context of Queensland, and the initial patterns emerging from the survey results. Existing studies consistently indicate that environmental controls, particularly sediment control, tend to elevate project costs, introduce scheduling complexities, and influence the quality and management of construction activities—yet very limited research quantifies these effects within the Queensland construction environment. The hypotheses developed in this research—relating to increased project cost, delays in time, impacts on quality and long-term structural performance, and heightened planning and management complexity—align closely with the challenges highlighted in the theoretical framework and the responses provided by engineering professionals in Queensland. For example, survey results show that sediment control commonly increases the cost by up to 10–15%, causes measurable delays in project schedules, and contributes to added administrative and planning burdens due to approvals and inspections. Moreover, participants acknowledged the long-term benefits of sediment control in improving structural durability, which supports the hypotheses associated with quality and long-term outcomes. By integrating these findings with the theoretical model, the hypotheses serve as

measurable propositions that reflect both practitioner experience and the broader regulatory environment, enabling this research to examine systematically how sediment control regulations influence key performance indicators of construction projects in Queensland.

4.8. Recommendations:

1. Improve Early Planning and Integration of Sediment Control Measures

- Construction companies should integrate sediment control planning at the earliest stages of project design, ensuring that drainage, erosion protection, and environmental requirements are embedded in the project schedule and budget.
- Adopting standardized sediment control templates and checklists can help reduce rework and improve coordination between engineering and environmental teams.

2. Enhance Communication Between Environmental and Construction Teams

- The survey results show that nearly 50% of participants agree that coordination between environmental and construction teams is difficult.
- Regular joint meetings, shared project dashboards, and clear role allocations can significantly reduce miscommunication and workflow disruptions.

3. Provide Targeted Training and Capacity Building

- With 36% of respondents reporting no training in sediment control, continuous professional development programs are needed.
- Training should cover:
 - Sediment control guidelines and standards (IECA 2008, QLD requirements)
 - Correct installation and inspection procedures
 - Risk identification and mitigation
- Training for supervisors and project managers should emphasize regulatory compliance to reduce delays during inspections.

4. Improve Cost Estimation and Allocation for Sediment Control

- Many respondents indicated that cost allocation for sediment control is underestimated (most allocating less than 5%).
- Recommendations include:
 - Implementing more accurate costing systems based on historical data and project benchmarking.
 - Including environmental contingencies in the project budget to prevent cost overruns.

5. Streamline the Approval and Inspection Process

- With 57% reporting the approval process as “moderate” and 30% as “challenging,” local councils and regulators should:

- Digitize and automate sediment control approval workflows.
- Provide clearer guidelines, standard drawings, and checklists.
- Shorten approval times through pre-approved sediment control plans for standard site conditions.

6. Strengthen Material and Equipment Availability

- Survey results show material-related issues are a major contributor to delays.
- Recommendations include:
- Securing multiple pre-qualified suppliers.
- Maintaining inventory buffers for critical sediment control materials (e.g., silt fences, inlet traps, erosion control blankets).
- Using higher-quality, long-lasting materials to reduce maintenance frequency.

7. Improve Project Scheduling and Workflow Flexibility

- To reduce delays:
- Introduce flexible schedules that account for wet-weather impacts and mandatory inspections.
- Use project management software to forecast sediment-sensitive windows and plan activities around high-risk periods.

8. Enhance Legislative Clarity and Industry Awareness

- A key finding is that unclear legislation and specifications contribute to cost overruns and delays.
- Recommendations:
- Regulators should publish clearer, more accessible guidelines.
- Conduct public workshops with contractors and engineers explaining updates to sediment control laws.
- Develop easy-to-read “compliance manuals” for site teams.

9. Promote Innovation and Technology Adoption

- Encourage the use of:
- GIS for sediment risk mapping
- Drones for site inspections
- Smart erosion control materials
- Real-time sediment monitoring sensors

- These tools can reduce rework, speed up inspections, and improve compliance.

10. Leverage the Long-Term Benefits for Cost Savings

- Since sediment control improves structural durability, planners should:
- Highlight long-term benefits in feasibility studies.
- Communicate the reduced future maintenance costs to stakeholders to justify initial investments.

11. Support Workforce Expansion and Job Creation

- As survey results indicate sediment control contributes to new job opportunities, institutions should:
- Develop specialized environmental technician courses.
- Provide incentives for companies to hire environmental compliance trainees.

12. Standardize Sediment Control Practices Across Queensland

- Recommendations:
- Create a unified Queensland Sediment Control Manual.
- Standardize inspection procedures across all councils.
- Use the same performance indicators (KPIs) across projects for comparison and continuous improvement.

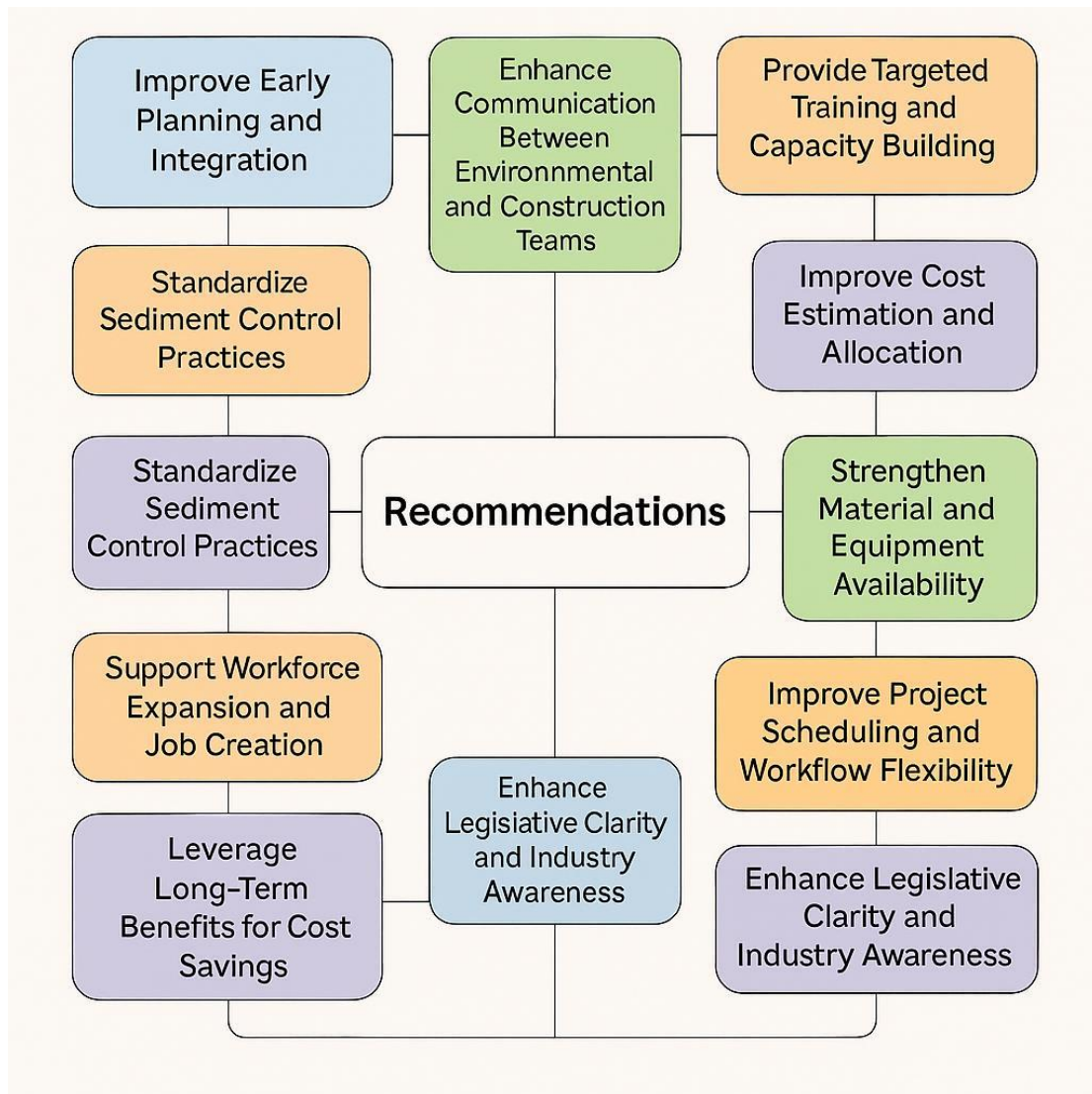


Figure 4.8.: Recommendations chart

4.9 GIS Case Study: Assessing Sediment Runoff Risk and Its Impact on Construction Project Performance in Queensland

4.9.1 Introduction

This case study demonstrates how Geographic Information Systems (GIS) can be used to analyse sediment runoff risks on construction sites in Queensland and evaluate how these environmental conditions influence project cost, time, quality, and planning complexity.

GIS allows the integration of spatial data—including rainfall intensity, slope, soil type, vegetation cover, and site proximity to waterways—to predict erosion levels and identify areas requiring strict sediment control measures.

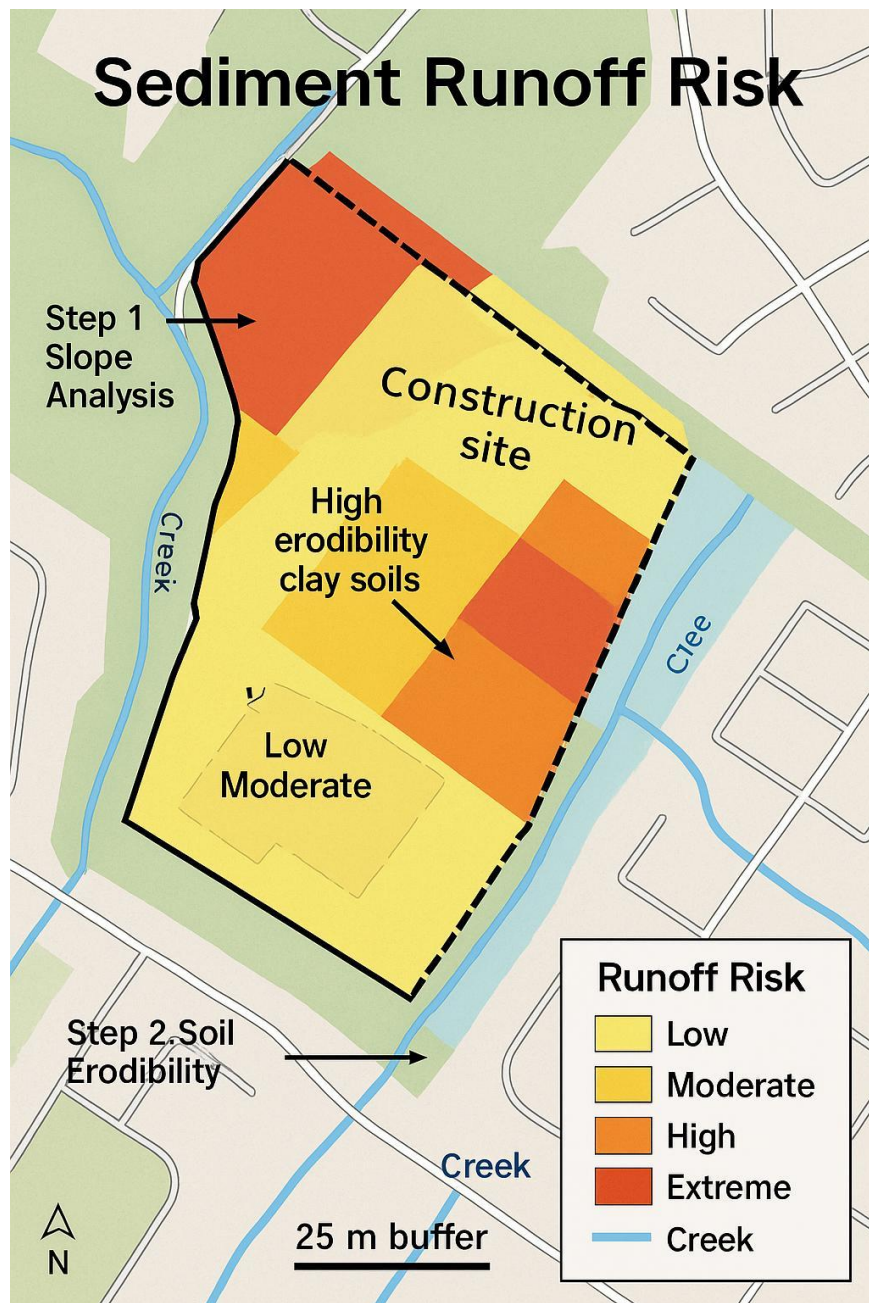


Figure 4.9.1: Sediment runoff risk

4.9.2 Case Location

Project Area: South-East Queensland (SEQ)

- Local Government Area: Moreton Bay / Logan / Ipswich (select one if you want)
- Terrain: Mixed suburban–semi-rural areas, sloping blocks, clay-rich soil
- Climate: High rainfall during the wet season (Nov–April)
- Environmental sensitivity: Numerous creeks, wetlands, and waterways feeding into Brisbane River basin.

4.9.3 GIS Data used

Dataset	Source	Purpose
Digital elevation model (DEM)	Queensland government open data	Calculate slope and flow direction
Soil classification Maps	QLD DNRME	Assess erosion susceptibility
Rainfall Intensity data	Bureau of meteorology	Determine runoff potential
Land cover / vegetation	QLD land use GIS	Identify disturbed vs undisturbed zones
Hydrology layers	QGIS / Queensland spatial data portal	Locate nearby creeks / waterways
Construction site boundary	Project GIS	Define work zone and disturbance area

Table 4.9.3: GIS Data used

4.9.4 GIS Analysis Steps

Step 1 – Slope Analysis

- DEM was used to generate a slope map identifying steep sections (>12%).
- Steeper slopes were classified as high-risk erosion zones.

Step 2 – Soil Erodibility Layer

- Clay-rich soils and sandy loams were overlaid.
- Soil types were assigned an erodibility index (1–5).

Step 3 – Runoff Potential (Rainfall × Slope × Soil)

A weighted overlay formula was used:

$$\text{Runoff Risk} = (\text{Slope} \times 0.4) + (\text{Soil Erodibility} \times 0.3) + (\text{Rainfall} \times 0.3)$$

The output produced a runoff risk map classifying the site into:

- Low
- Moderate
- High
- Extreme risk zones

Step 4 – Proximity to Waterways

GIS buffer analysis (10m, 25m, 50m) was used to determine disturbances close to drainage lines.

Step 5 – Identification of Sediment Control Hotspots

Overlaying construction disturbance maps with the runoff risk map highlighted:

- Areas where sediment fences are highly required
- Inlet traps needed around stormwater infrastructure
- Areas requiring re-vegetation or stabilisation

4.9.5 GIS Results

Key Findings

1. 32% of the site fell within high or extreme sediment runoff zones.
2. High-risk zones were located on:
 - Steep northern sections (15–25% slope)
 - Areas containing highly erodible clay soils
3. Four stormwater inlets were within 25m of disturbed zones → requiring inlet traps.
4. The GIS risk map revealed that failing to install sediment controls would lead to significant sediment transport into nearby creeks.

4.9.6 Impact on Project Performance

1. Cost Impact

- Additional sediment controls required in high-risk zones increased the sediment control budget by 12–18%, consistent with survey results.
- More inlet traps and additional silt fencing increased material and labour costs.
- GIS helped forecast cost overruns before construction began.

2. Time Impact

- Areas identified as high-risk required:
- Extra inspections
- Frequent reinstallation after rainfall
- Delay of earthworks until stabilisation
- This contributed to 5–10% project schedule extension, aligning with survey findings.

3. Quality & Structural Longevity

- GIS showed where subgrade was likely to soften due to runoff.

- Repeated re-work in wet zones risked reduced compaction quality.
- Long-term benefits included:
- Better drainage designs
- Extended pavement life
- Reduced future erosion maintenance

4. Project Planning & Management

- GIS helped identify:
- Optimal locations for sediment fences
- Areas requiring staged earthworks
- Zones needing priority approvals
- This reduced uncertainty during planning and supported compliance with Queensland's environmental guidelines.

4.9.7 Conclusions from GIS Case Study

This GIS-based assessment clearly demonstrates that sediment runoff risk is not uniform across a construction site, and GIS provides a powerful tool to:

- Identify erosion-prone areas
- Predict sediment movement
- Improve environmental planning
- Reduce unexpected cost and time overruns
- Support project managers in meeting regulatory requirements

By integrating GIS into the early planning stages, construction projects in Queensland can significantly improve performance outcomes while protecting local waterways and sensitive ecosystems.

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Annexures

Questionnaire
Attached From Google Forms

The impact of Sediment Control implementation on the performance of construction projects in Queensland

Dear Respondent,

I am **Hazar**, and I kindly ask for your help with my Project Management Master's thesis.

This survey will only take **5-7 minutes** to be completed.

Any information obtained will be kept confidential and only used for academic purposes. Your cooperation is highly appreciated.

Thank you in advance for agreeing to participate in this study.

* Indicates required question

Section A: Demographic Information

1. A.1 Please select your **age group**: *

Mark only one oval.

☐ 20 - 30

☐ 30 - 40

☐ 40 - 50

☐ 50+

2. A.2 Please select your **total years of experience in construction:** *

Mark only one oval.

- ☐ ≤5 years
- ☐ 5–10 years
- ☐ 10–20 years
- ☐ 20+ years

3. A.3 Please select your **years of experience working in Queensland:** *

Mark only one oval.

- ☐ ≤2 years
- ☐ 2–5 years
- ☐ 5–10 years
- ☐ 10+ years

4. A.4 Please select your **current role:** *

Mark only one oval.

- ☐ Engineer
- ☐ Manager
- ☐ Safety/Environmental position
- ☐ Administration

5. A.5 Have you ever received **any training on environmental controls** ? *

Mark only one oval.

- ☐ Yes
- ☐ No

Section B: Cost Impact

6. B1. Usually in construction projects, what cost percentage is allocated for sediment control out of the total cost of the project ? *

Mark only one oval.

- ☐ Less than 5%
- ☐ 5%–10%
- ☐ 10%–15%
- ☐ 15%–20%
- ☐ More than 20%

7. B2. How often do you encounter cost overrun due to sediment control requirements? *

Mark only one oval.

- ☐ Rarely
- ☐ Occasionally
- ☐ Frequently

8. B3. How much cost overrun is typically observed when sediment control is implemented compared to the original budget? *

Mark only one oval.

- ☐ Less than 2%
- ☐ 2%–4%
- ☐ 4%–6%
- ☐ More than 6%

9. B4. What is the main cause of cost overrun in regard to sediment control implementation?

Mark only one oval.

- ☐ Manpower/Plants
- ☐ Material
- ☐ Poor planning
- ☐ Unclear legislation & Specifications

Section C: Time & Resources

10. C1. On the critical path of a project's program, what should be the percentage duration for sediment control implementation?

Mark only one oval.

- ☐ less than 5%
- ☐ 5% - 10%
- ☐ 10% - 15%
- ☐ More than 15%

11. C2. How much delay in project duration occurs due to implementing sediment control? *

Mark only one oval.

- ☐ Less than 5%
- ☐ 5% - 10%
- ☐ 10% - 15%
- ☐ More than 15%

12. C3. Rate the following factors causing project delays due to sediment control implementation (1 = most critical, 5 = least critical). *

Mark only one oval per row.

	1	2	3	4	5
Manpower/Plants	☐	☐	☐	☐	☐
Material	☐	☐	☐	☐	☐
Poor planning	☐	☐	☐	☐	☐
Unclear legislation & Specifications	☐	☐	☐	☐	☐

13. C4. How often do project face delays due to sediment control requirements? *

Mark only one oval.

- ☐ Rarely
☐ Occasionally
☐ Frequently

Section D: Quality & Long-Term Benefits

14. D1. Coordination between environmental and construction teams is difficult. *

Mark only one oval.

- ☐ Strongly Disagree
☐ Disagree
☐ Neutral
☐ Agree
☐ Strongly Agree

15. D2. Implementing sediment control contributes to the creation of necessary new job opportunities in construction. *

Mark only one oval.

- ☐ Strongly Disagree
- ☐ Disagree
- ☐ Neutral
- ☐ Agree
- ☐ Strongly Agree

16. D3. The benefits of sediment control on environmental and structural longevity outweigh the short-term disruptions during construction. *

Mark only one oval.

- ☐ Strongly Disagree
- ☐ Disagree
- ☐ Neutral
- ☐ Agree
- ☐ Strongly Agree

Section E: Project Planning & Management

17. E1. How challenging is to to obtain sediment control approvals before starting construction? *

Mark only one oval.

- ☐ Simple
- ☐ Moderate
- ☐ Challenging

18. E2. Sediment control requirements increase the complexity of project planning and documentation. *

Mark only one oval.

- ☐ Strongly Disagree
- ☐ Disagree
- ☐ Neutral
- ☐ Agree
- ☐ Strongly Agree

19. E3. Environmental inspections and approvals often cause changes to project workflows. *

Mark only one oval.

- ☐ Strongly Disagree
- ☐ Disagree
- ☐ Neutral
- ☐ Agree
- ☐ Strongly Agree

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Google Forms

