Robert Bird Group
Member of the Surbana Jurong Group

Jacaranda Flame
Consulting

PROJECT CHARTER

SOLAR FARM DESIGN OPTIMISATION & SUSTAINABILITY OPTIONS

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1. Purpose

This project charter aims to outline the scope, objectives and general strategy of the '*Solar Farm Design Optimisation and Sustainability Options*' project to be completed by Jacaranda Flame Consulting (JFC) Group 12 over the next 6 weeks (by 29th July). It is an integrated documentation that highlights the preliminary guidance on initiating, planning, monitoring, implementing and evaluating procedures of the project. It should be used as a reference for the project goals, objectives, organisation and management strategies including time, cost, key stakeholders, communication, resources and risks. Additionally, this project charter should serve as a contract between the Project Team (JFC Group 12) and the Project Sponsor (Robert Bird Group), stating what will be delivered at the end of the project in accordance with the expectations of the client.

2. Executive Summary

The primary goal of this project is to investigate alternative pavement and scouring control solutions that are cost effective and sustainable, and to investigate if solar panels affect the rainfall runoff on grass. The overall strategy adopted to complete the project is explained in the project overview and approach section.

The scope section outlines the details of the goals and objectives for this project and defines what is in and out of scope. It also outlines what the project aims to deliver and the criteria for evaluating the deliverables. Assumptions, constraints and the motivation for the project are included.

The project runs for 6-weeks from 20th June 2022 to 29th July 2022. A detailed Gantt chart for the tasks involved and a table for milestones to be completed are provided in the timeline section.

The cost section outlines the materials needed to conduct the runoff experiment, last day to obtain and the estimated costs. For the organisational management, the governance section, the stakeholder section and the communication strategy section are provided for JFC consultants for reference. The human resources and material resources are provided in the resource section. The risk section listed the risks for this project, alongside their respective priority and mitigation strategy.

3. Project Overview and Approach

3.1. Overview

In 2018, the Robert Bird Group (RBG) led the development project of both the Wemen and Swan Hill Solar Farms. These solar farms embody the values of the organisation concerned with environmental sustainability and therefore, the organisation has proposed an optimization project in 2022. The primary aspects of improvement that can maximise the organisations sustainability and cost goals in relation to solar farm design include;

- Research into product types that can pose benefits in optimising design of pavements accommodating light traffic throughout solar farms.
- Research into products that can optimise the design of drainage scouring protection measures within the stormwater system of the solar farms.
- Optimising material utilisation when undertaking and/or developing the investigations and implementation methodologies of the previous two dot points.

For each of these aspects, a primary emphasis has been denoted upon the **design solutions to prioritise sustainability and cost effectiveness.**

Furthermore, RBG has voiced an avenue of investigation and research into the effect of water flow within the confines of a solar array. This aspect of research is to be carried out in the form of a **physical experiment determining the effects of solar panels upon water runoff**.

The current pavement employed within the grounds of typical solar farms are evaluated as slightly conservative and improvements to both costs and sustainable practices can be maximised by researching alternative approaches to current standard paving designs and methods. This would involve investigating replacement materials such as **geosynthetic** products and comparing benefits amongst multiple differing design solutions.

Similarly, the current stormwater system employs standardised rock protection in areas of scouring and forceful water flow. Therefore, research of alternative products and methods can optimise scouring protection measures and designs. This can assist to combat both flood risks and scouring. Therefore, this project can ultimately allow the solar farm designs to be more environmentally sustainable, environmentally tolerable and pose a lower impact upon the natural landscapes.

As consultants, our team's collective role is to research, investate and propose optimisations and design(s) approaches that address each of the **THREE** goals of the project (mentioned above) within a **six-week period**. Therefore, a review of the pre-existing or conventional design measures must be carried out, dictating our research opportunities and implementation strategies. Furthermore, direct comparisons and an evaluation of both alternative approaches and pre-existing measures are to be carried out to determine the most effective and desirable solution capable of satisfying the aforementioned project goals.

3.2. Approach

The project will involve a number of steps to be undertaken. Firstly, for the rainfall runoff experiment, the approach that is planned to be undertaken includes developing a methodology for the experiment, collecting resources and equipment. After the experiment is carried out the results will be presented and interpretation provided drawing relevant conclusions of interest.

Figure 1: Experiment Summary - Water Run-Off Investigation

Secondly, for the pavement optimization investigation, the approach to be undertaken includes evaluating current pavement techniques and design in solar farms and researching and reviewing geosynthetic materials and their applications. From this stage comparisons of pavement approaches proposed and recommendations will be documented.

Thirdly, for the scouring prevention investigation, the approach planned to be undertaken consists of investigating traditional scouring prevention techniques and products used on solar farms. Then research and investigation of alternative scouring prevention techniques or optimisations are proposed. A comparison of all proposed scouring prevention techniques and pre-existing measures are documented along with recommendations to the client.

The investigation of scouring protection optimisation and pavement design optimisation will be carried out concurrently. A report with references and presentation will then be given to the client consisting of each of the aforementioned sections.

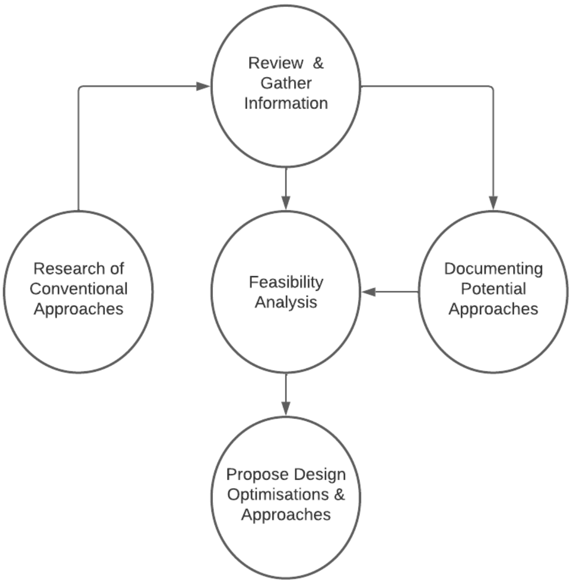

Figure 2: Project Approach Summary - Pavement & Scouring Protection Optimisation

4. Scope

4.1. Goals and Objectives

GOALS	OBJECTIVES
To experimentally investigate if solar panels have an impact on rainfall runoff.	• **To investigate the variables that affect water run-off and how so.** • **To research, set up, test and obtain results through a physical experiment.** • **To deliver conclusions regarding results by the 29th of July 2022.**
To investigate and provide pavement approaches that are sustainable within solar farm arrays.	• **To investigate, compare and research a range of current conventional pavements within typical solar farms.** • **To investigate the utilisation of geosynthetic materials in the employment of pavements within solar farms.** • **To prioritise cost, categorise products and propose benefits within comparisons.** • **To deliver conclusions regarding optimisation by the 29th of July 2022.**
To investigate options and products available that optimise scouring protection in terms of cost effectiveness and sustainability within solar farm stormwater systems.	• **To investigate, compare and research current conventional scouring protection within typical solar farms.** • **To prioritise cost, categorise products and propose benefits within comparisons.** • **To deliver conclusions regarding optimisation by the 29th of July 2022.**
To further determine areas where sustainable measures can be implemented within solar farm design.	• **To investigate alternative and/or optimised approaches for an aspect of solar farms that can employ a further sustainable design model.** • **To carry this goal once previous goals are accomplished within the delegated time span.**

Table 1: Goals & Objectives

4.2. In Scope

- Perform a review of solar farm civil engineering aspects.
- Design a physical experiment to simulate rainfall.
- Perform analysis on rainfall effects upon simulated solar panels.
- Perform a review of conservative pavement designs and approaches.
- Research, collate data, compare and propose potential for optimised pavement approaches.
- Generate comparison through criteria documenting risks, cost, quality, sustainability and benefits in regard to pavements.
- Research pre-existing scouring protection approaches.
- Generate comparison through criteria documenting risks, cost, quality, sustainability and benefits in regard to scouring protection approaches to optimise design.
- Research opportunities to employ more sustainable approaches in solar farms.

4.3. Out of Scope

Designs of Implementing Pavements & Scouring

The optimisation ideas and approaches will be investigated; however, no further design specifics for employment within a certain site will be included. A conclusion of options will be the objective of the report in regard to pavement and scouring protection.

Budget of Optimisation Approaches Proposed

There is no specific budget associated with the project, only comparisons of options proposed for optimisation. Hence, all optimisation ideas and approaches will not be limited to a cost.

Sourced Data

Any sourced data relevant to existing solar farm parameters such as, conventional solar farm topology, soil data, weather conditions, layout and geotechnical data will not be further documented or generated.

4.4. Project Deliverables

- *Project Charter*
- *Presentation*
- *Singular Final Report consisting of:*
    - Alternative solutions for less conservative pavements;
        - Research & review pre-existing approaches
        - Define assumptions
        - Research & review alternative proposed approaches
        - Comparisons of proposed approaches
        - Cost and sustainability discussion & considerations
    - Alternative solutions for scouring problems of channels;
        - Research & review pre-existing approaches
        - Define assumptions
        - Research & review alternative proposed approaches
        - Comparison of proposed approaches
        - Cost and sustainability discussion & considerations
    - Rainfall run-off experiment
        - Undertake a review of published literature relevant to rainfall run-off within solar arrays.
        - Define aim, variables & control
        - Define setup & materials
        - Define scalability aspects & assumptions
        - Define experimental method
        - Carry out physical experiment & testing
        - Hydrographs & visualisation of results (without panels & with panels)
        - Define source of errors - reliability, accuracy & precision
        - Experiment results, discussion & conclusion(s)

4.5. Success Criteria

The success criteria of this project will be as follows:

Time

All the project deliverables are submitted on time. The project is completed within the planned duration.

Satisfaction

- Technical Aspect:
    - Proposed solutions are innovative, cost-effective and eco-friendly in comparison with conventional materials and approaches.

- Supervisor:
    - The project supervisor is satisfied with the weekly progress and performance of each team member. Positive response based on the feedback provided by the project supervisor throughout the entire project time frame.

- Client:
    - All client expectations are met.

4.6. Benefits

- Potentially cheaper, easier to maintain, more environmentally friendly and sustainable pavement.
- Potentially cheaper, more efficient, more environmentally friendly and sustainable scouring solutions.
- Collect realistic and experimentally verified data on rainfall runoff as affected by solar panels.

4.7. Project Constraints

In terms of successful completion of the project, the main constraints for the project involve; the amount of time available to group members, the ability to conduct the rainfall runoff experiment, write up the final report and preparation of a final presentation for the client.

4.8. Assumptions

- The optimisation solutions will be proposed for no specific solar farm site or location both pre-existing or to be developed.
- Information and/or data that is provided to consultants by RBG is the latest or most up-to-date.
- Relevant Engineering Australia Standards and RBG Engineering Design Standards apply.
- The optimised solutions will adhere to the outlined conditions or requirements discussed through either the project descriptions, brief(s) and/or meetings with the client.
- Technology and resources that are involved within the discussed optimization approaches and are available.
- Frequent communication will occur between the client, consultant team and project supervisor.
- Project spans from 20th June to 29th July 2022.

5. Time

5.1. High Level Schedule

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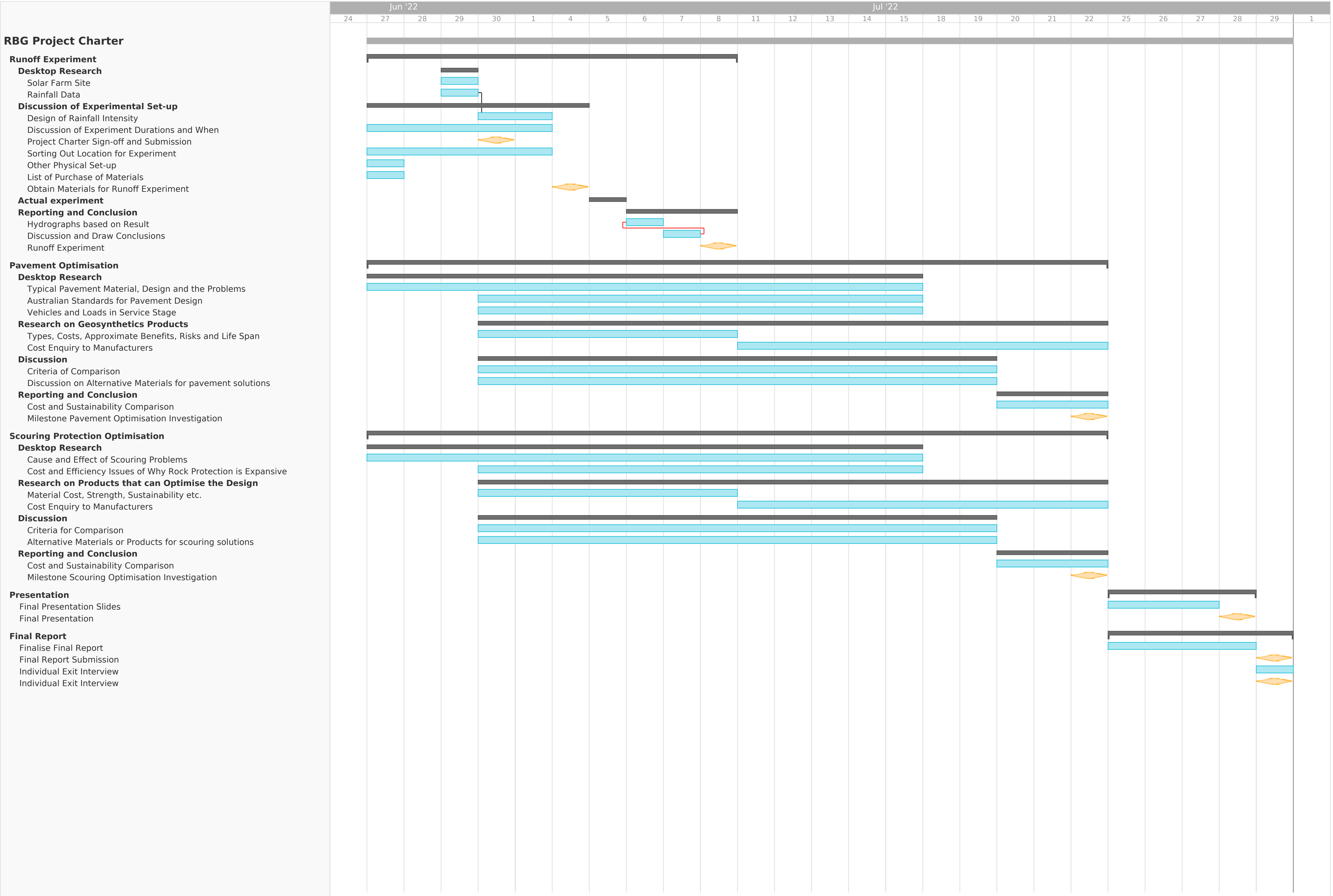
5.2. Milestones

SUMMARY MILESTONES	DEPENDENCIES	DUE DATE
Project Charter Sign-Off and Submission	Project Charter Completed & signed off by Supervisor	30th June 2022
Obtain Materials for Runoff Experiment	Project Charter signed off by Client	4th July 2022
Runoff Experiment	Obtain Materials for Runoff Experiment	8th July 2022
Pavement Optimisation Investigation	Project Charter signed off	15th July 2022
Scouring Optimisation Investigation	Project Charter signed off	22nd July 2022
Final Presentation	Experiment and Investigations Complete	28nd July 2022
Final Report	Experiment and Investigations Complete	29th July 2022

Table 2: Project Milestones


Jun '22
Jul '22
24 27 28 29 30 1 4 5 6 7 8 11 12 13 14 15 18 19 20 21 22 25 26 27 28 29 1
RBG Project Charter
Runoff Experiment
Desktop Research
Solar Farm Site
Rainfall Data
Discussion of Experimental Set-up
Design of Rainfall Intensity
Discussion of Experiment Durations and When
Project Charter Sign-off and Submission
Sorting Out Location for Experiment
Other Physical Set-up
List of Purchase of Materials
Obtain Materials for Runoff Experiment
Actual experiment
Reporting and Conclusion
Hydrographs based on Result
Discussion and Draw Conclusions
Runoff Experiment
Pavement Optimisation
Desktop Research
Typical Pavement Material, Design and the Problems
Australian Standards for Pavement Design
Vehicles and Loads in Service Stage
Research on Geosynthetics Products
Types, Costs, Approximate Benefits, Risks and Life Span
Cost Enquiry to Manufacturers
Discussion
Criteria of Comparison
Discussion on Alternative Materials for pavement solutions
Reporting and Conclusion
Cost and Sustainability Comparison
Milestone Pavement Optimisation Investigation
Scouring Protection Optimisation
Desktop Research
Cause and Effect of Scouring Problems
Cost and Efficiency Issues of Why Rock Protection is Expansive
Research on Products that can Optimise the Design
Material Cost, Strength, Sustainability etc.
Cost Enquiry to Manufacturers
Discussion
Criteria for Comparison
Alternative Materials or Products for scouring solutions
Reporting and Conclusion
Cost and Sustainability Comparison
Milestone Scouring Optimisation Investigation
Presentation
Final Presentation Slides
Final Presentation
Final Report
Finalise Final Report
Final Report Submission
Individual Exit Interview
Individual Exit Interview

6. Cost

The cost of materials to carry out the experiment is calculated to be around $420. The materials listed in the table are based on the experimental set-up we accounted for, including the set-up for the solar panels (stand and plastic sheeting), rainfall (hose head, hose, and sloped guttering), the ground (synthetic grass, and drainage mesh/sheet) and other essential materials (table, knife tape and etc.) needed in the experiment. However, there might be more unforeseen costs with alternative set-ups that are not mentioned in the table.

ACTIVITIES/DELIVERABLES	DUE DATE	COST
Synthetic Grass	4th July 2022	\$30 - \$50/m^2
Hose Head	4th July 2022	~ \$20
Hose	4th July 2022	~ \$40
Plastic Sheeting	4th July 2022	~ \$55/m^2, based on the size needed
Sloped Guttering	4th July 2022	~ \$15
Rectangular Measuring Container	4th July 2022	~ \$25
Plastic Bag Material	4th July 2022	~ \$18
Tape	4th July 2022	~ \$5 per one
Drainage Mesh/Sheet	4th July 2022	~ \$30/m^2
Stand	4th July 2022	~ \$35
Weight Scale	4th July 2022	~ \$20
Impermeable layer (e.g plastic sheet)	4th July 2022	~ \$10 - \$20 (Difference on the length and thickness)

Stanley Knife	4th July 2022	~ $15
Table	4th July 2022	~ $70
TOTAL		~ $420

Table 3: Project Costs

7. Project Governance

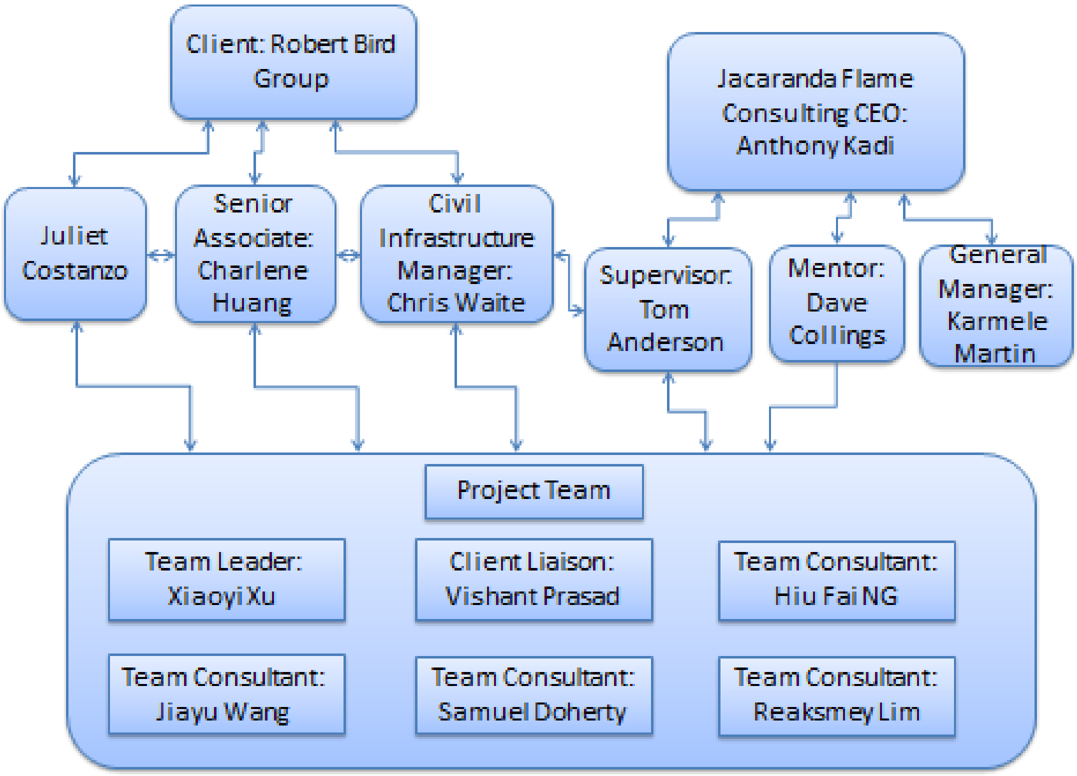


Figure 3: Project Governance

8. Stakeholder Management

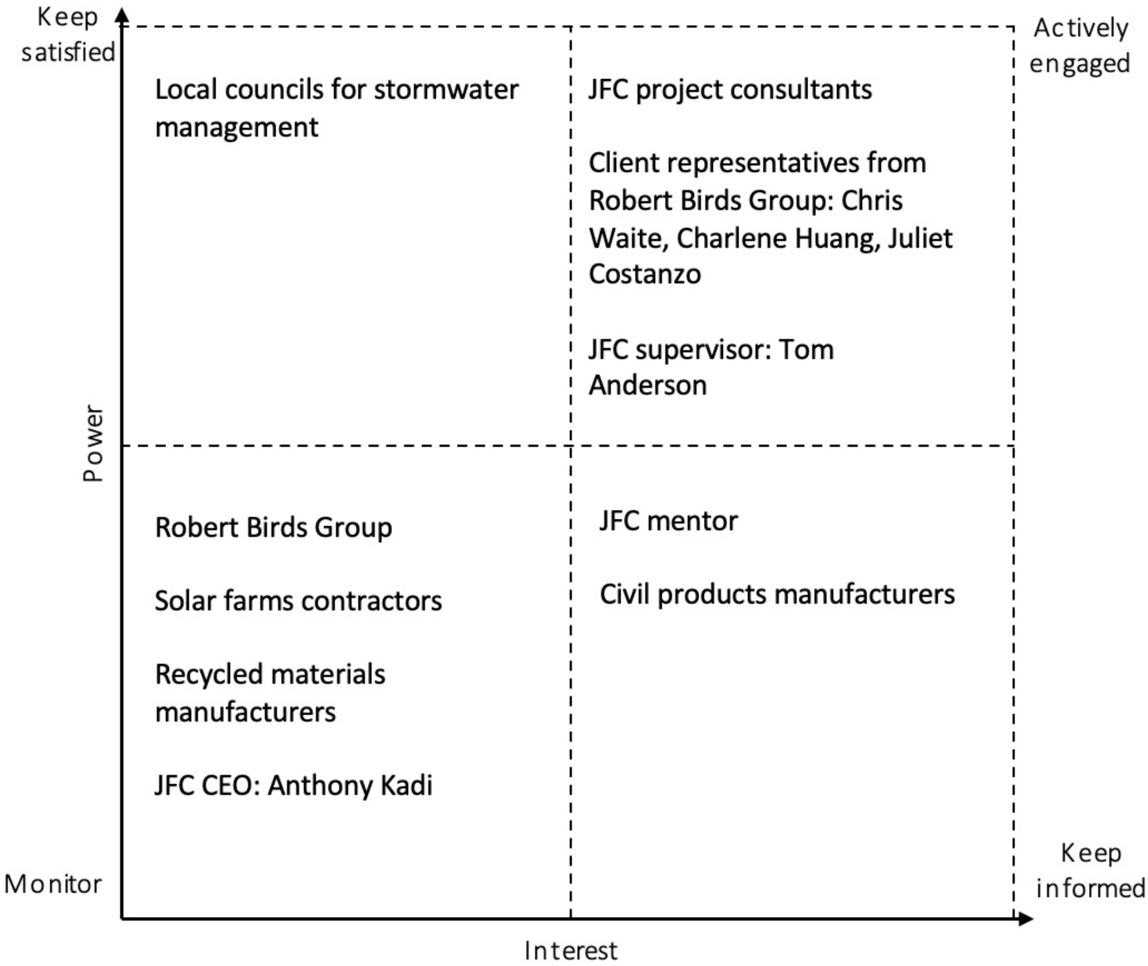


Figure 4: Stakeholder Management

9. Communication Strategy

TARGET AUDIENCE	COMMUNICATION NEEDS & DELIVERABLE	INFORMATION (IN BOUND)	INFORMATION (OUT BOUND)
Chris Waite and his team (Project Client)	Project Kickoff Meeting	• Introduction to the JFC consulting team in charge of the project • The team's understanding of the project from the project brief • Preliminary project goals/objectives	• Introduction to the client's requirements, project-in-scope, out-of-scope and deliverables. • Provide relevant documents, i.e. soil data, geo-investigation report, layout of the solar farms
	Weekly Progress Update Meetings	• Regular updates on the project milestones, plans, and any other relevant information • Questions to ask the client for feedback	• Provide feedback on team suggestions • Answer to questions asked by the team • Provide clarification and additional information if required
Thomas Anderson (Project supervisor)	Weekly Meetings on Project Progression and frequent updates during the week.	• Provide updates on project progression and plans • Any type of enquiry regarding the project • Important emails required to be sent to the client	• Advise the team as required and provide feedback on the project progression and plans • Review and approve emails that are to be sent to the client
The Consulting Team	Daily Team Meetings (10am and 4pm)	• Updates on project plans and progression	• Opinions on project progression, tasks

		• Assign project tasks to each consultant with expertise and preference taken into consideration. • Research sources for findings that are relevant to the project	delegation and findings. • Allocation of tasks to be completed • Meeting minutes, Daily logs and any relevant findings are to be recorded in Google Drive

Table 4: Communication Strategy

10. Resources

10.1. Human Resources

HUMAN RESOURCE	PRIORITY
Continued access to Client (Chris Wait, Charlene Huang & Juliet Costanzo)	• Provides feedback on project updates from the team.
Thomas Anderson (Team Supervisor)	• Provides feedback in regard to any enquiries from the team and to ensure the team is on the right track.
Shirley Xu (Team leader)	• Organise team meetings, Lead all the meetings, manage the schedules for the team, support and manage the team, and make sure the project is a success. • A lead in doing research on literature review in regard to the influence of solar panels on rainfall runoff.
Vishant Prasad (Client Liaison)	• A direct point of contact with the client, setting up weekly client meetings and writing emails. • Assisting in doing calculations related to the runoff experiment. • Doing research in regard to sustainability aspects; maintenance and production processes.
Samuel G Doherty (Civil Engineering)	• A lead in investigating the optimisation of scouring protection. • A lead in calculations and formulas based around the scouring protection and experiment goals.
Jiayu Wang (Civil Engineering)	• A lead in doing research on approaches that could optimise pavements. • Carrying out research of established/published literature.

Hiu Fai Ng (Civil Engineering)	● A lead in conducting a water runoff experiment. ● Researching differing materials and material based approaches for each of the goals.
Reaksmey Lim (Biomedical Engineering)	● Generating cost comparisons between proposed and existing materials

Table 5: Resources

10.2. Material Resources

MATERIAL RESOURCE	PRIORITY
JFC Office	● Provide meeting rooms where the team can have face-to-face and remote meetings with supervisor and/or client. ● Provide a face-to-face meeting spot for daily team meetings.
Individual Computers	Doing research, writing up a final report, preparing slides for presentations and having meetings remotely.
Google Drive	Sharing documents within the team and supervisor and obtaining relevant documents from the client.
Project Specific Documents/Data: ● RBG's Civil and Structural Engineering Design Report: West Wyalong Solar Farm ● West Wyalong Solar Farm Issued for Construction Civil Engineering Drawings	Soil data, rainfall analysis or other relevant information provided in these documents are important when guiding the experiment and investigating optimization of pavements and scouring protection.
Materials for Rainfall Run-Off Experiment: ● A list of materials and cost is stated in Section 6 of this document.	Materials plan for conducting the rainfall runoff experiment.

Table 6: Material Resources

11. Risks

RISK	RISK RATING	MITIGATION STRATEGIES	PRIORITY
Project schedule is not properly followed.	Impact = 5 Probability= 2 Rating = 5 x 2 = 10 ⇒ High	• Weekly plans or Gantt Chart referenced to the project deadline • Daily meetings to update progression and discuss what should be improved • Assign project tasks to individual sections based on the expertise and preference	High
Lack of communication with team members, supervisor or client.	Impact = 3 Probability= 2 Rating = 3 x 2 = 6 ⇒ Medium	• Set regular meeting • Preparation of meeting questions beforehand • Complete meeting records • Complete LinkedIn Learning - Working in Teams Module • Keep client and supervisor well informed via emails, shared google folders etc.	Medium
Change in work caused by misinterpreting the project brief.	Impact = 5 Probability= 3 Rating = 5 x 3 = 15 ⇒ Extreme	• Hold weekly meetings with the client, supervisor and/or mentor • Keep client and supervisor well informed with the current progression	High
Inaccurate data and/or reading errors of the runoff experiment.	Impact = 3 Probability= 2 Rating = 3 x 2 = 6 ⇒ Medium	• At least three consultants participate in the reading procedures	High

		• Take the average as the final result	
Lack of professional knowledge.	Impact = 3 Probability= 3 Rating = 3 x 3 = 9 ⇒ High	• Hold meetings with client, supervisor and/or supervisor for advice • Youtube class learning • LinkedIn lesson • Literature review • Google research	High
Team member's absence from work.	Impact = 2 Probability= 2 Rating = 2 x 2 = 4 ⇒ Medium	• Prior approval of the supervisor is required • Keep other team members informed beforehand • Review of daily log and meeting records • Update daily progress via Messenger Group Chat	Low
Loss of data/resources/current work	Impact = 5 Probability= 2 Rating = 5 x 2 = 10 ⇒ High	• Regular monitoring and backups of shared google folders	High

Table 7: Risks

12. Draft Report Structure

1. Executive Summary
2. Introduction
3. Project Scope and Overview
4. Water Run-Off Experiment Section
    a. Methodology
    b. Analysis
    c. Recommendations
    d. Future Works
    e. Conclusions
5. Pavement Optimisation Investigation
    a. Review
    b. Perform Comparison/Analysis
    c. Recommendations
    d. Future Works
    e. Conclusions
6. Scouring Protection Optimisation Investigation
    a. Review
    b. Perform Comparison/Analysis
    c. Recommendations
    d. Future Works
    e. Conclusions
7. Sustainability Optimisation Investigation (**OPTIONAL**)
    a. Review
    b. Perform Comparison/Analysis
    c. Recommendations
    d. Future Works
    e. Conclusions
8. References
9. Appendix

13. Authorisation*Ver_4

POSITION	NAME	SIGNATURE	DATE
Team Supervisor	Tom Anderson	Tom Anderson	29/6/2022

Table 8: Authorisation

14. Appendix A

14.1. Risk Likelihood Rating

The likelihood rating was allocated based on the scale seen below in table 1

LIKELIHOOD	CODE	DESCRIPTION
ALMOST CERTAIN	5	Expected to be the most likely outcome
LIKELY	4	Will probably occur in most circumstances
POSSIBLE	3	Might occur at some time
UNLIKELY	2	Not expected to occur in normal circumstances, but could occur.
RARE	1	Rare that this would occur - no previous occurrence in similar circumstances

Table 1: Risk Likelihood Rating

14.2. Risk Impact Rating

The impact rating was allocated based on the scale seen below in table 2.

IMPACT	CODE	DESCRIPTION
INSIGNIFICANT	1	A risk event, should it occur, that will have little to no impact on achieving the desired result of the project.
MINOR	2	A risk event, should it occur, will have a minor impact on achieving the desired result of the project.
MODERATE	3	A risk event, should it occur, that will have a moderate impact on achieving the desired result of the project.
MAJOR	4	A risk event, should it occur, that will have a significant impact on achieving the desired result of the project.
EXTREME	5	A risk event, should it occur, will have a severe impact on achieving the desired result of the project.

Table 2: Risk Impact Rating

14.3. Risk Rating

The risk rating is calculated using the likelihood and impact ratings (i.e. risk likelihood x risk impact = risk rating) and rated as low, medium, high or extreme based on the range the rating was within as seen in in table 3 below.

RATING	RANGE	DESCRIPTION
E	15-25	**Extreme** – Immediate action required. Detailed control measures and responsibility specified.

H	**8-12**	**High** – Immediate action required. Detailed control measures and responsibility specified.
M	**4-6**	**Medium** – Control measures and responsibility specified.
L	**1-3**	**Low** – Manage by routine procedures.

Table 3: Risk Rating

14.4. Risk Priority

The risk priority was allocated based on the scale seen below in table 4.

PRIORITY	RANGE	DESCRIPTION
High	**12-25**	**Extreme** – Immediate action required. Detailed control measures and responsibility specified.
Medium	**4-10**	**Medium** – Control measures and responsibility specified.
Low	**1-3**	**Low** – Manage by routine procedures.

Table 4: Risk Priority