21/04/2017

Oakland Park Grade Separation Feasibility Study

Environmental Management System

DPC
The Difference In thinking

Government of South Australia
Department of Planning, Transport and Infrastructure

Declaration

University Declaration

We declare the following to be our own work, unless otherwise referenced, as defined by the University's policy on plagiarism. This report is a part of a university project and is not an official document.

DPC Declaration

On behalf of DPC Engineering, we declare as a whole, that the presented Environmental Impact Assessment, is our recognized document aimed at providing the necessary requirements for the feasibility study. The following document contains our professional analysis and recommendations for the proposed tender options. We can confirm that this document is both current and accurate as of the submission date (21/04/2017).

Document Control Record

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Approval					
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Signature		**Signature**		**Signature**	

Executive Summary

As part of the feasibility study to instigate the feasibility of the Road Overpass and the Rail Overpass for the Oakland Park Grade Separation, DPC Engineering has commissioned the making of the following documentation. This documentation is to provide an Environmental Management Plan and Impact Assessment for the two feasible options; whilst helping establish an educated opinion to choose between them, from an environmental viewpoint.

DPC Engineering aims to protect the environment through the use and guidance of Australian legislation and our own internal processes, which are defined in the report. The structure of this report is to identify the impact, highlight the legislative requirements or processes to address the impact, to clearly state our control measures and our targets, and to cost the projects environmental elements.

As the main purpose of this document is to inform our client (DPTI) of the environmental impacts of both the feasible options, it was found that the best design from an environmental viewpoint is the;

Rail Overpass

Thus, DPC Engineering recommends that the **Rail Overpass** is to be built in terms of an environmental perspective. However, it is advised that this option is to be consulted with the other departments, such as structural and urban planning to finalise the concluding option.

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1.0 Plan Structure

The following two options for the feasibility study are considered; the rail overpass and the road overpass. This document aims to provide information relevant to the Environment and the subplans DPC Engineering has created to manage the two chosen options. This document also provides details on the solutions that will ensure the environmental impact of the surrounding areas are minimized. The following document is structured as follows;

Part A – Overview

- Purpose and scope of the project.
- Aims and objectives.
- Environmental Management system structure.

Part B - Environmental Impact Assessment

- Environmental Impact matrix.
- Environmental matrix finding analysis.

Part C –Environmental Management Plans

- Environmental impacts on the affected areas will be identified.
- Solutions to control and reduce the environmental impact.
- The procedures that will implement the environmental impact.

Part D– Implementation and Costing

- The cost of all solutions that will implement to control and reduce the environmental impact.

2.0 Project Overview

2.1 Purpose

The project, located at Oakland Park intents to design and construct a rail/road grade separation. This project is a part of 30-year plan for Greater Adelaide, which will provide easy access to Adelaide city and the surrounding suburbs, while supporting local business and promoting growth in the economic sector. On this project, the Department of Planning Transport and Infrastructure (DPTI) will be closely working with us.

The Environmental Management Plan is one document that relates the clients and details legislated environmental requirements on construction.

The Environmental Management Plan highlights the need to;

- Identify any risks and hazards relevant to the project.
- Provide an environmental protection plan, guided by government legislation.
- Highlight the types of environmental harm, while providing a solution to reduce and prevented it.
- Recognize the community impact from the environment during the construction and after completion of project.
- For DPC Engineering to comply with the certified ISO14001 requirements.
- Identifying and Implementing the proper solution to reduce the environmental impact that are beyond the required by legislation.

The environmental management team, project manager, team leader and all staff are responsible for implement and follow the Environmental Management Plan.

2.2 Project Scope

There are designs constraints that will be consider during the construction of the project, which are defined below.

Grade separation:

- Grade separation is confined to diagonal road and Morphett road.
- Non-distracted rail line.
- Location of the new interchange to be close as possible to Morphett road.
- Easy access on nearby street.

- Decrease traffic problem on Oakland park.

At grade

- 2 lanes on diagonal road and Morphett road.
- Rail line on service.
- Maintain local traffic.
- Minimise impact on surrounding local traffic and business.

Some other considerations are

- Impact on heritage sites will be minimised or avoid.
- Disturbance to the nearby business and community during construction will be minimised.
- Impact on significance tree will be minimised.
- Existing infrastructure will be used/destroyed.

Figure 1- Locality plan for Oakland park Grade separation

2.3 Objectives

As clarified in the project scope, two options are mentioned to improve the traffic condition in Oakland Park. The first option is to build a rail overpass and road overpass. Hence, the Environmental Management Plan objectives are listed below.

- To prepare a sustainable and innovative environmental management plan.
- To identify and minimize the potential and detrimental environmental impacts.

- Provide the capability to take the correct plan of action to environmental incidents and emergency situations.
- To identify and protect special environmental characteristics.
- To identify and minimize the environmental hazards in construction site.
- To prepare further environmental improvements in after construction.
- To build specific schedule to monitor the process.
- To prepare audit to monitor the compliance with the environmental regulations.
- To apply the information from other departments and allocate the resources.

2.3.1 Environment Specific

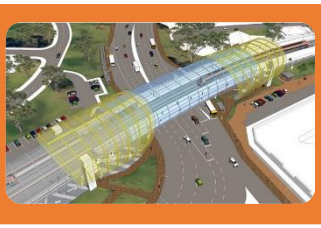
- Minimize any impact on environment during and after construction.
- Transfer the waste from landfill and, if possible, recycle any usable materials.
- Comply with strict supervision on any potential environmental incidents.
- Comply the environmental management plan with relevant environmental regulations and legislations towards sustainability and innovation.

2.4 Description of Options

Two feasible options have been defined after consulting with the client and discussing the options with DPC's internal departments, using the DPC Engineering "Red Light and Green Light system". Upon fulfilling the client's requirements, the following, two options were agreed on; they are two types of overpasses which in some case are similar, however, differences still exit and will be discussed below.

Figure 2 - Discussed Feasible Options Rail Overpass and Road Overpass

2.4.1 Rail Overpass



Rail Overpass

This option consists of a rail over pass and Diagonal Road running at grade. To build a rail overpass, it requires railway redevelopment and relocation of current infrastructure. Heavy materials such as rocks, stones, gravels and sand are commonly used on the railway base construction. Their storage requires a certain portion of land to meet the requirements of material storage policies in case of any environmental damage occurs in extreme weather. Trees and other infrastructure like water systems may need to be removed and relocated which could cause dust issues, noise and vibration. Moreover, drainage system on the overpass railway should also be taken into consideration during the construction and when the rail line is operational.

2.4.1 Road Overpass

Road Overpass

This option requires the Diagonal Road overpass and rail line operating at grade which may include a redesign of the intersection with Morphett Road. Compared with the rail overpass, this option does not require redeveloping railways and will not influence railway function. Road overpass, however, requires much more effort and cost to build the elevated intersection of two roads. In other words, this option requires more material and longer construction period which may increase the potential risk towards negative environmental impacts. Major environmental issues such as dust and noise are similar to the rail overpass option, moreover, elevated intersection may cause, huge shading areas and the relocating of vegetation, which may lead to citizen complaints.

2.5 Management System

The environment department of DPC Engineering, prides ourselves on our management systems, innovative and efficient manner. Used to monitor the progress and compliance with contract requirements, the management system directs the way the project is being managed to meet client and stakeholders' requirements.

- Overarching Policies

  Environmental department will review all relevant policies to ensure everything will comply with these policies and regulations.

- Plans and Procedures

  Environmental department will set up an innovative and efficient plan and a schedule which is specific into details to keep the progress running well.

- Tools and Information

  Environmental department will use tools to gather necessary information from other departments and site inspections.

- Business Software

  Environmental department is capable to utilize any business software to improve the environmental management plan.

- Feedback and Report

  Environmental department will collect feedbacks and suggestions on the plan or any other perspectives and prepare reports for self-improvements.

2.6 Key Environmental Stakeholders

During the review the panel met with the following key environmental stakeholders:

Primary stakeholders

- South Australian State Government.
- City of Marion.
- Department of Planning, Transport and Infrastructure.
- National Parks and Wildlife Advisory Council.
- Environment Protection Authority.
- Kaurna Nation Cultural Heritage Association.
- State Aquatic Centre.

Secondary stakeholders

- Local Home Owners.
- Local Tenants.

- Local Business owners.
- Local employment agency.
- Local Workers.
- Nearby clubs.
- Public transport users.
- Road Users.
- Cyclists.
- Pedestrians.
- Airport Traffic.

2.6.1 Communication and Complaints Management

The project manager will arrange a Marion Residents Group stakeholders meeting with DPC Engineering to manage major concerns such as land disturbance, dust control, noise, vibration, litter, road cleaning and car parking. The meeting will focus on efficient complaints resolution, and detailed procedures will be discussed during the meeting to support a resolution.

2.7 Our Environmental Policy

Proudly, the DPC Engineering group provides a wide range of engineering solutions, which are friendly and have low impacts on the environment. An essential assessment, which are used to evaluate both long-term and short-term environment problems, is carefully taken into consideration for each project of the company.

Being conscious of the environmental problems which are closely linked to each project plays a vital role in civil engineering field. The application of Environment and Sustainable policies contributes to a reduction in both long-term and short term environmental impacts. An environmental management system (EMS) should be highly recommended to reduce the environmental impacts after the construction progress.

Our group attempts to improve the quality of the projects, while still complying with the environmental laws, legislations, and policies. Training with the objective of providing accurate assessments as regard to each project will be held for employees who work under the supervision of the Environment Management team.

As part of this Environmental Management System, DPC Engineering Group's focus will be to:

- Comply with Australian Government environmental policies, legislation and regulations.

- Consider sustainability issues in the preparation and management of DPC Engineering Group constructions and operations.
- Prevent pollution; minimise construction wastes and greenhouse gas emissions; and minimise consumption of water, electricity and gas energy etc.
- Set and review environmental objectives and targets frequently.
- Perform the principles of the Environmental Policy during procurement procedures.
- Announce and communicate the environmental policy and environmental. management system to contractors, consultants and staff.
- Training in these principles to ensure staff are aware of their environmental responsibility.
- Apply energy-saving technologies and sustainable resources to attain expected outcome.
- Monitor the achievements of company regularly for improvement of environmental performance and report to government and contractor.

3.0 Environmental Management System

3.1 System Overview

An environmental management system (EMS), which is known as a set of processes and practices to manage the impacts of different organisation's activities on the environment that enable to reduce environmental impacts and increase operating efficiency. DPC engineering has established a structure for environmental management and cover areas through EMS such as objectives, policies, inspections, training and record management.

DPC engineering will implement an EMS by the following steps:

- Develop an environmental policy.
- Appoint staffs responsible for their coordination.
- Identify how DPC interacts with the environment.
- Classify current and potential environmental impacts.
- Identify related legal and other requirements.
- Establish environmental objectives, targets and agendas.
- Monitor and measure the progress to achieve our objectives.
- Review the system and environmental performance.
- Improve DPC's environmental performance continuously.

The following diagram represents a continuous improvement cycle system and environmental performance design by DPC engineering.

Figure 3 - DPC Engineering's Company Policy Framework

3.2 Company Policy

It is our strong mindset of, "operating with the client and community", that allows DPC Engineering to facilitate an in-depth and clear policy management system for this project. Our policies are designed towards an overall process that strictly adheres to the levitative requirements, and often in times goes a step further to cater to the project's needs. The polices in place ensures that there is confidence in the cooperative approach across all departments, guaranteeing that all sectors function together to ensure all environmental specifications and certificates are met and obtained.

It is our environmental policy that clearly states our company's commitment and values in upholding our environmental obligations, and outlines the minimum requirements for the project not just from a legislative perspective but from a quality assurance one as well. The frame work of our polices guides the projects quality and commitment in the environmental sector and all projects must demonstrate a level of compliance at all times.

3.3 Project Specific Policy

All projects undertaken by DPC engineering ensures that an environmental management plan (EMP) and environmental environment system (EMS) is in place, to accurately describe the actions that need to be taken for each project to comply with the environmental legislations and guidelines at the time of the project. the EMP for this specific project is gear towards the following requirements;

- All contractors and partners adhere to the environmental requirements not just our company.
- Compliance with legislations and guidelines are adhered to at all times.
- Mitigation measures, particularly where the community is involved are taken, and minimized where feasible.

The required steps and actions, along with the resources which are to be utilised, are outlined in the environmental procedure guidelines. These resources include but are not limited to, preformatted forms used to collect and collate data for a specific purpose, reference material to provide guidance or additional information and software applications which can be used to support environmental operations.

3.4 Continual Improvement

At DPC Engineering we understand that no policy is perfect, and that not every situation can be assessed against an already pre-formatted plan. This is why the continual improvement of our current systems is necessary in providing clarity to grey.

It is possible to assess the continual improvement cycle by analysing it in terms of a graphic shown below in Figure 4. The figure demonstrates the four key points which are;

- Planning – The initial ideas, objectives and processes.
- Actioning – Implementation of the ideas, objectives and processes.
- Checking – continual monitoring and evaluation.
- RE-Act – make actions to improve systems based on the checking stage (implement amendments).

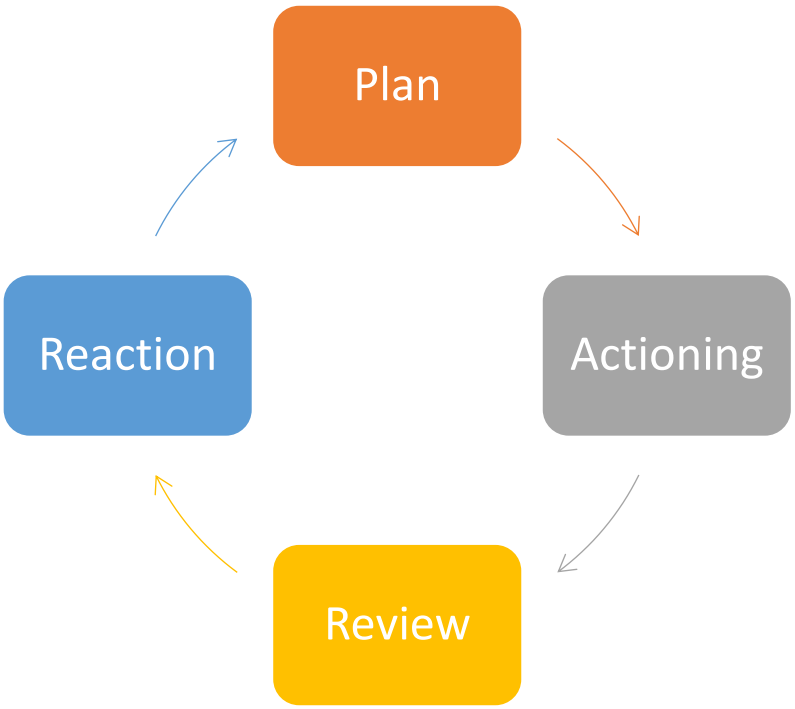


Figure 4 - DPC Engineering Improvement Cycle for Each Project

3.5 Significant Identified Environmental Hazards and Subplans

The Environmental concerns to be addressed, are shown in subsections below in Table 1.

Identified Environmental Hazards	Environmental Subplan
Air Pollutants	Air Quality Subplan
Noise and/or vibration	Noise and Vibration Subplan
soil contamination	Soil Subplan
Stormwater runoff and sediment transportation	Soil and Water Resources Subplan
Aboriginal heritage	Community Subplan
Trees and other vegetation	Flora Subplan
Storage, handling & disposal processes	Waste management Subplan
hazardous substances	Hazardous Materials Subplan
Generation emissions	Energy Use Subplan

Table 1- Environmental hazards Subplans

4.0 Environmental Impact Assessment

4.1 Purpose

The main aspect of this environmental impact assessment is to find out the potential effects on the metropolitan and natural environmental around Oakland Park where the grade separation is going to happen. During construction, there might be an impact on environment or living standards of the community, thus, a risk matrix has been conducted.

4.2 Methodology

The matrix below identifies the impacts of the two possible solutions for the grade separation rail overpass and road overpass. The impacts will be rated in a range of 0 to 5 where 0 represent no impacts and 5 represent highest impact. In order of predict which solution will have less impact, the end ratings will be added for both possible solutions.

Risk Assessment Matrix				
Consequences rating				
Very High (5)	High (4)	Medium (3)	Low (2)	Very Low (1)

4.3 Environmental Impact Assessment Matrix

4.3.1 Construction

The table below is constructed to indicate the impacts during the construction phase.

Table 2- Risk Matrix for Construction Stage

Construction Phase			
Area Impacted		Rail overpass	Road overpass
Water	quality	2	2
	Ground water	3	3
	Drainage	2	3
Soil	Contamination	3	4
	Erosion	3	3
	slope stability	3	4
Air	Quality	4	4
Flora	Native	3	4
	Non-Native	3	4
Fauna	Mammals	3	3
	other animals	3	3
	Birds	2	3
community	heritage	2	3
	Aesthetics	4	4
	Landscape	4	5
	Road users	4	5
	Public transport	5	5
	Pedestrians	5	5
Noise and Vibration		4	5

4.3.2 Operation

Below table is the impact matrix for operation phase.

Table 3 - Risk Matrix for Operation Stage

Operation Phase			
Area Impacted		**Rail overpass**	**Road overpass**
Water	quality	2	2
	Ground water	2	3
	Drainage	1	3
Soil	Contamination	2	2
	Erosion	2	3
	slope stability	2	3
Air	Quality	2	3
Flora	Native	2	2
	Non-Native	2	2
Fauna	Mammals	1	1
	other animals	1	1
	Birds	1	1
community	heritage	2	2
	Aesthetics	1	2
	Landscape	2	4
	Road users	2	3
	Public transport	3	3
	Pedestrians	2	3
Noise and Vibration		1	1

4.4 Findings

By adding the rated impacts matrices from the above tables the less impeccable solution is rail overpass.

Table 4 - Findings

Possible solutions	Construction	Operation
Rail overpass	62	33
Road overpass	72	44

5.0 Existing Conditions

As mentioned in the project purpose, site inspections should be carried on in order to understand the current environmental conditions and estimate potential environmental issues. Several conditions are listed below.

5.1 Soil Quality

After site inspection, main features around the constructions site mainly covered by residential blocks are, an aquatic centre, a shopping centre and several parking lots located along the rail line and shopping centre.

In regard to the shopping centre, there is a high potential that the soil underlying the shopping centre may be contaminated due to several things. Firstly, dry cleaners and other chemicals may produce chlorinated or other organic solvents which are generally toxic to humans. Secondly, the high amount of traffic and parking volume may generate harmful gases and fuel leakage to the ground. Moreover, plastic waste generated by human may pollute the soil.

As for the aquatic centre, huge drainage system was built under the centre. It is highly likely that minor failures may happened to those pipes and small amount of water will leak into the soil and change the current soil profile. Moreover, chemicals such as chlorines would be utilized to clean the poor which is toxic and harmful if they leak into the soil.

5.2 Air Quality

As mentioned in the previous section, the surrounding area of the construction may generate several toxic chemicals which may not only pollute the soil profile but also the air. High traffic volume near the construction site and high energy consumption of the shopping mall may produce harmful gases and greenhouse gases.

5.3 Flora

According to the site inspection and satellite image, trees along the rail line and Morphett Road may need to be removed for both railway and road overpass options. No rare spices or vegetation have been identified in the construction area or the surrounding area which may require vegetation removals.

Figure 5- Project location satellite image for an initial look at the vegetation

5.4 Fauna

The project location has a significant amount of population and traffic volume, and highly paved ground surface with few vegetation. Even if this location cannot be defined as an ideal environment for animals, fauna still exists, which should be taken into account. After further investigation and surveying, result shows that no rare fauna species in the project area.

5.5 Noise and Vibration

After investigating the current noise level along the Morphett Road and Diagonal Road, it was found that there is in average of 80 dB, where areas like aquatic centre and shopping malls have relatively higher noise due to the high traffic volume, and lower noise level in residential areas. Considering heavy machines would be used in the construction site, noise and vibration level may become higher which requires further measures.

6.0 Environmental Subplans

6.1 Water Management

This section will discuss more details about the sub-plan which is relating to water management during construction and operation. The key focuses are drainage management, groundwater quality and storm water and local waterway quality.

6.1.1 Construction

6.1.1.1 Legislated Requirements for Water Management

The legislation will be implemented to the water management during construction, the detailed legislated requirements are listed below.

Table 5 - Legislated requirements for water quality

Relevant Legislation	Key Requirements
Environment Protection Act 1993 (SA)	Must not undertake an activity that pollutes or might pollute, the environment, without taking all feasible measures.
	Must not undertake an activity of environmental significance unless authorized.
Environment Protection (Water Quality) Policy 2003	Must not discharge or deposit a pollutant into any waters.

6.1.1.2 Drainage

Maintenance of adequate drainage are required to prevent flood and pooling of stagnant water during the construction. The relocation and maintenance of drainage routes around the site are required to ensure that the local residents are not affected by stagnant water or flooding after heavy rainfall. Extenuation measures are represented in the table below.

6.1.1.3 Groundwater Quality

It is very important to maintain and monitor groundwater quality during construction, as large numbers of people could be affected by serious issues, related to water supply. Issues that could occur include seepage from chemical spills into water tables. Extenuation measures are represented in the table below.

6.1.1.4 Storm Water and Local Waterway Quality

The site runoff needs to be retained and monitored until it reaches the standard because storm water and waterway quality are impacted during the construction. Extenuation measures are represented in the table below.

6.1.1.5 Water Management Controls During Construction

The required controls for water management during the project have shown below.

Table 6 - Water Management Controls(construction)

Impact	Controls
Disruption to drainage systems	Clean water alternatives must be prepared in advance to works.
Reductions in groundwater quality	See Section 7.9 on Hazardous Materials
Reductions in storm water and local waterway quality	Contaminants are to be tested regularly.
	Contaminants must be tested before approval.

6.1.1.6 Water Quality Targets During Construction

Targets for water management during construction have shown below in Table 7.

Table 7- Water management targets (Construction)

Objective	Target	Timeframe
Non-conforming storm water test results	Nil	Project lifetime
Non-conforming site runoff test results	Nil	Project lifetime

6.1.2 Operation

6.1.2.1 Water Management Controls During Operation

The details of mitigation measures for possible impacts to water quality during operation have shown below in Table 8.

Table 8 - Water management controls(operation)

Impact	Control
Possibility of quality degradation of storm water and waterway quality due to construction	Routine testing of storm water and waterways will be implemented at the end of each month by following 6 months of completion of construction, the water quality will be tested to ensure that it have not been negatively impacted during construction processes
	Water quality reports will be drafted and forwarded to the applicable bodies

6.1.2.2 Water Quality Targets During Operation

Water management targets for the operation of the project have shown below in table 9.

Table 9 - Water management targets (Operation)

Objective	Target	Timeframe
Growth percentage of storm water and waterway pollution due to construction	Nil	Ongoing

6.2 Soil Quality Subplan

This sub-plan will discuss the environmental impacts throughout operation and construction of Oaklands Park Grade Separation, in regard to soil erosion in the area.

6.2.1 Construction

6.2.1.1 Legislated Requirements

The legislated requirements for soil quality management is specified below.

Table 10 -Legislated Soil Quality Requirements

Relevant Legislation	Key Requirements
Environment Protection Act 1993 (SA)	Must not undertake an activity that pollutes or might pollute, the environment without mitigation measures.
	Follow EPA Guidelines
Environment Protection Regulations 2009 (SA)	Identify potentially contaminating activities, conduct site contamination auditors.
National Environment Protection (Assessment of Site Contamination) Measure 1999	Identify the uncommented provisions and amendments, modifications and provisions.

6.2.1.2 Erosion

Erosion in the construction process is a likely cause of vegetation removal, as the soil is being exposed, and often disturbed. In this situation, it is particularly sensitive to wind erosion. The wind causes three different processes of erosion which includes surface creep, saltation and suspension. Surface creep is where large soil particles are rolled across the soil surface which causes them to collide and dislodge with each other. Saltation occurs with middle-sized soil particles as it bounces over the surfaces which can cause abrasion, and suspension describes the process where tiny soil particles moved into the air by saltation and cause dust storms. The causes of these three processes of erosion will influence at different extents on the environment. The buildings, facilities and vegetation around the construction site would be covered with dust, and small dust storm will cause harmful effects to the respiratory system of nearby people.

Erosion due to water can also cause negative impacts from the disturbed nature of soil and removal of surface vegetation, this normally occurs when water flows and picks up fine soil particles. Furthermore, silt from construction needs to be treated properly to ensure it does not deposit into stormwater systems.

6.2.1.3 Soil Contamination and Quality

The surrounding building and facilities do not have the noticeable condition to affect soil contamination and quality, but it is possible that some chemical or fuel spills could cause soil contamination during the construction.

6.2.1.4 Soil Contamination Controls

The impact and mitigation processes for soil quality management during construction is shown below.

Table 11 -Soil Impact Controls

Impact	Controls
Erosion due to wind	Earth stockpiles will be covered or exposed less than 24 hours
	Exposed soil surfaces will be watered frequently in hot and dry weathers
	Erect silt barriers around the site perimeter
Erosion due to water	All stockpiled soil will be stored and cover during rain events
	Suspension of works will be executed during heavy rain events
	Silt fences will be utilized ensure silt does not move offsite due to flowing water
Soil contamination	All contaminated earth stockpiles will be shifted and placed on plastic liners
	The contamination of soil where excavated within 50m of service stations will be tested
	Manufacturer instruction must be followed to ensure correct maintenance of all plant
	All soil been identified as contaminated soil will be transferred to EPA licensed landfills unless they are confirmed as re-use materials on site
	See Section 7.9 on Hazard Materials

6.2.1.5 Soil Quality Targets

Soil management targets for the operation of project have shown below.

Table 12- Soil management targets

Objective	Target	Timeframe
Non-conforming test results at discharge points	Nil	Project lifetime
Received infringement notices	Nil	Project lifetime

6.2.2 Operation

6.2.2.1 Erosion and Soil Contamination

The erosive area will be paved to minimize erosion during the construction. In terms of soil contamination, it is not possible to eliminate soil contamination after the construction but the effects on it can be reduced to an acceptable level. Soil Contamination occurred due to the leakage of fuel from machinery, spillage of hazardous chemicals and the leaching of hot asphalt into the soil (Sadler et al 2008). There are no solutions to eliminate these contaminations but precaution can be taken to minimise it.

6.3 Air Quality Management

Air quality management is important for this project as the Oaklands Park Grade Separation will involve a lot of earthworks such as digging and transporting. It is vital to restrict the amount of dust and greenhouse gas to reduce the impact toward the surrounding. This part aims to investigate and identify the potential problems that contribute towards air pollution and the counter measure to it.

6.3.1 Construction

6.3.1.1 Legislated Requirements

The legislated requirement of the air quality during a construction at the site is shown below.

Table 13 - legislated requirements for air quality

Relevant Legislation	Key requirements
National Environment Protection Measure for Ambient Air 2003	Carbon monoxide, nitrogen dioxide, sulphur dioxide and particulate matter must not exceed the diameter of 10µm or less or 2.5µm or less
National Environment Protection Measure for Air Toxics 2004	Concentration of air toxins from specific sources must be specified
Environment Protection Act 1993 (SA)	Activity that will pollute the environment cannot be tolerated unless reasonable measure is taken
Environment Protection (Air Quality) Policy 2016	Pollutant concentration and the method to reduce it must be recorded

6.3.1.2 Dust and Fumes

Activities that will release dust and greenhouse gases on-site during the construction period are listed below:

- The use of machinery such as Excavator, grader etc.
- transportation of machinery, equipment, materials and waste to/ from the site
- Use of Solvents
- Waste Materials from site
- Wind erosion

6.3.1.3 Air Quality Controls

The table below shows the mitigation strategies that will be implemented during the project to ensure that the project meet the required air quality legislation:

Table 14 - Air Quality Controls

Impacts	Controls
Dust Generation	Section 7.2.2.1
Greenhouse Gas Emissions	Use another kind of clean energy such as gas and electricity. Reduce the usage of fuels
	Machinery must be serviced and maintained regularly
	Gases and smoke from the chimney of the plant must be monitored regularly and need to be fit with emission control equipment
	Carry out inspection regularly on the plant to ensure that it function properly
	Use electric driven Machinery

6.3.1.4 Air quality Targets

The targets complain and problems expected regarding the air quality during the project timeline have shown below in Table 15.

Table 15 - Air quality targets

Objective	Target	Timeframe
Notice of infringement notices from regulating body	Nil	Project lifetime
Exceedances of legislated requirements for air pollution	Nil	Project Lifetime

6.3.2 Operation

The emissions of greenhouse gas post construction will be reduced significantly at the railway and road overpasses because the driver does not need to stop at the intersection anymore. Green walls are also considered.

6.4 Flora management

The flora which exists along the footpaths on the rail line and Morphett Road in the project area is considered the primary flora and steps such as revegetation need to be taken to preserve these floras.

The project group had listed down the concerns that will affect the flora around the project site and came out with few solutions to deal with it.

6.4.1 Construction

6.4.1.1 Legislated Requirement

The legislation regarding the management of flora during the construction period has represented below in table 16.

Table 16 - Legislated requirements for flora management

Legislation	Key requirements
Natural Resources Management Act 2004	Any construction project that will affect the waterway in presence must obtain a Water Affecting Activities Permit before the project started. This also includes the vegetation around it
Native Vegetation Act 1991	Native South Australia Plant must not be disrupted unless permit granted
	Application and Permit needed to remove native vegetation.

6.4.1.2 Vegetation Removal and Impacts

From the project site, there are only small amounts of vegetation present but disrupting these vegetation's may also cause impact to the ecosystem. Below show the impacts that are expected if the vegetation's were removed or affected:

- Destruction of natural habitat.
- Introduction of foreign flora that will affect the current ecosystem.
- Soil Contamination through leakage of fuel and chemical products during construction.
- Affect the amenity of the areas which will cause frustration from the community.
- Leakage and spillage of hazardous chemical will cause soil contamination.
- Heavy machinery will compact and hurt the roots of the plant present.
- Worker and machinery stepping and driving on the vegetation.

6.4.2 Revegetation

Revegetation plays an important role in the project. The project team will implement a revegetation project to reduce and improve the affected area. This plan will meet all legislation process.

6.4.2.1 Objectives and Goals

- Develop a detail revegetation plan which includes a 10-year lifespan revegetation project.
- Only Australian and present plant species at the site will be considered.
- Investigate the soil, climate, topography, altitude and durability to find out the best plant to be planted at the site.
- Fence will be used to surround the revegetation areas to ensure that no personnel is allow to enter the areas.
- Use the carbon neutral status as a guide for the revegetation process to reduce the carbon footprint.

6.4.2.2 Flora Controls

The essential processes that ensure flora meet requirements with legislated requirements have detailed below in table 17.

Table 17- Flora Management Controls

Impact	Controls
Effect on the quantity and Quality of present Flora	Revegetation of the same species
Introduction of foreign species	Ensure that all machinery on site to be clean before enter the site.
	Introduce personnel in charge to assist with the cleaning of machinery before entering the site.
Soil Contamination due to leakage of hazardous chemicals.	Monitor the condition of soil time by time
	Precaution must be taken once leakage was reported
Soil Compaction	Design specified routes to move around the site to minimise the impact area
	Once the project is almost complete, soil aeration process should be taken for the revegetation process

6.4.2.3 Flora Management Targets

Flora management targets for the project have shown below in table 18 below.

Table 18 - Soil Management Targets

Objectives	Target	Timeframe
Removal of plant in the site	Permit must be granted before removing the plant	Entire Project
Introduction of foreign species	Zero	Entire Project

6.4.3 Operation

Impact on the local flora during the construction is minimal due to the present flora and the site is not much.

6.5 Fauna Management

There is limited fauna located on the project site but steps must also be taken to reduce the impact on the fauna. This section focus on the management of fauna at the site throughout the project timeline.

6.5.1 Construction

6.5.1.1 Legislated Requirements

The legislated requirements for the fauna management during construction have detailed below in table 19.

Table 19 - Legislated requirements for fauna management

Required Legislation	Key Requirement
National Park and Wildlife Act 1972	Before the project, studies must be taken on the fauna on site and a relocate plan must be developed to obtain permit from the department in charge to remove and relocate the fauna.

There are some potential impacts toward the local fauna

- Noise Pollution
- Soil Contamination which leads to water pollution around the site. Shifting of animals' habitat

6.5.1.2 Fauna Controls

The summary of impact and mitigation strategies for fauna management have shown below in table 20.

Table 20 - Fauna Management Controls

Impact	Controls
Shifting of the habitat of fauna	A report on the effect towards the fauna present will be developed in advance for the fauna removal.
	Opinions from specialist must be considered to reduce the impact on the fauna.
Toxification of fauna	Soil Contamination must be reported and precaution must be taken immediately
	Reduce the use of Hazardous materials, require someone expert to be on site when used
	Chemicals must be stored with cautious
Noise Pollution	Relocate the fauna before construction starts
	Reasonable precaution needs to be taken to reduce the amount of noise on the site.

6.5.1.3 Fauna management Targets

The fauna management targets for the project have shown below.

Table 21- Table Q: Fauna Management Targets

Objectives	Target	Timeframe
Fauna relocation before construction commenced	100%	Entire Project
Animals disrupted and harmed during the construction period	Nil	Entire Project

6.5.2 Operation

Minimal impacts on the fauna during construction if every step is taken and this project will also make fauna habitat to be safer compared to before after the project completed.

6.6 Noise and Vibrations

The following section of this document will focus on addressing the issues, impacts and mitigation measures associated with noise and vibration during the construction and operation of the Oakland park grade separation. These impacts include but are not limited to, the impact on local residences from untimely noise disturbances, disruption of daily activities and any damage impact from vibration or noise.

6.6.1 Noise

6.6.1.1 Noise Sensitive Businesses and Residences

The businesses and residential properties along the corridor where the construction and operation of the grade separation is planned will all be affected by increased noise and vibration during construction and operation. Additionally, should the demolition of any properties occur, the properties behind, will be exposed to higher noise and vibration levels due to the lack of shielding the demolished buildings once provided. Thus, these properties are impacted by noise and vibration. A list identifying these non-residential properties that are not directly in line with the corridor of works, has been established, and is as follows (table 22).

Table 22 - Considered Noise Sensitive Businesses

Non-residential property name	Location
Coles supermarket	Next to the sites construction corridor
Warradale hotel	Within 100m of site Corridor
Christ the king school	Within 100m of site Corridor
splodge	Next to the sites construction corridor
Lewis Prior	Next to the sites construction corridor
Shri Ganesh Temple	Within 100m of site Corridor
SA aquatic and leisure centre	Within 100m of site Corridor

6.6.1.2 Vibration Sensitive Businesses and Residences

Although there are guidelines on acceptable noise and vibration levels, some properties are going to still be affected by noise vibration. This can hinder the properties structural integrity, should it be particularly sensitive. Thus, a list of buildings that are estimated to be impacted has been made, with attention payed to any heritage listed or old buildings.

Table 23 - Considered Vibration Sensitive Businesses

Non-residential property name	Location
Coles supermarket	Next to the sites construction corridor
Warradale hotel	Within 100m of site Corridor
Christ the king school	Within 100m of site Corridor
splodge	Next to the sites construction corridor
Lewis Prior	Next to the sites construction corridor
Shri Ganesh Temple	Within 100m of site Corridor
SA aquatic and leisure centre	Within 100m of site Corridor

6.6.2 Noise and Vibration Modelling

Noise and vibration will be approached, with the method illustrated below. The model will accurately predict and manage the noise and vibration output during and after operation.

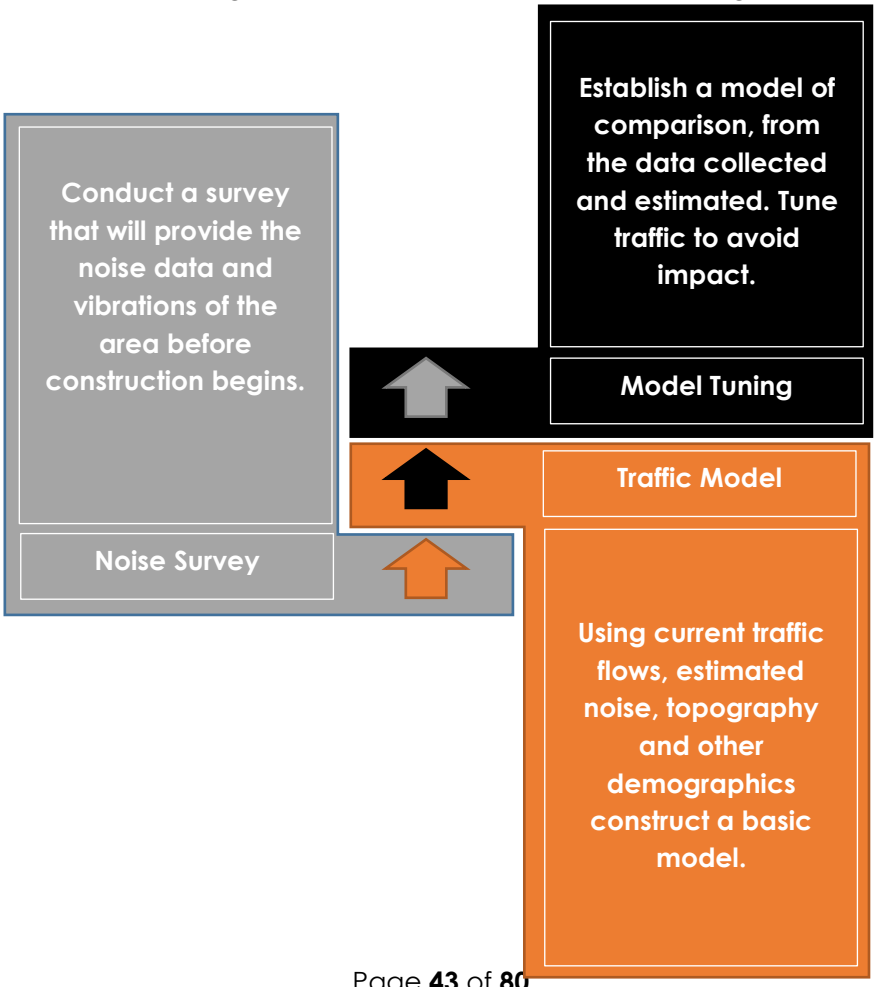


Figure 6- Noise modelling process

6.6.3 Construction

6.6.3.1 Legislated Requirements

Table 24, below contains the required legislation for the management of noise and vibration, during the construction of the Oakland parks grade separation.

Table 24 - Legislated Requirements for Noise and Vibrations

Relevant Legislation	Key Requirements
Environmental Protection act 1993	General environmental duty
Environment Protection (Noise) Policy 2007	• Compliance with Australian Standard AS 1259-1990 • This Division does not apply to (a) construction activity at or within the immediate vicinity of a site if development authorisation is not required under the Development Act 1993 in respect of any of the activities undertaken at the site; or (b) construction activity related to roads, railways or other public infrastructure
EPA Noise Information Sheet – Construction Noise April 2014	Working hours and recommended controls.
AS 2436 - Guide to noise and vibration control on construction, demolition and maintenance sites	General Recommendations

6.6.3.2 Construction noise restriction

The Oakland park grade separation is exempt from EPA Noise restrictions, due to the fact it is a public infrastructural work. This means working hours do not restrict this project, nevertheless, the scoping document for this project has highlighted the need for minimal disruption. Thus, the following time table has established to guide the works.

Table 25- Noise Restrictions

Day	Time	Short term works (2 days per week with 5 days' respite)	Medium term works (3 days per week with 4 days' respite)	Long term works (up to 5 days per week with 2 days' respite)
Weekdays	7am to 7pm	Reasonable precautions will be taken to minimise noise		
	7pm to 7am	Max 70 dB(A) Avg	Max 60 dB(A) Avg	Max 60 dB(A) Avg
Weekend	9am to 7pm	Reasonable precautions will be taken to minimise noise		
	7pm to 9am	Max 70 dB(A) Avg	Max 60 dB(A) Avg	Max 60 dB(A) Avg

The standards AS 2436 - Guide to noise and vibration control on construction, demolition and maintenance sites will be consulted with throughout the building process. Below is an example of one of the recommendations DPC Engineering will comply with.

Table 26 - TABLE C1 SOME NOISE SOURCES AND POSSIBLE REMEDIES (AS 2436)

Machine	Source	Possible remedies	Possible Alternatives
Piling equipment	Pneumatic/diesel hammer or steam winch vibrator driver	Enclose hammer head and top of pile inn acoustic screen, acoustically dampen sheet steel piles to reduce vibration and resonance	Alternative quieter method of piling.

6.6.3.3 Construction Vibration Restrictions

Although there are no numerical standards that dictate the maximum vibration allowed there is a rough guideline which discusses preventative measures. The following documents will be utilized in ensuring vibration is kept to a minimum.

- AS 2763.
- ISO 5349 Parts 1 and 2.
- Australian Safety and Compensation Council, National Code of Practice for Prevention of Musculoskeletal
- Disorders from Performing Manual Tasks at Work. Canberra, Commonwealth of Australia, 2007
- AS 2670.
- ISO 2631 Parts 1 and 5.
- Guidance on management and limiting exposure of both hand–arm and whole body vibration may be obtained from: EU Directive 2002/44/EC.
- Queensland Tunnelling Code of Practice 2007.

The general approach to deal with a validated complaint that vibration is to high is outlined below.

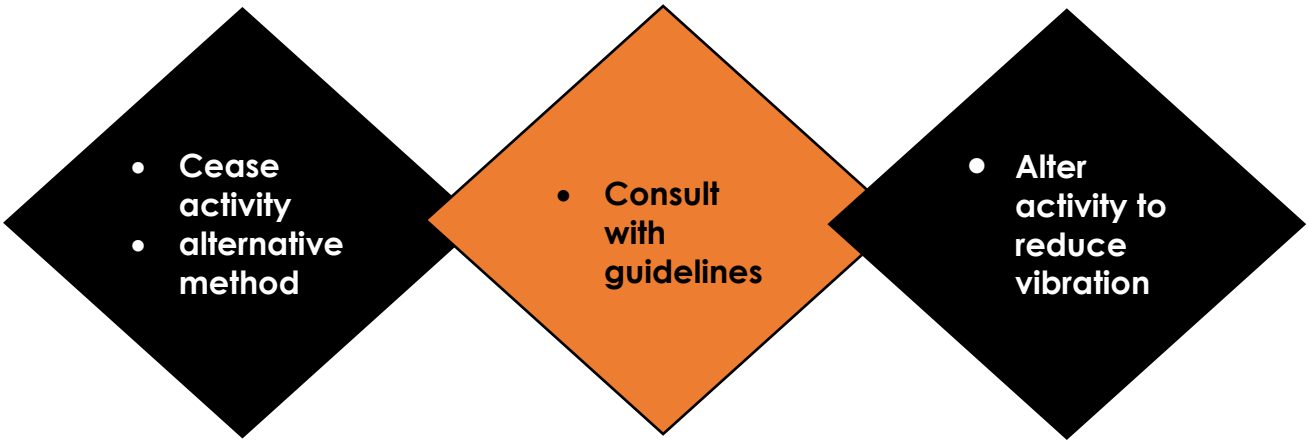


Figure 7- Vibration management steps

6.6.3.4 Vehicle Movements

To account for vehicle noise and vibration impacts, an alternate route will be constructed with the help of other relevant departments here at DPC engineering. Our aim will be to ensure all sensitive receivers are accounted for and construct a plan for each class of vehicle.

6.6.3.6 Noise and Vibration Controls

Table 27 below specifics the environmental impacts and mitigation processes for noise and vibrations during construction.

Table 27 - Noise and Vibration Controls

Impact	Controls
Sleep disturbances and general discomfort/annoyance due to increased received noise levels	Refrain from using loud equipment where appropriate.
	Monitor and minimise
	Follow the guidelines outlined above for noise levels
	Comply with AS 2436 - Guide to noise and vibration control on construction, demolition and maintenance sites
	Plan haulage routes with sensitive receivers in mind and use them wherever possible
	Hire Sound Barriers for Construction site perimeter (DEFINED IN AS 2436)
Discomfort due to vibration & Damage to structures due to vibration	Comply with AS 2436 - Guide to noise and vibration control on construction, demolition and maintenance sites

6.6.3.7 Noise and Vibration Targets

Table 28 below specifics the noise and vibration targets for the project.

Table 28- Noise and vibration targets (construction)

Objectives	Target	Timeframe
Number of noise related complaints	< 5	From Start to finish
Number of non-compliances with noise and vibration regulations	None	From Start to finish

6.6.4 After Construction and During Operation

Due to the known impact that noise and vibration can have both during and after construction a monitoring period will need to occur during the operation of the Oakland park grade separation. A monitoring stage of 6 months, will ensure that no unreasonable disruption occurs. Both of the feasible options; the rail overpass and the road over pass will present noise from the train, vehicle (in the form of bulk traffic noise) and the noise produced by each individual vehicle. The mitigation measures and guidelines will still be in compliance 6 month after commissioning of the project and will be discussed in the following subplan.

6.6.4.1 Comparison with pre-construction

An assessment of the noise and vibration levels, pre-construction will be completed, following the noise and vibration modelling model above to allow for a comparative measure of before and after construction. If possible, noise and vibration levels after-construction will be equal to or lower than the noise levels pre-construction. The subsequent aspects that impact the volume of the expected road noise during operation are:

- Road grades (Hight dependent)
- Traffic lights
- Pavement material type
- Sound barriers

6.6.4.2 Noise and Vibration Controls (Operation)

Table 29 specifics the mitigation measures during construction to ensure that noise levels during operation are minimised as much as practicable.

Table 29 - Noise and vibration Controls (Operation)

Impact	Controls
noise levels effecting local businesses and residents	Reduce road Grades
	Reduce traffic lights
	Select pavements materials that produce lower volumes of road noise.
	Assembly of sound barriers

6.6.4.3 Noise and vibration Targets During Operation

Table 30 below details noise and vibration targets for the operation phase of the project.

Table 30 - Noise and vibration targets during operation

Objective	Target	Timeframe
Noise levels during operation	To not exceed levels prior to construction	Start till 6 month after operation

6.7 Waste Management

It is in this subplan that the management of waste materials, along with the impact from these materials from the project, which will be addressed. Considerations on the impact to the project, key stakeholders and the business and residences will be reviewed.

6.7.1 Construction

Project related waste products have been identified and are specified in Table 31 below. The identification of these materials stems from the examination of similar projects.

Table 31 - Waste Producing Activities

Source	Hazard	Risk
Construction stage	Generation of waste product	Soil and water contamination
Machinery maintenance	Generation of waste oil and coolants	Soil and water contamination
Operation and maintenance of site facilities	Generation of general wastes	Soil and water contamination and unclean amenities.

6.7.1.1 Waste Sectors

Complying with the South Australian Environmental Protection Act 1993, all waste defined to be discarded, rejected, abandoned or is considered unwanted or surplus, will be managed appropriately within the guidelines. This is irrespective of how it will be utilized later on, i.e., for sale, recycling, reprocessing or recovery. The Waste Streams are identified in Table 32 below. All waste subjected to recycling processes, will be actioned if feasible, to ensure the waste is minimised. The EPA Listed Waste, requires that the waste movements be tracked through the use of EPA Waste Transport Certificates.

Table 32- Waste Sectors

Waste stream	Classification
General Wastes	Recoverable
Construction and demolition waste	Recoverable
Concretes	Recoverable
Asphalt	Recoverable
Metals & Timbers	Recoverable
Funa and flora	Recoverable
Contaminated Soil	EPA Listed
Clean Fill	Recoverable
Grease and Oils	EPA Listed
Hazardous Waste	EPA Listed
Rubbers & Plastics	EPA Listed
Dewatering/groundwater pump out	EPA Listed

6.7.1.2 Legislated Requirements

The Project is subject to the following (table 33);

Table 33 - Legislated requirements for waste management

Relevant Legislation	Key Requirements
Environment Protection Act 1993 (SA)	must not undertake an activity that pollutes or might pollute, the environment unless the all reasonable measures to prevent or minimise the action is taken.
Environment Protection (Waste Resources) Policy 2010	Must not dispose of waste except at; licensed or approved depots Council kerbside waste collection services EPA-authorised incinerations Specified Sites provided there is no risk of land contamination
	Must not dispose of waste at a landfill unless the waste has been subject to, resource recovery processes.
	Must not dispose of prohibited landfill waste at a landfill depot, unless approved by the EPA
	Cover, contain or secure the waste, and ensure no leakage from the vehicle during transport
Natural Resources Management Act 2004	Permit is requirements

6.7.1.3 Waste Management Controls

DPC Engineering's waste management is managed in conjunction with the relevant legislations and guidelines above. A hierarchy with the aim of minimising the amount of recoverable waste that gets placed into landfill is explained below with the aid of a hierarchy model DPC Engineering adheres to;

- Reduce – Minimize the waste output
- Re-use – Re-use any waste in accordance with EPA guidelines
- Recycle – Avoid land fill, place for recycling if applicable
- Recover – Control what is actually recovered
- Remedy – Treat any contaminated waste, in accordance with the standards
- Remove – Dispose to certified landfill depots.

Figure 8 - Waste Control methodology

A list of the environmental controls to be implemented are Specified in Table 34.

Table 34 - Waste Management Controls

Impact	Control
Waste production pollutants	Project induction is to Include information on waste management and mitigation requirements.
	All wastes need to be classified, stored, tracked, transported and treated in accordance with legislative requirements.
	A Waste Transport Certificate must be produced for all Listed wastes.

Impact	Control
Waste production pollutants	Waste storage containers must facilitate the appropriate separation of waste.
	Concrete Cleaning water is not to be discharged to land or stormwater.
	All contractors are required to provide waste data statements.

6.7.1.4 Waste Management Targets

The legislative requirements and the potential impacts are specified in Table 35 below;

Table 35 - Waste Management targets

Objective	Target	Timeframe
Waste transport certificates	100% compliance	Ongoing
Infringements/penalties received	Zero	Ongoing
Volume of spoil diverted from landfill	90%	Project life cycle
Volume of non-hazardous materials diverted from landfill	Approx. 90%	Project life cycle

6.7.1.5 Waste Monitoring

DPC engineering waste monitoring system, involves the continual collection of data on the project, supplemented with monthly reports on the following elements;

- Volume and types of waste which is sent to landfill
- Volume of waste which is recycled or reused
- Volume and type of listed waste which was generated by the project
- Destination records of waste transported
- Records confirming the transport, treatment and/or disposal of waste

In conjunction with the above documentation, the utilization of site Inspections will be carried out by the environmental team on a weekly basis. This allows for the monitoring and evaluation of the system to be checked, along with a concluding statement to be released at the end of each month.

6.8 Energy Use

The following subplan aims to address the use and impact of energy and greenhouse gas (GHG) emissions produced on the project. This will be achieved by monitoring the emissions used, by identifying and measuring the emissions released into the atmosphere. This will then be followed by the evaluation of possible opportunities to reduce emissions and improve energy efficiency.

6.8.1 Construction

6.8.1.1 Energy Consumption

Project specific activities that emit large amounts of GHG are shown in Table 36 below:

Table 36 - Energy Emissions and GHG

Emission Source	Fuel Used
Transport	Diesel
Earthworks Machinery	Diesel
Power Generators	Diesel
Lighting / Security Electronics	Electricity

6.8.1.2 Energy Use Targets

Established around DPC Engineering's risk management process, the following energy consumption and emissions targets have been set for the project.

Table 37 - Energy targets

Objective	Target	Timeframe
Implementation of energy efficiency measures	Every quarter	Life of project
Fuel Record	All Fuel usage is to be recorded	Life of project
Reduction in energy use	As much as feasibly possible	Life of project

6.8.1.3 Energy Use Controls

Controls employed to reduce energy use and GHG emissions are illustrated in Table 38.

Table 38 - Energy Use Controls

Impact	Controls
Emissions	All energy use will be recorded, tracked and evaluated
	Opportunities for improving energy usage are assessed and a report is prepared.
	Contractors are required to implement energy efficiency initiatives. Furthermore, they are required to provide energy use reports.

Note that the monitoring of the project's energy use and emissions is guided by government legislation.

6.9 Hazardous Materials

The following subplan aims to accurately estimate the impact of hazardous materials on the environment as a result of the project. furthermore, the management procedures and controls to eliminate and/or mitigate their effects will be outlined.

6.9.1 Construction

DPC Engineering has identified the plausible actions which may produce or uncover hazardous materials during the construction stage, all of which are provided in the Table 38 below:

Table 39 - Hazards and risks from hazardous materials

Construction Activity	Hazard	Risk
Operation processes	Use of hazardous materials	Soil / water contamination
Excavation	Old buildings could uncover asbestos and other contaminants	Soil/water contamination

6.9.1.1 Hazardous Materials

A list of hazardous materials likely to be relevant to our project are shown in Table 40 Below

Table 40 - Hazardous Materials and their locations

Material	Site Location
Chemicals (Dangerous Goods)	Along existing corridor of construction
Petrol and fuels	Along existing corridor of construction
Asbestos	Along existing corridor of construction

6.9.1.2 Legislated Requirements

The Project is required to comply with the following regulations specified in table 41 bellow.

Table 41 - Legislated requirements for Hazardous material

Relevant Legislation	Key Requirements
Environment Protection Act 1993 (SA)	Must not undertake an activity that pollutes or might pollute, the environment unless s all practicable measures to prevent or minimise any resulting environmental harm is taken.
Dangerous Substances Act 1979	Must not keep a prescribed dangerous substance in any premises without a licence. Storage of flammable liquids must comply with AS 1940.

6.9.1.3 Hazardous Materials Controls

Table 42 below details the hazards posed by different hazardous materials and the associated controls.

Table 42 - Hazardous material controls

Hazard	Control
Chemicals & Fuels	MSDS forms and data is compulsory.
	Induction will cover important chemical handling and procedures.
	Storage and handling will be handled in accordance with the appropriate legislation and MSDS recommendations.
	Bunded areas is to be utilized where necessary.
	Spill kits and training on their use is a requirement.
	Refuelling must not occur within 20m of a waterway, unless plant cannot be moved, in which case the refuelling must be approved.
Chemicals & Fuels	Weekly inspections.

Hazard	Control
	An Emergency Response Plan shall be sustained during the project
Asbestos	Training on Identifying asbestos shall be implemented where necessary.
	If asbestos is found all works are stopped and the relevant mangers are to be advised for further action.

6.9.1.4 Hazardous Materials Targets

DPC Engineering aims to minimise risk, through the use of our management procedures. By understanding the perceived impacts to the stakeholders involved in this project, the following targets have been set.

Table 43 - Hazardous Material Management Targets

Objectives	Target	Timeframe
Hazardous/toxic spills	None	From Start to finish
water quality of stormwater systems	None	From Start to finish
Asbestos impacts	None	From Start to finish

6.9.1.5 Hazardous Materials Monitoring

DPC environmental division has ensured that all hazardous Materials will be monitored in compliance with the legal requirements, outlined in Dangerous Substances Act 1979. Our competent and certified employees have the task of monitoring and identifying any risk, misconduct or complacency during the project. Incident reports will be assessed and acted upon swiftly. The following consideration shall be taken into account;

- Where applicable asbestos, and the spread through air related tasks will be monitored
- Site Inspections are a mandatory, weekly task.
- Non-compliance will need to be acted upon and a corrective action report produced.
- Monthly environmental management reports are to be conducted by our staff.

6.10 Community Management

Due to the scale of this project, it is inevitable that there will be some negative environmental impacts on the community. Through careful planning of prevention and mitigation strategies,

these impacts may be reduced but may not be entirely avoided. It should be noted that all other subplans include provisions for community management where appropriate for that subplan.

The following areas have been identified as being of particular concern with respect to community management:

Aboriginal and Non-Aboriginal Heritage

General Aesthetics and Landscape

6.10.1 Construction

6.10.1.1 Legislated Requirements

Table 44 below specifies the relevant legislated requirements for community management.

Table 44 - Legislated requirements for community management

Relevant Legislation	Key Requirements
Burial and Cremations Act 2013	Exemption is required to disturb bodily remains if found.
Aboriginal Heritage Act 1988	Must not damage, disturb or interfere with any Aboriginal site or object, without approval.

6.10.1.2 Indigenous Heritage Subplans

Although there are no known Aboriginal heritage sites within the construction area, the land once did belong to the Kaurna people. They are the indigenous inhabitants of the land, and are recognised by todays current government, thus, a plan must be in action to deal with the possibility that any indigenous objects or remains are found during construction. The two following subsystems shown in figure10 and figure 11 below, illustrates the steps taken by DPC Engineering on the matter.

Figure 9 - Aboriginal map

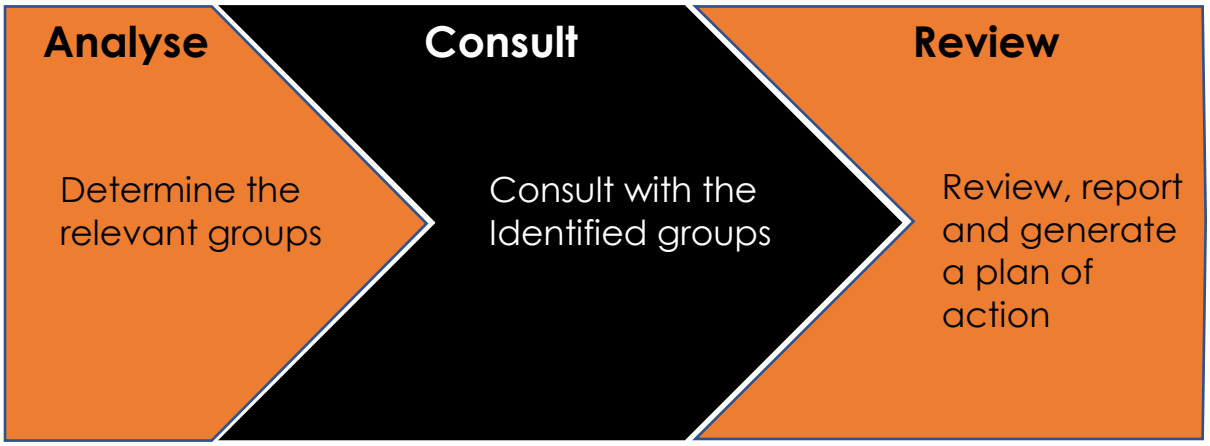


Figure 10 - Aboriginal heritage survey process

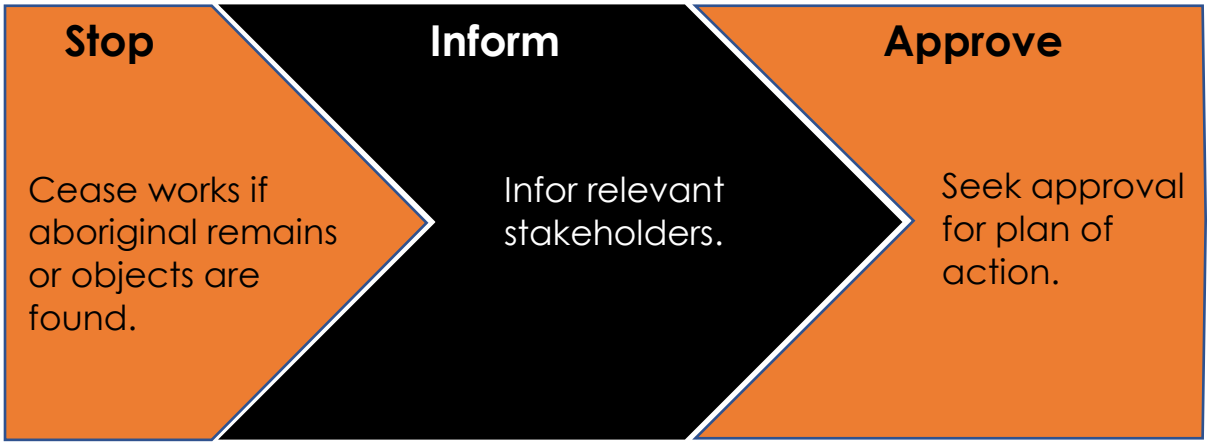


Figure 11 - Aboriginal Artefact or Remain Recovery Plan

6.10.1.3 Aesthetics and Community Engagement

Throughout the project DPC Engineering aims to cooperatively build a project that best projects what the community in the area wants, building a vibrant hub, as outlined in the 30-year plan for greater Adelaide. To ensure this plan is achieved, the design, construction and operation stages of the project, will need approach the impact on the landscape and aesthetics of the project in both an environmental mindset and a community one as well.

Discussing design points such as lighting, barriers and landscape character, with the community can allow for a collaborative effort, that strengths community involvement throughout the project. Allowing DPC Engineering to produce a project that is mindful of the existing vegetation and landscaped, while also engaging the local residents and businesses that will be impacted.

6.10.1.4 Community Engagement Controls

Table 45 below specifies the impacts and controls relevant to the management of the community during the project.

Table 45 - Community Management Controls

Impact	Control
Disturbance of Aboriginal Heritage Sites	Survey the area and proceed with the steps outlined in figure 10 and Figure 11
	Object of aboriginal significant must not be disturbed without permission.
	Training on the relevance and procedural steps to take for aboriginal heritage and culture will be undertaken where necessary.
Reductions in landscape aesthetics	If Feasible, preserve existing landscaping and vegetation
	Inclusion of the public's view throughout the project is mandatory.
	Continual assessment of the visual aspects during construction, along with a plan of action is advised.

6.10.1.5 Community Management Targets

Table 46 below specifies, community management targets.

Table 46 - Community management targets

Objective	Target	Timeframe
Disruption to Aboriginal artefacts, without following process set by DPC Engineering in guidance with government legislation.	Zero	From Start to finish
Complaints	Zero	From Start to finish

6.10.2 Operation

6.10.2.1 Aboriginal Heritage & lasting Aesthetics

DPC Engineering aims to not only consider aboriginal heritage during construction, but also the lasting effects of the project, when it is up and running in operation. In conjunction with the 30-year plan of greater Adelaide, creating a vibrant community hub can be achieved by designing an environment that supports aboriginal heritage, through vibrant art works and a landscape that reflects the community.

7.0 Road and Rail Overpass Specific Subplans

7.1 Shading

Shading is an inevitable problem that cause negative impacts to nearby environment associated with the overpass, some major impacts of shading are listed below:

- Diminishing the efficiency of nearby solar power systems.
- Causing localised changes of climate under overpass.
- Increasing rates of soil erosion.
- Causing negative effect to growth of vegetation.
- Reducing the value of nearby properties.
- Reducing range of visibility and aesthetic.

The control and mitigation of shading is difficult to implement due to the design of overpass. However, microinverters optimiser can be assembled to nearby solar power systems that solving the problem of solar efficiency in order to minimise the effects of shading.

7.2 Environmental Friendly Materials

There are a lot of materials can be used for the construction of this project. Every material has its own purposes in the project. However, some of these materials can be replaced by other sustainable and environmental friendly materials.

In this project, the project team plans to construct a concrete overpass. Materials such as recycled steel can be used for the pre-made steel reinforcement. Recycled steel is cheaper and share the same properties of new steel from the factory. Manufacturing of steel need a lot of fuels to melt down and shape the steel. Burning of fuel can released a lot of greenhouse gasses that could harm the environment. Using recycled steel can also reduce the amount of waste going to landfill. Steel is non-biodegradable and will have long lasting effect towards the environment.

Another material that can be replaced are the aggregate for the road pavement. Asphalt pavement is environmental friendly because it requires less energy to construct compare to other pavements but recycle asphalt pavement can be a better option for this project.

Materials such as glass, recycled rubber or sand can also be considered. By using sustainable materials in this project, the greenhouse gas emission can be reduced and these will have positive impacts toward the environmental.

7.3 Noise Barrier

Sound pollution can be a major problem and cause disturbances to the properties near the construction site. Noise pollution can cause a lot of health problems such as stress, sleep disturbance, high blood pressure and hurt your hearing abilities. The construction site of this project is close to resident and business properties. In this project, there will be a lot of machineries used for earthwork and logistic properties. If the noise is too loud, it will cause a lot of complaints and fines from the community and the government, therefore to avoid complains, temporary noise barrier need to be set up around the construction site to reduce the amount of noise.

Figure 12- Noise Barrier (Heras 2017)

Noise barrier, sound wall or acoustical barrier is an exterior structure designed to protect and reduce noise pollution to the community who lived nearby. By setting up a noise barrier around the construction site, the amount of noise that will reach places outside the construction site will reduce significantly, such as the example in figure 12 above. With the noise barrier around the construction site, it will increase the project period where workers and contractors can work for a longer duration especially during night time. Noise barriers proves to increase the efficiency and profits of the project especially during summer where workers could not work during the hot afternoon. These noise barriers will provide a good soundproofing effect to ensure that the noise would not be too loud and affect the communities living nearby. Noise barrier can also control the spreading of dust from the construction site. Noise barrier act as a

wall to trap the dust in the site and prevent strong winds to blow into the site. These noise barriers can also be reused after the projects for other project.

8.0 Optional Additional Environmental Innovations

8.1Green Roof

As mentioned in previous sections, construction sites and surrounding areas are subject to high traffic volume, in other words, large amounts of harmful exhaust gases and greenhouse gases are discharged into atmosphere. These gases would consequently cause a detrimental impact to environment. To improve the air quality, green roofs can be implemented, in places such as the station roof, and even carpark shelters for the train station.

Comparing a normal roof to a green roof, shows that a green roof is partially or completely covered with vegetation and a growing medium, planted over a waterproofing membrane. There are two types of green roof: intensive roofs, which are thicker, and can support a wider variety of plants but are heavier and require more maintenance, and extensive roofs, which are shallow, and lighter than intensive green roofs, and require minimal maintenance. DPC Engineering recommends a extensive roof for both of the feasible options.

Figure 13 - Green roof

Furthermore, green roof can be effective in high density of population distinct due to the following reasons. Firstly, plants on roofs can decrease urban air temperatures and secondly, it can absorb rainwater to decrease storm water runoff and filter pollutants and heavy metals

out of rainwater. Green roof can also absorb the carbon dioxide and pollutants, helping in highly paved area.

8.2 Swale

A swale is a graded and engineered landscape, that are used with plants that are have high flood tolerance and erosion resistance. Swales can be used to control stormwater at a slower rate and capture runoff. Swale can also benefit vegetation planted along the swale, moreover, these swales can act as a filter removing pollutants in rainwater and promote air quality. Swales are commonly implemented around parking lots where automotive pollutions will be flushed by rain.

Figure 14 - Grassed Swale

8.3 Permeable Paving

Permeable paving is a range of permeable materials and techniques for pavements with a base and subbase that allow the storm water to go through the pavement. The goal of using permeable paving is to reduce surface runoff, trap suspending solids and filters pollutants from water. This paving can be used in roads, paths and parking lots with light vehicular traffic, cycle paths, lane and residential sidewalks.

Figure 15 - Permeable Paving

There are several benefits from applying permeable paving. One of them is to manage the surface runoff and decrease erosion while the other one can be count on controlling pollutants. The permeable paving surface can trap pollutants such as heavy metals in the soil or other materials, underlying the roadway. Furthermore, permeable pavements can give the space for plants to grow their roots which can decrease the surface runoff and stabilize the soil.

9.0 Implementation and Costing

DPC Engineering has conducted an initial costing estimates based on our experience from other projects and by consultation with the relevant parties, for the control measures listed in **section 7** of the report. Please be advised that all costings are subject to change.

9.1 Construction Implementation and Costing

The below table contains the implementation of the controls mentioned in **section 7**, during the construction, accompanied by its estimated costs.

Table 47- Controls Costing for Water Quality (During Construction)

Impact	Controls	Cost
Stormwater Quality	• Runoff at site will be tested	$45,000
	• Retention of site runoff until deemed safe.	$175,000
Disturbance of drainage flows	• Separation of drainage flow from site will be built to stop runoff from joining the storm water drainage used by the community.	$100,000
Estimated cost		$320,000

Table 48 - Controls Costing for Soil Management (During Construction)

Impact	Controls	Cost
Wind erosion	• Soil stockpiles will be kept safe to avoid erosion. • Watering at site to prevent wind erosion. • Fences will be built as needed	$250,000
Water erosion	• Fencing to help stop soil moment.	$75,000

	• During heavy rain, work will stop and soil will be covered.	
Contamination To Soil	• During construction Soil will be regularly tested for contamination • All contaminated soil will be dispose properly • EPA instruction will be followed to prevent contamination.	$500,000
Estimated cost		$ 825,000

Table 49 - Controls Costing for Air Quality (During Construction)

Impact	Controls	Cost
Greenhouse gas emission	• Clean energy like electricity will be used. • All vehicle and mechanical device that run through fuel and energy will be maintained regularly. • Appropriate emission control equipment will be installed. • The plant or any other equipment will not be used if they produce smoke for longer time than expected.	$150,000
Estimated cost		$150,000

Table 50 - Controls Costing for Flora (During Construction)

Impact	Controls	Cost
Local flora and its quantity	• Revegetation program around project area	$1,120,000
Machines leaks and damaged vegetation through polluting	• Making sure all machines will be well maintained prior to work and emergency prevention procedures will be used.	$100,000
Estimated cost		$1,220,000

Table 51 - Controls Costing for Fauna (During Construction)

Impact	Controls	Cost
Relocation of Fauna	• Before cutting down any tree or vegetation, inspection will be done to check bird nests or animals • If there is any nest or animal discovered they will be transfer to another safe place. • Chemicals and any-other harm full substance will be used safely	$15,000
Estimated cost		$15,000

Table 52 - Controls Costing for Noise and Vibration (During Construction)

Impact	Controls	Cost
Increases of noise can disturb peoples sleep and create discomfort	• Use sound barriers • Minimise noise by not using machines that produce high level of noise, unless necessary. • Follow the guidelines. • Minimise the number of working hours at night.	$125,000
Vibration disturbance and structure damage	• Not using the equipment that generates vibration more than average level. • Keep checking the vibration level all the time during the construction • Implementing the strategies that reduce and maintain the vibration to low level.	$75,000
Estimated cost		$200,000

Table 53 - Controls Costing for Waste(During Construction)

Impact	Controls	Cost
Waste production during the construction	• Waste management training and induction are provided to all the staff prior of project. • Wastes are classified and transfer to the waste management centre according to the company waste management regulation. • Regularly check contamination of chemical and toxic stuff in waste. • Any kind of waste is not permitted to burn and not allow disposing in ground or anywhere other than waste disposal place. • For different types of waste different types of storage containers are provided in site. • Water that use to clean concrete and concrete will not allow to discharge in ground or stormwater. • Tracking of transported waste	$3,220,000
Estimated cost		$3,220,000

Table 54 - Controls Costing for Energy Emissions (During Construction)

Impact	Controls	Cost
Greenhouse gas emission through energy use	• Keeping record of all energy uses, • Minimise using fuel, diesel or gasses • Implementing the energy saving strategies • Use environmentally friendly equipment like electric equipment and minimise using the equipment that run from gas or diesel or fuel.	$15,000
Estimated cost		$15,000

Table 55 - Controls Costing for Hazardous Materials (During Construction)

Impact	Controls	Cost
Spilling chemicals	• Prior to work. all staff will get training on chemicals hazard. • Respond team will be provided for chemical spills. • Before introducing any chemical on the construction site environmental management team and chemical management team will examine. • Spill kit will be provided. • Chemical disposal contractor will be hired to dispose remaining chemical in proper way.	$750,000
Asbestos	• Induction will be provided to all staff about asbestos. • If asbestos is discovered on site the work will stop to dispose the asbestos and to make sure the site is safe again • Asbestos removal contractor will be hired to remove the asbestos from site.	
Estimated cost		$750,000

Total estimated cost	**$6,415,000**

9.2 Construction Targets

The table below specifies DPC Engineering's construction targets for the project.

Table 56 - Construction targets for Grade Separation

Objective	Target	Timeframe
Water		
Compliant Site contaminant and stormwater test result	100%	Lifetime
Drainage disturbance	Zero	Lifetime
Soil		
Soil Erosion as a result from our project	Zero	Lifetime
Contamination	Zero	Lifetime
Flora		
Lost tree or vegetation	Only justified and approved vegetation will be cleared	Lifetime
Machine leaks and damage vegetation record	Zero	Lifetime
Fauna		
Relocate the animal	100%	Lifetime
Record of animal harm	Zero	Lifetime
Noise and vibration		
Complain about noise pollution	Zero	During constructions
Complain about vibration	Zero	During construction
Noise and vibration damage	Zero	Lifetime
Waste management		
Waste management training	100%	Prior to project
Penalties or fine on waste management	Zero	Lifetime
Implementing waste management procedure	100%	Lifetime
Toxic waste generation during construction	>5%	Construction period
Non-toxic waste	>90%	Construction period

Energy use		
Minimising the uses of non-environmental friendly energy	100%	Lifetime
Record of all energy use	100%	Lifetime
Chemical and asbestos		
Spill of chemical	Zero	Lifetime
Identifying asbestos	Zero	Lifetime
Taking care of chemical and dispose the remaining in a right way	100%	Lifetime

9.3 Operation Implementation and Costing

Table 57- Controls Costing for Water Quality (During Operation)

Impact	Controls	Cost
During the construction stormwater and local waterways might be affected	• A year testing of stormwater and local waterways will be done to make sure water quality is good and it's not affected by construction • Water quality report will be published	$70,000
Estimated cost		$70,000

Table 58 - - Controls Costing for Noise and Vibration (During Operation)

Impact	Controls	Cost
Noise and vibration during operation	• Building the sound barriers • Using the road pavement that prevent noise and vibration • Reduce traffic lights	$50,000
Estimated cost		$50,000

9.4 Operation Targets

Objective	Target	Timeframe of project
Stormwater		
Increase the record of affected water quality	Zero	Lifetime
Noise and vibration		
Complain about noise pollution	1-5 per week	During operations
Complain about vibration	1-5 per week	During operation
Noise and vibration damage	Zero	Lifetime

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