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EIA – Environmental Impact Assessment

An Environmental Impact Assessment is a process in which detailed information about effects on the environment due to construction works is gathered, assessed and then considered by the company on whether the decision to carry out the works can go ahead. The purpose of this assessment is to improve on the quality of decision making, by identifying potential environmental issues early on in the project. An environmental statement on the EIA must be provided, to describe the proposed development. Information that must be included consists of:

- The overall purpose and the specific aims of the development
- Physical characteristics of the development
- Production process that will be involved
- Levels of waste and emissions likely to arise from the development
- Consider which types of alternatives that could be proposed for the development, that could potentially be more beneficial for the environment.
- A study of the environment of potential areas which could be affected prior to the project, so that the possible effects can be measured.
- A prediction of possible significant effects due to the development such as, air quality, visual and landscape aspects, ecological impacts, hydrogeology, transport and economic impacts.
- Make a clear distinction between the significance and magnitude of the environmental impacts which could occur.
- Make a description of measurements which are in place to avoid or reduce the significance of the effects that the development will have on the environment.
- Clearly document all efforts which were taken to reduce or stop the environmental effects.

Environmental Factors

In projects that require an Environmental Impact Assessment (EIA), a scoping process will be carried out early in the project's planning stages. This helps the project to prevent or reduce adverse effects on the environment, which offers an incentive to integrate meaningful environmental change into the project. The EIA Directive allows the EIA to 'identify, define and analyse the direct and indirect impact of a project on the following aspects: human beings, flora and fauna; water, earth, atmosphere, landscape and weather, also material properties such as cultural heritage.

A variety of factors are crucial to investigate when doing an EIA. One of these factors being the quality of surface water during on-site operations. Building practices can promote soil erosion and raise the sediment loads, while unintended fuel/oil leakages from vehicles and facilities can also pollute surface waters.

Construction operations may also have major impacts on hydrology and safety of the groundwater. The site could potentially require drainage to provide the suitable condition for infrastructure work to proceed, resulting in temporary changes to the ground flow. During building works, soil tainted by prior land usage may also be disrupted, allowing contaminants such as heavy metals to penetrate the earth and surface.

Water

Activities and potential impacts

Potential receptors of impact	**Construction phase**	**Operation phase/ongoing site maintenance**	**Decommissioning/post-operation**
Surface water hydrology and channel morphology	**Use of vehicles and machinery** • Increase of surface drainage from compaction of the soil **Works next to or near water** • Increased erosion and changes in bed and bank stability • Increased flood risk **Earthworks** • Increased sedimentation	**Physical presence of bridge** • Increase of flood risk	**Site drainage** • Increase in surface runoff from bank areas during decommissioning due to soil compaction • The possible increase of a flood risk

Surface water quality	Earthworks • Pollution from material disturbance of contaminated soil and related pollution **Materials management** • Pollution from petrol spills or fires, gasoline and building materials.	**Physical presence of bridge** • Reduction in the water quality	**Materials management** • Pollution of the water from spillages of fuels and oil cause by vehicular activities
Groundwater hydrology	**Earthworks and site drainage** • Reduction in water table • Changes to groundwater distribution and flow	**Physical presence of bridge** • No significant impact	**Materials management** • Pollution of the surface water from spillages of fuels and oil cause by decommissioning vehicular activities

Land

Landscape	**Excavations and earthworks** • Creation of a new landform	**Physical presence of bridge** • Change of surrounding landscape	**Decommissioning** • Temporary visual impacts due to work being carried out on site
Soils	**Use of vehicles and machinery on site** • Compaction • Erosion **Earthworks** • Further erosion of the exposed soil • Removal of the soils on site for the bridge	**Use of vehicles and machinery for on-site maintenance** • Soil erosion • Soil compaction	**Use of vehicles and machinery on site** • Compaction • Erosion **Decommissioning earthworks** • Further erosion of the exposed soil • Removal of the soils on site for the bridge
Geology	**Excavations**		

	• Removal of soils and rocks		

Air

Local air quality	**Use of vehicles and machinery** • Emissions from construction site work • Emissions from vehicular usage such as excavators and dump trucks. • Dust generation	**Use of vehicles and machinery for on-site maintenance** • Short term exhaust emissions, with no major impacts.	**Decommissioning activities** • Temporary emissions associate with vehicles
Regional/global air	NO IMPACT	NO IMPACT	NO IMPACT

Aquatic wildlife

Aquatic life	**Drainage works and use of vehicles** • Negative impact on flora and fauna from increased sedimentation. • Possible impact on aquatic habitat due to Cofferdam construction **Materials management** • Harm to marine life as oil and fuel spills can occur during construction. Also, dangers from cement and other substances.	**Physical presence of Pier/preconstruction cofferdam** • Dangers to marine life as the cofferdam placement could affect the natual habitat of fish, which could decrease the number of marine life in the area. • Potential barrier created by the pier which can affect migration of wildlife. • Changes to the deposition and depth of the water may	**Decommissioning activities** • Negative impact on marine life due to increase of sedimentation. **Materials management** • Harm to marine life due to oil and fuel spills.

		contribute to the loss of sensitive plant life. • Shading from the bridge may reduce the aquatic flora in the vicinity due to lack of possible sunlight. **Materials management from ongoing site maintenance** • Direct and indirect effects from oil, fuel and other substances such as cement entering the marine environment.	

Amenity	**Earthworks and excavation** • Temporary loss of amenity during construction phase	**Physical presence of bridge** • Loss of view	**N/A**
Public affect	**Use of vehicles and machinery** • Noise from construction and traffic. • Potential affect on traffic during material deliveries, causing air pollution from vehicles. • Possible materials on	**Use of vehicles** • Noise increase • Possible sedimentation in the air and surround area • Traffic problems •	**Decommissioning activities** • Temporary noise increase. • Temporary affects to views

	roads such as sedimentation and mud.		
Architectual and archaeological heritage	No impact	No impact	No impact

Following the scope exercise and the recognition of possible environmental consequences, preventative steps should be introduced to prevent or mitigate future adverse impacts on soil, water, air, humans and ecosystems, or to add positive aspects to the development.

Activities in building and site planning have the ability to influence all responses to the environment. The following list does however outline the most important preventative steps for these types of engineering structures.

- Housing of fuels such as gasoline and oil, building materials and supplies to reduce the risk of soil and water contamination.
- Building work phasing to mitigate wildlife disruption at crucial times of the year, for example during the breeding season.
- Timing and routing of construction traffic to avoid residential areas or other areas such as hospitals and schools.
- Usage of soil compaction mitigation methods, such as limiting entry during wet weather, and using safe boarding and low ground pressure machines. Soil should be carefully drained and preserved for future re-establishment where necessary.
- Use of techniques for controlling dust.

To mitigate future impacts in the construction and execution of bridge construction activities on the water system the project must ensure that:

- When constructing cofferdams that it will not affect surrounding marine life or harm any habitats.
- The cofferdam shouldn't restrict the flow of water.
- Drip trays and oil interceptors are used, checked and washed periodically in car parking areas.
- A risk assessment is carried out for each material that will be used or stored on site and the necessary safety procedures are to be put in place.

Impact on the landscape and soil may be reduced by the following strategies:

- Successful stabilization of altered land types to mitigate soil degradation and water emission risk from suspended solids.
- Adequate visual impact screening.

Energy

When looking at the energy aspects of designing a sustainable bridge there are many things to take into consideration. There are three main reasons, these are:

- Economic
- Environmental
- Social

There are many underlying aspects within these three that can be solved by looking at some simple questions. If you are looking at the economic aspect, then these should be taken into consideration:

- Will the design of the bridge bring in investments?
- Will local construction businesses and contractors be the ones to work on the construction of the bridge?
- Will the bridge construction create jobs?

The environmental aspect is the most important factor when looking to create a sustainable bridge some things to consider are as follows:

- Will the use of recyclable materials be used for construction and/or will already recycled materials be used?
- Future proofing of the bridge, so that the bridge can have a long-life span, which will reduce the amount of renovations that are required.
- Use of preventative maintenance methods, so that bridge repairs can be carried out before it's too late.

The third and final aspect is social, to find out the best approach for this, you will want to know how the bridge is going to impact people.

- How does the bridge impact the environment?
- Is the bridge located where it is going to be beneficial for use and will people use it?
- Will the bridge be aesthetically pleasing?
- Could the bridge make future projects possible?

Going green for energy efficiency has become a part of life. For decades the world has been moving towards a more eco-friendly and more affordable approach. This has changed everything from the vehicles we drive to the way that power is generated and to the way that construction is completed. Due to this it has greatly changed the way that bridges, and related infrastructure are planned, designed, maintained, decommissioned and replaced.

Green and sustainable bridge designs can mean different things to certain companies and agencies. Not only are green and sustainable bridges designed for being safe and efficient but also for climate mitigation and adaptation.

- Green design – this focuses on bridge construction and other infrastructure that mitigates harmful effects on human health and well-being impacts. The architect and the designer of the project takes additional precautions to protect the land, water and air, but also humans and wildlife using environmentally sustainable construction materials and construction practices that mitigate environmental and human health impacts.

- Sustainable design – goes a step beyond, to consider the long-term effects of these matters along with economic factors to ensure that the beneficial effects will be sustained in the long term.

For the design of the foot bridge in Swansea's SA1 reinforced concrete is used for the piers due to its durability, low maintenance and resistance to water. Concrete is economical which will reduce the costs of construction, but due to its ability to be precast offsite it will also be beneficial to save time, effort and energy. Concrete is the only option for the piles as they will be located in water, if steel piles were used, they would corrode causing major problems in the future.

The deck of the bridge will be made from a steel frame. This is majorly beneficial to the environment as it's extremely eco-friendly and has endless recyclable possibilities. By using steel, it benefits the environment greatly by minimizing the use of concrete. By avoiding a concrete deck, it helps stop massive amounts of carbon dioxide being released into the atmosphere. The cement industry is one of the primary producers of carbon dioxide. By not using concrete it will also help avoid permanent soil damage. Some of the main benefits of using steel are:

- Its endless recyclable possibilities
- Relatively little energy used to produce it
- The waste that is produced is reusable
- It's not toxic to humans or the environment.

Steel will help save a lot of energy, money and manpower. In the last 60 years steels energy consumption and carbon dioxide emissions have decreased by half, making it a very eco-friendly material. A benefit of a steel bridge is that it is safer during construction, and it also lasts longer than other materials, a steel bridge has proven to last well over 100 years. The use of steel allows longer spans to be built which limits the impact on habitats below.

For this foot bridge, solar panels will be implemented into the bridges design, this will help reduce the amount of energy that is required to illuminate the bridge, but not only that, it will help the community by giving energy back creating new sustainable energy.

Aesthetics

There are some guidelines to take into consideration when designing the aesthetic of a bridge, these being:

- Good lighting
- Space above the bridge
- A clear structural system
- Integration into the environment
- Choices of materials
- Colour
- Simplicity

These are what will be looked at when designing the foot bridge for Swansea's SA1.

Good lighting

Lighting is important when it comes to aesthetics as it can improve the aesthetic appearance of the bridges structure during night. The foot bridge will hold solar panels which will help to power the illumination of the bridge but will also give power back to the community.

Fig 1: Illuminated arch bridge

Space above bridge

The space above the bridge is important. It should give pedestrians a feeling of comfortability and safety when walking across, it should also grab the attention of people.

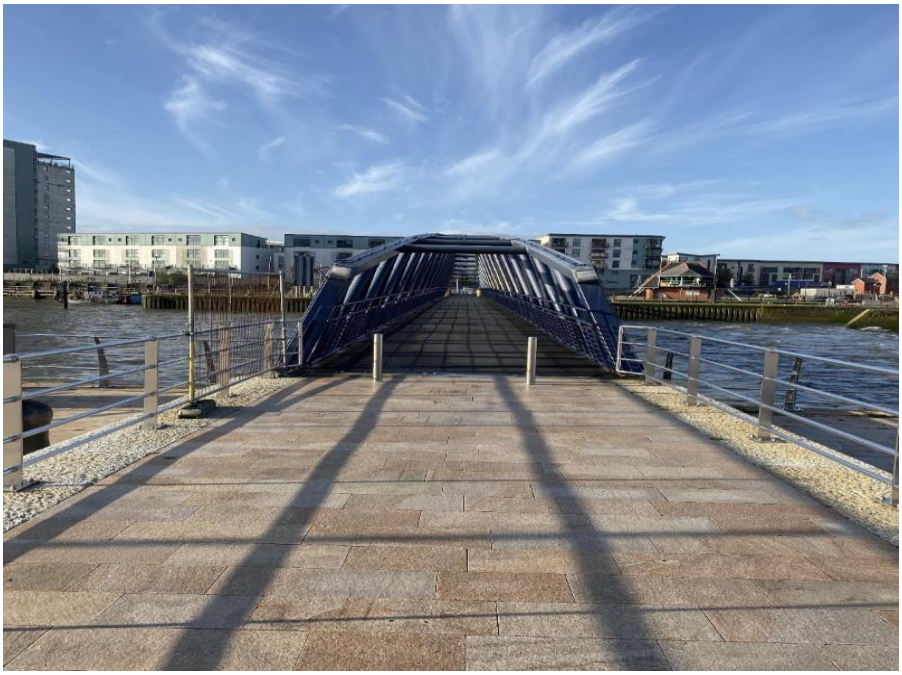

Fig 2: Picture of Swansea's arch bridge in SA1

Clear structural design system

For a clear structural system, it is important to ensure that the load bearing components of the bridges structure are decreased as low as possible. In this case it not only looks safe and reliable but it also consistent in that's sense. To briefly summarize, the bridges loading bearing system should be simple and convincing at the same time.

Fig 3: Swansea's simple but aesthetically pleasing sail bridge

Environmental integration

For a bridge to be integrated into the environment it can be done using a proper selection of materials that are used in the construction and scale of the structure. This can be done by using local materials such as steel from Tata. By using this measure, it will make the bridge more integrated into the environment.

Suitable materials

Suitable materials should be selected for the bridge construction in terms of its load bearing capacity and appearance. For example, steel is being used for the bridge deck as it is a local metal and will provide great strength and flexibility. Not only is this a benefit for aesthetic but also the environment as it has low emissions and can last over 100 years in its life span with minimal repairs needed.

Fig 4: Swansea's steel deck sail bridge

Colour

The colour of a bridge plays a crucial role when designing. The colour of the bridge helps to make the bridge look more visually appealing and can help with illumination during the night. The steel of the bridge will be coated in zinc to help prevent rust from the elements, such as rain or evaporation from the body of water below the bridge, this process is known as galvanizing. The bridge that is being designed for Swansea's SA1 project will be coated in a copper coloured paint. The bridge itself won't contain any copper, but the paint will give off that colour to link the bridge to Swansea's heritage of the copper works.

Fig 5: copper paint for a steel bridge.

Simplicity

Simplicity is one of the most important factors when it comes to the structure of the bridge. The structural shape of the bridge should provide an aesthetically pleasing view but also be safe and reliable.

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