Scottish & Southern Electricity Networks

Cost Benefit Analysis Model

The Protection Cost Benefit Analysis (CBA) Recommendation

The current **Protection CBA Recommendation** for the 33kV submarine electricity cable **Skye - Harris** is Option 1K:

- Split pipe protection applied to both shore ends – Approximately 300m
- Burial through Post Lay Jetting - Approximately 20,250m
- Cable surface laid on the seabed – Approximately 11,450m
- New cable removed at the end of its economic life.

This was deemed to be the best value solution based on the available information because it addressed the following risks, impacts and needs of stakeholders:

- Split pipe at the shore end limits the risk to the cable from abrasion as well as providing some cable stability. Additionally, this provides protection to public safety should the shore end be exposed due to erosion
- Burial stabilises the cable and provides protection from 3rd party interactions
- This scenario has higher engineering installation costs relative to the baseline; however, this is deemed necessary to reduce conflict with other marine users and to protect our infrastructure.

The **Final CBA Recommendation** scenario has an overall societal value of **minus £18,447,386.** This includes consideration of impacts on health and safety, socio-economic, environmental and wider economic and engineering impacts.

The final recommendation of this summary report may not fully align with the final **Project Description.** This is because following a Cable Burial Risk Assessment (CBRA) and On-bottom Stability Study (OBSS), further protection/stabilisation of the cable may be required. It will be confirmed whether the proposed installation method deviates from the CBA recommendation and justification given as to why this deviation is required.

The CBRA will identify whether additional protection measures may be required, including rock placement, in areas where burial is not anticipated to be achievable and there is evidence of fishing activity on the seabed. Rock placement has therefore been allowed for as an option within the Project Description and Marine Licence application.

Areas where stabilisation is required will be defined in the OBS On-Bottom Stability (OBS) study. The OBS study will define how much the cable is predicted to move under storm conditions using DNV approved software, if the cable is predicted to move by more than 10 x its Outer Diameter then it is considered to be unstable. Where the cable is shown to be unstable, Rock Bags, burial or similar methods may be proposed in addition to the CBA recommendation in order to stabilise the cable.

Background

On Friday 16th of October, the 33kV subsea cable between Harris and Ardmore faulted on the red phase at around 10:30am resulting in loss of supplies to the 13,600 customers in Lewis & Harris. Backup generation from Battery Point Power Station in Stornoway and Arnish Power station are currently in place as mitigation for the fault. Following the fault an extensive review of the potential options/solutions has been carried out.

A partial inspection was undertaken in 2016 and a full end to end inspection was carried out in August 2020. No material issues have been identified. There have been no faults on this cable since its installation in 1990. The Skye – Harris 33kV submarine cable is the only connection from mainland Scotland to the isles of Harris and Lewis in the Western Isles. The cable leaves from Ardmore on the North West of Skye and connects into the

Western Isles network on the south end of Harris. All demand customers are currently being fed via mobile diesel generation and all generation customers are currently having their export constrained.

This CBA model has been designed to help with the identification of the best value method of cable installation, burial, protection, inspection and maintenance which satisfies all current legislation. It allows modelling of the material risks and impacts identified by stakeholders for the Skye – Harris 33kV submarine electricity cable. This model must be used in conjunction with the Cable Burial Risk Assessment (CBRA) and On Bottom Stability Study (OBSS). The CBRA will indicate where there is risk of damage to the existing cable and recommend a suitable burial depth to mitigate this risk, additionally the OBSS will show were the cable requires additional stabilisation, if the cable is determined to be "unstable". A combination of the three assessments will be used to form the final project description. At present, due to a fault scenario, a CBRA and OBSS have yet to be carried out and therefore the models run in this CBA are based on theoretical install scenarios, SHEPD knowledge of current cable install, preliminary design and engineering studies and likely achievable levels of burial.

The CBA model assigns financial values across the following key categories for each cable installation method and design:[1]

- Health and safety
- Socio-economic
- Environmental
- Wider economic and engineering

These values are then aggregated to estimate the **'societal value[2]'** of each solution.

The output of the CBA model helps to demonstrate (to ourselves, our customers, our regulators and all users of the sea environment) that the method(s) proposed to deploy for installing this submarine electricity cable justifies the expenditure and provides best value[3]. The CBA model supports our marine licence application by illustrating how we consider the cumulative impact of our engineering design.

Initially 29 different CBA models, including the baseline scenario, have been developed to identify the best value solution i.e. the solution with the highest **societal value** which balances the risks, impacts and the needs of stakeholders. The number of models may be subsequently increased or reduced if and when further information, like the CBRA and OBSS, become available.

Following completion of the installation design by the appointed contractor, the proposed protection/installation method will be updated and included within the CBA documents to allow direct comparison to other options. This version of the CBA Recommendation report supersedes all previous versions.

[1] The Submarine Electricity Cables Cost Benefit Analysis Methodology Statement can be found here: http://news.ssen.co.uk/media/266365/SSEN-CBA-Method-Paper-120pp-22336-WEB.pdf

[2] Societal value is the cost or benefit to society which includes the private costs / benefits plus any external costs / benefits. Private costs / benefits in the CBA model would be regarded as the Economic and Engineering category and the external costs would be noted as the Health and Safety, Socio-economic and the Environment categories.

[3] We define best value as the method(s) of installation which satisfy all current legislation and provides a sustainable balance of economic, safety and wider social and economic impacts.

The process to arrive at the final recommendation

The starting point for the CBA process is Scotland's National Marine Plan (NMP) (2015) which highlights the following policies, in Chapter 14, which need to be taken into account on a case by case basis for reaching a decision regarding the development and activities involved in installing a submarine electricity cable:

- Cables should be suitably routed to provide sufficient requirements for installation and cable protection.
- New cables should implement methods to minimise impacts on the environment, seabed and other users, where operationally possible and in accordance with relevant industry practice.
- Cables should be buried to maximise protection where there are safety or seabed stability risks and to reduce conflict with other marine users and to protect the assets and infrastructure.
- Where burial is demonstrated not to be feasible, cables may be suitably protected through recognised and approved measures (such as rock or mattress placement or cable armouring) where practicable and cost-effective and as risk assessments direct.
- Consideration of the need to reinstate the seabed, undertake post-lay surveys, monitoring and carry out remedial action where required.

Based on the need to comply with the Scotland's National Marine Plan the following three phases of work with regards to the CBA model have been carried out as part of this marine licence application.

Phase one:
Phase one draws on the initial burial assessment[4] and the Scotmap National Marine Plan Interactive Map to address Factor 1 and identify a suitable route against which the impacts included within the CBA model categories can be compared. The CBA model[5] is then used to identify the **Burial Scenario** using our three[6] recognised burial methods and to provide evidence to address Factor 3 (cables should be buried to maximise protection where there are safety or seabed stability risks and to reduce conflict with other marine users). The output of this phase of analysis is described as the **Burial Scenario**.

From a technical and operational perspective, the following parameters (used in the cost benefit analysis following agreement with stakeholders) identify where burial is achievable by:

- Jetting and Mass Flow Excavation where there is a minimum sediment depth of 1.5 metres for 50 metres along the seabed
- Ploughing where there is a minimum sediment depth of 2 metres for 500 metres along the seabed

From initial engagement with contractors, the method of burial installation proposed for this cable, is by post lay jetting. Therefore, in this CBA model, post lay jetting is the only method which has been considered when considering burial.
The above statements indicate where it is deemed feasible to undertake burial activities using the stated methods as part of the CBA. The depths indicated do not represent the depths at which a cable must be covered to be deemed "buried" as part of the analysis. The minimum depth of cover which is required to deem the cable "buried" is where the top of the cable is covered by layers of sediment no less than 0.6m deep. The CBRA and

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[4] The initial burial assessment is the output of the process which SSEN has carried out in conjunction with stakeholders to identify a suitable route and obtain the required environmental surveys of the seabed and benthic habitats on which to carry out the cost benefit analysis.
[5] The CBA tool methodology is available at http://news.ssen.co.uk/submarinecables/information/
[6] The three methods commonly used by the industry to install cables are: Ploughing, Jetting and Mass Flow Excavation. A forth installation method of horizontal directional drill (HDD) - can be used on submarine electricity cables shorter than 2km in length.

OBSS will provide recommended minimum depths of burial/cover at given locations along the route based upon the perceived risks to the cable and marine users. For the purposes of the CBA, cable burial of 0.6m or greater will be deemed “Buried” any depth shallower than 0.6m will be deemed as surface laid.

Phase two:
The **Burial Scenario** is then input into phase two of the CBA model which uses the key assumptions around our three recognised protection methods to develop a **Hybrid solution(s)** which include elements of both burial and protection that are feasible. This phase seeks to address Factor 2 (a method to minimise impacts on the environment, sea bed and other users) and Factor 4 (where burial is demonstrated not to be feasible, cables may be suitably protected where practicable and cost-effective and as risk assessments direct). A process of engagement is then conducted to identify if these scenarios are practicable, cost effective and address the possible risks. The **Final CBA Recommendation** will then be made for the scenario which represents the overall best value solution.

Phase three:
Based on the process of engagement, including the pre applications consultation events, the **Hybrid solution(s)** can be refined and then entered into the CBA model to obtain estimated societal value. During the phase three analyses a sensitivity analysis is carried out on key assumption to understand how the value of impacts may vary. Phase three also provides the evidence base to support consideration of Factor 5 which examines the need to reinstate the seabed, undertake post-lay surveys and monitoring and carry out remedial action on an ongoing basis. The **Final CBA Recommendation** will then be made for the scenario which represents the overall best value solution.

Skye - Harris: Phase one
The input to phase one of the CBA analysis was standalone installation assessments. Additional protection may be required at the inshore areas if burial is not possible.

The initial burial assessment identifies that it would be technically feasible to obtain high percentages of burial for the new proposed route given that sediment has been observed as being present along the majority of the route with areas of the existing cable being buried.

From initial site investigations and historic inspections of the cable shore ends it has been confirmed that split pipe protection will be required on both shore ends, for all installation scenarios. This will provide additional protection in the inshore area and minimise damage from abrasion. Additionally, this will increase cable stability. As such, all install scenario models show split pipe protection on both shore ends, with the exceptions of option 1A (100% surface lay), just to show all possibilities. Due to the confirmation that split piping will be required, this has been taken as the base case scenario in which to compare all other options. The base case shows both shore ends with split pipe protection with the remainder of the cable being surface laid.

Table 1 provides an overview of the scenarios that were considered in this phase of the analysis.

Table 1 Phase 1 initial burial scenarios

Option	Scenario methods	Total Societal Value	Net change^ (£)	Net Change^ (%)
Baseline	Split pipe 0.94% (0.3km) / Surface lay 99.06% (31.7km)	-£17,791,507	-	-
1A	Surface lay 100% (32km)	-£13,273,404	£4,518,103	-25.39%
1B	Jetting 50.47% (16.15km) / Split pipe 0.94% (0.3km) / Surface lay 48.59% (15.55km)	-£18,270,653	-£479,146	2.69%

1C	Jetting 99.06% (31.7km) / Split pipe 0.94% (0.3km)	-£16,941,806	£849,701	-4.78%
1D	Jetting 90.00% (28.8km) / Split pipe 0.94% (0.3km) / Surface lay 9.06% (2.9km)	-£18,630,396	-£838,889	4.72%
1E	Jetting 84.38% (27.00km) / Split pipe 0.94% (0.3km) / Surface lay 14.68% (4.7km)	-£18,636,355	-£844,848	4.75%
1F	Jetting 79.80% (25.54km) / Split pipe 0.94% (0.3km) / Surface lay 19.26% (6.16km)	-£18,560,831	-£769,324	4.32%
1G	Jetting 75.30% (24.10km) / Split pipe 0.94% (0.3km) / Surface lay 23.76% (7.60km)	-£18,485,307	-£693,800	3.90%
1H	Jetting 69.70% (22.30km) / Split pipe 0.94% (0.3km) / Surface lay 29.36% (9.40km)	-£18,491,266	-£699,759	3.93%
1I	Jetting 31.25% (10.00km) / Split pipe 0.94% (0.3km) / Surface lay 67.81% (21.70km)	-£18,050,040	-£258,533	1.45%
1J	Jetting 14.69% (4.70km) / Split pipe 0.94% (0.3km) / Surface lay 84.37% (27.00km)	-£17,936,596	-£145,089	0.82%
1K	Jetting 63.28% (20.25km) / Split pipe 0.94% (0.3km) / Surface lay 35.78% (11.45km)	-£18,447,386	-£655,879	3.69%

^The net change is compared to the baseline assumption of end to end surface lay

From this phase of analysis, two options showed a positive increase in societal value when comparing against the baseline option. These were option 1A (100% surface lay), and option 1C (Shore end split piping and + 99.06% burial by jetting). As explained previously, split pipe protection will be a requirement on both shore ends to avoid physical damage to these sections of cable, so this rules out option 1A and being feasible. It is highly unlikely that 99% burial can be achieved along this route based on the historic data, which shows sections of the cable on top of the sea bed. When burial percentage is reduced from 99% to 90% (Option 1D) the societal cost of this installation increases above the baseline installation, a 4.72% circa £839k more than base case.

Based on the phase one outputs and the fact that 100% burial in not achievable on this route, the output models indicate that the baseline scenario is the least cost to society and have the highest societal benefit. Where burial may be required along the route, following CBRA or OBSS, the CBA model shows lower levels of burial in this route, will have a better value to society. However, the recommendation from this phase of analysis would be that option 1K be pursued which would offer a significant portion of burial (64%%) whilst only having a small variance in societal value from the lowest burial percentages (Option 1J – 15%). The change in societal value between both options is £511k.

Skye - Harris: Phase two

Phase two of the analysis then sought to identify scenarios beyond the initial assessment scenarios (Phase 1 output) where burial only was considered, by adding additional protection which may be practicable, cost-effective and address marine user risk.

Table 2 provides an overview of the scenarios that were considered in this phase of the analysis.
These models have been run using additional methods of protection as it is believed 100% burial is unlikely to be achievable, some rock bagging of mattressing may be required to provide suitable cable stability and/or further protection.

For clarification, the assumption has been taken that 1 rock bag will cover 2.4m of submarine cable, in each scenario where rock bags have been used. The length of cable indicated in each model to be covered with this protection method, is assumed to be covered by these bags. When it comes to installation, these bags are likely to be spread out along the cable allowing much greater lengths of cable to be stabilised. This will be determined within the OBSS.

For concreate mattressing, it is assumed 1 mat would cover approximately 6m of cable.

Table 2 Practicable and cost-effective burial and protection scenarios

Option	Scenario methods	Total Societal Value	Net change^ (£)	Net Change^ (%)
Baseline	Split pipe 0.94% (0.3km) / Surface lay 99.06% (31.7km)	-£17,791,507	-	-
2A	Jetting 90.00% (28.8km) / Rock Bagging 4.53% (1.45km) / Split pipe 0.94% (0.3km) / Surface lay 4.53% (1.45km)	-£27,749,866	-£9,958,359	56%
2B	Jetting 79.80% (25.54km) / Rock Bagging 4.53% (1.45km) / Split pipe 0.94% (0.3km) / Surface lay 14.73% (4.71km)	-£27,680,301	-£9,888,794	56%
2C	Jetting 75.30% (24.1km) / Rock Bagging 4.53% (1.45km) / Split pipe 0.94% (0.3km) / Surface lay 19.23% (6.15km)	-£27,604,777	-£9,813,270	55%
2D	Jetting 75.30% (24.1km) / Rock Bagging 9.06% (2.90km) / Split pipe 0.94% (0.3km) / Surface lay 14.7% (4.7km)	-£36,724,247	-£18,932,740	106%
2E	Jetting 90.00% (28.8km) / Mattressing 4.53% (1.45km) / Split pipe 0.94% (0.3km) / Surface lay 4.53% (1.45km)	-£42,139,346	-£24,347,839	137%
2F	Jetting 79.80% (25.54km) / Mattressing 4.53% (1.45km) / Split pipe 0.94% (0.3km) / Surface lay 14.73% (4.71km)	-£42,069,781	-£24,278,274	136%
2G	Jetting 75.30% (24.1km) / Mattressing 4.53% (1.45km) / Split pipe 0.94% (0.3km) / Surface lay 19.23% (6.15km)	-£41,994,257	-£24,202,750	136%
2H	Jetting 75.30% (24.1km) / Mattressing 9.06% (2.90km) / Split pipe 0.94% (0.3km) / Surface lay 14.7% (4.7km)	-£65,503,207	-£47,711,700	268%
2I	Jetting 75.30% (24.1km) / Rock Bagging 2.27% (0.72km) / Split pipe 0.94% (0.3km) / Surface lay 21.50% (6.88km)	-£23,090,646	-£5,299,139	30%
2J	Jetting 75.30% (24.1km) / Rock Bagging 2.265% (1.45km) / Mattressing 2.265% (1.45km) / Split pipe 0.94% (0.3km) / Surface lay 19.23% (6.15km)	-£34,913,367	-£17,121,860	96%

^The net change is compared to the baseline assumption of end to end surface lay.

Within the ten scenarios considered in Table 2, zero scenarios provided a reduction in the cost to society when comparing to the baseline installation. It was show that Concrete mattressing has a significant negative effect on the value to society when comparing the same length of cable being protected by rock bagging. Option 2A and Option 2E indicate this by the 81% variance/increase in costs between both options.

Should any level of rock bagging or mattressing be required following detailed route engineering, it is likely to have a negative impact on the overall value to society. Any requirement for these methods to be utilised should be clearly justified.

Skye - Harris: Phase three

In this phase of analysis, the best value solutions from phases 1 and 2 were refined and challenged to identify the best value solution using the societal value as an indicator of value before a **Final CBA Recommendation** was made.

Sensitivity analysis was conducted to help identify the key variables which have a major influence on the cost and benefits of a submarine electricity cable project. These are:

- Age: Life expectancy of the cable
- Full life cycle costs
- Social costs
- Decommissioning costs
- Health and safety risk

The sensitivity scenarios considered changes in predicted lifecycle of the new cable when looking at the best value solution identified in phases 1 & 2.

*Option 1K has been taken as the most likely install method, as although it has a higher cost to society than the baseline options it is anticipated that some level of burial will be required in order to provide stability to the cable, there is also evidence of seabed trawling and burial is likely to be required to mitigate this fishing risk upon the conclusion of the CBRA. Many of the burial options 1D-1H and 1K gave similar values of cost to society whilst providing significant portions of burial along the route. The best value to society of these 5 options was option 1K. Options 1I & 1J had a better value to society but provided much less burial along the route.

Table 3 shows the impact of an increase in the life expectancy of the cable when compared against the base case. In the baseline options, unprotected (surface laid) sections of cable have life expectancy set at 30 years as per the existing cable life.

***Option 1K has been introduced since the original CBA analysis was undertaken and is now the preferred solution. The existing phase 3 sensitivity analysis is still valid though and will also apply to option 1K, showing there will be an improvement in societal value if the cable life is extended.**

Table 3 Sensitivity testing

Option	Scenario methods	Total Societal Value	Net change^ (£)	Net Change^ (%)
Baseline	Split pipe 0.94% (0.3km) / Surface lay 99.06% (31.7km)	-£17,791,507	-	-
3A	Jetting 84.38% (27.00km) / Split pipe 0.94% (0.3km) / Surface lay 14.68% (4.7km) **[Unprotected sections life extended to 40 years]**	-£17,362,555	£428,952	-2%
3B	Jetting 84.38% (27.00km) / Split pipe 0.94% (0.3km) / Surface lay 14.68% (4.7km) **[Unprotected sections life extended to 45 years]**	-£16,823,136	£968,371	-5%
3C	Jetting 75.30% (24.10km) / Split pipe 0.94% (0.3km) / Surface lay 23.76% (7.60km) **[Unprotected sections life extended to 40 years]**	-£17,228,902	£562,605	-3%
3D	Jetting 75.30% (24.1km) / Rock Bagging 2.27% (0.72km) / Split pipe 0.94% (0.3km) / Surface lay 21.50% (6.88km) **[Unprotected sections life extended to 40 years]**	-£21,590,914	-£3,799,407	21%
3E	Jetting 75.30% (24.1km) / Rock Bagging 2.27% (0.72km) / Split pipe 0.94% (0.3km) / Surface lay 21.50% (6.88km) **[Unprotected sections life extended to 45 years]**	-£20,960,450	-£3,168,944	18%
3F	Jetting 84.38% (27.00km) / Split pipe 0.94% (0.3km) / Surface lay 14.68% (4.7km) **[Whole cable life set at 30 years]**	-£18,636,355	-£844,848	5%
3G	Jetting 75.30% (24.1km) / Rock Bagging 2.27% (0.72km) / Split pipe 0.94% (0.3km) / Surface lay 21.50% (6.88km) **[Whole cable life set at 30 years]**	-£23,090,646	-£5,299,139	30%

^The net change is compared to the baseline assumption.

Overall there is an increase in the societal value, as expected, if the cable life is extended. The current cable installation has been installed in this location for 30 years. The external condition of the cable has found to be in a good condition and has experienced 1 electrical fault. The average cable life of SHEPDs cable fleet is around 25 years with the majority of SSEN’s historical installs having no cable protection. Given that the current unprotected installation has survived for 30 years and providing that the new cable will be suitably stabilised, and include areas of burial and or protections along with shore end split piping, minimal mechanical damage from abrasion should be expected, this again forms part of the assumption that cable life could be extended for the new cable. Additionally, the existing install has a high duty factor which could be reducing the cables electrical life, this new cable has a higher rating and future reinforcement schemes are anticipated which should reduce the duty factor on this cable, which could further improve chances of cable life being extended.

Models 3A & 3B show the change in societal value of the original Option 1E should cable life expectancy of the surface laid sections be extended. It can subsequently be seen in model 3C that as the life expectancy increases, the overall value to society also increases.

Models 3D,G & F are models which consider additional protection through rock bagging or mattressing, again this shows that were cable life is increased the societal value also increases, although for all options including rock bags or mattresses, the baseline scenario still comes out as a better value to society.

Given the reasoning and justification for assuming cable life could be extended, this indicates Option 1K is a better option to pursue over the base case installation. An increase in cable life expectancy is not unreasonable to assume, when considering the additional mechanical protection on the cable at both shore ends as well and some protection through burial, the 25year average life of SHEPD's cables is also generally from SWA cables. Significant route engineering and micro routing as well as CBRA's and OBSS being conducted as part of this install give confidence that an increase in life over the average age of SHEPD's cables can be achieved. This shows there is likely to be a positive impact on societal value by installing the cable with this level of protection over the base case assumption.

Interpretation of results

Phase one of the CBA model shows surface laying the new Skye - Harris submarine electricity cable results in the highest societal value (i.e. lowest net cost) when compared to the baseline scenario, however, it has already been pre-determined that split pipe protection will be required on both shore ends for mechanical protection of the cable, and thus this option is eliminated. The next best option is option 1C, which in addition to split piping the shore ends, models the remainder of the cable being buried through post lay jetting. From existing information, it is not believed this can be achieved. With the elimination of Options 1A & 1C, there are no other options in the phase 1 analysis which provide a greater societal value than the baseline installation, therefore this leaves a preferred option from phase 1 being the baseline install of Split pipe 0.94% (0.3km) / Surface lay 99.06% (31.7km). Should it be preferential to bury the cable to avoid risks to marine users then Option 1K Jetting (63.28% (20.25km) / Split pipe 0.94% (0.3km) / Surface lay 35.78% (11.45km)) would allow significant portions of burial to be undertaken with a delta against the baseline of £655,879.

Phase two shows combinations of protection scenarios in compliance with the National Marine Plan hierarchy of installation and the need to consider the views of other stakeholders and marine users. The Baseline option still provides an overall better value to society than any of the hybrid options modelled in phase 2. Option 1K also provides a better value to society that any of the options assessed in phase 2.

From the models investigated, it would indicate that should the OBSS determine further stability/protection is required in specific locations rock bags will provide better value to society than concrete mats. But in the main the use of these installation methods will greatly reduce the societal value of any installation and should be kept to a minimum.

Phase three shows the impact of other possible outcomes to the initial results when considering sensitivities compared to the baseline scenario. The sensitivity testing examined if the cable life expectancy was greater or lesser than expected what societal benefit this would produce. The results from this were that as life expectancy increased the overall societal benefit also increased. This phase of the modelling showed that should Option 1G or 1K be taken forward, there is a potential positive value to society over the baseline should cable life be extended to 40 years.

Recommendation

The CBA model considers the societal value of different installation methods for the Skye - Harris submarine electricity cable. It is understood that other externalities not modelled need to be considered. These include marine planning policy, final engineering design requirements including any requirements for shore end protection and the cumulative impact of our submarine electricity cables on other legitimate marine users. It is therefore proposed, at this stage, that option 1K which is a combination of 0.3km of split pipe protection, 20.25km of post lay jetting and 11.45km of surface lay is put forward for further design consideration.

The specific locations for areas of burial and surface lay will be derived at detailed design stage to mitigate the risk to other marine users and minimise the environmental impacts at a micro siting basis.

Whilst the marine licence CBA has identified the baseline option to have the lowest societal impact when considering feasible install options, the National Marine plan suggests that burial should be maximised as far as possible for replacement subsea cables. The phase 1 analysis indicates that additional burial can be delivered whilst only having a small impact on the overall societal value of versus the baseline. Option 1K (64% Burial) has a societal value of -£18,447,386 compared with the baseline (0% burial) of -£17,791,507. The total variance between both options is approximately **£656k**. Option 1K also has the potential to add societal value over the base line option when considering a potential extension to cable life.

Following detailed design there may be the requirement for additional protection or burial, for stability of the replacement cable. This will be determined through the refinement phase of the project and reference will be made in the final CBA recommendation summary.