

Appraisal Summary Table – PAR Options						
Project Name	Sandsend Coast Protection Scheme – Upper Coastal Slope Options					
Description of Key Problems	<p>Summary:</p> <p>The upper coastal slope falls predominantly into MU5. It is located landwards of the A174, which sits on a bench in the coastal slope.</p> <p>Key Problems:</p> <ul style="list-style-type: none"> Instability of cut slopes inland of A174 coast road. 					
Option	Baseline (Do Nothing)	Do Minimum	Slope Option 1: Slope re-grading & trench drain installation	Slope Option 2: Slope re-grading & horizontal drain installation	Slope Option 3: Installation of king post wall to form a barrier wall	Slope Option 4: Soil nailing and horizontal drain installation
Overview Description	<p>Do Nothing: no further maintenance or capital works are carried out. Coastal slope will fail and collapse on to road, and continue to add to deterioration of revetment.</p> <p>Potential for large scale deep routed failure plane beneath the A174 and lower coastal slope revetment, as well as more frequent surface slips associated with insufficient drainage and steep slope angle.</p>	<p>Coastal slope will continue to undergo minor failures requiring clear up and temporary piecemeal stabilisation works.</p> <p>Potential for large scale deep routed failure plane beneath the A174 and lower coastal slope revetment, as well as more frequent surface slips associated with insufficient drainage and steep slope angle.</p>	<p>Existing slope profile to be re-graded to 22°.</p> <p>Trench drains of circa 2.5m deep will be installed as drainage measures to digress excessive pore water pressure likely to be encountered in interbedded sandy/gravelly layers in glacial till/boulder clay.</p> <p>Filter drains should be provided as cut-off drain at the slope crest area to collect the surface runoff from rainfalls. Trench drains and crest cut-off drains should be connected to existing drainage systems;</p> <p>Erosion control mats in a form of geotextile or geosynthetics material or any type of flexible facing may have to be provided for slope surface protection.</p> <p>Vegetation should be incorporated in the surface protection design.</p>	<p>Existing slope profile to be re-graded to 22°.</p> <p>Horizontal drains will be installed as part of the proposed new drainage system (length of proposed bored drains will be reviewed after the first stage of site investigation.</p> <p>Filter drains should be provided as cut-off drain at the slope crest area to collect the surface runoff from rainfalls. Crest cut-off drains should be connected to existing drainage systems.</p> <p>Erosion control mats in a form of geotextile or geosynthetics material or any type of flexible facing should be provided for slope surface protection.</p> <p>Vegetation should be incorporated in the surface protection design.</p>	<p>No re-grading to the existing slope profile is required.</p> <p>King post wall to be formed by two H or I beam sections and concrete planks. Proposed height of upstanding wall is approximately 4m. Embedment depth of the king post wall is approximately 4m and 8m below road level for anchored wall and cantilever wall option. Active anchors may have to be installed as a lateral support for the king post walls. All anchors are required to be extended some distance behind identified slip planes and to be bonded into competent glacial till/boulder clay or bedrock (Mudstone).</p> <p>Filter drains should be provided as cut-off drain at the slope crest area to collect the surface runoff from rainfalls. Two rows of filter drains to be installed at 20m and 40m above Sandsend Road to collect water from surface runoff and seepage water from the interbedded sandy/gravelly layers in glacial till/boulder clay. Proposed new drainage system should be integrated into existing drainage system.</p>	<p>No re-grading to the existing slope profile is required.</p> <p>Horizontal drains are to be installed prior to the soil nails. Length of soil nails should be extended beyond identified slip planes and to be bonded into competent glacial till/boulder clay or bedrock.</p> <p>Horizontal drains will be installed as part of the proposed new drainage system. Filter drains should be provided as cut-off drain at the slope crest area to collect the surface runoff from rainfalls. Proposed new drainage system should be integrated into existing drainage system.</p> <p>Flexible facing should be provided for slope surface protection for the soil nailed slope;</p>
Technical Issues	<p>Until road is lost through coastal erosion there will be considerable H&S risks to the public using the road from minor failures of the coastal slope onto the road. Therefore Do Nothing includes for the costs of clearing the road after slips until the road is no longer passable.</p>	<p>Until road is lost through coastal erosion there will be considerable H&S risks to the public using the road from minor failures of the coastal slope onto the road. Therefore Do Minimum also includes for the costs of clearing the road after slips until the road is no longer passable.</p>	<p>Regular maintenance is required for the existing or newly built drainage systems, and also for slope surface protection including vegetation.</p> <p>Discharge capacity of the existing drainage systems should be checked against the increased water flow from seepage water through the interbedded sandy/gravelly layers and rainfalls.</p> <p>Excavated/trimmed slope material should be disposed to an agreed site/location.</p>	<p>Regular maintenance is required for the existing or newly built drainage systems, and also for slope surface protection including vegetation.</p> <p>A robust surface protection may have to be provided locally at the areas of outfall of water.</p> <p>Discharge capacity of the existing drainage systems should be checked against the increased water flow from seepage water through the interbedded sandy/gravelly layers and rainfalls.</p> <p>Excavated/trimmed slope material should be disposed to an agreed site/location.</p>	<p>King post walls are to be toed into competent stratum at least 3 to 4m below identified slip planes.</p> <p>Difficulties may be encountered when driving king post wall into boulder clay or bedrock.</p> <p>Discharge capacity of the existing drainage systems should be checked against the increased water flow from seepage water through the interbedded sandy/gravelly layers and rainfalls.</p>	<p>Regular maintenance is required for the existing or newly built drainage systems, and also for slope surface protection including vegetation.</p> <p>Discharge capacity of the existing drainage systems should be checked against the increased water flow from seepage water through the interbedded sandy/gravelly layers and rainfalls.</p> <p>This remedial option is not feasible when slip planes or potential slip planes can not be identified in the site investigation.</p> <p>A robust surface protection may have to be provided locally at the areas of outfall of water.</p>
Assumptions/Uncertainties	Road will be lost in Year 20.	Road will be lost in Year 20.	Monitoring data from piezometers, settlement markers and inclinometers should be continuously collected for sometime after the stabilization works.	Monitoring data from piezometers, settlement markers and inclinometers should be continuously collected for sometime after the stabilization works	Monitoring data from piezometers, settlement markers and inclinometers should be continuously collected for sometime after the stabilization works	Monitoring data from piezometers, settlement markers and inclinometers should be continuously collected for sometime after the stabilization works
Approaches to adaptation						
Category	Description and Quantification of Impacts	Description and Quantification of Impacts	Description and Quantification of Impacts	Description and Quantification of Impacts	Description and Quantification of Impacts	Description and Quantification of Impacts
Economic Impacts						
Properties	There are no properties directly at risk from the upper coastal slope.	-	-	-	-	-
Emergency Costs	Loss of A174 through blockages due to small scale surface slips or destruction of	As Do Nothing	Do Nothing impacts avoided; the road would be protected.	Do Nothing impacts avoided; the road would be protected.	Do Nothing impacts avoided; the road would be protected.	Do Nothing impacts avoided in short term through dealing with shallow slips,

	section of road through large scale deep routed failure plane would result in emergency services having to use the 22km diversion either temporarily or permanently. This would increase their transport costs but also have knock on implications for patients/residents dependant on their services.					however there will still be a risk of deep seated slips which could potentially destroy a section of the road and the lower coastal defence assets.
Infrastructure	Risk to road from large scale deep routed failure planes beneath level of road may result in large section of road being destroyed. Road contains services which serve the village of Sandsend (BT, Transco, Yorkshire Water, Northern Electric). Cleveland Way National Trail footpath runs along the A174 road and will be affected by blockages due to falls of material onto the road from the upper slope and if a large scale slip occurs which destroys a section of road then the footpath will also be lost , breaking the 109 mile route.	As Do Nothing	Do Nothing impacts avoided; the road would be protected and the services within, therefore avoiding potential environmental impacts from breakage of the sewer mains.	Do Nothing impacts avoided; the road would be protected and the services within, therefore avoiding potential environmental impacts from breakage of the sewer mains.	Do Nothing impacts avoided; the road would be protected and the services within, therefore avoiding potential environmental impacts from breakage of the sewer mains.	Do Nothing impacts avoided in short term through dealing with shallow slips, however there will still be a risk of deep seated slips which could potentially destroy a section of the road and the lower coastal defence assets. This would affect the services within the road potentially leading to a pollution incident which could affect water quality through breakage of the sewers within the road.
Transport	Loss of A174 through blockages due to small scale surface slips or destruction of section of road through large scale deep routed failure plane would result in vehicles having to use the 22km diversion either temporarily or permanently.	As Do Nothing	Do Nothing damages avoided; road would be protected. Reduced disturbance and improved health and safety to human receptors through the prevention of slippages onto the A174.	Do Nothing damages avoided; road would be protected. Reduced disturbance and improved health and safety to human receptors through the prevention of slippages onto the A174.	Do Nothing damages avoided; road would be protected. Reduced disturbance and improved health and safety to human receptors through the prevention of slippages onto the A174.	Do Nothing impacts avoided in short term through dealing with shallow slips, however there will still be a risk of deep seated slips which could potentially destroy a section of the road and the lower coastal defence assets. Reduced disturbance and improved health and safety to human receptors through the prevention of shallow slippages onto the A174.
Agriculture	Potential large deep routed failure may result in head of slope regression resulting in loss of agricultural land at top of slope. In addition if the lower coastal defence assets fail and coastal erosion commences then there will be some loss of land from edge of fields at top of upper coastal slope, as the slope retreats due to coastal erosion. Approximately 50m retreat over 100 years.	As Do Nothing	Loss of small area of agricultural land due to regrading.	Loss of small area of agricultural land due to regrading.		Loss of small area of agricultural land due to regrading. Potentially Do Nothing damages may occur as there will still be a risk of deep seated slips which would result in slope head regression.
Tourism	Loss of A174 Sandsend to Whitby link road will remove Sandsend village from the coastal through-route and turn it into a dead-end destination, having a large impact on its tourism potential.	As Do Nothing	Do Nothing damages avoided; road would be protected.	Do Nothing damages avoided; road would be protected.	Do Nothing damages avoided; road would be protected. There may be small impact on the tourism potential of the area as option appearance may have detrimental affect on the attractiveness of the area.	Do Nothing impacts avoided in short term through dealing with shallow slips, however there will still be a risk of deep seated slips which could potentially destroy a section of the road and the lower coastal defence assets.
Indirect effects on business	Reduction in tourism will have implications for the businesses in Sandsend which cater to it, e.g. cafes, hotels, B&Bs, and galleries.	As Do Nothing	Do Nothing damages avoided; road would be protected.	Do Nothing damages avoided; road would be protected.	Do Nothing damages avoided; road would be protected.	Do Nothing impacts avoided in short term through dealing with shallow slips, however there will still be a risk of deep seated slips which could potentially destroy a section of the road and the lower coastal defence assets.
Environmental Impacts						
Geology & Coastal Processes	Slope is composed of glacial till and is currently over steep. Natural processes will work to establish a more stable shallower slope angle through slips.	As Do Nothing	Regrading will form a more stable slope at a shallower angle, imitating the natural processes over a shorter timescale	Regrading will form a more stable slope at a shallower angle, imitating the natural processes over a shorter timescale	Natural processes would continue behind the king-post wall as under the Do Nothing to establish a more stable slope angle.	Regrading will form a more stable slope at a shallower angle, imitating the natural processes over a shorter timescale
Ecosystem Services	The option would result in the loss of a large section of Upgang to Sandsend coastal slope SINC and Maritime Cliff and Slope BAP habitat as the coastline retreats.		Stabilisation of slope will allow for colonisation by floral species, thus enhancing the SINC and BAP habitat.	Stabilisation of slope will allow for colonisation by floral species, thus enhancing the SINC and BAP habitat.	The option does not provide a permanent solution to the slope stability issue, and future landfalls are likely to result in further loss of habitat present within the SINC and further loss of BAP habitat.	Stabilisation of slope will allow for colonisation by floral species, thus enhancing the SINC and BAP habitat.
Change in Status under	Water quality in the coastal waterbody would likely be reduced due to the release	As Do Nothing	Do Nothing damages avoided	Do Nothing damages avoided	Do nothing damages mainly avoided, however potential to affect the	Potentially as Do Nothing if a deep seated slip occurs, otherwise avoided in the short

WFD	soils within the coastal slope as slope fails. This could potentially affect the chemical and physico chemical quality elements of the waterbody depending on the potential presence of contaminants. There are likely to be impacts on the biological quality elements of due to smothering of benthic communities from increased fines entering the system.				waterbodies which drain the upper coastal slope as slips continue to happen.	term as shallow surface slips are avoided.
Historic Environment	There is one cultural heritage site at the top of the upper coastal slope adjacent to the unnamed watercourse close to Raven Hill Farm. This will be at risk in the Do Nothing scenario.	As Do Nothing	Regrading of the slope could affect unknown features of archaeological interest. A number of archaeological sites are present within Raithwaite Gill. The deposition of material from the coastal slope onto these features would allow for the <i>in-situ</i> preservation of such features and sites.	Regrading of the slope could affect unknown features of archaeological interest. A number of archaeological sites are present within Raithwaite Gill. The deposition of material from the coastal slope onto these features would allow for the <i>in-situ</i> preservation of such features and sites.	As Do Nothing as the slope will continue to slip placing the heritage site at the top of the slope at risk	Regrading of the slope could affect unknown features of archaeological interest. A number of archaeological sites are present within Raithwaite Gill. The deposition of material from the coastal slope onto these features would allow for the <i>in-situ</i> preservation of such features and sites.
Landscape	Upper coastal slope landscape is currently relatively natural, with a vegetated slope and little hard engineering interventions. This landscape would not change under Do Nothing, with slope re-colonising with vegetation naturally after any landslide activity.	As Do nothing	Slope would return to a natural appearance after construction due to the inclusion of vegetation planting in the design to 'green-up' the slope.	Slope would return to a natural appearance after construction due to the inclusion of vegetation planting in the design to 'green-up' the slope.	Significant adverse impact to the visual amenity value of the area and local landscape / seascape character due to the presence of the wall.	Slope would return to a natural appearance after construction due to the inclusion of vegetation planting in the design to 'green-up' the slope. However some of the slope measures may still be visible, e.g. soil nail heads and mesh.
Social Impacts						
Way of Life	Loss of the A174 would have a significant impact on the way of life for residents of Sandsend, with the village becoming more isolated and services harder to access. Longer journey times would impact on travel to Whitby for jobs, leisure, health and social reasons. In addition the nature of the village as a tourist destination would be affected.	As Do Nothing	Do Nothing damages avoided	Do Nothing damages avoided	Do Nothing damages generally avoided, however there may be some impact on the tourism trade due to the appearance of the works affecting the attractiveness of the area.	Potentially as Do Nothing if a deep seated slip occurs, however in the short term the Do Nothing impacts would be avoided as shallow slips are avoided.
Community	Sandsend is a small village, with the majority of its services based in Whitby, including schools, hospital, supermarkets, employment etc. Currently it takes ~5mins to drive to centre of Whitby (4km); loss of road would increase this to ~25mins (26km). Loss of A174 would isolate the village, making it a dead-end destination rather than a through route. This could result in loss of trade for businesses reliant on tourist/recreation trade, which could result in the loss of businesses affecting locally job market and range of services available locally for residents.		Do Nothing damages avoided	Do Nothing damages avoided	Do Nothing damages generally avoided, however there may be some impact on the tourism trade due to the appearance of the works affecting the attractiveness of the area.	
Culture	Limited impact from loss of historic environment		As Do Nothing (potentially)	As Do Nothing (potentially)	As Do Nothing	
Health & well being	Increased distance and journey time for emergency services would increase risk to life for patients. Could be considerable stress impacts from loss of road leading to feeling of isolation and blight on property values.		Do Nothing damages avoided	Do Nothing damages avoided	Do Nothing damages avoided	
Fears & Aspirations	Affected residents may feel isolated and abandoned, and suffer stress from blight on property values and concerns regarding ongoing viability of properties/community.		Do Nothing damages avoided	Do Nothing damages avoided	Some concerns from business owners over the appearance of the scheme affecting the attractiveness of the area to tourists, affecting their businesses.	