

Option	Description	Standard of Protection			Technical		Economic		Environment		Social		Political		Legal		Total	Summary of long list
		Short-term Present day to 2030	Mid-term Present day to 2070	Long-term Present day to 2118	Technical performance and adaptability	Buildability	Capital cost	Maintenance and monitoring	Ecology and environment	NFM and RBMP	Landscape and Heritage	Tourism	Strategic alignment	Stakeholder views	Waste management and contamination	Regulatory consenting and approvals		
		Aims: Provides desired standard of protection throughout the design life of the scheme or is easily adaptable to allow for modifications for climate change through time. Provides protection to full extent of benefit zone.	Aims: Safe to construct, local sources of appropriate material for construction, suitable ground conditions and would not conflict with existing services, primarily the sewer main along the front.	Aims: Low capital cost.	Aims: Minimal ongoing maintenance and/or monitoring requirements and costs.	Aims: No environmental impact on local habitats, geology and ecology, including local designations.	Aims: Works with nature to provide natural protection and does not downgrade the existing classifications.	Aims: Works with the existing landscape and is sensitive to listed buildings and heritage designations.	Aims: Maintains access to beaches, considers local views and provides connectivity along the frontage.	Aims: Aligns with local strategies.	Aims: Supported by stakeholders and the local community.	Aims: Minimal waste disposal requirements or contamination risks.	Aims: Regulatory framework would be readily achievable.					
1	Replace sea wall				4	3	2	4	3	3	3	4	5	3	3	4	41	Option bought forward to short list as it provides flood protection in the long-term by raising the height of the defence. This option may require beach maintenance and replenishment to achieve overtopping requirements.
	A new wall could be built of concrete, steel piles or masonry. This option would seek to replace the existing defence or be built seaward of the existing wall. To adapt to climate change, the wall would need to be taller than the current defence, which may require raising the promenade and footpath area behind.				+ High standard of protection and long design life. - Potential for increased scour and beach loss	- High capital costs	+ manganocene for concrete works and potential scour and beach loss	- take so no impacts on geology and ecology following	+ If the replacement wall has the same extent as the	- of existing defence would increase amenity space behind but	- to raise land behind walls in Cowie. Access to beach	+ Provides HTL policy with increased SoP	- Waste from demolition of concrete and excavation around wall	- Marine licence required				
2	Raise existing sea wall				2	5	4	2	3	3	3	4	3	3	5	5	42	Option bought forward to short list as it provides flood protection by raising the height of the defence. This option may require beach maintenance and replenishment to achieve overtopping requirements.
	Raising the existing wall would increase the flood protection performance of the defence in the short to mid-term. However, as this option relies on the existing structure it can only practically be raised so far without a complete rebuild. In addition, without raising the promenade, sea views could be affected and therefore the wall could only be raised so far. In areas where the existing structures are currently in poor condition a concrete 'shroud' would be used to encase the existing defence to prevent premature failure of the new raised defence.				+ increased performance - Poor design life as relies on the existing wall - Potential for increased scour	+ works predominantly land-based.	+ High maintenance costs for existing structures	- shroud increases footprint of defence. Potential impacts on geology of SSSI and non-	+ Raising the existing wall would not increase the area of coastline affected by	- on amenity value of existing and new materials would require consideration. Schedule	- to raise land behind walls in Cowie. Access to beach will need to be	+ Provides HTL in short-medium term only	+ Limited demolition required, utilises existing structures	+ limited consenting required				
3	Small rock armour revetment				2	4	4	3	3	2	3	4	3	3	4	4	39	Discounted due to the limited benefit in mid to long term along while encroaching onto the amenity beach.
	Rock armour could be installed at the base of the existing sea wall to increase flood protection performance. As this solution does not increase the height of the defence it is suitable in the short to mid-term without the full effects of sea level rise. The rock armour would encroach onto the amenity beach (or into the mooring zone within the harbour), but it would not affect line-of-site from the town.				+ Increased performance in the mid term + provides scour protection	- Beach based activity - difficulty excavating at toe of defences	+ low / medium capital costs.	+ High maintenance costs for existing structures	- than sea wall so habitat loss would occur. Potential new	+ May alleviate the need to expand defences elsewhere along	- on amenity value of beach, but equally could become a feature	+ Provides HTL in short-medium term only	- Excavation of beach	- Marine licence required				
4	Setback walls with flood gates				4	3	3	2	4	3	3	4	2	2	3	4	37	Discounted as the option would not address the large rates of wave overtopping predicted over existing defences resulting in damage to vehicles, infrastructure and presenting a danger to pedestrians during storms
	Flood protection walls could be installed set-back from the existing coastal defences, these would run parallel to the roads and private property boundaries. In some instances, it is envisioned that private properties may require integrating into the defence line to ensure flood wall continuity; this would require waterproofing or shrouding of vulnerable areas. This option would help prevent flooding to the town through a secondary defence line; while it does not help reduce wave overtopping, it would prevent flood water from inundating properties. In the long-term this option will be less effective due to the extreme sea levels expected and it does not seek to improve the condition of existing defences. However, if used in conjunction with other defence improvements it could effectively work into the long-term scenario.				+ Mid to long term performance - relies on existing defences for long term performance - does not mitigate scour	+ land based construction	- Medium capital costs	+ high maintenance costs for existing structures	- on terrestrial habitat. Reduced geological and ecological impacts. Potential to	+ No additional coastal land take which works toward the RBMP objectives. - Not full realignment and therefore still	- existing and new materials would require consideration. Schedule monuments to north of Cowie	- Potential loss of amenity space on seaward side. Access to beach only effected during flood event.	- Excavation on land for wall foundations - Possible demolition of existing walls and surfaces	+ Land-based construction				
5	Offshore breakwater				4	1	2	2	2	4	3	5	4	5	3	2	37	Discounted as existing low-lying defences would still be at risk of overtopping from sea level rise in the long term. Option also considered costly and difficult to construct for the scale of breakwater required. Note - offshore breakwater not to be confused with beach control structures as in option 8 which are located close to shore.
	An offshore breakwater would seek to reduce the flood risk by dissipating wave energy within Stonehaven Bay. The size of the structure (height and width) would determine how much wave energy is dissipated. For this reason, a breakwater could be designed to be submerged such that it is not visible, creating a reef-like structure to break the largest waves offshore. As this option does not increase the height of the existing defences it may only offer limited protection in the long-term, however coupled with other defence options it could aid in reducing the size of other defences.				+ long term performance - relies on condition of existing defences	- Difficult to construct, water based activities	- High capital costs for volume of material required and construction	+ high maintenance costs for existing structures	- significant alteration to coastal processes and downdrift erosion issues,	+ May increase the area of sandy foreshore which would have NFM benefits by	- structure would have no impacts on landscape or seascape. Potential impacts	- works required along the frontage, thus keeping wall heights down -	+ Allows for HTL to be implemented more effectively through	- Marine licence required - offshore work				
6	New wall extension with a rock armour revetment				5	3	2	4	3	2	3	2	5	3	4	4	40	Option bought forward to short list as it can efficiently provide flood protection into the long-term.
	The existing defence could be increased in height with the addition of rock armour installed on its seaward face. The rock armour would serve as protection to the wall whilst also significantly reducing wave overtopping making it an effective coastal flood defence in the long-term scenario. To adapt to climate change, the wall would need to be taller than the current sea wall, which may require raising the promenade and footpath area behind the defence. In areas where the existing structures are currently in poor condition a concrete 'shroud' would be used to encase the existing defence to prevent premature failure of the new raised defence.				+ High standard of protection - relies on existing defences, though less so than other options + limited risk of scour	- land and beach based activities - disruption to locals - conflict with services	- large volumes of material and scale of construction	+ no maintenance for rock armour	- than sea wall alone so habitat loss would occur. Potential new habitats in rock armour.	+ If the overall area of extension is minimal it may not have a significant impact on the existing	- on amenity value of beach, but equally could become a feature with rock pools and weathering.	- unlikely to require raising of promenade in Cowie. Rock armour would reduce	- Excavation of beach	- Marine licence required				
7	New stepped or sloping revetment				5	3	1	4	2	2	3	3	5	3	3	4	39	Option discounted due to the high capital cost and footprint.
	The existing defences could be replaced by a new stepped revetment (as currently seen along the Cowie promenade), or by a similar modular blockwork structure or rock armour structure. All solutions could be designed such that their wave overtopping performance is suitable into the long-term scenario. Given the present-day overtopping risk, a higher crest level than existing will be required. To adapt to climate change, the wall would need to be raised further, which may require raising the promenade and footpath area behind the defence.				+ High standard of performance + does not rely on existing structures	- complex construction on beach	- large capital costs	- medium maintenance	- footprint of existing defences. Potential impacts on geology of SSSI and non-	+ Replacement of existing defences may not increase the defence footprint thus	- defences already present within the bay, so limited impact in terms of visual setting.	- already present, but potential loss of amenity space on beach. Need to maintain	- Waste from demolition of concrete and excavation around wall	- Marine licence required				
8	Beach recharge + control structures				3	3	2	2	2	4	4	5	4	5	3	2	39	Option taken forward - will need to consider differences between north (rocky foreshore) and south (existing beach) of the zone. Contact with SNH would be helpful to ascertain viability of option in an environmental context.
	The beach within Stonehaven could be recharged increasing the beach crest width and height. To prevent the beach mobilising and moving around within the bay beach control structures would also likely be required. With a large enough beach in both height and width this option could be a solution in the long-term, however it would also require replenishment over time if it is shown that material is lost offshore or the beach migrates shoreward through 'roll-over'. This option may also require the raising of existing hard defences.				- Potential short design life + high standard of protection - relies on existing structures	+ simple construction - added complexity with beach control structures	- Medium / large capital costs	+ maintenance costs depending on beach loss - maintenance of existing structures	- potential for high maintenance costs depending on beach loss - maintenance of existing structures	+ This is an NFM option which would require 'hard-defence' landscape and	- larger beach would add amenity value and is likely to enhance landscape and	- increase in beach amenity space. Access to beach maintained. No detrimental effects on views.	- offshore dredging for beach sediment - requirement for recharge with suitable sediment - excavation for control structures	- large change to coast and foreshore, licences required				
9	Foreshore recharge				2	2	2	2	2	5	4	5	4	5	3	1	36	Option discounted due to cost, environmental impact and uncertainty whether the option would work in the long term.
	Similar to beach replenishment, this would look to have large quantities of beach material dumped near the centre of Stonehaven Bay, effectively making a very large beach / sand bar. Over time this material would move around within the bay, replenishing the existing beaches. This option would reduce the water depths within the bay and thus create a large area in which wave action would be dissipated across. This option would be suitable up until the long-term scenario given sufficient material deposition. It is possible that the beach would need replenishing by mid-century.				- Potential short design life + high standard of protection - relies on existing structures	+ simple construction - uncertainty around placement	- Medium / large capital costs	- maintenance costs depending on beach loss - maintenance of existing structures	- potential for high maintenance costs depending on beach loss - maintenance of existing structures	+ Creation of new foreshore habitats. - Impact of coastal water quality and	- foreshore area - add amenity value and likely to enhance landscape and	- amenity space. Access to beach maintained. No detrimental effects on views.	- offshore dredging for beach sediment - requirement for recharge with suitable sediment	- large change to coast and foreshore, licences required				
11	Managed realignment - Cowie				4	1	1	2	4	4	3	3	1	2	1	3	29	Discounted as not HTL and in stakeholder interest.
	Partial realigning the defence in the northern benefit area (Helen Row and Boatie Row) could be considered due to the flood risk and lower number of residential and businesses in this area. Within a partial realignment scenario, a secondary defence, potentially in the form of a vegetated earth bund, would be built set-back from the existing coastal defences; this would be required to prevent flooding to the remaining properties.				+ good standard of protection from reduced risk to properties	- very difficult to relocate properties	- high costs for relocation	- maintenance costs for existing defences	- habitat would be increased, resulting in ecological	+ Makes space for coastal habitat development. Would improve	- on amenity space, but also potential to make feature and undertake	- amenity space. Earth bund could effect views and access would	- Against HTL policy	- Excavation and movement of large volumes of material	- Significant change to land + no maritime licences required			
12	Ground raising				4	1	1	2	2	3	3	4	2	2	3	3	29	Discounted as not in stakeholder interest or practical.
	The flood risk in the northern benefit area is a result of the low ground level, meaning that any wave overtopping will flow down and flood this area. An option to consider instead of realigning the defence would be to raise the ground level immediately behind the defences such that flood water can only flow back out to sea. While this option is a large undertaking, it could secure the flood risk beyond the long-term scenario if coupled with repairs or replacements of the existing defences to manage erosion risk.				+ good standard of protection from reduced risk to properties	- very difficult to relocate properties	- High capital costs	- maintenance costs for existing defences	- footprint of defence. Impacts on terrestrial habitats and potential to	+ Opportunity to integrate NFM measures with ground raising e.g. woodland and vegetation	- on amenity space, but also potential to make feature and undertake landscaping. Schedule	- Potential impacts on views and access would need to be incorporated.	- Partial implementation of HTL - without reducing overtopping along the front	- Significant change to land + no maritime licences required				
20	Property relocation				3	2	2	2	2	3	2	3	1	1	3	3	25	Discounted as not in stakeholder interest or practical.
	Properties at immediate flood risk behind the current coastal defences could be relocated, reducing potential flood damages while also providing additional space for flood protection improvement schemes behind the existing defences. While this option does not seek to reduce wave overtopping it could be coupled with other mid to long-term strategies to reduce flood risk damages.				+ Reduces properties at risk - relies on condition of existing defences	- difficult to relocate	- high costs for relocation	- maintenance costs for existing defences	- Potential bat habitats in existing buildings. Disruption to	- No impact.	- character of frontage, but also potential to landscape area	- character of area could detract from tourism appeal, although	- Against HTL policy	- Demolition of buildings - land based excavation	- Significant change to land + no maritime licences required			
21	Property Flood Resilience and Resistance (PFR)				2	5	5	2	3	3	3	5	4	3	5	5		Taken through as 'quick win' instead of short list option.
	A short-term option to address flooding in less severe storm events, PFR measures could be a valuable option to incorporate into those properties at risk of flooding. For more severe storms and with increasing sea levels, the level of resilience will be limited and is therefore not considered to be a mid-term option, unless coupled with improvements to the coastal defences.				- low standard of protection	+ Easy to construct	+ low cost	- low maintenance costs - maintenance costs for existing defences	- No impacts.	- No impact.	- No obvious issues.	- No issues.	+ Partially supports HTL - but only in short-term	+ limited waste and disturbance	+ limited consenting			
22	Do Nothing				1	5	5	5	2	3	3	3	1	1	2	5	33	
23	Do minimum				1	5	5	2	3	3	3	3	1	1	3	3	35	