Ullapool – Shore Street Widening & Promenade
&
Small Boat Harbour Development

EIA Screening - Support Document

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1 Introduction

There are proposals to widen Ullapool's Shore Street in order to enable an increase in road carriageway width and the introduction of a pedestrian promenade. The proposals will improve safety for vehicles and pedestrians and remove the hazardous bottleneck which currently exists over this length of the primary access route between Ullapool's Ferry Terminal and the rest of the trunk road network. The Ullapool Shore Street Widening and Promenade proposals include the renewal of the sea defences.

In addition, there is the potential for a Small Boat Harbour Development in the inner basin of Ullapool harbour to be carried out at some time after the completion of the Promenade Works. It is likely that the Harbour Development works would consist of a new quay at the eastern end of Shore Street and the installation of additional pontoons in the area to the north side of the existing main pontoon. To facilitate safe navigation and berthing of vessels utilising the facilities provided, the area would require to be dredged and a breakwater pontoon installed on the eastern end of the main pier.

Shore Street is the main trunk road into Ullapool and serves as an access road to the Ullapool-Stornoway ferry terminal, which is the main gateway between the mainland and the Outer Hebrides. Shore Street is also popular with residents and visitors to Ullapool as it includes shops, cafes, tourist accommodation, a pavement adjacent to the seawall, and on-street parking. The street is protected from the sea by a small seawall and concrete block revetment on the seaward side of the promenade.

The trafficable width of Shore Street is currently around 7.5m overall, including an on-street parking strip on the landward side of the carriageway that is 2.5m wide, leaving a carriageway width of only 5m. Shore Street also includes a Scottish Water pumping station part way along the street, which requires access for maintenance. Despite frequent pedestrian use, there are currently no designated crossing points along Shore Street.

As the current road is evidently too narrow for normal two-way traffic, there are many traffic related issues along Shore Street. Cars and HGVs commonly mount the seaward pavement in order to pass each other. Sewage manhole covers on the pavement have been damaged due to car and HGV movements on the seaward pavement. Maintenance vehicles accessing the Scottish Water pumping station and Combined Storm Overflow (CSO) also block traffic on Shore Street during servicing. These issues present a significant element of danger to pedestrians walking along the promenade, particularly during the tourist high season. With visitor numbers to the region and the number of people using the Ullapool to Stornoway ferry route increasing year on year, this problem will likely exacerbate without action (Comhairle nan Eilean Siar, 2018; Visit Scotland, 2018). By widening the road and creating a seaward promenade, the planned development will improve transport access issues, pedestrian safety and amenity.

The widening of Shore Street requires the installation of a new sea wall and new sea defence revetment. This has added benefit that the current 40 year old concrete block revetment sea defence is in need of maintenance due to age related damage and undercutting.

The potential Small Boat Harbour Development part of the proposed development is intended to upgrade Ullapool harbour in order to meet growing demand for the use of Ullapool harbour facilities. Additional quay space and pontoons will provide extra berths and access for inshore fishing fleet, blue tourism companies and recreational boat users.

Both aspects of the development will involve works both below Mean High Water Spring (MHWS) and above Mean Low Water Spring (MLWS). Therefore, Marine Licences and Town and Country planning permissions will need to be sought, where individual marine licences and planning permission will be sought for each aspect of the development. The exact licences and permission needed to be acquired are listed in Table 1.1.

Table 1.1 Planning Permission and Marine Licences required for the proposed development

	Planning permission*[1]	Marine Construction Licence*[2]	Marine Dredge and Disposal Licence*[2]	Marine Pontoon Licence*[2]
Shore Street Widening & Promenade	✓	✓	✓	
Small Boat Harbour Development	✓	✓	✓	✓

*[1] under Town and Country Planning (Scotland) Act 1997

*[2] under the Marine (Scotland) Act 2010

A formal Screening Opinion is requested from Marine Scotland under regulation 10(1) of The Marine Works (Environmental Impact Assessment (EIA)) (Scotland) Regulations 2017 ('EIA Regulations') and The Highland Council under Regulation 8(1) of The Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2017 respectfully. This is to determine whether an EIA will be required to support the Marine Licence and Planning applications for the proposed Ullapool Shore Street Widening and Promenade and the Small Boat Harbour Development.

With regard to the potential need for an EIA, if the project falls under Schedule 2 of The Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2017 and The Marine Works (Environmental Impact Assessment) (Scotland) Regulations 2017, then the projects need to be screened under Schedule 3 of the same regulations to determine whether or not an EIA Report needs to be submitted in support of the applications.

Relevant sections under Schedule 2 of the EIA regulations are:

- 10. Infrastructure:
  - (f) Construction of roads – where the area of works exceeds 1 hectare
  - (g) Construction of harbours and port installations, including fishing harbours – where the area of works exceeds 1 hectare
  - (m) Coastal work to combat erosion and maritime works capable of altering the coast through the construction, for example, of dykes, moles, jetties and other sea defence works, excluding the maintenance and reconstruction of such works – all works
- 13. Any change to or extension of works of a description mentioned in paragraphs 1 to 12 of Column 1 of this table where those works are already authorised, executed or in the process of being executed.

The Shore Street Widening and Promenade works are less than one hectare in area. However, they could be seen to trigger 10(m) if they were to alter the coastline. Although the Small Boat Harbour Development construction would be small in area, when considered and combined with the proposed Shore Street construction works, then the development encompasses a combined area of greater than 1-hectare, and thus, Section 13 of Schedule 2 could apply. Because of this, it is recognised that a screening opinion is required for all of the works, to determine whether or not an EIA will be required, for the Shore Street Widening and Promenade on its own, or for both projects together if the Small Boat Harbour Development were to be taken forward.

This report provides the information requested under Section 10 of the EIA Regulations, in order to assist in the consideration of these requests, and inform the corresponding screening opinion, namely a description of:

- The location of the proposed works;
- The proposed works;
- The environmental sensitivities of the geographical area;
- The aspects of the environment likely to be significantly affected by the proposed works;
- The likely significant effects; and
- The features of the proposed works or proposed measures envisaged to avoid or prevent significant adverse effects on the environment.

2 Location

Ullapool is a coastal village in the Highland region that lies on the eastern shoreline of the sea loch, Loch Broom (Drawing 63.01.01). Ullapool Shore Street (A893) lies on southern limit of Ullapool, the proposed Shore Street Widening and Promenade lie between the junction with the A835 to the east (NH1313 9407) and the pier to the west (NH1284 9396) (Drawing 2059-999). The existing layout of Shore Street is shown in Drawing 2127-901. The Planning Consent and Marine Licence boundaries of the Shore Street Widening and Promenade project are shown on Drawing 2059-951.

The Small Boat Harbour Development is situated at the west end of Shore Street. Drawing 2127-902 shows the layout of both developments, which are discussed further in Section 3. Drawing 2059-952 shows the combined Planning and Marine Licencing boundaries for the Shore Street Widening and Promenade Project and the Small Boat Harbour Development.

Ullapool falls within the boundaries of the Highland Council. Ullapool harbour is managed by the Ullapool Harbour Trust. The Ullapool Harbour Port limits extend throughout Loch Broom and beyond out to Cailleach Head, the landward limits extended to harbour junction on Shore Street and includes part of the seating area and small boat layout area at the west end of Shore.

3 Characteristics of Development

The Shore Street Widening & Promenade is currently expected to be funded by Transport Scotland and Ullapool Harbour Trust, with contributions being sought from Crown Estates and Highlands & Islands Enterprise and has come to fruition from discussions between Transport Scotland and Ullapool Promenade Community Group (led by Loch Broom Community Council) regarding concerns for road and pedestrian safety along Shore Street.

The Small Boat Harbour Development may be taken forward by the Ullapool Harbour Trust, if it were to proceed it would be after the Shore Street works have been completed.

3.1 Development description

3.1.1 Shore Street Widening & Promenade

Shore Street will be widened to 17.65m including the new seaward promenade which will be 4.5m wide (Drawing 2059-910D). A low stone wall will be built between the road and the promenade to provide protection to pedestrians. Four crossing points will be installed and marked with dropped kerbs, textured paving and gaps in the stone wall. The off-street parking bay on the landward side (2.7m wide) will be updated to accommodate for designated crossing points, a loading bay and disabled parking bays.

The new road will be transformed from the current unmarked two-lane narrow road (Drawing 2127-901) to a marked two-lane road with an overall width of 6.95m (Drawing 2059-910); the road itself will be 6.5m wide with an additional 0.45m on the promenade side at road level that will allow vehicle clearance from the low wall. The existing inland footpath will also be widened at the east and west end of the path so that it is no less than 3m wide along its whole length.

Gully drainage will be installed on the seaward side of the road. Existing gully drainage pipes will be extended through the new infill and concrete sea wall into the rock armour (Drawing 2059-910).

The section of the promenade adjacent to the Scottish Water pumping station and screening chamber will be made wider to accommodate space for vactor service vehicles to access chambers without blocking road or promenade (Drawing 2059-910).

The sea defence will be reinstated along the sea wall in the form of rock armour. Two ramps and a set of concrete steps will be constructed within the rock armour to permit inclusive access to the shingle beach (Drawing 2059-910). An anchor wall will also be installed under the promenade at the west end to provide structural support for a new quay, if the Small Boat Harbour Development is to proceed.

The boundary of the Shore Street Widening & Promenade works shown in Drawing 2059-951 is 9,721m^2, all of which is above MLWS and hence subject to planning consent. 3,891m^2 of the development area is below MHWS and subject to Marine Licensing.

3.1.2 Small Boat Harbour Development

If the Small Boat Harbour Works proceed a new quay and small laydown area will be constructed at the west end of the promenade (Drawing 2127-902) which will match the height of the existing quay. The area in front of, and to the west of the new quay will be dredged to -2.0m (relative to chart datum) to create a permanent inner basin in the harbour. This will allow access for small boats to the quay and pontoons along the harbour wall irrespective of tide state. The existing quay wall in the inner harbour will be upgraded with sheet piling frontage to facilitate dredging.

New pontoons will be installed in the dredged area along the new quay and main pier, incorporating the existing main pier pontoons (Drawing 2127-902). A floating breakwater (pontoon) will be added to the end of main pier (south east corner), this will be anchored by mooring chains the exact location of which will be determined by detailed design.

The total area of the Small Boat Harbour Development is 6,143m^2, 3,194m^2 of which is above MLWS and subject to planning consent. The area below MHWS and hence subject to Marine Licensing is 5,832m^2, 3,268m^2 of which is the dredge area.

3.1.3 Combined Works

The boundary of the combined works as shown on Drawing 2059-952 is 14,511m^2, including 11,561m^2 above MLWS and 8,682m^2 below MHWS. The floating breakwater pontoon will be anchored by mooring chains, but as these have not been designed yet Drawing 2059-952 does not show their location, however allowance has been made for them in the areas detailed here.

3.2 Construction

3.2.1 Shore Street Widening & Promenade

The current road, footpath and street furniture will be removed in a phased approach to reduce disturbance to businesses. The existing revetment will need to be removed to facilitate the proposed works. The volumes of demolished material will be minimised through design and where possible will be recovered and reused in the infill used to build out new promenade and rock armour sea defence. After removal of revetment a toe trench will be dug prior to installation of rock armour. Around 1,500m^3 of material will be excavated.

An embankment will be created to support the new promenade using infill from the toe trench. As much of the toe trench material will be used as possible but there may be some material remaining that will need to be dealt with. It is acknowledged that a Best Practicable Environmental Option (BPEO) assessment will be required to determining the use/disposal route for this material to support the dredge licence application. The rock armour stone will be constructed in two distinct layers. The primary layer will be 1.1m thick and will be composed of larger 300-500kg rocks and the secondary base layer will be 0.5m thick composed of smaller rock, 25-50kg (Drawing 2059-910). The ramps and set of steps will constructed within the rock armour on concrete support foundations (Drawing 2059-910).

The infill material will be compacted using compaction plant prior to surfacing of the new promenade. The tubular steel poles for carrying festive lights and street furniture will be reinstated on the new promenade. It is envisaged that existing street furniture will be supplemented by additional furniture including new seating and planters.

Prior to the road resurfacing the Scottish Water pumping station and screening chamber covers will be lowered and upgraded to HGV load capacity to suit the widened road. The client's engineer is in discussion with Scottish Water regarding all works relevant to the pumping station and screening chamber.

An anchor wall for the future quay wall under the Small Boat Harbour Works scheme will be installed prior to promenade surfacing and will likely comprise 3m long sheet piles that will be vibro piled into the sand & gravel beach deposits for half their length, then backfilled the rest.

3.2.2 Small Boat Harbour Development

The new quay will be a sheet pile construction tied to the anchor wall installed as part of the Promenade works. The laydown area will be infilled and appropriately surfaced to blend in with the promenade. A sheet pile wall will also be installed along the adjacent harbour wall, to support that wall when dredging is carried out. Vibro-piling will be utilised to install the sheet pile walls.

A back-hoe dredger will be utilised as the method of dredging, to suit the small area and shallow water depths. The dredge material is expected to be a mixture of shingle, clay, silt and sand. Scour protection will be required on the dredge slope on the east side of the new quay. This is likely to be constructed of rock armour, with armour material being re-cycled so far as possible from that portion of the Promenade revetment being covered by the new works, to reduce further armour import.

Sediment sampling and testing will be required to inform a Best Practicable Environmental Option (BPEO) assessment to determining the use/disposal route for the dredge material to support the dredge licence application. However, it is assumed that dredged arisings will be deposited at an appropriate dredge disposal site, the closest being the Ullapool (Loch Broom) dredge spoil disposal site (58.89250°N, -5.15665°E).

Pontoons will be secured in place by steel guides attached to quay walls once the dredge works have been completed and furnishings will be installed thereafter.

3.3 Operation

The improved Shore Street and promenade area will be widely used and enjoyed safely by both residents and visitors to Ullapool alike. The wider road and presence of vactor sewage maintenance area will prevent traffic issues that currently plague Shore Street. The installation of a low-lying wall next to the promenade will also ensure that no vehicles will drive on the promenade and four demarcated crossing points will be installed contributing to increased pedestrian safety.

The new and existing pontoons will benefit from tidal restricted-free access and calmer waters due to the breakwater; the increased number of pontoon berths will be used by local and visiting small boats. It is possible that maintenance dredging will be required during operation to maintain the required depth alongside the new pontoon berths, but any such requirement is expected to be infrequent.

3.4 Demolition/Reinstatement

There are no plans to discontinue use of this site in the future, therefore, it is not considered necessary to plan for demolition and reinstatement works for closure of this site.

4 Known Sensitivities

4.1 Biodiversity

4.1.1 Designated sites

Table 4.1 details the Statutory Nature Conservation Designations Sites (Marine Protected Areas (MPA), Special Scientific Interest (SSSI), Special Area of Conservation (SAC), and Special Protection Area (SPA) within 20km of the proposed development, their locations are shown on Drawing 63.01.02. Those unlikely to be affected by the development due to their location and/or associated designated features (e.g. terrestrial biological features that will not interface with site), are shown in grey. Due to the nature of the works being predominantly in the marine environment, marine specific designations have been described in more detail in subsequent sub-sections.

Table 4.1: Statutory Nature Conservation Designations within 20km of the Development Site (Marine Scotland, 2019; SNH, 2020)

Site	Designation	Distance Direction	Designated Features (relevant designation)	Comments
Wester Ross	MPA	Immediately adjacent	Protected Biodiversity Features: Burrowed mud habitats; Circalittoral muddy sand communities; flame shell beds; kelp and seaweed communities on sublittoral sediment; maerl beds; maerl or coarse shell gravel with burrowing sea cucumbers; northern feather star aggregations on mixed substrata. Conservation objectives: recovery of maerl and flame shell beds; conserve other protected features.	Include in screening – Due to close proximity to works.
Rhidorroch Woods	SAC	3.9km ENE	Annex I habitats: Caledonian forest; Northern Atlantic wet heaths with *Erica tetralix*.	No potential effects of projects on this designation site
Rhidorroch Woods	SSSI	3.9km ENE	Biological feature: Native Pinewood; Upland birch woodland; Upland habitat, subalpine dry heath; Beetle (click beetle *Microrhagus pygmaeus*).	No potential effects of projects on this designation site and associated mobile species will not utilise the urban and coastal area.
Inner Hebrides and the Minches	SAC	4.4km NNW	Annex II species: Harbour porpoise (*Phocoena phocoena*).	Include in screening – Harbour porpoise as they are a mobile feature.
An Teallach	SSSI	7.0km SW	Biological features: Upland habitats (subalpine dry dwarf shrub heath, subalpine wet heath, alpine heath and alpine moss heath); Vascular plants (tufted saxifrage and Highland saxifrage).	No potential effect on the site due to distance.
Dundonnell Woods	SSSI	7.3km S	Biological features: Upland mixed ash woodland.	No potential effect on the site due to distance.

River Oykel	SAC	7.6km NE	Annex II Species: Freshwater pearl mussel; Atlantic salmon.	The River Oykel runs eastwards into the North Sea, hence there is no connectivity between Loch Broom and the site or associated Atlantic salmon.
Inverpolly	SAC	11.8km NNE	Annex I Habitats: Clear-water lakes or lochs with aquatic vegetation and poor to moderate nutrient levels; Natural dystrophic lakes and ponds; Northern Atlantic wet heaths with *Erica tetralix*; Blanket bogs; Transition mires and quaking bogs; Depressions on peat substrates; Dry heaths; Alpine and subalpine heaths; Montane acid grasslands; Acidic scree; Plants in crevices on acid rocks; Western acidic oak woodland. Annex II Species: Otter (*Lutra lutra*); Freshwater pearl mussel.	Include in screening – Otter (*Lutra lutra*) due to their mobility.
Inverpolly	SSSI	11.8km NNE	Biological features: Upland habitats (Alpine moss heath and associated vegetation, Alpine heath, Subalpine dry heath community, Spring-head, rill& flush, Subalpine wet heath); Blanket bog; Upland birch woodland; Vascular plants (Norwegian mugwort); Beetle (*Otiorhynchus auropunctatus)*; Moths; Breeding bird assemblage (Red-throated diver, black-throated diver, heron, greylag goose, wigeon, teal, goldeneye, red-breasted merganser, snipe, curlew, greenshank, common sandpiper and grey wagtail).	Include in screening – Breeding Birds assemblage due to their mobility.
Beinn Dearg	SSSI	12.5km SE	Biological features: Upland habitats (subalpine dry heath, subalpine wet heath, blanket bog, alpine heath, alpine moss-heath, snowbed, subalpine and alpine calcareous grassland, rocky slope, tall herb ledge, springhead rill and flush, alpine flushes); Native pinewood; Vascular plants (rare montane species); Breeding bird assemblage (golden eagle, dotterel, snow bunting, ptarmigan, ring ouzel, raven, golden plover and peregrine falcon).	No potential effects of projects on this designation site and associated mobile species will not utilise the urban and coastal area.
Beinn Dearg	SAC	12.5km SE	Annex I habitats: Acidic scree; Alpine and subalpine calcareous grasslands; Alpine and subalpine heaths; Blanket bog; Caledonian forest; Clear-water lakes or lochs with aquatic vegetation and poor to moderate nutrient levels; Dry	No potential effects of projects on this designation site.

			heaths; High-altitude plant communities associated with areas of water seepage; Montane acid grasslands; Mountain willow scrub; Plants in crevices on acid rocks; Plants in crevices on base-rich rocks; Species-rich grassland with mat-grass in upland areas; Tall herb communities; Wet heathland with cross-leaved heath.	
Beinn Dearg	SPA	14.4km SE	Protected birds: Dotteral.	No potential effects of projects on this designation site and associated mobile species will not utilise the urban and coastal area.
Inverpolly, Loch Urigill, and nearby lochs	SPA	12.6km N	Protected birds: Black-throated diver (*Gavia arctica*).	Include in screening – Black-throated diver is mobile.
Knockan cliff	SSSI	15.4km NNE	Biological feature: Upland habitats (tall herb, calcareous grassland, calcareous screes, blanket bog, flush).	No potential effects of projects on this designation site.
Rubha Dunnan	SSSI	16.4km NW	Biological feature: Hydromorphological mire range.	No potential effects of projects on this designation site.
Corrieshalloch Gorge	SSSI	16.6km SSE	Biological features: upland birch woodland; cranefly, *Lipsothrix ecucullata.*	No potential effects of projects on this designation site and associated mobile species will not utilise the coastal habitat.
Wester Ross Lochs	SSSI SPA	17.6km WSW	Biological feature (SSSI): Black-throated diver. Protected birds (SPA): Black-throated diver.	Include in screening – Black-throated diver is mobile.
Ardlair – Letterewe	SSSI	18.3km SSW	Biological feature: upland oak woodland; upland birch woodland; upland habitats (subalpine wet heath, subalpine dry heath, alpine heath, alpine moss	No potential effects of projects on this designation site.

			heath, calcareous grasslands, snowbeds, tall herb ledges, blanket bog and rocky slopes).	
Fannich Hills	SSSI	18.4km SSE	Biological feature: upland habitats (heath and mire, montane grassland, snowbeds, summit moss heath and cliff ledges); beetles (leaf beetle *Phyllodecta polaris*); flies.	No potential effects of projects on this designation site as no connectivity between site and this designation.
Fannich Hills	SAC		Habitat feature: Acidic scree; Alpine and subalpine heaths; Blanket bog; Clear-water lakes and lochs with aquatic vegetation and poor to moderate nutrient levels; Dry heaths; Montane acid grasslands; Plants in crevices on acid rocks; Wet heathland with cross-leaved heath.	No potential effects of projects on this designation site as no connectivity between site and this designation
Loch Urigill	SSSI	18.6km NE	Biological feature: Oligo-mesotrophic loch; Black-throated diver; Breeding birds (waterfowl, ringed plover, common sandpiper and waders).	Include in screening – Black-throated diver (*Gavia arctica*) and Breeding bird assemblage are mobile.
Little Guinard River	SAC	18.7km WSW	Annex II Species: Atlantic salmon	Include in screening – Atlantic Salmon (*Salmo salar*) are mobile.

4.1.2 Biodiversity – Terrestrial

The project is surrounded on the landward side by the village of Ullapool and does not include or adjoin any ‘green’ areas. Hence there are no terrestrial ecosystems that will be directly affected by the development. There are areas of rough ground and scrub and trees to the east of the village. There are gardens with trees in Ullapool, but none of these directly adjoin the construction site. No sensitive flora species are expected to be affected by the development.

No trees or buildings will be disturbed by the development hence no bat or red squirrel surveys have been completed. Badgers are unlikely to be in the immediate vicinity to the works due to the lack of suitable habitat.

Inverpolly SAC which is 11.8km north of site is designated for European Otters (*Lutra lutra*) as it supports a high-quality population representative of north-west Scotland. Otters are a European Protected Species (EPS) and are protected under the Conservation (Natural Habits and Species) Regulations 1994 (as amended) in Scotland which transposes into Scottish law from the European Community’s Habitats Directive (92/43/EEC).

Otters can travel over large distances (20km or more) along river habitat (The Mammal Society, 2016) and there is an aquatic route between Inverpolly SAC and Ullapool harbour less than 20km via River Canaird, Loch Kanaird and Loch Broom. Also of note, the mouth of Ullapool river is approximately 1.2km along the coastline from Ullapool harbour and there are a number of otter records in and around Loch Broom (National Biodiversity Network Atlas, 2019). However, it should be mentioned that records within the mid basin of Loch Broom are 20 years old or older. The current Shore Street revetment as shown in Figure 4.1 does not provide suitable habitat for couches, layups or holts.

Figure 4.1: Shore Street Revetment

4.1.3 Biodiversity – Ornithology

A total of 162 bird species have been recorded within a 5km radius of the proposed development (National Biodiversity Network Atlas, 2019). The area of the proposed development is not considered an important site for breeding bird species. There are two SPAs within 20km of the site that are designated for Black-throated Divers (*Gavia arctica*)- Inverpolly, Loch Urigill, and nearby lochs SPA and Wester Ross loch SPA. Black-throated divers breed on small pools and freshwater lochs, predominantly in North-west Scotland during summer and during winter on the coasts of Scotland and further afield. There have been a number of records of black-throated divers in the outer basin of Loch Broom (National Biodiversity Network Atlas, 2019), the most recent of which was in 2011 about 2km from Ullapool Harbour.

There are records of species including red-breasted mergansers, red throated divers, red shank, common scoter, little grebe, goldeneye, curlew, eider, ringed plover, common sandpiper, and various see birds in Loch Broom. However, the development area is already subject to a high level of disturbance and has minimal habitat suitable for nesting birds.

4.1.4 Biodiversity – Marine

Important benthic, fish and marine mammal receptors are all present within and close to Loch Broom. Designations are in place for all three groups of marine receptors within 20km of the development.

Most notably, the site is adjacent to the Wester Ross Nature Conservation MPA. At its closest point the site is approximately 10 m away from the MPA boundary. No Priority Marine Features (PMF) are present within the site. However, PMFs present within the mid basin of Loch Broom where Ullapool is situated, includes the Burrowed mud habitat and tall seapen (*Funiculina quadrangularis*) which is a characteristic species of this habitat. There are also kelp and seaweed communities on sublittoral sediments on the opposite side of the basin to Ullapool and flame shell beds (*Limaria hians*) have been recorded at the in Sruth Lagaidh Narrows which is approximately 2.8km south of the development site (SNH, 2013b).

There are records of tall seapens 250-900m south of site the most recent of which was recorded in 2010 during SNH's "Ullapool Approaches" video surveys (National Biodiversity Network Atlas, 2019). It is noted that there is a record of tall seapens within the Loch Broom dredge disposal site (Marine Scotland, 2019).

The Inner Hebrides and the Minches Special Area of Conservation (SAC), designated for Harbour porpoise (*Phocoena phocoena*), is located 4.4km to the northwest of the development. It is noted that the Harbour porpoise are afforded protection when they are outwith the SAC, and they are known to swim into Loch Broom. There are a number of records of porpoise from Loch Broom, however most records are concentrated in the outer basin towards the mouth of the loch (National Biodiversity Network Atlas, 2019). Other marine mammals have been recorded in Loch Broom and may swim close to Ullapool Harbour (National Biodiversity Network Atlas, 2019), these include grey seal (*Halichoerus grypus*), harbour seal (*Phoca vitulina*), and common dolphin (*Delphinus delphis*).

Little Gruinard river which runs into Gruinard Bay 18km to the west of Ullapool is designated for Atlantic Salmon (*Salmo salar*) because it supports a high-quality population. These salmon may use Loch Broom when they migrate to sea, rivers that run into Loch Broom also support salmon e.g. Cuileig and Ullapool River and migrating salmon from these rivers are likely to swim in the vicinity of the development particularly from rivers at the head of Loch Broom. River Oykel SAC (7.6km NE of Ullapool) is also designated for Salmon but this river runs to the east coast so this development will have no impact.

4.2 Cultural Heritage

The development area intersects the Ullapool Conservation Area which was designated in 1972 under the Civic Amenities Act 1967.

There are 75 Canmore and 29 Canmore maritime entries (Historic Environment Scotland, 2019) within a 2km radius of the proposed development site. There are no wrecks within the footprint of the development and dredge area. However, there is one unclassified wreck in the vicinity of the development which lies approximately 35m north of the end of the breakwater pontoon (57.89583°N, -5.15500°E) at a water depth of 3m (lowest astronomical tide) (Canmore, 2019). This wreck may lie within navigation routes into the inner harbour after the end pontoon is installed.

There are 11 listed buildings within 2km of the site, as detailed in Table 4.2.

Table 4.2: Details of listed buildings within a 2km radius of the Development Site.

Site/Description	Index No. Primary Reference	Designation/Status	Location (OS NGR)
Ullapool Quay Street, The Captain's Cabin Late 18th century former warehouse, 3 storeys, 3 bays; harled. Centre door in 1st floor reached by forestairs; ground floor doors symmetrically sited in outer bays, each with later shop window slapped to left. South (Shore Street) gable with single ground, 1st and apex windows; end stack to north.	LB7792	Listed Building (B)	NH 12822 93969
Ullapool, West Shore Street, Ornsay House Thomas Telford, 1829, with subsequent alterations and re-casting of main entrance. 2-storey, 3-bay house, with 2-storey wing to rear. All harled with contrasting painted margins and long and short detailing to frontage. Centre door (later insertion); 2-pane glazing; coped end stacks; slate roof.	LB7787	Listed Building (C)	NH 12735 93911
Ullapool West Shore Street Caledonian Macbrayne And Tourist Office Possibly Thomas Telford, circa 1800. Alterations, Robert Hurd & Partners, 1978. Tall 2-storey, wide 3-bay former warehouse; all harled. 1 wide and 1 narrow entrance in south elevation with 2 assymetrical small windows. 3 small regularly spaced 1st floor windows. Long modern stair window rises to roof line from ground floor in east gable; slate roof.	LB7765	Listed Building (C)	NH 12752 93915
Ullapool Argyle Street Former Ullapool Parish Church And Burial Ground. Thomas Telford, 1829. Plans and specifications by James Smith. Standard Parliamentary T-plan church; coursed squared rubble, harled flanks and rear; contrasting	LB7764	Listed Building (A)	NH 12685 93998, NH 12687 94020

Site/Description	Index No. Primary Reference	Designation/Status	Location (OS NGR)
tooled ashlar dressings. Depressed arched outer doors in south elevation with similarly detailed paired windows in centre bays with standard cast-iron 2-light, latticed glazing. Similar windows in end gables and in east and west elevations of T-wing. Standard bellcote at west gable apex; slate roofs. Interior; plain galleried interior. Burial ground: pair squared dressed rubble gate piers with caps; coped drystone wall.			
Ullapool Quay Street, Memorial Clock Dated 1899. Handsome cast-iron clock on column. Square plinth supported fluted column, paired lamp brackets. Corinthian capital and square pedimented clock with face to each side; terminal urn and decorative weathervane.	LB7791	Listed Building (B)	NH 12795 94019
Ullapool Argyle Street Old Bank House Early 19th century, 2-storey and attic, 3-bay house; coursed red rubble, harled flanks and rear. Centre door with simple fanlight and plain wooden portico supported on slender Roman Doric columns. Smaller 1st floor windows; 12-pane glazing; 3 early piended dormers with 6-paneglazing; corniced end stacks; slate roof. Symmetrical fenestration to rear with centre stair window; single storey centre rear wing. Low rubble front retaining wall with ashlar cope.	LB7785	Listed Building (B)	NH 12898 94046
Ullapool Main Road, The Manse Circa 1844. Renovated, 1906. 2-storey and attic, 3 wide bays; coursed rubble, tooled dressings. Recessed narrow centre bay with entrance approach by 3 steps; fanlight; modern door; bipartite above; taller bipartites in ground floor outer bays; 12-pane glazing; 2 small gabled barge-boarded dormers (probably 1906) with 4-pane glazing; corniced end stacks; slate roof. Single storey, single bay wing to rear.	LB7788	Listed Building (B)	NH 13338 94147
Ullapool Old Mill Street, Parish Church (Church Of Scotland) Probably william Henderson, Architect, Aberdeen 1844. Reconstructed in 1906, with further alterations after 1929. Plain rectangular church with lower single storey, 3-bay wing at north. Coursed rubble, harled rear, tooled ashlar margins and dressings.	LB7789	Listed Building (C)	NH 13021 94245

Site/Description	Index No. Primary Reference	Designation/Status	Location (OS NGR)
Round-headed entrance in centre of east gable with gallery window above. 5 long round-headed windows in symmetrical south elevation; lattice pane glazing; finialled bellcote at east gable apex; ridge ventilator; apex ball finials; slate roof.			
Ullapool, 1, 2 Custom House Street, Drill Hall And House Drill hall and adjoining 2-storey villa-like house built circa 1887 for the Seaforth Highlanders, on the site of the Custom House.South facing Custom House Street elevations, stone-built; snecked to front, rubble or rendered elsewhere, ashlar detailing; arched openings; plate glass timber sash and case windows to hall, modern uPVC replacements to house. 3-bay south front to hall, central double door with flanking windows and central timber louvred opening above door; segmental-arched corrugated iron roof. Door with 2 windows to long elevation on Ladysmith Street with north lean-to. Timber tongue and groove to some interior walls and to arched roof with thin metal tie beams. Attached 3-bay house of similar arrangement with central door (uPVC with timber effect finish) and flanking windows. Curvilinear gable to left bay; timber-corbelled oriel breaking eaves to right bay, both with finials. Pitched and piended slate roof, stone skews, prominent stacks. Rear single storey lean-to extension.	LB49788	Listed Building (C)	NH 12886 94283, NH 12874 94294
Ullapool 4 (L) And 5 (R) Custom House Street. Mid 19th century; pair 2-storey, 3-bay houses, of slightly differing build. Coursed rubble, tooled dressings; centre doors; 12-pane glazing; end and ridge stacks; slate roofs.	LB7786	Listed Building (C)	NH 12926 94288, NH 12937 94294
Ullapool Old Mill Street, Hill Cottage And Rear Byre Range. Earlier 19th century, 2-storey and attic, wide 3-bay house; west facing with late 19th century single storey and attic, 2 bay wing at south gable. All harled. Panelled centre door. 12-pane glazing; 2 later canted dormers with 2-pane glazing; flat skews with late 19th century skew-putts; corniced end stacks; slate	LB7790	Listed Building (C)	NH 13225 94371, NH 13240 94375

Site/Description	Index No. Primary Reference	Designation/Status	Location (OS NGR)
roof. 2-storey, single bay bathroom wing to rear. Contemporary single-story harled rubble byre range to rear. Corrugated iron roof.			

4.3 Landscape and Visual

The site lies between two designated National Scenic Areas, Assynt Coigach (approx. 6.0km to the north west) and Wester Ross (approx. 7.4km south west). Both are designated for having some of finest mountainous scenery in Scotland. As the development is outside these areas and is not providing a significant change to wider landscape, we consider that the low-lying works will not compromise the integrity of the nearby National Scenic Areas.

4.4 Land

The underlying geology of the development is sandstone and pebble of Applecross Formation, with superficial deposits of marine beach gravel deposits (BGS, 2019c).

There is baseline borehole data close to the dredge area, taken during the previous main pier development (BGS, 2019b). Data for this borehole sample (taken adjacent to ferry pier, 57.894636°N, -5.159267°E) indicates that the dredge material will compose of silty sand and medium gravel in the surface layer and then the remainder will be coarse sand and fine gravel.

There is also baseline borehole data onshore from Argyle Street which is immediately parallel to Shore street (approximately 30m north, 57.896553°N, -5.156988°E) (BGS, 2019a). A description of the strata here indicates that under the initial bitumac and crushed limestone road base (0.35m) there is loose dark brown very silty sandy cobbly gravel, with rootlets (0.35m-1.0m) and underlying dense brown sandy rounded fine and coarse gravel and cobbles (1.0m-5.55m).

Designated sites with geological features within 20km of the site are outlined in Table 4.3. Creag Chorcurach SSSI is the closet designation for a terrestrial geological feature, situated 5.4km south of the site and is designated for Moine. The development will not impact geological features at this distance away and therefore other terrestrial geological designations are not considered for the remainder of the screening document.

The Wester Ross MPA includes geodiversity features and detailed in Table 4.3, the closest of these features to Ullapool are moraines a few 100m offshore (SNH, 2013a).

Table 4.3: Statutory Nature Conservation Designations with Geological Designations within 20km of the Development Site (Marine Scotland, 2019; SNH, 2020)

Site	Designation	Distance Direction	Designated Features (relevant designation)
Wester Ross	MPA	Immediately adjacent	Protected Geodiversity Features: Marine geomorphology of the Scottish shelf seabed - banks of unknown substrate; Quaternary of Scotland – glaciated channels/troughs, megascale glacial lineations, moraines; Seabed fluid and gas seep- pockmarks; Submarine mass movement -slide scars
Creag Chorcurach	SSSI	5.4km S	Geological features (SSSI): Moine;
An Teallach	SSSI	7.0km SW	Geological features (SSSI): Moine; Quaternary of Scotland (glacial and periglacial features)
Inverpolly	SSSI	11.8km NNE	Geological feature (SSSI): Quaternary of Scotland
Beinn Dearg	SSSI	12.5km SE	Geological features (SSSI): Quaternary of Scotland (moraines)
Cailleach Head	SSSI	14.8km W	Geological feature (SSSI): Torridonian
Knockan cliff	SSSI	15.4km NNE	Geological feature (SSSI): Moine
Rubha Dunnan	SSSI	16.4km NW	Geological feature (SSSI): Torridonian
Corrieshalloch Gorge	SSSI	16.6km SSE	Geological features (SSSI): Quaternary of Scotland; Fluvial geomorphology of Scotland
Meall an t-Sithe and Creag Rainich	SSSI	16.9km S	Geological features (SSSI): Moine
Fannich Hills	SSSI	18.4km SSE	Geological feature (SSSI): Quaternary of Scotland; Moine

4.5 Air

The development site is not within an air quality management zone. There is only one Air Quality Management Area in the whole of the Highland Council Area (Air Quality in Scotland, 2019) This is within Inverness City Centre and covers a small area on a busy junction between 3 streets. No air quality data exists for the development area, but it is anticipated that air quality will be high based on its rural and coastal location.

4.6 Water and Coastal Processes

Loch Broom is classed as a coastal water body (ID: 200161) in the Scottish River Basin District, it has an overall status of good which it has retained since 2007, although the status of some biological elements considered by the scheme have dropped from high to good, while other have increased from good to high (SEPA, 2020).

There are no records of bathing water quality in Ullapool. There are no freshwater courses within the proposed development area, there are surface water drainage gullies passing under the road discharging onto the foreshore.

The frontage at Shore Street is exposed to wind driven waves generated over the local fetch in Loch Broom. The area to the north of the main pier where the existing pontoons are located can have rougher seas than are desired in certain weather conditions.

4.7 People

The total population of Ullapool as of the 2016 was 1,520 (National Records of Scotland, 2018). The main employment sectors in the Highland region are health and social care, tourism and hospitality; Ullapool is a popular tourism hotspot and contains numerous hotels, B&B's, guest houses, and holiday cottages as well as shops and restaurants. 5-10% of the population (% of total employment) in the Ullapool region are directly employed by the fishing, fish processing or aquaculture industry (Baxter, 2011). As of September 2019, the unemployment rate was 1.6% in the Wester Ross region (Highlands and Islands Enterprise, 2019).

Ullapool has a medical health centre which offers GP services and minor surgeries. For major medical requirements the closest hospital is Raigmore Hospital in Inverness which is 57miles away by road.

The onshore side of Shore Street is a row of residential and business properties which runs along the whole length of the development area (approximately 29 properties). These businesses operating on Shore Street include cafes, pubs, holiday accommodation (guesthouses, B&B's, and a youth hostel) and shops (including newsagent, pharmacy, clothes and gift shops).

There are a number of marine users which are likely to use the development area directly and if not will use its surroundings (e.g. slipway, mooring buoys, and Ullapool harbour). These include the Royal Yacht Association Loch Broom Sailing club, Ullapool Coastal Rowing club, Blue tourist businesses kayak, sailing and wildlife tour companies.

Ullapool harbour is an important fishing harbour representing a significant proportion of Scottish landings from demersal and shellfish fisheries (Table 4.4). The harbour is used by Scottish and Spanish fishing vessels that catch white fish and squid in summer and monkfish in winter (Ullapool Harbour Trust, 2020). These larger boats mostly berth and land their catch in the deeper parts of the harbour outside of the development area. There is also an inshore shellfish fleet operating out of Ullapool that lands crab, lobsters and prawn on daily/weekly basis (Ullapool Harbour Trust, 2020).

Table 4.4: Ullapool Fish and Shellfish Landings 2018 (Scottish Government, 2019)

Species Category	Ullapool (live tonnes)	Whole of Scotland (live tonnes)	Proportion of national landings in Ullapool
Demersal	9,403	117,216	8.0%
Shellfish	1,924	140,948	1.4%
Pelagic	13	43,966	0.03%

4.8 Traffic, Transport, Access and Navigation

The proposed developed is situated on one of busiest streets in Ullapool. Shore Street (A893) is the main route to the ferry terminal and serves as key route to access amenities in the south side of Ullapool. Annual average daily traffic using this road was estimated at 2262 motor vehicles (of which 60 were HGVs) in 2018 (Department of Transport, 2020).

The footpaths along the street provide access to business and residential properties on one side and the seafront on the other side.

Ullapool's main pier has a navigation light (fixed red beacon) on the South East corner which marks the edge of the pier and assists safe passage up to the pier and into the part of harbour that will be upgraded in the development. This is maintained by Ullapool Harbour Trust. Currently Ullapool harbour has an average of 20-50 vessel transits per week from vessels that record AIS Shipping Traffic data (usually large vessels – fishing vessels below 15m are exempt from requiring AIS) (Marine Scotland, 2019). Most of these transits are carried out by the Caledonian MacBrayne ferry that links Ullapool to Stornoway but includes large fishing vessels, aquaculture service vessels and military vessels. There are also smaller fishing vessels and recreational vessels that operate from and use Ullapool harbour. Visiting recreational sailors use Ullapool as passing place for Northern routes to Cape Wrath, Orkney and Shetland (Sail Scotland, 2019).

4.9 Cumulative planning applications

There are 13 planning permission applications within 2km of the site (Highland Council e-planning website - https://wam.highland.gov.uk/wam/ accessed 10/12/2019). None of applications are considered to interact with the Shore Street promenade and harbour upgrade proposal.

Further afield there is a holiday development on the Summer Isle, Tanera Mòr that indirectly interacts with this proposal. Tanera Mòr, described as an idyllic island retreat, is proposed to host 60 guests and house a resident staff population. When the development is complete, a ferry service could operate between Ullapool Harbour and the Island to transport guests, staff and visitors.

5 Potential Effects

5.1 Construction

Table 5.1 provides a description of the environmental aspects resulting from the Shore Street Widening & Promenade works (yellow) the Small Boat Harbour Development (blue) and both projects (green). It outlines the sensitivities as detailed in Section 4, identifies any likely significant effects and proposes mitigation measures for negative effects.

Table 5.1: Construction Effects and Sensitivities

Aspect		Source	Sensitivities	Likely Significant Effects (excluding mitigation)	Any mitigation measures?
Use of Natural Resources	Use of Material (eg steel)	Rock for rock armour. Infill material for land reclamation Tarmac, bricks etc for road, promenade and wall. Steel for sheet piles.	None	NO	Efficient use of resources. Appropriate design for long life in marine environment including corrosion protection of steel elements.
	Use of Land and/or Soil	Dredge spoil from rock armour toe trench and dredge pocket.	NO	NO	The volumes of removed material will be minimised through design and re-used where possible.
	Water	Construction water requirements.	NO	NO	No mitigation required.
	Biodiversity / Land-Take	Removal of intertidal habitat associated with widening of Shore Street and the Small Boat Harbour Development.	Biodiversity – Intertidal Benthic	NO	Construction footprint minimised by design.
Residues and Emissions	In-Air Noise and Vibration	Road, promenade and rock armour construction works. Vibro piling.	Cultural Heritage People	YES - Negative	Noise and Vibration assessment to be completed prior to works to inform specific mitigation requirements, for agreement through the planning process.

Aspect		Source	Sensitivities	Likely Significant Effects (excluding mitigation)	Any mitigation measures?
		Plant and vessel movements for dredging and pontoon installation.			Works conducted in line with current practice for noise and vibration control on construction and open sites. Good communications with the community so they are aware of planned works.
	Underwater Noise and Vibration	Plant and vessel movements. Rock infill / Material placement. Vibro piling.	Biodiversity – Marine (incl. the qualifying features of the Inner Hebrides and the Minches SAC)	NO	Vibro piling carried out in shallow waters and mainly above MLWS protected from the wider Loch Broom by the existing harbour, hence noise levels experienced in water depths suitable for marine mammals will not cause physical harm, and disturbance effects will be minimal. Rock infill will not be dropped from height by the excavator, majority of works completed out of the water column. All plant vehicles / vessels used will be well maintained.
	Air Quality (Emissions – dust)	Removal of old pavements, roads and promenade. Rock infill / Material placement. Plant movements.	Air People	NO	Dust management including localised dampening and road sweeping.
	Air Quality (Greenhouse Gases and Climate Change)	Plant and vessel movements	No Local Sensitivities Possible Climate Change Contribution	NO	Plant, vehicles and vessels will be well maintained. Reuse and recycling of materials to limit the amount of bulk material needing to be imported onto site.
	Terrestrial Pollution	Risk of unplanned emissions / release of pollutants from, i.e.	Land Quality	NO	Quantities of hazardous materials, fuels and oils stored on site minimised.

Aspect		Source	Sensitivities	Likely Significant Effects (excluding mitigation)	Any mitigation measures?
		• Oil/fuel storage and handling • Hazardous material storage and handling • Plant/machinery fault			Works conducted in line with standard best practice and Guidance on Pollution Prevention with regard to hazard material and fuel storage and handling. Spill procedures and kits in place. Plant and machinery will be appropriately maintained. Works associated with Scottish Water sewage pumping station will be conducted in conjunction with Scottish Water requirements.
	Water Quality (Marine)	Risk of unplanned emissions / release of pollutants from, i.e. • Oil/fuel storage and handling • Chemical storage and handling • Plant/machinery/vessel fault	Water Biodiversity – Marine (incl. Wester Ross NCMPA; Inner Hebrides and the Minches SAC)	NO	Works conducted in line with standard best practice and existing guidelines: • Storage and handling; • Waste management; and • Surface water management Plant and machinery will be appropriately maintained. Works associated with Scottish Water sewage pumping station will be conducted in conjunction with Scottish Water requirements.
	Water and Seabed Quality (Marine)	Increased sediment in the water column associated with primarily with dredging disposal activities. Drop out of sediments onto the seabed. Resuspension of contamination into water column.	Biodiversity – Marine (incl. PMF tall seapen (*Funiculina quadrangularis*) of the Wester Ross MPA; Salmon; Marine mammals Loch Broom	YES - Negative	Dredge limited in depth, minimising volume and duration of dredge. Ensure dredged material is not contaminated and appropriate dredge disposal route is identified through the dredge licensing BPEO assessments processes. Reuse dredge spoil in the construction works as far as practicable.

Aspect		Source	Sensitivities	Likely Significant Effects (excluding mitigation)	Any mitigation measures?
	Light Emissions	Light for construction	Biodiversity – Terrestrial Biodiversity – Marine People	NO	Works will follow the Scottish Executive Guidance Note, 'Controlling Light Pollution and Reducing Lighting Energy Consumption'; • Over-lighting will be avoided and designed to industry recommended levels; and • All lights will be carefully directed to where they are most needed and will be designed to minimise light pollution
Traffic, Transport, Access and Navigation	Traffic and Transport	Vehicle movement restrictions associated with construction works associated with the Shore Street Widening and Promenade Works.	Traffic, Transport	YES - Negative	A Traffic, Transport and Access Management Plan will be produced and submitted to support the planning application, this will identify the requirements of the various project phases and appropriate mitigation, this may include: • The use of traffic lights if one carriageway needs to be closed; • Temporary use of parking bay as traffic or construction access corridor; • Diverting traffic along Quay Street and Argyle Street to allow both lanes to be closed; • Timing road closures around the ferry timetable where practicable; • Communication with local residents and stakeholders such as local businesses & CalMac;

Aspect		Source	Sensitivities	Likely Significant Effects (excluding mitigation)	Any mitigation measures?
					• Appropriate signage.
	Access	Construction works on the footpath and the promenade.	People (Locals and Visitors) Businesses on Shore Street	YES - Negative	The Traffic, Transport and Access Management Plan to produced and submitted to support the planning application will specifically cover pedestrians and cyclists, it will identify the requirements of the various project phases and appropriate mitigation, this may include: • Works on landward side footpath being phased to minimise disturbance. • Accesses to businesses will always be maintained. • Alternative pedestrian routes being set up to provide safe routes along Shore Street. • Ongoing two-way communications with local businesses & residents. • Appropriate signage.
	Navigation	Dredge and dredge disposal activities including vessel movements associated with the Shore Street Widening and Promenade works.	Ferry Commercial Vessels including fishing boats Recreational Vessels from kayaks, row boats to yachts.	No	Appropriate Notice to Mariners posted. Input from the Harbour Master pre and during construction works. Harbour Master retains control of safety during works, coordinating movements as required.

Aspect		Source	Sensitivities	Likely Significant Effects (excluding mitigation)	Any mitigation measures?
	Navigation	Dredge and dredge disposal activities including access requirements and vessel movements associated with the Small Boat Harbour Development. Delivery and installation of pontoons.	Ferry Commercial Vessels including fishing boats Recreational Vessels from kayaks, row boats to yachts.	YES - Negative	Early communication with local vessel owners to allow alternative berths and arrangements to be put in place. Appropriate Notice to Mariners posted. Input from the Harbour Master pre and during construction works. Harbour Master retains control of navigational safety during works, coordinating movements as required.

Without mitigation there are potentially five likely significant negative effects arising from the construction stage of the project as identified in Table 5.1.

5.1.1 In-Air Noise and Vibration

The location of the Shore Street Widening & Promenade works on a road lined by residential and business properties, coupled with the use of heavy machinery for construction will give rise to in-air noise and potentially vibration effects. Similarly, the Small Boat Harbour Development is close to residential and business properties at the west end of Shore Street and Quay Street and will utilise some heavy plant. However, noise and vibration effects of construction activities are well understood and predictable which allows appropriate mitigation to be identified to minimise effects. It is also recognised that the effects will be limited to the construction period(s) only. The two projects will be carried out at different times hence the noise and vibration levels will not be a cumulative.

As mentioned in Table 5.1 and detailed in Section 6.1.1 a noise and vibration assessment will be completed once the design is further progressed to inform specific mitigation requirements and submitted in support of the planning application(s). Standard construction noise mitigation techniques and communication strategies will be put in place as detailed in Section 6.2.1.

5.1.2 Water and Seabed Quality (Marine)

Both projects will require an element of dredging, where practicable this will be reutilised as infill material, however there is a potential that it will need to be disposed of. Although there are no known contaminants present, until the material is sampled this cannot be confirmed.

Sediment sampling and analysis will be completed to inform BPEO assessments to identify the best management of dredge spoil in support of the dredge licences.

The Shore Street Widening & Promenade toe dredge is in the intertidal area, hence dredging will only give rise to sedimentation issues when the tide is in and these are not expected to be significant.

The Small Boat Harbour Development dredge includes some intertidal areas but more of it will be underwater than the toe dredge. However, sedimentation effects will be localised.

Dredge disposal would give rise to localised sedimentation and smothering effects at the dredge disposal site. The closest dredge disposal site is the Ullapool (Loch Broom) disposal site number HE050 however, it is recognised that there may be tall seapens in the vicinity of this disposal site which would need to be considered within the BPEO(s).

Recognising that the sampling, analysis and BPEO(s) will be completed to support the dredge licence and appropriate management put in place through this mechanism no significant effects are expected to occur.

5.1.3 Traffic, Transport and Access

The widening of Shore Street including the upgrade of the footpaths and the road will impact upon both pedestrian and vehicle users. This is likely to include reducing traffic flows to a single lane and potentially stopping vehicle access completely during some phases of the works. At this stage phasing has not been developed, but options to temporarily divert vehicles via Quay Street and Argyle Street are available. Pedestrian access to businesses and residential properties will have to be retained for the duration of the works, this will require temporary arrangements to be put in place during some phases of the works and appropriate safety segregation (fencing) to prevent the public interacting with the construction works. As discussed in Table 5.1 and Sections 6.1.3 and 6.2.3 a Traffic, Transport and Access Management Plan will need to be developed considering the various phases of the works, this will be submitted as part of the planning application for the Shore Street Widening and Promenade project.

5.1.4 Navigation

To provide access to the Small Boat Harbour Development area, vessels currently utilising the inner walls of the main pier and the existing pontoons will need to be relocated elsewhere within the harbour. This will give rise to a short-term inconvenience for the fishing and recreational vessel owners. The works will give rise to additional vessel movements within the harbour area and Loch Broom, the management of these movements will have to take account of the existing harbour users to prevent delays to the ferry service and avoid navigational risks. As discussed in Table 5.1 and Sections 6.1.4 and 6.2.4 mitigation including early communications and temporary arrangements can be put in place to minimise the effects arising.

5.2 Operations

Table 5.2 provides a description of the environmental aspects arising during operations of Shore Street Widening & Promenade (yellow) the Small Boat Harbour Development (blue) and both projects (green). It outlines the sensitivities as per Section 4, identifies likely significant effects and proposes mitigation measures for negative effect on the environment.

Table 5.2: Operational Effects and Sensitivities

Aspect		Source	Sensitivities	Potential Significant Effect (no mitigation)	Any mitigation measures?
Use of Natural Resources	Underwater Noise and Vibration	Potential slight increase in numbers of small vessels utilising the Harbour.	Biodiversity – Marine	NO	Only small vessels will be accommodated by the development, hence unlikely to give rise to significant additional noise effects.
	Coastal Processes	Rock Armour Revetment and Quay Fronts	Coast Line	NO	
	Coastal Processes	Breakwater Pontoon	Coast Line	NO	
	Coastal Processes	Flooding of Shore Street	Public -Locals and Visitors Buildings Local Businesses	NO	
	Social and Economic Benefits	Shore Street Widening and Promenade and Small Boat Harbour Development Infrastructure Provided	Public – Locals and Visitors Local Businesses	YES - Positive	
Traffic, Transport, Access and Navigation	Pedestrian Access and Safety	Widened path, road widening new promenade with wall segregation form the road and safe crossing points.	Public - Locals and Visitors	YES - Positive	
	Traffic Flow and Road Safety	Road widened, and provision for sewage maintenance.	Ferry Traffic Local and Visiting Vehicles.	YES- Positive	
	Navigation	New Pontoons, dredged area and breakwater pontoon.	Small Boats	YES – Positive	Harbour Master retains control of navigational and coordinating movements.

5.2.1 Coastal Processes

As detailed in Table 5.2 there will be changes associated with the Shore Street Widening and Promenade on the coastline as the existing revetment will be replaced with a rock armour revetment located outward of the existing line. In addition, the Small Boat Harbour Development includes a breakwater and a dredged area. As discussed in Section 1 projects capable of altering the coast fall under Schedule 2 of the EIAR regulations, as such to inform this Screening Report and the Screening Opinion Requested it is important to consider this aspect further.

An independent wave study has been conducted to model the wave environment in normal and extreme weather events in connection to the proposed works, this is provided as Appendix 1 to this document. The findings of this study indicate that overtopping rate in an extreme 1 in 200 year weather event the maximum overtopping rate will reduce from a 20 litres per second per metre in the existing seawall set up to 0.5litres per second per metre for the proposed new promenade. This latter rate is well within the EurOtop manual's recommended values for safe pedestrian access (EurOtop, 2018). Modelling also indicated that wave heights in new inner basin of the harbour (to the specification described in Section 3.1.2) will be reduced to a level within the limits recommended for safe berthing of small boats. The latter reduction is due to the addition of the floating breakwater and pontoon at the south east corner of main pier.

Replacement of concrete block revetment sea defences with rock armour will either continue the effectiveness of Shore Street coastal flood defence or improve it based on the modelling report (Appendix 1). Replacement is particularly important because the current sea defences are damaged and undercut in parts.

The existing coastline of the development area is all man made (rock revetment, or piled quay walls) the wave studies do not identify any changes to coastal processes outwith the development footprint, hence no likely significant negative effects are predicted.

5.2.2 Social and Economic Benefits

The amenity value of Shore Street will be increased the provision of a safe promenade for locals and visitors to utilise with ramp and step access to the foreshore coupled with improvements for vehicle and pedestrian safety as discussed in Section 5.2.3. The separation between the road and the promenade will improve visitor experience to the shore front. If people are more inclined to spend time on Shore Street then they are more likely to frequent the shops and food outlets, contributing to the local economy. Due to its attractive shorefront location, exceptional views, shops and range of eateries, Shore Street is one of the principal destinations for visitors to Ullapool. The creation of a shoreside Promenade and widening of the pavement beside the shops and other businesses will alleviate the congestion currently experienced throughout the tourist season. The proposed works will significantly enhance the visitor experience, with consequential economic benefits expected to all tourist related businesses in the village, not only on Shore Street itself. The works will also significantly improve the experience of those permanently resident in Ullapool through easing of pedestrian and road congestion.

The Small Boat Harbour may encourage additional yachts to visit Ullapool. The facilitates will also assist the water related recreational businesses and the fishing sector, allowing them to enter and leave the harbour in a wider range of tide states. All of which has knock on benefits to the economy of the village.

5.2.3 Traffic, Transport and Access

The purpose of the Shore Street Widening and Promenade development is to improve traffic flow and pedestrian safety. The widening of the road will minimise congestion especially that associated with the vehicles embarking and disembarking the ferry, as the restricted carriageway width will no longer imped the flow of traffic. Pedestrian safety will be increased as vehicles will no longer need to, or be able to mount the shoreside pavement, as the new Promenade will be segregated by a wall from the road. The wider path in front of the buildings will allow pedestrians to pass each other without having to step out onto the road. In addition, the dedicated area for Scottish Water maintenance vehicles off the road and off the pavement will alleviate both traffic flow and pedestrian safety issues. Dedicated pedestrian crossing points will also increase safety on Shore Street.

5.2.4 Navigation

The new pontoons and associated breakwater and dredge will provide additional facilities for small boats in Ullapool. Boats which may have previously moored in the bay will be able to berth alongside where they are afforded additional protection and have easy access to shore side facilities. Any increase in vessel numbers is not expected to give rise to a significant navigational rise, and navigational safety will remain under the control of the Harbour.

6 Mitigation

Mitigation identified to avoid significant negative effects along with general mitigation measures to minimise other environmental effects are detailed within this section. These will form the basis of the mitigation which will be submitted in support of planning and marine licence applications.

6.1 Pre-Construction Requirements

6.1.1 In-Air Noise and Vibration

Noise and vibration assessments will be completed, considering the noise sources associated with the various stages of the work, in alignment with BS 5228-1:2009+A1:2014 – the 'Code of practice for noise and vibration control on construction and open sites' (British Standards Institute, 2014). Appropriate specific mitigation will be identified to minimise noise and vibration levels at receptor locations and the associated disturbance caused for each construction phase.

6.1.2 Water and Seabed Quality (Marine)

Sediment sampling and analysis in line with the Pre-Disposal Sampling Guidance (Marine Scotland, 2017) will be completed and a BPEO assessment carried out to identify the appropriate management and submitted with dredge licence applications to Marine Scotland. Dredge spoil will be reused in the construction works as far as practicable.

6.1.3 Traffic, Transport and Access

A Traffic, Transport and Access Management Plan will be produced and submitted to support the planning application, this will identify the requirements of the various project phases and appropriate mitigation.

6.1.4 Navigation

A sufficient period prior to construction there will be communication with local vessel owners to allow alternative berthing arrangements to be put in place, to allow access for the Small Boat Harbour Development works to be undertaken.

Appropriate Notice to Mariners will be posted prior to works commencing.

Input from the Harbour Master will be sought with regard to the planning of construction works, such that navigational risks are minimised. Plans will also take account of the ferry timetable.

6.1.5 General Mitigation

The detailed design process will take account of the environmental sensitivities identified in Section 4 of this document. Where potential effects arise from the construction works appropriate mitigation will be identified, details of which will be provided with the planning consent and marine licence applications. Risk Assessment Method Statements will be in place for all construction tasks, these will include any environmental precautions and mitigation measures. Mitigation measures will be in alignment with construction guidance as discussed in Section 6.2.5.

6.2 Construction Mitigation

6.2.1 In-Air Noise and Vibration

Relevant guidance including Pollution Prevention Guidance 6 (PPG6) – for Working at Construction and Demolition Sites (Environmental Agency, NIEA, & SEPA, 2012) will be followed where appropriate. The construction mitigation is likely to include:

- Good communications with the community so they are aware of planned works and the programme and have a contact to raise any concerns to during the works.
- Timing restrictions for noisy activities.
- Use of appropriate well-maintained equipment for the given task.
- Potential use of acoustic barriers.
- The contractor will be made aware of the issues and the workforce appropriately trained to ensure unnecessary noise is avoided.
- Monitoring to ensure mitigation employed is effective.

These will be confirmed through the noise and vibration assessment submitted in support of the planning application(s).

6.2.2 Water and Seabed Quality (Marine)

Sediments suitable for use within the construction works shall by reused, the rest will be managed in accordance with the findings of the BPEO.

6.2.3 Traffic, Transport and Access

Mitigation shall be implemented as identified by the Traffic, Transport and Access Management Plan, mitigation measures may include:

- The use of traffic lights if one carriageway needs to be closed;
- Diverting traffic along Quay Street and Argyle Street to allow both lanes to be closed;
- Timing road closures around the ferry timetable where practicable;
- Temporary use of parking bay as traffic or construction access corridor;
- Communication with local residents and stakeholders such as CalMac;
- Works on landward side footpath being phased to minimise disturbance;
- Ensuring access to businesses and residential properties is always maintained;
- Alternative pedestrian routes being set up to provide safe routes along Shore Street;
- Ongoing two-way communications with local businesses and residents.

6.2.4 Navigation

There will be ongoing communications with the owners of boats affected by the works on the Small Boat Harbour Development, so that they are aware of progress and when they will be able to utilise the upgraded facility.

The Harbour Master will retain control of navigational safety during works, coordinating movements as required. Appropriate Notice to Mariners will continue to be posted during the works.

6.2.5 General Mitigation

Due to the potential effects the projects could have on a range of stakeholders during the construction phase stakeholder communications will be carried out throughout the works, this may include both verbal and written communications. The Ullapool Harbour Trusts website will be kept up to date with regard to progress and the next stages of the works.

In addition to the specific mitigation identified to manage effects that could be significant in the absence of mitigation, construction guidance will be followed to minimise other potential negative effects of the projects, this is likely to include:

- Guidance on the Assessment of Dust from Demolition and Construction (IAQM, 2014)
- Pollution Prevention Guidance 6 (PPG6) – for Working at Construction and Demolition Sites (Environmental Agency et al., 2012)
- Coastal and Marine Environmental Site Guide: C584 (Budd, John, Simm, & Wilkinson, 2003)
- Guidance for Pollution Prevention 8 (GPP8) – Safe storage and disposal of used oils (SEPA, Natrual Resources Wales, & NIEA, 2017)
- Pollution Prevention Guidance 7 (PPG7) – The safe operation of refuelling facilities (Environment and Heritage Service, SEPA, & Environment Agency, 2011) and
- Guidance for Pollution Prevention 5 (GPP5) – Works and maintenance in or near water (NIEA, 2017)

In addition, any applicable General Binding Rules from the Water Environment (Controlled Activities) (Scotland)Regulations 2011 as amended will be applied.

7 Summary

There are proposals to widen Ullapool's Shore Street and to develop a promenade, in addition there is a potential that following the completion of that project Ullapool Harbour Trust will undertake a Small Boat Harbour Development.

Both projects fall under both the Marine Act (Scotland) 2010 and the Town and Country Planning (Scotland) Act 1997. Screening opinions are sought from Marine Scotland and the Highland Council under the Marine Works (EIA)(Scotland) Regulations 2017 and the Town and Country Planning (EIA)(Scotland) Regulation 2017 respectively with regard to the Shore Street Widening and Promenade on it own and in combination with the Small Boat Harbour Development.

Likely significant negative effects were identified for both projects without mitigation. However, mitigation has been identified for all of these aspects which reduce the resultant effects such that they are unlikely to be significant.

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9 Glossary

Acronym	Definition
BPEO	Best Practicable Environmental Option
EIA	Environmental Impact Assessment
EPS	European Protected Species
MHWS	Mean High Water Spring
MLWS	Mean Low Water Spring
MPA	Marine Protected Areas
NSA	National Scenic Areas
PMFs	Priority Marine Features
SAC	Special Areas of Conservation
SEPA	Scottish Environment Protection Agency
SNH	Scottish Natural Heritage
SPA	Special Protection Areas
SSSI	Sites of Special Scientific Interest

Appendix 1 – Ullapool Wave Study

ULLAPOOL HARBOUR TRUST

ULLAPOOL WAVE STUDY

ADDITIONAL COMPUTATIONAL MODEL STUDIES

IBE1403
Ullapool Wave Study
Additional Computational
Model Studies
1
07 Oct 2019

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1 INTRODUCTION

A promenade development scheme is being designed for the Shore Street frontage at Ullapool and the Harbour Trust are also proposing to increase the dredged depth and size of the small boat harbour which is located to the east of the Harbour Building in the lee of the main pier.

As RPS had already undertaken wave studies at Ullapool in connection with the Shore Street development, the firm was commissioned to undertake additional wave studies in connection with the proposed promenade and the enhanced small boat harbour facilities. The brief for theses wave studies was as follows:

1. Update the original wave study to take account of the revised SEPA climate change sea level rise figures issued in 2019.
2. Undertake Joint Probability analysis for extreme waves and water levels. Run the wave transformation models for the combinations of waves and water levels to simulate the overtopping of both the existing Shore Street revetment and the proposed new seawall and rock revetment.
3. Set up harbour wave disturbance models for the proposed small boat harbour and run simulation for the existing and proposed Shore Street revetment.
4. Run harbour disturbance simulations to test the need for and effectiveness of floating breakwater wave attenuator located off the south eastern corner of the Pier.

The details for the various facilities to be tested in the model were provided by the Harbour Trusts engineering consultants Wallace Stone LLP, drawings 2059/909, 910 and 911 for the revetment and 2127/901 and 902 for the small boat harbour. Wallace Stone LLP Drawing 2127/902 shows a plan of the proposed small boat development and the proposed revetment and is reproduced in Figure 1.1 below.

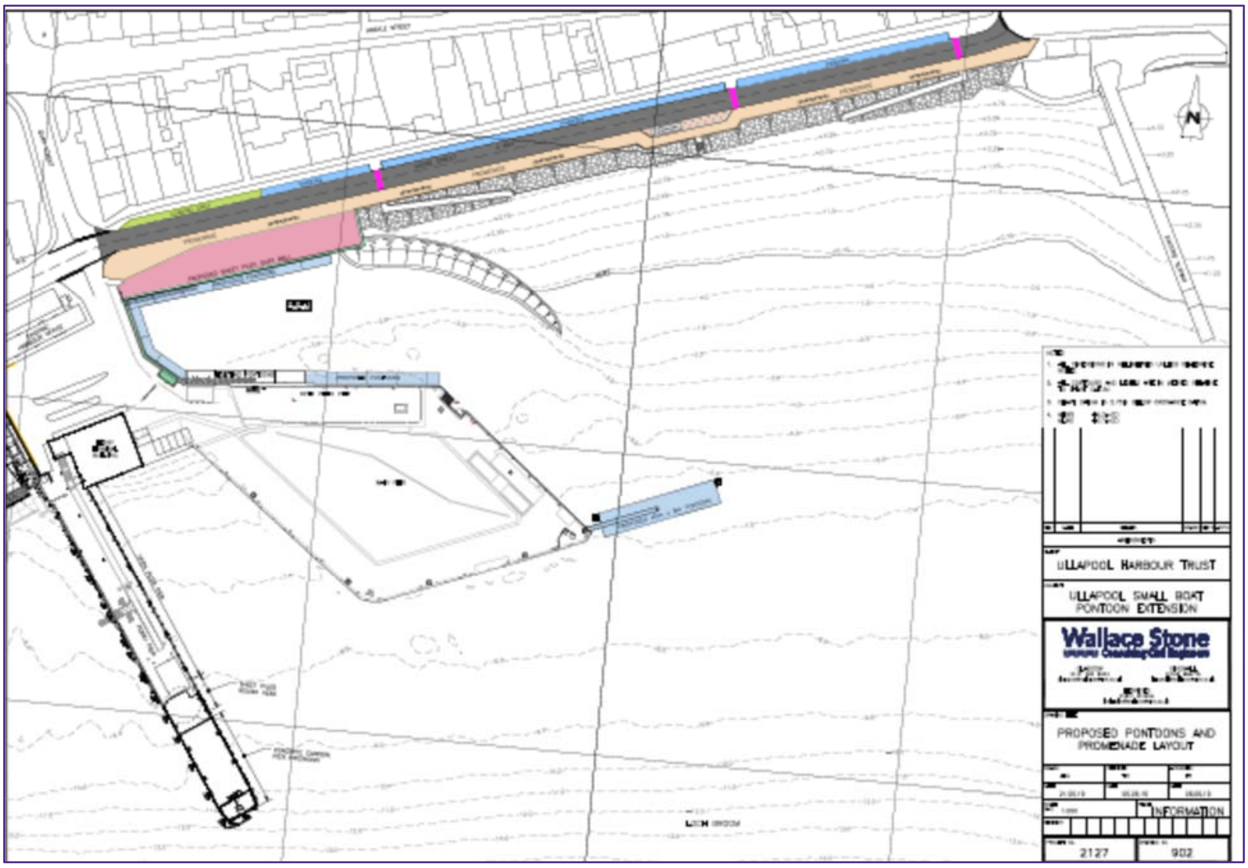

Figure 1.1 Layout of proposed promenade at Shore Street and enlarged small boat facilities at Ullapool Harbour

2 THE WAVE TRANSFORMATION MODEL STUDY

2.1 Conclusions from the Original Wave Study

The original wave studies for the Ullapool frontage at Shore Street were completed in November 2017, RPS report *IBE1403/AKB/Ullapool*. The conclusions from this November 2017 report were;

"The wave climate along the frontage at Shore Street Ullapool has been simulated for 1 in 1, 1 in 50, 1 in 100, and 1 in 200 year return period storm conditions using advanced computational modelling techniques. The simulations were undertaken at high tide, with an allowance for storm surge where appropriate, as the storm wave penetration into the site is expected to be greater at high water levels than at lower tidal levels.

The largest waves approach the site during storms from south south east to the south south west when the maximum significant wave heights at the designated wave points at the site vary from 0.393 metres to 0.648 metres for the 1 in 1 year return period storms with spectral peak wave periods varying between 2.76 seconds and 2.80 seconds. During 1 in 200 year return period storms the maximum significant wave heights at the designated wave points at the site vary from 0.770 metres to 1.331 metres with spectral peak wave periods varying between 3.63 seconds and 3.71 seconds.

The predicted sea level rise by 2080 is about 0.58 metres and this will only increase the significant wave high at the frontage by about 0.025 metre at times of high water."

2.2 SEPA Extreme Water Levels and Predicted Sea Level Rise

Following the IPCC report on Climate Change due to Global Warming issued in late 2018, SEPA has revised its extreme water levels and predicted sea level rise to 2100 for Scottish Coastal Regions.

The current SEPA predicted extreme water levels and recommended allowance for sea level rise to 2100 for the coast at the entrance to Loch Broom is shown in Table 2.1.

Table 2.1 Ullapool SEPA recommended Extreme Water Levels and Sea Level rise to 2100

Return Period years	Extreme Water Level [m OD]
1	3.22
2	3.32
5	3.44
10	3.53
20	3.62
50	3.74
100	3.82
200	3.90
500	4.00
1000	4.08

Sea level rise to 2100 0.89m

2.3 Revised Wave Climate with Sea Level Rise

The storm wave climate simulations along the Shore Street frontage for the critical storm directions of 120° to 240° were simulated using the storm wind data as reported in the previous wave study but with the water levels increase to take account of the latest sea level rise projections. The wave heights are only increased by about 10mm due to the revision of the sea level rise provision from 0.58m to 0.89m.

The results for the simulations including the latest sea level rise projections are given in Tables 2.2 to 2.5. The locations of the wave points along the Shore Street frontage are shown in Figure 2.1.

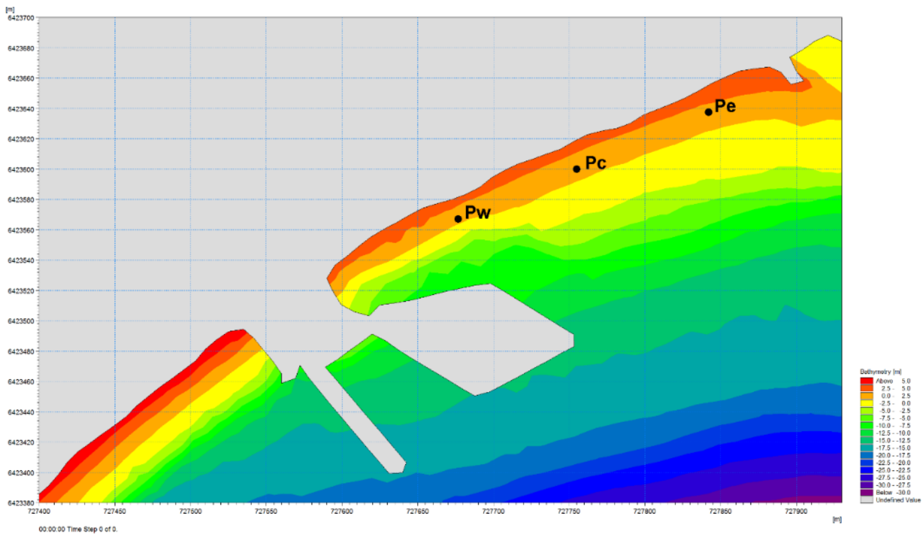

Figure 2.1 Location of wave climate points along Shore Street frontage

Table 2.2 1 in 1 year return period wave climate with SLR of 0.89m to 2100

Wave point Pw

Storm Direction	Significant Wave Height Hm0 [m]	Maximum Wave Height Hmax [m]	Spectral Peak Wave Period Tp [s]	Mean Energy Wave Period T_{m10} [s]	Mean Wave Direction MWD degree N
120	0.351	0.735	2.44	1.94	121
135	0.376	0.785	2.56	2.04	125
150	0.400	0.835	2.73	2.14	128
165	0.400	0.834	2.73	2.14	128
180	0.372	0.776	2.77	2.18	132
195	0.334	0.703	3.00	2.01	155
210	0.304	0.462	1.75	1.59	195
225	0.276	0.409	1.36	1.30	223
240	0.267	0.416	1.37	1.22	236

Wave point Pc

Storm Direction	Significant Wave Height Hm0 [m]	Maximum Wave Height Hmax [m]	Spectral Peak Wave Period Tp [s]	Mean Energy Wave Period T_{m10} [s]	Mean Wave Direction MWD degree N
120	0.483	1.004	2.49	2.17	141
135	0.551	1.141	2.64	2.30	146
150	0.605	1.250	2.76	2.39	148
165	0.606	1.251	2.77	2.39	148
180	0.600	1.240	2.78	2.41	150
195	0.603	1.247	2.82	2.42	159
210	0.552	1.144	2.84	2.33	172
225	0.454	0.949	2.75	2.04	190
240	0.375	0.540	1.56	1.66	215

Wave point Pe

Storm Direction	Significant Wave Height Hm0 [m]	Maximum Wave Height Hmax [m]	Spectral Peak Wave Period Tp [s]	Mean Energy Wave Period T_{m10} [s]	Mean Wave Direction MWD degree N
120	0.458	0.953	2.47	2.12	147
135	0.540	1.120	2.58	2.25	151
150	0.603	1.248	2.71	2.34	154
165	0.604	1.249	2.71	2.34	154
180	0.612	1.265	2.74	2.36	158
195	0.657	1.358	2.76	2.39	169
210	0.658	1.359	2.78	2.39	180
225	0.587	1.218	2.70	2.27	192
240	0.494	1.033	2.51	2.02	206

Table 2.3 1 in 50 year return period wave climate with SLR of 0.89m to 2100

Wave point Pw

Storm Direction	Significant Wave Height Hm0 [m]	Maximum Wave Height Hmax [m]	Spectral Peak Wave Period Tp [s]	Mean Energy Wave Period Tm10 [s]	Mean Wave Direction MWD degree N
120	0.581	1.205	3.01	2.31	123
135	0.640	1.323	3.21	2.47	126
150	0.681	1.405	3.44	2.57	131
165	0.672	1.389	3.54	2.56	138
180	0.613	1.270	3.61	2.46	149
195	0.574	1.022	3.11	2.20	172
210	0.532	0.639	1.70	1.82	203
225	0.494	0.665	1.74	1.59	226
240	0.486	0.674	1.75	1.54	237

Wave point Pc

Storm Direction	Significant Wave Height Hm0 [m]	Maximum Wave Height Hmax [m]	Spectral Peak Wave Period Tp [s]	Mean Energy Wave Period Tm10 [s]	Mean Wave Direction MWD degree N
120	0.826	1.690	3.16	2.69	144
135	0.944	1.900	3.32	2.87	147
150	1.038	2.037	3.48	2.99	149
165	1.063	2.070	3.53	3.03	152
180	1.038	2.079	3.53	3.01	157
195	1.022	2.072	3.57	2.99	164
210	0.926	1.899	3.55	2.81	177
225	0.771	1.564	3.19	2.34	197
240	0.659	0.864	1.98	2.00	218

Wave point Pe

Storm Direction	Significant Wave Height Hm0 [m]	Maximum Wave Height Hmax [m]	Spectral Peak Wave Period Tp [s]	Mean Energy Wave Period Tm10 [s]	Mean Wave Direction MWD degree N
120	0.803	1.636	3.13	2.66	150
135	0.930	1.821	3.26	2.82	153
150	1.040	1.927	3.43	2.93	156
165	1.091	1.953	3.48	2.98	161
180	1.102	2.010	3.47	2.98	166
195	1.147	2.091	3.51	3.01	174
210	1.123	2.137	3.50	2.95	184
225	0.980	1.981	3.23	2.68	197
240	0.849	1.752	3.01	2.41	209

Table 2.4 1 in 100 year return period wave climate with SLR of 0.89m to 2100

Wave point Pw

Storm Direction	Significant Wave Height Hm0 [m]	Maximum Wave Height Hmax [m]	Spectral Peak Wave Period Tp [s]	Mean Energy Wave Period T_{m10} [s]	Mean Wave Direction MWD degree N
120	0.627	1.299	3.11	2.37	123
135	0.689	1.422	3.33	2.54	126
150	0.733	1.510	3.53	2.65	131
165	0.722	1.490	3.63	2.63	138
180	0.658	1.363	3.72	2.52	149
195	0.620	1.102	3.22	2.26	172
210	0.578	0.682	1.76	1.87	204
225	0.538	0.699	1.78	1.64	226
240	0.529	0.707	1.79	1.59	237

Wave point Pc

Storm Direction	Significant Wave Height Hm0 [m]	Maximum Wave Height Hmax [m]	Spectral Peak Wave Period Tp [s]	Mean Energy Wave Period T_{m10} [s]	Mean Wave Direction MWD degree N
120	0.891	1.808	3.24	2.79	144
135	1.020	2.016	3.46	2.96	147
150	1.123	2.117	3.58	3.08	149
165	1.146	2.136	3.61	3.15	152
180	1.121	2.178	3.61	3.11	157
195	1.107	2.225	3.65	3.09	165
210	1.005	2.055	3.64	2.90	177
225	0.838	1.649	3.19	2.42	197
240	0.718	0.903	2.02	2.07	219

Wave point Pe

Storm Direction	Significant Wave Height Hm0 [m]	Maximum Wave Height Hmax [m]	Spectral Peak Wave Period Tp [s]	Mean Energy Wave Period T_{m10} [s]	Mean Wave Direction MWD degree N
120	0.868	1.743	3.21	2.74	150
135	1.005	1.912	3.41	2.91	153
150	1.125	1.980	3.54	3.03	157
165	1.181	1.994	3.57	3.08	161
180	1.193	2.057	3.56	3.07	166
195	1.244	2.169	3.60	3.12	174
210	1.220	2.224	3.60	3.04	185
225	1.064	2.115	3.33	2.77	197
240	0.923	1.899	3.13	2.50	209

Table 2.5 1 in 200 year return period wave climate with SLR of 0.89m to 2100

Wave point Pw

Storm Direction	Significant Wave Height Hm0 [m]	Maximum Wave Height Hmax [m]	Spectral Peak Wave Period Tp [s]	Mean Energy Wave Period Tm10 [s]	Mean Wave Direction MWD degree N
120	0.685	1.417	3.19	2.44	123
135	0.753	1.552	3.48	2.61	127
150	0.800	1.647	3.63	2.72	131
165	0.786	1.620	3.79	2.71	138
180	0.717	1.482	3.88	2.60	150
195	0.682	1.072	2.89	2.32	173
210	0.637	0.725	1.81	1.93	204
225	0.595	0.752	1.84	1.71	226
240	0.585	0.768	1.86	1.66	237

Wave point Pc

Storm Direction	Significant Wave Height Hm0 [m]	Maximum Wave Height Hmax [m]	Spectral Peak Wave Period Tp [s]	Mean Energy Wave Period Tm10 [s]	Mean Wave Direction MWD degree N
120	0.973	1.953	3.40	2.89	145
135	1.116	2.112	3.57	3.06	147
150	1.226	2.168	3.68	3.21	150
165	1.258	2.193	3.73	3.26	153
180	1.229	2.258	3.73	3.23	158
195	1.214	2.387	3.81	3.21	165
210	1.108	2.260	3.77	2.99	177
225	0.925	1.838	3.40	2.52	197
240	0.792	0.980	2.11	2.15	219

Wave point Pe

Storm Direction	Significant Wave Height Hm0 [m]	Maximum Wave Height Hmax [m]	Spectral Peak Wave Period Tp [s]	Mean Energy Wave Period Tm10 [s]	Mean Wave Direction MWD degree N
120	0.945	1.851	3.33	2.85	150
135	1.098	1.978	3.53	3.01	154
150	1.228	2.019	3.63	3.15	157
165	1.291	2.033	3.66	3.21	161
180	1.305	2.102	3.66	3.20	167
195	1.363	2.256	3.71	3.24	174
210	1.337	2.337	3.69	3.18	185
225	1.170	2.302	3.53	2.88	197
240	1.020	2.032	3.19	2.60	209

3 JOINT PROBABILITY AND OVERTOPPING

3.1 Joint Probability Analysis

As the waves which approach the revetment at Shore Street are the result of winds blowing over the local fetches, the joint probability analysis was undertaken between extreme water levels and wind speeds. The analysis was undertaken in accordance with the Defra/EA report "Joint Probability: Dependence Mapping and Best Practice" Technical report FD2308.

The analysis was undertaken for storm directions from 165° to 195° which give the largest wave heights approaching the lowest section of the revetment. The extreme water levels were taken from the SEPA data referenced in Section 2 above and the extreme winds speed were derived from BS EN 1991-1-4:2005+A1:2010 for extreme wind speeds throughout the British Isles. The wind speeds were adjusted tor overwater wind conditions and the length of time required to fully generate the waves over the fetches.

A correlation factor of 0.4 was used for the correlation between the wind/waves and the water levels as indicated for Ullapool in FD2308/TR1. An example of the Joint Probability curves is shown in Figure 3.1 and the combinations of wind speeds and water levels is shown in Table 3.1 for the 195° storm direction.

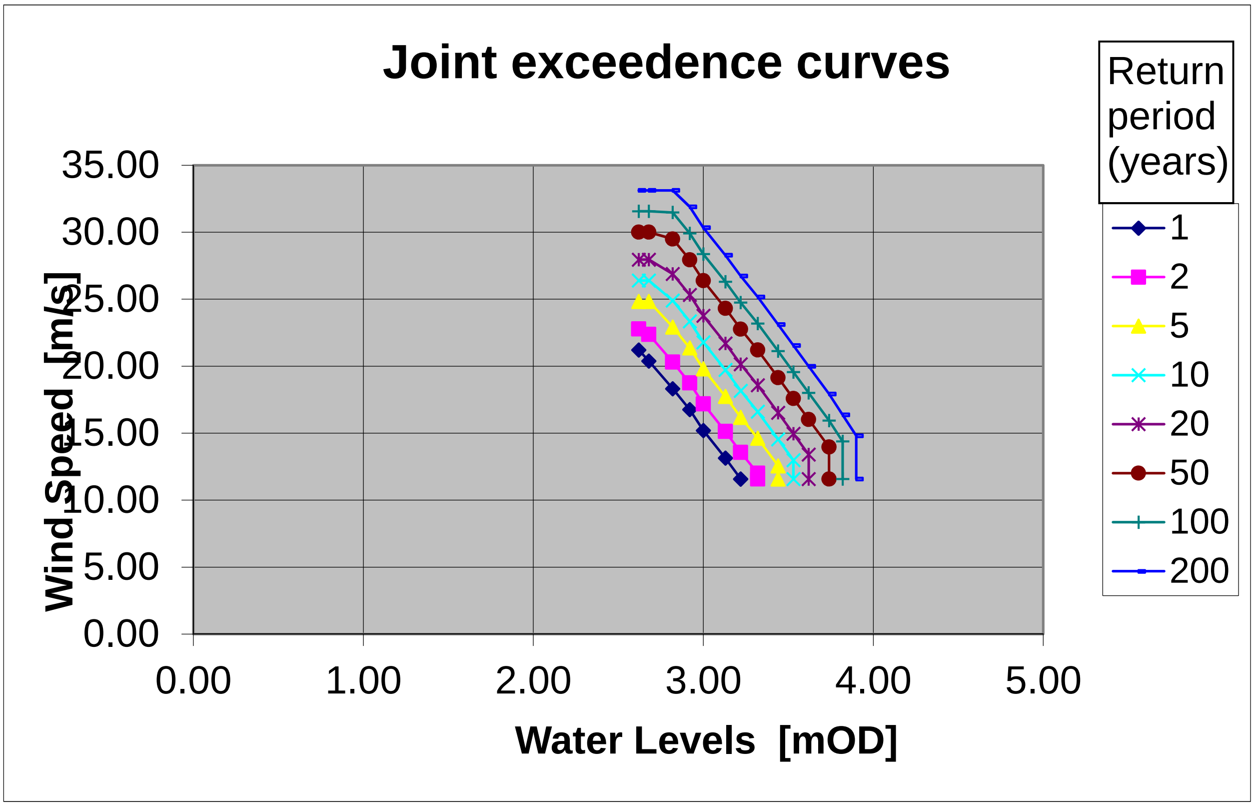

Figure 3.1 Joint Probability curves for extreme winds and water levels

Table 3.1 Joint Probability combinations of extreme water levels and storm wind speeds

Value of first variable:	Joint exceedence return period (years) 1	2	5	10	20	50	100	200
Present-day sea level off Ullapool (mOD)	Value of second variable:			Wind speed 165-195 sector				195 deg
2.62	21.21	22.77	24.83	26.39	27.95	30.00	31.56	33.12
2.68	20.38	22.36	24.83	26.39	27.95	30.00	31.56	33.12
2.82	18.32	20.30	22.92	24.90	26.88	29.49	31.47	33.12
2.92	16.76	18.74	21.36	23.34	25.32	27.94	29.91	31.89
3.00	15.20	17.18	19.80	21.78	23.76	26.38	28.36	30.33
3.13	13.14	15.12	17.74	19.72	21.70	24.32	26.30	28.28
3.22	11.58	13.56	16.18	18.16	20.14	22.76	24.74	26.72
3.32	#N/A	12.00	14.62	16.60	18.58	21.20	23.18	25.16
3.44	#N/A	#N/A	12.56	14.54	16.52	19.14	21.12	23.10
3.53	#N/A	#N/A	#N/A	12.98	14.96	17.58	19.56	21.54
3.62	#N/A	#N/A	#N/A	#N/A	13.40	16.02	18.00	19.98
3.74	#N/A	#N/A	#N/A	#N/A	#N/A	13.96	15.94	17.92
3.82	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	14.38	16.36
3.90	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	14.80

3.2 Wave and Water Level Simulations

As 1 in 200 year return events are used for coastal flood analysis, the combinations of extreme water levels and winds speeds for these JP events were used with the Mike21 SW wave generation and transformation model for Ullapool, Figure 3.2, to generate the combinations of wave and water levels approaching the revetment at Shore Street. The wave climate approaching the lowest point along the existing revetment and at points some 27 and 54 metres further east along the revetment, locations as shown in Figure 3.3, were extracted from the wave model simulations for use in the overtopping analysis.

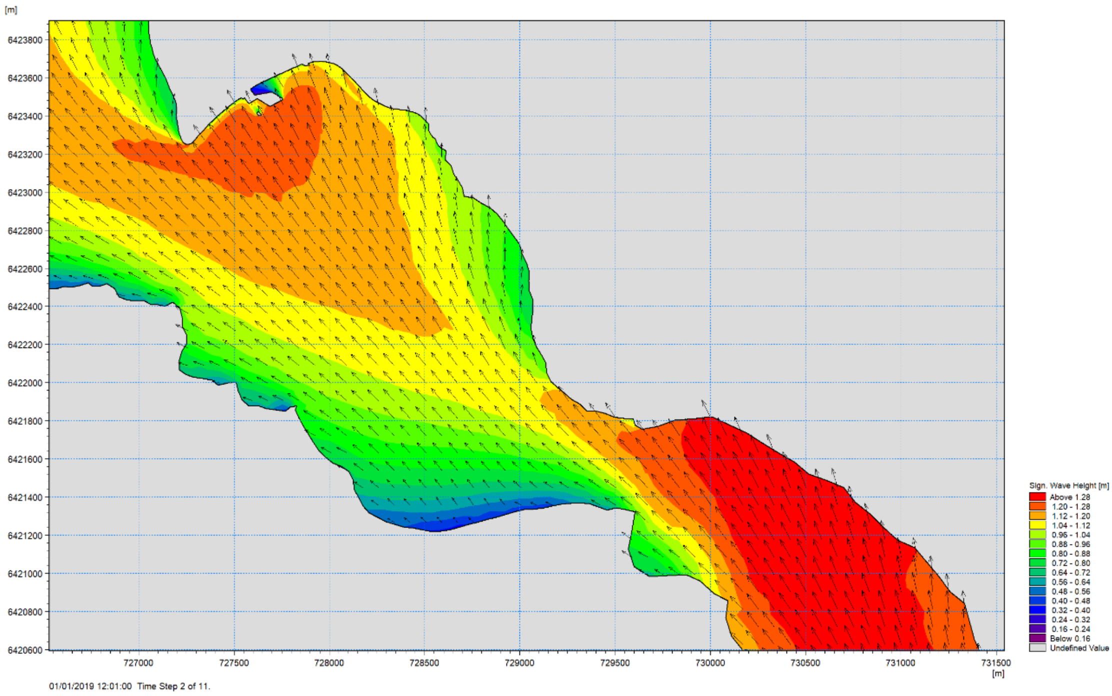

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Figure 3.2 Significant wave height and mean wave direction – 1 in 200 year Joint Probability return period storm from 165ºwitha water level of 3.00m OD

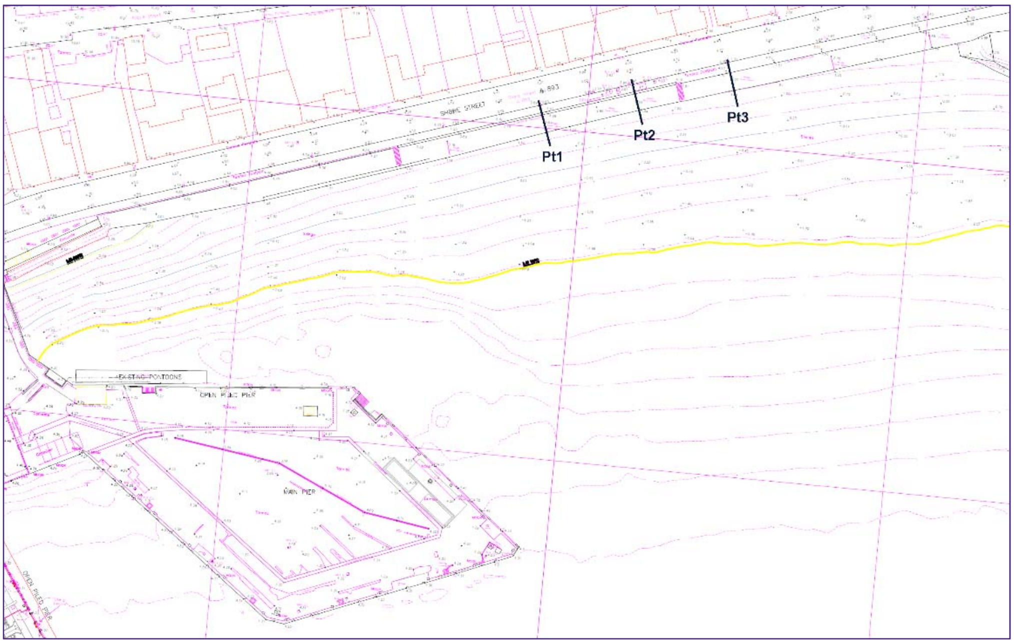

Figure 3.3 Location of Joint Probability analysis points along the revetment

The combinations of water levels, wave heights and periods derived from the 1 in 200 return period JP modelling for the three points along the existing revetment for each of the storm directions 165º, 180º and 195º directions are shown in Tables 3.2, 3.3 and 3.4.

Table 3.2 1 in 200 JP return period water levels and waves at revetment – storm from 165º

pt1			pt2			pt3		
Wl mOD	Hm0 m	Tm10 s	Wl mOD	Hm0 m	Tm10 s	Wl mOD	Hm0 m	Tm10 s
2.82	1.213	3.28	2.82	1.231	3.30	2.82	1.248	3.27
2.92	1.143	3.19	2.92	1.167	3.20	2.92	1.183	3.18
3.00	1.059	3.07	3.00	1.084	3.08	3.00	1.100	3.06
3.13	0.948	2.93	3.13	0.971	2.94	3.13	0.985	2.92
3.22	0.867	2.84	3.22	0.888	2.84	3.22	0.901	2.82
3.32	0.792	2.73	3.32	0.812	2.73	3.32	0.823	2.71
3.44	0.698	2.60	3.44	0.715	2.60	3.44	0.725	2.58
3.53	0.630	2.51	3.53	0.646	2.51	3.53	0.655	2.49
3.62	0.570	2.41	3.62	0.584	2.41	3.62	0.591	2.39
3.74	0.493	2.30	3.74	0.506	2.29	3.74	0.512	2.27
3.82	0.493	2.30	3.82	0.506	2.29	3.82	0.511	2.27
3.90	0.394	2.17	3.90	0.407	2.16	3.90	0.410	2.13

Table 3.3 1 in 200 JP return period water levels and waves at revetment – storm from 180º

pt1			pt2			pt3		
Wl mOD	Hm0 m	Tm10 s	Wl mOD	Hm0 m	Tm10 s	Wl mOD	Hm0 m	Tm10 s
2.82	1.178	3.24	2.82	1.211	3.27	2.82	1.240	3.26
2.92	1.110	3.15	2.92	1.147	3.18	2.92	1.174	3.17
3.00	1.025	3.03	3.00	1.063	3.05	3.00	1.090	3.05
3.13	0.917	2.89	3.13	0.951	2.91	3.13	0.975	2.91
3.22	0.838	2.79	3.22	0.869	2.81	3.22	0.891	2.80
3.32	0.765	2.69	3.32	0.794	2.70	3.32	0.814	2.69
3.44	0.673	2.56	3.44	0.698	2.57	3.44	0.715	2.56
3.53	0.609	2.47	3.53	0.631	2.48	3.53	0.646	2.47
3.62	0.607	2.47	3.62	0.629	2.48	3.62	0.644	2.47
3.74	0.472	2.25	3.74	0.490	2.26	3.74	0.501	2.25
3.82	0.471	2.25	3.82	0.489	2.26	3.82	0.501	2.25
3.90	0.449	2.26	3.90	0.468	2.27	3.90	0.480	2.25

Table 3.4 1 in 200 JP return period water levels and waves at revetment – storm from 195º

pt1			pt2			pt3		
Wl mOD	**Hm0 m**	**Tm10 s**	**Wl mOD**	**Hm0 m**	**Tm10 s**	**Wl mOD**	**Hm0 m**	**Tm10 s**
2.82	1.153	3.23	2.82	1.206	3.28	2.82	1.253	3.29
2.92	1.086	3.13	2.92	1.142	3.18	2.92	1.188	3.19
3.00	1.003	3.01	3.00	1.057	3.05	3.00	1.101	3.06
3.13	0.895	2.86	3.13	0.945	2.90	3.13	0.985	2.91
3.22	0.818	2.76	3.22	0.862	2.79	3.22	0.898	2.80
3.32	0.745	2.66	3.32	0.785	2.68	3.32	0.819	2.69
3.44	0.653	2.53	3.44	0.688	2.55	3.44	0.718	2.56
3.53	0.589	2.43	3.53	0.621	2.45	3.53	0.647	2.46
3.62	0.587	2.44	3.62	0.619	2.46	3.62	0.645	2.46
3.74	0.451	2.22	3.74	0.477	2.24	3.74	0.499	2.24
3.82	0.451	2.22	3.82	0.476	2.24	3.82	0.498	2.24
3.90	0.427	2.24	3.90	0.452	2.25	3.90	0.476	2.25

A similar analysis was undertaken for the proposed promenade which has slightly increased incoming wave heights (typically about 1.3% higher) as the revetment for the promenade is slightly seaward of the existing structure.

3.3 Overtopping Analysis - 2019 Water Levels

The second edition of the EurOtop “Manual on wave overtopping of sea defences and related structures” which was published in 2018 describes methods to predict wave overtopping of sea defences and related coastal or shoreline structures. The manual recommends a series of empirical methods to represent the physics of the overtopping process in a series of equations that relate the main overtopping response parameter to key wave climate and structure properties.

The EurOtop manual also provides guidance for use of an Artificial Neural Network (ANN) tool to predict mean overtopping discharges for all structure geometries, for a number of hydraulic and geometrical input parameters. The ANN tool is based on a large extended database that contains more than 13,000 physical model tests. For the purposes of this study, RPS utilised the online ANN tool to predict the mean, 5% and 95%’ile discharge rates for both the existing and proposed revetments along Shore Street.

The analysis was undertaken for the combination of waves and water levels derived from the joint probability analysis for points 1 and 3 along the revetments, Tables 3.2, 3.3, 3.4 and Figure 3.3 above.

3.3.1 Overtopping of existing revetment – 2019 water levels

The overtopping rates for location pts 1 and 3, Figure 3.3, for the existing revetment for 1 in 200 return period Joint Probability events are given in Tables 3.5 to 3.10

Table 3.5 Overtopping rates for location pt1 1 in 200 yr. JP event from 165ºN - Existing

For 1 in 200 JP return period events			Overtopping Litres/s/m		
Wl mOD	Hm0 m	Tm10 s	Mean	5%tile	95%tile
2.82	1.213	3.28	18.50	2.00	172.00
2.92	1.143	3.19	20.00	2.17	179.00
3.00	1.059	3.07	18.60	2.13	162.00
3.13	0.948	2.93	18.20	2.44	145.00
3.22	0.867	2.84	17.20	2.28	134.00
3.32	0.792	2.73	16.60	1.96	121.00

Table 3.6 Overtopping rates for location pt3 1 in 200 yr. JP event from 165ºN - Existing

Water level and Wave Climate			Overtopping Litres/s/m		
Wl mOD	Hm0 m	Tm10 s	Mean	5%tile	95%tile
2.82	1.248	3.27	5.33	0.61	51.10
2.92	1.183	3.18	5.65	0.61	54.20
3.00	1.100	3.06	5.06	0.53	46.00
3.13	0.985	2.92	4.66	0.49	43.20
3.22	0.901	2.82	4.13	0.48	34.70
3.32	0.823	2.71	3.65	0.44	31.70

Table 3.7 Overtopping rates for location pt1 1 in 200 yr. JP event from 180ºN - Existing

Water level and Wave Climate			Overtopping Litres/s/m		
Wl mOD	Hm0 m	Tm10 s	Mean	5%tile	95%tile
2.82	1.178	3.24	16.40	1.76	148.00
2.92	1.110	3.15	17.70	1.88	153.00
3.00	1.025	3.03	16.10	1.97	142.00
3.13	0.917	2.89	15.50	2.04	124.00
3.22	0.838	2.79	14.40	1.69	115.00
3.32	0.765	2.69	13.90	1.59	101.00

Table 3.8 Overtopping rates for location pt3 1 in 200 yr. JP event from 180°N - Existing

Water level and Wave Climate			Overtopping Litres/s/m		
Wl mOD	Hm0 m	Tm10 s	Mean	5%tile	95%tile
2.82	1.240	3.26	5.46	0.60	52.20
2.92	1.174	3.17	4.86	0.51	44.50
3.00	1.090	3.05	4.44	0.46	41.50
3.13	0.975	2.91	3.83	0.43	33.20
3.22	0.891	2.80	3.38	0.38	30.20
3.32	0.814	2.69	2.62	0.31	20.00

Table 3.9 Overtopping rates for location pt1 1 in 200 yr. JP event from 195°N - Existing

Water level and Wave Climate			Overtopping Litres/s/m		
Wl mOD	Hm0 m	Tm10 s	Mean	5%tile	95%tile
2.82	1.153	3.23	15.40	1.68	133.00
2.92	1.086	3.13	16.30	1.92	141.00
3.00	1.003	3.01	14.80	1.81	125.00
3.13	0.895	2.86	13.80	1.84	106.00
3.22	0.818	2.76	12.80	1.45	95.70
3.32	0.745	2.66	12.10	1.43	81.70

Table 3.10 Overtopping rates for location pt3 1 in 200 yr. JP event from 195°N - Existing

Water level and Wave Climate			Overtopping Litres/s/m		
Wl mOD	Hm0 m	Tm10 s	Mean	5%tile	95%tile
2.82	1.253	3.29	5.60	0.64	53.50
2.92	1.188	3.19	5.81	0.64	55.70
3.00	1.101	3.06	5.08	0.53	46.20
3.13	0.985	2.91	4.57	0.47	42.20
3.22	0.898	2.80	3.94	0.44	34.50
3.32	0.819	2.69	3.45	0.38	31.40

It will be seen from Tables 3.5 to 3.10 that the largest overtopping of the existing seawall along Shore Street occurs at the centre of the frontage during storms from the south south east with a predicted mean overtopping rate 20 litres/s/m. This rate of over topping is likely to result in significant flooding and the overtopping rate is such that the maximum volume for an individual wave (Vmax) will be about 2000 litres per metre. This is greatly in excess of the 600 litres limit recommended in the 2018 Overtopping Manual for pedestrians with a clear view of the sea. Even at location pt3, where the levels of the Shore Street seawall are higher, the Vmax value will be about 800 litres per metre.

3.3.2 Overtopping of proposed revetment – 2019 water levels

The overtopping rates for location pts 1 and 3, Figure 3.3, for the proposed revetment for 1 in 200 return period Joint Probability events are given in Tables 3.11 to 3.16

Table 3.11 Overtopping rates for location pt1 1 in 200 yr. JP event from 165ºN - Proposed

Water level and Wave Climate			Overtopping Litres/s/m		
Wl mOD	Hm0 m	Tm10 s	Mean	5%tile	95%tile
2.82	1.213	3.27	0.532	0.105	1.370
2.92	1.142	3.19	0.504	0.093	1.230
3.00	1.058	3.07	0.440	0.058	0.953
3.13	0.946	2.93	0.387	0.036	0.711
3.22	0.866	2.84	0.353	0.023	0.614
3.32	0.792	2.73	0.328	0.011	0.687

Table 3.12 Overtopping rates for location pt3 1 in 200 yr. JP event from 165ºN - Proposed

Water level and Wave Climate			Overtopping Litres/s/m		
Wl mOD	Hm0 m	Tm10 s	Mean	5%tile	95%tile
2.82	1.264	3.25	0.349	0.030	0.508
2.92	1.192	3.17	0.346	0.029	0.499
3.00	1.105	3.05	0.321	0.018	0.445
3.13	0.991	2.92	0.294	0.011	0.285
3.22	0.907	2.82	0.263	0.007	0.238
3.32	0.829	2.71	0.191	0.004	0.263

Table 3.13 Overtopping rates for location pt1 1 in 200 yr. JP event from 180ºN - Proposed

Water level and Wave Climate			Overtopping Litres/s/m		
Wl mOD	Hm0 m	Tm10 s	Mean	5%tile	95%tile
2.82	1.177	3.23	0.473	0.087	1.070
2.92	1.108	3.14	0.451	0.070	0.995
3.00	1.022	3.03	0.399	0.046	0.710
3.13	0.915	2.89	0.358	0.028	0.582
3.22	0.837	2.79	0.329	0.014	0.529
3.32	0.764	2.69	0.307	0.008	0.601

Table 3.14 Overtopping rates for location pt3 1 in 200 yr. JP event from 180ºN - Proposed

Water level and Wave Climate			Overtopping Litres/s/m		
Wl mOD	Hm0 m	Tm10 s	Mean	5%tile	95%tile
2.82	1.253	3.24	0.351	0.031	0.520
2.92	1.182	3.15	0.340	0.026	0.471
3.00	1.095	3.04	0.316	0.017	0.421
3.13	0.980	2.90	0.289	0.010	0.270
3.22	0.896	2.80	0.240	0.006	0.237
3.32	0.819	2.69	0.175	0.003	0.263

Table 3.15 Overtopping rates for location pt1 1 in 200 yr. JP event from 195ºN - Proposed

Water level and Wave Climate			Overtopping Litres/s/m		
Wl mOD	Hm0 m	Tm10 s	Mean	5%tile	95%tile
2.82	1.149	3.22	0.438	0.071	0.889
2.92	1.082	3.12	0.420	0.057	0.842
3.00	0.998	3.01	0.375	0.038	0.603
3.13	0.891	2.87	0.339	0.020	0.504
3.22	0.814	2.76	0.313	0.010	0.498
3.32	0.741	2.66	0.292	0.006	0.552

Table 3.16 Overtopping rates for location pt3 1 in 200 yr. JP event from 165ºN - Proposed

Water level and Wave Climate			Overtopping Litres/s/m		
Wl mOD	Hm0 m	Tm10 s	Mean	5%tile	95%tile
2.82	1.267	3.26	0.354	0.033	0.537
2.92	1.195	3.17	0.348	0.029	0.510
3.00	1.105	3.05	0.321	0.018	0.448
3.13	0.988	2.90	0.293	0.010	0.285
3.22	0.902	2.80	0.252	0.006	0.246
3.32	0.823	2.69	0.179	0.003	0.267

The overtopping analysis for the 1 in 200 year Joint Probability return period events show that the proposed revetment will result in the overtopping volumes being reduced by a factor of about 37 compared to those with the existing revetment and seawall. The resulting over topping rates are well within the recommended limits for pedestrians given in the 2018 EurOtop Overtopping Manual.

3.4 Overtopping with 2100 Water Levels

The 1 in 200 year return period water level is predicted to be some 0.89 metres higher than the current level of +3.90m OD as a result of rising sea levels due to climate change. This water level is some 0.9m above the lowest level of Shore Street so much of the area will flood directly from the sea. Even if the proposed seawall was to be raised, the area would still flood via the drainage system and/or though the slipway opening etc. Thus overtopping calculations have not been undertaken for the 2100 water levels as the flooding around the Shore Street area would be so extensive by 2100 that it makes such an analysis nonsensical in the absence of a defined policy on the future flood protection of the area.

4 HARBOUR DISTURBANCE MODELLING

4.1 General

The wave generation and transformation modelling undertaken for the Ullapool frontage does not include the impact of wave reflections or wave to wave interactions (See Appendix for wave model descriptions). The proposed extension to the small boat harbour facilities at Ullapool Harbour involve the dredging and construction of a basin with a vertical quay wall along this section of the shoreline. There is the potential for standing wave patterns and/or wave resonance issues with this type of basin thus the performance of the proposed small boat facility was evaluated using an advanced Boussinesq wave disturbance model.

Simulations were undertaken for the existing harbour infrastructure as well as for the new small boat facility with the existing and proposed seawalls along Shore Street. Simulations were also undertaken to examine the effectiveness of an additional floating breakwater installation off the south east corner of the Pier area.

The boundary conditions for the harbour disturbance modelling were taken from the results of the simulations for 1 in 50 and 1 in 1 year return period events using the overall wave generation and transformation spectral wave model. Simulations were undertaken at mean tidal levels so that the results of the modelling would be reasonably applicable for most of the tidal ranges at the site. The extent of the harbour disturbance model is shown in Figure 4.1.

In this Boussinesq wave model the boundary waves are generated along the southern side of the model with wave absorbing “sponge” layers along the eastern and western sides of the model and in areas which do not affect the wave climate in the small boat basin, i.e. the western side of the Pier area. The wave reflection properties of the various walls and revetments are controlled in the model by “porosity” layers placed along the various structures. In the simulations it was assumed that the existing open piled quays would have a 90% reflection from the back wall (under the pier deck), the existing seawall along Shore Street was given a 60% wave reflection factor while the new rock armour revetment was given a 40% wave reflection coefficient. These factors are well established values for the types of structures at Ullapool.

The largest waves which approach the pier occur during storm from about 165^{o} direction with the waves approaching the pier from about 160^{o}. However as the proposed small boat basin is situated in the lee of the main pier area it was found that the new basin was more exposed to storms from the 150^{o} N. Thus after the initial model simulations with the 1 in 50 year from 165^{o} direction all the remaining simulations were undertaken with waves approaching the harbour from 150^{o}N.

The results of the simulations are shown in terms of the typical wave disturbance patterns and the distribution of significant wave heights around the basin and adjoining areas.

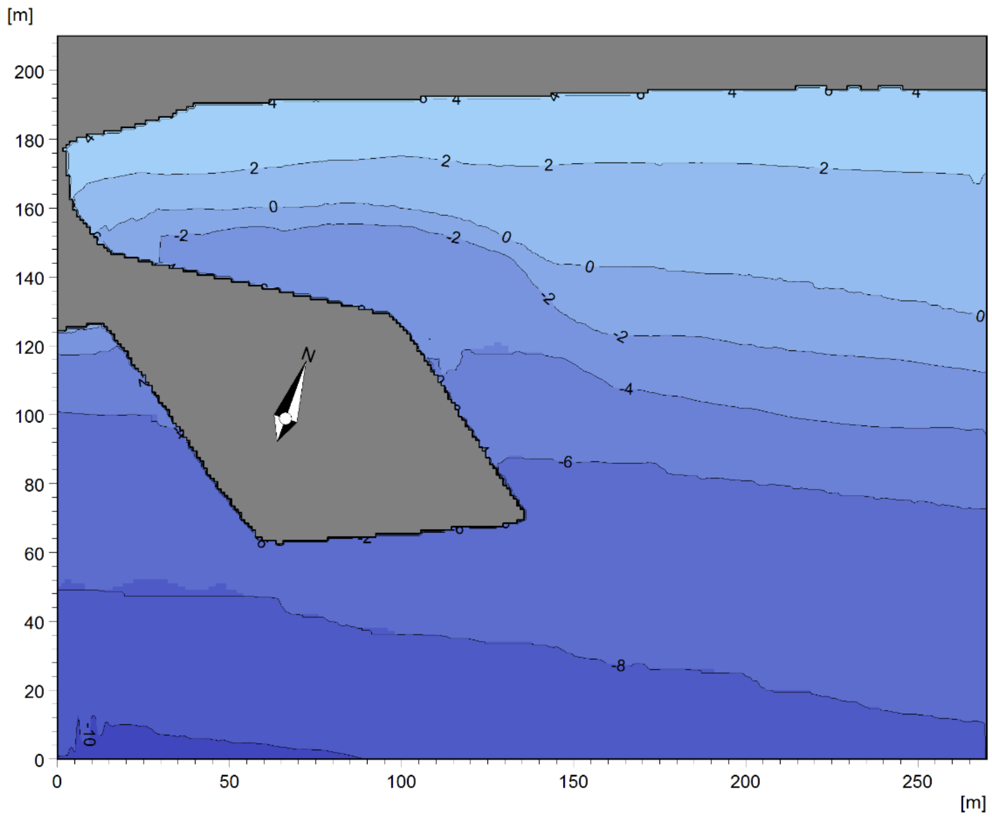

Figure 4.1 **Extent of harbour disturbance model of existing bathymetry [m CD]**

4.2 Wave Disturbance simulations 1 in 50 year return period storm from 165° N

The wave disturbance patterns and significant wave heights around the existing small boat harbour facility and Shore Street seawall are shown in Figures 4.2 and 4.3. Figures 4.4 and 4.5 show the wave disturbance patterns and significant wave heights with the new Shore Street revetment in place, while Figures 4.6 and 4.7 show the wave disturbance patterns and significant wave heights with the new Shore Street revetment and the enlarged small boat facility developed.

From Figure 4.2 to 4.7 it will be seen that the addition of the new quay wall along the Shore Street frontage at the small boat facility produces at standing wave pattern in the enlarged dredged basin. As noted in Section 4.1, storms from 150° result in greater wave penetration into the proposed enlarged small boat harbour facility and thus the wave disturbance model simulations were rerun using the 150° storm direction.

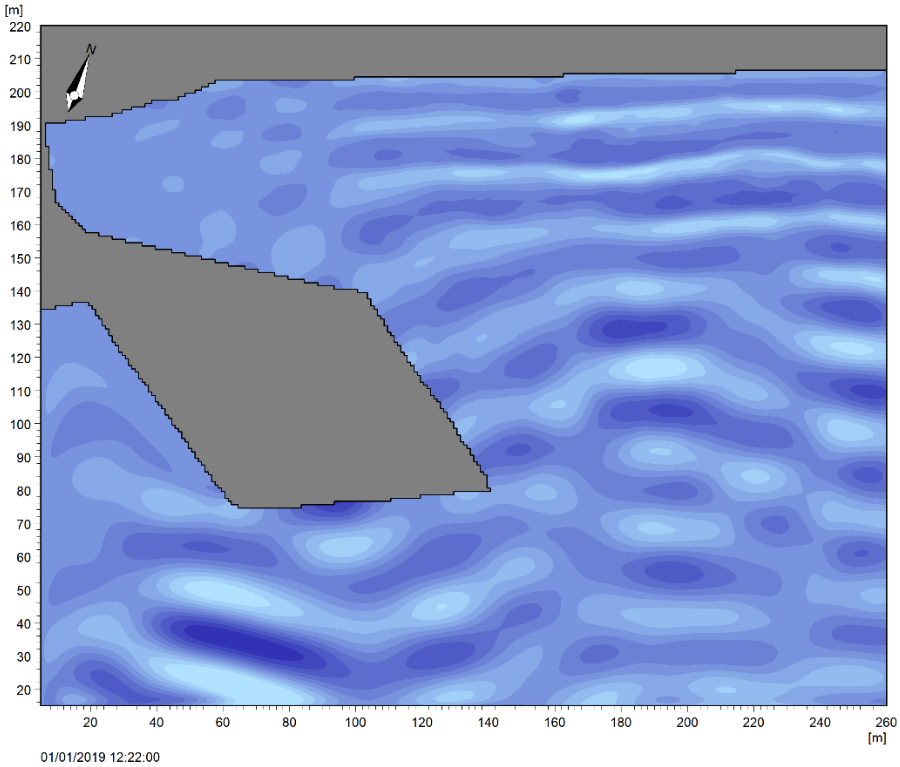

Figure 4.2 Typical wave disturbance patterns around the existing small boat facility and Shore Street seawall - 1 in 50 year return period storm from 165º N

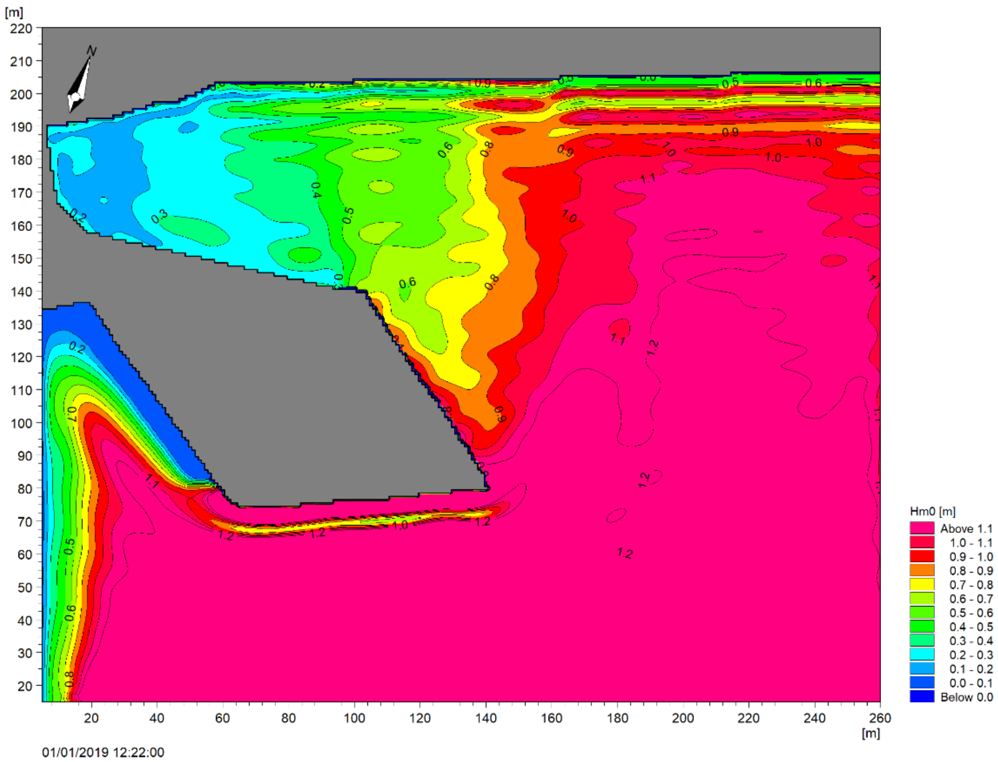

Figure 4.3 Significant wave heights around the existing small boat facility and Shore Street seawall - 1 in 50 year return period storm from 165º N

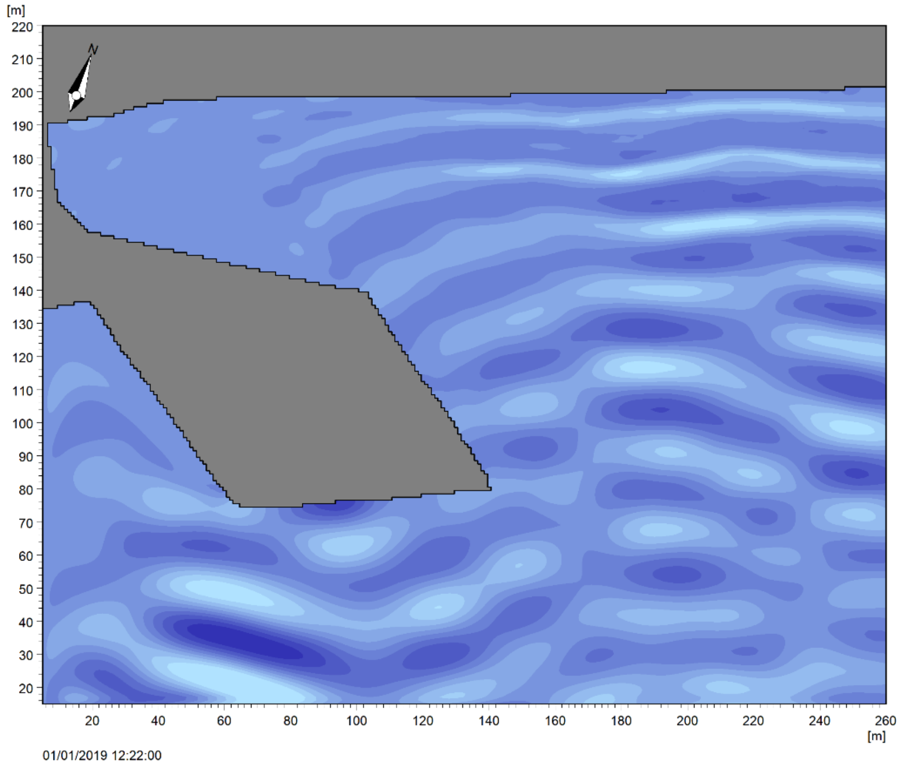

Figure 4.4 **Typical wave disturbance patterns around the existing small boat facility and new Shore Street revetment - 1 in 50 year return period storm from 165º N**

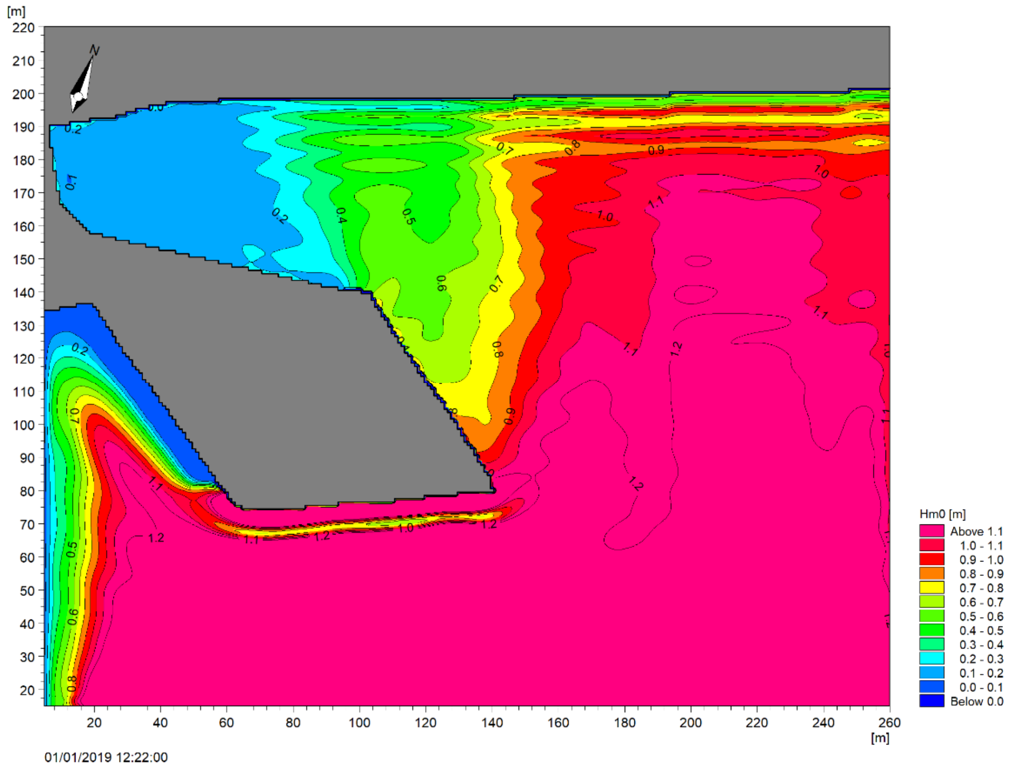

Figure 4.5 **Significant wave heights around the existing small boat facility and new Shore Street revetment - 1 in 50 year return period storm from 165º N**

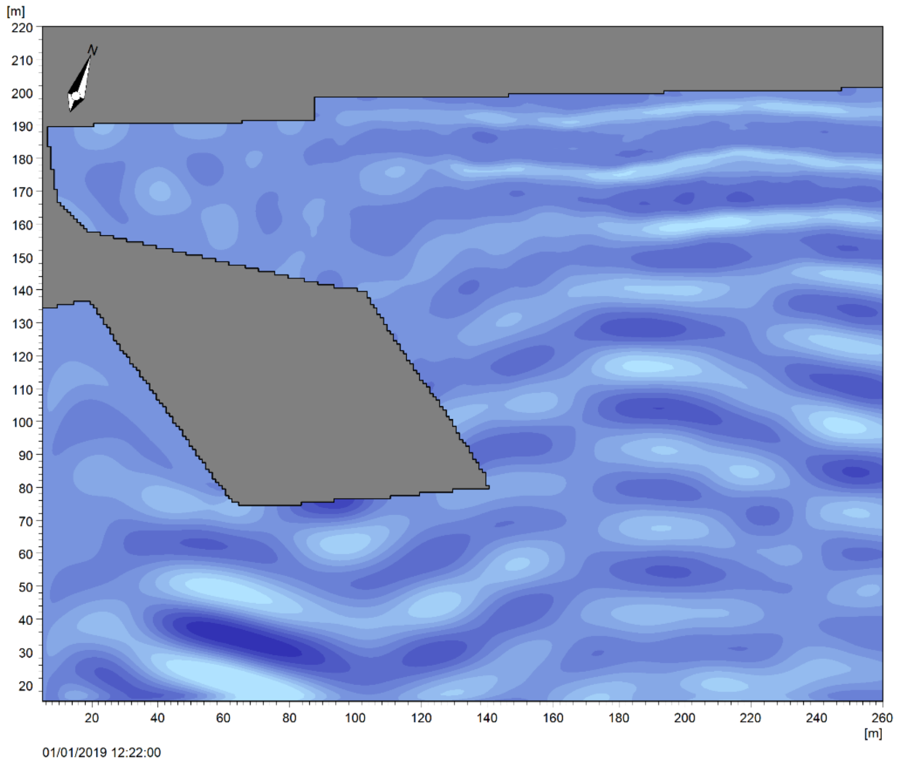

Figure 4.6 Typical wave disturbance patterns around the enlarged small boat facility and new Shore Street revetment - 1 in 50 year return period storm from 165º N

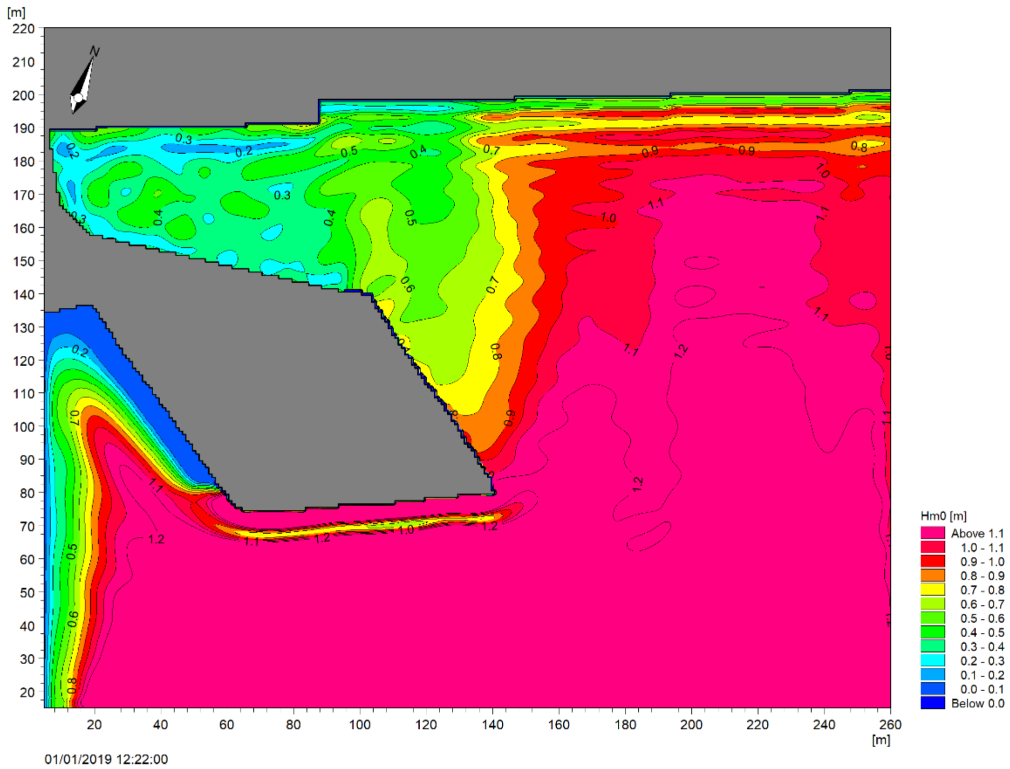

Figure 4.7 Significant wave heights around the enlarged small boat facility and new Shore Street revetment - 1 in 50 year return period storm from 165º N

4.3 Wave Disturbance simulations 1 in 50 and 1 in 1 return period storm from 150º N

The wave disturbance patterns and significant wave heights around the existing small boat harbour facility and Shore Street seawall during a 1 in 50 year return period storm are shown in Figures 4.8 and 4.9. Figures 4.10 and 4.11 show the wave disturbance patterns and significant wave heights for the same storm with the existing Shore Street seawall and the enlarged small boat facility in place. The wave heights in the new small boat basin are larger than would normally be recommended thus the use a 5m wide floating breakwater off the south east corner of the pier area has been simulated for the 1 in 50 year return period storm as shown in Figures 4.12 and 4.13.

The wave disturbance patterns and significant wave heights around the existing small boat harbour facility with the new Shore Street revetment during a 1 in 50 year return period storm are shown in Figures 4.14 and 4.15. Figures 4.16 and 4.17 show the wave disturbance patterns and significant wave heights for the same storm with the new Shore Street revetment and the enlarged small boat facility in place. As the wave heights in the new small boat basin are larger than would normally be recommended, the use of a 5m wide floating breakwater off the south east corner of the pier area has been simulated for the 1 in 50 year return period storm as shown in Figures 4.18 and 4.19.

Wave disturbance simulations have also been undertaken for 1 in 1 year return period storms from 150º N. The boundary waves for this 1 in 1 year storm had significant wave heights of 0.67metres with wave period of 2.6 seconds. The wave disturbance patterns and significant wave heights around the existing small boat harbour facility and Shore Street seawall during this 1 in 1 year return period storm are shown in Figures 4.20 and 4.21. Figures 4.22 and 4.23 show the wave disturbance patterns and significant wave heights for the same storm with the existing Shore Street seawall and the enlarged small boat facility in place. The wave heights in the new small boat basin are larger than would normally be recommended thus the use of a 5m wide floating breakwater off the south east corner of the pier area has been simulated for the 1 in 1 year return period storm as shown in Figures 4.24 and 4.25.

The wave disturbance patterns and significant wave heights around the existing small boat harbour facility with the new Shore Street revetment during a 1 in 1 year return period storm are shown in Figures 4.26 and 4.27. Figures 4.28 and 4.29 show the wave disturbance patterns and significant wave heights for the same storm with the new Shore Street revetment and the enlarged small boat facility in place. As the wave heights in the new small boat basin are larger than would normally be recommended, the use of a 5m wide floating breakwater off the south east corner of the pier area has been simulated for the 1 in 1 year return period storm as shown in Figures 4.30 and 4.31.

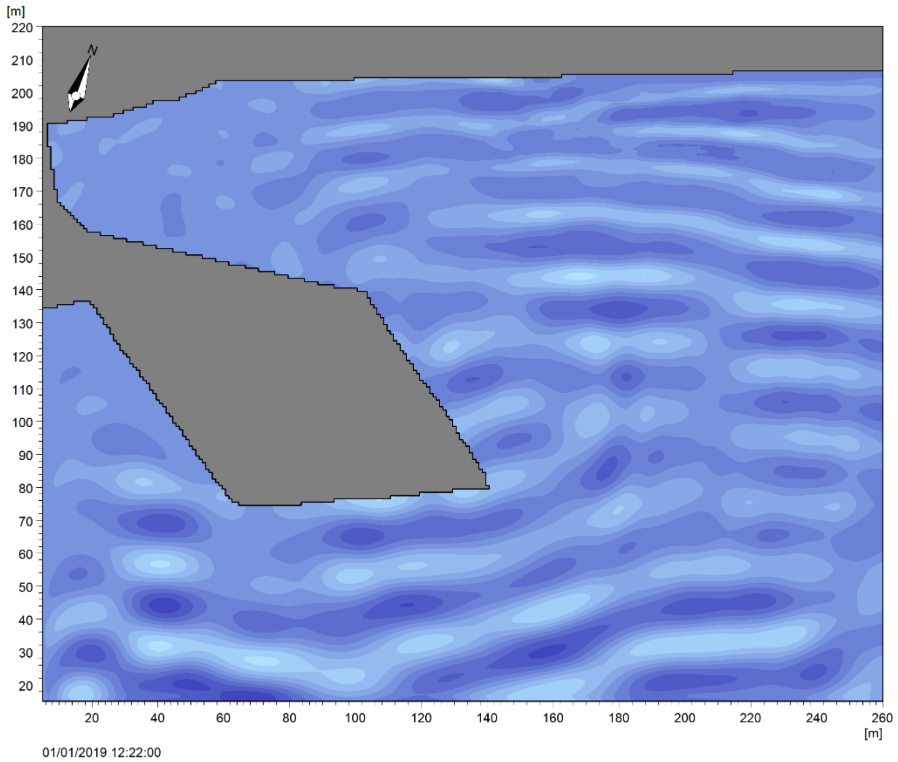

Figure 4.8 Typical wave disturbance patterns around the existing small boat facility and Shore Street seawall - 1 in 50 year return period storm from 150º N

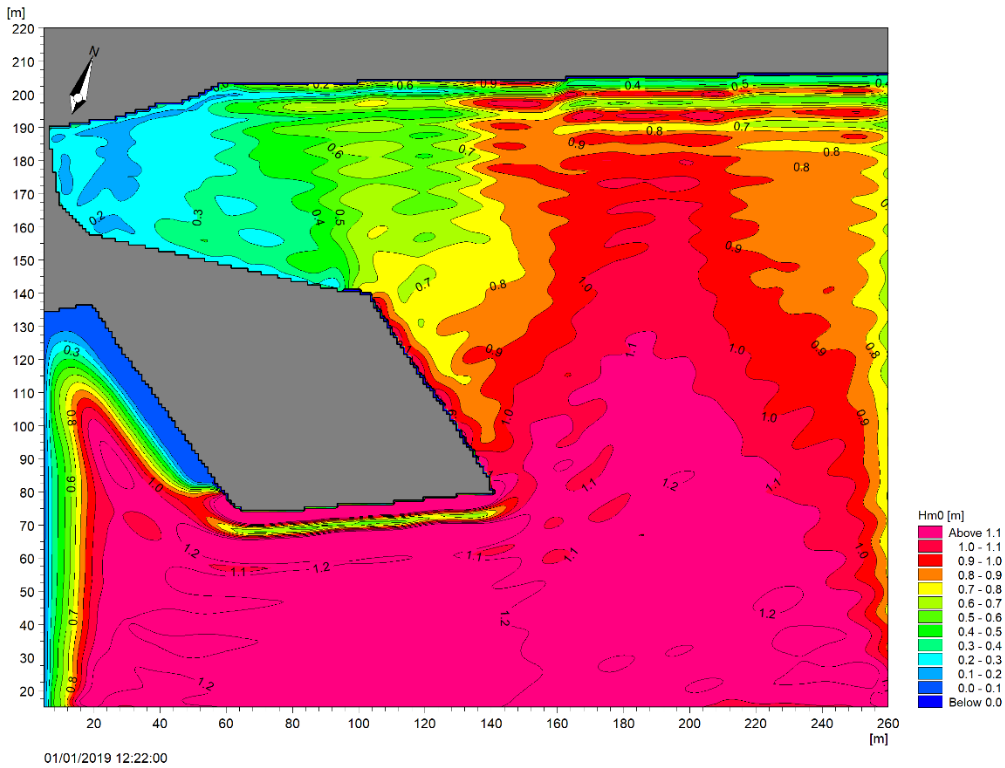

Figure 4.9 Significant wave heights around the existing small boat facility and Shore Street seawall - 1 in 50 year return period storm from 150º N

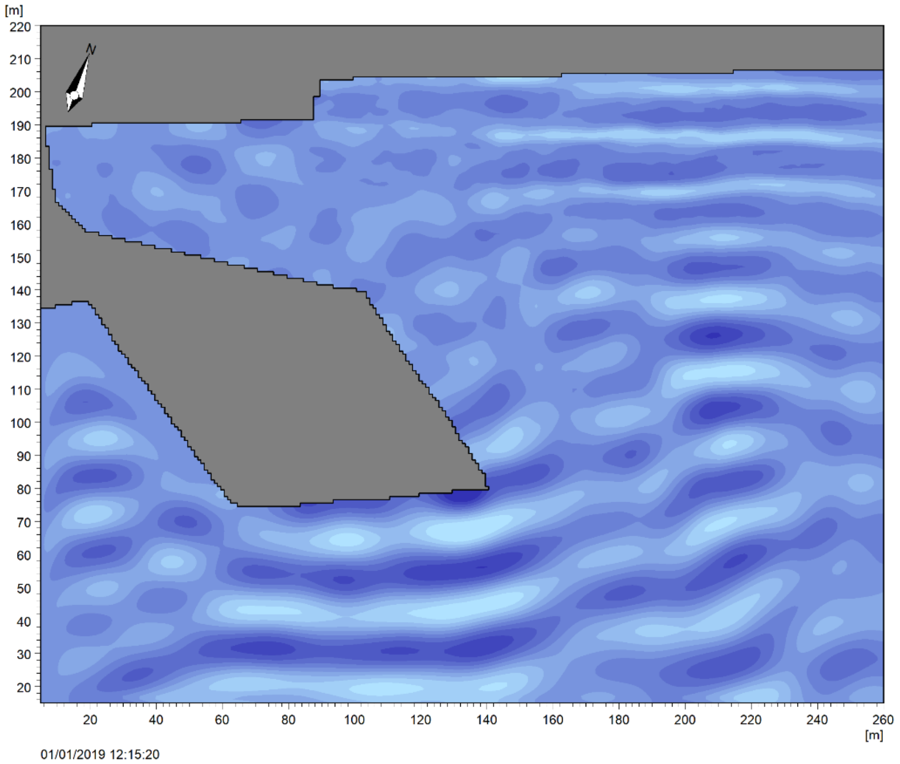

Figure 4.10 Typical wave disturbance patterns around the enlarged small boat facility and Shore Street seawall - 1 in 50 year return period storm from 150º N

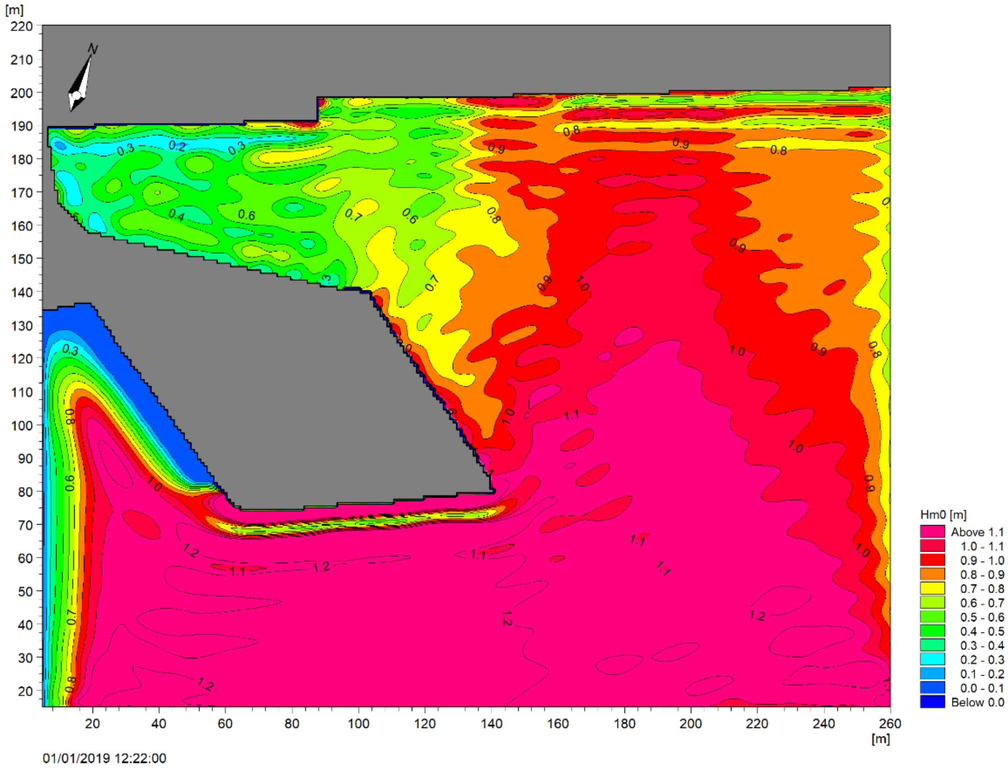

Figure 4.11 Significant wave heights around the enlarged small boat facility and Shore Street seawall - 1 in 50 year return period storm from 150º N

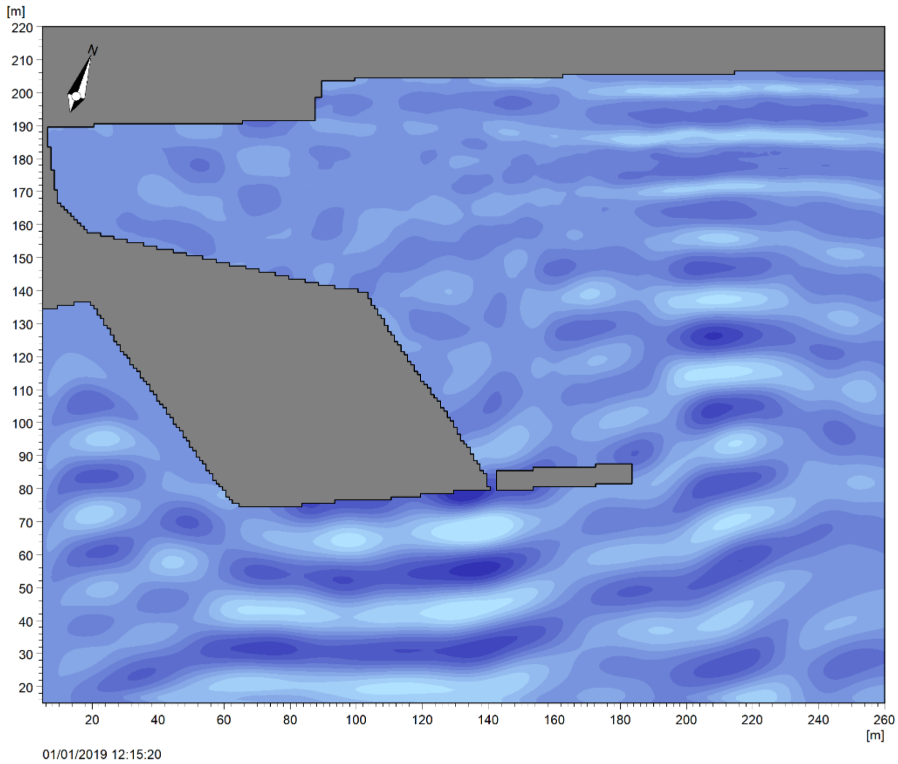

Figure 4.12 Typical wave disturbance patterns around the enlarged small boat facility with floating breakwater and Shore Street seawall - 1 in 50 year return period storm from 150º N

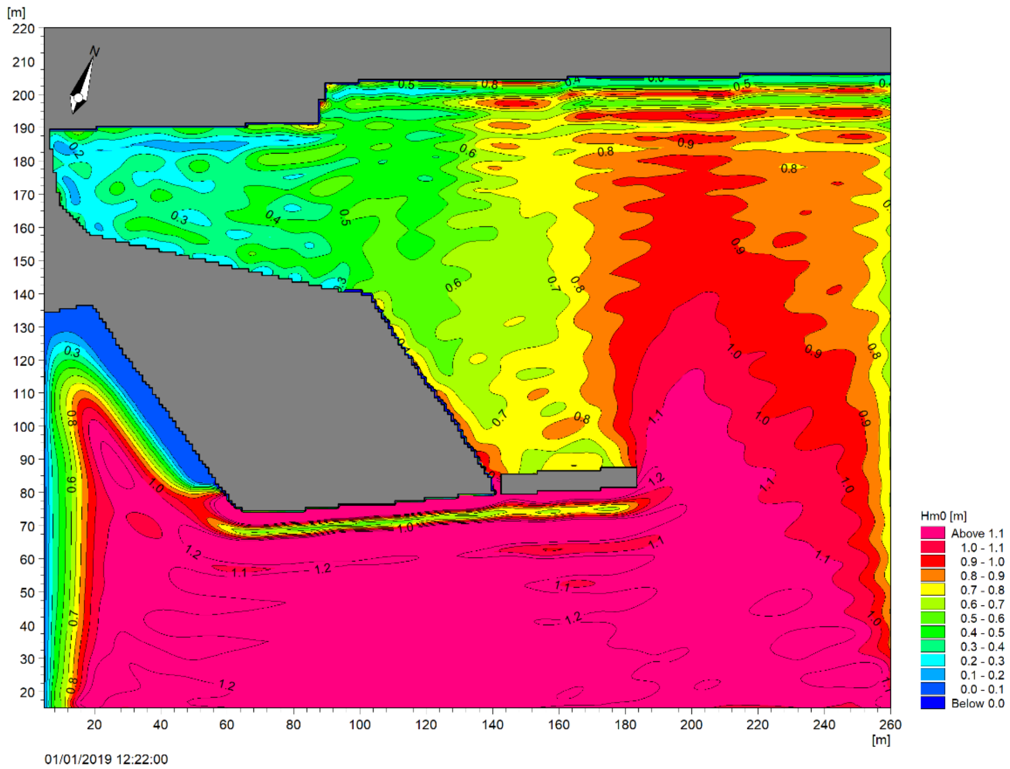

Figure 4.13 Significant wave heights around the enlarged small boat facility with floating breakwater and Shore Street seawall - 1 in 50 year return period storm from 150º N

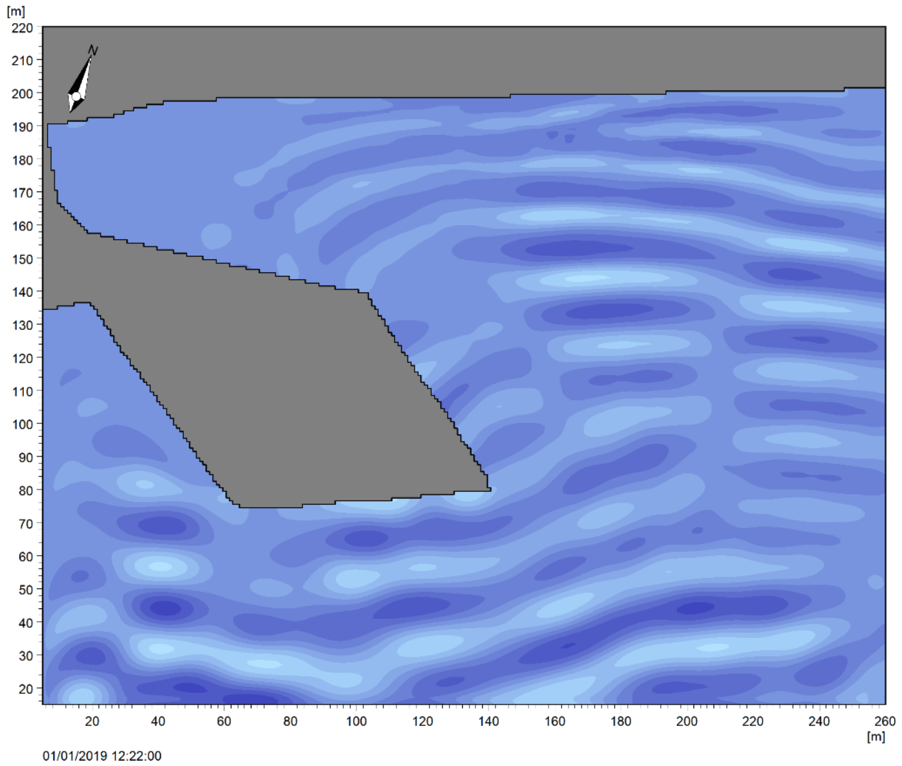

Figure 4.14 Typical wave disturbance patterns around the existing small boat facility and the new Shore Street revetment - 1 in 50 year return period storm from 150º N

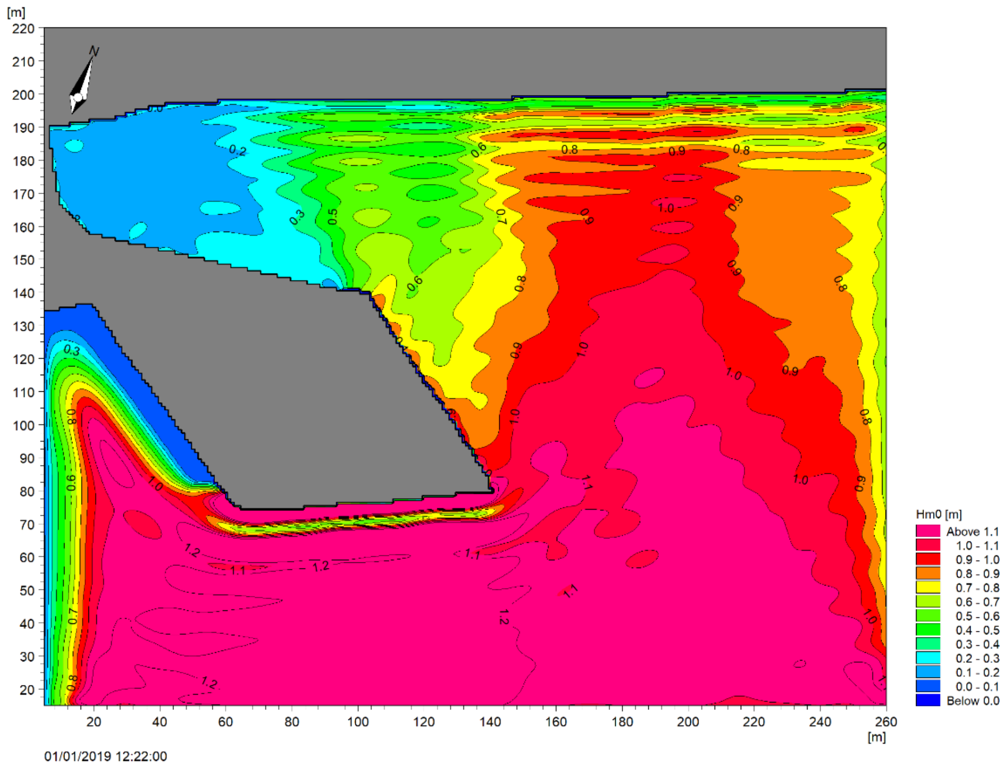

Figure 4.15 Significant wave heights around the existing small boat facility and new Shore Street revetment - 1 in 50 year return period storm from 150º N

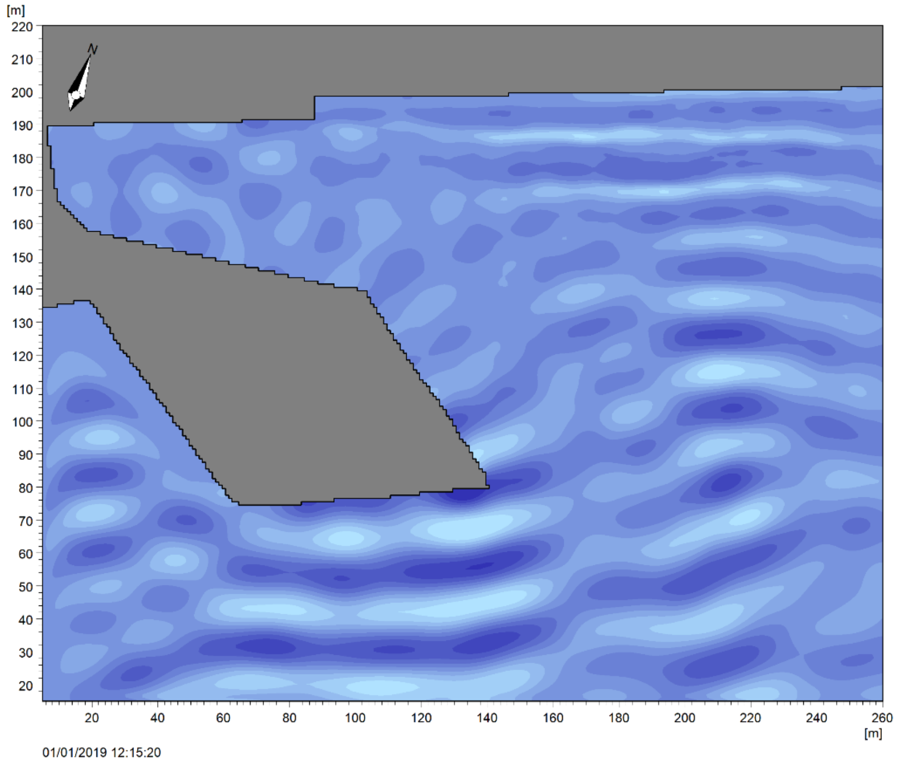

Figure 4.16 Typical wave disturbance patterns around the enlarged small boat facility and the new Shore Street revetment - 1 in 50 year return period storm from 150º N

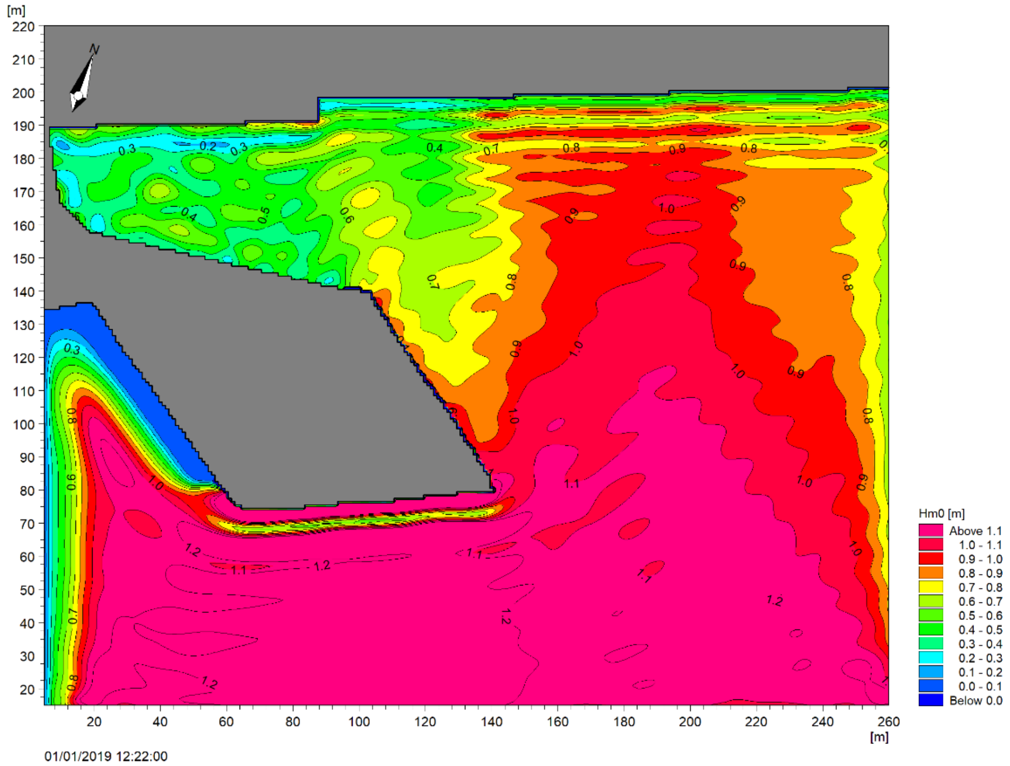

Figure 4.17 Significant wave heights around the enlarged small boat facility and new Shore Street revetment - 1 in 50 year return period storm from 150º N

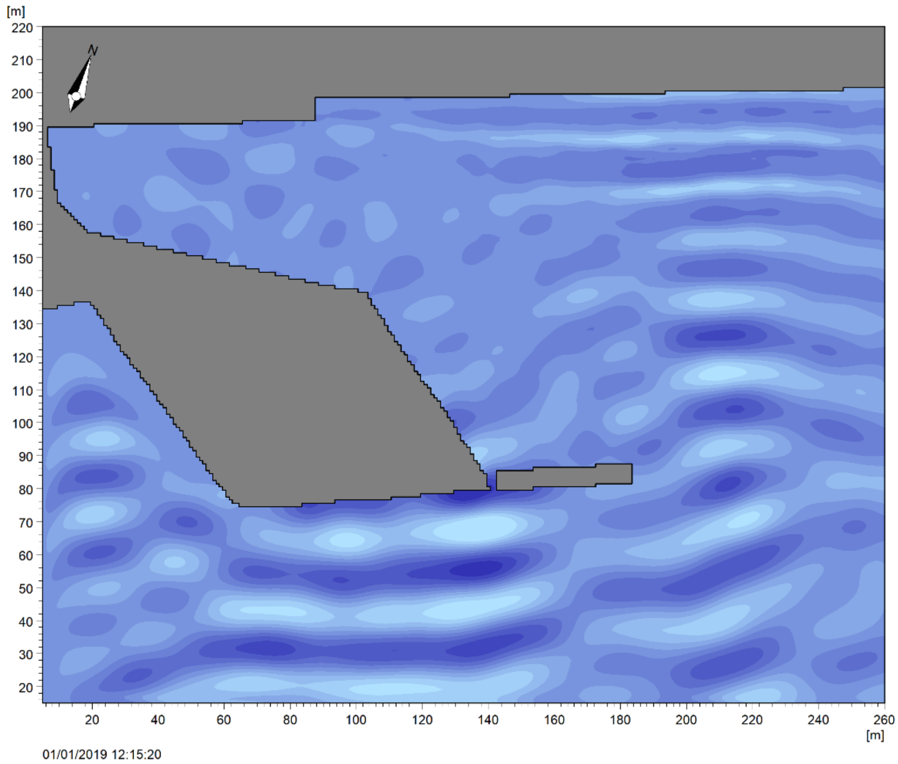

Figure 4.18 Typical wave disturbance patterns around the enlarged small boat facility with floating breakwater and Shore Street revetment - 1 in 50 year return period storm from 150º N

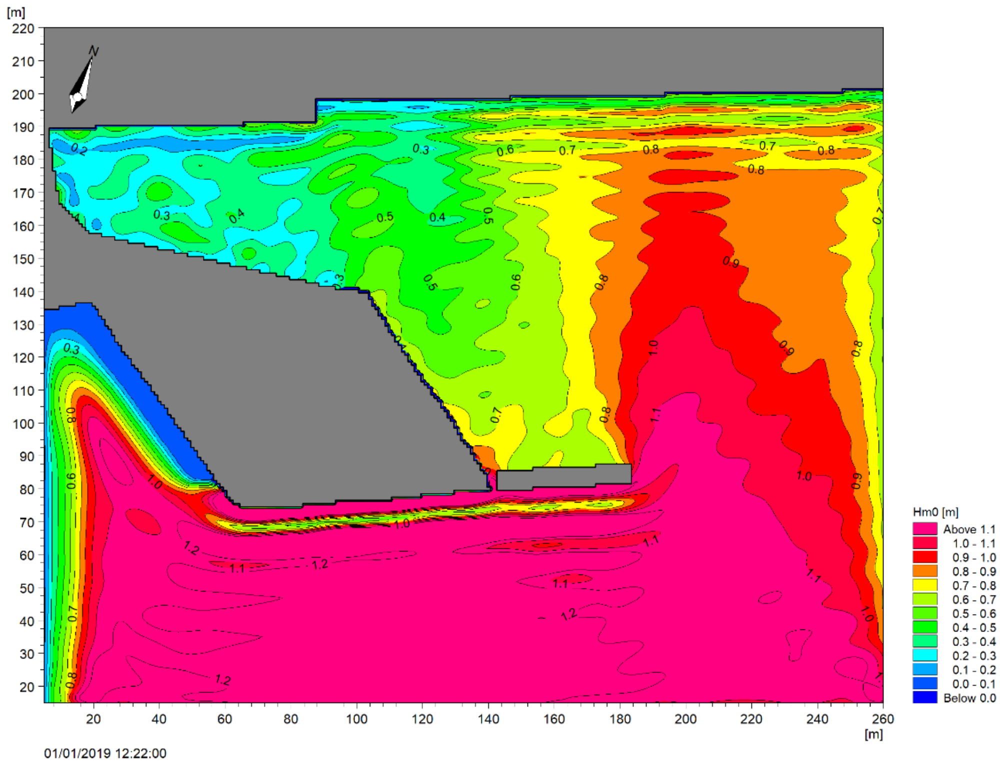

Figure 4.19 Significant wave heights around the enlarged small boat facility with floating breakwater and Shore Street revetment - 1 in 50 year return period storm from 150º N

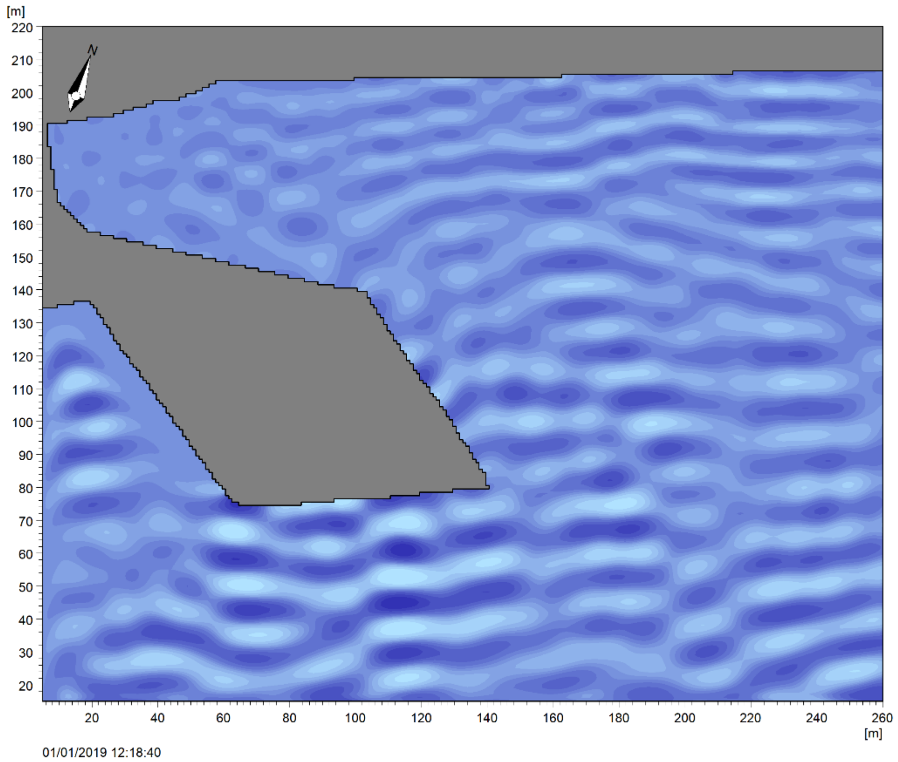

Figure 4.20 Typical wave disturbance patterns around the existing small boat facility and Shore Street seawall - 1 in 1 year return period storm from 150º N

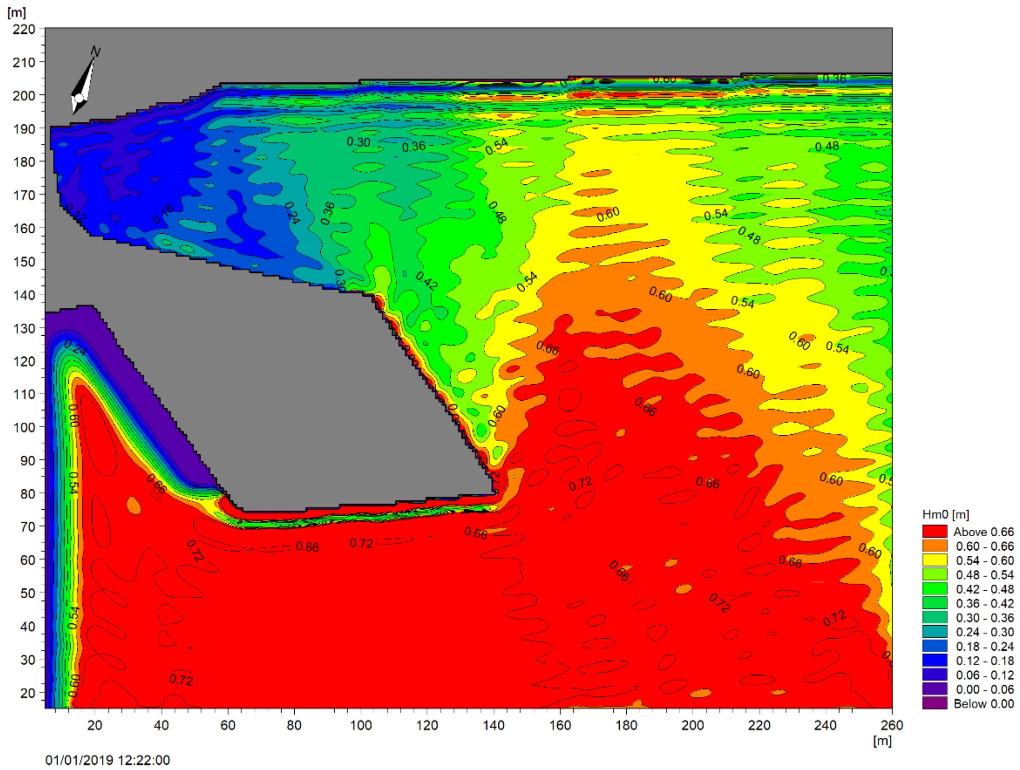

Figure 4.21 Significant wave heights around the existing small boat facility and Shore Street seawall - 1 in 1 year return period storm from 150º N

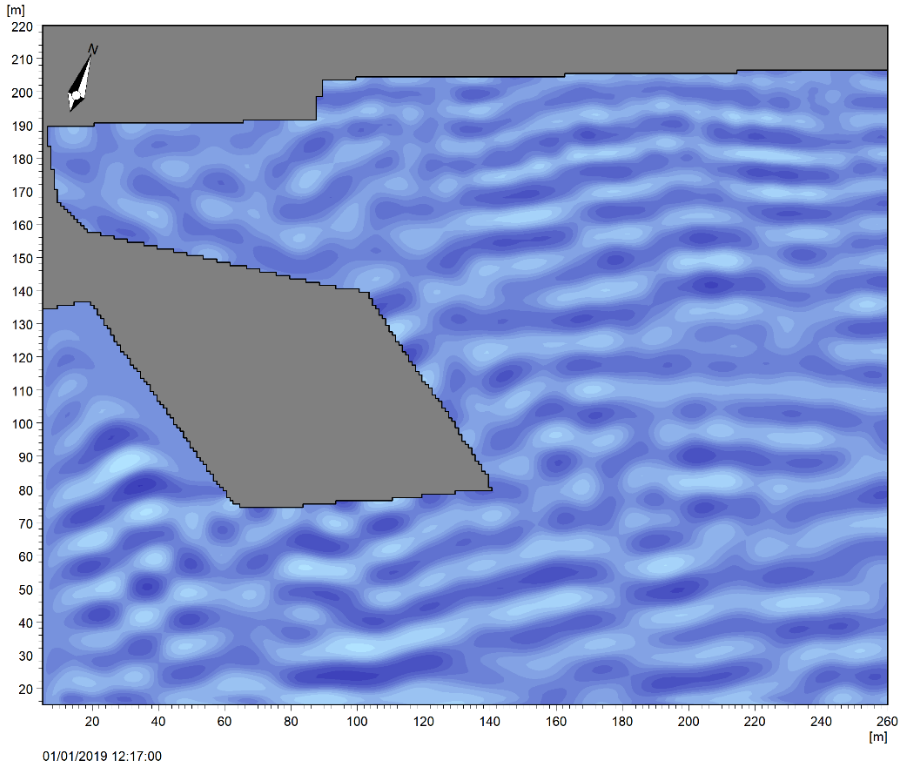

Figure 4.22 Typical wave disturbance patterns around the enlarged small boat facility and Shore Street seawall - 1 in 1 year return period storm from 150º N

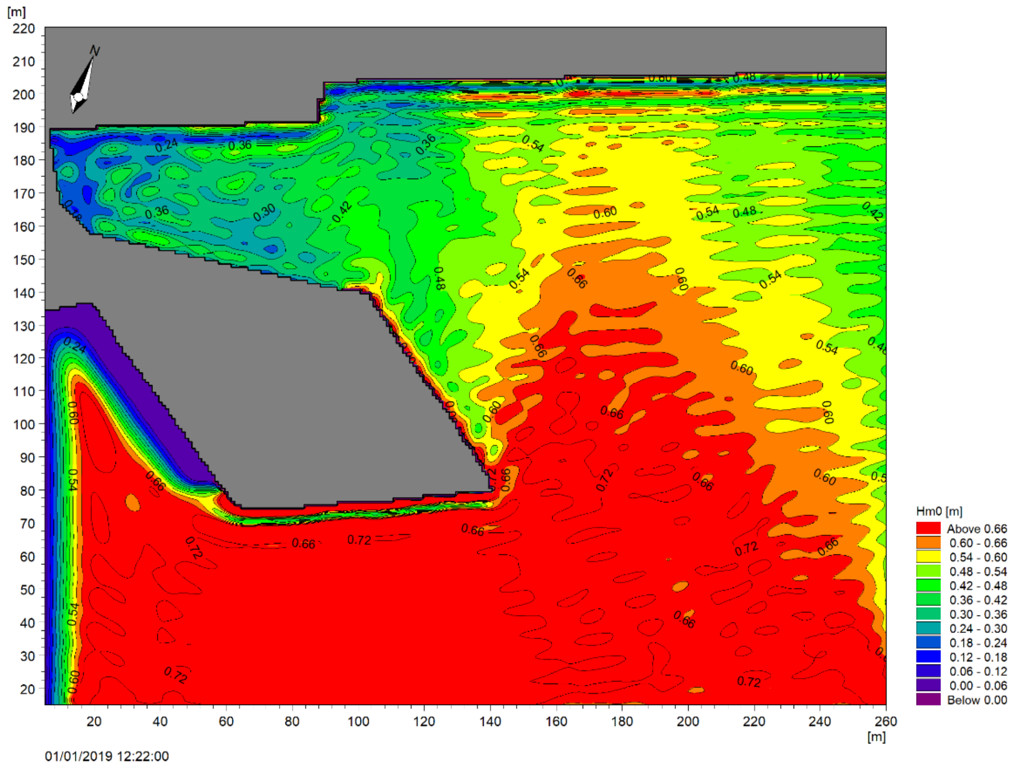

Figure 4.23 Significant wave heights around the enlarged small boat facility and Shore Street seawall - 1 in 1 year return period storm from 150º N

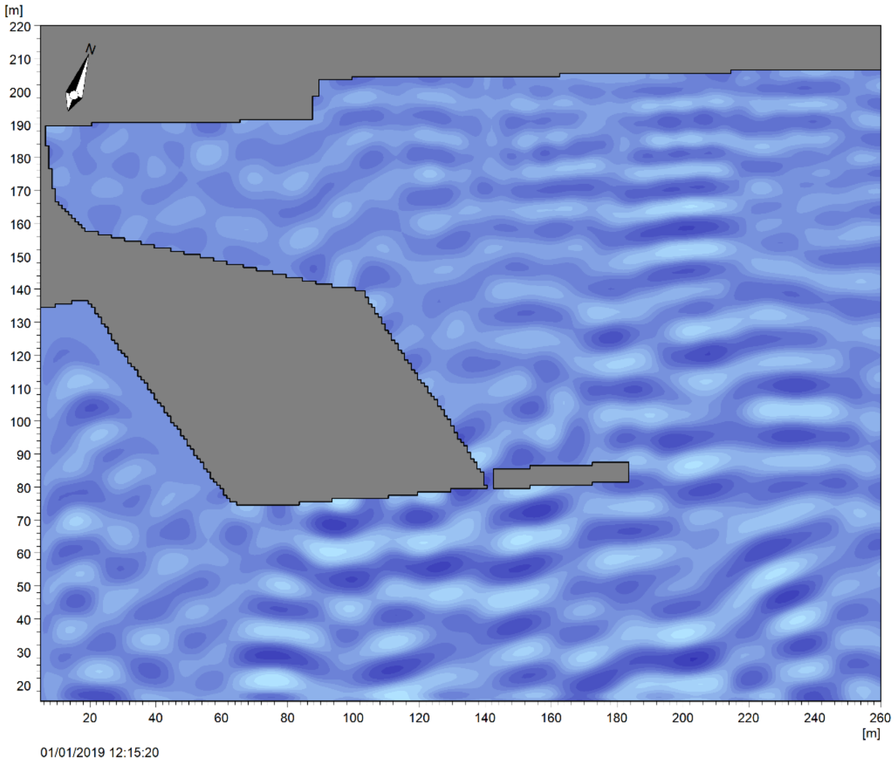

Figure 4.24 Typical wave disturbance patterns around the enlarged small boat facility with floating breakwater and Shore Street seawall - 1 in 1 year return period storm from 150º N

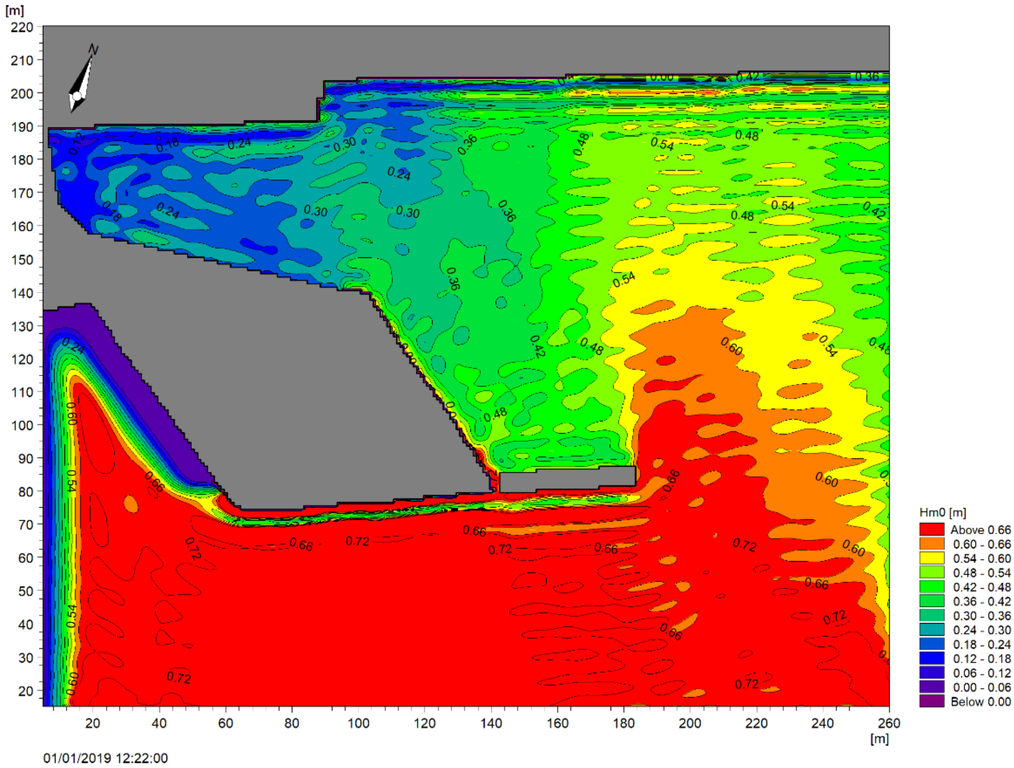

Figure 4.25 Significant wave heights around the enlarged small boat facility with floating breakwater and Shore Street seawall - 1 in 1 year return period storm from 150º N

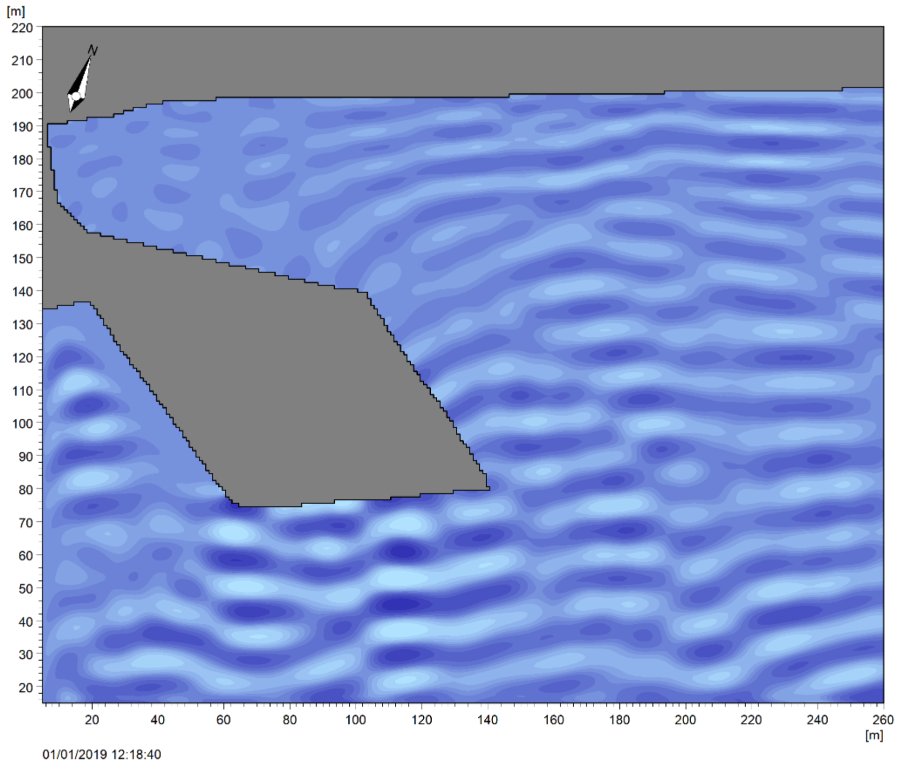

Figure 4.26 Typical wave disturbance patterns around the existing small boat facility and the new Shore Street revetment - 1 in 1 year return period storm from 150º N

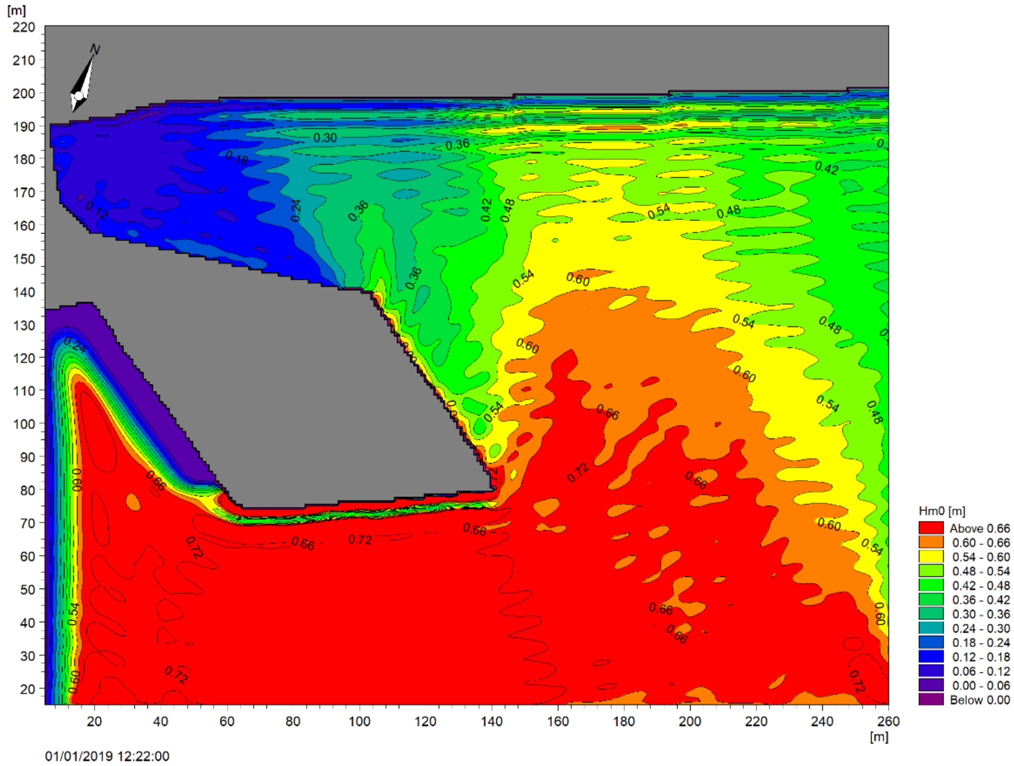

Figure 4.27 Significant wave heights around the existing small boat facility and new Shore Street revetment - 1 in 1 year return period storm from 150º N

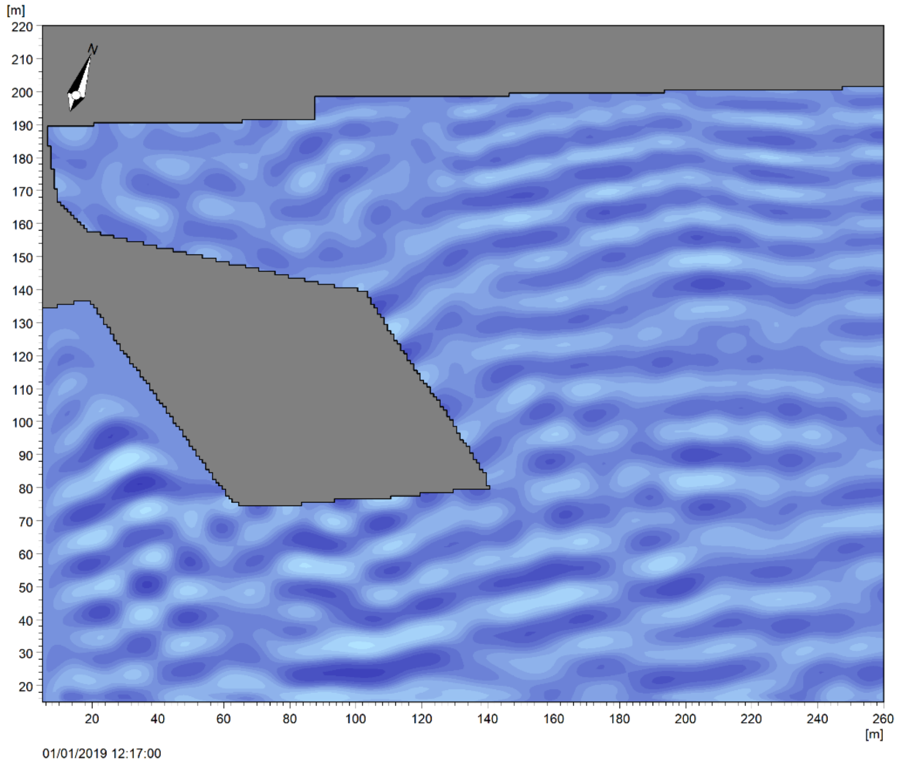

Figure 4.28 Typical wave disturbance patterns around the enlarged small boat facility and the new Shore Street revetment - 1 in 1 year return period storm from 150° N

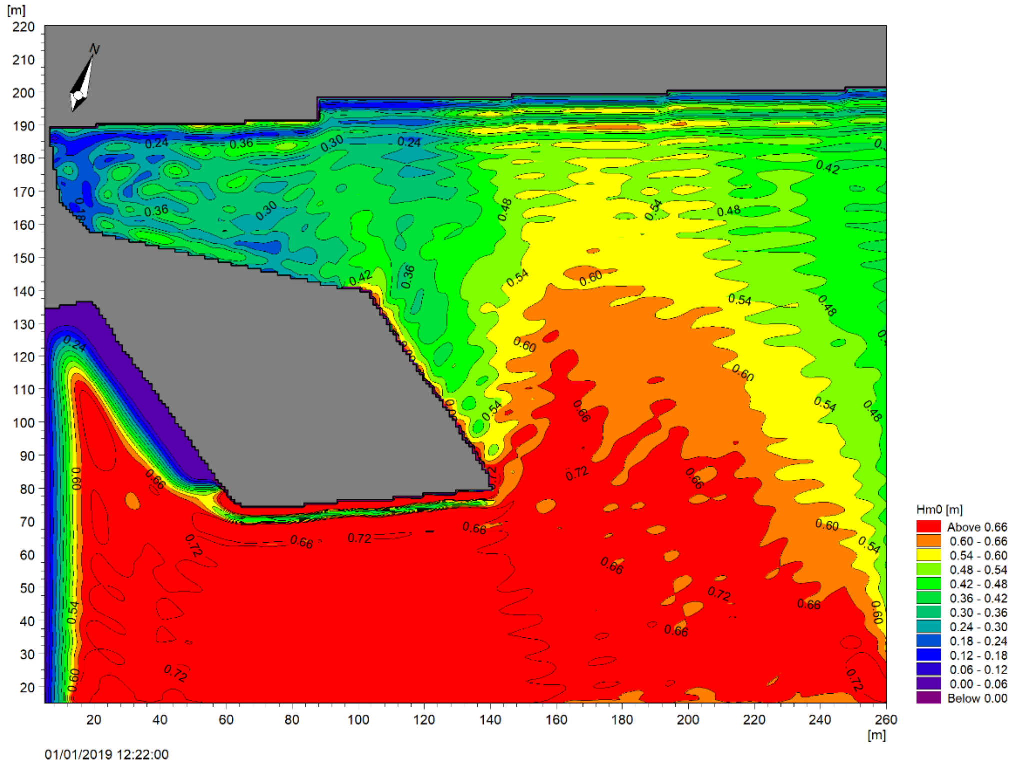

Figure 4.29 Significant wave heights around the enlarged small boat facility and new Shore Street revetment - 1 in 1 year return period storm from 150° N

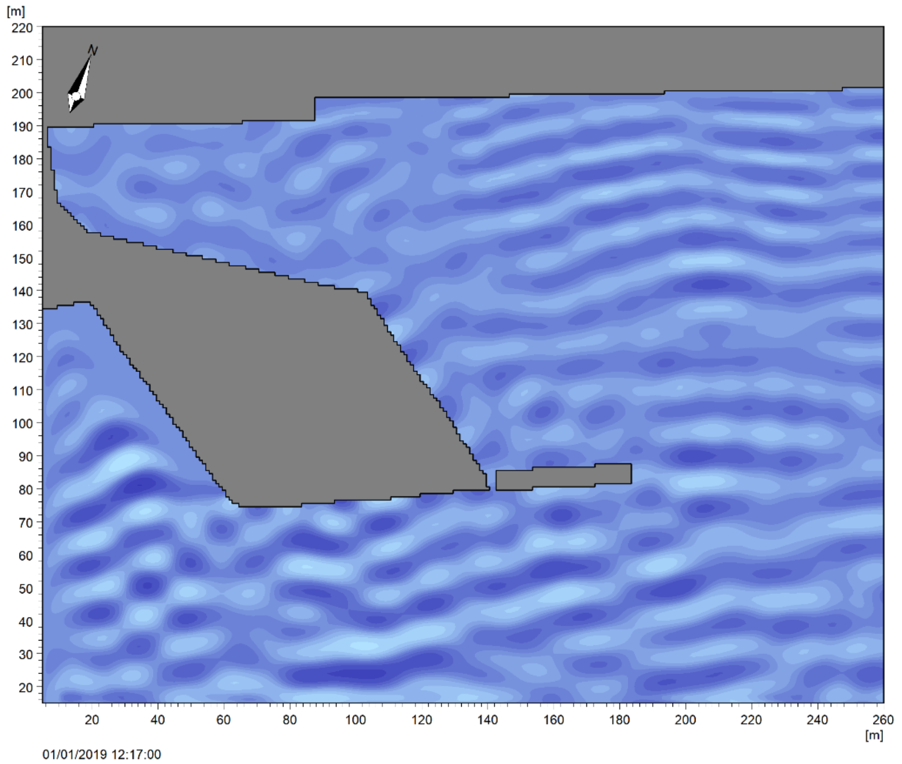

Figure 4.30 Typical wave disturbance patterns around the enlarged small boat facility with floating breakwater and Shore Street revetment - 1 in 1 year return period storm from 150º N

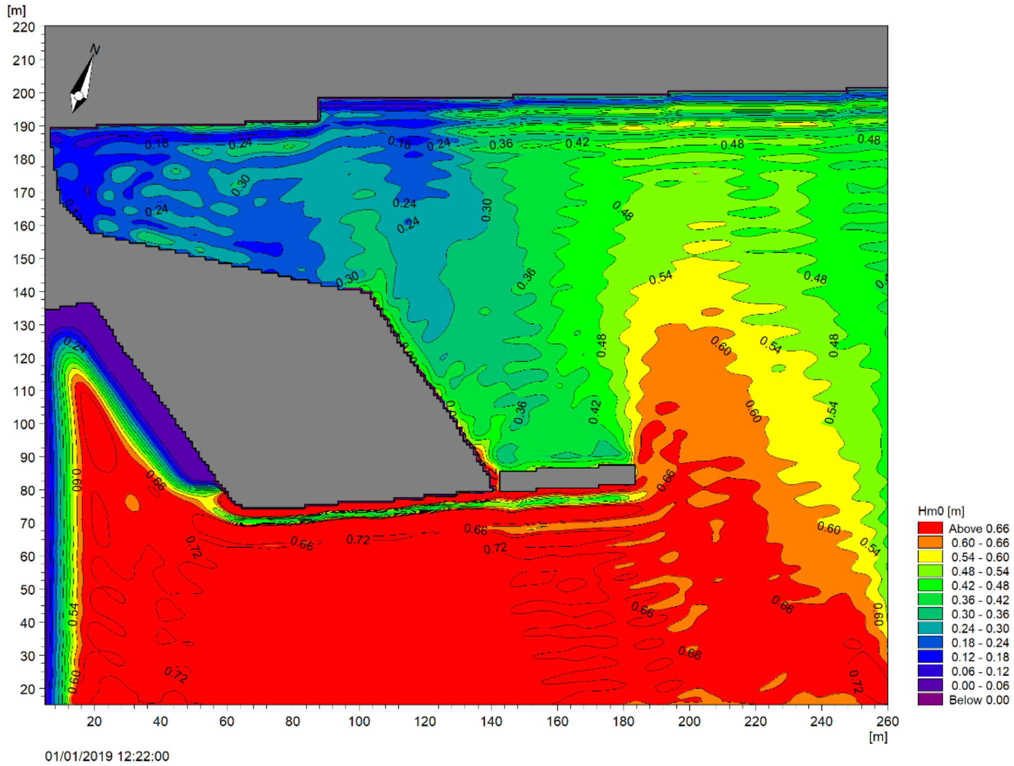

Figure 4.31 Significant wave heights around the enlarged small boat facility with floating breakwater and Shore Street revetment - 1 in 1 year return period storm from 150º N

4.4 Discussion of Results of Wave Disturbance Simulations

The results of the wave disturbance simulations have shown that while the conditions within the existing small boat harbour facility at Ullapool are satisfactory, the construction of the quay and dredging for the enlarged facility will result in the storm wave conditions exceeding the recommended wave heights in the basin. Due to the size and depth of the enlarged basin, the proposed small boat facility is proportionally more affected by the 1 in 1 year storm than the 1 in 50 year storm. It is predicted that the wave conditions in the proposed basin will be marginally worse with the exiting seawall along Shore Street than with the proposed new promenade and revetment.

A 40 metre length of 5m wide floating concrete breakwater moored off the south east corner of the pier area will be effective in attenuating the wave climate in the proposed new small boat harbour and when installed, will bring the wave heights in the proposed enlarged basin to within 0.3m during the 1 in 1 year storm and 0.4m during the 1 in 50 year storm. These are considered to be acceptable values for the berthing of the small boats at the proposed facility.

The floating breakwater must at least be a 5m wide skirted concrete structure which typically will have a weight of about 52 Tonnes per 20 meter length and attenuation characteristics similar to a Marinetek K series 5300 floating breakwater. The modelling has predicted that the breakwater will be subjected to a wave climate with a JONSWAP spectra with the following characteristic during a 1 in 100 year storm.
Hm0 – 1.345m, H_{max} – 2.727m, Tp – 3.56s, T_{01} – 2.88s and Tm_{10} – 3.18s.

5 CONCLUSIONS

The original wave study for the wave climate along the Shore Street frontage has been updated to take account of the increase in sea level rise by 2100 predicted as a result of the IPCC panel 2018 assessment. The increase in the allowance for sea level rise from 0.58 metres to the current SEPA recommended value of 0.89 metres results in an increase in the 1 in 200 year return period storm wave heights of about 10mm.

The frontage at Shore Street is exposed to wind driven waves generated over the local fetch in Loch Broom. Thus a joint probability analysis of extreme wind speed and water levels has been undertaken for the most exposed directions for wave attack along Shore Street. An overtopping analysis has been undertaken using the neural network methodology recommended in the 2018 EurOtop overtopping manual. The results of the analysis showed that for a 1 in 200 year joint probability return period event the current maximum overtopping rate at the existing seawall along Shore Street would be about 20 litres per second per metre length of wall. For the same event the overtopping rate for the proposed new promenade revetment and seawall would be 0.532 litres per second per metre length of wall. This latter rate is well within the 2018 EurOtop manual's recommended values for safe pedestrian access.

It was noted that by 2100 Shore Street would be under water during a 1 in 200 year return period tidal event. Thus no overtopping calculations have been made for the projected 2100 sea levels as these will depend upon what flood mitigation measures are to be undertaken around this part of Ullapool.

Harbour disturbance modelling has been undertaken to investigate the performance of the new quay and dredging for the proposed enlarged small facility at Ullapool. The modelling showed that while the storm wave conditions within the existing small boat harbour are satisfactory, the construction of the new quay and dredging would result in standing wave patterns within the basin during storm events from the south south east to south direction. The inclusion of a 40 metre long, 5 metre wide floating breakwater running east from the south east corner of the Pier area was found to reduce the significant wave heights within the proposed enlarged small boat facility to 0.4 metres and 0.3metres during 1 in 50 and 1 in 1 year return period storms respectively. These wave heights are within the limits recommended for the safe berthing of small boats alongside pontoon facilities.

It is recommended that the floating breakwater should be a concrete breakwater with a minimum width of 5 metres, a weight of at least 52 tonnes per 20 metre length and wave attenuating properties similar to that of a Marinetek K series 5300 breakwater.

APPENDIX

Wave Generation and Transformation Modelling Software

The wave transformation modelling was undertaken using the MIKE21 Spectral Wave model (SW). The MIKE 21 SW model is a new generation spectral wind-wave model based on unstructured meshes. The model simulates the growth, decay and transformation of wind-generated waves and swells in offshore and coastal areas.

MIKE 21 SW includes the following physical phenomena:

- Wave growth by action of wind
- Non-linear wave-wave interaction
- Dissipation due to white-capping
- Dissipation due to bottom friction
- Dissipation due to depth-induced wave breaking
- Refraction and shoaling due to depth variations
- Diffraction
- Wave-current interaction
- Effect of time-varying water depth and flooding and drying

The discretization of the governing equation in geographical and spectral space is performed using a cell-centred finite volume method. In the geographical domain, an unstructured mesh technique is used. The time integration is performed using a fractional step approach where a multi-sequence explicit method is applied for the propagation of wave action.

MIKE 21 SW includes two different formulations:

- Directional decoupled parametric formulation
- Fully spectral formulation

The fully spectral formulation was used in the simulations. The spectral formulation is based on the wave action conservation equation, as described in e.g. Komen et al. (1994) and Young (1999), where the directional-frequency wave action spectrum is the dependent variable.

Harbour Disturbance Modelling Software

The wave disturbance studies were undertaken using the MIKE21 Boussinesq wave model which is the most advanced wave model in the MIKE21 modelling system.

The Boussinesq Wave model, MIKE 21 BW, is the state-of-the-art numerical model for calculation and analysis of short- and long-period waves in ports, harbours and coastal areas. MIKE 21 BW is capable of reproducing the combined effects of all important wave phenomena of interest in port, harbour and coastal engineering. These include:

- Shoaling
- Refraction
- Diffraction
- Wave breaking
- Bottom friction
- Moving shoreline
- Partial reflection and transmission
- Non-linear wave-wave interaction
- Frequency spreading
- Directional spreading

Phenomena, such as wave grouping, surf beats, generation of bound sub-harmonics and super-harmonics and near-resonant triad interactions, can also be modelled using MIKE 21 BW. The 2DH module (two horizontal space co-ordinates) solves the enhanced Boussinesq equations by an implicit finite difference technique with variables defined on a space-staggered rectangular grid.

The Boussinesq wave model includes the provision of wave reflection and transmission properties for various structures within the harbour. This is achieved by placing porosity layers in the model either along the face in front of fixed structures or, in the case of floating breakwaters, along the line of the breakwater location.

Drawings

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Farr, Inverness, IV2 6AW

Telephone: 01808 521 498
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www.affriclimited.co.uk

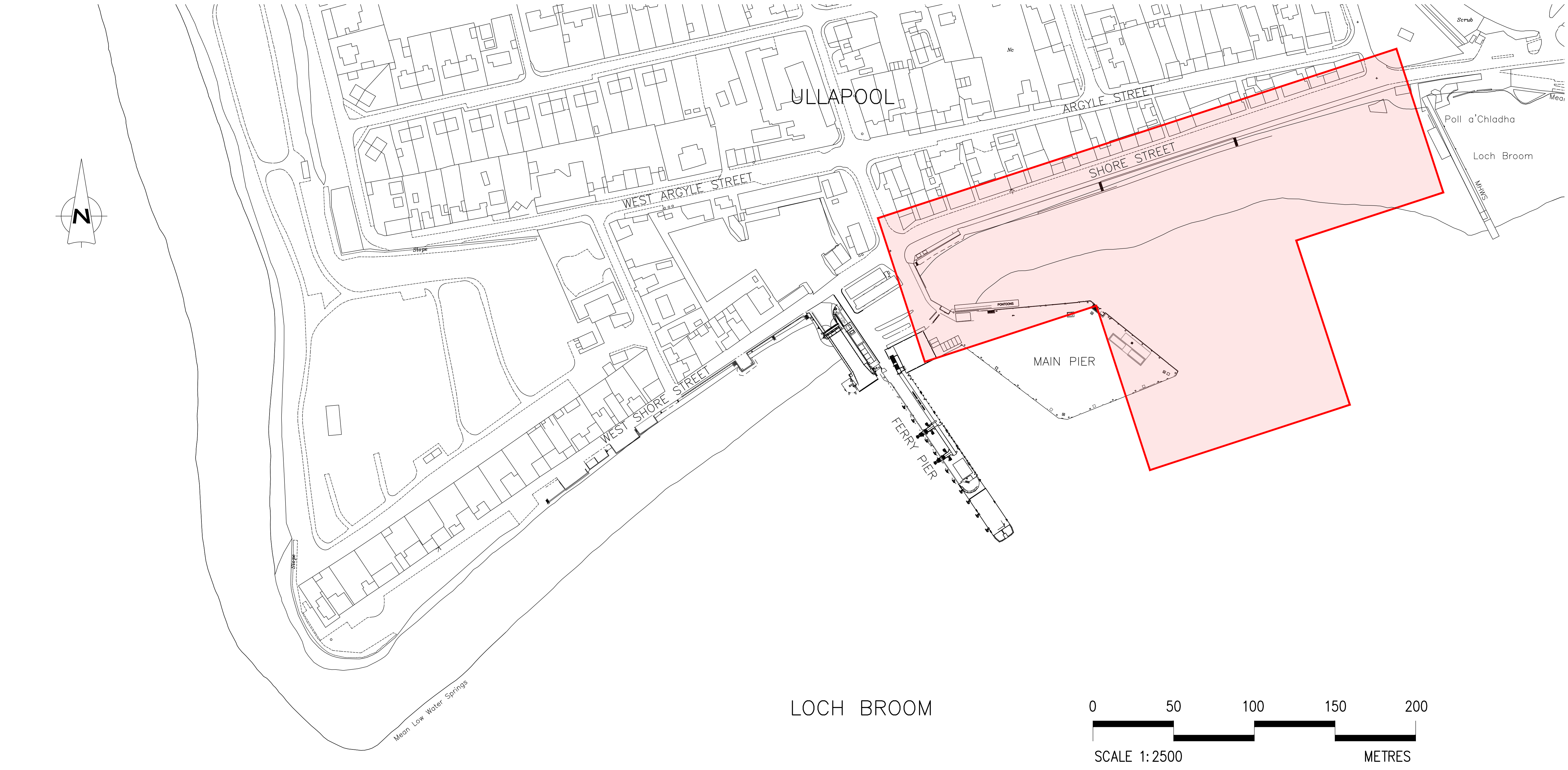
Title: Ullapool Location 63.01.01

Projection: OSGB 1936/British National Grid EPSG: 27700

Page 1	Rev No: 1	Drawing Date: 07/02/2020

Legend

- Ullapool
- Foreshore
- Fresh water
- Tidal Water
- Woodland



LEGEND

AREA OF INTEREST

ULLAPOOL PROMINADE GROUP
SHORE STREET WIDENING & PROMENADE
LOCATION PLAN

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DRAWN: JHG	DATE DRAWN: 07.02.20
CHKD: TR	DATE CHKD: 11.02.20
APPRVD: TR	DATE APPRVD: 10.02.20
DRG NO. 2059-999A	SCALE: 1:2500

NOTES

1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
2. ALL CONTOURS AND LEVELS ARE IN METRES RELATIVE TO CHART DATUM.
3. CHART DATUM IS 2.75m BELOW ORDNANCE DATUM.
4. MHWS +5.2mCD
   MLWS +0.7mCD

REV	DATE	DETAILS	DRAWN	CHK'D	APP'D

AMENDMENTS

CLIENT
ULLAPOOL HARBOUR TRUST

PROJECT
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HEBRIDES 01851 612454 hebrides@wallacestone.co.uk

DRAWING TITLE
EXISTING LAYOUT

DRAWN	CHECKED	APPROVED
JHG	TR	TR
DATE 21.06.19	DATE 06.06.19	DATE 06.06.19

SCALE (A1) 1:500 — STAGE INFORMATION

REVISION

PROJECT No. 2127 — DRAWING No. 901

GENERAL NOTES

1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
2. ALL CONTOURS ARE IN METRES RELATIVE TO CHART DATUM.
3. ALL TOPOGRAPHIC SURVEY LEVELS ARE IN METRES AND RELATE TO ORDNANCE DATUM.
4. CHART DATUM IS 2.75m BELOW ORDNANCE DATUM.
5. MHWS +5.2mCD
   MLWS +0.7mCD

LEGEND

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(cyan)	WORKS BOUNDARY MARINE CONSENT	3,891m²
(red/cyan dashed)	WORKS SHARED BOUNDARY MARINE AND PLANNING CONSENT	

REV	DATE	DETAILS	DRAWN	CHK'D	APP'D
A	11.02.20	WORKS BOUNDARIES REVISED	JHG	TR	TR

AMENDMENTS

CLIENT
ULLAPOOL PROMENADE GROUP

PROJECT
SHORE STREET WIDENING & PROMENADE, ULLAPOOL

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DRAWING TITLE
PROPOSED PROMENADE DEVELOPMENT AREA BOUNDARIES

DRAWN	CHECKED	APPROVED
JHG	EC	TR
DATE FEB 2020	DATE FEB 2020	DATE FEB 2020

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STAGE CONSENTS
REVISION A

PROJECT No.	DRAWING No.
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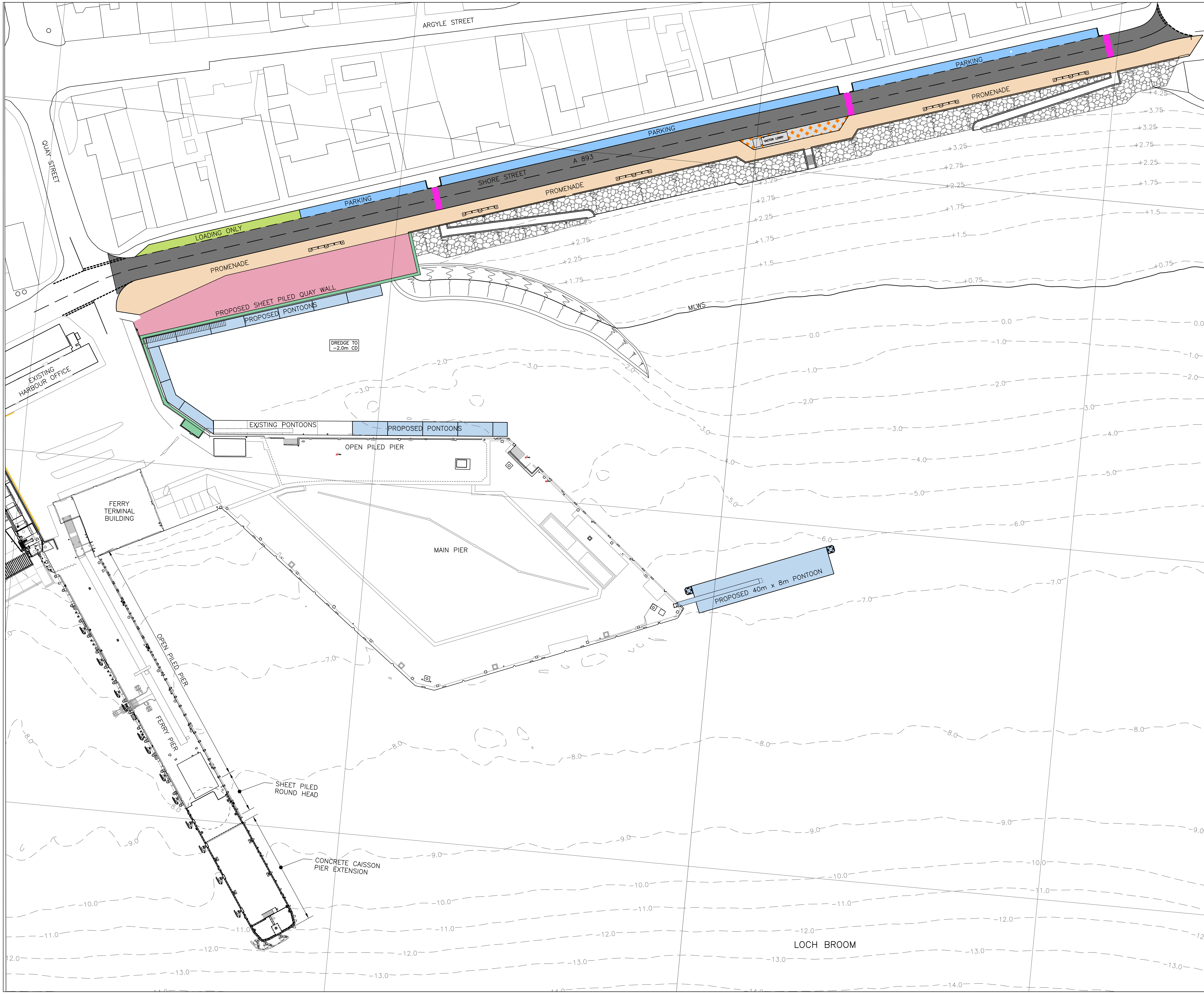

NOTES

1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
2. ALL CONTOURS AND LEVELS ARE IN METRES RELATIVE TO CHART DATUM.
3. CHART DATUM IS 2.75m BELOW ORDNANCE DATUM.
4. MHWS +5.2mCD
   MLWS +0.7mCD

REV	DATE	DETAILS	DRAWN	CHK'D	APP'D

AMENDMENTS

CLIENT
ULLAPOOL HARBOUR TRUST

PROJECT
ULLAPOOL SMALL BOAT PONTOON EXTENSION

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DRAWING TITLE
PROPOSED PONTOONS AND PROMENADE LAYOUT

DRAWN	CHECKED	APPROVED
JHG	TR	TR
DATE 21.06.19	DATE 06.06.19	DATE 06.06.19

SCALE (A1) 1:500
STAGE INFORMATION
REVISION

PROJECT No. 2127
DRAWING No. 902

GENERAL NOTES

1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
2. ALL CONTOURS ARE IN METRES RELATIVE TO CHART DATUM.
3. ALL TOPOGRAPHIC SURVEY LEVELS ARE IN METRES AND RELATE TO ORDNANCE DATUM.
4. CHART DATUM IS 2.75m BELOW ORDNANCE DATUM.
5. MHWS +5.2mCD
   MLWS +0.7mCD

LEGEND

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(cyan)	WORKS BOUNDARY MARINE CONSENT	8,126m^2 FORESHORE, DREDGE AND PONTOONS 556m^2 BREAKWATER AND MOORINGS
(red/cyan dashed)	WORKS SHARED BOUNDARY MARINE AND PLANNING CONSENT	

REV	DATE	DETAILS	DRAWN	CHK'D	APP'D
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A	11.02.20	WORKS BOUNDARIES REVISED	JHG	TR	TR

AMENDMENTS

CLIENT
ULLAPOOL PROMENADE GROUP

PROJECT
SHORE STREET WIDENING & PROMENDADE, ULLAPOOL

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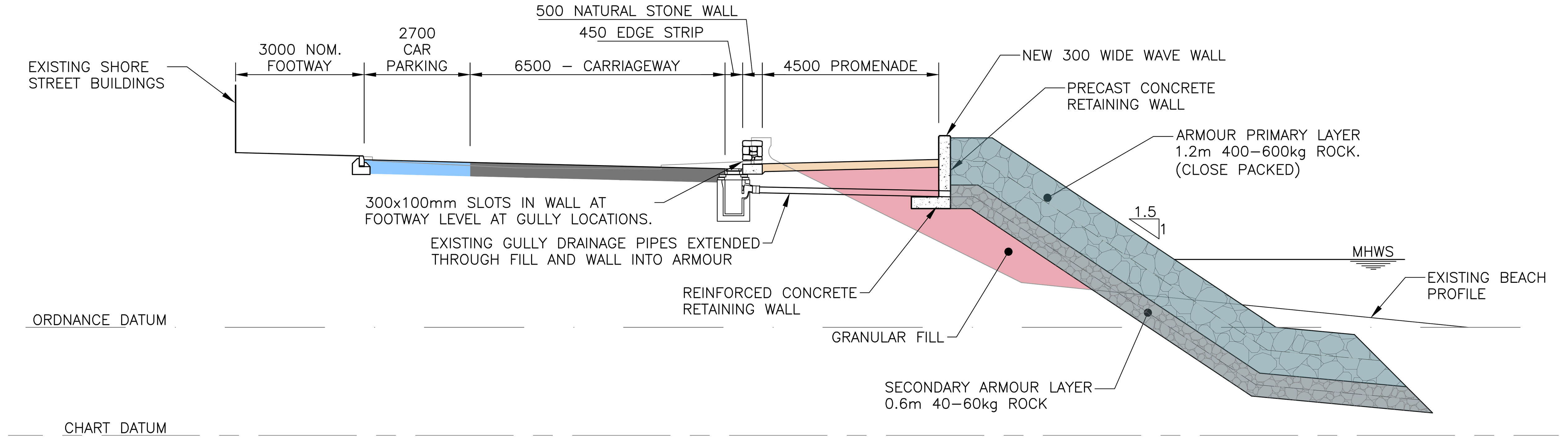
DRAWING TITLE
PROPOSED PONTOONS AND PROMENADE DEVELOPMENT AREA BOUNDARIES

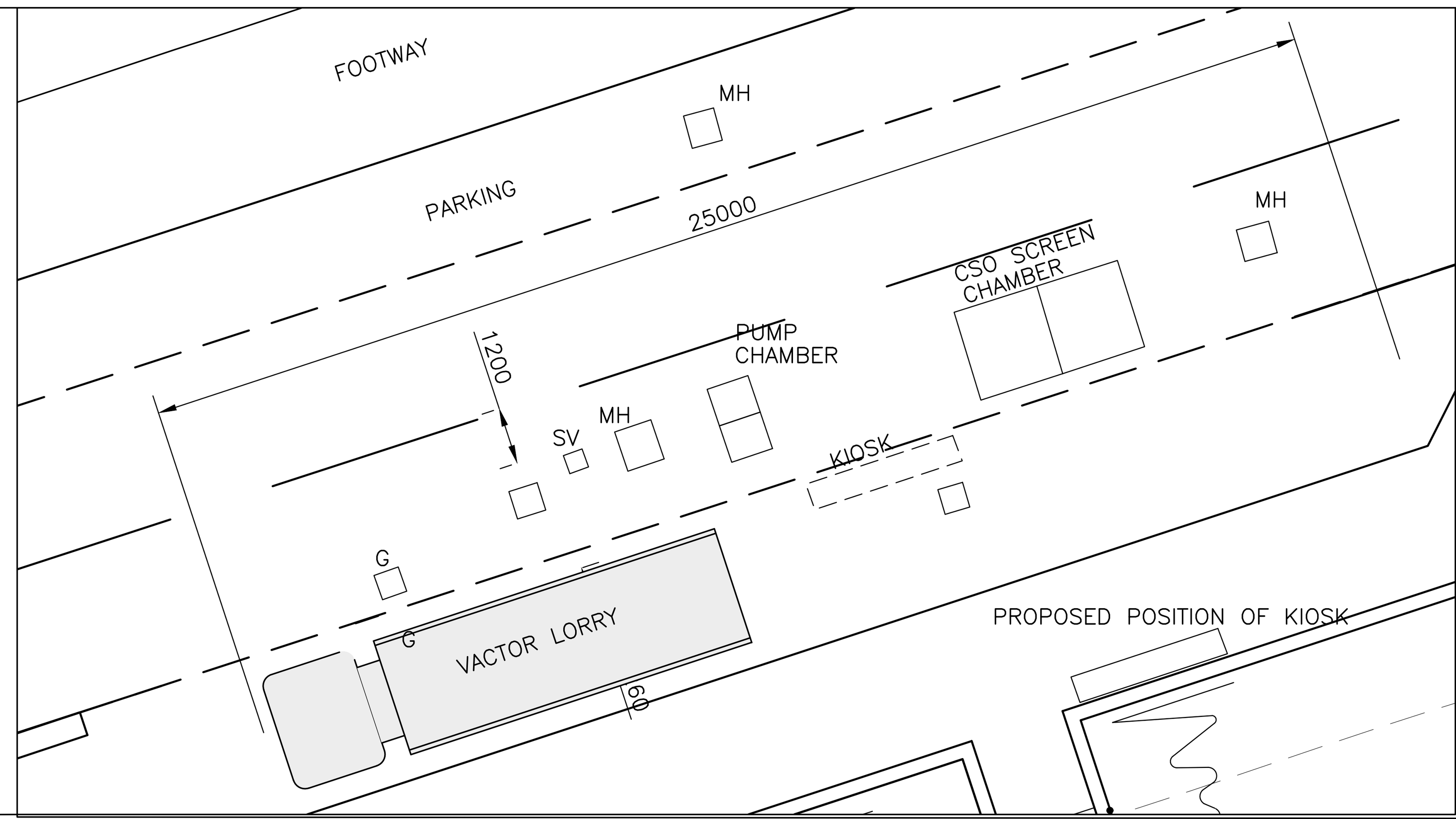
DRAWN	CHECKED	APPROVED
JHG	EC	TR
DATE FEB 2020	DATE FEB 2020	DATE FEB 2020

SCALE (A1) 1:500 (1:1000 AT A3)
STAGE CONSENTS
REVISION A B
PROJECT No. 2059
DRAWING No. 952



TYPICAL SECTION

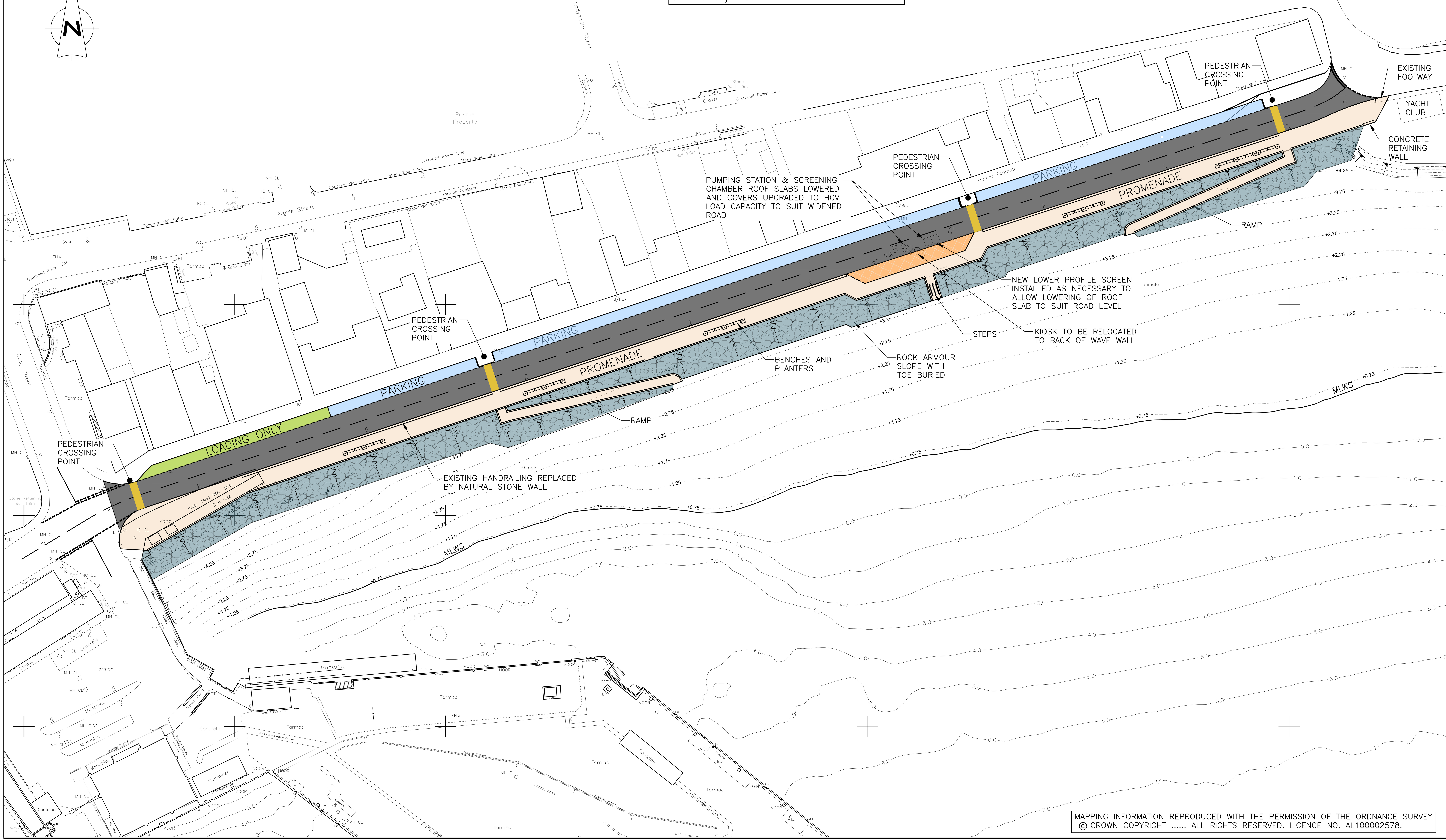
SCALE 1:100



DETAIL OF PROPOSED ROAD WIDENING AT PUMPING CHAMBER

SCALE 1:125

NOTE: ROADWORKS DETAILS SHOWN ARE INDICATIVE ONLY. DETAILED DESIGN AND CONSTRUCTION OF THOSE WORKS TO BE UNDERTAKEN BY TRANSPORT SCOTLAND/BEAR



GENERAL NOTES

1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
2. ALL CONTOURS ARE IN METRES RELATIVE TO CHART DATUM.
3. ALL TOPOGRAPHIC SURVEY LEVELS ARE IN METRES AND RELATE TO ORDNANCE DATUM.
4. CHART DATUM IS 2.75m BELOW ORDNANCE DATUM.
5. MHWS +5.2mCD
   MLWS +0.7mCD
6. REFER TO DRAWING 2059/909 FOR TYPICAL SECTIONS.

REV	DATE	DETAILS	DRAWN	CHK'D	APP'D
F	17.01.20	MINOR AMENDMENTS	LS		
E	18.12.19	MINOR AMENDMENTS & TYPICAL SECTION ADDED.	LS	TR	TR
D	18.07.19	TOPOGRPAHIC SURVEY ADDED.	LS	EC	EC
C	15.05.19	MINOR AMENDMENT	LS	EC	EC
B	23.04.19	PAVEMENT WIDENED TO 3.5m	JHG	TR	TR
A	12.03.19	WIDTH AMENDED TO 4.5m	PM	TR	TR

AMENDMENTS

CLIENT
ULLAPOOL PROMENADE GROUP

PROJECT
SHORE STREET WIDENING & PROMENDADE, ULLAPOOL

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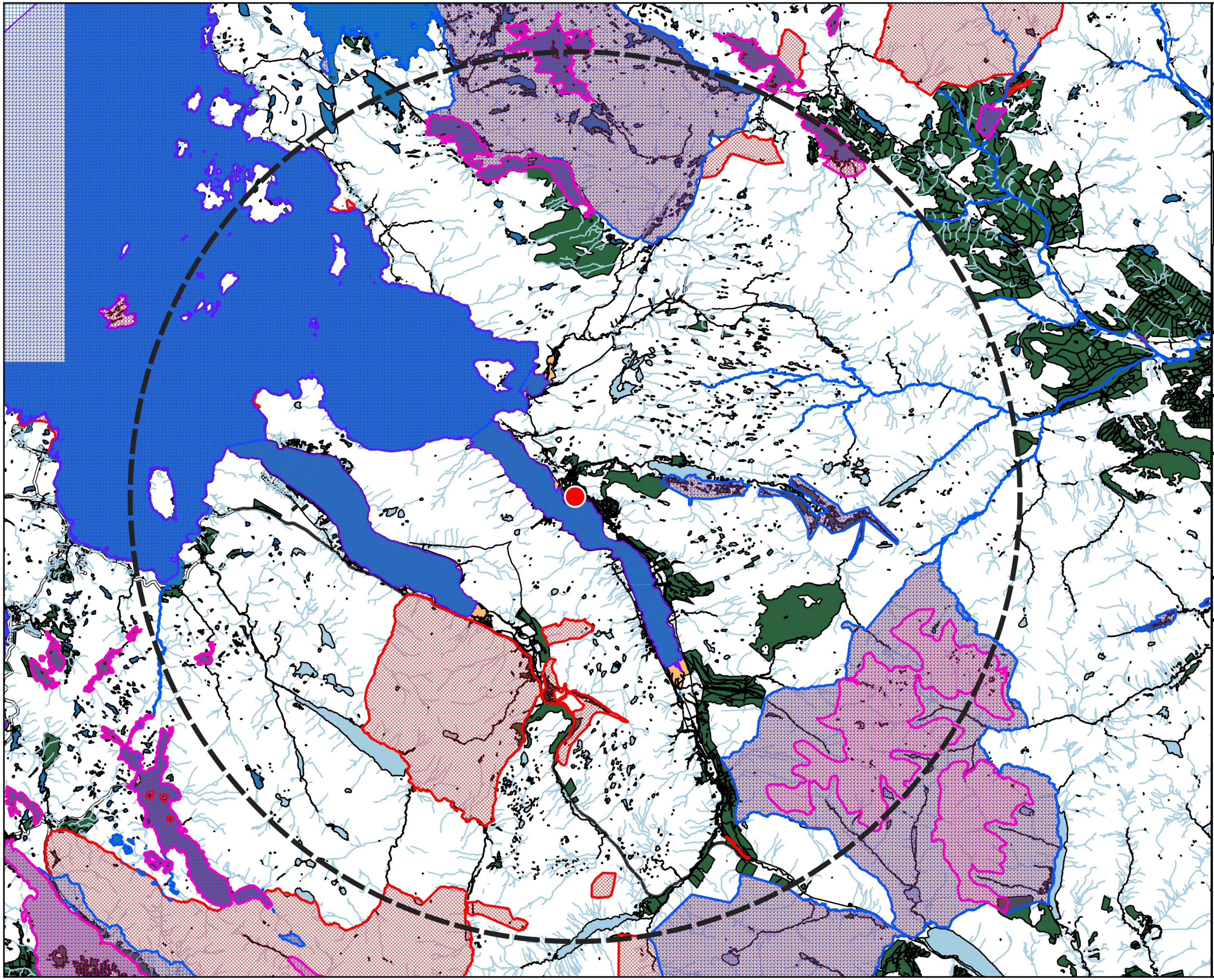
DRAWING TITLE
PROPOSED SITE LAYOUT & TYPICAL SECTION

DRAWN	CHECKED	APPROVED
JHG	TR	TR
DATE FEB 19	DATE 05.03.19	DATE 05.03.19

SCALE (A1) 1:500 (1:1000 AT A3)
STAGE CONSENTS
REVISION A B C D E F

PROJECT No. 2059
DRAWING No. 910



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making it happen

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Title: Designated Sites 20Km Buffer
63.01.02

Projection: OSGB 1936/British National Grid EPSG: 27700

ORDNANCE SURVEY DATA LICENCE

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Legend

- Ullapool
- Foreshore
- Tidal Water
- Woodland
- 20km buffer
- MPA
- SAC
- SSSI
- SPA

N

0 5 10 15 20 25 30 km