Kyleakin Fish Feed Factory

Marine Harvest

Environmental Impact Assessment - Volume 2 of 4: Main Report

Chapter 17: Water Quality

Final

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Contents

17. Water Quality

17.1 Introduction

This chapter of the ES provides an assessment of the potential impacts to marine water quality during the construction and operation phases of the Proposed Development. Consideration is also given to the potential for sediment bound contaminants released during dredging works (excavation) to affect marine water quality characteristics.

The assessment will identify sensitivities of the surface waters, their constraints and the potential impacts of the activities during all phases of the development. In doing so the assessment includes consideration of the potential for remobilised sediments during dredging (or other activities) to affect water quality, specifically in the construction phase; and the potential for changes to marine water quality from the operational discharge.

Mitigation measures for the potential impacts will be proposed and the resultant residual impacts, taking into account the stated mitigation measures, will be reported. Following consent due regard will be given to the requirements of the Construction and Environmental Management Plan (CEMP) document and Scottish Environment Protection Agency (SEPA) consenting licence(s).

The development will incorporate the capital dredging of an area of seabed covering approximately 5.8 hectares. Material will be removed to a minimum depth of 8.5 m Below Chart Datum (BCD). Over the duration of the capital dredging, approximately 190,000 m^3 of material will be removed from the immediate area and placed in the quarry for re-use in the construction process (**see Chapter 2: Project Description**).

17.1.1 Key Consultation Considerations

Within the Scoping Opinions received (see **Chapter 3: Development Design and Alternatives; Appendix 1.1**) were several comments relating to Water Quality.

Marine Scotland Science (MSS) stated on 13 June 2016 that '*investigations need to include all aspects of the physical environment, such as sediments (sediment plumes for example, especially considering the proximity to the Marine Protected Area (MPA)), hydrodynamics (for example changes to tides and currents), water quality (and subsequent effects on the flame shells), coastal processes, sea level rise mitigations, and storm surge events*.'

In terms of the Water Framework Directive (2006/7/EC) (WFD) it was the opinion of the SEPA that *'there is unlikely to be any significant impact upon hydromorphological status in this water body from these works. So long as the designated sites and MPA are protected then the River Basin Management Plan (RBMP) and WFD objectives will be fulfilled.*'

It was also noted by SEPA that careful consideration of consentability will be required during the application determination in relation to any abstraction/discharges to/from the MPA.

Following a meeting in summer 2016 (26/7/16) further discussion was had with SEPA on the assessment process. It was acknowledged by SEPA that no discrete WFD assessment would be required; however, it was requested that some commentary in the ES be provided on whether there would be any significant impact on overall waterbody status. This would include acknowledgment of any effects on geomorphology/hydromorphology (see **Chapter 18: Coastal Processes and Geomorphology**) and water quality. Consideration should also be given to the potential effects on biota from the introduction of non-native species. It should be noted that the potential for introduction of non-native species is dealt with in **Chapter 19: Marine Ecology***;* as it is these receptors which their introduction would ultimately impact.

In January 2017 (19/01/17) a formal consultation response was received from SEPA in relation to the planning application (16/03869/FUL) for the Proposed Development. Within the consultation response SEPA requested that the process discharge be modified in such a way that the discharge point was directly into the marine environment, seaward of the Mean Low Water Spring (MLWS) mark. The required construction and operation activities associated with the outfall are detailed in **Chapter 2**; however, to inform the assessment directed dilution modelling has been carried out (**Appendix 17.1**). The dilution modelling has utilised the baseline data on flows and the results of hydrodynamic modelling (**Appendix 18.1**) and a summary of the numerical outputs is presented in this chapter.

In February 2017, SEPA confirmed that the marine Environmental Quality Standards (EQS) as per Scottish Standards (2014) (**Ref 17-22**) be used to ensure compliance for the operational discharge, and that a maximum mixing zone of 100m, from the point of discharge, be considered.

17.1.2 Structure of Chapter

The structure of this chapter follows the generalised approach of other marine technical chapters and covers:

- Legislation, Policy and Guidance.
- Methodology.
- Baseline Conditions.
- Modelling
- Predicted Impacts.
- Mitigation Measures.
- Residual Impacts.
- Difficulties Encountered in Compiling Information.
- Overview.

17.2 Legislation, Policy and Guidance

Although both the Bathing Waters Directive (**Ref 17-1**) and Water Environment (Shellfish Waters Protected Area Designation) (Scotland) Order (2013) (**Ref 17-2**) are pertinent to water quality legislation, there are no designated bathing waters near to the scheme. The nearest active aquaculture site is ~5 km away, to the east of the works. No impact is predicted on aquaculture from the development and it is not considered further in the ES.

17.2.1 Water Framework Directive

The WFD (**Ref 17-3**) which is transposed into Scottish law by the 'Water Environment and Water Services (Scotland) Act 2003' (WEWS Act) (Scottish Executive, 2003) (**Ref 17-4**), aims to classify surface waters according to their ecological status and sets targets for restoring/improving the ecological status of waterbodies. The objectives of the Directive aim for 'Good' status for all ground and surface waters (rivers, lakes, transitional waters, and coastal waters) in the EU. Water quality and hydromorphology (see **Chapter 18**) are characteristics against which ecological status are assessed.

Marine Scotland is a designated authority under the WEWS Act (Scottish Executive, 2003) and should ensure that marine licensing assists in the delivery of RBMP objectives. River basins comprise all transitional waters (estuaries) and coastal waters extending to three nautical miles seaward from the territorial baseline. Any proposed development within three nautical miles must have regard to the requirements of the WFD to ensure that all transitional and coastal waterbodies achieve 'Good Ecological Status' and that there is no deterioration in status.

To help fulfil the aims of the WFD, the river basin planning process has been implemented to manage the water environment. This involved the production by SEPA of a RBMP for the Scotland River Basin District and supplementary Area Management Plans (AMPs) outlining how the water environment will be managed and improved to meet WFD objectives, which was published in late 2009. However, an updated RBMP was published by SEPA in late 2015 (SEPA, 2015).

River basin planning allows for planned improvements for particular parameters over time. Measures are identified, which will act to protect or improve the water environment in order that all natural waterbodies attain at least 'Good' status over successive RBMP cycles.

The development sits along the south eastern edge of the Inner Sound waterbody (200491). This coastal body covers an area of 341 km^2. The eastern boundary of the Inner Sound waterbody is the Skye Bridge, this feature delineating the adjacent waterbody of Loch Alsh, another coastal waterbody (200352), covering 29 km^2.

17.2.2 Scottish National Marine Plan

Acknowledgement is given to the general policies outlined in the Scottish National Marine Plan (Marine Scotland, 2014) (**Ref 17-5**). Within this Plan the planning policy 'GEN 12' states '*Water quality and resource: Developments and activities should not result in a deterioration of the quality of waters to which the Water Framework Directive, Marine Strategy Framework Directive or other related Directives apply*.'

The policy GEN 12 then goes on to state '*Marine planners and decision makers should be satisfied that impacts of development and use on water have been taken into account. With regards to WFD, reference should be made to the '*ecological status of the water environment*' which includes water quality and quantity and changes to water level as well as biological aspects such as the impact of non-native species.*'

It should be noted that the potential ecological impact of marine non-native species from the development is dealt with in **Chapter 19.**

17.3 Methodology

The assessments in this chapter solely cover water quality and in doing so, the potential for disturbed marine sediments from the Scheme activities to effect the water quality.

This chapter, of the ES adopts the generic assessment process used for EIA i.e. an assessment of impact significance is carried out by first determining the baseline conditions and value/sensitivity (importance) of the receptor, followed by identifying the magnitude of change on the receptor; the impact significance being a combination of these variables. For water quality it is deemed appropriate to use 'sensitivity' rather than 'value' to assign importance and it is this variable that is determined for the area proximal to the development.

The level of significance of an impact was determined based on the sensitivity attributed to the water quality (**Section 17.3.1**) and the magnitude of change from the potential impact (**Section 17.3.2**) during either the construction or operation phase. Where appropriate, mitigation measures are then provided and an assessment of any residual impacts, following application of the measures, detailed.

Determination of baseline water quality was carried out using classification data held by SEPA, including the overall ecological status of the waterbody and the specific water quality status.

SEPA reports baseline conditions for waterbodies following a risk-based WFD (2000/60/EC) classification system, as stated above. This classification system provides a holistic approach to monitoring for a range of different pressures, helping to identify and monitor any pressures on waterbodies which may threaten the aims of the WFD (2000/60/EC). These pressures are generally anthropogenic and may include point source discharges, abstractions and morphological alterations such as flood defence schemes, realignments and impoundments.

This WFD classification system for rivers, lochs, transitional and coastal waterbodies is based on an ecological classification system with five quality classes (High, Good, Moderate, Poor and Bad). It has been devised following EU and UK guidance and is underpinned by a range of biological quality elements, supported by measurements of chemistry, hydrology (changes to levels and flows) and morphology (changes to the shape and function of waterbodies).

Although no specific sediment receptors have been identified as part of this assessment, changes to the sediments, such as disturbance during dredging, can potentially remobilise contaminants into the water column and increase suspended sediment concentrations. This can subsequently affect water quality and, therefore, the physico-chemical properties of the sediments are considered in this chapter.

Information was collated from the following sources:

- the River Basin Management Plan for the Scotland river basin district: 2015-2027 (RBMP). Approved in 21 December 2015 (SEPA, 2015) (**Ref 17-6**);
- Inner Sound waterbody (200491) information sheet published in December 2014 (SEPA interim report, 2014) (**Ref 17-7**);
- Loch Alsh waterbody (200352) information sheet published in December 2014 (SEPA interim report, 2014) (**Ref 17-8**);
- An t-ob lagoon waterbody (200353) information sheet published in December 2014 (SEPA interim report, 2014) (**Ref 17-9**);
- Abhainn Lusa river (20710) information sheet published in December 2014 (SEPA interim report, 2014) (**Ref 17-10**);
- interim classification data available on SEPA website (water environment hub); and
- marine sediment sampling carried out in 2016 (**Appendix 18.2** (ALHS, 2016)).

Potential impacts and mitigation proposals were identified through relevant literature, drawing on guidelines and procedures, by means of a desk-based assessment.

17.3.1 Sensitivity

For determination of impact significance, the sensitivity of the receptor to change is considered more relevant to water quality. This is due to the dynamic nature and buffering capacity of coastal waterbodies.

The sensitivity of water quality is categorised on a scale of 'high' 'to low' in accordance with the criteria provided in **Table 17.1**.

Table 17.1 : Sensitivity of Water Quality

Sensitivity	Surface Water Criteria
High	The water quality of the receptor supports or contributes to the designation of an internationally or nationally important feature *and* has a very low capacity to accommodate any change to current water quality status, compared to baseline conditions.
Medium	The water quality of the receptor supports high biodiversity and has low capacity to accommodate change to water quality status.
Low	The water quality of the receptor has a high capacity to accommodate change to water quality status, for example, the receiving water of a comparatively large size and with the capacity for dilution and flushing.

17.3.2 Magnitude of Change

The magnitude of change is influenced by the timing, scale, size and duration of the potential impact, as defined in **Table 17.2**.

Table 17.2 : Magnitude of Potential Impacts on Water Quality

Magnitude of change	Surface Water Criteria
Large	Very significant change to key characteristics of the water quality status of the receiving water quality feature, resulting in loss of attribute and/or quality and integrity of the attribute. Water quality status degraded to the extent that permanent changes would occur. Equivalent to downgrading one WFD Class.
Medium	Significant changes to key characteristics of the water quality status from baseline conditions, taking account of the receptor volume, mixing capacity, flow rate etc. Results in effect on integrity of attribute, or loss of part of attribute (representing deterioration within WFD class). These changes are likely to be medium (1 - 5 years) to long term (> 5 years) in their effect.
Small	Detectable changes from the baseline conditions, but not considered significant to result in a change in the water quality status of the receiving water feature. Changes are likely to be temporary in nature with no effect to the current WFD Class.
Negligible	No perceptible changes to water quality such that there is no readily detectable effect upon the water quality status of the receiving water feature or; a detectable effect but of insufficient magnitude to affect the integrity of the feature.

17.3.3 Impact Significance

Assessing impact significance is carried out by determination of the baseline conditions and value/sensitivity of the receptor, followed by identifying the magnitude of change on the receptor; the impact significance is the combination of these variables. To understand how significance has been assigned against these criteria in this chapter and **Chapter 19** a matrix is presented (see **Table 17.3**).

Table 17.3 : Matrix for Determination of Impact Significance

Magnitude / Value/ Sensitivity	Negligible	Small	Medium	Large
High	Negligible	Minor/ Moderate	Moderate/ Major	Major
Medium	Negligible	Minor	Moderate	Moderate/ Major
Low	Negligible	Negligible	Minor	Moderate

It should be acknowledged that depending on the topic under consideration, the term value/sensitivity may be replaced by one better suited to the topic; for example, 'sensitivity' is used for water quality (**Section 17.3.1**); however, the term 'importance' is used for marine ecological receptors (see **Chapter 19**).

The significance of effects on water quality is determined with reference to impact criteria. These criteria apply a common EIA approach of classifying impacts according to whether they are major, moderate, minor adverse/beneficial; or if they are negligible. The impact significances are defined as given in **Table 17.4.**

Table 17.4 : Generic Impact Significance Definitions

Impact	Definition
Major Adverse	Considerable detrimental or negative impact to an environmental resource or receptor impact (by extent, duration or magnitude) of more than local significance or in breach of recognised acceptability, legislation, policy or standards.

Impact	Definition
Moderate Adverse	Limited detrimental or negative impact to an environmental resource or receptor (by extent, duration or magnitude) which may be considered significant.
Minor Adverse	Slight, very short or highly localised detrimental or negative impacts to an environmental resource or receptor.
Negligible	No significant impacts to an environmental resource or receptor.
Minor Beneficial	Slight, very short or highly localised advantageous or positive impact to an environmental resource or receptor.
Moderate Beneficial	Limited advantageous or positive impact to an environmental resource or receptor (by extent, duration or magnitude) which may be considered significant.
Major Beneficial	Considerable advantageous or positive impact to an environmental resource or receptor (by extent, duration or magnitude) of more than local significance.

Although professional judgement is the principal factor in determining which effects would be significant, the assessment is guided by the methodology outlined above. Impacts described during the assessment should be considered adverse unless stated otherwise.

17.4 Baseline Conditions

It is acknowledged that effects on the marine environment, in regard to water quality, have the potential to be far reaching based on the large tidal excursion, hence consideration is given to a study area encompassing part of the Inner Sound and Loch Alsh waterbodies, with a 5 km boundary to the study area from the development. Consequently, this includes the full width of the water from the development north, across to the mainland.

The development, including the footprint of the dredging extent, is encompassed by the ‘Inner Sound’ coastal waterbody (200491); however, its close proximity (<1 km) to the adjacent coastal waterbody ‘Loch Alsh’ (200352) means acknowledgment is also given to this waterbody.

In December 2014 SEPA assigned the ‘Inner Sound’ and ‘Loch Alsh’ waterbodies as having an overall status of ‘Good’ (including water quality), with overall ecological status of ‘Good’ and overall chemical status of ‘Pass ’ (**SEPA interim report, 2014**). The official 2015 classification has not been officially published (at date of this document, **September 2016**), though no changes from the latest interim classification (**SEPA interim report, 2014**) are expected.

Two other classified waterbodies are noted within the study area, to the southwest is the Abhainn Lusa river (approximately 4.5 km from the development) and to the east the An t-ob lagoon. However, no effects pathway is considered on the water quality to these waterbodies from the development and they are not considered further.

SEPA also provide information on the condition of the waterbody for Lochs Duich, Long and Alsh SAC (UK0017077). In 2014 the waterbody condition was considered to be at its target objective and expected to maintain this condition for the 2021 and 2027 cycles (water-environment-hub, SEPA 2016) (**Ref 17-11**).

As discussed above, no historic baseline water quality data exists for the development area. Following discussion with SEPA on the 26th July 2016, it was agreed as a precautionary approach, that the receiving water be considered as having an annual mean concentration of suspended particulate matter of between 10 to <100 mg/l. In accordance with the classification of transitional waterbodies this would assign an intermediate turbid type to the receiving water (**Table 17.5**), though acknowledgment is given to the receiving waters being coastal rather than transitional.

Table 17.5 : Types of transitional water as identified from the Scotland River Basin District (Standards) Directions 2014

Type	Annual Mean Concentration of Suspended Particulate Matter (mg/l)
Very turbid	>300
Turbid	100 to 300
Intermediate turbid	10 to <100
Clear	<10

The dissolved oxygen (DO) values in both waterbodies (Inner Sound and Loch Alsh) are classified as 'High' by SEPA and hence equate to a value of 5.7 mg/l (as 5-percentile values).

17.4.1 Marine Sediment Analyses

In 2016 a series of sediment samples were collected from within, and adjacent to, the footprint of the dredged extent. Physico-chemical parameters were analysed from a series of grab and vibrocore samples. A total of 12 grabs were collected by Aspect Land & Hydrographic Surveys Ltd (ALHS); and eight vibrocores. Although additional vibrocores were intended it was not possible to take a sample due to the coarse nature of the seabed, therefore additional grabs were taken (see **Appendix 18.2**).

Particle size analysis (PSA) was carried out on all the samples and of these, fourteen samples (including all vibrocores) were analysed for sediment chemistry and a range of determinands in accordance with Marine Scotland guidance (**Ref 17-12**) the results of which can be found in **Appendix 18.2,**

The sediments comprised a varied mix of sands and gravels. The grab samples had very low silt content (less than 4 %). The vibrocores had a higher silt content, ranging from 5 % to 50 % in the sands and only 5 % in the sandy gravel. The average silt content was 18 % from all the vibrocores and sands are considered the dominant particle size. A number of the samples contained pebbles and/or cobbles. The results of the particle size analysis were used to inform the sediment plume and transport modelling (see **Chapter 18**).

There are no statutory Environmental Quality Standards (EQSs) for marine and estuarine sediments in the UK. Therefore, in accordance with Marine Scotland guidance (**Ref 17-12**), the results of the sediment chemistry analyses were directly compared against the Revised Action Levels (RALs). These are derived from a combination of chemical and eco-toxicological data sets, and are used to assess the chemical quality of dredged material.

Two tiers of action levels are provided within the Marine Scotland guidance; Revised Action Level 1 (RAL1) and Revised Action Level 2 (RAL2). RAL1 has been set as a criterion below which the material is unlikely to pose a significant chemical risk to the marine environment and, as such, disposal at sea would be considered acceptable. If contaminant levels are above RAL1 but below RAL2, then further consideration would be required to determine whether disposal at sea is appropriate before approval can be given. Where contaminant concentrations exceed RAL2 there is the potential for harmful levels of contamination to be present and alternative disposal methods should be considered.

RAL2 are not set for Polycyclic Aromatic Hydrocarbons (PAHs) compounds, therefore the current recommended approach is to use the Canadian Council of Ministers of the Environment (CCME) Sediment Quality Guidelines for the Protection of Aquatic Life (**Ref 17-13**).

CCME Standards have two guideline values, the Interim Sediment Quality Guidelines (ISQG) and Probable Effect Level (PEL). The ISQGs are typically more conservative than the PEL, with the PEL representing "the lower limit of the range of chemical concentrations that are usually or always associated with adverse biological effects" (**Ref 17-13**). An interpretation of the guideline values of the potential biological effect of the sediment on receiving flora and fauna is as follows:

- Sediment concentrations < ISQG = Rare biological effect
- Sediment concentrations > ISQG < PEL = Occasional biological effect
- Sediment concentrations > PEL = Frequent biological effect

Typically ISQG is the lowest of these standards, followed by RAL1 then PEL/RAL2. Where it has been derived, for metals, RAL2 is significantly higher than PEL.

The ISQG and RAL1 criteria are effectively those used to categorically discount any likely effect to receptors. Similarly, the PEL and RAL2 can be used to demonstrate that an effect is likely to occur. Between these two criteria, sound technical judgement must be applied to determine the likelihood of an effect occurring. In the absence of RAL2 for the PAHs, CCME PELs were selected as the criteria above which placement of the sediments in retention sites would be restricted. It is considered that exceedances of the RAL1/ISQG may be acceptable providing concentrations do not reach or exceed the PEL, particularly if these are close to existing background levels.

The sediment chemistry data collected was screened against the guidance standards (**Ref 17-12**) and reported in the Geotechnical Report by ALHS (**Appendix 18.2**). A summary of the report findings are given below.

No PAHs exceeded the RAL1 and of the metal determinands, only chromium, copper and nickel exceeded the RAL1. In all cases the exceedance was less than twice the RAL1 and none of these exceeded the PEL or RAL2 (**Table 17.6**). Chromium exceeded the RAL1 at eight stations, while copper and nickel exceeded RAL1 at three and five stations respectively. Where the RAL1 was exceeded the value was also compared against the ISQG; however, in several cases the chromium concentrations did not exceed the ISQG (see **Table 17.6**).

Table 17.6 : Marine sediment samples collected at Kyleakin in June 2016. Determinand concentrations that exceeded the RAL1 are listed and highlighted red. In several instances these values also exceeded ISQG. A number of the samples did not record any concentrations in exceedance of guideline values, and no samples exceeded RAL2 or PEL.

Sample	Analytes exceeded	Concentration (mg/kg)	RAL1	ISQG	RAL2	PEL
VC 1-2-1	Chromium	57.3	50	52.3	370	160
VC 1-2-2	None	n/a	n/a	n/a	n/a	n/a
VC 2-2-1	Chromium	50.7	50	52.3	370	160
VC 2-2-2	None	n/a	n/a	n/a	n/a	n/a
VC 3-2-1	None	n/a	n/a	n/a	n/a	n/a
VC 3-2-2	None	n/a	n/a	n/a	n/a	n/a
GRVC 4	None	n/a	n/a	n/a	n/a	n/a
VC 5-2-1	None	n/a	n/a	n/a	n/a	n/a

Sample	Analytes exceeded	Concentration (mg/kg)	RAL1	ISQG	RAL2	PEL
VC 5-2-2	None	n/a	n/a	n/a	n/a	n/a
VC 6-2-1	Chromium	85.2	50	52.3	370	160
	Copper	49.3	30	18.7	300	108
	Nickel	35.3	30	NP	150	NP
VC 6-2-2	Chromium	65.2	50	52.3	370	160
	Copper	35.1	30	18.7	300	108
	Nickel	33.1	30	NP	150	NP
VC 6-2-3	Chromium	74.2	50	52.3	370	160
	Copper	44	30	18.7	300	108
	Nickel	33.6	30	NP	150	NP
VC 7-1-1	Chromium	58.5	50	52.3	370	160
GRVC 8	Chromium	51.9	50	52.3	370	160
	Nickel	34.2	30	NP	150	NP
VC 9-1-1	None	n/a	n/a	n/a	n/a	n/a
GRVC 10	Chromium	67.4	50	52.3	370	160
	Nickel	30.3	30	NP	150	NP
VC 11-1	None	n/a	n/a	n/a	n/a	n/a
G4	None	n/a	n/a	n/a	n/a	n/a

Sample	Analytes exceeded	Concentration (mg/kg)	RAL1	ISQG	RAL2	PEL
G7	Chromium	56	50	52.3	370	160
G11	Chromium	68.2	50	52.3	370	160

The highest recorded value of chromium was 85.2 mg/kg at sampling station VC6. This station also recorded the highest concentrations of nickel and copper. This station is inshore and adjacent to the eastern side of the pier. As previously mentioned, all concentrations were well below RAL2 and PEL (if listed). These particular determinands are possibly indicative of marine anti-fouling paints used by vessels; however, metals also occur naturally in the environment. Binding of the metals will occur more readily to the finer sediments and it is acknowledged that station VC6 had a greater proportion of fine sediments than the other sampling stations.

17.4.2 Water Quality Sensitivity

The waterbodies of the Inner Sound and Loch Alsh are an important water resource and support a number of European and nationally designated conservation areas such as SACs, SPAs and SSSIs. The proposed SAC for harbour porpoise encompasses the Inner Sound waterbody. As previously stated, the waterbodies surrounding the development and adjacent to it, have an overall status of 'Good' and form part of the migratory corridor for diadromous fish species including Atlantic salmon, sea trout and European eel (see **Chapter 19**).

Consideration is given to this large body of receiving water adjacent to the development and also the large tidal excursion. The very strong flows, particularly on the peak-ebb tide (see **Chapter 18**) in the area, provides a rapid mixing and diluting mechanism, especially when considered in the context of the large body of water.

Acknowledging just the physical characteristics of the receiving water, it is considered that it would have a low sensitivity to changes in suspended solid loads and/or the effects from chemical input. However, based on the supporting role of the receiving water for a number of conservation features, a medium sensitivity is assigned to the potential changes identified (changes in suspended solid loads and changes in chemical input).

17.5 Modelling

To inform the assessment made against the potential effects of operational discharge on the receiving water a study of the initial dilution rates was carried out. The details of this study are provided in **Appendix 17.1.**

The purpose of this study was to provide predictions of available initial dilution to inform the design of the proposed wastewater treatment process and the selection of the optimum marine outfall length. Two options were considered, one extending to the 4m Below Chart Datum (BCD) contour at a length of approximately 145m, the other extending to the 8m BCD contour at a length of approximately 300m.

However, following the results of the study it was found that dilutions at the 8m BCD contour were significantly greater than at the 4m BCD contour, and it is the former that has been taken forward and considered for the assessment (see **Chapter 2**).

17.5.1 Initial dilution modelling

The extent to which initial dilution takes places is a function of several physical characteristics of the effluent, including density, velocity and temperature. These together with the ambient conditions of the receiving water body, such as current speed and direction, govern the extent and rate of initial dilution.

At the discharge port, the initial plume tends to behave as a coherent jet and its behaviour and dispersion is dominated by momentum and buoyancy. As the plume interacts with the receiving water body, these forces no longer dominate and the plume becomes a diffuse mass carried by the ambient current. Mixing initially occurs by turbulent flows at the boundaries of the plume, and later primarily by pure diffusion processes.

These processes have been numerically resolved using the Cornell Mixing Zone Expert System (CORMIX). The CORMIX package is recognised by numerous regulatory authorities including the Scottish Environment Protection Agency (SEPA) for the assessment of initial dilution and environmental impact of marine discharges.

Further details on ambient conditions and discharge parameters used for the CORMIX modelling are given in **Appendix 17.1** with reference to **Appendix 18.1** also suggested.

17.5.2 Modelling results

Following fifty CORMIX simulations to quantify and assess the potential initial dilution it was found that in all instances the effluent reached the surface of the receiving water body within 100m of the point of discharge.

Statistical analyses of all simulations runs were undertaken at downstream distances of 40m and 100m. These distances correspond to the closest proximity to the flame shell bed from the discharge point and the extent of the 100m maximum mixing zone limit allowed by SEPA.

The maximum initial dilution achieved at the 40m and 100m marks were found to be 810:1 and 1235:1 respectively. The corresponding mean dilutions for each mark were found to be 497:1 (S.D=160, n=50) and 729:1 (S.D=328, n=50) respectively (see **Table 17.7**).

Table 17.7 : Summary of all dilutions (n=50) for an outfall at the -8m contour.

	Dilution			
Downstream distance	**Min**	**Max**	**Mean**	**95th Percentile**
40m (flame shell bed)	63.76	810.51	497.88	212.16
100 m (mixing zone limit)	63.76	1235.76	729.71	212.16

The modelling also showed that the discharge is positively buoyant and quickly rises to the surface of the water column. As virtually all of the discharge is confined within the surface layer of the water column during the initial mixing process, it is acknowledged that the concentration of the discharge at the seabed will be significantly lower than that at the surface layer.

17.6 Predicted Impacts

This section describes the potential impacts on water quality that could arise in the absence of mitigation, during both the construction and operational phases of the development. Consequently, this section presents a worst-case scenario of the potential impacts and it should be noted that the mitigation measures proposed in **Section 17.7** would help reduce or avoid the potential impacts. Any design mitigation is described in **Chapter 2**; however, particular reference should be made to the process discharge and the adoption of both primary treatment and secondary treatment to ensure that reduction of ammoniacal nitrogen will be achieved to 10mg/l, and thus meet the marine EQS within 40 m of the discharge (**Section 2.10.2.2**).

Unless stated, all significant impacts identified should be considered adverse. Measures to prevent or reduce the potential impacts are provided in **Section 17.7**, and the significance of any impacts following mitigation is then given in **Section 17.8**.

Consideration is given to sources of impacts that could affect the marine water environment, including sources that despite being generated on land, have a readily available pathway into the marine water environment. For example, land runoff, spills and leaks are highlighted as they are seen as one of a number of key sources that could lead to potential significant impacts on the water quality receptor, either independently or as a part of a cumulative effect.

Throughout this section acknowledgement has been given to the outputs of the coastal processes studies, specifically the understanding of tidal flow rates and sediment transport mechanisms in the area (**Chapter 18**).

17.6.1 Construction Phase Impacts

The key marine construction activities of the development can be separated into the following:

- Construction and removal of temporary jetty.
- Piling (includes piling of quayside and slipway).
- Capital dredging.
- Pier extension (includes construction of the foundation bund and completion of the caisson walls).
- Rock armouring and shore reclamation.
- Long sea outfall (placement of pipe and concrete anchoring on intertidal and subtidal habitats).

As part of these activities will be the requirement for vessel movements to facilitate the work. Consideration is also given to the movements of marine vessels during the construction phase.

The activities outlined above could potentially lead to impacts on water quality from:

- Increased suspended solid loads as a result of the works (primarily dredging operations, including dewatering of relocated dredged material and consequent water discharge).
- Resuspension of contaminated sediments (primarily dredging operations).
- Discharge of concrete, cement and admixtures.
- Pollution risks from spillages, runoff, leaks of fuels and chemicals.
- Foul water discharge (sewage).

Please refer to **Table 17.8** for a summary of the potential construction phase impacts and their impact significance.

17.6.1.1 Increased Sediment Load

During the construction works there could be a potential, albeit temporary, increase in suspended solids as a result of surface water runoff, marine construction activities (e.g. piling and drilling) and capital dredging activity. There is no intention to dispose of excavated material at sea; instead material will be removed by backhoe dredger, taken to a temporary jetty and then stockpiled in the quarry for reuse. Loss of material from the backhoe activity will primarily occur at the seabed during the excavation and from the bucket as it breaks the surface. During the relocation of the dredged material it will initially be placed in a settlement pond for dewatering and 'cleaning' before finally being placed in the quarry.

Due to the high dilution and dispersal capacity of the receiving waters, any increases in suspended solids from runoff are likely to be highly localised and temporary in nature. Similarly, piling and drilling activities would not result in more than a highly localised, temporary and minimal increase in suspended solids. The final assessment considers the cumulative impact of capital dredging during excavation and also the dewatering of dredged material, combined with all other potential sources of increased sediment load e.g. from piling, drilling etc..

During dredging, there is also potential for the release of sediment-bound contaminants (see **17.6.1.2**). Other potential impacts arising from capital dredging activity, such as deposition of suspended sediments, direct habitat loss and the potential to affect navigation, are covered elsewhere within the ES (see **Chapter 16: Navigation, Chapter 18** and **Chapter 19**).

Sediment plume modelling specific to the location, dredging methodology and sediment type was carried out to understand the likely residence time of the excavation plume and its extent based on the initial dredging scenarios (**Appendix 18.1**); however, following detailed discussions with experienced dredging contractors it was confirmed that the use of backhoe dredging would be most suitable for the capital dredging activity.

Consequently, further sediment plume modelling specific to the use of a backhoe dredger was carried out (**Appendix 18.3**) and should be referred to for detail on the modelling.

The summary conclusions of the sediment plume modelling are presented in **Chapter 18.** It was found that the typical total increase in suspended sediment concentrations (SSCs) from the backhoe dredging do not generally exceed 30mg/l and where they do, increases are highly localised (<200m^2) and very short in duration. Under normal tidal conditions there were no increases in SSCs greater or equal to 10mg/l beyond either the overall dredge extent or, to the north, the -9.5m CD contour.

Furthermore, the average increase in SSCs over the entire dredging campaign (84 days) indicated that there would be no changes in SSCs >10mg/l either within or beyond the overall dredge extent.

Although detectable changes in SSCs would occur, these would be highly transient in nature, restricted to the period of the capital dredge and tidal conditions, and highly localised being generally confined to the immediate proximity of the dredged area. The strength of flows and large volume of water passing through the region will greatly assist dispersal and dilution of re-suspended material.

The dredged material will be dewatered and ‘cleaned’ once placed in the settlement pond. The material removed during this process (organic and inorganic) has the potential to affect the receiving water quality. Organic material could cause localised increases in nitrogen and increase the biochemical oxygen demand (BOD). However, the strong dilution and dispersal capacity of the receiving water would mean that any increases would be highly temporary.

The use of backhoe dredger will mean that the requirement for dewatering of dredged material will be minimal, and thus dispersal of fines back into the marine environment, will likewise be minimal.

Consideration is given to the very small and localised increases in SSCs during the dredging process. Beyond this period (up to 14 weeks) marine activities would not lead to any readily detectable increases in sediment load to the receiving waters. Given the above conclusions the magnitude of change against increases in sediment load on water quality is **small.** Following from this, and considering the sensitivity of the receiving water against changes sediment load, the impact significance is assessed as **minor adverse.**

17.6.1.2 Resuspension of Contaminated Sediments

Subject to the presence of elevated levels of contamination, the process of resuspension and redistribution of sediments during dredging, could result in the re-distribution of contaminants of concern with consequential effects on water quality and potentially the benthic environment. During any disturbance of sediment and re-suspension in the water column, there would be a risk of pollutants dissolving in the water. However, this is unlikely as, for example, metals and hydrocarbons are likely to remain preferentially bonded to the fine sediment with fines likely to rapidly disperse in plumes as they pass through the water column, especially where there are strong currents.

A number of construction activities have the potential to cause resuspension of sediment bound contaminants within the water column (i.e. piling, drilling and vessel movements). However capital dredging activity (excavation) would be the predominant source.

Following recent sediment chemistry analysis carried out by ALHS several determinands were found to exceed the RAL1 guidance concentrations; chromium, copper and nickel. However, the concentrations generally only just exceeded RAL1 and no determinands were found to exceed either the PEL or RAL2.

Further consideration of the concentrations for each of these metals (chromium, copper and nickel) was given by calculating the arithmetic mean for all samples collected (where multiple samples were analysed at a single sampling station the average of these values was taken). For chromium this gave a value of 50.9 mg/kg which is slightly above the RAL1 (50 mg/kg) but below the ISQG (52.3 mg/kg). The arithmetic means for copper and nickel were well below the RAL1.

It is also noted that the concentrations of determinands derived from the analyses of the coarse substrata presents a bias towards the near surface results and does not account for the full volume being dredged. Given this, it is considered that the representative concentrations of the determinands in relation to the whole dredging volume would be even lower than the calculated means.

The large volume of receiving water would substantially dilute any contaminants released by the dredging activity, with tidal movements and strong currents aiding dispersal. Bearing in mind the very low concentrations of pollutants picked up by sediment analysis and their proclivity for binding to sediments, it is considered that any increases in dissolved pollutants above background levels would be highly localised. They are unlikely to be detectable on the scale of the receiving waters and would not affect the integrity of the waterbody.

Given the above conclusions it is considered that the magnitude of change on the receiving water from the potential resuspension of contaminated sediments, predominantly the capital dredging excavation and, to a much lesser extent dewatering of relocated material, is **negligible**. Following this, and considering the medium sensitivity of the receiving water against changes in chemical status, the impact significance is assessed as **negligible**.

Furthermore, from the results of the analyses, it is recognised that the observed contamination concentrations would be highly unlikely to result in the realisation of a probable effect on aquatic life from the chemical quality of dredged sediments.

17.6.1.3 Concrete, Cement and Admixtures

During construction works, there would be potential for accidental spillage of concrete and admixtures into the water. Uncured concrete and cement are highly alkaline and therefore their release has the potential to cause elevations in the pH of the receiving water.

However, any discharge of this material into the environment would be highly localised. Further to this, the high dilution and dispersal capacity of the receiving water would mean that any accidental releases of concrete, cement and admixtures would not be expected to have any detectable effect on the overall chemistry of the receiving waters.

Following the above considerations, the potential impact significance of accidental concrete, cement and admixture spillages on the receiving water is assessed as **negligible** and of **negligible** magnitude.

17.6.1.4 Oils, fuels and chemicals (accidental spillage)

Accidental spillage and/or leakage from mobile or stationary plants and vessels could result in the release of oils, fuels or chemicals into the water. Many mineral oils and other hydrocarbons are toxic, persistent and bio-accumulate in the environment. Additionally, biodegradation of oils in aquatic systems can lead to oxygen depletion.

Consideration is given to the total duration of the works (approximately 17 months) and the nature of the activities proposed. Acknowledging the high dilution and dispersal capacity of the receiving water, the impact significance of accidental oil, fuel and chemical spillages on marine water quality is assessed as **minor adverse,** due to a **small** magnitude of change.

17.6.1.5 Sewage

Accidental release of sewage effluent from temporary facilities on site or through damage to pipelines during construction may pose a hazard to the microbiological quality of the receiving water. There would also be potential for a localised increase in BOD.

Due to the relatively small scale and duration of the works (approximately 17 months), and the high dilution and dispersal capacity of the receiving water, any increases in pollutants in the water column are likely to be highly localised and temporary.

Acknowledgment is given to SEPA's opinion with regard to sewage discharges and, consequently, discharges from temporary welfare facilities during construction will be to sealed units and removed off site via licensed carriers.

In the context of the wider marine water environment, it is considered that any changes to water quality would have no detectable effect upon the receiving waters. Consequently, the impact significance of accidental release of sewage effluent on marine water quality is assessed as **negligible** due to a **negligible** magnitude of change.

17.6.2 Operation Phase Impacts

The key operational elements can be separated in to the following:

- General facility related activities e.g. loading/unloading of vessels; processing of fish feed.
- Vessel movements – cargo ships transiting to and from the facility.
- Presence of dredged area and extension to the pier.
- Maintenance dredging.

The operation activities outlined could potentially impact water quality from:

- Increased suspended sediment concentrations (from discharge and, to a lesser extent, the infrequent maintenance dredging);
- Changes to water chemistry (from discharge).
- Release of sediment-bound contaminants (during maintenance dredging activities).
- Pollution risks from spillages, runoff, leaks of fuels and chemicals etc.
- Changes to coastal processes potentially resulting in changes to water quality (from localised changes to seabed topography).

Please refer to **Table 17.8** for a summary of the potential operation phase impacts of the development.

17.6.2.1 Increased Sediment Load

During operational activities there would be a potential increase in suspended solid concentrations. The principal sources during operation would be the discharge and, to a lesser extent, the infrequent maintenance dredging.

As part of development operations process discharge will be ongoing, though at varying flows and volumes (see **Chapter 2**). Following primary treatment (as detailed in section 2.10.2.2) the range of suspended solids is anticipated to be from 50 to 300 mg/l, with an average flow rate of 5.6l/s.

However, the requirement for secondary treatment, specifically for the reduction of ammoniacal nitrogen, will further reduce the suspended solids being discharged.

At the request of SEPA (see section 17.1.1) the process water will be discharged directly into the marine environment. Initial dilution modelling has shown that within 40m and 100m of the discharge point the mean dilution would be 497:1 and 729:1 respectively. Consequently the increase in suspended solids from this source would be minimal and not readily detectable in the context of the receiving water body.

The requirement for maintenance dredging would be low as natural depositions of material in this area are slow due to the strong flows. Periods of maintenance dredging work would be very short in duration, lasting approximately one to two weeks, as compared to the capital dredging activity.

Given the coarse nature of the sediments and the much shorter duration of maintenance dredging works, it is considered that any effect on water quality from increases in the suspended sediment concentrations caused by maintenance dredging would be notably less than that resulting from the capital dredging activities.

Acknowledging the above considerations and given the high dilution and dispersal capacity of the receiving waters, any increases in suspended solids would be extremely localised and highly temporary in nature. Consequently, increases in suspended solids are unlikely to be detectable on the scale of the receiving waters and would not affect the integrity of the waterbody. Given this the magnitude of change on the receiving waters during operation is **negligible**, leading to an impact significance of **negligible**.

17.6.2.2 Changes to Water Chemistry (from discharge)

Operation of the discharge will result in highly localised changes in water chemistry at the point of discharge and within a 40m mixing zone around the discharge. Initial dilution modelling has shown that within 40m and 100m of the discharge point the mean dilution would be 497:1 and 729:1 respectively.

As the discharge location is just over 40m from the edge of a flame shell bed a conservative buffer has been used that essentially reduces the maximum mixing zone as stated by SEPA (100m) to a 40m mixing zone. The potential effect on the flame shell bed from the discharge is covered in detail in **Chapter 19**; however, the adoption of the 40m buffer is also relevant for consideration within this chapter.

In terms of the effects on water chemistry from the discharge it is acknowledged that meeting the ammonia EQS is the limiting factor. The marine EQS for ammonia is an annual mean concentration of 21µg/l.

Although it is not known what the likely concentrations of ammonia would be at the point of discharge (after primary treatment) the ‘Total Nitrogen’ discharged ranges from 50 to 150 mg/l (see **Table 2.4**, **Chapter 2**). Thus a conservative and worst case scenario would be to assume that the maximum concentration of the ‘Total Nitrogen’ (150 mg/l) is all in the form of ammonia.

Hence, application of the dilution ratio within the 40m buffer (497:1) means that at the point of discharge the concentration of ammonia would need to be an average of 10.5mg/l with a maximum of 17mg/l to comply with the ammonia EQS (21µg/l). By comparison, if the 100m mixing zone was adopted then these values would increase to 15.3mg/l and 26mg/l respectively.

As detailed in Chapter 2, secondary treatment will be applied to the discharge for nutrient removal, reducing ammonia to the required level (i.e. an average of 10.5mg/l) before it is discharged into the marine environment. The exact method of treatment would not be confirmed until a contractor is appointed and it is envisaged that after appointment of the contractor further consultation with SEPA will be carried out to assure that the process will provide compliance with the marine EQSs. However, acknowledging that compliance with the marine EQS for ammonia would be achieved within the reduced mixing zone (100m to 40m), it is clear that there would be no exceedance of the marine EQS for ammonia or other standards (**Ref 17-22**).

Given the above leads to the conclusion that any changes in water chemistry would be highly localised and transitory, and therefore not readily detectable on the scale of the receiving water body. Consequently, there would be no effect on the integrity of the water body. Therefore a **negligible** magnitude of change leading to an impact significance of **negligible** is given for the potential impacts on water chemistry from the process discharge.

17.6.2.3 Resuspension of Contaminated Sediments

Chemical analyses of the sediments under the footprint of the proposed dredging extent and adjacent areas found very few exceedances of RAL1 for the determinands (see **17.4.1**). Where there were exceedances, these concentrations never exceeded RAL2 or PEL thresholds.

Acknowledging that a maintenance dredging event will be infrequent, localised and short in duration it is not considered that there is a potential source for contaminant uptake by sediments within this timescale. It is also acknowledge that the intention would be to reuse any maintenance dredged material and therefore it is assumed that there would be no disposal. Bearing in mind the already low levels of contaminants recorded in an area that has not been dredged before (see **17.4.1**), the very low levels of industry and therefore industrial discharges in the region, the proposed operational activities and the naturally strong tidal movements experienced in this area, leads to an assessment of **negligible** for the magnitude of change of contaminated sediments on the receiving water. Following from this, the impact significance is assessed as **negligible.**

17.6.2.4 Oils, fuels and chemicals (accidental spillage)

There would be a small but detectable, increase in road and sea traffic around the development area which could impact marine water quality. Road runoff from tyre rubber, brake and clutch linings, fuel, de-icing agents, oil and coolant, etc. could introduce pollutants including suspended solids, volatile organic compounds, hydrocarbons, copper, zinc and lead into the water.

Stationary and mobile plant use would pose a risk of oil or fuel spillage, which could have an impact on water quality through run-off entering the receiving waters. Similarly, accidental spillage and/or leakage from transiting vessels could result in the release of oils, fuels or chemicals into the water. Many mineral oils and other hydrocarbons are toxic, persistent and bio-accumulate in the environment. Additionally, biodegradation of oils in aquatic systems can lead to oxygen depletion.

Due to the dilution and very high dispersal capacity of the receiving water, it is considered that the effect of accidental releases and/or spillages on the receiving waters would be minimal but potentially detectable. Consequently, an impact significance of **minor adverse** is assessed for the potential effect of oil, fuel and chemical spillages on marine water quality, based on a **small** magnitude of change.

17.6.2.5 Changes to coastal processes

It is recognised that changing the topography of the seabed over the area dredged and constructing the pier extension have the potential to alter the local hydrodynamics. This could potentially affect suspended solid loads and therefore water quality. However, modelling carried out by RPS has predicted minimal changes to both the wave climate and tidal flows. **(**see **Chapter 18** and **Appendix 18.1).**

Considering the conclusions of the wave and tidal flow modelling, in the context of the wider water environment, the impact significance from changes to estuarine processes on water quality is assessed as **negligible**, based on a **negligible** magnitude of change.

Table 17.8 : Summary of potential impacts on water quality (unmitigated).

Phase	Source of Impact	Impact Description Summary	Potential Impact	
			Magnitude of change	**Significance**
Construction	Increased suspended sediment load	Potential changes to suspended solids arising from sediment mobilisation – principally through capital dredging works	Small	Minor adverse
	Resuspension of sediment bound contaminants	Potential change to water chemistry arising from sediment mobilisation – principally through capital dredging works	Negligible	Negligible
	Concrete, cement, admixtures – accidental spillages	Potential change to water chemistry arising from concrete release into water column – general construction activities	Negligible	Negligible
	Oils, fuels and chemicals – accidental spillages	Potential change to water quality arising from accidental spills and leakages of oil, fuels and chemicals – general construction activities	Small	Minor adverse
	Sewage – foul water discharge	Potential change to microbiological quality from release of sewage effluent - general construction activities	Negligible	Negligible
Operation	Increased suspended sediment load	Potential changes to suspended solids arising from sediment mobilisation – principally through maintenance dredging works	Negligible	Negligible
	Changes to water chemistry – operational discharge	Potential change to localised water chemistry following discharge of water with different chemical properties from receiving water	Negligible	Negligible
	Resuspension of sediment bound contaminants	Potential change to water chemistry arising from sediment mobilisation – principally through maintenance dredging works	Negligible	Negligible

Phase	Source of Impact	Impact Description Summary	Potential Impact	
			Magnitude of change	Significance
	Oils, fuels and chemicals – accidental spillages	Potential change to water quality arising from accidental spills and leakages of oil, fuels and chemicals – general construction activities	Small	Minor adverse
	Changes to estuarine processes from presence of approach channel	Potential change to water quality arising from changes in hydrodynamics	Negligible	Negligible

17.7 Mitigation Measures

Two minor adverse impacts were assessed in the construction phase (increased sediment load and accidental oil, fuel and chemical spillages) and one during the operation phase of the works (accidental oil, fuel and chemical spillages). All other potential impacts to water quality from the construction and operation of the development were assessed to have **negligible** impact significance.

Several mitigation measures are proposed on the basis of a good practice approach to minimise effects on the receiving waters. Many of these are generic measures which would reduce the likelihood of occurrence and/or magnitude of a potentially adverse impact to the marine water environment.

The application of these measures would reduce the overall cumulative effects from the impacts identified on marine water quality. The provision of the mitigation measures presented is not only considered in terms of water quality but also as mitigation for potential impacts on other environmental receptors e.g. oil spills on fish species (i.e. marine ecology). Hence a number of the measures provided in this chapter are repeated in the following chapter (**Chapter 19**).

It should be acknowledged that following approval of the marine licence application a Construction and Environmental Management Plan (CEMP) will be drafted that is cognisant of mitigation measures presented in this ES. The CEMP will be adhered to by the successful contractor(s), within which will be a section specific to the water environment detailing such things as pollution prevention measures. As part of the CEMP, a Pollution Emergency Response Plan will be appended. The Pollution Emergency Response Plan will have been submitted to the Highland Council and SEPA before being appended to the CEMP, prior to construction.

The CEMP will acknowledge the content of the Code of Construction Practice (CoCP) but will be specific to the commitments of the successful contractor(s).

17.7.1 Construction Phase

As part of the mitigation measures in the construction phase a number of Pollution Prevention Guidelines (PPGs) (**Ref 17-14**) will be adhered to by the successful contractor including:

- PPG1: Understanding your environmental responsibilities – good environmental practices;
- PPG2: Above ground oil storage tanks;
- PPG3: Use and design of oil separators in surface water drainage systems;
- PPG4: Treatment and disposal of sewage where no foul sewer is available;
- PPG5: Works and maintenance in or near water;
- PPG6: Working at construction and demolition sites;
- PPG7: Safe Storage – the safe operation of refuelling facilities (see also SEPA: Underground storage tanks for liquid hydrocarbons: code of practice for the owners and operators of underground storage tanks (and pipelines));
- PPG8: Safe storage and disposal of used oils;
- PPG13: Vehicle washing and cleaning;
- PPG18: Managing fire water and major spillages;
- PPG21: Pollution incident response planning;
- PPG22: Incident Response – dealing with spills; and
- PPG26: Safe Storage - drums and intermediate bulk containers.

A number of these PPGs are also relevant to the operation phase and are consequently referred to in the operation phase section below.

Cognisance will also be given to the following guidance:

- Defra (2006).Code of Practice for using plant protection products (**17-15**);
- CIRIA (2003). C584 Coastal and marine environmental site guide (**17-16**);
- National SUDS Working Group (2004). C609 Sustainable drainage systems (**17-17**); and
- CIRIA (2007). C697 The Sustainable Urban Drainage Systems (SUDS) manual (**17-18**).

An Ecological Clerk of Works (ECoW) will be present on site during the construction phase, to supervise the implementation of the appropriate environmental safeguards.

It should also be noted that as part of the scoping opinion received by SEPA it was requested that any discharges from temporary welfare facilities during construction should be to sealed units and removed off site via licensed carriers. This measure will be adopted by the successful contractor.

17.7.1.1 Oils, fuels and chemicals (accidental spillage)

The contractor will be required to implement best practice measures associated with storage of oils and fuel and to provide effective mitigation for potential impacts associated with storage of oil and fuels as follows:

- Above ground fuel and oil storage tanks will be required to comply with the Water Environment (Oil Storage) (Scotland) Regulations 2006 (**17-19**) and PPG2 (**17-20**): ‘Above ground oil storage tanks’. Accordingly, there will be an impermeable floor under any oil storage tanks and impermeable bund around the tank. The secondary containment system will provide storage of at least 110 % of the tank’s maximum capacity. If more than one tank is present, the bunded area will be sufficient to store 110 % of the biggest tank capacity or 25 % of the capacity of all the tanks, whichever is greater.
- The stationary plant will be fitted with drip trays to retain any leakage of oil or fuel. The trays will be emptied at appropriate intervals to prevent overflow.
- Construction plant and vehicles will be properly maintained. Any maintenance to construction plant carried out on site will be carried out in designated areas on an impermeable surface well away from any waterbody or drainage system, unless vehicles have broken down necessitating maintenance at the point of breakdown.
- Stationary oil storage tanks will be located above the 0.5 % AEP (one in 200 year return period) flood level or appropriately protected from such an event.
- Fuel or oil tanks will not be located and refuelling will not be undertaken within 10 m of a waterbody or 50 m of a spring, well or borehole.
- Lighting, alarm and/or CCTV systems should be considered to reduce the likelihood of accidental spillages due to vandalism.
- An oil interceptor with appropriate spillage containment capacity to SEPA requirements will be provided for drainage from the refuelling area and would comply with PPG3. It will be fitted with a shut-off valve to allow containment of spillage.
- Spillage kits will be stored at key locations on site (refer to the Pollution Emergency Response Plan) and in particular at refuelling areas. If feasible, spillage kits will also be kept with mobile bowsers. Alternatively, spillage kits will be kept near where mobile bowsers are used.
- If underground oil storage tanks are considered necessary the siting of these will be in compliance with SEPA’s code of practice (CoP) for the owners and operators of underground storage tanks.
- Enclosed spraying will be practiced when waterproofing or using other sprayed chemicals, preventing chemicals from entering the aquatic environment.

In relation to the vessels associated with the construction phase the following will apply:

- Vessels associated with the development will comply with International Maritime Organisation (IMO)/Maritime Coastguard Agency (MCA) codes for prevention of oil pollution.
- Vessels, where appropriate (i.e. vessels over 400 gross tonnes), will have onboard Ship Oil Pollution Emergency Plans (SOPEPs).

- All contracted vessels will carry oil and chemical spill mop up kits.

17.7.2 Operation Phase

As detailed in **Section 17.7.1**, adherence will be given to the relevant PPGs.

17.7.2.1 Oils, fuels and chemicals (accidental spillage)

Appropriate spillage control kits shall be kept on site, including floating booms. Staff will be trained in the use of spillage control kits, floating booms and the operation of the Pollution Emergency Response Plan.

SEPA pollution prevention guidelines PPG1, PPG2, PPG5, PPG7, PPG8, PPG13, PPG18, PPG21, PPG22 and PPG26 shall be adhered to in so far as applicable.

Oil interceptors will be incorporated into the surface water drainage system of the site. These will be designed in accordance with PPG3: use and design of oil separators in surface water drainage systems. In addition, SUDS will be incorporated into the drainage system as far as practicable.

The drainage system will be designed in accordance with the following guidance:

- Sustainable Drainage Systems, CIRIA (CIRIA, 2004); and
- The SUDS Manual, CIRIA C697 (CIRIA, 2007).

Where liquids including oils are to be handled, appropriate spillage containment will be provided. A full retention oil interceptor will be installed for the refuelling area.

Where required, authorisation for the surface water drainage discharge under the Water Environment (Controlled Activities) (Scotland) Regulations 2011 (**Ref 17-21**) shall be obtained from SEPA.

In relation to the vessels associated with the operation phase the following will apply:

- Vessels associated with the development will comply with International Maritime Organisation (IMO)/Maritime Coastguard Agency (MCA) codes for prevention of oil pollution.
- Vessels, where appropriate (i.e. vessels over 400 gross tonnes), will have onboard Ship Oil Pollution Emergency Plans (SOPEPs).
- All vessels will carry oil and chemical spill mop up kits.

17.8 Residual Impacts

Following implementation of the mitigation measures outlined above (**Section 17.7**), the potential for significant adverse impacts from leaks and spillages i.e. from oil, fuels and chemicals, would be avoided. Subsequently, the assessment for impact significance from accidental oil, fuel and chemical spillages on water quality is **negligible.**

No specific mitigation measures were suggested to reduce the effect of increased sediment load during the construction phase. However, the strong dilution and dispersion capacity of the water body combined with the highly temporary (short term) nature of the increase is acknowledged.

17.8.1 Monitoring

Pre-construction monitoring will be done in line with that agreed with regulators; however, it is likely that this will incorporate monitoring of turbidity, DO and suspended solid concentrations.

During the construction phase of works it is suggested that monitoring will be carried out as follows:

The successful contractor will likely be required to monitor water quality during construction by assessing chemical parameters, as required by SEPA. Parameters, frequency of sampling and limits will be agreed with SEPA in advance of construction.

Regular inspections will be carried out by an ECoW to identify:

- spillages and leakages;
- non-compliance with the CoCP; and
- any suspected incidences of pollution.

An ECoW will be appointed to monitor construction activities and ensure that compliance occurs with all relevant environmental legislation. It will be the responsibility of the main contractor to appoint an ECoW. The ECoW shall visit the development at suitable intervals to monitor and advise on implementation of mitigation and ensure that adverse ecological impacts are minimised and environmental commitments are met.

As part of the environmental mitigation strategy a defined reporting structure, with clearly identified personnel with responsibility for implementing an ecological incident response action plan, shall be maintained. The ECoW will have the authority to initiate the ecological incident response action plan.

17.9 Difficulties Encountered in Compiling Information

As described above, this study was carried out through a desk-based assessment and the magnitude and significance of impacts, as well as the resulting mitigation recommendations are therefore predominantly based on qualitative assessments. However, the assessments are supported by the outputs and conclusions of the initial dilution modelling (**Appendix 17.1**), hydrodynamic and sediment plume modelling (see **Chapter 18**, **Appendix 18.1** and **18.3)** and the results of the geotechnical investigative survey (**Appendix 18.2**).

After discussion with SEPA and MSS (through Marine Scotland Licencing Operations Team (MS-LOT)), it was found that very limited water quality sampling has been carried out in this area of the North Highlands. To date, there is no baseline water quality sampling data relevant to the development area. However based on the SEPA classifications assigned to the waterbodies (Inner Sound and Loch Alsh) and acknowledgement of the criteria defined by the Environmental Standards for Scotland (**Ref 17-22**) it was possible to understand what assumptions had been made in relation to each of the classification parameters of the relevant waterbodies.

17.10 Overview

Following implementation of the mitigation measures outlined, including adoption and adherence to best practice guidelines and specific pollution prevention guidelines all potential impacts were assessed as **negligible** impact significance; with the exception of increased sediment load, which was assessed as **minor adverse**.

Consideration is given to the WFD and specifically the WFD status of the Inner Sound and Loch Alsh waterbodies. Given the results of the assessments and acknowledging the overall status of the waterbodies as 'Good' and of the parameter 'water quality' as 'Good' (SEPA interim report, 2014), it is not believed that there would be any effect on the WFD status.

SEPA stated in their scoping opinion that '*there is unlikely to be any significant impact upon hydromorphological status in this water body from these works'* **(**see **Appendix 1.1).** Acknowledging the assessments of this chapter and **Chapter 18,** it is believed that this opinion is still valid. Although specific consideration of the potential impact from marine invasive non-native species on biota is covered in **Chapter 19**; for the sake of completion it is considered that there would no change in the status, 'High', on this parameter for each of the coastal waterbodies, as a result of the development (see **Chapter 19**).

17.11 References

Ref 17-1 Water Environment (Shellfish Waters Protected Area Designation) (Scotland) Order (2013). [Online]. [Accessed: November 2016]. Available from: http://www.legislation.gov.uk/ssi/2013/324/contents/made.

Ref 17-2 Bathing Waters Directive, 1976. [Online]. [Accessed: November 2016]. Available at: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:31976L0160.

Ref 17-3 EU Water Framework Directive (WFD), 2000. [Online]. [Accessed: November 2016]. Available from: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32000L0060.

Ref 17-4 Scottish Executive, 2003. *Water Environment and Water Services (Scotland) Act 2003 (WEWS Act).* [Online]. [Accessed: November 2016]. Available at: http://www.gov.scot/Resource/0045/00458328.pdf.

Ref 17-5 Marine Scotland, 2014. *The Scottish National Marine Plan.* [Online]. [Accessed: November 2016]. Available at: http://www.gov.scot/Resource/0046/00465865.pdf.

Ref 17-6 SEPA, 2015. *River Basin Management Plan for the Scotland river basin district: 2015-2027.* [Online]. [Accessed: November 2016]. Available from: http://www.sepa.org.uk/media/163445/the-river-basin-management-plan-for-the-scotland-river-basin-district-2015-2027.pdf.

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