

16. Marine water and sediment quality

16.1 Introduction

16.1.1 This chapter presents a preliminary assessment of likely significant effects on marine water and sediment quality arising from the Moorside Project (**Figure 16.1**). Of particular relevance to this chapter is the potential for impacts on sediment and water quality from the construction of a MOLF (including its breakwaters) and the infrastructure for the seawater cooling systems, which includes the circulating water system (CWS) and service water system (SWS), as well as other associated shoreline and offshore infrastructure and the impacts of discharges to sea of cooling water and process effluents from the main outfalls and treated sewage effluent from the Moorside Project Sites. However, the assessment of change to marine water and sediment quality is also of relevance to other environmental receptors, which are described in the following sections of the PEIR, notably:

- Socio-economics and Human Population (**Chapter 10**);
- Marine and Coastal Physical Processes (**Chapter 15**);
- Marine Ecology (**Chapter 17**);
- Terrestrial and Freshwater Ecology (**Chapter 18**);
- Ornithology (**Chapter 19**); and
- Radiological (**Chapter 21**).

16.2 Limitations of the PEIR

General

16.2.1 The scale and complexity of the Moorside Project means that it is continuing to evolve at this preliminary stage, which presents limitations in terms of programme and phasing. The preliminary environmental information report (PEIR) has focussed on potential effects on the marine water and sediment quality arising from the construction and operation of the Moorside Project. The assessment considers potential effects arising from the Moorside Site and the Accommodation Sites. A single Study Area has been used in this assessment and has been defined in terms of the potential for effects to arise on marine water and sediment quality from these sites. Due to the limited scale of development and distance from the coastal waters the Additional Sites have demonstrated no pathways of effect to marine environment and, therefore, are not expected to have a direct impact on marine water and sediment quality; Additional Sites are, therefore, not considered further in this chapter.

16.2.2 With respect to the decommissioning of the Moorside Project, potential effects are likely to be similar to or less than the effects arising from the construction

phase. It is not anticipated that additional receptors would be affected beyond those identified for the construction phase assessment as this assessment has assumed a reasonable worst case. It is anticipated that the decommissioning works would be of shorter duration and would occupy more limited footprints than those currently assumed for construction of the relevant facilities. Subject to further design and delivery details, and for the purposes of this PEIR, a worst case scenario has been applied, i.e. it has been assumed that the effects would be the same (rather than less) as those identified for the construction phase. Decommissioning is, therefore, not considered further in the assessment tables (Table 16.7 - 16.10) below that address the construction and operational phases.

Technical

- 16.2.3 The hydrodynamic model has very recently been completed. As such, it was not available in time for the assessments contained within this chapter; therefore, the assessments set out below are based on expert judgment. These judgements will be revised within the Environmental Statement (ES) (to be submitted as part of the application for a DCO for the Moorside Project in 2017), following more detailed analysis and refinements in engineering design and will take full account of the model that has now been produced.
- 16.2.4 The full extent and location of discharges direct to the marine environment is yet to be finalised and, as such, the impact assessment is still preliminary and based on a worst-case scenario. This work is on-going and will be reported on in the ES in 2017.

16.3 Policy and legislative context

Policy Context

- 16.3.1 Issues that are highlighted in national policy documents that are of specific relevance to defining the scope of the assessment of marine water and sediment quality are listed below.

National Policy Statement EN-1 (NPS EN-1)

- 16.3.2 The Overarching National Policy Statement for Energy (EN-1) contains a series of impacts associated with aquatic and marine water and hydrological resources, noting the potential for Nationally Significant Infrastructure Projects (NSIPs) in the energy sector to generate adverse effects on the water environment and coastal waters. Section 5.15.1 of NPS EN-1 states that:

“these effects could lead to adverse impacts on health or on protected species and habitats and could, in particular, result in surface waters, groundwaters or protected areas failing to meet environmental objectives established under the Water Framework Directive”.

16.3.3 Section 5.15 of NPS EN-1 (entitled ‘Water Quality and Resources’) outlines a number of policy tests that the applicant must satisfy. Paragraphs 5.15.2 and 5.15.3 state:

- Where the project is likely to have effects on the water environment, the applicant should undertake an assessment of the existing status of, and impacts of the proposed project on, water quality, water resources and physical characteristics of the water environment as part of the ES or equivalent.
- The ES should in particular describe:
 - the existing quality of waters affected by the proposed project and the impacts of the proposed project on water quality, noting any relevant existing discharges, proposed new discharges and proposed changes to discharges;
 - existing water resources affected by the proposed project and the impacts of the proposed project on water resources, noting any relevant existing abstraction rates, proposed new abstraction rates and proposed changes to abstraction rates (including any impact on or use of mains supplies and reference to Catchment Abstraction Management Strategies);
 - existing physical characteristics of the water environment (including quantity and dynamics of flow) affected by the proposed project and any impact of physical modifications to these characteristics; and
 - any impacts of the proposed project on water bodies or protected areas under the Water Framework Directive and source protection zones (SPZs) around potable groundwater abstractions.

Overarching National Policy Statement for Nuclear Power Generation (EN-6) (NPS EN-6)

16.3.4 National Policy Statement for Nuclear Power Generation (EN-6) also relates to marine water and sediment quality. Section 3.7 of NPS EN-6 is entitled ‘Nuclear Impact: Water Quality and Resources’. Paragraphs 3.7.3, 3.7.6, 3.7.7 and 3.7.8 outline further policy tests that the applicant must satisfy:

- In addition to fulfilling the requirements of Section 5.15 of EN-1, the applicant’s assessment should also set out the characteristics of cooling water for new nuclear power stations and the specific implications of the proposal on marine and estuarine environments.
- In the design of any direct cooling system, the locations of the intake and outfall should be sited to avoid or minimise adverse impacts on legitimate commercial and recreational uses of the receiving waters, including their ecology. There should also be specific measures to minimise impact to fish and aquatic biota by entrainment or by excessive heat or biocidal chemicals from discharges to receiving waters.

- Discharges into water bodies will be controlled in accordance with permits issued by the EA. Applicants will be expected to demonstrate Best Available Techniques to minimise the impacts of cooling water discharges. The contamination of soils and water resources can be mitigated through the EIA process and managed through the possible implementation of Environmental Management Plans.
- 16.3.5 Sections 7.37- 7.39 and 7.121-7.123 of National Policy Statement for Nuclear Power Generation (EN-6) also relates to the marine environment. Specifically in relation to flood risk.

Local Policy

- 16.3.6 The Copeland Local Plan (2013 - 2028) highlights relevant issues to this Chapter in Policy ENV3 (Biodiversity and Geodiversity) and Policy ENV2 (Coastal Management).
- 16.3.7 The Defra/EA published North West River Basin Management Plan (RBMP) (Reference 1: Defra/Environment Agency) has delineated, characterised and set targets for the Cumbria and Solway Outer South coastal WFD water bodies and nearby transitional WFD water bodies. Under Article 13 of the WFD, RBMPs:
- “shall be reviewed and updated at the latest 15 years after the date of entry into force of this Directive and every six years thereafter”.*

Guidance

- 16.3.8 Guidance documents that are of specific relevance to the impact assessment of the Moorside Project on marine water and sediment quality are as follows:
- Defra guidance (Reference 2: Defra) on new and updated standards to protect the water environment.
 - Recommendations for Environmental Quality Standards (EQS) and for assessment of effects on water quality for European Marine Sites have been provided by the UK Technical Advisory Group on The Water Framework Directive (Reference 3: UKTAG).
 - The British Energy and Marine Studies (BEEMS) management framework which was set up to support the Nuclear New Build Programme provides guidance for marine physical process assessments, including the definition of thermal standards for cooling water discharges (Reference 4: BEEMS).
 - There are currently no statutory standards against which to assess the quality of marine sediments, therefore contaminant levels will be compared against standards for dumping of dredged material at sea, i.e. Cefas Action Levels¹ (available on London Port Authority website), and those standards which deal with ascertaining the likely biological impacts

¹ <https://www.pla.co.uk/Environment/Cefas-Guideline-Action-Levels-for-the-Disposal-of-Dredged-Material> (accessed on 12 April 2016)

of a given level of contamination, i.e. Canadian Sediment Quality Guidelines (Reference 5: Canadian Council of Ministers of the Environment) (also available on Port of London Authority website²) and Dutch Standards (Reference 6: IADC/CEDA).

- The EA guidance on Complying with the Water Framework Directive with respect to marine dredging applications and operations, Clearing the Waters (Reference 7: Environment Agency).

Legislation

16.3.9 The following list of legislation is relevant to the assessment of likely effects on marine water and sediment quality:

- the Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR convention);
- the Water Framework Directive (2000/60/EC) (WFD) (provides the framework for the protection of EU coastal waters out to one nautical mile from the territorial baseline and out to 12 nautical miles in relation to water quality);
- the Marine Strategy Framework Directive (2008/56/EC) (MSFD) (covers coastal and offshore marine waters);
- the Priority Substances Directive (2008/105/EC) (amended by Directive 2013/39/EU) (defines Environmental quality standards (EQS) for priority substances);
- the Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015 (sets out all EQS established under the WFD and its daughter directives);
- the Bathing Waters Directive (2006/7/EC) (establishes EQS for designated bathing waters); and
- the Bathing Water Regulations 2013 (implement the Bathing Waters Directive).

16.4 Data gathering methodology

Study Area

16.4.1 The Study Area within which baseline conditions and potential effects have been considered for effects resulting from the marine infrastructure in the Moorside Site (i.e. the MOLF, breakwaters, CWS and beach landing) is shown in **Figure 16.1**. The Study Area for the marine and sediment quality monitoring is the same as the Zone of Influence (Zoi) which was established based on the design details for the Moorside Project, initial hydrodynamic modelling

² <http://www.pla.co.uk/Environment/Canadian-Sediment-Quality-Guidelines-for-the-Protection-of-Aquatic-Life> (accessed on 20 April 2016)

(undertaken by ABPmer) and discussions with statutory consultees. The Study Area extends to include two times the maximum length of the tidal ellipse (tidal excursion) north and south from the midpoint of the offshore component of the Moorside Site and parallel to the coastline. It therefore includes the waters adjacent to St Bees Head, located approximately 13 km to the north-west of the Moorside Site. The northern boundary of the Study Area is broadly consistent with the boundary between the Cumbria and Solway Outer South WFD coastal water bodies. The southern boundary extends to include the Ravenglass Estuary complex (i.e. the area where the Rivers Irt, Mite and Esk converge) in order to account for any residual displacement of the cooling plume discharge to the south-east. The Study Area also extends 10 km out to sea and incorporates the estuarine areas of the rivers Ehen and Calder that fall within the Cumbria WFD coastal water body.

- 16.4.2 There is the possibility that treated sewage effluent from the Corkickle Development may be discharged into existing sewage treatment infrastructure such as Whitehaven (Parton) wastewater treatment works. Therefore, included in the Study Area are receptors in the Solway Firth, such as Solway Outer South coastal waterbody.

Desk study

- 16.4.3 In order to determine the requirement for new survey work, a desk study was undertaken to review the availability (and suitability) of existing marine and sediment quality environmental data. This study underpinned the marine water and sediment quality survey campaign which forms part of the evidence plan for the ES and will assist with the HRA. A range of existing datasets and reports were considered:
- Environment Agency (EA) Water Framework Directive (WFD) data;
 - EA WFD designated sites data; and
 - other EA water quality data.
- 16.4.4 The analysis demonstrated that enough existing secondary data was available to provide a broad description of marine water and sediment quality within the Study Area. However, the available datasets were found to be less informative at the detailed level and were considered to be insufficient to fully address EIA requirements. A programme of surveys was subsequently commissioned to address the identified data gaps. These data gaps included:
- additional chemicals not routinely monitored by the EA; and
 - additional sample sites within the Study Area that do not form part of the EA surveys.

Survey work

- 1.1.1 Surveys were undertaken to sample water and sediment quality within the Study Area. The water quality and sediment surveys were based upon the JNCC Marine Monitoring Handbook (procedural guideline 1.1) (Reference 8:

Davies et al) the Clean Seas Environment Monitoring Programme (CSEMP) 'Green Book' (Reference 9: MARG) and UKTAG sampling method statements (Reference 10: UKTAG). Survey requirements under the MSFD were also considered.

- 16.4.5 The sediment survey work was required in order to inform the baseline and assessment of potential changes in sediment quality and consequent effects on subtidal habitats and species and the associated Cumbria Coast Marine Conservation Zone (MCZ) and Drigg Coast Special Area of Conservation (SAC). Such changes may be the result of direct effects (e.g. land take and construction activity leading to sediment disturbance or chemical discharges affecting sediment quality) or indirect effects (e.g. through changes to coastal processes such as sediment transport and sorting).
- 1.1.2 The water and sediment samples were analysed for non-radiochemical and radiochemical substances. Sediment samples were collected in May 2015 using grab sample equipment to retrieve seabed sediments from 35 subtidal locations and core sampling was employed at 15 intertidal locations. The water depth of the subtidal sites was recorded at each location. In addition to this, 30 locations were sampled on a quarterly basis during 2015 for marine water quality at either one, two or three depths depending on the overall depth of the water column. The four water sampling surveys were undertaken in March, June, September and November 2015.
- 1.1.3 An extensive suite of determinands for sample analysis was selected to:
- collectively allow a broad characterisation of baseline water and sediment quality conditions (to include radiochemical and non-radiochemical substances);
 - include supporting elements for ecological status under the WFD and environmental status under the MSFD;
 - include relevant specific pollutants, priority substances and priority hazardous substances defined by the WFD and its daughter directives³;
 - take account of substances which may be discharged into the marine environment from the Moorside Project and by-products generated in the marine environment (for example from use of corrosion inhibitors or use of disinfectants in the cooling water circuit), which may not be included in existing national or European scale survey programmes;
 - inform an assessment of the current quality of sediment and any potential historic contamination; and
 - inform the assessment of potential changes in water and sediment quality and consequent effects.

³ Directive 2013/39/EU and Directive 2008/105/EC on environmental quality standards in the field of water policy (EQS Directive)

Consultation

- 16.4.6 Consultation feedback received from the following organisations has been used to inform the scope of the assessment; outlined in **Section 16.5** below.
- 16.4.7 The organisations that have been consulted on issues related to marine water and sediment quality include:
- Marine Management Organisation (MMO);
 - Environment Agency (EA);
 - Natural England (NE);
 - The Crown Estate;
 - Sellafield Ltd;
 - Cumbria County Council (CCC);
 - Copeland Borough Council (CBC); and
 - North West Inshore Fisheries and Conservation Authority (NW IFCA).
- 16.4.8 **Table 16.1** provides details of the issues which have been raised during these consultations, and a response on how they are being considered in the EIA process.

Table 16.1 Consultation responses received

Issue raised	Consultees	Response
More detail required for receptors and sensitivities assigned for impact assessments	Cumbria County Council	Details included in Section 16.7 and Tables 16.6 - 16.9 .
There needs to be better coordination between PEIR chapters including ensuring consistency of assessments	Cumbria County Council and the Environment Agency	Greater clarity on what each chapter includes and links between chapters are now provided
Construction Environmental Management Plan (CEMP) measures are required to minimise pollution incidents and further information would be sought on this in the PEIR.	Copeland Borough Council	CEMP now referenced in Table 16.2 as a measure to control potential pollution incidents during construction and operational phases of the project.
An EIA should assess whether a project is likely to have a significant effect on the environment, not just those receptors that are protected. In addition, there are a number of protected features/receptors within each site that may or may not be affected by different activities within each chapter, so it is not appropriate to group together 'receptors' by designated site.	Marine Management Organisation	Any changes to water and sediment quality are reported in this chapter, whether these relate to a designated site or not. Any socio-economic, ecological or physical features that may be impacted due to changes in water or sediment quality are reported in Chapters 10, Socio-economics and Human Population, Chapter 15, Marine and Coastal Physical Processes or Chapter 17, Marine Ecology .
The Cumbria Coast MCZ is not identified as a marine water and sediment quality receptor. The MCZ may have higher sensitivity to water quality impacts, including the thermal plume, than the coastal WFD water body that is considered.	Environment Agency	The Cumbria Coast MCZ is highlighted as a receptor. However, specific EQS regarding water or sediment quality have not been established, so any potentially significant impacts arising from changes in water or sediment quality are reported in Chapter 17, Marine Ecology .

Issue raised	Consultees	Response
<p>It is not possible to design the cooling water system to prevent significant adverse environmental effects until the specific potential effects on receptors are known. Designing the cooling water system to avoid significant environmental effects pre-judges the impacts identified through the relevant assessments.</p>	<p>Environment Agency</p>	<p>The full environmental assessment for the CWS is not included in this PEIR as modelling is on-going. However, a preliminary assessment has been undertaken to indicate likely impacts based on the potential locations for the outfall.</p>
<p>The effects of the construction impacts of the fish return system and outfall on marine water and sediment quality receptors are not assessed. The need for any mitigation to address detrimental impacts from the fish return system and outfall structure on marine water and sediment quality is unknown.</p>	<p>Environment Agency</p>	<p>The detail of the fish return system and outfall will be included in the ES, to be submitted in 2017, including potential effects on marine water and sediment quality. However, a preliminary assessment of the potential impact is included in this chapter.</p>
<p>The effects of the operational impacts of the cooling water discharge on subtidal and intertidal sediment quality are not assessed.</p> <p>Subtidal and intertidal sediment quality may be detrimentally affected by the cooling water discharge and the associated contaminants within it.</p>	<p>Environment Agency</p>	<p>A preliminary assessment of the operational impacts of the CWS discharge is provided in this chapter in the assessment of the effects on subtidal and intertidal sediment quality.</p>
<p>Environmental information used to determine the environmental baseline of the Drigg Coast SAC has changed. The latest and most up to date information that is available has not been used so</p>	<p>Environment Agency</p>	<p>The draft site information provided by the Government for the Drigg Coast SAC (in June 2015⁴) will be used to inform the impact assessment.</p>

⁴ <https://www.gov.uk/government/publications/marine-conservation-advice-for-special-area-of-conservation-drigg-coast-uk0013031>

Issue raised	Consultees	Response
the environmental effects cannot be accurately determined.		
Potential effects on Allonby Bay, Walney & Mud Hole rMCZ (recommended) are discounted in relation to marine water/sediment quality. The effects of the proposed development on Allonby Bay, Walney & Mud Hole rMCZ in relation to marine water/sediment quality are unknown.	Environment Agency	Allonby Bay & West of Walney MCZ & Mud Hole rMCZ are located outside the Study Area for marine water and sediment quality. It is anticipated that Allonby Bay & West of Walney MCZ will be scoped out as initial hydrodynamic modelling shows they are too far away to be affected indirectly. There is the potential for Mud Hole rMCZ to be affected by the marine infrastructure at the Moorside Site, and modelling results will determine this (although again, initial studies indicate that this is not the case). However, they are designated for marine life and habitats and as such any assessment on their features will be included in Chapter 15, Marine and Coastal Physical Processes and Chapter 17, Marine Ecology .
The Bathing Water Directive appears not to have been taken into account when determining impacts on receptors. Bathing water sites may be subject to unnecessary risk.	Environment Agency	St Bees (45920) and Seascale (45600) bathing water designated sites are noted in the impact assessments and Table 16.2 .

16.5 Scope of the assessment

Potential receptors

- 16.5.1 Several categories of receptor have been considered in this assessment (**Figure 16.1**). These include:
- coastal waters (including WFD coastal water bodies);
 - internationally and nationally designated nature conservation sites (e.g SACs, MCZs);
 - internationally and nationally in the process of designation (e.g. rMCZs and pSACs);
 - sub tidal sediments;
 - intertidal sediments; and
 - tidal stretches of local surface watercourses (such as WFD transitional water bodies).
- 16.5.2 This chapter of the PEIR deals with the assessment of potential effects on the water and sediment quality receptor categories presented in paragraph 16.5.1, as a result of the Moorside Project. It describes direct changes to marine water and sediment quality as a result of the construction and operational activities at the Moorside Project Sites, excluding the Additional Sites. Any direct effects on habitats and ecological receptors other than those presented in 16.5.1, even if caused by changes in water quality, are assessed in **Chapter 17, Marine Ecology** or **Chapter 18, Terrestrial and Freshwater Ecology**, while effects on commercial fisheries are addressed in **Chapter 10, Socio-economics and Human Population**.
- 16.5.3 There are five nearby receptors which are completely, or the majority of which are outside of the Study Area and have no specific water or sediment quality standards above the WFD or other related marine quality standards. The sites have been designated based on habitats and ecology. As such the following features are not considered assessed in this chapter:
- Allonby Bay MCZ, (located outside of the Study Area);
 - Walney MCZ (located outside of the Study Area);
 - Mud Hole rMCZ (located outside of the Study Area);
 - Solway Firth dSPA (draft Special Protection Area) (located outside of the Study Area); and
 - Morecambe Bay and Duddon Estuary pSPA (proposed Special Protection Area) (of which only a small proportion is located inside of the Study Area, at its southern extent adjacent to the Ravenglass Estuary Complex).
- 16.5.4 Any potential impacts on these sites are assessed in **Chapter 15, Marine and Coastal Physical Processes** and **Chapter 17, Marine Ecology**. Furthermore,

the Cumbria Coast MCZ falls within the Study Area, it will also be assessed specifically in **Chapter 15, Marine and Coastal Physical Processes**, due to the potential impacts of water and sediment quality on the habitats for which it has been designated.

Spatial and temporal scope

- 16.5.5 The assessment of likely significant effects is being undertaken with consideration of potential changes to marine water and sediment quality that could occur within the geographical extent of the Study Area (**Figure 16.1**). Consideration will be given to the potential for significant effects to occur during the construction period (approximately a decade), and operational period (duration of decades).
- 16.5.6 The spatial extent of the assessment is described in **Section 16.4**. The Study Area incorporates the locations of the MOLF and breakwaters, the beach landing, wastewater treatment work outfalls and the CWS water intake and outfall structures, where any direct effects are likely to occur, as well as the wider area where indirect effects may also arise from inputs such as increases in discharges of treated sewage effluent, whether it be from current or new infrastructure.

Potentially significant effects

- 16.5.7 All of the receptor categories identified for this topic could potentially be affected by construction, operation and decommissioning activities associated with the Moorside Project. These effects could occur either directly (e.g. due to emplacement of structures directly onto the receptor) or indirectly (e.g. through the modification of sediment transport pathways).
- 16.5.8 All potential impacts on water quality are reported, where possible, against the relevant WFD water body that they have a direct impact on (e.g. direct discharges into coastal water bodies). However, all potential receptors have had a preliminary assessment to ensure that all potential effects are reported and any receptors that will not be affected are scoped out of any further assessment. Only the Moorside Site, Egremont Site, Corkickle Site and Mirehouse Site have confirmed potential for significant direct effects on marine water or sediment quality due to possible discharges directly to sea. All Moorside Project Sites have the potential to discharge to rivers first from construction and operational phases such as surface water drainage and dewatering. All activities that involve discharges to non-tidal stretches of rivers, rather than direct discharges to the marine environment, are included in **Chapter 14, Freshwater Environment: Surface Water**.

16.6 Environmental measures incorporated into the proposed development

- 16.6.1 The details of environmental measures that have been incorporated into the overall design of the Moorside Project are set out in **Section 2.3** of the PEIR.

Specific measures relating to how these have been targeted to specific marine water and sediment quality receptors at each of the Moorside Project sites are set out in **Table 16.2**. Where environmental measures are currently unknown or uncertain, they are not included within **Table 16.2**.

- 16.6.2 Environmental permits for water discharge activities will be sought where required and these will control the quality of effluent discharge and afford an appropriate level of protection for water and sediment quality from pollutants such as phosphates, ammonia, nitrates, enteric bacteria, chemicals and temperature increases.

Table 16.2 Rationale for incorporation of environmental measures

Potential receptor	Predicted changes and potential effects	Incorporated measure
Moorside Site only		
Cumbria coastal waterbody including WFD protected areas (Drigg Coast SAC and St Bees and Seascale Bathing Beaches).	Activities undertaken during the construction phase (e.g. excavations and land forming) could result in an increase in the amount of sediment (potentially contaminated) discharged into the marine environment from surface water runoff.	The use of swales, settlement ponds and other related drainage techniques will be used during construction to prevent excess sediments from entering the marine environment.
	During the construction and operational phases of the project there could be accidental spillages and leaks of pollutants into the marine environment (including sewage from temporary facilities, sediment from surface water runoff and hydrocarbons from surface water runoff).	The use of settlement ponds, oil interception and other related drainage control techniques within the Moorside Site will prevent sediments and heavy metals from entering the marine environment. Measures set out in the finalised CEMP as described in the ES will reduce potential adverse effects upon the marine environment.
	There could be increased concentrations of pollutants such as ammonia, nutrients and enteric bacteria which could occur in the marine environment from increases in treated sewage discharges. The discharges could occur during the construction and operational phases of the project, from new sewage treatment plant(s) or effluent increases routed to existing infrastructure e.g. Braystones wastewater treatment works which currently treats sewage from all the local public sewers	Standard treatment options at current or new onsite wastewater treatment works will protect marine water and sediment quality. See Section 16.6.2 . Where necessary and feasible ultraviolet treatment may be used on the treated sewage effluent to protect bathing beaches.

Potential receptor	Predicted changes and potential effects	Incorporated measure
	around the Moorside Site and discharges direct to sea.	
	The operational phase of the project will involve discharges of process chemicals used in the power station and potentially discharges of disinfectants and their by-products arising from use of chemicals to keep the cooling water intake/outfall clear of marine fouling growth.	Standard treatment options at current or new onsite wastewater treatment works will protect marine water and sediment quality. See Section 16.6.2 for more information.
	The operational phase of the project will involve discharge of cooling water at a temperature above ambient, providing an input of heat to the marine environment and a zone of increased water temperature (thermal plume).	The outfall is being designed to maximise effective diffusion of the thermal plume. See Section 16.6.2 for more information.
	The operational phase of the project could result in an impact on water quality due to discharges of sediments settled out from the cooling water intake flows.	The outfall is being designed, placed and operated in a way to minimise any impacts on water quality. This may also include the removal of sediments by filtering or mechanically from the forebay area prior to discharge. See Section 16.6.2 for more information.
Egremont Site		
Cumbria coastal waterbody including WFD protected areas (including St Bees and Seascale Bathing Beaches).	There is the possibility of increased concentrations of pollutants such as ammonia, nutrients and enteric bacteria which could occur in the marine environment from increases in discharges of treated sewage effluent. The discharges could occur during the construction and operational phases of the project, from new sewage treatment plant(s) or effluent increases routed to existing infrastructure e.g. Braystones wastewater treatment works which currently treats sewage from all the local public sewers around the Moorside Site and discharges direct to sea.	Standard treatment options at current or new onsite wastewater treatment works will protect marine water and sediment quality. See Section 16.6.2 . Where necessary and feasible ultraviolet treatment may be used on the treated sewage effluent to protect bathing beaches.

Potential receptor	Predicted changes and potential effects	Incorporated measure
	During the construction and operational phases of the project there could be accidental spillages and leaks of pollutants into the marine environment (including sewage from temporary facilities).	Measures set out in the final CEMP and as described in the ES will reduce adverse effects to the marine environment.
Corkickle Site		
Solway Outer South coastal waterbody	During the construction and operational phases of the project there could be accidental spillages and leaks of pollutants into the marine environment (including sewage from temporary facilities).	Measures set out in the final CEMP and as described in the ES will reduce potential adverse effects to the marine environment.
	There could be increased concentrations of pollutants such as ammonia, nutrients and enteric bacteria which could occur in the marine environment from discharges of treated sewage effluent. The discharges could occur during the construction and operational phases of the project, from new sewage treatment plant(s) to the Pow Beck or effluent increased routed to existing infrastructure e.g. Whitehaven (Parton) wastewater treatment works which discharges directly to sea.	Standard treatment options at current or new onsite wastewater treatment works will protect marine water and sediment quality. See Section 16.6.2.
	During the construction and operational phases of the project there could be accidental spillages and leaks of pollutants into the marine environment (including sewage from temporary facilities or pumping stations).	During construction, measures set out in the CEMP will reduce adverse effects to the marine environment. During operation, standard measures and appropriate design of wastewater infrastructure will reduce adverse effects to the marine environment.
Mirehouse Site		
Solway Outer South coastal waterbody	Depending on the treatment option used there could be increased concentrations of pollutants such as ammonia, nutrients and enteric bacteria which could occur in the marine environment from discharges of treated sewage effluent. The	Standard treatment options at current or new onsite wastewater treatment works will reduce adverse effects to marine water and sediment quality. See Section 16.6.2.

Potential receptor	Predicted changes and potential effects	Incorporated measure
	discharge could occur during the operational phase of the project, from routing the sewage to existing infrastructure e.g. Whitehaven (Parton) wastewater treatment works which discharges direct to sea.	
Cumbria coastal WFD water body	Depending on the treatment option used there could be increased concentrations of pollutants such as ammonia, nutrients and enteric bacteria which could occur in the marine environment from discharges of treated sewage effluent. The discharges could occur during the operational phase of the project from a new sewage treatment plant(s) discharging the Pow Beck (SW lakes).	Standard treatment options at current or new onsite wastewater treatment works will reduce adverse effects to marine water and sediment quality. See Section 16.6.2 .

16.7 Assessment methodology

- 16.7.1 **Chapter 3, EIA Methodology** of this PEIR, along with this section, describes how the assessment has been undertaken and the approach to the evaluation of the significance of effects identified.
- 16.7.2 There are no UK or international regulatory frameworks against which to compare radioactivity in marine waters or sediments against predetermined standards. In the absence of a set of guidance levels that are directly relevant, the seawater and sediment sampling results are compared against background levels reported by other sampling campaigns (e.g. annual RIFE reports and Sellafield Environmental Monitoring reports).

Methodology for prediction of effects

- 16.7.3 The general methodology for assessment of effects is described in **Chapter 3, EIA Methodology**. In this chapter the significance of an effect is evaluated as a product of the sensitivity of a given receptor and the magnitude of change that may occur to that receptor as a result of the proposed Moorside Project.
- 16.7.4 **Table 16.3** provides a summary of the criteria used to classify the sensitivity of the marine and sediment quality receptors that have been identified. This is based on an assessment of a number of criteria, including the following:
- the spatial scale of the receptor water feature;
 - its WFD status, including all supporting elements; and

- the presence of international or national nature conservation designations (where designations relate specifically to habitats or interest features that are dependent on marine water and sediment quality).

16.7.5 Compliance with the WFD is based on the concept that there is ‘deterioration’ as soon as the status of one of the quality elements falls by one class, even if this does not result in a fall in the overall classification of the water body.

Table 16.3 Criteria used to determine the value and sensitivity of marine and sediment quality receptors

Value and Sensitivity	Guidelines
Very High	Water and/or sediment quality supports or contributes towards an internationally designated nature conservation site (e.g. Drigg Coast SAC, Solway Firth pSPA).
High	<p>Water quality of receptor water body: supporting WFD element type (e.g. Priority Substances) classified as high, pass or good.</p> <p>Bathing Water protected areas currently at excellent standard in the new directive.</p> <p>Shellfish protected areas that meet all guideline and imperative standards applied under the WFD</p> <p>Water quality of specific receptor site supports or contributes towards the designation of a nationally important feature (e.g. MCZ, SSSI).</p> <p>Sediment quality complies with all Cefas Action Levels and Canadian marine sediment standards</p> <p>Very low capacity to accommodate any change in current water quality status, compared to baseline conditions.</p>
Medium	<p>Water quality of receptor water body: supporting WFD element type classified as at least Good in all cases.</p> <p>Bathing Waters protected areas are at good or sufficient status.</p> <p>Shellfish protected areas where evidence suggests at less than the guideline and imperative standards</p> <p>Water quality of receptor site supports high biodiversity (not designated). Receptor has low capacity to accommodate change in water quality status.</p> <p>Sediment quality complies with Cefas Action Level 2 and Canadian marine sediment standards but not Cefas Action Level 1</p>
Low	<p>Water quality of receptor water body: supporting WFD element type classified as less than Good in any situation (any supporting element).</p> <p>Bathing Waters protected areas are failing.</p>

Value and Sensitivity	Guidelines
	<p>Baseline conditions define an environment that has a high capacity to accommodate proposed change in water quality status, due for example to large relative size of receiving water feature and effect of dilution.</p> <p>Sediment quality does not comply with Cefas Action Levels or the Canadian marine sediment standards</p>
<p>Very low</p>	<p>Water quality of receptor water body: supporting WFD element type classified as Poor or Bad.</p> <p>Poor or bad status water bodies which have severely restricted ecosystems and may be very polluted.</p> <p>Specific water quality conditions of receptor water feature likely to be able to tolerate proposed change with very little or no impact upon the baseline conditions detectable.</p>

- 16.7.6 The significance of potential effects resulting from the Moorside Project is being determined through consideration of the sensitivity of each receptor and the magnitude of change that would be brought about by the construction, operational and/or decommissioning phases of the Moorside Project. Potential effects are assessed against the baseline that is described in **Section 16.8**.
- 16.7.7 The methodology being used also includes the use of numerical modelling tools, such as hydrodynamic models, as required. These models will determine the scale and scope of any impacts such as extent of the thermal plume and, therefore, will inform the potential magnitude of changes to the marine environment. Details of the modelling methodologies are currently being discussed with the relevant consultees and will be included in the ES that will accompany the application for a DCO in 2017.
- 16.7.8 The magnitude of change presented in **Tables 16.7 to 16.10** has been based on professional judgement of the likely consequences that the Moorside Project may have for marine water and sediment quality. This includes the implications of any changes that may affect the ability to meet current and future standards (e.g. for WFD status or bathing water).
- 16.7.9 The descriptions of magnitude of change outlined in **Table 16.4** are specific to the assessment of marine water and sediment quality environment effects. Where the magnitude of change could reasonably be placed within more than one magnitude rating, professional judgement has been used to determine which magnitude rating is appropriate.

Table 16.4 Criteria used to determine the magnitude of change

Magnitude		Guidelines
Very High	General - Water Quality EQS & sediment	<p>Major change to key characteristics of the water quality status of the receiving water feature due to effluent discharge.</p> <p>Water and sediment quality degraded to the extent that there is a permanent inability to meet EQS (EQS thresholds as defined by current WFD status), resulting in a deterioration in WFD status.</p> <p>Sediment quality complies with all Cefas Action Levels and Canadian marine sediment standards.</p>
	Drigg Coast SAC, Solway Firth dSPA, Morecambe Bay pSPA	<p>Changes in water or sediment quality resulting in permanent or irreversible effects, on key characteristics or features of the particular receptor.</p>
High	General - Water Quality EQS & sediment	<p>Moderate to major change to key characteristics of the water quality status of the receiving water feature due to effluent discharge.</p> <p>Water and sediment quality degraded to the extent that permanent change and inability to meet EQS is likely (EQS thresholds as defined by current WFD status) resulting in the potential for WFD deterioration.</p> <p>With regards to marine water mixing zones: area of EQS exceedance predicted to be >20 % of WFD water body unit area⁵.</p> <p>Sediment quality complies with all Cefas Action Levels and Canadian marine sediment standards.</p>
	Cumbria Coast MCZ, Bathing Waters, Allonby Bay & Walney Bay MCZ, & Mud Hole rMCZ	<p>Changes in water or sediment quality resulting in temporary or permanent/irreversible effects, over a wide area, on key characteristics or features of the particular receptor.</p>
Medium	General - Water Quality EQS & sediment	<p>Significant changes to key characteristics of the water quality status taking account of the receptor volume, mixing capacity, flow rate, etc.</p> <p>Water and sediment quality likely to take considerable time to recover to baseline conditions and may impact upon potential future thresholds in relation to objective WFD status - potential for prevention of waterbody reaching its future WFD objectives.</p> <p>With regards to marine water mixing zones: area of EQS exceedance predicted to be 10 to 20 % of WFD water body unit area.</p> <p>Sediment quality complies with Cefas Action Level 2 and Canadian marine sediment standards but not Cefas Action Level 1.</p>

⁵ To be confirmed by the Environment Agency

Magnitude		Guidelines
	Cumbria Coast MCZ, Bathing Waters, Allonby Bay & Walney MCZ, & Mud Hole rMCZ	Changes in water or sediment quality resulting in noticeable, temporary (during the project duration) effects, over a partial area, on key characteristics or features of the particular receptor.
Low	Water Quality EQS & sediment	<p>Noticeable but not considered significant changes to water quality status of receptor water feature.</p> <p>Activity not likely to alter local status to the extent that water and sediment quality characteristics change considerably or EQSs are compromised. Activities are likely to have an impact for a short time scale (e.g. relative to turnover of water feature) and baseline quality conditions are maintained.</p> <p>With regards to marine water mixing zones: area of EQS exceedance predicted to be 5 to 10 % of WFD water body unit area.</p> <p>Sediment quality does not comply with Cefas Action Levels or the Canadian marine sediment standards.</p>
	Cumbria Coast MCZ, Bathing Waters, Allonby Bay & Walney MCZ, & Mud Hole rMCZ	Changes in water or sediment quality resulting in noticeable, temporary (for part of the project duration) effects, or barely discernible effects for any prolonged length of time, over a small area, on key characteristics or features of the particular receptor.
Very Low	Water Quality EQS	<p>Although there may be some impact upon water and sediment quality, activities predicted to occur over a short period. Any change to water and sediment quality will be quickly reversed once activity ceases.</p> <p>With regards to marine water mixing zones: Area of EQS exceedance predicted to be <5 % of WFD water body unit area.</p>
	Cumbria Coast MCZ, Bathing Waters, Allonby Bay & Walney MCZ, & Mud Hole rMCZ	Changes in water or sediment quality producing effects on receptors which are not discernible from background conditions.

16.7.10 Effects will be assessed by relating the magnitude of change to the sensitivity and/or value of the resource, whilst maintaining application of professional judgement. Potential effects will be considered in terms of permanent or temporary, adverse (negative) or beneficial (positive). A preliminary assessment of cumulative effects is also set out below.

16.7.11 The indirect effects of changes in marine water or sediment quality, for example on biodiversity receptors or on recreational or commercial users of the sea, are described in other chapters such as **Chapter 17, Marine Ecology** and **Chapter 18, Terrestrial and Freshwater Ecology**.

Significance evaluation methodology

- 16.7.12 The methodology for assessing the significance of effects is outlined in **Chapter 3, EIA Methodology, Section 3.3** and is based on the sum of receptor sensitivity and magnitude of change that is likely to occur on that receptor as a result of the Moorside Project (**Table 3.2**). This is presented as a matrix (**Table 3.2 in Section 3.3**). In practice the assessment involves a degree of professional judgement based on the nature of the potential impact and detailed understanding of the receptor affected.

16.8 Preliminary assessment of residual effects

Baseline conditions

Marine water and sediment quality (non-radiochemical)

- 16.8.1 Results from the water quality surveys relate only to the Study Area described in **Section 16.4**. However, sufficient survey and third party data has been collated to undertake the impact assessment. With regard to impacts from the thermal plume, as noted above modelling has been completed very recently and as such professional judgement has been used when providing a preliminary assessment. The model will be fully incorporated into the conclusions of the ES in 2017.
- 16.8.2 The Cycle 2 2015 RBMP classifications for the coastal water bodies indicate that water quality in the Cumbria coastal water body achieves good or high status but the Solway Outer South water body is failing for mercury (**Table 16.5**). The WFD classification is based on multiple elements, not just water quality, and a full breakdown of all WFD water bodies and their classifications will be included in a separate WFD assessment as part of the ES in 2017.

Table 16.5 WFD Coastal Water Body Status (Cycle 2, 2015)

Water body	Physico-chemical status	Specific pollutants	Chemical status	Overall water body status
Cumbria GB641211630002	good	high	good	good
Solway Outer South GB641211630003	good	high	fail (mercury)	moderate

- 16.8.3 The water quality data collected from monitoring undertaken during 2015 indicates that there are no significant baseline marine water quality issues. However, elevated levels of iron and suspended solids have been recorded at approximately one third of the sites, at the middle water column sampling depth and near the sea bed. There appears to be no consistent pattern across the year, for example elevated levels of iron were recorded in March but not

July. This along with the elevated levels of iron recorded in the subtidal sediments indicates potential mobilisation of seabed sediments due to windy weather preceding the sampling events (Reference 11: Met Office). The data collected has provided results consistent with the WFD classification data obtained from the EA for the Cumbria coastal water.

- 16.8.4 The sediment quality survey data indicates that sediments within the Study Area largely consist of muddy sand and sandy mud with sandier sediment in the shallower, inshore waters. An area of slightly gravelly muddy sand is situated to the south-west, with small patchy areas of mixed sediment (gravelly mud) to the north and south of the Study Area. A belt of muddier sediment (sandy mud) runs northwards parallel to the coast at depths ranging from approximately 15-20 m. In general, in the north and north-western parts of the Study Area there are muddier sediments (sandy mud) with the silt fraction lowering to the south and east (inshore, along the coast) and the sediment becoming more sand influenced with muddy sand being the predominant sediment present. Hard substrate is mainly found in the eastern corner of the Study Area with small patchy areas of hard substrate also found to the south-east adjacent to Seascale and Drigg.
- 16.8.5 To give a broader overview of chemical levels in the marine sediments and in the absence of any quantified UK standards, the sediment quality data have been compared against the Canadian Sediment Quality Guidelines (as used by the London Port Authority as best practice guidance on this field) for the protection of marine aquatic life as well as Cefas Action levels used to consider dredged material for sea disposal. These standards are relevant as they relate to the protection of marine life.
- 16.8.6 The preliminary analysis of the chemical data from subtidal sediments compared to Cefas Action Levels shows chromium potentially exceeds Cefas Action Level 1 (40 mg/kg dry weight) at 10 locations. Most of the exceedances are not substantial; however, the highest chromium value measured at 50.8 mg/kg making it 10 mg/kg greater than Cefas Action Level 1. Nickel levels also exceeded Cefas Action Level 1 (20 mg/kg) at seven sites. Again, exceedances are not substantial, with the highest nickel value measured at 24 mg/kg. Concentrations of nickel did not exceed Cefas Action Level 2.
- 16.8.7 The preliminary analysis of the chemical data from subtidal sediments compared to the Canadian guidelines indicate elevated levels of acenaphthene, dibenz(a,h)anthracene, fluoranthene, fluorene, naphthalene and phenanthrene. One sample location also had elevated concentrations of anthracene, benz(a)anthracene, benzo(a)pyrene, chrysene and pyrene. With respect to comparison against the Cefas Action Levels⁶, concentrations for relevant metals and chemicals were only slightly higher than the Action Level.
- 16.8.8 The subtidal sites which show elevated levels of non-radiochemical substances are located within the belt of muddier sediment (sandy mud) that runs northwards from the study area parallel to the coast.

⁶ <https://www.pla.co.uk/Environment/Cefas-Guideline-Action-Levels-for-the-Disposal-of-Dredged-Material>

- 16.8.9 The preliminary analysis of the results of non-radiochemical analysis for the intertidal sediment samples indicates that concentrations of these substances are below the Cefas Action Levels and Canadian guidelines.
- 16.8.10 The features of the Drigg Coast SAC, Cumbria Coast MCZ and other MCZs and SPAs are not currently reported to be at risk from water quality.
- 16.8.11 The two designated bathing beaches within the Study Area, St Bees and Seascale, have been classified as good and sufficient by the EA, indicating that they are both currently compliant with Bathing Water standards (Reference 12: Defra).

Marine water and sediment quality (radiochemical)

Marine water

- 16.8.12 No positive gross alpha results were recorded during any of the campaigns.
- 16.8.13 Positive values were recorded at all of the sites for gross beta across the four sampling campaigns. The gross beta results observed are predominantly attributable to the presence of elevated levels of the naturally occurring radionuclide potassium-40 (K-40). Large quantities of natural potassium are present in seawater, a proportion of which is potassium-40. The average potassium-40 activity concentration of seawater is reported consistently across the four sampling campaigns with 11.4 Bq/kg in March, 11.6 Bq/kg in June, 11.6 Bq/kg in September and 12.1 Bq/kg in November, which correlates closely to the average gross beta results of 9.2 Bq/kg in March, 9.5 Bq/kg in June, 8.9 Bq/kg in September and 9.6 Bq/kg in November.
- 16.8.14 Positive values for tritium were recorded for all but one site in March and September. All sites in June and November recorded positive values. The average concentration of tritium varies between 4 Bq/l in September to 38 Bq/l in June when two of the results exceeded 100 Bq/l. The levels of tritium vary from the top to the bottom of the water column, with the highest top of water column result being reported as 79 Bq/l and the highest bottom of the water column result being reported as 188 Bq/l. The average water column values for H-3, are 30 Bq/l for the top of the water column and 49 Bq/l for the bottom. Further investigation into these results is ongoing.
- 16.8.15 Positive values for carbon-14 were detected in a small proportion of the samples. An investigation into the analytical method employed is underway as it is suspected that these results consist of false positives.
- 16.8.16 High resolution gamma spectrometry analysis of the samples did not identify any positive values in March. In June, positive values were identified as follows:
- Caesium-137 (Cs-137) was detected in 7 samples at levels very close to the detection limit;
 - Thallium-208 (TI-208) was detected in 1 sample at close to the detection limit;

- Lead-212 (Pb-212) was detected in 14 samples at levels close to the detection limit; and
 - Lead-214 (Pb-214) was detected in 3 samples at levels close to the detection limit.
- 16.8.17 In September, positive values were identified as follows:
- Thallium-208 (TI-208) was detected in 2 samples at the limit of detection;
 - Lead-212 (Pb-212) was detected in 10 samples at levels close to the detection limit; and
 - Lead-214 (Pb-214) was detected in 3 samples at levels close to the detection limit.
- 16.8.18 In November, positive values were identified as follows:
- Thallium-208 (TI-208) was detected in 1 sample at the limit of detection;
 - Lead-212 (Pb-212) was detected in 4 samples at levels close to the detection limit; and
 - Lead-214 (Pb-214) was detected in 1 sample at levels close to the detection limit.
- 16.8.19 Thallium-208, lead-212 and lead-214 are naturally occurring.
- 16.8.20 The preliminary conclusion is that there are no concerns with regards to the levels of gross alpha, gross beta, carbon-14 (C-14) and gamma-emitting radionuclides. The carbon-14 and tritium results require further assessment before a baseline conclusion can be reached.

Intertidal sediments

- 16.8.21 The results show that positive samples were found for the following: gross alpha, gross beta, C-14, K-40, Cs-137, TI-208, lead-210 (Pb-210), Pb-212, Pb -214, bismuth-212 (Bi-212), bismuth-214 (Bi-214), radium-226 (Ra-226), actinium-228 (Ac-228), thorium-234 (Th-234), uranium-235 (U-235) and americium-241 (Am-241) collected during the water quality surveys found positive readings for most radionuclides. Most of these are naturally occurring radionuclides and their daughter products.
- 16.8.22 One site contained elevated activity concentration of gross alpha (approximately 0.9 Bq/g) in relation to the rest of the sampling campaign. Two other depths at the same location were considered to be consistent with the rest of the sampling set. Further analysis of this sample is being considered.
- 16.8.23 Positive results were found for 97 % of sites for Cs-137. Most of these were very low, around or below 0.05 Bq/g. A higher activity concentration was found at one site, with a value of 0.25 Bq/g. The other two depths on this transect were considered to be consistent with the rest of the sampling set. All of these levels fall below the EPR10 guideline values.

16.8.24 Further assessment is required before a baseline conclusion can be reached.

Subtidal sediments

- 16.8.25 Positive samples were found for the following: gross alpha, gross beta, C-14, K-40, cobalt-60 (Co-60), ruthenium-106 (Ru-106), antimony-125 (Sb-125), Cs -137, europium-154 (Eu-154), Tl-208, Pb-210, Pb-212, Pb-214, Bi-212, Bi-214, Ra-226, Ac-228, Th-234, Pa-233, U-235 and Am-241. The majority of these are naturally occurring radionuclides and their daughter products.
- 16.8.26 There is evidence that a residual gross alpha activity remains in all of the samples once the contribution of Am-241 has been accounted for. Further analysis of a subset of the samples for plutonium-alpha and uranium-alpha is planned.
- 16.8.27 There is a weak correlation between sediment size and the activity concentration of gross alpha. A slightly stronger correlation is recorded for sediment size and activity concentration of gross beta.
- 16.8.28 One sample site had substantially higher activity concentrations for gross alpha and gross beta than any other site. There is well documented build-up of americium, plutonium and fission products in the estuary.
- 16.8.29 Further analysis and assessment of the results is required before a baseline conclusion can be reached.

Predicted residual effects and their significance

- 16.8.30 The evaluation tables below have been completed based on the most up to date information available on the project design and the magnitude and significance tables set up in methods highlighted above. The assessment set out in the tables assumes the incorporated environmental measures set out above.
- 16.8.31 For Drigg Coast SAC, Natural England's Marine conservation advice for Special Area of Conservation⁷ was used to assess significance of impacts.
- 16.8.32 Impact assessments in **Table 16.6 to Table 16.9** are only completed where sufficient design information is available. Where there is uncertainty or a full assessment is not possible at this time, potential impacts are noted but there is no assessment of significance (this will be done in the ES for submission in 2017).

⁷ <https://www.gov.uk/government/publications/marine-conservation-advice-for-special-area-of-conservation-drigg-coast-uk0013031>

Table 16.6 Development at the Moorside Site: Summary of predicted residual effects

Receptor and summary of predicted effects	Probability	Sensitivity/value of receptor	Magnitude of change	Significance of effect	Rationale
Construction					
Cumbria WFD coastal water body GB641211630002 (including tidal stretch of River Ehen)					
Disturbance or discharges of contaminated sediments from construction activities affecting marine water quality	Likely	High	Low	Moderate (Potentially significant)	<p>Sensitivity = High, due to water quality elements being and good or high status. Magnitude of impact after mitigation = Low due to suitable mitigation although there is uncertainty over the magnitude of residual impacts after mitigation. This will be addressed for in the ES for 2017.</p> <p>The Cumbria WFD coastal water body is highly sensitive to changes in water quality due to water quality elements being at good or high status. Although the water body is sensitive to weather impacts on the seabed, construction of marine infrastructure at the Moorside Site (i.e. MOLF, including breakwaters, intake and outfall seabed structures, beach landings and intake and outfall shafts constructed for the Moorside Site) could potentially increase the mobilisation of contaminated sediments into the water column. This could cause a temporary failure of WFD standards. More information on the construction methodology within the coastal water body is required to identify the full scale of any potential impacts on WFD compliance.</p>

Receptor and summary of predicted effects	Probability	Sensitivity/value of receptor	Magnitude of change	Significance of effect	Rationale
Deterioration in marine water quality due to run-off from the Moorside Site during construction	Unlikely	High	Very Low	Minor (Not Significant)	<p>Sensitivity = High, due to water quality elements being and good or high status. Magnitude of impact after mitigation = Very Low due to suitable mitigation.</p> <p>The Cumbria WFD coastal water body is highly sensitive to changes due to water quality elements being at good or high status under the WFD and with implementation of environmental measures described above in Table 16.2, discharge of suspended solids and contaminants during the construction phase of the project on the Moorside Site would only be temporary and is unlikely to result in significant or long term changes in marine water quality. Suitable drainage systems will be used to mitigate any significant sources. These measures will be defined in the CEMP and will be subject to environmental permit conditions.</p>
Spillages from plant operations (including vessels) or on-site activities affecting marine water quality.	Unlikely	High	Very Low	Minor (Not Significant)	<p>Sensitivity = High, due to water quality elements being and good or high status. Magnitude of impact after mitigation = Very Low due to suitable mitigation.</p> <p>The Cumbria coastal water body is highly sensitive to changes due to water quality elements being at good or high status under the WFD. Any accidental spillages would be temporary and unlikely to cause long term or significant changes due to implementation of environmental measures described above in Table 16.2 and measures defined in the CEMP.</p>

Receptor and summary of predicted effects	Probability	Sensitivity/value of receptor	Magnitude of change	Significance of effect	Rationale
Deterioration in marine water quality due to discharges of treated sewage effluent from either a new treatment plant or Braystones Waste Water Treatment Works (WwTW). Including emergency discharges from the sewer network due to storm events.	Likely	High	Very Low	Minor (Not Significant)	<p>Sensitivity = High, due to water quality elements being at good or high status. Magnitude of impact after mitigation = Very Low due to suitable mitigation.</p> <p>The Cumbria coastal water body is highly sensitive to changes due to water quality elements being at good or high status under the WFD. There will be an increase of treated sewage effluent from the Moorside Site whether from a discharge to the Ehen or a direct discharge to the Cumbria coastal water body (this could also include accidental releases of sewage and sewage from the Egremont Development if they use the same sewage treatment option). Both scenarios have the potential to impact on marine water quality. In particular this may increase the amount of phosphates, nitrates and ammonia entering the coastal waters. Any new or increased sewage discharges will be subject to appropriate treatment and discharge arrangements designed to prevent significant impacts and will be regulated through environmental permit conditions (either new or through existing infrastructure) which will significantly reduce the level of potential impact.</p>

Receptor and summary of predicted effects	Probability	Sensitivity/value of receptor	Magnitude of change	Significance of effect	Rationale
<p>Deterioration in sub tidal and intertidal sediment quality</p>	<p>Unlikely</p>	<p>Low</p>	<p>Low</p>	<p>Negligible (Not Significant)</p>	<p>Sensitivity = Low, due to current quality of sediments. Magnitude of impact after mitigation = Low due to suitable mitigation.</p> <p>Sediment quality has a low sensitivity to change as the subtidal sediments have several chemicals that are higher than the Cefas action levels. With implementation of environmental measures defined above in Table 16.2, the construction phase of the project as it applies to the Moorside Site is unlikely to significantly increase the discharge of sediments via surface water runoff beyond current inputs (and existing inputs could potentially be reduced with appropriate drainage from the Moorside Site). Thus the quality of subtidal and intertidal sediments is unlikely to be impacted by discharges into the marine environment. Suitable drainage systems will be used to mitigate any significant sources. These measures will be defined in the CEMP and will be subject to environmental permit conditions.</p>

Receptor and summary of predicted effects	Probability	Sensitivity/value of receptor	Magnitude of change	Significance of effect	Rationale
<p>Deterioration in water quality due to increased shipping</p>	<p>Unlikely</p>	<p>High</p>	<p>Very Low</p>	<p>Minor (Not Significant)</p>	<p>Sensitivity = High, due to water quality elements being and good or high status. Magnitude of impact after mitigation = Very Low due to suitable mitigation.</p> <p>The Cumbria WFD coastal water body is highly sensitive to changes due to water quality elements being at good or high status under the WFD. Although there will be an increase in shipping movements along this part of the coast during the construction phase (primarily in relation to shipping access to the MOLF), there is not expected to be a significant increase in shipping movements overall relative to the baseline position and therefore no significant increases in inputs of oils, hydrocarbons and sediment disturbance are anticipated. As a result it is currently considered to be unlikely that there will be a significant impact on marine water quality beyond impacts identified elsewhere in this table.</p>

Receptor and summary of predicted effects	Probability	Sensitivity/value of receptor	Magnitude of change	Significance of effect	Rationale
Drigg Coast SAC (water quality only)					
Deterioration in marine water quality	Unlikely	Very High	Low	Major (significant)	<p>Sensitivity = Very High, due to SAC designation. Magnitude of impact after mitigation = Low to provide a worst case scenario as there is uncertainty over the level of impacts the mitigation may reduce. This will be addressed for in the ES for 2017.</p> <p>This SAC includes marine and non-marine interest features. Water quality is only relevant to the former. The statutory advice provided by Natural England under Regulation 35 of the Conservation of Habitats and Species Regulations 2010 has identified that the marine interest features of this site are sensitive to increases in nutrients and to organic pollution. The site is sufficiently remote from the Moorside Site such that changes in nutrient and organic concentrations during construction (as a result of treated sewage discharges from the Moorside Site) are expected to be very low. This conclusion is subject to a review of water quality modelling for which outputs are anticipated for the 2017 application for a DCO for the Moorside Project.</p> <p>This assessment will be kept under review for the ES and will be subject to change once further design information is available.</p>

Receptor and summary of predicted effects	Probability	Sensitivity/value of receptor	Magnitude of change	Significance of effect	Rationale
St Bees and Seascale Bathing Waters					
Deterioration in marine water quality due to discharges of treated sewage effluent from either a new treatment plant or Braystones WwTW. Including emergency discharges from the sewer network due to storm events.	Unlikely	High	Low	Moderate (Potentially Significant)	<p>Sensitivity = High, bathing beach designation. Magnitude of impact after mitigation = Low</p> <p>The bathing waters are highly sensitive to changes in water quality due to it currently being at good status under the WFD. There will be an increase of treated sewage effluent from the Moorside Site whether from a discharge to the Ehen or a direct discharge to the Cumbria coastal water body (this could also include accidental releases of sewage and sewage from Egremont Development if they use the same sewage treatment option). Both scenarios have the potential to impact on marine water quality. In particular this may increase the amount of enteric bacteria entering the coastal waters. Any new or increased sewage discharges will be subject to appropriate treatment and discharge arrangements designed to prevent significant impacts and will be regulated through environmental permit conditions which will significantly reduce the level of potential impact. Additionally the nature of the tidal ellipses and the distance between the potential discharge and the beaches significantly reduces the potential magnitude of impact.</p> <p>This assessment will be kept under review for the ES and may be subject to change once further design information is available.</p>
Ravenglass Shellfish Water					
Deterioration in marine water quality due to	Unlikely	High	Very Low	Minor (Not Significant)	Sensitivity = High, shellfish water designation.

Receptor and summary of predicted effects	Probability	Sensitivity/value of receptor	Magnitude of change	Significance of effect	Rationale
<p>discharges of treated sewage effluent (including emergency discharges from the sewer network due to storm events) and disturbance of polluted sediments.</p>					<p>Magnitude of impact after mitigation = Very Low as mitigation is available in the form of disinfection of treated sewage discharges. This will be addressed for in the ES for 2017.</p> <p>The shellfish waters are highly sensitive to changes in water quality due to it currently being at good status under the WFD. There will be an increase of treated sewage effluent from the Moorside Site whether from a discharge to the Ehen or a direct discharge to the Cumbria coastal water body from Braystones WwTW (this could also include accidental releases of sewage and sewage from the Egremont development if they use the same sewage treatment option). Both scenarios have the potential to impact on marine water quality. In particular this may increase the amount of enteric bacteria entering the coastal waters. Any new or increased sewage discharges will be subject to appropriate treatment and discharge arrangements designed to prevent significant impacts and will be regulated through environmental permit conditions which will significantly reduce the level of potential impact. Additionally the nature of the tidal ellipses and the distance between the potential discharge and the beaches significantly reduces the potential magnitude of impact from both treated effluent discharges and any disturbed sediment. Full mitigation is available if required using disinfection techniques.</p> <p>This assessment will be kept under review for the ES and may be subject to change once further design information is available.</p>

Receptor and summary of predicted effects	Probability	Sensitivity/value of receptor	Magnitude of change	Significance of effect	Rationale
Operation					
Cumbria WFD Coastal water body, GB641211630002 (including tidal stretch of the River Ehen)					
Increase in water temperature from cooling water discharge	Likely	High	Low	Moderate (Potentially Significant)	<p>Sensitivity = High, due to water quality elements being at good or high status. Magnitude of impact after mitigation = Low due to initial modelling indicating limited range of the thermal plume.</p> <p>The Cumbria WFD coastal water body is highly sensitive to changes due to water quality elements being at good or high status under the WFD. The operational phase of the Moorside Project will include the discharge of water used for cooling into the marine environment from the Moorside Power Station. This will create a thermal plume which will be at a higher temperature than the surrounding coastal water. The discharge could have direct and indirect effects on water quality. Diffusers will be used for the discharge, however further hydrodynamic modelling is required to be able to fully assess any potential impacts. This will be reported on in the ES to be submitted in 2017.</p>
Deterioration in marine water quality resulting from discharges of process effluents.	Likely	High	Very Low	Minor (Not Significant)	<p>Sensitivity = High, due to water quality elements being at good or high status. Magnitude of impact after mitigation = Very Low due to the potential for appropriate mitigation and dilution provided before discharge by the cooling water flow.</p> <p>The Cumbria WFD coastal water body is highly sensitive to changes due to water quality elements being at good or high status under the WFD. The operational phase of the Moorside Project will include the discharge of process effluents to the marine environment via the cooling water</p>

Receptor and summary of predicted effects	Probability	Sensitivity/value of receptor	Magnitude of change	Significance of effect	Rationale
					outfall. The discharge could affect marine water quality. However, permits will be sought for any new discharge and relevant standards will limit any potential impact. This assessment will be kept under review for the ES and may be subject to change once further design information is available.
Deterioration in marine water quality resulting from discharges of treated sewage effluent from either a new treatment plant or Braystones WwTW. Including emergency discharges from the sewer network due to storm events.	Likely	High	Low	Moderate (potentially significant)	<p>Sensitivity = High, due to water quality elements being and good or high status. Magnitude of impact after mitigation = Low rather than very low to provide a worst case scenario as there is uncertainty over the level of impacts the mitigation may reduce. This will be addressed in the ES for 2017.</p> <p>The Cumbria WFD coastal water body is highly sensitive to changes due to water quality elements being at good or high status under the WFD. There will be an increase of treated sewage effluent from the Moorside Site whether from a discharge to the Ehen or a direct discharge to the Cumbria coastal water body (this could also include accidental releases of sewage and sewage from the Egremont Development if they use the same sewage treatment option). Both scenarios have the potential to impact on marine water quality. In particular, this may increase the amount of phosphates, nitrates and ammonia entering the coastal waters. Any new or increased sewage discharges will be subject to appropriate treatment and discharge arrangements designed to prevent significant impacts and will be regulated through environmental permit conditions (either new or through existing infrastructure) which will significantly reduce the level of potential impact. Any proposed discharge of treated</p>

Receptor and summary of predicted effects	Probability	Sensitivity/value of receptor	Magnitude of change	Significance of effect	Rationale
					sewage via the main outfall will be subject to detailed water quality modelling.
Deterioration in marine water quality from chemicals used to keep intakes and outfalls clear of biofouling.	Likely	High	Low	Moderate (Potentially Significant)	<p>Sensitivity = High, due to water quality elements being and good or high status. Magnitude of impact after mitigation = Low due the potential for appropriate mitigation.</p> <p>The Cumbria WFD coastal water body is highly sensitive to changes due to water quality elements being at good or high status under the WFD. There could be adverse effects on water quality from discharges of chemicals used to keep the intake and outfall clear of biofouling. Appropriate environmental permit conditions should address these effects. However, further hydrodynamic modelling is required to be able to fully assess any potential effects.</p>
Deterioration in sub tidal and intertidal sediment quality from the CWS discharge	Likely	Low	Medium	Minor (Not Significant)	<p>Sensitivity = Low, due to current quality of sediments. Magnitude of impact after mitigation = Medium due to mitigation but low certainty as detailed design information is currently being developed.</p> <p>Sediment quality has a low sensitivity to change as analysis of subtidal sediment samples has recorded several chemicals higher than Cefas Action Levels. With implementation of environmental measures defined above in Table 16.2, the CWS could still have an impact on sediment quality; however, with no detailed design information the scale of the impact is uncertain. The quality of subtidal and intertidal sediments is unlikely to be significantly impacted by discharges into the marine</p>

Receptor and summary of predicted effects	Probability	Sensitivity/value of receptor	Magnitude of change	Significance of effect	Rationale
					environment and appropriate permitting should limit any impacts.
<p>Deterioration in subtidal and intertidal sediment quality resulting from discharges of process effluents.</p>	Unlikely	Low	Low	Negligible (Not Significant)	<p>Sensitivity = Low to current quality of the sediments. Magnitude of impact after mitigation = Low due appropriate mitigation.</p> <p>Sediment quality has a low sensitivity to change as analysis of subtidal sediment samples has recorded several chemicals higher than Cefas Action Levels. With implementation of environmental measures defined above in Table 16.2, the operational phase of the project, as it applies to the Moorside Site, is unlikely to increase significantly the discharge of sediments via surface water runoff beyond current inputs (and existing inputs could potentially be reduced with appropriate drainage from the Moorside Site). Thus, the quality of subtidal and intertidal sediments is unlikely to be impacted by discharges into the marine environment. Suitable drainage systems will be used to mitigate any significant sources. These measures will be defined in the CEMP and will be subject to environmental permit conditions.</p>

Receptor and summary of predicted effects	Probability	Sensitivity/value of receptor	Magnitude of change	Significance of effect	Rationale
Drigg Coast SAC (water quality only)					
Increase in water temperature from Cooling Water System Discharge	Likely	Very High	Medium	Major (Significant)	<p>Sensitivity = Very High, due to SAC designation. Magnitude of impact after mitigation = Medium so as to provide a worst case scenario due to uncertainty over results of modelling and how much the mitigation will reduce the level of impact.</p> <p>This site includes marine and non-marine interest features; marine water quality is only relevant to the former. The statutory advice provided by Natural England under Regulation 35 of the Conservation of Habitats and Species Regulations 2010** has identified that some of the marine interest features of this site are sensitive to changes in thermal regime. The SAC is not subject to specific water quality targets; however, there is a quality standard for temperature in the SAC. The average temperature gradient throughout the SAC should not deviate significantly from an established baseline, subject to natural change. The operational phase of the Moorside Project will have an effect on the temperature of the marine environment. However, further hydrodynamic modelling is required to be able properly to assess any potential effects on the thermal regime within the SAC.</p> <p>This will be kept under review for the ES and will be reported on fully once further design information is available.</p>

Receptor and summary of predicted effects	Probability	Sensitivity/value of receptor	Magnitude of change	Significance of effect	Rationale
Deterioration in marine water quality	Unlikely	Very High	Low	Major (significant)	<p>Sensitivity = Very High as a result of SAC designation. Magnitude of impact after mitigation = Low rather than very low to provide a worst case scenario as there is uncertainty over the level of impacts the mitigation may reduce. This will be addressed in the ES for 2017.</p> <p>This site includes marine and non-marine interest features; marine water quality is only relevant to the former. The statutory advice provided by Natural England under Regulation 35 of the Conservation of Habitats and Species Regulations 2010** has identified that some of the marine interest features of this site are sensitive to changes in sediment regime, nutrient enrichment and organic enrichment. The SAC is not subject to specific water quality targets; effects of changes in water quality are therefore assessed in Chapter 17, Marine Ecology. The site is sufficiently remote from the Moorside Site that changes in nutrient and organic concentrations during operation (as a result of any treated sewage discharges from the Moorside site) are expected to be very low.</p> <p>This assessment will be kept under review for the ES and may be subject to change once further design information is available.</p>

Receptor and summary of predicted effects	Probability	Sensitivity/value of receptor	Magnitude of change	Significance of effect	Rationale
St Bees and Seascale Bathing Waters					
<p>Deterioration in marine water quality due to discharges of treated sewage effluent from either a new treatment plant or Braystones WwTW. Including emergency discharges from the sewer network due to storm events.</p>	<p>Unlikely</p>	<p>High</p>	<p>Very Low</p>	<p>Minor (Not Significant)</p>	<p>Sensitivity = High, bathing water designation. Magnitude of impact after mitigation = Very Low as mitigation is available in the form of disinfection of treated sewage discharges. This will be addressed for in the ES for 2017.</p> <p>The bathing waters are highly sensitive to changes in water quality due to it currently being at good status under the WFD. There will be an increase of treated sewage effluent from the Moorside Site whether from a discharge to the Ehen or a direct discharge to the Cumbria coastal water body (this could also include accidental releases of sewage and sewage from the Egremont Development if they use the same sewage treatment option). Both scenarios have the potential to impact on marine water quality. In particular, this may increase the amount of enteric bacteria entering the coastal waters. Any new or increased sewage discharges will be subject to appropriate treatment and discharge arrangements designed to prevent significant impacts and will be regulated through environmental permit conditions which will significantly reduce the level of potential impact. Additionally the nature of the tidal ellipses and the distance between the potential discharge and the beaches significantly reduces the potential magnitude of impact.</p> <p>This assessment will be kept under review for the ES and may be subject to change once further design information is available.</p>

Receptor and summary of predicted effects	Probability	Sensitivity/value of receptor	Magnitude of change	Significance of effect	Rationale
Ravenglass Shellfish Water					
Deterioration in marine water quality due to discharges of treated sewage effluent from either a new treatment plant or Braystones WwTW. Including emergency discharges from the sewer network due to storm events.	Unlikely	High	Very Low	Minor (Not Significant)	<p>Sensitivity = High, shellfish water designation. Magnitude of impact after mitigation = Very Low as mitigation is available in the form of disinfection of treated sewage discharges. This will be addressed for in the ES for 2017.</p> <p>The shellfish water are highly sensitive to changes in water quality due to it currently being at good status under the WFD. There will be an increase of treated sewage effluent from the Moorside Site whether from a discharge to the Ehen or a direct discharge to the Cumbria coastal water body (this could also include accidental releases of sewage and sewage from the Egremont Development if they use the same sewage treatment option). Both scenarios have the potential to impact on marine water quality. In particular, this may increase the amount of enteric bacteria entering the coastal waters. Any new or increased sewage discharges will be subject to appropriate treatment and discharge arrangements designed to prevent significant impacts and will be regulated through environmental permit conditions which will significantly reduce the level of potential impact. Additionally the nature of the tidal ellipses and the distance between the potential discharge and the beaches significantly reduces the potential magnitude of impact.</p> <p>This assessment will be kept under review for the ES and may be subject to change once further design information is available.</p>

Receptor and summary of predicted effects	Probability	Sensitivity/value of receptor	Magnitude of change	Significance of effect	Rationale
Estuaries and tidal stretches of the Rivers Ehen, Irt, Mite and Esk (Ravenglass estuary complex)					
Increase in water temperature from cooling water discharge	Unlikely	High	Very Low	Minor (Not significant)	<p>Sensitivity = High, due to water quality elements being and good or high status. Magnitude of impact after mitigation = Very Low due to initial modelling indicating limited range of the thermal plume.</p> <p>These waters are sensitive to changes in temperature. Taking account of tidal conditions, the thermal plume discharged from the Moorside Power Station outfall is unlikely to have a significant impact on temperature in these estuarine waters. This conclusion is subject to review on completion of water quality modelling for which outputs are anticipated during the first quarter of 2016. (Note that potential indirect effects on river ecology via effects on migratory fish are addressed in Chapter 17, Marine Ecology and Chapter 18, Terrestrial and Freshwater Ecology).</p>

** Regulation 33 of the Conservation (Natural Habitats &c.) Regulations 1994 has subsequently been replaced by Regulation 35 of The Conservation of Habitats and Species Regulations 2010.

Table 16.7 Development at the Corkickle Site: Summary of predicted residual effects

Receptor and summary of predicted effects	Probability	Sensitivity/value of receptor	Magnitude of change	Significance of effect	Rationale
Construction					
Solway Outer South coastal water body GB641211630003					
Deterioration in marine water quality resulting from discharges sewage from temporary facilities	Unlikely	High	No change	No Effect (Not significant)	<p>Sensitivity = High, due to relevant water quality elements being and good status. Magnitude of impact after mitigation = No effect as no sewage would be discharged into the Pow Beck (Whitehaven).</p> <p>The Solway Outer South water body is currently failing for water quality but only for mercury (dissolved oxygen (DO) and dissolved inorganic nitrogen (DIN) are at good status). During the construction phase of the Corkickle Development workers are expected to be using temporary toilet facilities which will be emptied and tankered away to the nearest appropriate WwTW. The volume of sewage is expected to be relatively low and unlikely to have any environmental impact on the Solway Outer South coastal water body.</p> <p>This assessment will be kept under review for the ES and may be subject to change once further design information is available and detailed modelling has been undertaken.</p>

Receptor and summary of predicted effects	Probability	Sensitivity/value of receptor	Magnitude of change	Significance of effect	Rationale
Operation					
Solway Outer South coastal water body GB641211630003					
Deterioration in marine water quality resulting from increased discharges of treated sewage effluent either from a new treatment plant into the Pow Beck or via Parton WwTW's sea outfall . Including emergency discharges from the sewer network due to storm events.	Likely	High	Low	Moderate (Potentially Significant)	<p>Sensitivity = High, due to relevant water quality elements being and good status. Magnitude of impact after mitigation = Low due to appropriate mitigation being available.</p> <p>The Solway Outer South water body is currently failing for water quality but only for mercury (DO and NIN are at good status). As such it is still sensitive to changes in water quality. Effluent from the Corkickle Development could be sent to Parton Wastewater Treatment Works which discharges to the Solway Outer South water body or a new treatment plant which could discharge to the Pow Beck just upstream of the coastal water body. In both cases, there will be an increase in the volume of treated sewage effluent entering the marine environment (this could also include the Mirehouse Development if they use the same sewage treatment option). This may increase the amount of phosphates, nitrates, ammonia and bacteria entering the coastal waters. Sewage discharges will be subject to appropriate treatment and discharge arrangements, designed to prevent significant impacts, and will be regulated through environmental permit conditions (either new or extension of existing permits). Although an impact is expected the magnitude is expected to be Low once mitigation is implemented. This assessment will be kept under review for the ES and may be subject to change once further design information is available and detailed modelling has been undertaken.</p>

Table 16.8 Development at the Mirehouse Site: Summary of predicted residual effects

Receptor and summary of predicted effects	Probability	Sensitivity/value of receptor	Magnitude of change	Significance of effect	Rationale
Construction					
Cumbria WFD coastal water body, GB641211630002					
Deterioration in marine water quality resulting from sewage discharges from temporary facilities	Unlikely	High	No change	No Effect (Not significant)	<p>Sensitivity = High, due to relevant water quality elements being and good or high status. Magnitude of impact after mitigation = No effect as no sewage would be discharged into the Pow Beck (SW lakes).</p> <p>The Cumbria WFD coastal water body is currently failing for water quality but only for mercury (DO and NIN are at good status). During the construction phase of the Mirehouse Development workers are expected to be using temporary toilet facilities which will be emptied and tankered away to the nearest appropriate WwTW. The volume of sewage is expected to be relatively low and unlikely to have any environmental impact on the Cumbria WFD coastal water body.</p> <p>This assessment will be kept under review for the ES and may be subject to change once further design information is available and detailed modelling has been undertaken.</p>

Receptor and summary of predicted effects	Probability	Sensitivity/value of receptor	Magnitude of change	Significance of effect	Rationale
Operation					
Cumbria WFD coastal water body, GB641211630002					
Deterioration in marine water quality resulting from increased discharges of treated sewage effluent via a new treatment plant discharging into the Pow Beck (SW lakes). Including emergency discharges from the sewer network due to storm events.	Unlikely	High	No change	No Effect (Not significant)	<p>Sensitivity = High, due to water quality elements being and good or high status and designated bathing beaches. Magnitude of impact after mitigation = No Effect due the potential for appropriate mitigation.</p> <p>The Cumbria coastal water body is highly sensitive to changes in water quality due to it currently being at good status under the WFD. There could be an increase of treated sewage effluent from a new treatment plant at the Mirehouse Site. However, if this option is used it will discharge into the Pow Beck (SW lakes) sufficiently upstream of the marine environment that there is expected to be no effect on marine water quality. Any new or increased sewage discharges will be subject to appropriate treatment and discharge arrangements designed to prevent significant impacts and will be regulated through environmental permit conditions (either new or through existing infrastructure) which will significantly reduce the level of potential impact. Any proposed discharge of treated sewage will be subject to detailed water quality modelling.</p>

Receptor and summary of predicted effects	Probability	Sensitivity/value of receptor	Magnitude of change	Significance of effect	Rationale
Solway Outer South WFD water body GB641211630003					
<p>Deterioration in marine water quality resulting from increased discharges of treated sewage effluent via Parton WwTW's sea outfall.</p>	<p>Likely</p>	<p>High</p>	<p>Low</p>	<p>Moderate (Potentially Significant)</p>	<p>Sensitivity = High, due to relevant water quality elements being and good status. Magnitude of impact after mitigation = Low due to appropriate.</p> <p>The Solway Outer South water body is currently failing for water quality but only for mercury (DO and NIN are at good status). As such it is still sensitive to changes in water quality. Effluent from Mirehouse Development could be sent to Parton Wastewater Treatment Works which discharges to the Solway Outer South water. If this option is used there will be an increase in the volume of treated sewage effluent entering the marine environment (this could also include the effluent from the Corkickle Development if they use the same sewage treatment option). This may increase the amount of phosphates, nitrates, ammonia and bacteria entering the coastal waters. Sewage discharges will be subject to appropriate treatment and discharge arrangements, designed to prevent significant impacts, and will be regulated through environmental permit conditions (either new or extension of existing permits). Although an impact is expected the magnitude is expected to be Low once mitigation is implemented. This assessment will be kept under review for the ES and may be subject to change once further design information is available and detailed modelling has been undertaken.</p>

Receptor and summary of predicted effects	Probability	Sensitivity/value of receptor	Magnitude of change	Significance of effect	Rationale
St Bees Bathing Water					
<p>Deterioration in marine water quality resulting from increased discharges of treated sewage effluent via a new discharge into the Pow Beck (SW lakes). Including emergency discharges from the sewer network due to storm events.</p>	<p>Unlikely</p>	<p>High</p>	<p>No change</p>	<p>No Effect (Not significant)</p>	<p>Sensitivity = High, bathing water designation. Magnitude of impact after mitigation = No effect as sewage would be discharged into the Pow Beck (SW lakes) sufficiently far upstream not to impact on the bathing beach.</p> <p>The bathing water is highly sensitive to changes in water quality due to its designated use. There could be an increase of treated sewage effluent from a new treatment plant at the Mirehouse Site. However, if this option is used it will discharge into the Pow Beck (SW lakes) sufficiently upstream of the marine environment that there is expected to be no effect on marine water quality. Any new or increased sewage discharges will be subject to appropriate treatment and discharge arrangements designed to prevent significant impacts and will be regulated through environmental permit conditions (either new or through existing infrastructure) which will significantly reduce the level of potential impact. Any proposed discharge of treated sewage via the main outfall will be subject to detailed water quality modelling.</p> <p>This assessment will be kept under review for the ES and may be subject to change once further design information is available.</p>

Table 16.9 Development at the Egremont Site: Summary of predicted residual effects

Receptor and summary of predicted effects	Probability	Sensitivity/value of receptor	Magnitude of change	Significance of effect	Rationale
Construction					
Cumbria coastal water body, GB641211630002 (including tidal stretch of the River Ehen)					
Deterioration in marine water quality resulting from discharges sewage from temporary facilities	Unlikely	High	No change	No Effect (Not significant)	<p>Sensitivity = High, due to relevant water quality elements being and good or high status. Magnitude of impact after mitigation = No effect due to appropriate mitigation.</p> <p>Water quality in the Cumbria coastal water body is currently at good status or above. During the construction phase of the Egremont Development, workers are expected to be using temporary toilet facilities which will be emptied and tankered away to the nearest appropriate WwTW. The volume of sewage is expected to be relatively low and unlikely to have any environmental impact on the Cumbria coastal water body.</p> <p>This assessment will be kept under review for the ES and may be subject to change once further design information is available and detailed modelling has been undertaken.</p>

Receptor and summary of predicted effects	Probability	Sensitivity/value of receptor	Magnitude of change	Significance of effect	Rationale
Operation					
Cumbria coastal WFD water body, GB641211630002 (including tidal stretch of the River Ehen)					
Deterioration in marine water quality resulting from discharges of treated sewage effluent from either a new treatment plant or Braystones WwTW. Including emergency discharges from the sewer network due to storm events.	Likely	High	Very Low	Minor (Not Significant)	<p>Sensitivity = High, due to water quality elements being and good or high status. Magnitude of impact after mitigation = Very Low due the potential for appropriate mitigation.</p> <p>The Cumbria coastal water body is highly sensitive to changes in water quality due to it currently being at good or above status under the WFD. There will be an increase of treated sewage effluent from the Egremont Development whether from a discharge to the River Ehen or a direct discharge to the Cumbria coastal water body (this could also include accidental releases of sewage and sewage from Moorside Site if they use the same sewage treatment option). Both scenarios have the potential to impact on marine water quality. In particular this may increase the amount of phosphates, nitrates and ammonia entering the coastal waters. Any new or increased sewage discharges will be subject to appropriate treatment and discharge arrangements designed to prevent significant impacts and will be regulated through environmental permit conditions (either new or through existing infrastructure) which will significantly reduce the level of potential impact. Any proposed discharge of treated sewage via the main outfall will be subject to detailed water quality modelling.</p>

Receptor and summary of predicted effects	Probability	Sensitivity/value of receptor	Magnitude of change	Significance of effect	Rationale
Ravenglass Shellfish Water					
Deterioration in marine water quality due to discharges of treated sewage effluent from either a new treatment plant or Braystones WwTW. Including emergency discharges from the sewer network due to storm events.	Unlikely	High	Very Low	Minor (Not Significant)	<p>Sensitivity = High, shellfish water designation. Magnitude of impact after mitigation = Very Low as mitigation is available in the form of disinfection of treated sewage discharges. This will be addressed for in the ES for 2017.</p> <p>The shellfish waters are highly sensitive to changes in water quality due to it designated use. There will be an increase of treated sewage effluent from the Egremont Development whether from a discharge to the Ehen or a direct discharge to the Cumbria coastal water body (this could also include accidental releases of sewage and also sewage from the Moorside Site if they use the same sewage treatment option). Both scenarios have the potential to impact on marine water quality. In particular, this may increase the amount of enteric bacteria entering the coastal waters. Any new or increased sewage discharges will be subject to appropriate treatment and discharge arrangements designed to prevent significant impacts and will be regulated through environmental permit conditions which will significantly reduce the level of potential impact. Additionally, the nature of the tidal ellipses and the distance between the potential discharge and the shellfish waters significantly reduces the potential magnitude of impact.</p> <p>This assessment will be kept under review for the ES and may be subject to change once further design information is available.</p>

Receptor and summary of predicted effects	Probability	Sensitivity/value of receptor	Magnitude of change	Significance of effect	Rationale
St Bees and Seascale Bathing Waters					
<p>Deterioration in marine water quality resulting from increased discharges of treated sewage effluent via Braystone WwTWs sea outfall or a new discharge. Including emergency discharges from the sewer network due to storm events.</p>	<p>Unlikely</p>	<p>High</p>	<p>Very Low</p>	<p>Minor (Not Significant)</p>	<p>Sensitivity = High, bathing water designation. Magnitude of impact after mitigation = Very Low as mitigation is available in the form of disinfection of treated sewage discharges. This will be addressed for in the ES for 2017.</p> <p>The bathing water are highly sensitive to changes in water quality due to their designated use. There will be an increase of treated sewage effluent from the Egremont Development whether from a discharge to the Ehen or a direct discharge to the Cumbria coastal water body (this could also include accidental releases of sewage and also sewage from the Moorside Site if they use the same sewage treatment option). Both scenarios have the potential to impact on marine water quality. In particular, this may increase the amount of enteric bacteria entering the coastal waters. Any new or increased sewage discharges will be subject to appropriate treatment and discharge arrangements designed to prevent significant impacts and will be regulated through environmental permit conditions which will significantly reduce the level of potential impact. Additionally, the nature of the tidal ellipses and the distance between the potential discharge and the bathing beaches significantly reduces the potential magnitude of impact.</p> <p>This assessment will be kept under review for the ES and may be subject to change once further design information is available.</p>

16.9 Whole Moorside Project Assessment

- 16.9.1 An assessment of the Moorside Project as a whole will be included in the ES. For the purposes of this PEIR, due to the limitations set out above, the PEIR has looked at the Moorside Site and the Accommodation Sites together and considered whether there would be any additional, "*accumulated effects*" on specific environmental receptors. Some construction and operational activities on the Moorside Site and Accommodation Sites could result in direct discharges to the coastal waters (e.g. discharges from the Moorside Site and discharges of treated sewage effluent if directed to United Utilities (UU) infrastructure). No impacts to the marine environment are expected from the Additional Sites. The ES will include all Moorside Project Sites in this assessment once the data becomes available.
- 16.9.2 The following paragraphs contain a preliminary high-level accumulated effects assessment of the effects to marine and sediment quality arising from the whole Moorside Project, taking into account the preliminary residual effects assessments for the individual project elements contained in **Tables 16.6 to 16.9** above. However, it should be noted that it is not possible at this stage to determine the magnitude of change and therefore the significance of whole Moorside Project marine water and sediment quality effects because of the on-going work on certain detailed design information. Full detailed assessments will be carried out subsequently and reported in the ES that is due to be submitted in 2017.
- 16.9.3 During both the construction and operational phases of the Moorside Project, accumulated effects could be seen from the following combination of Moorside Project Sites:
- The Moorside Site and the Egremont Site affecting the Cumbria coastal water body, Ravenglass shellfish waters and designated bathing waters; and
 - The Corkickle Site and the Mirehouse Site affecting the Solway Outer South water body (note this is would only be the case if sewage effluent from both sites were directed to UU's Parton WwTW).
- 16.9.4 The resulting whole project effects are summarised in **Table 16.10**.

Table 16.10 Summary of predicted residual marine water quality effects - whole project, construction and operational phases

Receptors	Whole Project accumulated effects /Significance of effects*				
	Moorside Site	Corkickle Site	Mirehouse Site	Egremont Site	Whole Moorside Project
Water and sediment quality of the Cumbria coastal water body	Potentially Significant	No Effects	No Effects	Potentially Significant	Potentially Significant
Water quality of designated Bathing Waters	Potentially Significant	No Effects	No Effects	Potentially Significant	Potentially Significant
Water quality of designated Ravenglass shellfish water	Potentially Significant	No Effects	No Effects	Potentially Significant	Potentially Significant
Water quality of Solway Outer South Coast water body	No Effects	Potentially Significant	Potentially Significant	No Effects	Potentially Significant

* The preliminary effects summarised under each Moorside Project Site by receptor are subject to change for individual receptors and groups of receptors as more project design information becomes available and will be reported in the ES that is to be submitted in 2017.

16.10 Preliminary assessment of cumulative effects

Scope of the assessment

- 16.10.1 As outlined in **Section 3.4**, an exercise has been undertaken to determine which other (non-Moorside) developments should be considered in the context of their ability to result in cumulative adverse environmental effects with the Moorside Project.
- 16.10.2 Of the other developments described in **Section 3.4**, listed in **Table 3.4** and considered in the context of **Table 3.9**, in terms of effects on marine water and sediment, it is considered appropriate at this stage not to consider the following projects on the basis that they unlikely to have a cumulative impact on marine water and marine sediment quality:
- 1. North West Coast Connections (NWCC), West Cumbria (National Grid)
 - 2. Whitehaven Coking Coal Project (West Cumbria Mining)
 - 3. Low Level Waste Repository, Drigg (LLWR Ltd)
 - 4. West Cumbria Water Supply Pipeline (United Utilities);

- 5. Walney Extension Wind Farm (Dong Energy);
- 6. Barrow-in-Furness Site (BAE Systems);
- 7. Ulverston Biopharmaceutical Manufacturing Facility (GSK);
- 8. Heysham New Nuclear Power Station (EDF Energy); and
- 9. Tidal Lagoon West Cumbria (Tidal Lagoon Power).

16.10.3 However, it should be noted that the situation with respect to the above sites will be kept under review during the preparation of the EIA, pending the availability of information from the respective developers regarding their own Study Areas.

16.10.4 Of the remaining other developments considered in Table 3.4, these are briefly discussed in the context of their likely interaction with respect to marine water and sediment quality in the sub-sections below. However, the sites will be kept under review during the preparation of the EIA, pending the availability of information from the respective developers regarding their own Study Areas.

Sellafield Site Decommissioning (Sellafield Ltd/Nuclear Decommissioning Authority)

16.10.5 The Sellafield Site Decommissioning project has the potential to interact with the Moorside Project, particularly with respect to the Moorside Site itself. This would notably occur during the construction phase of the Moorside Site, when potentially significant cumulative effects could occur with respect to surface water drainage impacts on the Cumbria coastal water body.

16.11 Consideration of additional mitigation

16.11.1 At this stage, all of the mitigation measures, which are anticipated will be required, are incorporated into the development proposals and are considered in the assessment of effects outlined in **Section 16.8**. However, if it emerges during the preparation of the ES that additional, non-incorporated measures, need to be considered, the relevant details will be presented in the ES.

16.12 References

1. Defra/ Environment Agency. (2016). River Basin Management Plan: North West River Basin District.
2. Defra (2015). Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015.
3. UK Technical Advisory Group on the Water Framework Directive (2008). UK Environmental Standards and Conditions (Phase 2), Final, SR1 - 2007.
4. BEEMS. (2011). Thermal standards for cooling water from new build nuclear power stations. Scientific Advisory Report Series 2011, no. 008.
5. Canadian Council of Ministers of the Environment (1995). Protocol for the derivation of Canadian sediment quality guidelines for the protection of aquatic life. CCME EPC-98E. Prepared by Environment Canada, Guidelines Division,

- Technical Secretariat of the CCME Task Group on Water Quality Guidelines, Ottawa.
6. IADC/CEDA (1997). Environmental aspects of dredging - conventions, codes and conditions: marine disposal. International Association of Dredging Companies (IADC) & Central Dredging Association (CEDA), Netherlands, 1-71
 7. Environment Agency (2012). Clearing the Waters. A user guide for marine dredging activities.
 8. Davies, J., Baxter, J., Bradley, M., Connor, D., Khan, J., Murray, E., Sanderson, W., Turnbull, C. & Vincent, M., (2001), Marine Monitoring Handbook. 405 pp, ISBN 1 85716 550 0.
 9. MARG (2011). UK Clean Seas Environment Monitoring Programme (CSEMP). Green Book. Marine Assessment and Review Group (MARG). Available at www.cefas.defra.gov.uk/media/510362/greenbookv15.pdf
 10. UK Technical Advisory Group on the Water Framework Directive (2014). UKTAG Transitional and Coastal Water Assessment Method: Benthic invertebrate fauna. Infaunal Quality Index. By the Water Framework Directive - United Kingdom Technical Advisory Group WFD-UKTAG). 22pp
 11. Met Office. (2014). St Bees Head Climate Statistics. <http://www.metoffice.gov.uk/public/weather/climate/>. Accessed September 2014.
 12. Defra (2013). 2013 compliance report for Bathing Waters in England. 17pp.