

CHAPTER 9: GROUND CONDITIONS AND CONTAMINATION

9. GROUND CONDITIONS AND CONTAMINATION

9.1 Introduction

This chapter presents an assessment of the likely significant effects of the development on soil and ground conditions. In particular, it considers the likely significant effects of ground contamination on human health and the quality of surface waters and groundwater.

The chapter provides a summary of the legislative and planning policy context and a description of the methods used in the assessment. This is followed by a description of the relevant baseline conditions of the site and surrounding area, and an assessment of the effects of the development during the construction works and once the development is completed and operational. Mitigation measures are identified, where appropriate, to prevent, reduce or offset any adverse effects and an assessment is provided of the significance of the likely residual effects.

This chapter draws primarily on information collated from a Preliminary Environmental Risk Assessment (PERA) undertaken by Waterman Infrastructure & Environment Ltd (formerly Waterman Energy, Environment and Design Ltd) in May 2014, which is included as Environmental Statement (ES) Appendix 9-A: Preliminary Environmental Risk Assessment.

An intrusive ground investigation was undertaken by Soil Engineering at Nigg Bay in 2013 (Soil Engineering, 2013) for the purposes of investigating the nature and extent of marine subsoils/overburden and depth to rock in relation to the Aberdeen Harbour Expansion Project. Whilst the majority of the investigation was undertaken either overwater or within the intertidal area of the bay, information has been used within this assessment where relevant.

9.2 Legislation and Planning Policy Context

This section outlines the policy, legislation and guidance that are relevant to ground conditions and contamination. Policy, legislation and guidance applicable to the wider project can be found in Chapter 4: Planning and Legislation.

9.2.1 Legislation

9.2.1.1 Environmental Protection Act, 1990

The Scottish contaminated land regime is set out in Part IIA of the Environmental Protection Act (EPA) 1990 as inserted by Section 57 of the Environmental Act 1995, which came into force in Scotland on 14 July 2000 through the introduction of the Contaminated Land (Scotland) Regulations 2000. The 1990 Act and 2000 Regulations were amended in 2005 with the implementation of the Contaminated Land (Scotland) Regulations 2005, which *inter alia* replaced the term 'controlled waters' with that of 'the water environment'. The amendment was to ensure that the contaminated land regime was consistent with regards to protection of water resources in Scotland, as defined by the Water Environment and Water Services (Scotland) Act 2003.

The above regime introduces a risk assessment methodology to be used in assessing whether a site is 'contaminated' or 'suitable for use'. Within the legislation, contaminated land is defined as:

“any land which appears to the local authority in whose area it is situated to be in such condition, by reason of substances in, or under the that land, that:

- a. Significant harm is being caused or there is significant possibility of significant harm being caused; or
- b. Significant pollution of the water environment is being caused or there is significant possibility of such pollution being caused.”

In order to prove that significant harm is being caused, and therefore the land is to be determined as contaminated, a significant pollutant linkage must be demonstrated using a site specific source-pathway-receptor model, the elements of which are listed below. All three elements must be present for a pollutant linkage to exist:

- **Source:** the key pollutant hazards associated with the site;
- **Receptor:** the key targets from the hazards identified; and
- **Pathway:** the means by which the contaminants can reach and impact the receptor.

9.2.2 National Planning Policy

9.2.2.1 Scottish Planning Policy 2014

Scottish Planning Policy (SPP) 2014, the Scottish Government’s strategy for long-term spatial development, indicates that planning authorities should ensure that new development safeguards and enhances environmental quality and acknowledges that brownfield land represents a potential source of new sites for development, stating that planning authorities should consider:

“...the re-use or re-development of brownfield land before new development takes place on greenfield sites.”

9.2.2.2 Planning Advice Note 33: Development of Contaminated Land 2000

Planning Advice Note (PAN) 33 provides advice on the relationship between development controls under planning law and the contaminated land regime. As part of the Scottish Government’s commitment to sustainable development, the legacy of historical contamination has to be dealt with and additional contamination prevented. The guidance aims to ensure that potentially contaminated sites are identified at an early stage and appropriate steps taken to ensure a site is suitable for its current and future use.

9.2.2.3 Marine Policy Statement 2011

The UK Marine Policy Statement of March 2011 sets out the framework for preparing Marine Plans and taking decisions that affect the marine environment. The Marine Policy Statement identifies potential impacts on the marine environment resulting from coastal and marine development projects. Chapter 2.6 (Detailed Considerations) states the following:

“As a general principle, development should aim to avoid harm to marine ecology, biodiversity and geological conservation interests (including geological and morphological features), including through location, mitigation and consideration of reasonable alternatives. Where significant harm cannot be avoided, then appropriate compensatory measures should be sought.”

9.2.3 Strategic Planning Policy

9.2.3.1 Aberdeen City and Shire Strategic Development Plan (SDP), 2014

The Aberdeen City and Shire SDP provides a clear direction for all future development of the north-east. The SDP does not cover all planning issues but only those which are nationally or regionally important. The main aims of the plan are to:

- Provide a strong framework for investment decisions which help to grow and diversify the regional economy, supported by promoting the need to use resources more efficiently and effectively; and
- Take on the urgent challenges of sustainable development and climate change.

There are no specific targets relating to ground conditions or contaminated land within the SDP. However, it does acknowledge that, although opportunities will vary from place to place and over time, redevelopment of brownfield sites should be a priority.

9.2.4 Local Planning Policy

9.2.4.1 Aberdeen Local Development Plan 2012

The Aberdeen Local Development Plan (ALDP) shows which land is being allocated to meet the city's needs over the next 10 to 20 years and it sets out the planning policies which will be applied in promoting the sustainable growth of the city over that period.

Policy R2 – Degraded and Contaminated Land states the following:

“The City Council will require that all land that is degraded or contaminated, including visually, is either restored, reclaimed or remediated to a level suitable for its proposed use. This may involve undertaking site investigations and risk assessments to identify any actual or possible significant risk to public health or safety, or to the environment, including possible pollution of the water environment, that could arise from the proposals. Where there is potential for pollution of the water environment the City Council will liaise with SEPA [Scottish Environment Protection Agency].”

It is considered that whilst there is a potential for contamination to be present locally within areas of the development site associated with historical land use, the site as a whole is not considered to be degraded or contaminated.

9.3 Assessment Methodology and Significance Criteria

9.3.1 Assessment Methodology

9.3.1.1 Establishing Baseline Conditions

As previously noted, a desk-based qualitative PERA was undertaken to establish the potential for significant ground contamination to exist at the development site and the likely contamination risk posed to a range of sensitive receptors, including human health and the water environment. The PERA is presented in ES Appendix 9-A: Preliminary Environmental Risk Assessment.

9.3.1.2 Development of a Conceptual Site Model

The PERA has been carried out in accordance with current UK guidance on the assessment of contaminated land, including Model Procedures for the Management of Land Contamination (CLR 11) (Defra/Environment Agency, 2004). As such, the PERA includes a site specific conceptual model which identifies the likely potential pollutant linkages. Consideration is given in the conceptual model to the potential sources of contamination, migration pathways and sensitive receptors. The likely risks and therefore impacts of ground contamination upon human health, the water environment and property have been assessed as part of the PERA using this source-pathway-receptor approach.

The findings of the PERA have been used to inform the qualitative assessment presented in this chapter of likely significant effect to, and from, any potential ground contamination likely to exist at the site.

There is no specific methodology or guidance for the assessment of potential effects in relation to ground conditions and contamination for the purposes of EIA. Significance criteria have therefore been developed on the basis of accepted methodologies for the definition of EIA criteria, together with professional judgement. The significance criteria used in this assessment are detailed within Table 9.1.

Table 9.1: Significance criteria for ground conditions and contamination assessment

Criterion	Description
Major adverse	Acute or severe chronic impacts to human health and/or animal/plant populations predicted. Impact to a potable groundwater or surface water resource of regional importance e.g. major aquifer, public water reservoir or inner protection zone of a public supply borehole.
Moderate adverse	Proven (or likely significant) pollutant linkages with human health and/or animal/plant populations, with harm from long term exposure. Impact to a potable groundwater or surface water resource at a local level e.g. impact to an outer groundwater source protection zone. Temporary alteration to the regional hydrological or hydrogeological regime or permanent alteration to the local regime.
Minor adverse	Potential pollutant linkages with human health and/or animal/plant populations identified. Reversible, localised reduction in the quality of groundwater or surface water resources used for commercial or industrial abstractions, minor aquifer etc. Noticeable or temporary changes to the local hydrogeological or hydrogeological regime.
Negligible	No appreciable impact on human, animal or plant health, potable groundwater or surface water resources.
Minor beneficial	Baseline risks to human, animal or plant health are reduced to acceptable levels. Local scale improvement to the quality of groundwater or surface water resources used for commercial or industrial abstraction.
Moderate beneficial	Moderate reduction in baseline risks to human, animal or plant health, to acceptable level. Moderate improvement to the quality of groundwater or surface water resources used for public water supply.
Major beneficial	Major reduction in baseline risks to human, animal or plant health. Significant regional scale improvement to the quality of potable groundwater or surface water resources.

In addition, effects are assessed as temporary or permanent, and as site wide, local (i.e. relevant beyond the site boundaries), regional (i.e. relevant to the Aberdeen area) or national (Scotland-wide).

9.3.2 Consultation

In the EIA Scoping Opinion, dated 10 January 2014 (see ES Appendix 1-D: Scoping Opinion 2014), Aberdeen City Council (ACC) stated that the assessment of ground conditions and contamination should “*consider the East Tullos Burn which is currently heavily contaminated and also discharges out to sea in Nigg Bay*”.

Advice from Scottish Natural Heritage (SNH) on the geological Nigg Bay Site of Special Scientific Interest (SSSI) located within the development site was provided on 2nd October 2015 and has been incorporated into this chapter.

ACC Environmental Health department reviewed a draft version of this chapter and stated on 8th October 2015 that they were “*generally in agreement with the conclusions and recommendations*”.

ACC Planning and Sustainable Development department also reviewed a draft version of this chapter and their comments, dated 12th October 2015, have been incorporated as appropriate.

9.3.3 Limitations and Assumptions

The assessment presented in this chapter is based on information presented in the PERA (ES Appendix 9-A: Preliminary Environmental Risk Assessment) and from draft borehole and trial pits logs produced from a land based Ground Investigation (GI) that was underway on site at the time of writing. This investigation follows on from an initial GI carried out by Soil Engineering in 2013. Pertinent information has been used where appropriate.

9.4 Baseline Conditions

9.4.1 Current Uses of the Site and Surrounding Area

9.4.1.1 Current On-Site Land Use

The site is irregular in shape and comprises a variety of land uses (refer to Figure 3.3 in Chapter 3: Description of the Development). The central area of the site consists of an area of tidal open sea water known as Nigg Bay, exposed rock headland, areas of rough vegetation and sand. A hard surfaced car park and pedestrian walkway/viewpoint area is located towards the north of the bay, off Greyhope Road. Exposed rock headland extends north from Nigg Bay towards Girdleness Lighthouse and Walker Park, which are located on the northern edge of the site.

To the west of the bay is the intersection between Greyhope Road, Coast Road and St Fittick’s Road. The intersection is bordered to the north and south by undeveloped areas of grassland/new tree planting. An electricity substation and area of littering/ dumping is located on Greyhope Road, to the north of the public car park/viewing area. Coast Road extending north-south is part of the National Cycle Network Route.

Rock headland extends south-east from Nigg Bay towards the sea. Cattle grazing fields and a telecommunications mast are located to the south of the bay, adjacent to Coast Road. The southern extent of the site stretches from the cattle fields to Altens Industrial Estate located at the southern edge of the site and comprises a 4 m strip abutting the eastern side of the Aberdeen – Dundee railway line.

The Nigg Bay Site of Special Scientific Interest (SSSI) and the Balnagask to Cove Local Nature Conservation Site (LNCS) are located within the site boundaries. The SSSI is designated for its geological importance for its Quaternary stratigraphy associated with glacial deposition (see Chapter 10: Nature Conservation for further information). The Balnagask to Cove LNCS is designated on account of its features which include coastal cliffs and caves, shingle beaches, coastal and natural grassland, heaths and coastal plants, insects and birds.

The site also partially incorporates two sites of the Aberdeen City Council Green Space Network. Site 69 (Balnagask Golf Course) extends into the north and west of the site and Site 70 (Balnagask) extends into the west and south of the site. Both sites are included as part of the Green Space Network on account of their land use classifications, habits and informal recreational uses.

9.4.1.2 Current Off-Site Land Use

Neighbouring off-site features include Balnagask Golf Course located immediately to the north of the bay, Nigg Bay Waste Water Treatment Works (WWTW) and St Fitticks Community Park (an informal recreational land use) to the west and the capped Ness Farm landfill located to the south-west. The former landfill rises up to the south-west from Coast Road. Numerous ground gas vents are present. The Aberdeen - Dundee railway line approaches the site from the south, running along the southwest boundary of the site before extending west past the WWTW towards Aberdeen. The railway line passes in cutting along the south of the site, passing at grade along the south-west boundary (approximately between the telecommunications mast and the WWTW before entering again into a cutting). The railway embankment is noted as being included within the Aberdeen City Council Green Space Network (Site 15 – Railway Embankment).

9.4.2 **Historical Land Uses**

The historical development of the site has been assessed in the 2014 PERA (ES Appendix 9-A: Preliminary Environmental Risk Assessment) through a review of available historical Ordnance Survey maps dating from 1868 to 2014. A summary of the findings are provided in Table 9.2. Potentially contaminative uses are shown in bold italics.

Table 9.2: Site history

Source	Site	Surroundings
OS Map, 1868	The majority of the site is occupied by agricultural land and rough grazing, although a lighthouse is shown in the far north-east, St Fittick's Church (in ruins) and graveyard are recorded on the western boundary and a rifle range is recorded to extend along the Bay. In addition, a railway line is shown to run south to north adjacent to the land in the south of the site and crosses the central area from east to west.	Further agricultural land is located to the north and west, while cliffs and the North Sea are present to the east.
1902	A marine laboratory and fish hatchery is now shown in the north of the site. The rifle range recorded in the previous map edition is no longer included.	A gravel pit is indicated 200 m to the north while an old sand pit is shown 380 m north-west. Old quarries are recorded 280 m west. The rest of the surrounding area remains predominately in agricultural use.
1928	A coast guard station is now shown in the central portion of the site. The rest of the site appears largely as in the earlier edition.	The land to the north is now indicated to be occupied by a golf course. A further sand pit is recorded 170 m north-west and although the gravel pit and sand pit present on the earlier edition are still visible they are no longer named on the map. The old quarries to the west are no longer shown.
1938	Tanks are now shown associated with the marine laboratory. No other changes are evident.	The surrounding area is largely unchanged from the previous edition.
1959	The site appears largely as in the earlier edition, although the marine laboratory is no longer shown.	The sand pit to the north-west is now disused. No other significant changes have been noted.
1967	No significant changes are noted.	No significant changes are noted.
1972	No significant changes are noted.	Residential development has taken place adjacent to the north-western corner of the site. The rest of the surrounding area remains largely as previous.
1982	A landfill is indicated to the immediate west of the site boundary, with the edge of this feature appearing to encroach onto the site itself.	Altens Industrial Estate is now present to the west of the site, with various factories, warehouses and works indicated in this locale. The closest property is located approximately 250 m from the site boundary. Loriston Country Park is shown adjacent to the western site boundary.
1991	No significant changes are noted within the site boundary.	The surrounding area appears largely as in the earlier edition, although the pits, previously located to the north and north-west of the site now appear to have been infilled .
2006	The site remains as in the earlier edition.	A water treatment works has been constructed adjacent to the western site boundary. The industrial estate to the south and south-west has increased in size. The landfill is still shown.
2014	Some masts are now shown in the far north-east of the site. No further changes are noted.	The landfill is now shown as disused workings .

9.4.3 Envirocheck Database Search

A Landmark Envirocheck report was procured in preparation of the PERA completed in 2014 (ES Appendix 9-A: Preliminary Environmental Risk Assessment).

According to the Envirocheck there are no Local Authority Pollution Prevention and Control Permits registered to the site.

The site is bound to the west by Ness Farm registered landfill site, part of which is managed by Taylors Industrial Cleaners.

There are ten discharge consents recorded within 500 m of the site, the nearest is recorded 10 m to the north-east and is described as Discharge of Other Matter – Surface Water. The discharge environment is described as groundwater.

9.4.4 Geology

The geology beneath the site is detailed in the 2014 PERA (ES Appendix 9-A: Preliminary Environmental Risk Assessment) with a summary presented in Table 9.3.

Table 9.3: Site geology

Stratum	Area Covered	Estimated Thickness [m]	Typical Description
Made ground	Along railway land	Unknown	Unknown but likely to contain ash ballast and stone
Made ground	South-west of Nigg Bay	0.6 - 3.7	Sand and gravel with cobbles and boulders of bedrock and concrete, broken bricks, plastic and polythene.
Marine beach deposits	Nigg Bay foreshore	0.4 - 4.4	Sand or sand and gravel with interbedded clays
Drumlithie sand and gravel formation	North of the site	Unknown	Sand and gravel
Lochton gravel formation	West of site, along railway line	Unknown	Sand and gravel
Mill of Forest till formation	To the north and south of Nigg Bay South of site along the line of the railway	1 - 4	Firm to stiff and very stiff sandy gravelly clay, often with cobbles and boulders of bedrock.
Aberdeen formation	Entire site	Unknown	Metasediments including psammites, pelites and semipelites

The geological summary provided above incorporates limited 'onshore' data from a marine Ground Investigation undertaken in 2013 by Soil Engineering. The marine Ground Investigation was carried out for the purposes of investigating the nature and extent of the marine subsoils/overburden and depth to rock, to predict in-situ strengths of these materials to enable initial design of quay structures, assess resistance to piling and for accurate estimation of volumes of material to be removed.

Further terrestrial site investigation work was undertaken during 2015 to confirm and verify initial geotechnical and contaminated land findings. At the time of writing, draft borehole and trial pits logs from the current land-based investigation and inspection of the subsoils and rock cores demonstrate that the geological sequences of both the overburden and rock are very similar to the marine deposits encountered during the 2013 investigation. In general, sequences of sands and gravels were encountered overlying a thick unit of Glacial Till extending to depths (so far) of up to 43 m before encountering bedrock. A large infilled trough-valley feature encountered offshore appears to extend westwards beneath the beach and land towards the Coast Road. The former ACC landfill has been further investigated and more accurately delineated, with material similar to that of the 2013 investigation being recovered.

The site is not in an area that could be affected by coal mining activity and the risk of non-coal or metalliferous mining is considered to be low. There are several ceased British Geological Survey (BGS) mineral sites located in the vicinity of the site. These all appear to be sand and gravel pits and the closest is indicated to lie approximately 200 m to the west of the site.

The Landmark Envirocheck report states that there is very low to no risk at the site associated with collapsible ground, and that there are moderate risks in relation to compressible ground and running sand stability hazards. There is no recorded risk associated with landslide.

According to information from the Health Protection Agency (HPA), the site is located in an area of elevated radon gas levels (a naturally occurring gas). Correspondingly, radon protection measures are required in the development of new buildings or extensions. However, current advice from the HPA (first issued in 2008 and reiterated in a 2010 HPA Press Release) is that all new buildings should include basic radon protective measures as a minimum whether they are in a radon affected area or not. The guidance states that "Building Regulations and supporting documents should be amended to ensure that all new buildings, extensions, conversions and refurbished buildings in the UK include basic Radon protective measures."

The Landmark Envirocheck report indicates that the Ness Farm registered landfill (Waste Management License WML/N/20016) could encroach onto the central portion of the site. Whilst this facility is now closed, it may still represent a potential source of ground gas. ACC records indicate that authorised wastes included asbestos, household, commercial and industrial waste, mineral oils and uncontaminated soils.

9.4.5 Hydrology

The East Tullos Burn is present on site, situated to the north of the Waste Water Treatment Works (WWTW). The burn was classed as 'Seriously Polluted' under the River Classification Scheme, with poor biology and poor chemistry, both of which are attributed to point source and diffuse pollution. It is understood that environmental improvements have been implemented by ACC to improve the physical and ecological condition of the burn, including creation of a new wetland feature to increase the flood plain storage and water retention time, leading to better water quality in the catchment and biodiversity improvements.

The coastal waters of Nigg Bay are situated to the east of the site. These waters form part of the Don Estuary to Souter Head Coastal Water Body under the Water Framework Directive. Under the River Basin Management Plan (RBMP), this is classified as being of good overall status, with ecology classified as 'good' and chemistry classified as 'pass'. This water body is located within a bathing water protected area and also the River Dee Special Area of Conservation (SAC).

Therefore, overall, data suggests that water quality is likely to be of poor quality within the East Tullos Burn and of good quality within Nigg Bay. Further information on water quality is provided in Chapter 7: Marine Water and Sediment Quality.

According to SEPA's indicative flooding data, the site is not located in an area on a flood plain. Further information on flooding is provided in Chapter 8: Flood Risk and Surface Water.

9.4.6 Hydrogeology

According to the BGS Hydrogeological Map of Scotland (1:625,000 scale), the geological deposits underlying the site are classified as per Table 9.4.

Table 9.4: Summary of hydrogeological properties of the main geological strata

Stratum	BGS Classification	Hydrogeological Significance
Made ground	Not classified	May contain limited volumes of groundwater within granular layers
Marine beach deposits Drumlithie sand and gravel Formation Lochton gravel formation	Minor or moderately permeable aquifer	Locally important aquifer, although groundwater volume is variable. Belong to the Lower Dee Valley Sand and Gravel Aquifer
Mill of Forest till formation	Non or weakly permeable aquifer	Unlikely to contain significant volumes of groundwater, except within weathered or granular horizons
Aberdeen formation	Non or weakly permeably aquifer	Unlikely to contain significant volumes of groundwater, except within weathered or granular horizons

The site is located within a Drinking Water Protection Zone and also within a Nitrate Vulnerable Zone.

There are no recorded groundwater abstractions within a 1 km radius of the site and the dataset does not provide any details of any pollution incidents affecting groundwater quality.

9.4.7 Previous Environmental Assessments

9.4.7.1 Soil Engineering – Ground Investigation Report for Bay of Nigg Harbour Development, 2013

This report was reviewed as part of the PERA prepared in 2014 (ES Appendix 9-A: Preliminary Environmental Risk Assessment). A summary of the main findings is provided below:

- Soil Engineering Geoservices Limited carried out a geotechnical assessment;
- The majority of the report is concerned with the offshore ground conditions, with only limited information relating to the onshore geology provided. In total, 49 No. cable percussion/rotary follow on boreholes were drilled, although only one of these was undertaken on land. In

addition, 18 No. machine trial pits were excavated within the intertidal foreshore area around Nigg Bay;

- Geotechnical testing was undertaken on samples recovered from the trial pits but no environmental analysis was undertaken on these materials;
- The report indicates that the onshore ground conditions comprise, for the most part, granular marine deposits, present from 0.40 m to 4.40 m below ground level. These appeared as sand or sand and gravel with interbedded clays;
- Made ground was recorded in six locations, mostly in the south-west of Nigg Bay. These deposits were found to be between 0.60 m and 3.70 m thick and comprised sand and gravel with cobbles and boulders of rock, concrete, brick, plastic and polythene;
- In places, Glacial Till was also recorded, at depths of between 0.40 m and 3.20 m below ground level; and
- Several trial pits also encountered shallow bedrock, at depths of between 0.85 m and 2.40 m below ground level. Where encountered, the bedrock was found to comprise Aberdeen Formation metasedimentary bedrock (a mixture of psammites, semipelites and pelites). Typically, the bedrock was weathered at shallow depth.

As discussed in Section 9.4.4, further terrestrial site investigation work was undertaken during 2015 to confirm and verify the findings of the 2013 investigation detailed above, and to support relevant ES chapters. At the time of writing, draft borehole and trial pits logs from the current land-based investigation and inspection of the subsoils and rock cores demonstrate the following:

- The geological sequences of both the overburden and rock are very similar to the marine deposits encountered during the 2013 investigation. In general, sequences of sands and gravels were encountered overlying a thick unit of Glacial Till extending to depths (so far) of up to 43 m until encountering bedrock;
- A large infilled trough-valley feature encountered offshore appears to extend westwards beneath the beach and land towards the Coast Road; and
- The former ACC landfill has been further investigated and more accurately delineated, with material similar to that of the 2013 investigation being recovered.

9.4.8 Conceptual Site Model

9.4.8.1 Potential Contamination Sources

On-site

Whilst significant on-site sources of contamination have not been identified across the majority of the site, historical plans record a historical rifle range as being formerly located near the shore of the bay and the 2013 investigation detailed above have identified the presence of made ground to the south-west of Nigg Bay. There is a potential that these land uses could have impacted upon the soils and/or groundwater at the site.

Off-site

Potentially contaminative off-site land uses include Ness Farm registered landfill, railway infrastructure, an industrial estate (including factories, warehouses and works), a waste water

treatment works, old quarries and a gravel pit. It is not possible to discount the risk of contaminants and ground gas associated with these land uses migrating onto and across the site.

9.4.8.2 Potential Pathways

Potential pathways which may exist at the site or could be established during construction and/or once the development is completed, are as follows:

- Potential pathways relating to human health and animal populations include: ingestion, inhalation of, or direct dermal contact with contaminated soils, groundwater, dust, asbestos fibres, gases and vapours;
- Potential pathways via which contamination may cause pollution of the water environment including downward and lateral migration through soils and groundwater; downward and lateral migration along foundations/service trenches, surface run-off and direct spills;
- Potential for root uptake of contamination by plant populations; and
- Potential pathways to building structures and services including direct contact with contaminated soils and groundwater.

9.4.8.3 Potential Receptors

The potential receptors relevant to the site are as follows:

- Human health, including future site users (workers and visitors), construction workers and maintenance personnel, and off-site land users including surrounding residents, pedestrians and nearby site users (i.e. golf course, public park, etc.);
- Water environment receptors including the East Tullos Burn, Nigg Bay and the underlying groundwater aquifers;
- The Nigg Bay SSSI;
- Plant and animal populations of the Balnagask to Cove LNCS; and
- Buried structures and services, including foundations, concrete and water supply pipes.

9.5 **Assessment of Effects**

9.5.1 **Construction**

9.5.1.1 Disposal of Excavated Material

Due to the potential for localised contamination to exist within the underlying soils, a proportion of any land excavated material may be classified as special waste for the purposes of disposal to landfill. This would, however, be confirmed by Waste Acceptance Criteria (WAC) testing to determine waste classification and allow identification of an appropriate disposal facility.

All special waste would then be transported to, and disposed of, at a licensed landfill site in accordance the Environmental Protection (Duty of Care) Regulations 1991 (as amended) and in accordance with the Special Waste Regulations 1996 (as amended).

Once the aforementioned legislative requirements have been complied with, the disposal of contaminated material would result in **negligible** environmental effects, which is not significant in EIA terms.

9.5.1.2 Impacts on Human Health from Ground Contamination and Ground Gas

Construction activities, particularly earthworks associated with the construction of new structures, roads, car parks and quay walls, could potentially disturb and expose construction workers to localised made ground soils and potential soil and/or groundwater contamination associated with both onsite and offsite historical land uses. Construction activities could create pollutant linkages through ingestion, inhalation and direct dermal contact pathways.

There is a recognised potential for ground gas generation at the site associated with the (closed) Ness Farm landfill which is recorded to extend into the site boundaries. Gas generated from this feature could potentially migrate, via granular deposits, into poorly ventilated confined spaces (such as excavations), thereby posing a potential risk to future construction workers.

All construction workers would, however, be subject to mandatory health and safety requirements under the Construction (Design and Management) (CDM) Regulations 2015 and the Control of Substances Hazardous to Health Regulations 2002 (as amended). Construction workers will be made aware of the possibility of encountering contaminated soils in made ground through toolbox talks. Safe working procedures will be implemented, good standards of personal hygiene will be observed and appropriate levels of personal protective equipment (PPE) and respiratory protective equipment (RPE) will be provided and utilised as necessary, thereby minimising the risk of exposure to potentially contaminated soils, ground gas and groundwater.

Adherence to these legislative requirements would reduce the health and safety risk posed to construction workers to a low level. Therefore the likely effect of ground contamination and ground gas on demolition and construction workers would be **negligible**, which is not significant in EIA terms.

In the event of exposing soils and stockpiling construction waste (including excavated materials), dust could be generated during dry and windy conditions. Under these conditions, users of neighbouring sites (including St Fitticks Community Park, Nigg Bay (Balnagask) Golf Club and the National Cycle Route), surrounding residents and the general public could temporarily be exposed to contamination via the inhalation of potentially contaminated dust. In the absence of mitigation, potential effects are considered to be **temporary, local**, and of **minor adverse significance**, which is not significant in EIA terms.

9.5.1.3 Impacts on Soils and the Water Environment

During construction, areas of existing hardstanding would be broken out locally to accommodate the Development, allowing increased rainwater and surface run-off infiltration to the subsurface. This could potentially mobilise previously contained residual contamination which could feasibly migrate into the underlying superficial aquifer or Nigg Bay giving rise to **temporary, local** effects of **minor adverse significance**, which is not significant in EIA terms. No construction works are proposed upstream of the East Tullos Burn outfall, and the culvert to the bay will be retained in its existing

location, so potential effects on this watercourse are considered to be **negligible**, which is not significant in EIA terms.

To facilitate construction, it is anticipated that potentially polluting substances and activities would be introduced to the site. These may include concrete pouring, the release of potentially contaminated materials during capital dredging (albeit that seabed sediment testing has revealed that levels of all contaminants are below Marine Scotland Revised Action Level 1- see Chapter 7: Marine Water and Sediment Quality, for more information), storage of fuels and chemicals and leaks and spills of fuel and oil from construction vehicles. In the event of an accidental pollution incident, and in the absence of mitigation, potential effects on soils and water environment receptors are considered to be **temporary, local** and of **moderate adverse significance**, which is significant in EIA terms.

9.5.1.4 Impacts on Designated Sites

Within the Nigg Bay SSSI, the cliff and the beach area in front of the cliff has been subject to visible erosion over the past three years and in places is very unstable. To achieve the dredged depth of 9 m below Chart Datum within the harbour basin, it is necessary to re-profile the beach area in front of the cliff. It is proposed to install a sheet piled wall along the western section of the beach, as shown in Figure 9.1. In addition, it is proposed to dredge the beach area to create a graded slope from 9 m below Chart Datum at the edge of the dredged area to Chart Datum.

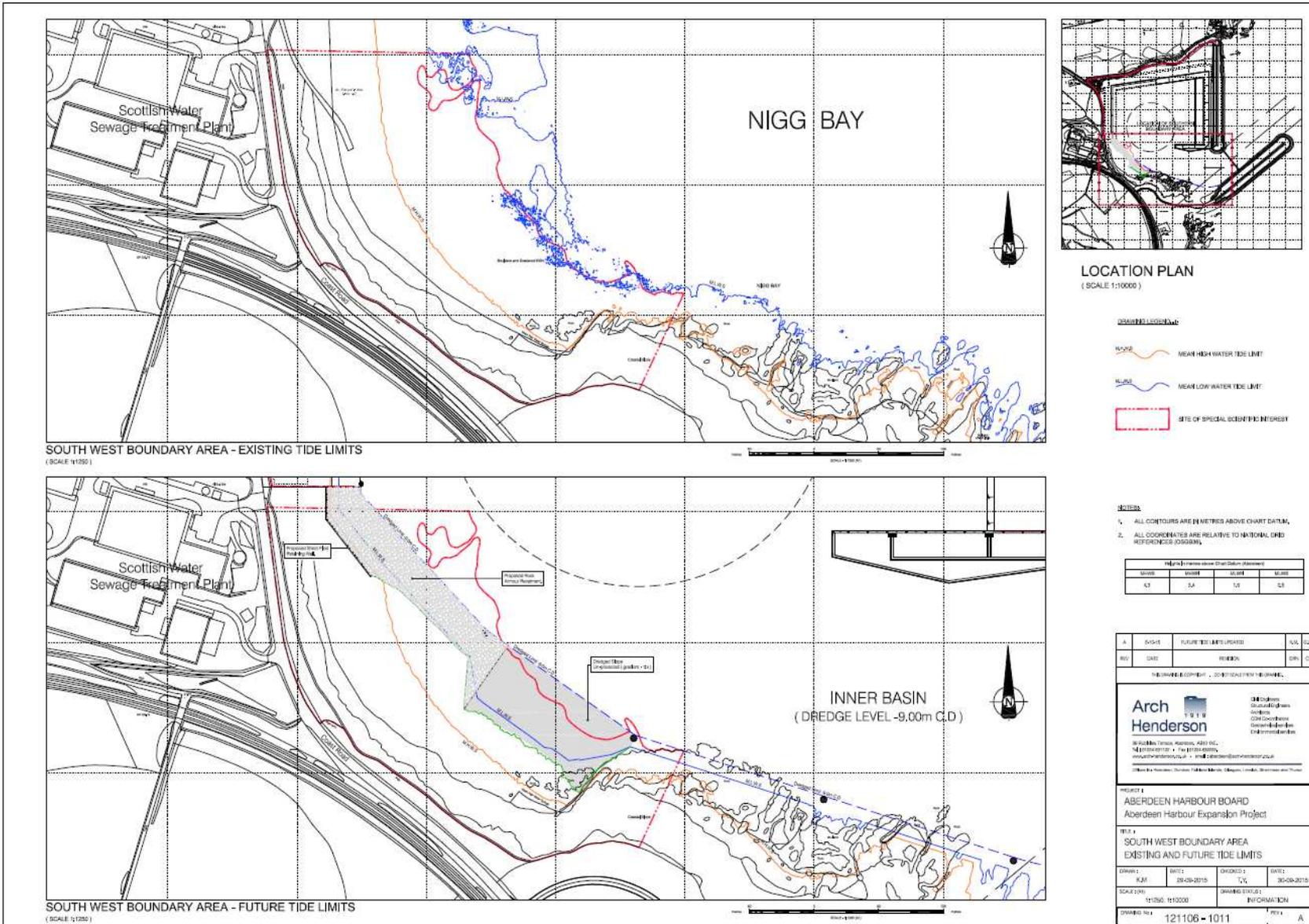


Figure 9.1: Aberdeen Harbour Expansion Project south-west boundary

Although the full report is not available at the time of writing, the preliminary results from terrestrial site investigation carried out in 2015 indicate that the protective toe/berm of the cliffs (which is actually landfill material imported and placed by ACC) extends in thickness from 3.5 m to a maximum of 14.5 m. Beneath the fill, the Quaternary succession consists of horizons of cobbles and boulder beds, glacial tills and sands and gravels ranging in thickness from 31 m in the northern part of the SSSI to only 2.85 m thickness in the south, before encountering the bedrock. Both the glacial till and bedrock at this location provide stable foundations for the proposed re-profiling of the beach as shown on Figure 9.1. If necessary, the re-profiled area may be further stabilised by placing rock armour along the slope. Although these measures encroach into the SSSI boundary, they will protect the cliff from further destabilisation and help to protect the interest feature of the SSSI from significant future erosion.

It is recognised that it is a delicate balance to maintain erosion of the SSSI so that the interest feature will continue to be exposed, and manage the significant erosion which has been observed at the site in recent years, which is likely to destabilise the cliff. As demonstrated in ES Appendix 6-B: Hydrodynamic Modelling and Coastal Processes Assessment, the construction of the breakwaters will significantly reduce wave heights within Nigg Bay. The wave energy acting upon the beach in front of the cliff will, therefore, be less likely to erode either the existing or proposed beach profile, thus providing additional protection to the SSSI. Consequently the effects on the Nigg Bay SSSI as a result of the construction works are considered to be **negligible**, which is not significant in EIA terms. Further assessment of the conservation objectives of the SSSI is provided in Chapter 10: Nature Conservation.

As discussed above, the construction of the proposed development would introduce potentially polluting substances and activities to the site. There is a potential that accidental releases, leaks or spills could occur leading to migration beyond the boundaries of the construction area and potential effects on animal and plant receptors of the Balnagask to Cove LNCS. Consequently, in the absence of mitigation, the potential effect on the Balnagask to Cove LNCS as a result of construction works is considered to be **temporary, local** and of **moderate adverse significance**, which is significant in EIA terms.

9.5.2 Completed Development

9.5.2.1 Impacts on Human Health from Ground Contamination and Ground Gas

The proposed development would comprise the construction of new quays and berths, breakwaters, a car park, security gatehouse, welfare accommodation, access roads, pedestrian walkways, vehicle weighbridges, protective barriers, security fencing and gates. Consequently, the potential risk posed to future site users from exposure to potentially contaminated soils and groundwater is considered to be low as the entire development area would be hard surfaced, thereby forming a barrier between site users and dermal contact, ingestion or inhalation with any potentially contaminated soil, dust or groundwater that might remain following excavation and groundworks. With regards to potential ground gas risks, all future buildings at the site would be designed to incorporate appropriate ground gas protection measures if required, based on the outcomes of the ongoing intrusive investigation.

In light of the above, it is considered that future site users would be unlikely to come into contact with contaminated soils, groundwater or ground gas and consequently effects to future site users are considered to be **negligible**, which is not significant in EIA terms.

9.5.2.2 Impacts on Soils and the Water Environment

The use of the site as a harbour could introduce potentially contaminative activities, materials and chemicals to the site which could potentially impact upon the underlying soils and adjacent water environment receptors. All activities undertaken at the site would, however, be carried out in accordance with activity-specific environmental risk assessments that outline the potential hazards and impacts of an activity as well as the risk control measures that would be put in place in order to reduce potential impacts as far as practicable. All potentially contaminative or hazardous materials used on-site during the operation of the development would be stored and handled appropriately and any spills/leaks cleaned up in accordance with SEPA Pollution Prevention Guidelines. In addition, oil/petrol interceptors and control valves would be included in the design of the drainage network to prevent contaminated run-off or spills from entering the sea. In light of this, whilst the potential for accidental pollution incidents, spillages, leaks or releases cannot be completely discounted, the potential impacts of the completed development on soils and the water environment will be significantly reduced and therefore potential effects are considered to be **long-term, local** and of **minor adverse significance**, which is not significant in EIA terms.

9.5.2.3 Impacts on Designated Sites

As described in Section 9.5.1.4, the re-profiling of the beach area in front of the cliffs and the construction of breakwaters would serve to protect the cliffs from further destabilisation and help to protect the interest feature of the SSSI from significant future erosion. Consequently, the completed development is predicted to have **negligible** effects on the Nigg Bay SSSI, which is not significant in EIA terms.

As described above, whilst the potential for accidental releases, spills and leaks associated with the day to day activities of the harbour cannot be completely discounted, all activities onsite would be carried out in accordance with activity-specific environmental risk assessments and risk control measures would be put in place in order to reduce the potential for pollution incidents as far as practicable. All potentially contaminative or hazardous materials used on-site during the operation of the development would be stored and handled appropriately and any spills/leaks cleaned up in accordance with SEPA Pollution Prevention Guidelines. Surface run-off would be discharged directly to the sea and oil/petrol interceptors and control valves would be included in the design of the drainage network. Consequently, the potential for accidental pollution incidents to migrate beyond the harbour boundaries and directly/indirectly impact upon plant and animal receptors within the Balnagask to Cove LNCS is considered to be reduced as far as practicable. It is however recognised that risks cannot be completely eliminated and therefore potential effects are considered to be, at worst, **long-term, local** and of **minor adverse significance**, which is not significant in EIA terms.

9.5.2.4 Impacts on Buried Services and Structures

Buried structures and services within the development would be suitably designed for the prevailing ground conditions and contaminant concentrations present in the soils and groundwater at the site to ensure that the integrity of the materials are maintained at all times. This may include a requirement

for sulphate resistant concrete and/or barrier water supply pipes. Consequently, the likely effect of ground contamination on buried structures and services at the site is considered to be **negligible**, which is not significant in EIA terms.

9.6 Mitigation Measures

A terrestrial Site Investigation was recently completed at the site to confirm and verify initial geotechnical and contaminated land findings; the results were not available at the time of writing. The investigation will determine if the site is suitable for its intended end use and will identify any potentially unacceptable risks to human health, water environment or ecological receptors from soil/groundwater contamination or ground gas. Should the investigation identify potentially unacceptable risks at the site, an appropriate remediation strategy would be prepared and agreed in consultation with ACC and SEPA. Implementation of any remediation strategy would be followed by a process of validation.

9.6.1 Construction

9.6.1.1 Disposal of Excavated Material

All land excavated material to be removed off-site would be subject to waste classification sampling and analysis in accordance with the requirements of the Special Waste Regulations 1996 (as amended) and transported, treated and disposed of in accordance with the Environmental Protection (Duty of Care) Regulations.

In the event that ground investigation reveals elevated concentrations of contaminants within material scheduled for excavation and disposal, such material may require on-site treatment to reduce contaminant concentrations prior to disposal to landfill or indeed, re-use within construction.

Material containing leachable contaminants would be suitably contained by bunding or other containment measures to prevent the release of contaminated run-off and thus protect underlying soils, groundwater and surface water receptors.

9.6.1.2 Impacts on Human Health from Ground Contamination and Ground Gas

Worker safety throughout the construction phase would be subject to mandatory requirements including the Control of Substances Hazardous to Health (COSHH) Regulations 2002 (as amended) and the Construction (Design and Management) (CDM) Regulations, 2015. These regulations set out extensive requirements for the protection of construction workers and stress the importance of appropriate procedures in the event of the workforce encountering unexpected contamination.

A Construction Environmental Management Plan (CEMP) will be prepared and implemented during construction of the development. The CEMP will include precautions to minimise the exposure of workers and the general public to potentially harmful substances, including:

- Personal hygiene, washing and changing procedures;
- Use of personal protective equipment (PPE) and, where necessary, respiratory protective equipment (RPE);

- Adoption of dust suppression methods as required, such as water spraying, wheel washing facilities for vehicles leaving the site and covering of stockpiled materials and materials being transported to and from site;
- Regular cleaning of all site roads, access roads and the public highway; and
- Measures to avoid surface water ponding.

The above measures would be carried out in accordance with the HSE publication 'Protection of workers and the general public during the development of contaminated land and CIRIA Report 132 'A guide for safe working on contaminated sites' (1996).

In respect of public safety, boundaries would be hoarded and secured during all stages of the construction works.

9.6.1.3 Impacts on Soils and the Water Environment

As stated above a CEMP would be prepared and implemented during construction of the development. The CEMP would minimise the potential for contamination of the underlying soils and water environment receptors through the following measures:

- Procedures for the management of materials, spillage clean-up, use of best practice construction methods and monitoring;
- The use of appropriate tanked and bunded areas for fuels, oils and other chemicals;
- Locating stockpiles of materials found to be contaminated on hardstanding surfaces to prevent mobile contaminants infiltrating into the underlying soils;
- Dust suppression measures; and
- Measures to avoid surface water ponding and collection and disposal of all on-site run-off.

9.6.1.4 Impacts on Designated Sites

As described above, the construction of the harbour would include the reprofiling of the beach (further stabilised along the slope by rock armour if necessary) and the construction of breakwaters which would serve to protect the SSSI from further destabilisation and help to protect the interest feature of the SSSI from significant future erosion. Consequently, as adverse effects have not been identified, mitigation measures are not considered to be required in this regard. Further assessment of the conservation objectives of the SSSI is provided in Chapter 10: Nature Conservation.

As above, measures implemented during future construction works as part of a CEMP would reduce the likelihood and severity of any accidental pollution incidents on plant and animal populations within the Balnagask to Cove LNCS as far as practicable.

9.6.2 **Completed Development**

9.6.2.1 Impacts on Human Health from Ground Contamination and Ground Gas

As previously highlighted, an intrusive Ground Investigation is currently underway at the site. The results of the investigation will be used to confirm the extent of mitigation and remedial measures required to ensure that the site is suitable for its intended end use and that there would be no

unacceptable risk posed to future human health receptors. Should ground gas monitoring identify elevated concentrations of gas, then appropriate protection measures (i.e. ventilation, damp proof membrane, etc.) would be incorporated into future building design.

9.6.2.2 Impacts on Soils and the Water Environment

As stated above all harbour activities will be risk assessed with appropriate control measures in place in order to ensure that potential impacts on soils and water environment receptors are minimised as far as possible. In addition, all potentially contaminative or hazardous materials used on-site as part of the day-to-day operation of the harbour would be stored and handled appropriately and any spills/leaks cleaned up in accordance with SEPA Pollution Prevention Guidelines. Surface water run-off would be discharged to the sea without the use of SUDS (see Chapter 8: Flood Risk and Surface Water for further details), however the receiving water would be protected from pollution through the installation of petrol/oil interceptors and control valves. Consideration of flow routes during normal operation and partial failure would also be considered in the detailed design.

9.6.2.3 Impacts on Designated Sites

As previously described, the construction of the harbour development would include the reprofiling of the beach and the construction of breakwaters. These features would serve to protect the SSSI from further destabilisation and help to protect the interest feature of the SSSI from significant future erosion. Consequently, no mitigation measures are considered to be necessary in this regard. Further assessment of the conservation objectives of the SSSI is provided in Chapter 10: Nature Conservation.

As previously described, all harbour activities will be risk assessed with appropriate control measures in place in order to reduce the likelihood and severity of accidental pollution incidents. Additionally, all potentially contaminative or hazardous materials used on-site as part of the day to day operation of the harbour would be stored and handled appropriately and any spills/leaks cleaned up in accordance with SEPA Pollution Prevention Guidelines. This should reduce, as far as practicable, the potential for pollutant migration beyond the harbour boundaries and subsequent impact on plant and animal populations within the Balnagask to Cove LNCS.

9.6.2.4 Impacts on Buried Services and Structures

As stated above, sulphate resistant concrete and barrier water supply pipes would be utilised as appropriate to ensure the integrity of buried services and structures within the completed development.

9.7 Residual Effects

9.7.1 Construction

9.7.1.1 Disposal of Excavated Material

The disposal of any contaminated material during the construction stage would be subject to appropriate legislative and regulatory control. As such, the residual effect would remain as **negligible**, which is not significant in EIA terms.

9.7.1.2 Impacts on Human Health from Ground Contamination and Ground Gas

As highlighted above, the legislative and regulatory framework set out to protect site workers and the public would be implemented through a CEMP. The CEMP would also serve to reduce contamination risks posed by the construction works through adoption of appropriate site practices, e.g. storage of materials. Consequently, the residual effect of ground contamination and ground gas on construction workers and the general public would be **negligible**, which is not significant in EIA terms.

9.7.1.3 Impacts on Soils and the Water Environment

Potential effects to underlying soils, underlying groundwater aquifers and surface waters associated with the introduction of potentially contaminative materials and activities to the site would be managed through the implementation of a CEMP. However, the potential for accidental spillages and releases cannot be completely discounted, although the severity of such an incident can be considered likely to be reduced. Consequently, the residual effect of construction works on soils and the water environment is considered to be **temporary, local** and of **minor adverse significance**, which is not significant in EIA terms.

9.7.1.4 Impacts on Designated Sites

The proposed construction activities would serve to protect the SSSI from further destabilisation and help to protect the interest feature of the SSSI from significant future erosion. Consequently, the residual effects of construction works on the Nigg Bay SSSI would be **negligible**, which is not significant in EIA terms.

As described above, whilst the possibility of accidental pollution incidents during future construction works cannot be completely discounted, the likelihood of an occurrence is considered to be reduced. In addition, spill procedures should ensure that the severity of a pollution incident and the likelihood of migration beyond the area of construction is minimised. Consequently, the residual effect of construction works on plant and animal populations within the Balnagask to Cove LNCS is considered to be **temporary, local** and of **minor adverse significance**, which is not significant in EIA terms.

9.7.2 **Completed Development**

9.7.2.1 Impacts on Human Health from Ground Contamination and Ground Gas

The extent of hardstanding surfacing across the proposed development would encapsulate any residual contamination present in the soils and/or groundwater at the site. In addition, a programme of intrusive Ground Investigation is currently underway which would identify the requirement for further remedial or mitigation measures (including gas protection measures) at the site to ensure that it is suitable for its intended end use. As such, the residual effect of ground contamination and ground gas on human health within the completed development would be **negligible**, which is not significant in EIA terms.

9.7.2.2 Impacts on Soils and the Water Environment

Whilst all harbour activities would be risk assessed and control measures put in place to reduce the potential for impact to soils and water environment receptors as far as practicable, risks cannot be completely eliminated, although the likelihood and severity of any accidental pollution incidents are

considered to be reduced. As such, residual effects are considered to be **long term, local** and of **minor adverse significance**, which is not significant in EIA terms.

9.7.2.3 Impacts on Designated Sites

The completed development would serve to protect the SSSI from further destabilisation and help to protect the interest feature of the SSSI from significant future erosion. Consequently, the residual effects of the completed development on the Nigg Bay SSSI would be **negligible**, which is not significant in EIA terms.

As described above, all harbour activities would be risk assessed and control measures put in place to reduce the potential for impact to plant and animal populations within the Balnagask to Cove LNCS. Whilst these measures would reduce the likelihood and severity of an accidental pollution incident, the potential for an incident to occur cannot be discounted. Consequently, residual effects of the completed development on the Balnagask to Cove LNCS are considered to be **long term, local** and of **minor adverse significance**, which is not significant in EIA terms.

9.7.2.4 Impacts on Buried Services and Structures

All buried services and structures would be appropriately designed to account for the ground conditions and contaminants concentrations present. As such, residual effects would be **negligible**, which is not significant in EIA terms.

9.8 References

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