



Greyhope Road Coastal Embankment

Phase 1 Desk Study

16 March 2017

Mott MacDonald
1 Atlantic Quay
Broomielaw
Glasgow G2 8JB
United Kingdom

T +44 (0)141 222 4500
F +44 (0)141 221 2048
mottmac.com

Aberdeen City Council
Marischal College
Broad Street
Aberdeen
AB10 1AB

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1 Introduction

1.1 Background and Scope

Aberdeen City Council (ACC) have commissioned Mott MacDonald Ltd (MML) to undertake an initial assessment of the condition of a section of coastal embankment at Greyhope Rd, Torry, Aberdeen and produce a Stage 1 Desk Study as part of an assessment of the site. A site plan is included as Figure 1.1.

Figure 1.1: Indicative Site Boundary



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The aim of this report is to present the findings of an initial Desk Study review, including development of a ground model for the site and recommendations as to further work required.

The objectives of this Desk Study are to:

- Review readily available existing information.
- Assess the ground conditions at the site.
- Advise of requirements for further work.

1.2 Sources of Information

The following sources of information summarised below have been used to compile this Desk Study report and are summarised in Section 2.

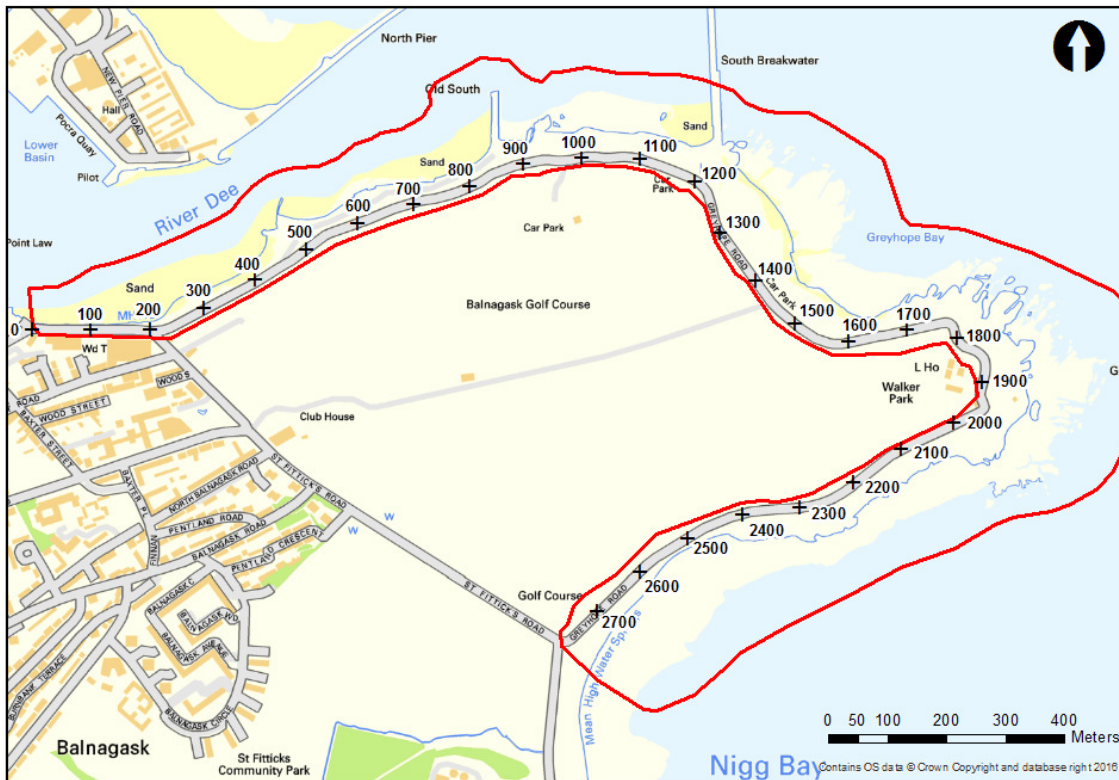
- National Library of Scotland, online historical map viewer (Ref. 1)
- British Geological Survey (BGS) Geology of Britain Online Viewer (Ref. 2)
- BGS GeolIndex Map Viewer (Ref. 3)
- BGS Hydrogeological Map of Scotland (Ref. 4)
- Scottish Environmental Protection Agency (SEPA) River and Basin Management Plan (RBMP) Online Viewer (Ref. 5)
- Coal Authority Gazetteer and Interactive Map (Refs. 6 and 7)
- BGS Non Coal Mine Plans Portal (Ref. 8)
- Zetica UXO Pre Desk Study Assessment (Ref. 9)
- ACC website, nature reserve maps (Ref. 10)
- Scottish Natural Heritage (SNH) interactive map (Ref. 11)
- Historic Environment Scotland (HES), Canmore database (Ref. 12)
- Google aerial imagery (Ref.13)
- Bing aerial imagery (Ref. 14)
- ACC tender information (Ref. 15)

2 Desk Study

2.1 Introduction

A desk-based assessment of the site and ground conditions has been undertaken using information from readily available sources outlined in Section 1.2. To aid with description of the site, chainages have been assigned to Greyhope Road, as shown in Figure 2.1.

Figure 2.1: Site Plan Showing Chainages



Source: OS OpenData Supply - Ordnance Survey © Crown copyright 2016. All rights reserved. Licence number 100026791

Note: Chainages in 100m intervals and noted as 'Ch100' in report text

2.2 Site Description

A summary of pertinent site details is presented in Table 2.1.

Table 2.1: Site Details

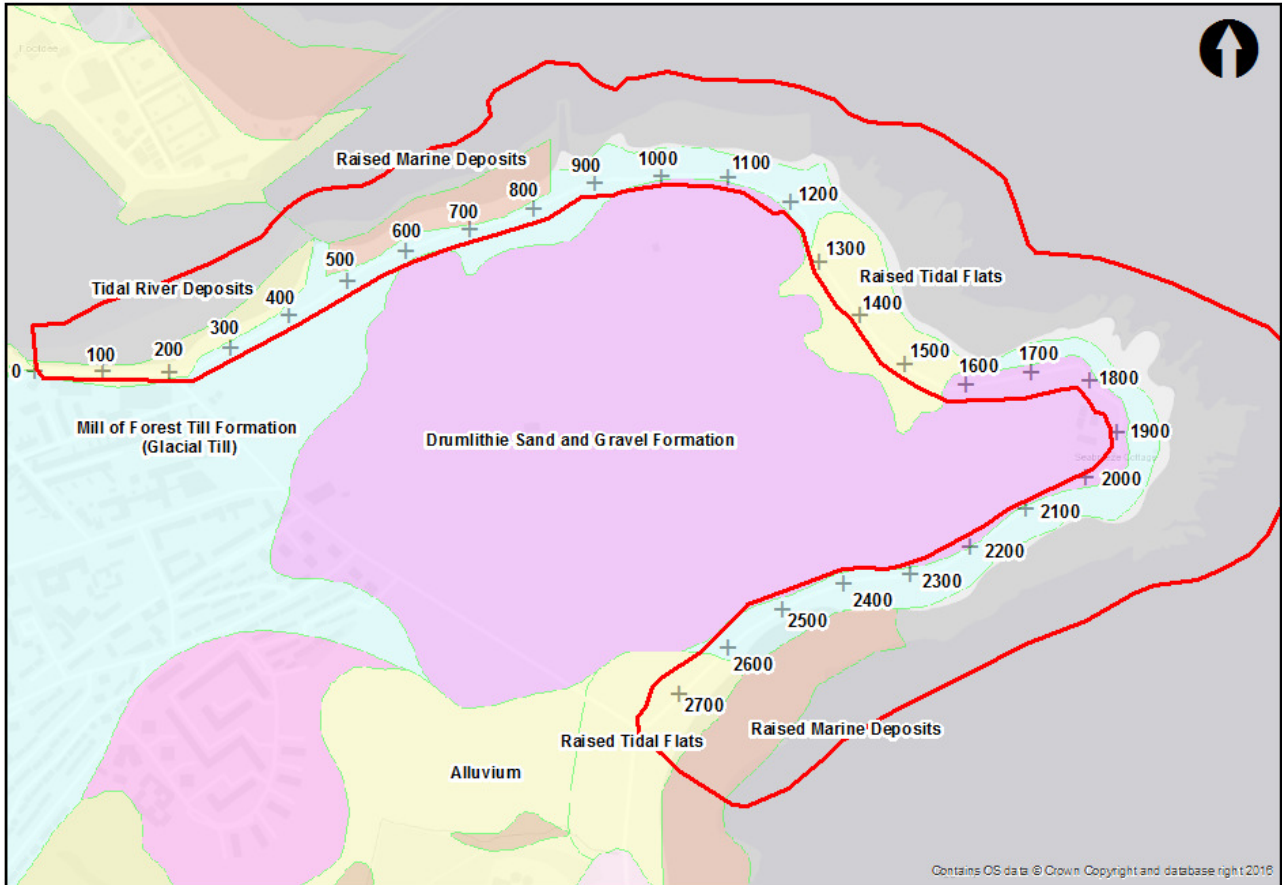
Aspect	Comments
Site Name	Greyhope Road, Aberdeen
Site Area	Approx. 55ha
National Grid Reference (NGR)	from NJ 95582 05418 (Ch0) to NJ 96479 04891 (Ch2780)

Aspect	Comments
Local Authority	Aberdeen City Council (ACC)
Location	The site lies at the mouth of the River Dee and follows the coastline south across Greyhope Bay to Nigg Bay. The site comprises the slopes and coastal embankments between Greyhope Road and the sea and the River Dee.
Current Land Use and Surface Conditions	Current land use is recreational. Greyhope Road is an unclassified road which follows the coastline from the mouth of the River Dee and Aberdeen Harbour in the north, running eastward along the coast past Torry Battery (Ch800), then south along Greyhope Bay (Ch1400-1600) and the Girdleness Lighthouse (Ch1800-2000), and then westward into Nigg Bay (Ch2000-2780). Numerous coastal footpaths are present in the north and west of the site below Greyhope Road and there are sea defences and breakwaters present along the foreshore.
Topography	<p>The ground slopes down from Greyhope Road to the foreshore, interrupted by coastal footpaths in the north and east of the site, with most slopes being vegetated.</p> <p>There are two wider areas where there is a carpark between the road and the crest of the slope, one near Greyhope Bay in the east (Ch1300-1500), and one to the south of the site in Nigg Bay.</p>
Surrounding Area	<p>The sites outer seaward boundary is formed by the foreshore, with the River Dee and Aberdeen Harbour to the north (Ch0-1100), Greyhope Bay and the North Sea to the east (Ch1200-1900) and Nigg Bay to the south (Ch2000-2780).</p> <p>The inner landward boundary consists of the Torry Allotments (Ch100-400), the Balnagask Golf Course and Torry Battery (Ch400-1600) in the north. Balnagask Golf Course continues along the eastern boundary, along with Walker Park (Ch1600) and the Girdleness Lighthouse (Ch1800-2000). The southern landward boundary is also partly formed by the Balnagask Golf Course and an area of rough ground that has no specific land use.</p>
Historical Site Use (Ref.1)	<p>The earliest available historical map, dated 1843-1882, shows there to be a track present in the position of the current Greyhope Road. The landward side of this track shows mainly undeveloped land with Girdleness Lighthouse (Ch1800-2000) in the east. The seaward side of the track is shown to slope down to the foreshore with two jettys and pier (South Peir) shown to the north (Ch500), along with the Aberdeen Harbour Breakwater (Ch850). The area between the South Pier and the Breakwater is known as Skates Nose (Ch500-850). Greyhope Bay (Ch1400-1600) is noted to the east and Nigg Bay to the south (Ch2000-2780). A Rifle Range is shown to the south of the site in Nigg Bay (south of Ch2780). The foreshore is shown to be mainly sandy between Ch0-900, rocky between the breakwater and south past the lighthouse, Ch900-2300, and becomes sandy again in Nigg Bay (Ch2300-2780).</p> <p>By the early 1900's, Greyhope Road is named as such. South Pier is no longer shown; a smaller jetty remains in its place (Ch500). Between this jetty and the Old South (Aberdeen Harbour) Breakwater (Ch500-850), an area of sea defences is shown, however its construction is not known. A sand pit is noted to the south of Greyhope Road at Ch600. A Rocket Apparatus House is noted to the south of the Old South Breakwater at Ch850. The new South Breakwater (Ch1200) and Greyhope Cottages (Ch1200) are located to the east of site, an Old Sand Pit is located inland to the west of the cottages. A Marine Laboratory and Fish Hatchery is recorded in the south of the site (Ch2600), near the junction with St. Fittick's Road.</p> <p>By 1925 a number of buildings to the landward side of Greyhope Road associated with a ship building yard (Ch0-200) in the north western extent of the site, the Torry Battery and associated buildings (Ch900) have been constructed, although not named as such. To the south east of Girdleness Lighthouse, a well, valve house and penstock chamber is recorded (Ch2000), associated with the Aberdeen Corp. Sewage Works. Tanks noted at the Marine Lab in the south (Ch2600). Sea defences are shown between the Marine Laboratory and the foreshore and also to the east of the Marine Laboratory (Ch2200-2600). The land inland of Greyhope Road is now Golf Links (Balnagask Golf Course)</p> <p>The 1954 mapping shows the Torry Research Station building immediately inland of Greyhope Road in the north (Ch100-200), west of St. Fittick's Road junction. To the east of St Fittocks junction, allotments are shown immediately inland of Greyhope Road (Ch200-500). A timber yard and travelling crane are recorded between Ch1300-1400.</p> <p>The was little change between the 1950-1970's, the only significant difference being that the Marine Laboratory (Ch2600) was demolished and timber yard / crane is no longer noted. No significant changes were noted between 1970's and</p>

Aspect	Comments
<p>Published Geology (Refs. 2 and 3)</p> <p>Please refer to Figure 2.2: Superficial Geology Plan</p>	<p>present day.</p> <p><u>Superficial Deposits</u></p> <p>The BGS Geoindex Map Viewer and Geology of Britain Viewer indicates the site to be underlain by:</p> <ul style="list-style-type: none"> • Tidal River Deposits described as clay, silt and sand with localised peat and gravel associated with infilling of tidal rivers, present in the north western extent of the site within the River Dee estuary (Ch0-500). • Marine Beach Deposits described as silt, sand and gravel, indicated to be present along the northern section (Ch500-800) and south western section (Ch2400-2600) of the site. • Raised Tidal Flat Deposits described and silt, clay and sand. From the tidal zone, but now above the level of the present shoreline as a result of earth movement or a general fall in sea level. Present on the east of the site (Ch1300-1600) and south (Ch2600-2700). • Drumlithie Sand and Gravel Deposit described as sand and gravel with clay and silt lenses, present throughout the east and south of the site. • Mill of Forrest Till Formation (glacial till) described as sandy diamicton, red-brown with clasts predominantly of sandstone, present in the north and east (Ch300-1300) and east and south east (Ch1600-2600). <p>Made ground is not recorded on the geological maps, however made ground of unknown thickness is anticipated to be present overlying the natural deposits associated with the historical development of the site and Greyhope Road.</p> <p><u>Bedrock Geology</u></p> <p>The solid geology beneath the site is semi pelite and psammite of the Aberdeen Formation (Argyll Group) described as interlayered psammite and semipelite. A dyke of unnamed metamorphosed igneous rocks described as amphibole and hornblende schist is recorded on the north east coast.</p> <p>A fault is located 10-150m to the north of the site, aligned south west to north east. There is therefore potential for faulted bedrock to be present beneath the site.</p> <p><u>BGS Landslip Records</u></p> <p>The British Geological Survey (BGS) do not hold any records of historical landslips.</p> <p><u>BGS Boreholes</u></p> <p>There are a significant number of BGS borehole records available, located onshore in the north west of the site, up to the area of the Old South Breakwater (Ch0-500) and also offshore within Aberdeen Harbour and continuing out into the estuary.</p> <p>The onshore boreholes record superficial deposits consisting of unconsolidated sands and gravels and stiff boulder clays (glacial till). Where rock has been encountered this is generally recorded as (micro)granite, with some occurrences of schist, both with varying degrees of weathering.</p>
<p>Hydrogeology (Ref. 4 and 5)</p>	<p>The BGS Geoindex Map Viewer indicates the site to be underlain by a 'Low productivity aquifer' with small amounts of groundwater in the near surface weathered zone, secondary fractures, and rare springs associated with the Argyll Group.</p> <p>The SEPA RBMP website records the 'Lower Dee Valley Sand and Gravel' groundwater body to be present beneath the site (Water Body No: 150297). A groundwater body is considered to be potentially capable of sustaining a water supply of 10m³ per day or 50 people on a continuous basis. It is considered to be a potential receptor with regards to contaminated land.</p> <p>In 2008, SEPA classified this groundwater body as having an overall status of 'Good with High confidence'.</p>
<p>Hydrology (Ref. 5)</p>	<p>The 'Dee (Aberdeen) Estuary' is present immediately north of the site (Water Body No: 200103). The River Dee is noted to be a Special Area of Conservation. In 2008, SEPA classified this water body as having 'overall status of Good ecological potential with Medium confidence in 2008 with overall ecological status of Poor and overall chemical status of Pass'.</p> <p>The coastal water body 'Don Estuary to Souter Head (Aberdeen)' is present immediately east and south of the site (Water Body No: 200105). In 2008, SEPA classified this water body as having an overall status of 'Good with Medium confidence'.</p> <p>A spring is recorded just upslope of the toe of the embankment to the north of</p>

Aspect	Comments
	Greyhope Road, between Old South Breakwater and the South Breakwater, to the north Torry Battery (Ch900).
Mining and Quarrying (Refs. 1, and 6 to 8)	<p>Aberdeen is not located within a Coal Authority Reporting Area and the geology is not noted to be coal bearing. Consequently, the risk associated with abandoned mine workings below the site is considered to be negligible.</p> <p>There are records of quarrying activity within the immediate vicinity of the site. A 'Sand Pit' was recorded immediately inland of Greyhope Road at Ch600, as well as an 'Old Sand Pit' 150m west of Greyhope Road at Ch1200. Both were disused by the mid 1920's.</p> <p>There are other quarrying works recorded inland of Greyhope Road, located within the now Balnagask Golf Course.</p>
Unexploded Ordnance (UXO) (Ref.9)	The Unexploded Ordnance risk map of North Scotland indicates a moderate risk of encountering UXOs at the site. Pre Desk Study Assessment (PDSA) concluded that a detailed desk study is recommended to assess, and potentially zone, the UXO hazard level on the site, due to bombing activity in World War II and the military infrastructure on site (Torry Battery).
Designated Areas (Refs. 5, 10 and 11)	The SNH Sitelink online viewer records that the River Dee and its estuary to the north of the site is part of the River Dee Special Area of Conservation (Ch0-1200). The Nigg Bay Site of Special Scientific Interest (SSSI) is located within Nigg Bay south of the site.
Archaeology (Ref. 12)	Historic Environment Scotland (HES) online viewer indicates that there are a large number of archaeological records (at least 50) within the site boundary and more in the immediate surrounding area. These include shipwrecks, coastal structures and sea defences.
Aerial Photography Interpretation (Refs. 13 to 15)	<p>A review of available aerial photography shows that from the north western edge of the site, there are sea defences up to the junction with St Fittocks Road (Ch0-200). Along the northern section (Ch400), the aerial imagery shows the embankment between the foreshore and Greyhope Road to be very steep, with the crest on the immediate edge of the road. This is also the case near the Old South Breakwater (Ch850) and to the north of the Torry Battery (Ch900).</p> <p>Along the eastern coast, between the South Breakwater and Walker Park (around Greyhope Bay), there is 30-50m between the road and the crest of the embankment, which appears to show limited signs of slope movement.</p> <p>From Greyhope Bay to Girdleness Lighthouse, along the northern edge of Walker Park (Ch1600-1800) there are two sections where the crest of the embankment is very close or immediately adjacent to the road.</p> <p>Around the promontory of Girdleness (Ch1800-2000), there is evidence of at least four historic slope movements in the embankment.</p> <p>From Girdleness to the south western extent of the site (Ch2000-2780), the aerial imagery shows minimal evidence of slope movement.</p>
ACC Tender Information (Ref. 15)	<p>The site photographs show the sea defences to the north west of the site appear to be in poor condition in places. There have been some remedial works carried out (placement of large concrete blocks) at the road side where movement of the slope has occurred. Photographs also show that there has been potential further erosion / movement that has occurred after remedial works have been carried out.</p> <p>Slopes along the northern coast are heavily vegetated with weeds and show clear evidence of recent slope movement with open scarring visible in numerous locations. Where scarring is at or near the road edge, barriers have been installed to keep traffic away from this part of the road.</p> <p>The photographs show one area more extensive slope movement near the South Breakwater.</p> <p>Along the eastern coast there is evidence of historical slope movement, where scars have been vegetated over and also some more recent movement to the north of Girdleness Lighthouse.</p> <p>To the west of Girdleness lighthouse there is evidence of recent slope movement with scarring visible.</p>
Utilities	Utilities associated with road drainage are anticipated to be present within the slope. Services associated with street lighting etc. may be present within the road. Additionally, a valve house and penstock chamber is recorded at Ch2000 associated with the sewage works and there may be services associated with the Girdleness Lighthouse and associated structures.

Figure 2.2: Superficial Geology Plan



Source: BGS Opensource Data NERC

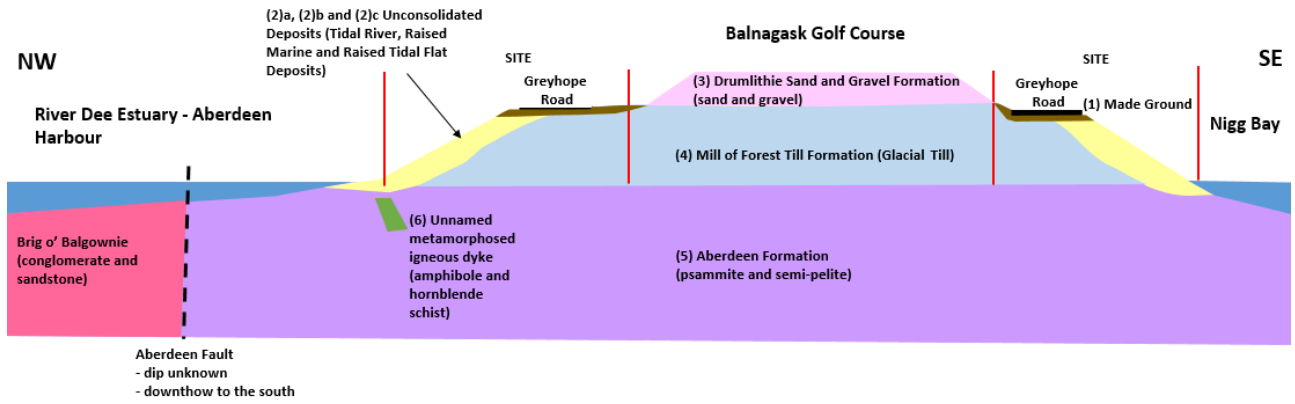
2.2.1 Preliminary Ground Model

The preliminary ground model for the site has been compiled using available published information, and is shown in Table 2.2 and Figure 2.3.

Table 2.2: Preliminary Ground Model

Strata ID	Thickness (m)	Description	Comment
(1) Made Ground	Unknown	Unknown	Associated with historical development of the site and Greyhope Road.
(2) Unconsolidated deposits	(2)a Tidal River Deposits	Clay, silt and sand with localised peat and gravel	Present in the north of the site within the River Dee estuary
	(2)b Raised Marine Deposits	Gravel, sand, silt and clay	Present along the north and south west of the site.
	(2)c Raised Tidal Flat Deposits	Silt, clay and sand	Present in the east of the site.
(3) Drumlithie Sand and Gravel Deposit	Unknown	Sand and gravel with clay and silt lenses	Present throughout the east and south of the site.
(4) Mill of Forest Till Formation	Unknown	Glacial till, described as sandy diamicton, red-brown with clasts predominantly of sandstone	Present in the north east, east and south east of the site.
(5) Aberdeen Formation	Unknown	Interlayered psammite and semipelite	May be present as outcrops along the coastline, based on interpretation of aerial photography and site photographs.
(6) Unnamed metamorphosed igneous dyke	Unknown	Amphibole and hornblende schist	Recorded on the north east coast.

Figure 2.3: Illustrative Preliminary Ground Model



Do not scale

3 Summary and Conclusions

3.1 Site and Ground Conditions

The review of available geological records indicates the site to be underlain by unconsolidated deposits, glacial till, underlain by psammite and semi-pelite metamorphosed igneous rocks of the Aberdeen Formation. BGS borehole records indicate there is granite present along the northern boundary of the site, however its extent is unknown.

Aerial imagery from 2012 indicates that there has been recent and historical movement of the embankments around Greyhope Road, and in some cases the crest of the slope is immediately adjacent or very near to the edge of Greyhope Road.

Photographs and information provided as part of the tender information shows that there has been more recent movement of the slopes around the site.

3.2 Recommendations for Further Work

Based on the above assessment, it is recommended that a site walkover is undertaken to map areas of erosion or damage to the coastal embankment. This information can then be used to assess the risk of instability along the coastal embankments, and determine the requirement for remedial measures and ground investigation at the site.

Should remedial measures be required at the site, consideration may need to be given to site constraints such as the sites location within a designated Special Area of Conservation and the Nigg Bay Site of Special Scientific Interest (SSSI) and any associated permissions or consents. Additionally, the presence of numerous archaeological features within the site may require consultation prior to any work being undertaken. Further considerations are the presence of made ground and the tidal location of the site.

It is recommended (as advised) that a detailed UXO desk study is undertaken to assess, and potentially zone, the UXO hazard level on the site, prior to any intrusive works being undertaken at the site.

4 References

1. National Library of Scotland, online mapping viewer, <http://maps.nls.uk/geo/explore> (accessed: December 2016)
2. British Geological Survey (BGS) Geology of Britain Viewer, <http://mapapps.bgs.ac.uk/geologyofbritain/home.html> (accessed: December 2016)
3. BGS GeoIndex Map Viewer, <http://mapapps2.bgs.ac.uk/geoindex/home.html> (accessed: August 2015)
4. BGS 1:625,000 Hydrogeological Map of Scotland
5. Scottish Environmental Protection Agency (SEPA) RBMP Online Viewer, <http://gis.sepa.org.uk/rbmp/> (accessed: August 2015)
6. Coal Authority Gazetteer for Scotland, <https://www.gov.uk/government/publications/coal-mining-andbrine-subsidence-claim-search-directory-of-places> (accessed: August 2015)
7. Coal Authority Interactive Map Viewer, <http://mapapps2.bgs.ac.uk/coalauthority/home.html> (accessed: December 2016)
8. BGS Non Coal Mining Plans Portal, <http://mapapps2.bgs.ac.uk/mineplans/home.html> (accessed: December 2016)
9. Zetica, Pre Desk Study Assessment, dated 16th December 2016
10. ACC, Map of Nature Reserve, <http://maps.aberdeencity.gov.uk> (accessed: December 2016)
11. Scottish Natural Heritage (SNH), interactive map, <http://www.snh.gov.uk/publications-data-and-research/snhi-information-service/map/> (accessed: December 2016)
12. Historic Environment Scotland (HES), Canmore Database, <https://www.historicenvironment.scot/archives-and-research/archives-and-collections/canmore-database/> (accessed: December 2016)
13. Google aerial imagery, <https://www.google.co.uk/maps> (accessed: December 2016)
14. Bing aerial imagery, <https://www.bing.com/maps> (accessed: December 2016)
15. ACC Tender Information Pack Vol 2.2 – Work Package 2 Scoping Document, Donmouth Road Coastal Embankment Condition Survey, dated October 2016.

