Govan Basin Infilling

Volume 3: Technical Appendices

August 2022

Volume 3: Technical Appendices

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Activity ID	Activity Description	Activity Start	Anticipated Finish	Remarks
Infill		01/05/2022 00:00	19/10/2023 16:00	
Consents - Infill		16/05/2022 08:00	30/12/2022 16:00	
Marine Scotland Consent		18/05/2022 08:00	13/12/2022 16:00	
Pre-Application Consultation (PAC)		23/05/2022 08:00	19/08/2022 16:00	
A1440	Agree Advert with Marine Scotland & BAE	23/05/2022 08:00	31/05/2022 08:00	Complete
A1430	Prepare Pre-Application Consultation (PAC) Information	23/05/2022 08:00	02-Jun-22 16 00 A	Complete
A1450	PAC Notifications	31/05/2022 08:00	03-Jun-22 16 00 A	Complete
A1460	Place Advert	31/05/2022 08:00	03-Jun-22 16 00 A	Complete
A1470	PAC Consultation Period	06/06/2022 08:00	18/07/2022 08:00	Complete
A1480	PAC Event	18/07/2022 08:00	22-Jul-22 16 00 A	Complete
A1490	PAC Response Period	25/07/2022 08:00	12/08/2022 16:00	
A1500	Prepare PAC Report	15/08/2022 08:00	19/08/2022 16:00	
Marine Scotland License		18/05/2022 08:00	13/12/2022 16:00	
BAE101	Prep Screening Report	18/05/2022 08:00	20-May-22 16:00 A	Complete
BAE112	Prep Scoping Report	23/05/2022 08:00	17-Jun-22 16 00 A	Complete - Now needs update following MS LOT response
BAE111	Screening Consultation	23/05/2022 08:00	08-Jul-22 16 00 A	Complete
BAE131	Prep EIA (incl. Flood Risk Assessment @ 35D)	20/06/2022 08:00	12/08/2022 16:00	
BAE124	Scoping Consultation	20/06/2022 08:00	19/08/2022 16:00	Not yet Started
BAE134	Prepare Application	15/08/2022 08:00	26/08/2022 16:00	
A1600	Application Submitted		26/08/2022 16:00	
BAE141	Application Review (and advert)	30/08/2022 08:00	27/09/2022 16:00	
BAE146	Consultation Period	28/09/2022 08:00	08/11/2022 16:00	
BAE148	Determination Period	09/11/2022 08:00	13/12/2022 16:00	
GCC Planning Permission		16/05/2022 08:00	29/12/2022 16:00	
GCC Planning Permission		16/05/2022 08:00	29/12/2022 16:00	
BAE103	Pre-Application Engagement	16/05/2022 08:00	06-Jun-22 16 00 A	complete
A1520	Contract Awarded to Planning Consultant	16/05/2022 08:00	20-Jun-22 16 00 A	complete
BAE118	Prep EIA Scoping Report	30/05/2022 08:00	29-Jun-22 16 00 A	complete
BAE127	EIA Scoping Consultation	28/06/2022 08:00	03/08/2022 16:00	Underway
BAE133	EIA Ready	22/08/2022 08:00	24/08/2022 16:00	
BAE138	Prepare Planning Application	19/08/2022 08:00	25/08/2022 16:00	
BAE139	Submit the Planning Application	26/08/2022 08:00		
BAE150	Planning Approved (GCC)		29/12/2022 16:00	
BAE151	Application Period	26/08/2022 08:00	29/12/2022 16:00	
Planning Application Prep		25/05/2022 08:00	22/08/2022 16:00	
A2130	Pre Application Submitted	25/05/2022 08:00		complete
A1950	Prepare Consultation Website	13/06/2022 08:00	08-Jul-22 16 00 A	complete
A1940	Public Consultation Event Press Notice	19/07/2022 08:00	19-Jul-22 16 00 A	complete
A1960	Consultation Website Live	19/07/2022 08:00	19-Jul-22 16 00 A	complete
A2070	Drawing Reqd. - Plans	27/06/2022 08:00	22-Jul-22 16 00 A	complete
A2080	Drawing Reqd. - Elevations	27/06/2022 08:00	22-Jul-22 16 00 A	complete
A2090	Drawing Reqd. - Sections	27/06/2022 08:00	22-Jul-22 16 00 A	complete
A2100	Drawing Reqd. - Levels	27/06/2022 08:00	22-Jul-22 16 00 A	complete
A2110	Drawing Reqd. - Landscaping	27/06/2022 08:00	22-Jul-22 16 00 A	complete
A2120	Drawing Reqd. - Lighting	27/06/2022 08:00	22-Jul-22 16 00 A	complete
A1970	Pre Application Consultation Event	26-Jul-22 08 00*	26/07/2022 16:00	
A1990	Architectural and Engineering Drawings Package (Plans, Elevations, Sections, Levels, Landscaping, Lighting)	13/06/2022 08:00	05/08/2022 16:00	
A1980	Prepare Pre Application Consultation Report	27/07/2022 08:00	09/08/2022 16:00	
A2010	Pre Application Consultation Report	10/08/2022 08:00	16/08/2022 16:00	
A2000	Design and Access Statement	11/07/2022 08:00	18/08/2022 16:00	
A2020	Sustainability / Energy Report	31/05/2022 08:00	18/08/2022 16:00	
A2030	Drainage Impact Assessment (Inc 3rd Party Check Certificate)	31/05/2022 08:00	18/08/2022 16:00	
A2040	Supporting Planning Statement	27/06/2022 08:00	18/08/2022 16:00	
A1910	Pre Application Period (Minimum)	07/06/2022 08:00	22/08/2022 16:00	
A1920	Pre Application Consultation with GCC & Statutory Consultees	26/05/2022 08:00	22/08/2022 16:00	
A1930	Community Council Meetings	26/05/2022 08:00	22/08/2022 16:00	
EIA		13/06/2022 08:00	19/08/2022 16:00	
A1810	Daylight / Sunlight	27/06/2022 08:00	15-Jul-22 16 00 A	
A1870	Waste (Materials and Resource Use)	27/06/2022 08:00	15-Jul-22 16 00 A	
A1890	Major Accidents (Flooding & Sea Level Rise)	27/06/2022 08:00	15-Jul-22 16 00 A	
A1730	Landscape and Visual Impact Assessment - F	27/06/2022 08:00	19/08/2022 16:00	
A1740	Flood Risk (Not Inc Drainage Design)	27/06/2022 08:00	19/08/2022 16:00	
A1750	Terrestrial Ecology / Biodiversity - F	27/06/2022 08:00	19/08/2022 16:00	
A1760	Marine Ecology / Biodiversity - F	27/06/2022 08:00	19/08/2022 16:00	
A1770	Water Quality (Needs Drainage Details for Building) - F	27/06/2022 08:00	19/08/2022 16:00	

A1780	Noise Inputs, Model, Outputs - F	27/06/2022 08:00	19/08/2022 16:00	
A1790	Vibration - F	27/06/2022 08:00	19/08/2022 16:00	
A1800	Wind	27/06/2022 08:00	19/08/2022 16:00	
A1820	Air Quality Assessment	27/06/2022 08:00	19/08/2022 16:00	
A1830	Transport Assessment	27/06/2022 08:00	19/08/2022 16:00	
A1850	Archaeology / Heritage - F	27/06/2022 08:00	19/08/2022 16:00	
A1860	Population and Human Health	27/06/2022 08:00	19/08/2022 16:00	
A1880	Climate Change - F	27/06/2022 08:00	19/08/2022 16:00	

Technical Appendix 3-1_Screening Report

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Govan Basin Infill
EIA Screening Report

May 2022

Govan Basin Infill
EIA Screening Report

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1 INTRODUCTION

1.1 Terms of Reference

EnviroCentre Ltd has been appointed by Arch Henderson on behalf of BAE Systems Ltd to submit an Environmental Impact Assessment (EIA) Screening Request to Glasgow City Council (GCC) and Marine Scotland (MS-LOT) in relation to the proposals to infill the wet basin at Govan Shipyard and Maintenance Facility (Govan Shipyard) (Refer to Drawing No 175756-GIS001).

1.2 Scope of Report

The Environmental Impact Assessment (EIA) Screening Report has been prepared in accordance with the requirements of The Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2017[1] (hereafter referred to as 'the EIA Regulations') and The Marine Works (Environmental Impact Assessment) (Scotland) Regulations 2017[2] (hereafter referred to as 'the Marine EIA Regulations').

This EIA Screening Report provides a desk-based study of the potential for the proposals to have effects on the site and surrounding environment. It provides environmental information compiled through a desktop review of readily available environmental information. The purpose of this document is to provide the relevant environmental information to assist both GCC and MS-LOT in reaching a Screening Opinion.

The EIA Screening Report has been prepared to ensure it conforms to both the marine and land-use planning regimes as follows.

1.2.1 The EIA Regulations

In accordance with Part 2/8(2) of these regulations, a request for a screening opinion must be accompanied by:

(a) a description of the location of the development, including a plan sufficient to identify the land;

(b) a description of the proposed development, including in particular—

  (i) a description of the physical characteristics of the proposed development and, where relevant, of demolition works;

  (ii) a description of the location of the proposed development, with particular regard to the environmental sensitivity of geographical areas likely to be affected;

(c) a description of the aspects of the environment likely to be significantly affected by the proposed development; and

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[1] *The Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2017* (SSI 2017/102). Available at: https://www.legislation.gov.uk/ssi/2017/102/contents

[2] *The Marine Works (Environmental Impact Assessment) (Scotland) Regulations (SSI 2017/115).* Available at: https://www.legislation.gov.uk/ssi/2017/115/contents

(d) a description of any likely significant effects, to the extent of the information available on such effects, of the proposed development on the environment resulting from—

(i) the expected residues and emissions and the production of waste, where relevant;

(ii) the use of natural resources, in particular soil, land, water and biodiversity.

1.2.2 The Marine EIA Regulations

In accordance with Part 2/10(2) of the Marine Works (Environmental Impact Assessment) (Scotland) Regulations 2017, a request for a screening opinion must be accompanied by:

(a) a description of the location of the proposed works, including a plan sufficient to identify the area in which the works are proposed to be sited;

(b) a description of the proposed works, including in particular—

(i) a list of all of the regulated activities which are proposed;

(ii) a description of the physical characteristics of the proposed works and, where relevant, works to be decommissioned; and

(iii) a description of the location of the proposed works, with particular regard to the environmental sensitivity of geographical areas likely to be affected;

(c) a description of the aspects of the environment likely to be significantly affected by the proposed works; and

(d) a description of any likely significant effects, to the extent of the information available on such effects, of the proposed works on the environment resulting from either, or both, of the following:—

(i) the expected residues and emissions and the production of waste, where relevant;

(ii) the use of natural resources, in particular soil, land, water and biodiversity.

1.3 Report Usage

The information and recommendations contained within this report have been prepared in the specific context stated above and should not be utilised in any other context without prior written permission from EnviroCentre.

If this report is to be submitted for regulatory approval more than 12 months following the report date, it is recommended that it is referred to EnviroCentre for review to ensure that any relevant changes in data, best practice, guidance or legislation in the intervening period are integrated into an updated version of the report.

Whilst the Client has a right to use the information as appropriate, EnviroCentre do not accept liability to any third party for the contents of this report unless written agreement is secured in advance, stating the intended use of the information. EnviroCentre accept no liability for use of the report for purposes other than those for which it was originally provided, or where EnviroCentre have confirmed it is appropriate for the new context.

2 EIA SCREENING

Under both the EIA and Marine EIA Regulations, proposals are screened to determine whether they fall within one of the types or scales of development which would require an Environmental Impact Assessment Report (EIAR) to support applications to both GCC and MS-Lot for infilling of the wet basin at Govan Shipyard. In screening an application, consideration is given to whether the proposal would fall into any of the categories set out in Schedules 1 or 2 of the Regulations.

The EIA Regulations do not attempt to define 'significant effects' as each development must be dealt with on its own merits.

Schedule 1 of the Regulations lists types and scales of development for which an EIA will always be required. Schedule 2 of the Regulations lists types and scales of development for which an EIA might be required, subject to assessment under Schedule 3.

2.1 Assessment in Relation to Schedule 1

The proposed development is not of a type/scale listed in Schedule 1 of the Regulations; it is therefore necessary to assess the proposal in terms of Schedule 2.

2.2 Assessment in Relation to Schedule 2

There is potential the proposals may be classed as a Schedule 2 development under the EIA and Marine EIA Regulations. The Table within Schedule 2 specifies the classes in which the proposed development could fall under are:

10. Infrastructure projects

a) Industrial estate development projects; The area of the development exceeds 0.5 hectare

As such it is considered necessary to assess the proposed development against the criteria contained in Schedule 3 in order to establish whether or not an EIA will be necessary.

2.3 Assessment in Relation to Schedule 3

Schedule 3 of the Regulations provides selection criteria for the screening of Schedule 2 developments. It must be noted that there are no rigid thresholds providing a universal test of whether or not an EIA is required. The proposal must be considered on a case-by case basis by virtue of factors such as its nature, size or location. The fundamental test to be applied in each case is whether that particular type of development proposed, and its specific impacts are likely, in that particular location, to result in significant effects on the environment.

3 SITE SETTING AND PROPOSED CONSTRUCTION WORKS

3.1 Site Location

Govan shipyard is situated in an urban area to the southwest of Glasgow City Centre. The surrounding area comprises a mixture of uses including industrial, business, commercial, residential along with a large health institution complex.

The Govan shipyard is located on the southern bank of the River Clyde and is bounded to the south by Govan Road, Elder Park and a residential area with another residential area to the east. Glasgow Harbour residential area lies opposite the site on the northern bank of the River Clyde. To the west of the site is the A739, the Queen Elizabeth University Hospital, and a large area comprising industrial, business and commercial activities.

The site has been used for ship building since the middle of the 19th century. It is located within an urban environment and covers approximately 10 hectares of land adjacent to the River Clyde with an existing waterfront 590m in length (Refer to Drawing No. 175756-GIS001 for site location). A combination of inclined slipways, masonry walls, sheet piled wharf structures and an extent of informal riverbank forms the water frontage to the site (northern boundary) with the wet basin located on the western area.

3.2 The Proposed Development

Bae Systems are currently considering their options for developing the Govan shipyard to support the long-term future of ship building at the site. The company has identified that the infilling of the existing wet basin will allow the expansion of the assembly line within a controlled environment. Options for how the newly created working platform can best be utilised in the shipbuilding assembly line are still being developed.

This screening request relates to Phase 1 of the development which is the infilling of the existing wet basin located at Grid Reference 254624 666109 to create a working platform.

The development site area (infilling area of the dock) is 1.70 hectares (below the threshold of 2 hectares for a major development and is therefore a local development with respect to planning). Arch Henderson Drawing 225010-BAE-AHN-ZZ-XX-DR-C0007 provided in Appendix A details the infill and new quay wall area that is proposed to be developed.

The area of the construction works is 4.57 hectares which includes the wet basin working area, access road and contractor compound. It is anticipated circa 190,000 m^3 of material will be required to infill the wet basin and that it will be brought to site primarily by barge (~95%) but also by road (~5%).

3.2.1 Plans

Illustrative layouts of the proposed construction works showing the wet basin, contractors compound and contractors access road are provided in Appendix A.

3.2.2 Construction Works Description

It is anticipated the works will comprise:

1. Enabling works including:
   a. Area to west of the site to be cleared of all debris to set up the contractor compound;
   b. Separate contractor access to be created from entrance roadway to allow construction traffic to be segregated from operational shipyard traffic;
2. Deployment of a silt curtain across the wet basin entrance (including a demountable section to allow passage of the barge);
3. Initial infill by long reach excavator from a barge which will place a 2 m layer of fill to cover existing sediment on the basin bed;
4. Infilling continuing using a combination of barge and excavators or self-discharging vessels. The infill material will extend beyond the line of the proposed quay wall;
5. An alternative option for infilling will incorporate construction of a stone bund at the entrance of the basin (to contain suspended solids). Infill would then incorporate placement of fluidised sand via pumping from a barge and distribution via spreader pontoon and dissipation bar.
6. Installation of a carrier drain around the existing basin quay wall to collect discharge from existing outfalls and direct to new outfalls protruding through the coffer dam;
7. Hydraulic compaction of infill material below mean sea level and dynamic compaction using rollers above mean seal level;
8. Land based piling through the infill material to create the outer quay wall. The work entails:
   a. Tubular piles being driven/vibrated into deep strata. These piles may need anchored by using a concrete pile toe bored into the rock through the tubular pile section;
   b. Sheet piles installed between the steel tubular piles. Sheet piles expected to be driven to shallower depths than the tubular piles;
   c. Reinforced concrete capping beam is installed to complete the quay wall.
9. Existing quayside at tie locations will be broken out and new tie ins installed between existing quay and the new cofferdam;
10. Basin infill taken up to design level by barged material placed over the new cofferdam and pushed into place by dozers;
11. Fill in front of cofferdam wall removed and berth pocket dredged to design level.

3.2.3 Construction Works Timing

It is anticipated that construction works will take a total of circa 34 weeks. Within this period piling to create the outer quay wall is estimated to last circa 14 weeks.

4 LOCAL SENSITIVITIES

This section notes some of the local sensitivities apparent from a high-level desk based review.

4.1 Ecologically Designated Areas

The site is not located within or in close proximity to a Special Area of Conservation (SAC), Special Protection Area (SPA) or a Site of Special Scientific Interest (SSSI).

4.2 Biodiversity

The following species and habitats are listed in the UK BAP (N) and the GLBAP and are potentially relevant to the site:

- Otter (N);
- Bats (various species) (N);
- Atlantic salmon (N);
- Common sturgeon (N);
- Allis shad (N);
- Twaite shad (N);
- European eel (N);
- River lamprey (N);
- Smelt (sparling) (N);
- Sea lamprey(N);
- Brown/sea trout (N);
- Swift; and
- Rivers (N).

4.2.1 Terrestrial

Otter
Despite the availability of food resources in the river, the wet basin and shipyard is considered sub-optimal for otters due to the lack of opportunity for holt creation along the bank. The majority of the quay-side is constructed of metal piling sheets with a concrete top and is therefore considered unsuitable.

The derelict area to the west of the site has gently sloping banks to the River Clyde with willow and birch trees present. However, the banks are heavily dominated by old building materials and has been subjected to fly-tipping. This reduces the banks suitability for holt creation.

Bats
The proposal does not include demolition of any buildings within the shipyard.

Badger
The derelict area to the west of the proposed construction compound could be suitable for badger but due to the high proportion of waste building material within the substrate it reduces the areas suitability for sett creation.

4.2.2 Marine Mammals

Although marine mammals are known to habituate the Clyde Estuary they are unlikely to regularly frequent the Inner Clyde Estuary where the Govan shipyard is located. Historically there have been very infrequent reports of individual marine mammals in the upper reaches of the Clyde. The most recent sighting was a Northern bottlenose whale spotted in the River Clyde around the Partick area in October 2020[3]

4.2.3 Migratory Fish

Atlantic salmon and Sea trout are known to migrate into the Clyde estuary and coastal streams and rivers. On returning to spawn, salmonids follow the coast. In the Inner Clyde estuary there are several salmon rivers, including the Kelvin, Clyde and Leven with large salmon and sea trout runs. Lamprey species also occur and migrate through the Inner Clyde Estuary.

4.3 Water Quality

4.3.1 Estuarine Classification

The shipyard is part of a waterbody (ID: 200510) identified as being heavily modified with overall classification of Moderate ecological potential.

4.3.2 Flood Risk

The SEPA flood risk maps were reviewed to ascertain whether the site was located in an area at risk from flooding.

Coastal Flooding

Figure 4-1 indicates that the shipyard is located within an area where each year there is a 10% chance of flooding.

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[3] Source: https://www.heraldscotland.com/news/18820857.glasgow-northern-bottlenose-whale-spotted-river-clyde/

Figure 4-1 Coastal Flooding
Source: https://map.sepa.org.uk/floodmaps/FloodRisk/Risk

Surface Water Flooding

Figure 4-2 indicates that the shipyard is located within an area where each year there is a 10% chance of flooding.

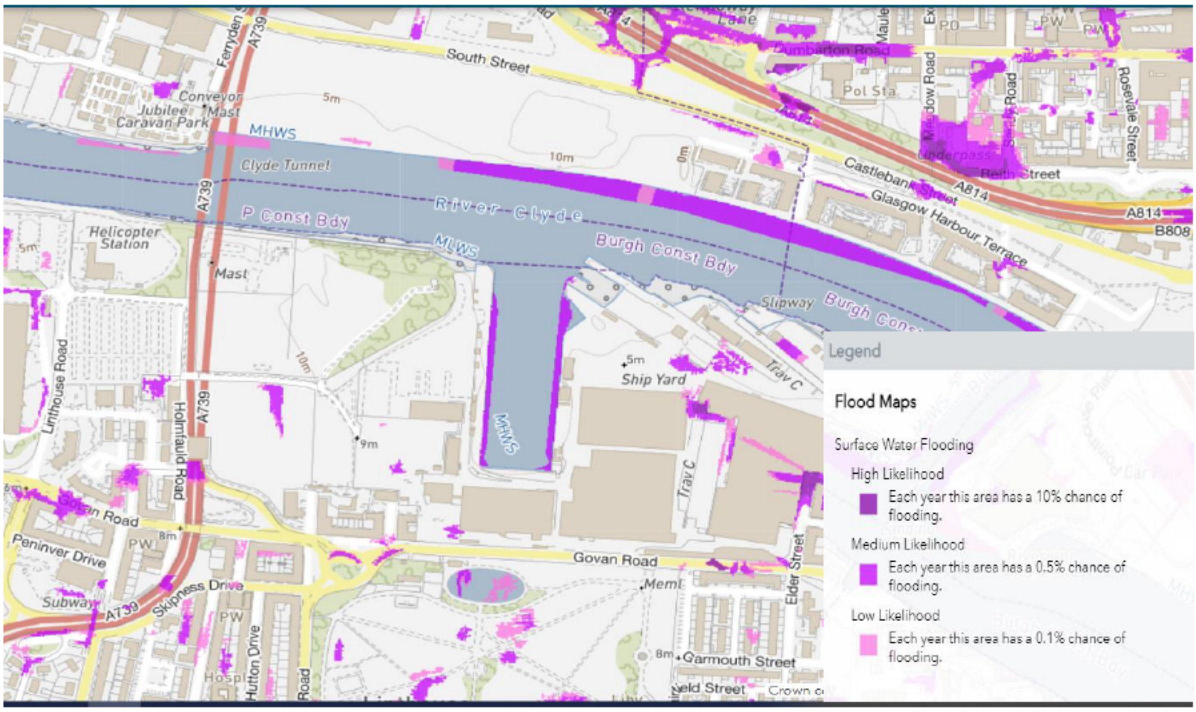

Figure 4-2 Surface Water Flooding
Source: https://map.sepa.org.uk/floodmaps/FloodRisk/Risk

River Flooding

There is no specific likelihood of river flooding identified for the shipyard area but there could still be localised effects from flooding in some places.

Future Flooding

Figure 4-3 indicates that the shipyard is located within an area where by the 2080's, each year there is a 0.5% chance of coastal flooding.

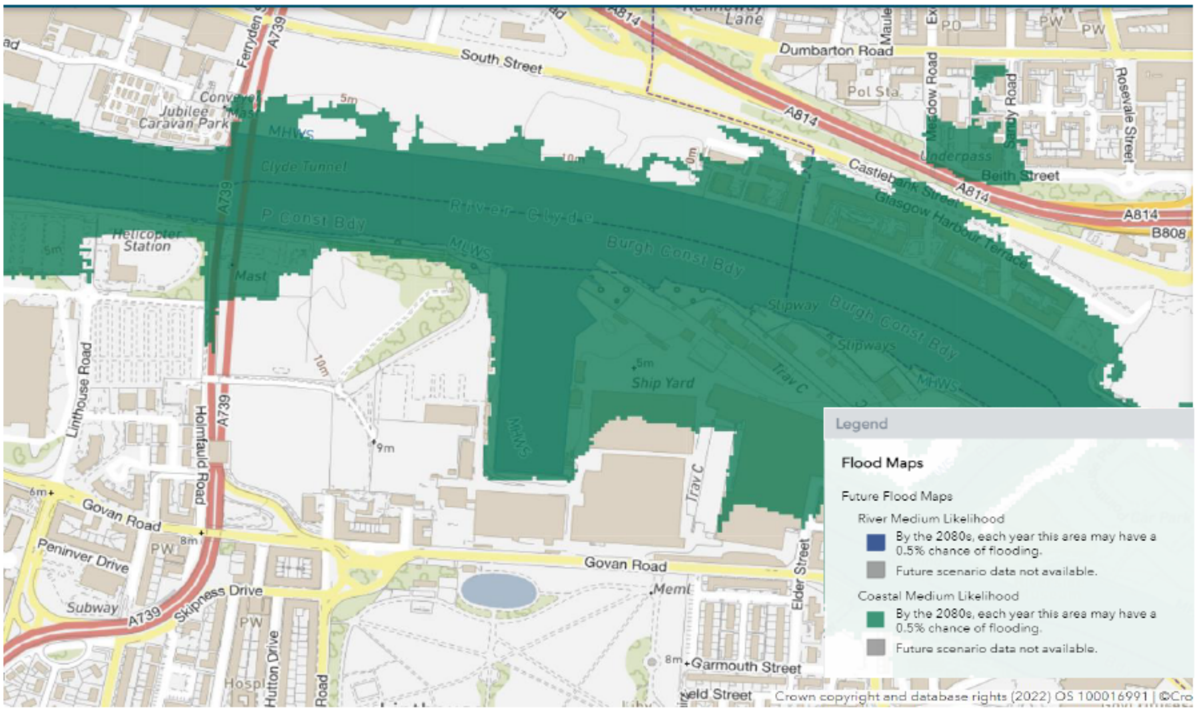

Figure 4-3 Future Year Flooding
Source: https://map.sepa.org.uk/floodmaps/FloodRisk/Risk

4.3.3 Groundwater

The shipyard is located within an area which has 2 groundwater classifications, namely; Govan Sand and Gravel and Glasgow and Motherwell, both of which have an overall classification of Poor.

4.4 Archaeology and Cultural Heritage

4.4.1 Scheduled Monuments

There are no scheduled monuments located within 500 m of the works site.

4.4.2 Canmore Terrestrial

There is a plethora of Canmore points located not only on the site but in the surrounding area as shown in Figure 4-4.

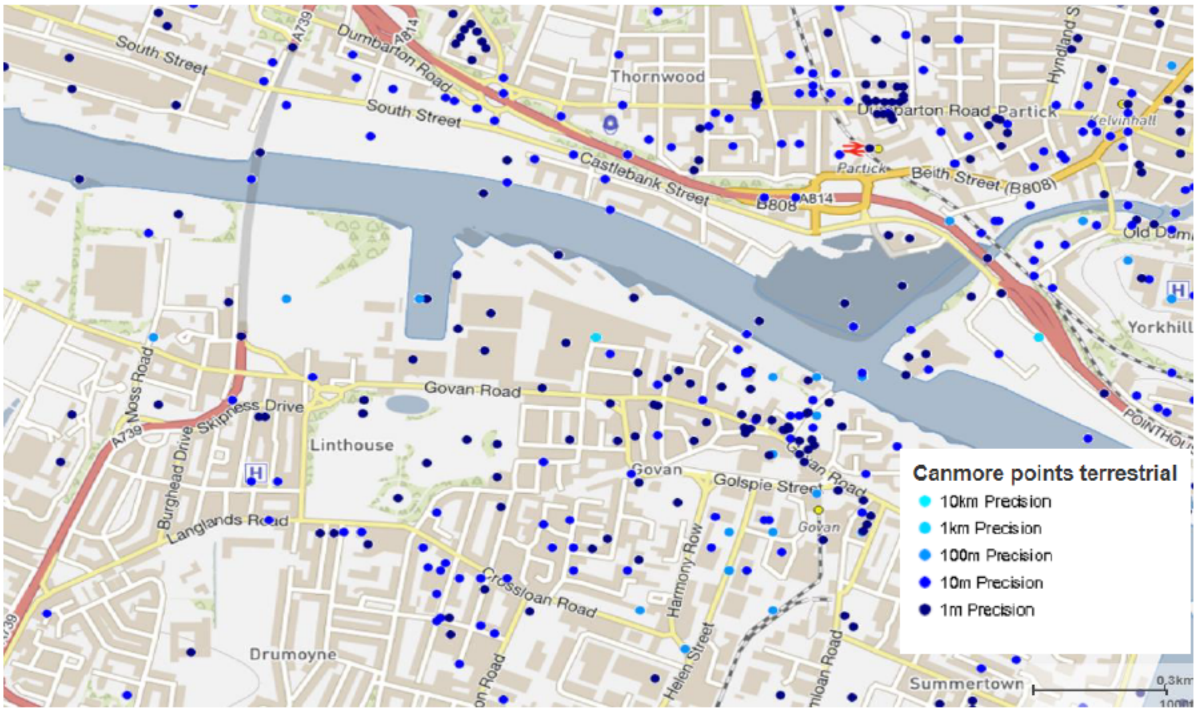

Figure 4-4: Canmore Terrestrial Points
Source: https://map.environment.gov.scot/sewebmap/

There are two Canmore points located within the construction site; namely Cranes (ID: 333983) and fit-out basin (ID: 270305) (both located in the wet basin). The Canmore points located within the surrounding shipyard area are associated with the shipyard in general (ID: 270305) and also for several individual structures relating to the shipyard including, the giant cantilever crane (ID: 79701), fabrication shed (ID: 79702), engine works (ID: 44196 and 270303), hammer stone (ID: 44228) etc.

4.4.3 Canmore Maritime

There are no Canmore Maritime points noted within 500m of the construction site.

4.4.4 Listed Buildings

There are two listed buildings located within the shipyard as shown in Figure 4-5.

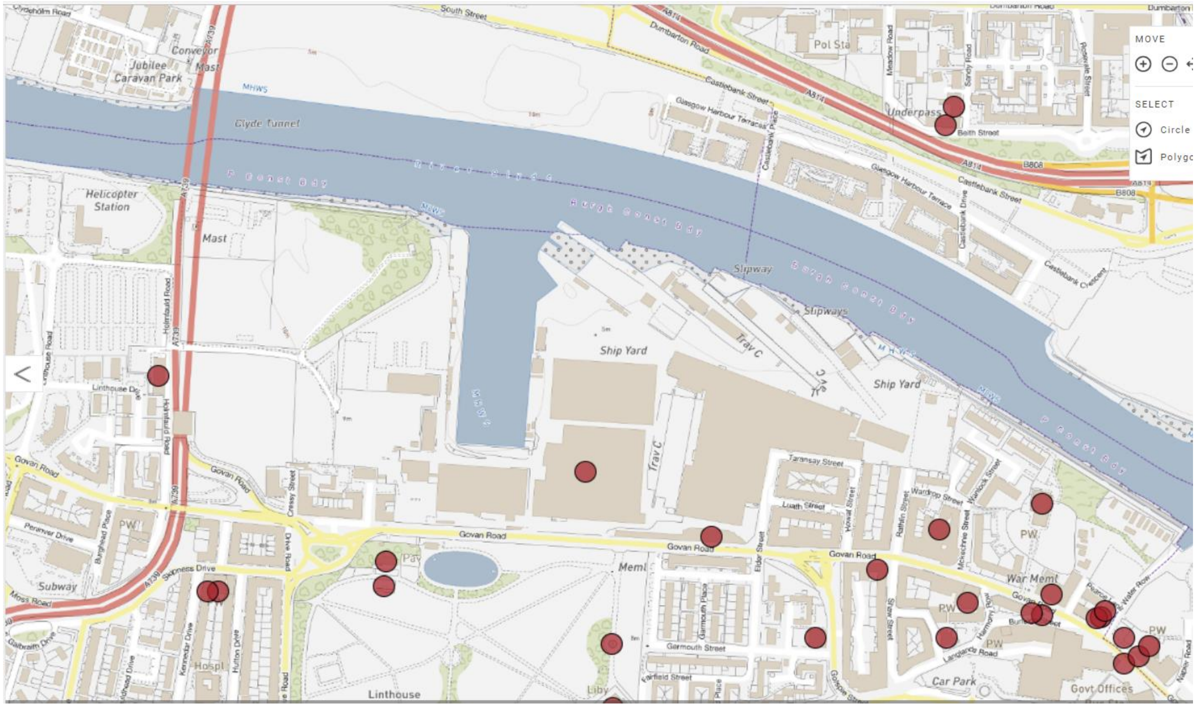

Figure 4-5: Listed Buildings
Source: https://pastmap.org.uk/map

The one on the left of the figure is identified as being the Former Engine Works of Fairfield Shipbuilding and Engineering Company (ID 1048). The other building on the right bounding Govan Road pertains to the General Offices (Excluding 1956 extension to the West) (ID 1030 and 1048).

Within the surrounding area there are numerous listed buildings identified with either A, B or C Listed Building Category's.

4.4.5 Conservation Areas

The Govan Conservation Area is located to the south of the shipyard.

4.5 Landscape and Visual

The site is located within an existing operational shipyard within an urban area of Glasgow City. It is considered unlikely that the proposal will significantly alter the landscape character or visual amenity of the area.

4.6 Noise

The shipyard is located within Glasgow City which is characterised by an urban noise environment. Figure 4.6 provides a strategic overview of the annual average noise levels at 4m above ground level on a 10m calculation grid associated with road, rail, industrial and aircraft within Scottish agglomerations such as Glasgow City.

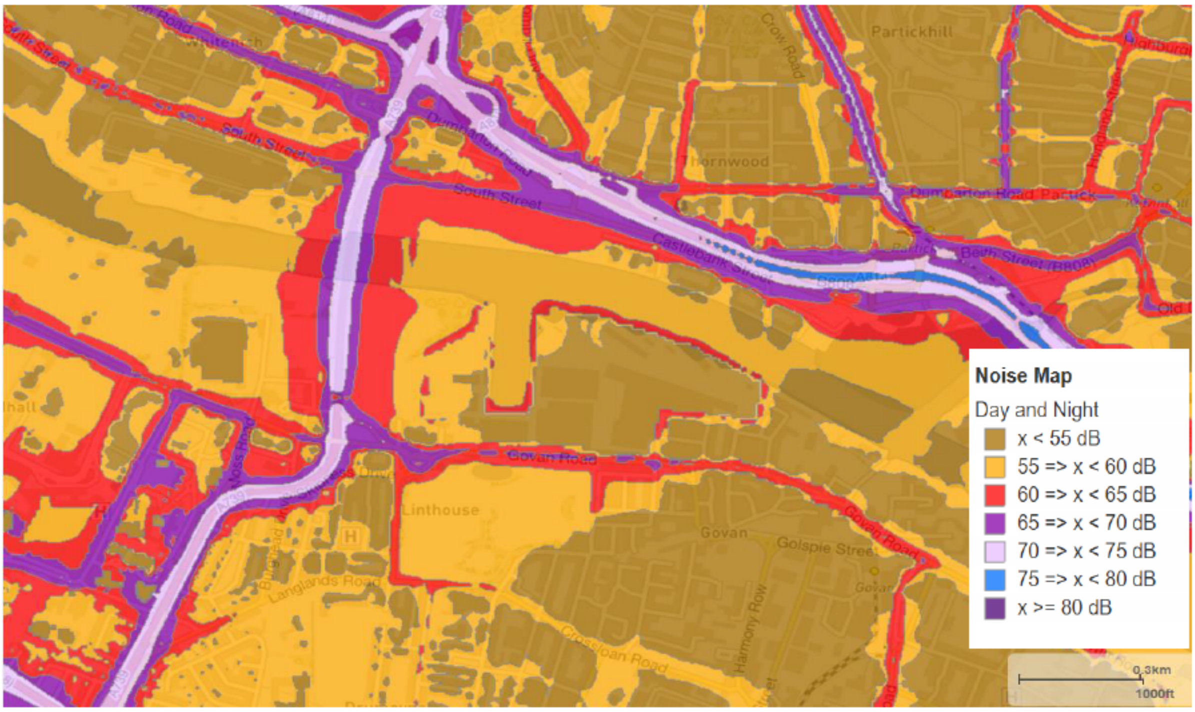

Figure 4-6: Consolidated Day, Evening and Night (Lden)
Source: https://noise.environment.gov.scot/noisemap/

On review of the noise map, it is noted that noise levels vary in the surrounding area, with the variations largely associated with road transport links. The shipyard is shown to have relatively low noise levels when compared with the surrounding area with the wet basin itself being slightly higher.

4.7 Air Quality

Glasgow City Council (GCC) have declared 3 AQMAs within their boundary, the closest being Dumbarton Road / Byres Road AQMA, declared for NO_2 and PM_{10}. This AQMA is circa 380m north of the shipyard.

Background air quality pollutant concentrations available from Air Quality Scotland[4] and DEFRA[5] websites were obtained for the OS 1 km grid square the shipyard is located in (Grid Square 254500 666500). The background pollutant concentrations for this square are outlined in Table 4-1 below.

Table 4-1: Background Air Quality Pollutant Concentrations

Year	Total Pollutant Concentration (µg/m³)		
	NO_2	PM_{10}	$PM_{2.5}$
2019	17.95	11.14	6.42

Note: 2020/21 pollutant concentrations are considered to have been influenced by the COVID 19 lockdown measures. To provide a conservative overview 2019 pollutant concentrations have been used for this report.

On review of the NO_2, PM_{10} and $PM_{2.5}$ pollutant concentrations for 2019 it is noted all are below the relevant Air Quality Objectives of 40µg/m³, 18 µg/m³ and 10 µg/m³.

The Scottish Pollutant Release Inventory (SPRI) data[6] was reviewed and the closest industrial / health operations that are required to report their air emissions to SEPA are identified as Thales Optronics

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[4] Available at: https://www.scottishairquality.scot/data/mapping/data
[5] Available at: https://uk-air.defra.gov.uk/data/laqm-background-maps?year=2018
[6] Available at: https://map.environment.gov.scot/sewebmap/

Ltd and the Queen Elizabeth University Hospital both located over 430m to the west of the construction site.

4.8 Population and Human Health

The shipyard is currently operational and located in an urban area. Given the nature of the proposals it is unlikely there will be significant issues associated with population and human health.

4.9 Waste

Due to the nature of the construction works, it is unlikely it will generate significant waste. A Site Waste Management Plan shall be prepared to ensure adequate measures for waste management are in place prior to and during construction.

4.10 Material Assets

The formation of the working platform will utilise material for infill but given the scale, this is not considered to be substantial. As such, significant effects are considered to be negligible.

4.11 Climate Change

Climate change has taken a prominent position within policy and legislation at a national level, with the Climate Change (Emissions Reduction Targets) (Scotland) Act 2019[7] amending the Climate Change (Scotland) Act 2009[8]. The 2019 Act sets a target date of 2045 for Scotland reaching net-zero emissions.

In addition, under Schedule 4(4), of both EIA Regulations require:

> "*A description of the factors …….. likely to be significant affected by the development… (Including) climate (for example greenhouse gas emissions, impacts relevant to adaption)*"

With Schedule 4(5) (f) of the EIA Regulations requiring:

> "A *description of the likely significant effects of the development on the environment resulting from…the impact of the project on climate (for example the nature and magnitude of greenhouse gas emissions) and the vulnerability of the project to climate change*"

It is considered that the proposals would not result in a significant effect upon climate given the nature of the shipyard. Any increase in emissions created during either construction or operation is likely to be negligible, and pollution and emissions control during construction would be discussed within a detailed Construction Environmental Management Plan (CEMP).

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[7] *Climate Change (Emission Reduction Targets) (Scotland) Act 2019 (asp 15).* Available at: https://www.legislation.gov.uk/asp/2019/15/enacted

[8] *Climate Change (Scotland) Act 2009 (asp 12).* Available at: https://legislation.gov.uk/asp/2009/12/contents

Discussion of the vulnerability of the project to climate change is primarily concerned with the water environment, including flood risk. Climate Change will be assessed as part of the Flood Risk Assessment.

4.12 Major Accidents

The construction and operation of the working platform are not likely to give rise to major accidents.

5 ASPECTS OF THE ENVIRONMENT POTENTIALLY AFFECTED AND POTENTIAL MITIGATION MEASURES

The table below provides commentary on each of the environmental topics considered with information on:

- Local setting and any key known features;
- Potential effects of development; and
- Any mitigation, avoidance or enhancement measures that could be implemented.

Table 5-1: Aspects of the Environment Potentially Affected and Potential Mitigation Measures

Topic	Potential Effects	Context and Observations	Potential Mitigation
Air Quality	Construction Dust Emissions	No residential receptors immediately adjacent to the proposed construction works. No AQMA within close proximity of the site.	Industry standard measures will be employed during the construction works which will be managed through the Construction Environmental Management Document (CEMD).
Archaeology and Cultural Heritage	Infilling of the wet basin	There are two cultural assets identified within the wet basin.	The wet basin will be documented prior to construction commencing. No mitigation proposed, nevertheless, it is recommended that suitable protocols for the recording of previously unrecorded cultural heritage assets are introduced.
Biodiversity, Flora and Fauna	Habitat Loss	Habitat is considered suboptimal for otter, bats and badger. Breeding birds (seasonal) could be present on the site between April to September.	Ecological surveys will be undertaken prior to construction works commencing. Should any species be found using the area then suitable mitigation measures shall be devised to mitigate accordingly.
Biodiversity, Flora and Fauna	Light nuisance	Minimise light nuisance on faunal species	Powerful night-time lighting should be avoided as this could potentially disturb faunal species and reduce potential foraging and commuting routes.
Biodiversity, Flora and Fauna	Damage to the Biodiversity, flora and fauna.	Degradation of water quality during infilling works through small accidental release of fuel and associated impacts on flora and fauna.	The following good practice guidelines shall be adhered to and incorporated into the CEMD: • GGP 1: GPP 1: A general guide to preventing pollution • GGP 5: Works and maintenance in or near water; • PPG 6: Working at construction and demolition sites; • PPG 7: Safe Storage – The safe operation of refuelling facilities; • GPP 21: Pollution and incident response planning; and

Topic	Potential Effects	Context and Observations	Potential Mitigation
			• GPP 22: Incident response – dealing with spills.
Biodiversity, Flora and Fauna	Noise and visual impact.	Noise impact resulting in disturbance to fish.	Piling through the temporary coffer dam will dampen down underwater noise generation. No piling will be undertaken during the hours from dusk to dawn. Piling is not a continuous process and there will be quiet periods between when one piling activity is completed and setting up the next. A soft start technique will be adopted where the source level of the sound source is increased gradually before use at operational power. The expectation is that nearby fish/marine mammals respond to the increasing sound level by swimming away from the sound source.
Biodiversity, Flora and Fauna	Sediment Suspension	Increased suspended solids in water column of River Clyde impacting migratory fish.	A silt curtain will be deployed at the basin entrance prior to construction works commencing.
Biodiversity, Flora and Fauna	Marine Mammal Collision	Increased marine traffic during the infilling leading to an increased risk of collision with marine mammals.	Develop a Marine Mammal Protection Plan to assess and manage the risks of causing injury or disturbance to marine mammals (cetaceans and seals), as a result of the increased traffic.
Biodiversity, Flora and Fauna	Introduction of new invasive species.	Minimising the spread of Non-Native Species.	Works will be undertaken in line with the Scottish Governments "Non-native species: code of practice[9] (2012)"

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[9] https://www.gov.scot/publications/non-native-species-code-practice/

Topic	Potential Effects	Context and Observations	Potential Mitigation
Climate Change	Flooding on site and the surrounding area.	The infilling of the basin will decrease the water capacity of the River Clyde.	Discussion of the vulnerability of the project to climate change is primarily concerned with the water environment, including flood risk. It should be noted that the development is a Water Compatible Use as defined within The SEPA Flood Risk and Land Use Vulnerability Guidance (LUPS-GU24 v.4) and land use with such a classification in an area with a 10% chance of flooding each year is considered to be generally suitable for development by SEPA. A flood risk assessment will be undertaken to inform the working platform design.
Landscape	Minor impact on visual amenity of the area during construction.	Impact on visual amenities to local populations in particular the Glasgow Harbour residents which over-look the shipyard.	Construction activities are occurring within an existing operational shipyard and are considered to be temporary in nature. No mitigation proposed in relation to visual impacts.
Major Accidents	Minimise major accidents	The construction works is not likely to give rise to major accidents.	No mitigation proposed
Material Assets	Promote the sustainable use and management of material assets.	Proposal will be protecting and enhancing existing assets and ensuring sustainable use.	No mitigation proposed.
Population and Human Health	Protect and improve human health and wellbeing.	Degradation of air quality on local communities, through emissions during construction.	The CEMP will contain standard construction site dust suppression techniques.
Population and Human Health	Protect and improve human health and wellbeing.	Degradation of the noise environment of local communities, through noise	It is considered that construction works are temporary in nature and the noise environment will return to pre-construction levels once work is completed. It is anticipated that construction works including piling will be

Topic	Potential Effects	Context and Observations	Potential Mitigation
		emissions during construction works.	restricted to the daytime period. A noise assessment will be undertaken to support the planning application.
Waste	Zero Waste	Adhere to the waste hierarchy wherever possible	A Site Waste Management Plan shall ensure adequate measures for construction waste management will be in place prior to and during construction.
Water	Protect and enhance the state of the water environment.	Potential degradation of water quality during construction and operation.	Potential degradation of the water environment during construction would be managed by the CEMD.
Water	Flooding	Potential flooding as a result of the infilling works.	A flood risk assessment will be undertaken to determine likely flooding effects and support the planning application.

6 ENVIRONMENTAL IMPACT ASSESSMENT: SCREENING CHECK LIST

6.1 Introduction

An Environmental Impact Assessment: screening check list has been completed to support the screening request. The check list has been developed taking cognisance of the Scottish Government guidance document available from the government website[10]. The screening check list considers the following:

- Characteristics of the Development;
- Location of the Development; and
- Characteristics of Potential Impact.

6.2 Characteristics of the Development

The assessment on the Characteristics of the Development is provided in Table 6-1.

Table 6-1 Characteristics of the Development

Criteria	Observations
The magnitude and spatial extent of the impact	
Will the effect extend over a large area?	The impacts of the construction works will be confined within the shipyard. There will be no effect on designated sites. Site level construction matters could be managed by implementation of a specific CEMP.
Will many people be affected?	There is potential for residents of Glasgow Harbour overlooking the shipyard to be impacted by construction noise during the works.
The nature of the impact	
Will there be the potential for a significant environmental impact as a result of the proposal?	During the works construction will be restricted to daytime hours. On completion the noise environment of Glasgow Harbour residents will return to pre-construction levels.
The transboundary nature of the impact	
Will there be any potential for transboundary impact? (nb. Development which has a significant effect on the environment in another Member State is likely to be very rare. It is for	No

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[10] Based on: www.gov.scot/publications/environmental-impact-assessment-screening-checklist/

the Scottish Ministers to consider whether there is likely to be such an effect in each case).	
Intensity and complexity of the impact	
Will there be a large change in environmental conditions?	No, temporary impacts associated with construction noise only.
Will the effect be unusual in the area or particularly complex?	No
Will many receptors other than people (fauna and flora, businesses, facilities) be affected?	No, potential for short term temporary effects during construction and dredging.
Will valuable or scarce features or resources be affected?	No
Is there a risk that environmental standards will be breached?	No
Is there a risk that protected sites, areas, features will be affected?	Best practice construction and dredging methods will be employed with strict adherence to regulations and guidance.
Probability of the impact	
Is there a high probability of the effect occurring?	Yes, although the effect will be temporary.
Is there a low probability of a potentially highly significant effect?	No
Expected onset, duration, frequency and reversibility of the impact	
Will the onset of the impact be sudden?	No, residents will be informed of the anticipated date of construction works commencing and will be updated throughout the project.
Will the effect continue for a long time?	During the works construction will be generally restricted to daytime hours, however the basin infill may require 24 hour working for the barge and distribution mechanisms should pump ashore methodology be adopted. On completion the noise environment of Glasgow Harbour residents will return to pre-construction levels.
Will the effect be permanent rather than temporary?	No
The cumulation of the impact with the impact of other existing and/or approved development	
Will the cumulative impact of this effect along with the impacts of other existing or approved	No

development result in a significant environmental impact?	
The possibility of effectively reducing the impact	
Has the developer detailed proposed mitigation measures to prevent significant adverse effects on the environment?	Mitigation measures have been identified.
Are the mitigation measures proposed by the developer, or different mitigation measures that may be proposed by the local authority, sufficient to mitigate adverse effects on the environment?	Yes

6.3 Location of the Development

The assessment on the Location of the Development is provided in Table 6-2.

Table 6-2: Location of the Development

Criteria	Observations
Existing land use	
Are there existing land uses, or approved uses which have yet to be implemented, on or around the location which could be affected by the development	No.
Are there any areas on or around the location which are occupied by sensitive land uses e.g. hospitals, schools, places of worship, community facilities, which could be affected?	None in the immediate vicinity of the shipyard. Elder Park is located on Govan Road directly opposite the shipyard entrance. The Queen Elizabeth University Hospital is located over 430m to the west.
Is the development located in a previously undeveloped area where there will be loss of greenfield land?	No
The relative abundance, quality and regenerative capacity of natural resources in the area	
Are there any areas on or around the location which contain important, high quality or scarce resources which could be affected by the development?	The site is located within an operational shipyard located within an urban area of Glasgow City comprising a mixture of industrial/residential/commercial uses.
The absorption capacity of the natural environment	
Are there any areas on or around the location which are protected under international or national or local legislation for their ecological, landscape, cultural or other value, which could be affected by the development?	No.
Are there any other areas on or around the location which are important or sensitive for reasons of their ecology?	Migratory Fish in the River Clyde.

Are there any areas on or around the location which are used by protected, important or sensitive species of fauna or flora e.g. for breeding, nesting, foraging, resting, overwintering, migration, which could be affected?	No.
Are there any inland, coastal, marine or underground waters on or around the location which could be affected?	Yes, the River Clyde is still designated as an estuary at this point.
Are there any groundwater source protection zones or areas that contribute to the recharge of groundwater resources?	No.
Are there any areas or features of high landscape or scenic value on or around the location which could be affected?	No.
Are there any routes or facilities on or around the location which are used by the public for access to recreation or other facilities, which could be affected?	No (short term restrictions during construction)
Are there any transport routes on or around the location which are susceptible to congestion or which cause environmental problems, which could be affected?	No, the works are within an existing shipyard. The infill material will be brought to site by barge.
Is the development in a location where it is likely to be highly visible to many people?	No, although there is a view from the northern bank of the Clyde with some residents of Glasgow Harbour overlooking the current shipyard. However, there is no change of use proposed as a result of the proposals.
Are there any areas or features of historic or cultural importance on or around the location which could be affected?	Yes, the wet basin itself is identified as a historical feature on the Canmore database. There are a number of features also identified in the shipyard associated with historical shipbuilding also identified on the Canmore database.
Are there any areas on or around the location which are already subject to pollution or environmental damage e.g. where existing legal environmental standards are exceeded, which could be affected?	No.
Is the location of the development susceptible to earthquakes, subsidence, landslides, erosion, flooding or extreme or adverse climatic conditions e.g. temperature inversions, fogs, severe winds, which could cause the development to present environmental problems?	No.

6.4 Characteristics of Potential Impacts

The assessment on the Characteristics of Potential Impacts are provided in Table 6-3.

Table 6-3: Characteristics of Potential Impacts

Criteria	Observations
The magnitude and spatial extent of the impact	
Will the effect extend over a large area?	The impacts of the proposals will be confined to the shipyard footprint. Site level construction matters could be managed by implementation of a specific CEMP.
Will many people be affected?	No
The nature of the impact	
Will there be the potential for a significant environmental impact as a result of the proposal?	No, site will continue to operate as a shipyard.
The transboundary nature of the impact	
Will there be any potential for transboundary impact? (nb. Development which has a significant effect on the environment in another Member State is likely to be very rare. It is for the Scottish Ministers to consider whether there is likely to be such an effect in each case).	No
Intensity and complexity of the impact	
Will there be a large change in environmental conditions?	No
Will the effect be unusual in the area or particularly complex?	No
Will many receptors other than people (fauna and flora, businesses, facilities) be affected?	No, potential for short term temporary effects during construction and dredging.
Will valuable or scarce features or resources be affected?	Yes, the wet basin is identified as a cultural heritage feature however it is not designated.
Is there a risk that environmental standards will be breached?	Best practice construction and dredging methods will be employed with strict adherence to regulations and guidance.
Is there a risk that protected sites, areas, features will be affected?	Yes, the wet basin is identified as a cultural heritage feature however it is not designated.
Probability of the impact	
Is there a high probability of the effect occurring?	No
Is there a low probability of a potentially highly significant effect?	No
Expected onset, duration, frequency and reversibility of the impact	
Will the onset of the impact be sudden?	No
Will the effect continue for a long time?	No
Will the effect be permanent rather than temporary?	Any contamination of the site would be subject to necessary remediation.
Will the impact be continuous rather than intermittent?	No
If intermittent, will it be frequent rather than rare?	Rare
Will the impact be irreversible?	No
Will it be difficult to avoid or reduce or repair or compensate for the effect?	No
The cumulation of the impact with the impact of other existing and/or approved development	
Will the cumulative impact of this effect along with the impacts of other existing or approved	No

development result in a significant environmental impact?	
The possibility of effectively reducing the impact	
Has the developer detailed proposed mitigation measures to prevent significant adverse effects on the environment?	Mitigation measures have been identified.
Are the mitigation measures proposed by the developer, or different mitigation measures that may be proposed by the local authority, sufficient to mitigate adverse effects on the environment?	Yes

7 CONCLUSIONS

It is expected that there will be some normal residues/emissions during the construction stage associated with the development works proposed which include infilling of a basin with association installation of drainage and outfalls.

Standard mitigation measures will be employed and monitored. These are set out in the Construction and Demolition Waste Management Plan accompanying the application. As such residues and emissions are not considered likely to have potential to cause significant effects on the environment.

Resources used will be construction materials which will be typical raw materials used in the infilling operation. The scale and quantity of the materials used will not be such that would cause concern in relation to significant effects on the environment. The construction or operation of the scheme would not use such a quantity of water to cause concern in relation to significant effects on the environment. The use of natural resources in relation to the proposed development is not likely to cause significant effects on the environment.

Biodiversity

A Preliminary Ecological appraisal Report will be submitted to the Council as a supporting document as part of the planning application. In addition a Marine Mammal Risk Assessment and Protection Plan will be produced detailing proposed mitigation requirements with respect to protection of marine mammals. As part of this assessment risk to migratory fish will also be considered.

Landscape and Visual

Given the proposed works relate to infilling of a dock in an operational industrial facility there is considered to be limited issues associated with landscape and visual impact. Therefore, it is unlikely to constitute grounds to require an EIA to be carried out

Archaeology and Cultural Heritage

There are no designated sites within the proposed working area As such, there would likely be minimal significant effects as a result of the development and it is therefore not considered to constitute grounds to require an EIA to be carried out.

Air Quality

Air quality is unlikely to be significantly altered as a result of the works. Dust can be controlled during construction via a Construction Environmental Management Plan/ Dust Management Plan.

Noise

Management control measures would be put in place to limit noise during construction and particularly related to the piling exercise. The previously noted Marine Mammal Risk Assessment will primarily consider risk associated with noise.

Water Environment

A flood risk assessment will be undertaken in support of the planning application, however, it is unlikely to constitute grounds to require an EIA to be carried out.

Population and Human Health

Given the nature of the development it is unlikely there will be significant issues associated with population and human health.

Waste

A Site Waste Management Plan shall ensure adequate measures for waste management will be in place prior to and during construction.

Material Assets

The construction and operation of proposed development will utilise material assets (access road) but given the scale of the development this is not considered to be significant.

Climate Change

Discussion of the vulnerability of the project to climate change is primarily concerned with the water environment, including flood risk. Flooding is not considered to be significant as it does not constitute a significant environmental aspect.

Major accidents

The construction and operation of the proposed development are not likely to give rise to major accidents.

In summary, it is not considered that the proposed development is likely to give rise to significant adverse effects on the environment requiring an EIA to be carried out.

Cumulative Effects

There are no known other zoned sites coming forward for development at this time in the immediate vicinity.

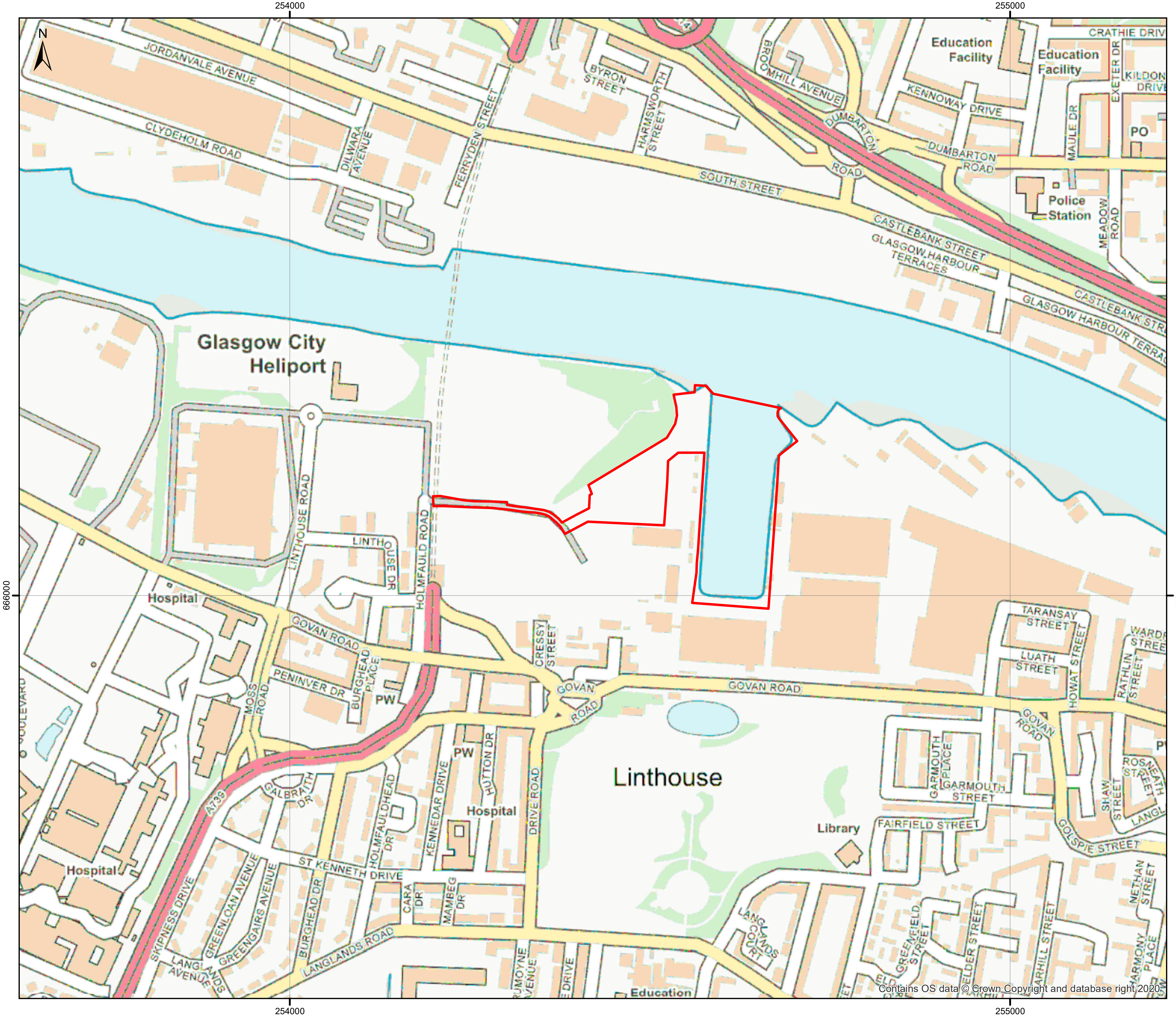
In conclusion, it is respectfully submitted that the proposed development is below the thresholds for a mandatory EIAR. The screening exercise has been completed in this report and the methodology used has been informed by the available guidance and legislation.

It is also considered that the proposed development, as described in detail in this application, will not result in significant impacts on the local environment to the extent that warrant an EIA being required.

All recommended mitigation measures and standard practices outlined in the application documents will be employed throughout the construction (and operational) phase of the development to ensure that the proposed development will not create significant impacts on the quality of the surrounding environment.

APPENDICES

A DRAWINGS



Legend

🟥 Site Boundary

Do not scale his map

Client
Arch Henderson

Project
Govan Facilities Investment

Title
Site Location Plan

Status
Final

Drawing No.	Revision	Date
175756-GIS001	-	18 May 2022
Drawn	**Checked**	**Approved**
AH	GD	GD

Scale
1:5,000 @A3
0 25 50 100 150 Metres

Rev	Date	Amendment	Initials

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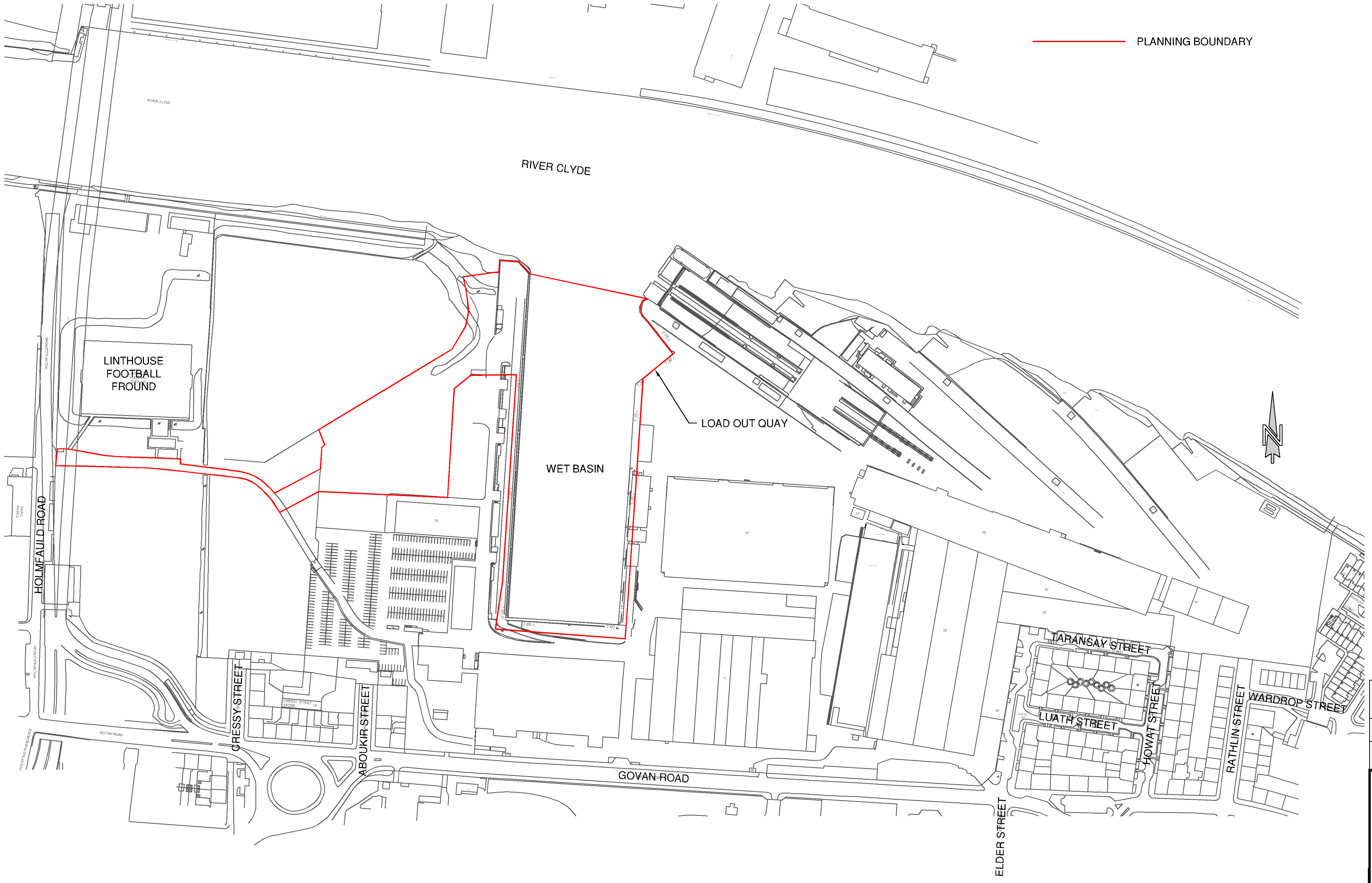

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Offices in : Aberdeen, Dundee, Glasgow, Lerwick, Southampton, Stromness and Thurso

PROJECT :
BAE Surface Ships Limited - Govan
Wet Basin Infill

TITLE :
Location Plan

DRAWN :	DATE :	VERIFIED :	APPROVED :
CAB	17.05.22	TR	GB

SCALE : (A1) 1:2500

DRAWING STATUS : S0

DRAWING No : 225010-BAE-AHN-ZZ-XX-DR-C-0001

REV : P01

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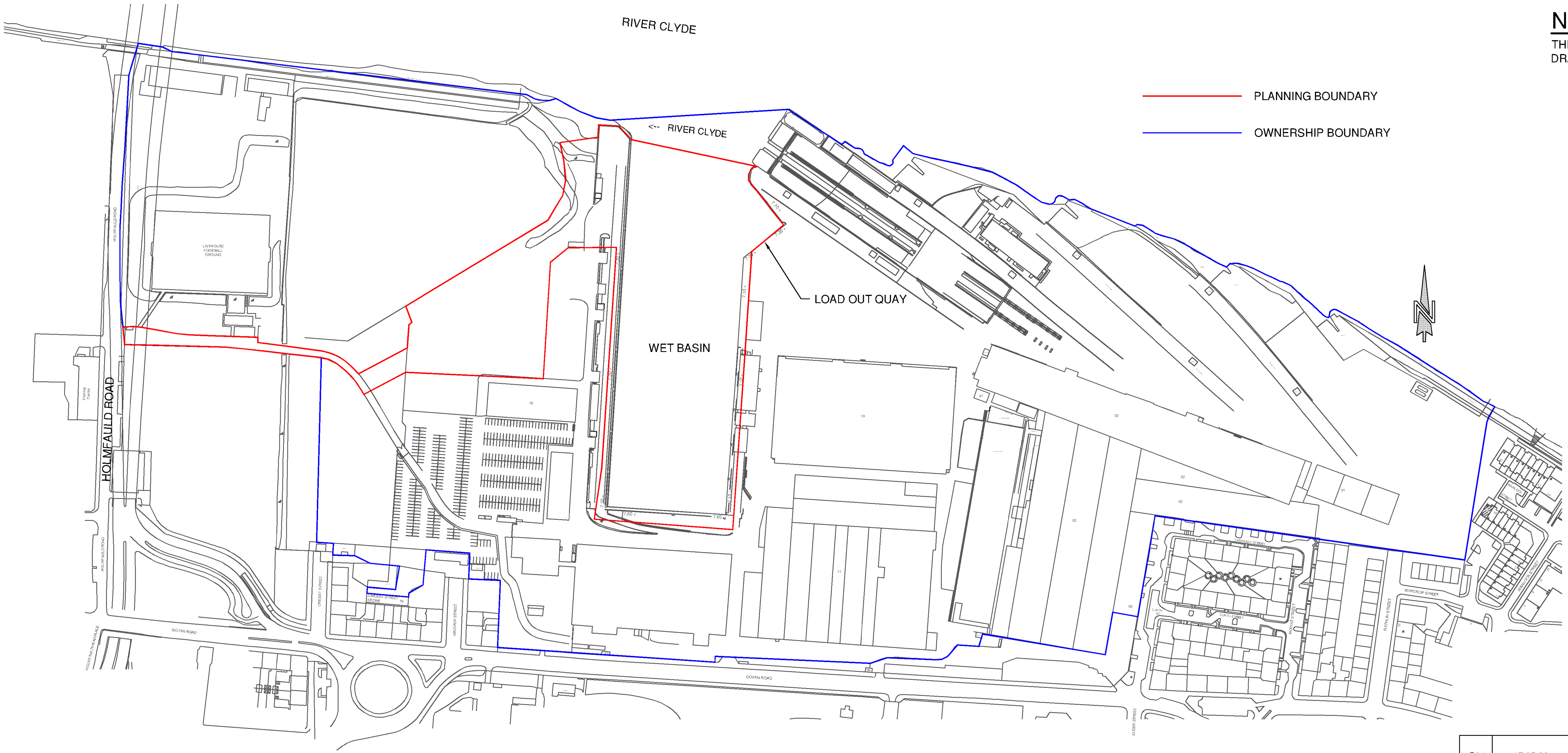

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PROJECT :
BAE Surface Ships Limited - Govan
Wet Basin Infill

TITLE :
Site Ownership Boundary

DRAWN : CAB
DATE : 17.05.22
VERIFIED : TR
APPROVED : GB
SCALE : (A1) 1:2500
DRAWING STATUS : S0
DRAWING No : 225010-BAE-AHN-ZZ-XX-DR-C-0002
REV : P01

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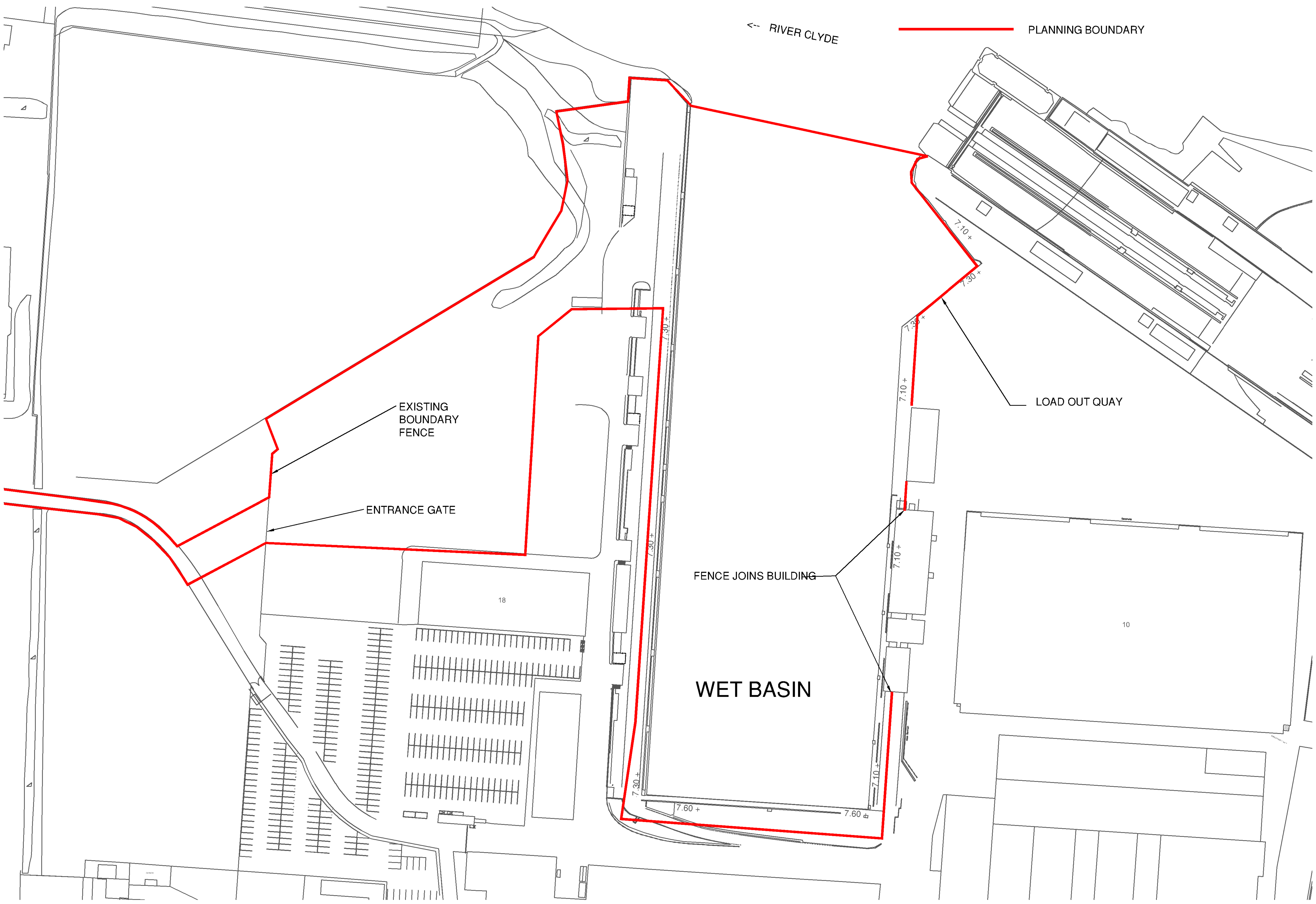

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PROJECT :
BAE Surface Ships Limited - Govan
Wet Basin Infill

TITLE :
Site Compound and Access

DRAWN : CAB
DATE : 17.05.22
VERIFIED : TR
APPROVED : GB
SCALE : (A1) 1:1250
DRAWING STATUS : S0
DRAWING No : 225010-BAE-AHN-ZZ-XX-DR-C-0003
REV : P01

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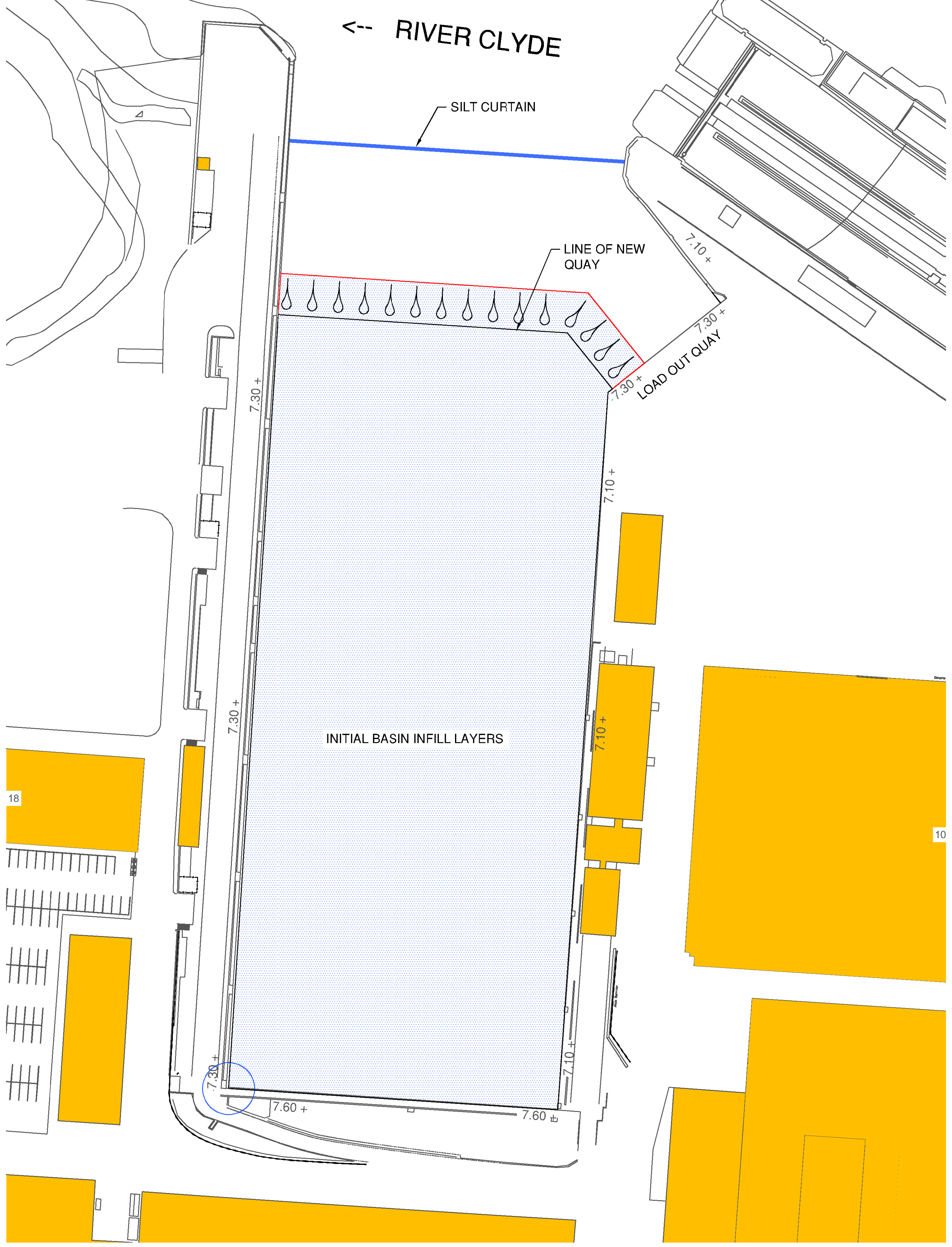
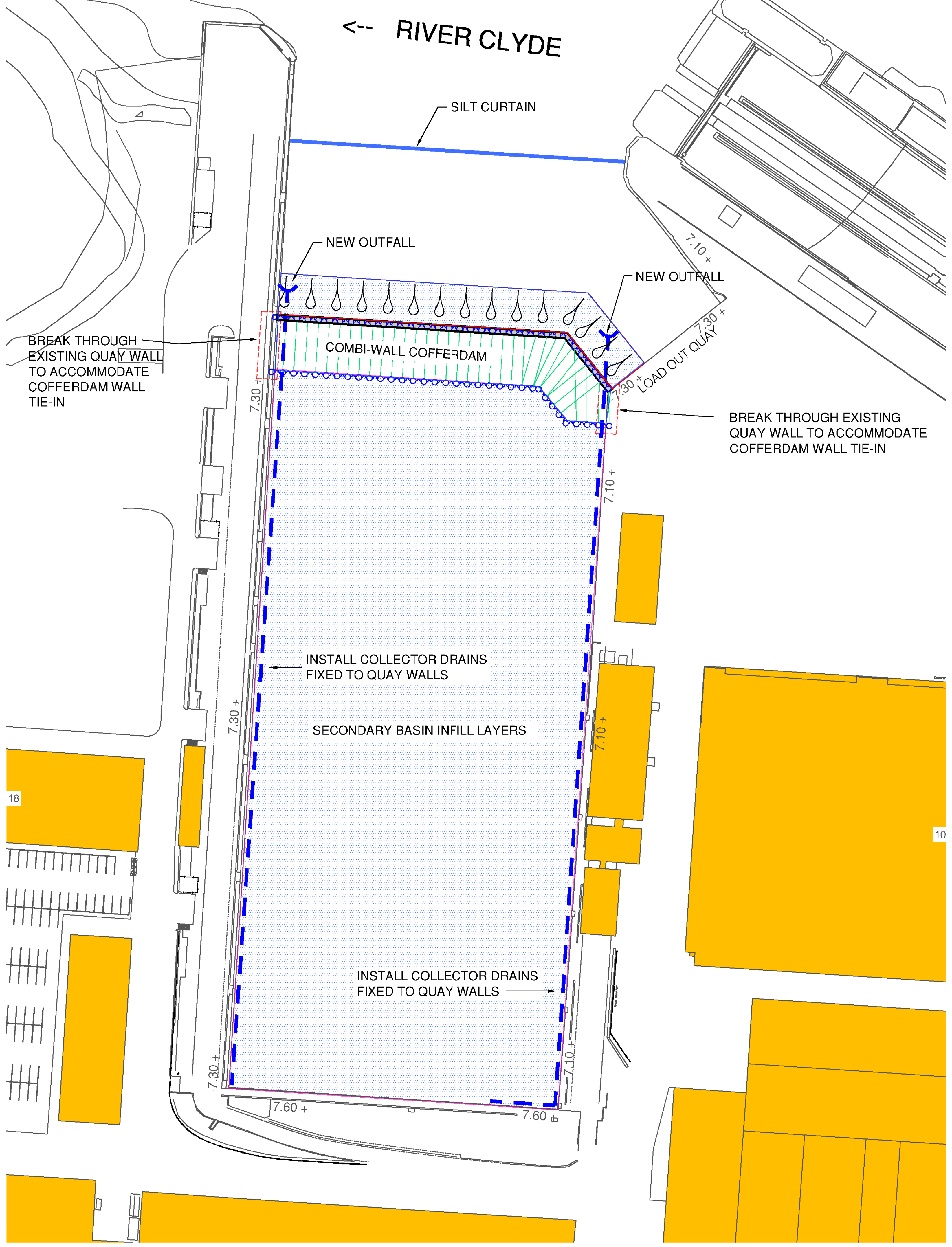
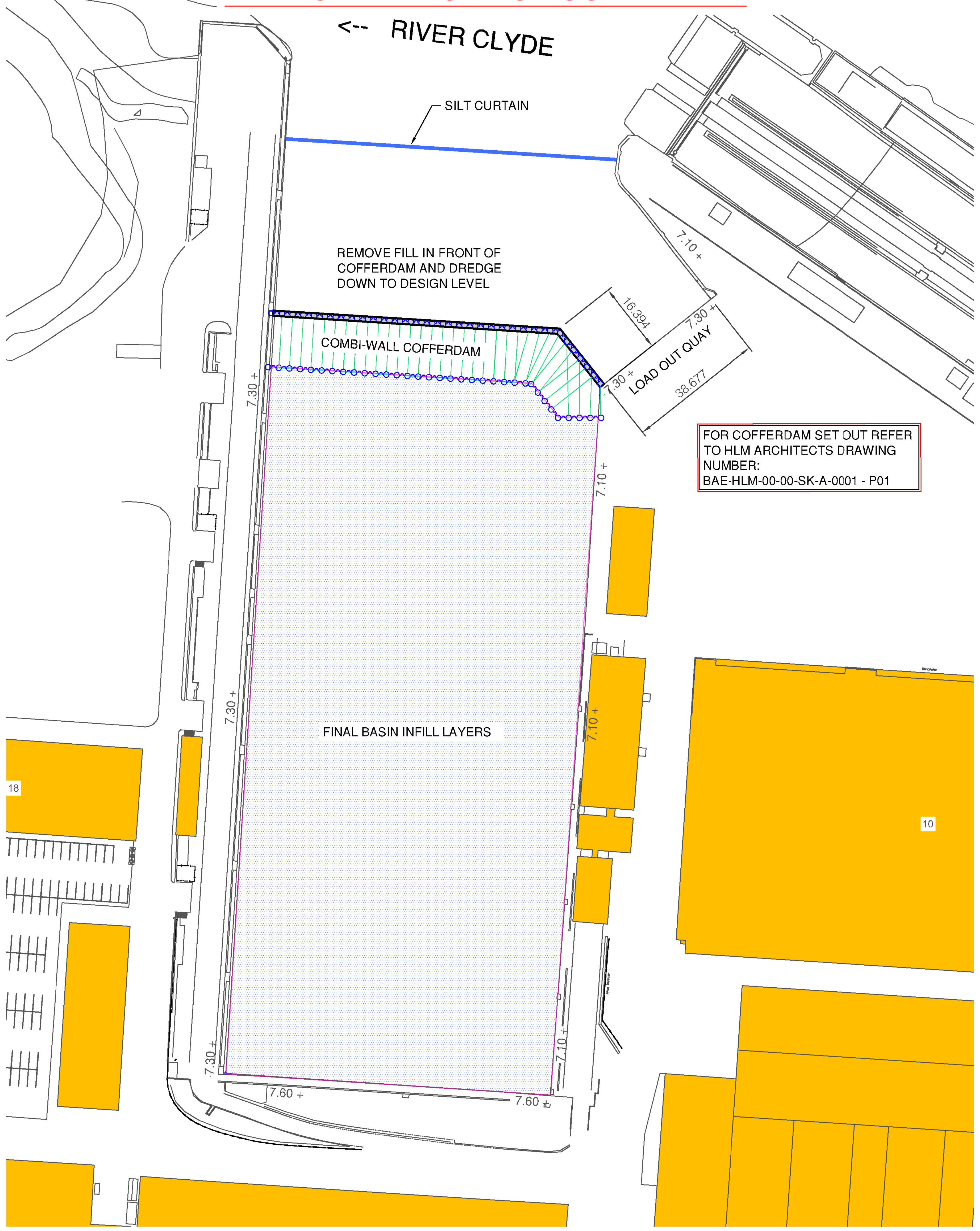
PHASE 1 - INITIAL FILL PLACEMENT



PHASE 2 - INSTALL COFFERDAM



PHASE 3 - FINAL FILL PLACEMENT AND DREDGE IN FRONT OF COFFERDAM



FOR COFFERDAM SET OUT REFER TO HLM ARCHITECTS DRAWING NUMBER:
BAE-HLM-00-00-SK-A-0001 - P01

1a INSTALL SILT CURTAIN AT ENTRANCE TO BASIN INCLUDING DEMOUNTABLE SECTION TO ALLOW PASSAGE OF BARGE.

1b INITIAL INFILL PLACEMENT BY LONG REACH EXCAVATOR FROM BARGE WHERE A 2m LAYER OF FILL WILL BE CAREFULLY PLACED TO COVER EXISTING SEDIMENT ON THE BASIN BED.

1c INFILL CONTINUING USING A COMBINATION OF BARGE, EXCAVATORS OR SELF DISCHARGING VESSELS. INFILL MATERIAL WILL EXTEND BEYOND THE LINE OF THE NEW QUAY WALL IN A TEMPORARY CONDITION.

1d HYDRAULIC COMPACTION BELOW MEAN SEA LEVEL , ROLLERS OF DYNAMIC COMPACTION ABOVE MEAN SEA LEVEL.

2a INSTALL CARRIER DRAIN AROUND EXISTING BASIN QUAY WALL TO COLLECT DISCHARGE FROM EXISTING OUTFALLS. CARRIER DRAIN WILL RUN TO NEW OUTFALLS PROTRUDING THROUGH THE NEW COFFERDAM.

2b PILE COFFERDAM STRUCTURE FROM NEWLY PLACED INFILL MATERIAL. THE EXISTING QUAYSIDE AT TIE IN LOCATIONS WILL HAVE TO BE BROKEN OUT TO ALLOW FOR A ROBUST CONNECTION TO BE CREATED BETWEEN EXISTING QUAY AND NEW COFFERDAM.

3a BASIN INFILL TAKEN UP TO DESIGN LEVEL, EITHER BY BARGED MATERIAL PLACED OVER THE COFFERDAM AND PUSHED INTO PLACE BY DOZERS OR BY ROAD DELIVERY.

3b FILL IN FRONT OF COFFERDAM WALL REMOVED AND BERTH POCKET DREDGED TO DESIGN LEVEL.

GENERAL NOTES

THIS DRAWING TO BE READ IN CONJUNCTION WITH ALL DRAWINGS IN THE 225010 SERIES.

FOR SECTION THROUGH WORKS, REFER TO DRAWING NUMBER BAE-AHN-XX-XX-DR-C-0005

P01	19.05.22	ISSUED FOR COMMENT	CAB	TR
REV	DATE	REVISION DESCRIPTION	DRN	VER

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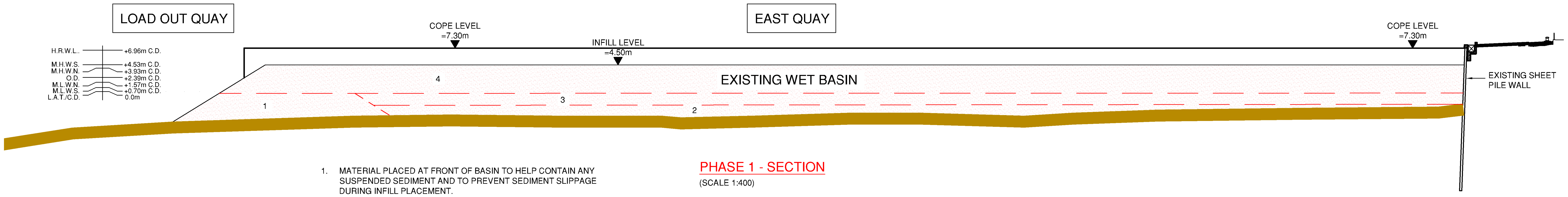
www.arch-henderson.co.uk - email : glasgow@arch-henderson.co.uk
Offices in : Aberdeen, Dundee, Glasgow, Lerwick, Southampton, Stromness and Thurso

PROJECT :
BAE Surface Ships Limited - Govan
Wet Basin Infill

TITLE :
Draft Phasing Plans

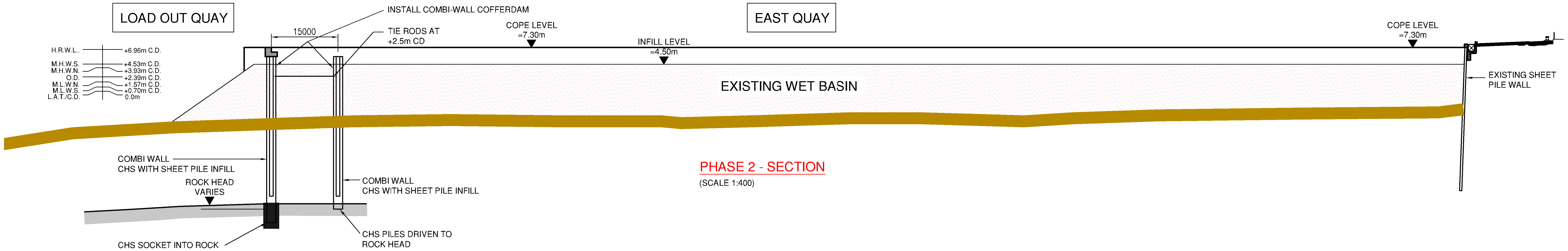
DRAWN : CAB	DATE : 11.05.22	VERIFIED : TR	APPROVED : GB
SCALE : (A1) AS SHOWN		DRAWING STATUS : S0	
DRAWING No : 225010-BAE-AHN-ZZ-XX-DR-C-0004			REV : P01

DO NOT SCALE

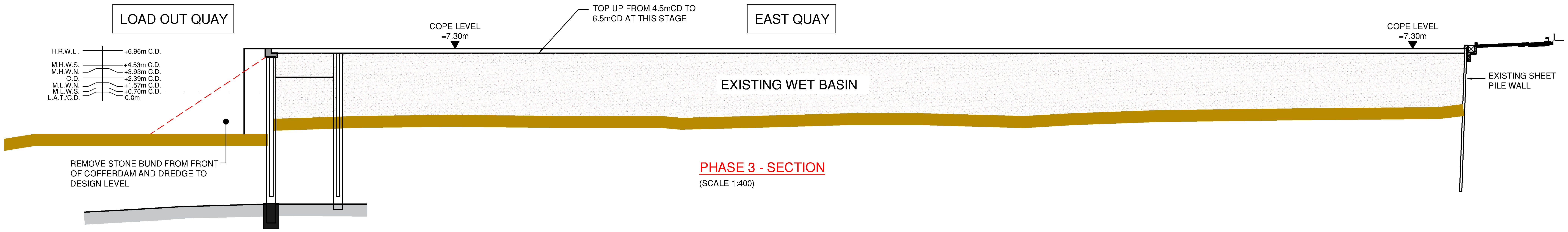


PHASE 1 - SECTION
(SCALE 1:400)

1. MATERIAL PLACED AT FRONT OF BASIN TO HELP CONTAIN ANY SUSPENDED SEDIMENT AND TO PREVENT SEDIMENT SLIPPAGE DURING INFILL PLACEMENT.
2. 2m INFILL PLACEMENT USING LONG REACH EXCAVATOR TO COVER EXISTING BASIN SEDIMENT.
3. CONTINUE TO FILL USING BARGE AND EXCAVATOR OR SPLIT HOPPER BARGE.
4. PLACE MATERIAL PLACEMENT BY BARGE AND EXCAVATOR AND PUSHING MATERIAL TO BACK OF BASIN USING DOZER IF NECESSARY.



PHASE 2 - SECTION
(SCALE 1:400)



PHASE 3 - SECTION
(SCALE 1:400)

NOTES

1. THIS DRAWING TO BE READ IN CONJUNCTION WITH ALL DRAWINGS IN THE 225010 SERIES.
2. FOR SECTION LOCATION, REFER TO DRAWING NUMBER 225010-BAE-AHN-ZZ-XX-DR-C-0004

AN ALTERNATIVE INFILL METHODOLOGY USING PUMPED SAND WILL BE CONSIDERED AT CONCEPT DESIGN STAGE. IF ADOPTED, THIS STRATEGY WOULD SEE AN INITIAL STONE BUND PLACED AT THE ENTRANCE OF THE BASIN TO CONTAIN ALL SUSPENDED SEDIMENTS WITHIN THE BASIN. INFILL BEHIND THE BUND WOULD BE THEN BE PLACED USING FLUIDISED SAND PUMPED FROM A BARGE, OVER THE BUND AND DISTRIBUTED VAI SPREADER PONTCON AND DISSIPATION BAR.

REV	DATE	REVISION DESCRIPTION	DRN	VER
P01	19.05.22	ISSUED FOR COMMENT	CAB	TR

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PROJECT :
BAE Surface Ships Limited - Govan
Wet Basin Infill

TITLE :
Draft Phasing Sections

DRAWN : CAB
DATE : 11.05.22
VERIFIED : TR
APPROVED : GB
SCALE : (A1) AS SHOWN
DRAWING STATUS : S0
DRAWING No : 225010-BAE-AHN-ZZ-XX-DR-C-0005
REV : P01

DO NOT SCALE

GENERAL NOTES

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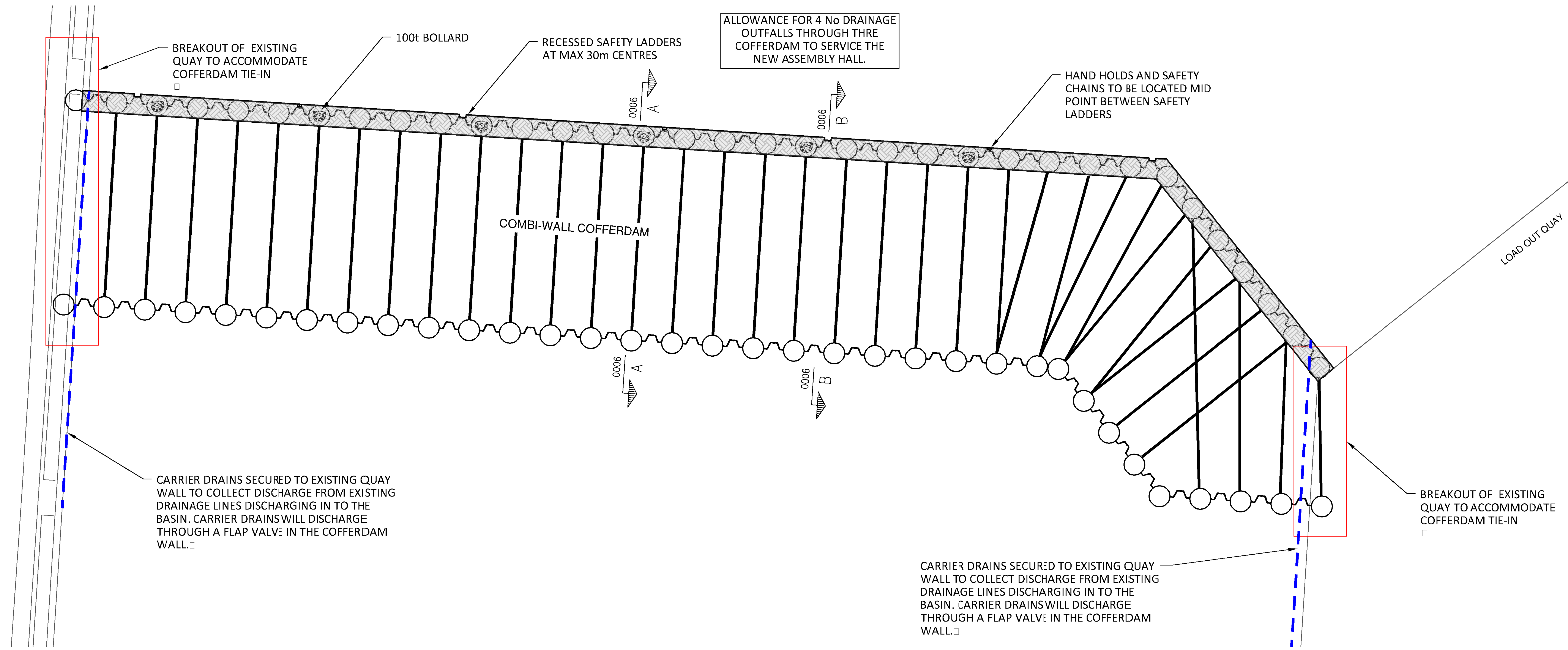
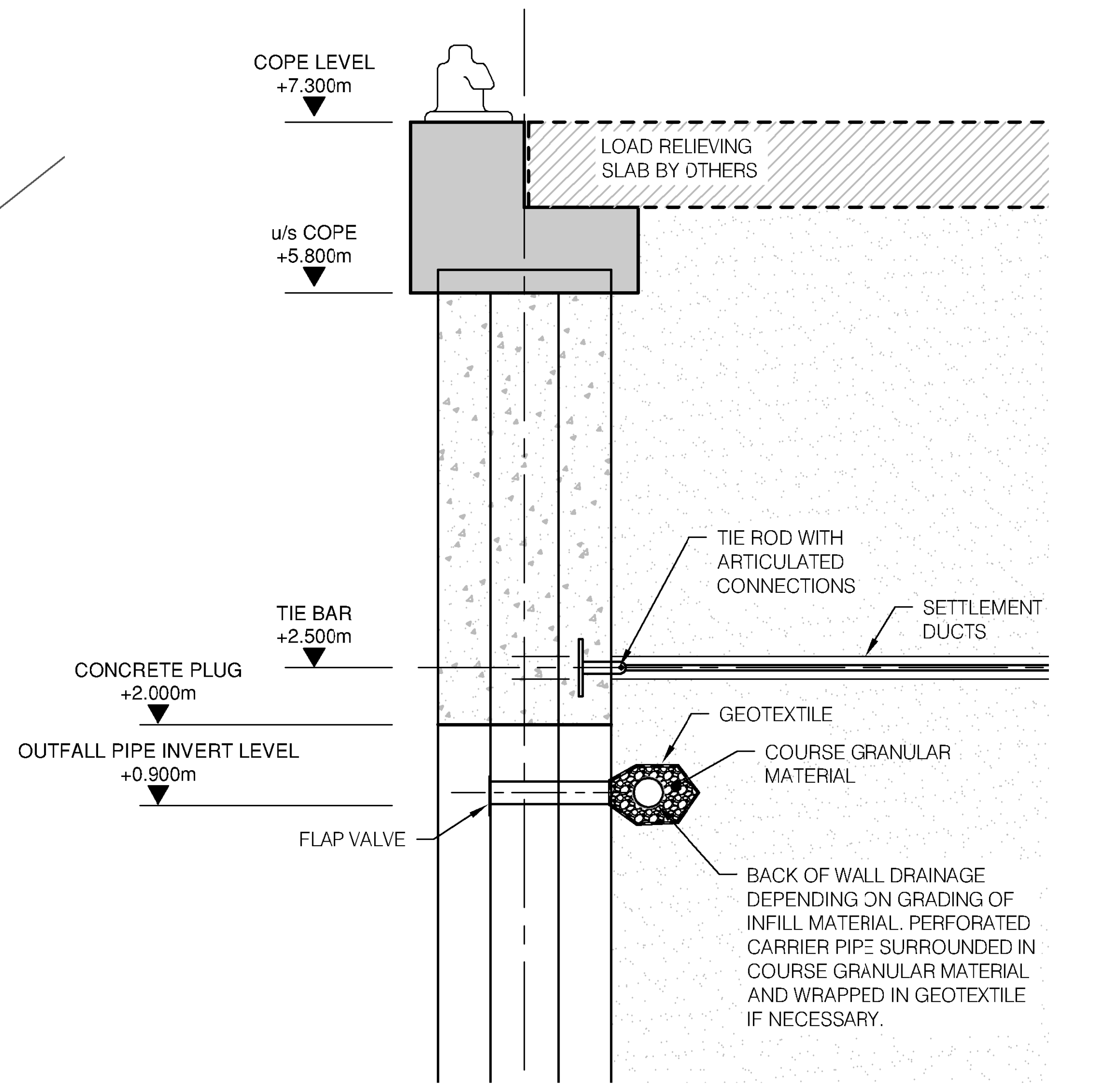
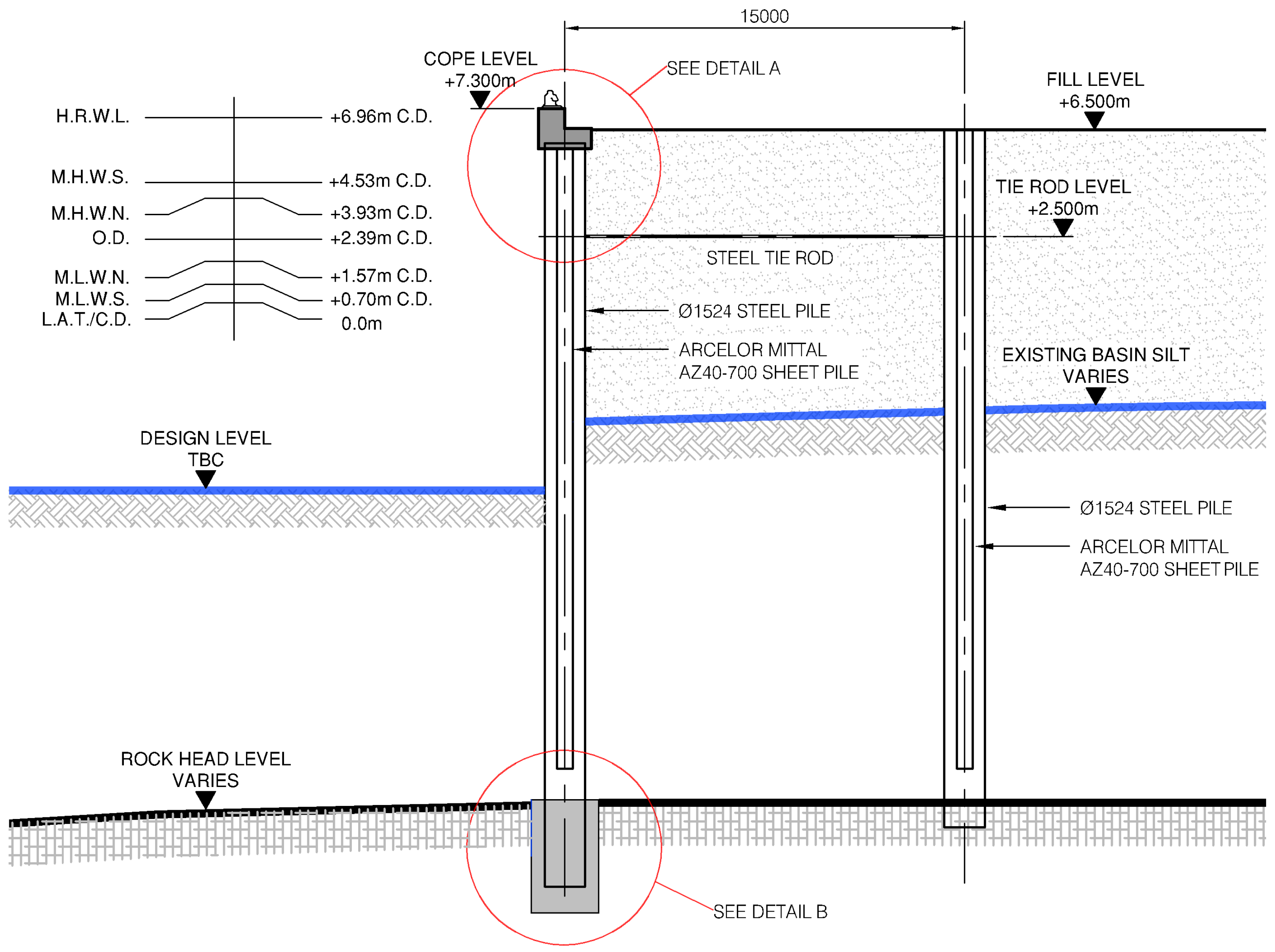
FOR SECTION THROUGH WORKS, REFER TO DRAWING NUMBER BAE-AHN-XX-XX-DR-C-0003



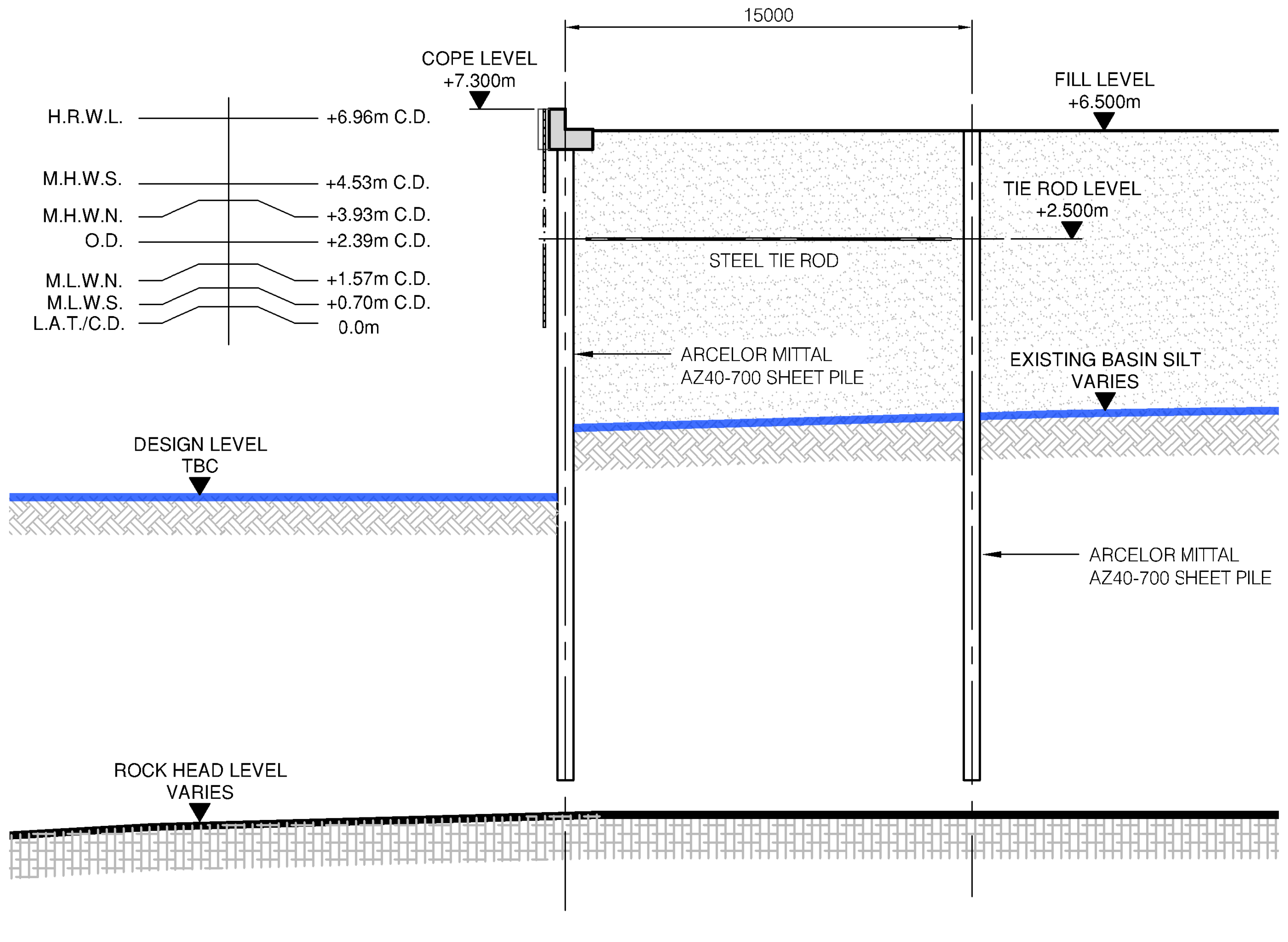
PLAN ON COFFERDAM
SCALE 1:200



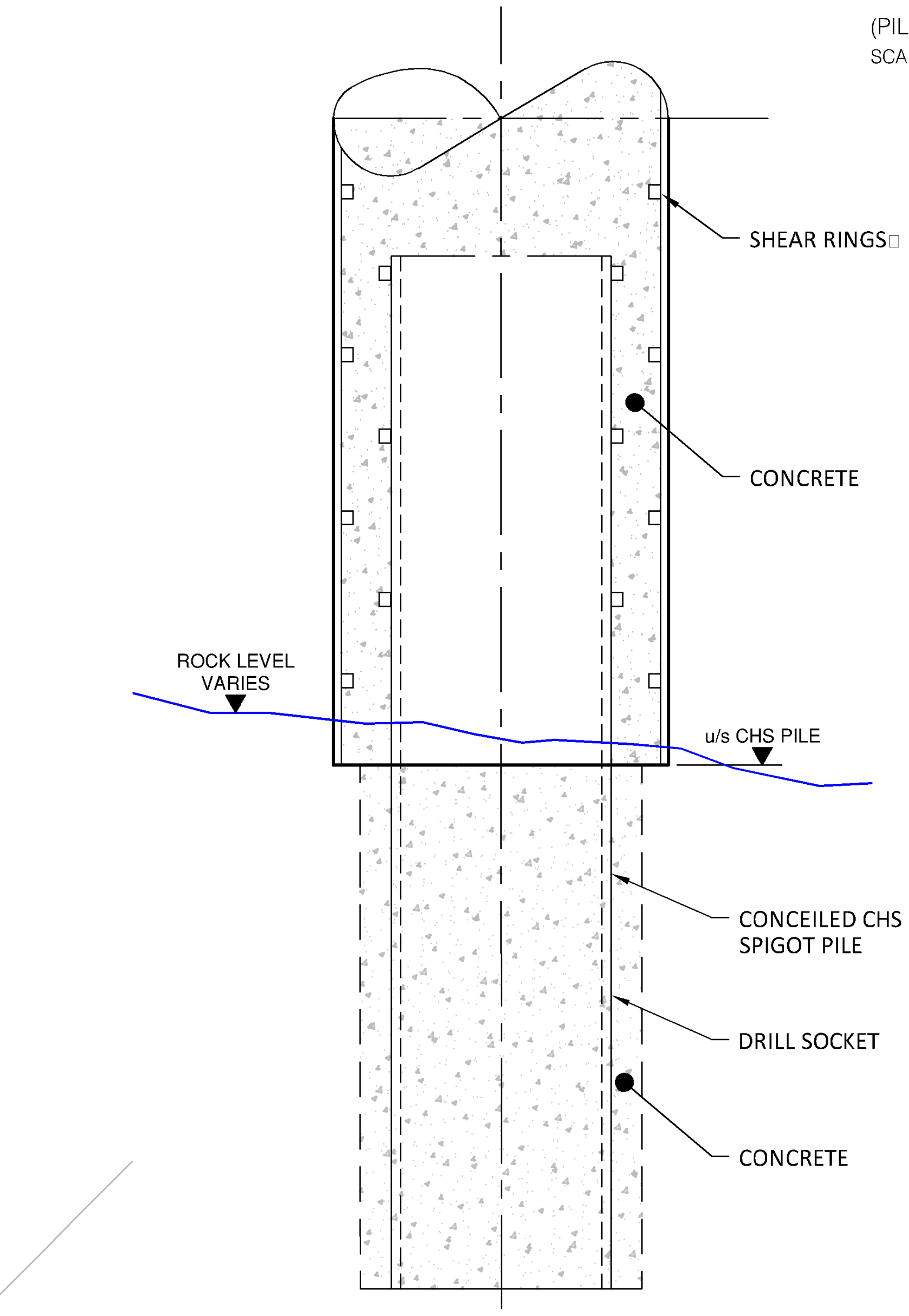
DETAIL A
(PILE HEAD)
SCALE 1:50



SECTION A-A
SCALE 1:200



SECTION B-B
SCALE 1:200



PILE TOE
SCALE 1:25

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PROJECT :
BAE Surface Ships Limited - Govan
Wet Basin Infill

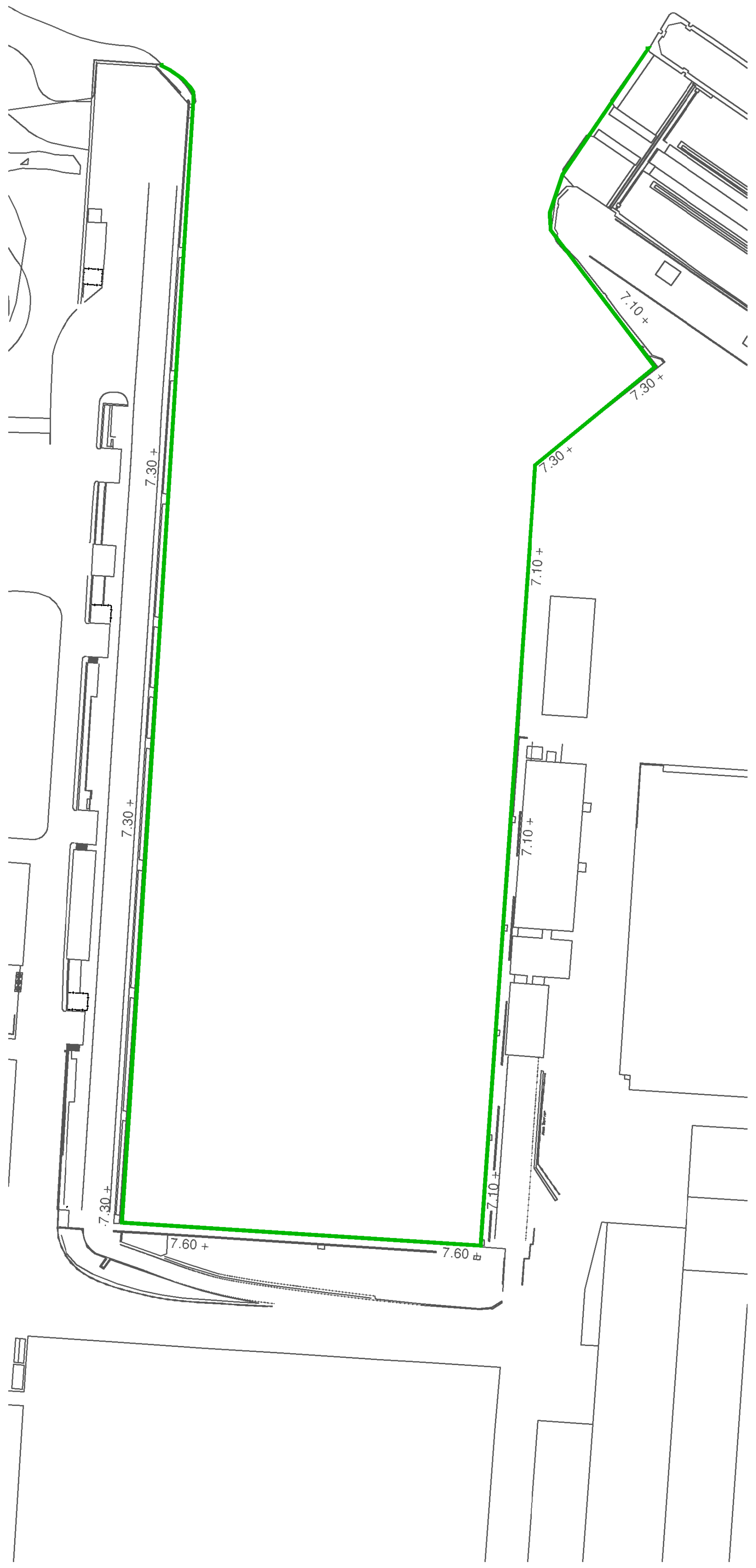
TITLE :
Cofferdam
Sections and Details

DRAWN :	DATE :	VERIFIED :	APPROVED :
CAB	19.05.22	TR	GB

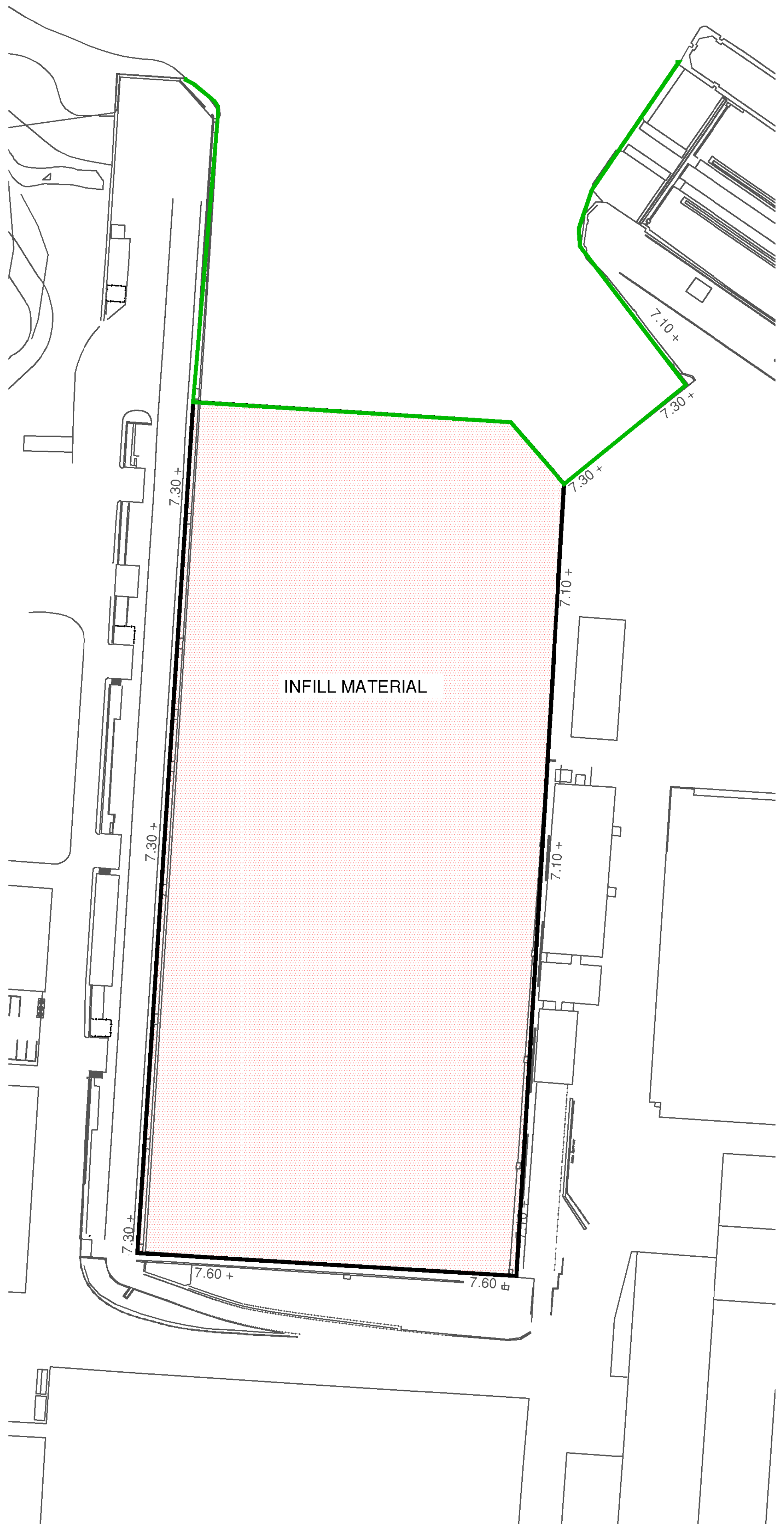
SCALE : (A1) AS SHOWN
DRAWING STATUS : S0

DO NOT SCALE

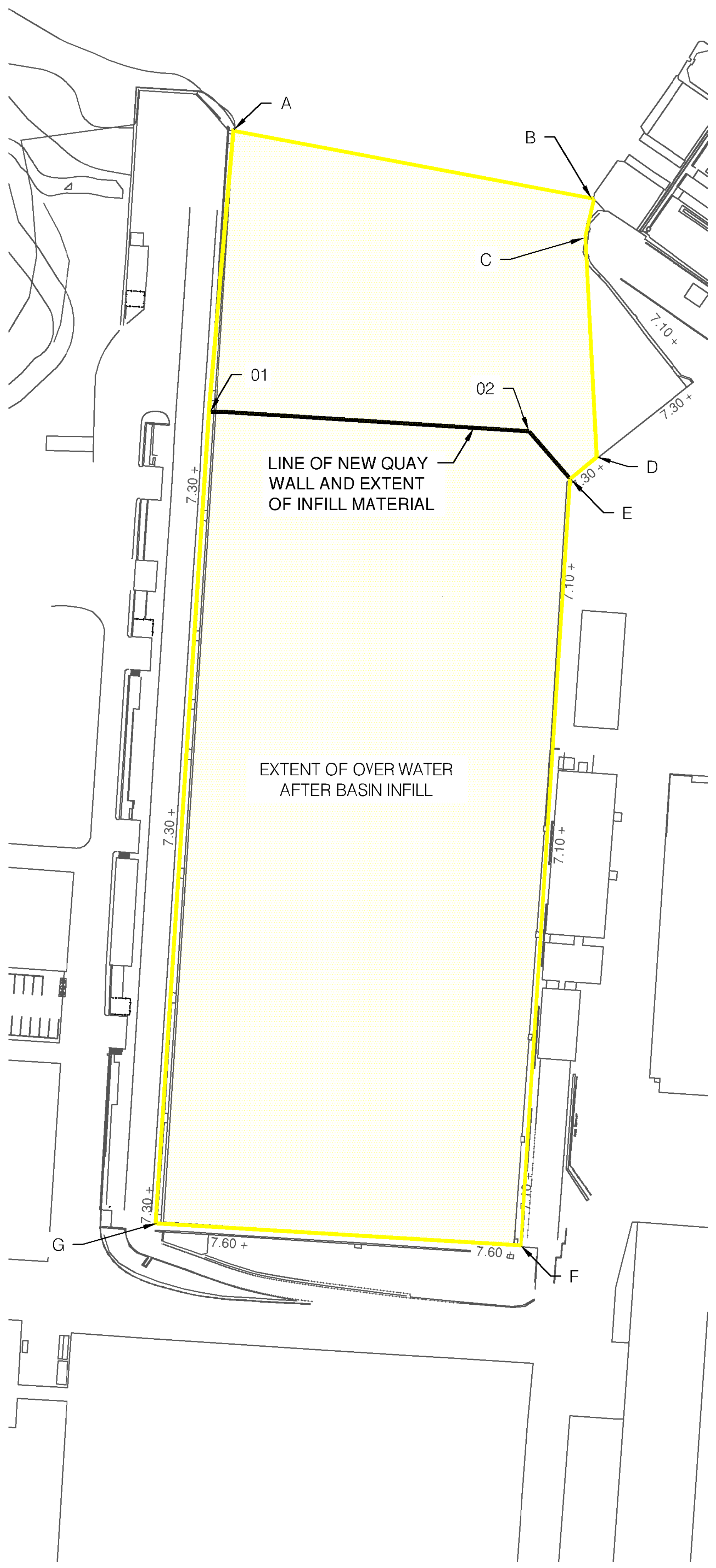
DRAWING No : 225010-BAE-AHN-ZZ-XX-DR-C-0006
REV : P01



EXISTING EXTENTS OF MHWS
SCALE 1:1250



MHWS EXTENTS AFTER INFILL WORKS
SCALE 1:1250



OVER WATER SITE BOUNDARY
SCALE 1:1250

NOTES

THIS DRAWING TO BE READ IN CONJUNCTION WITH ALL DRAWINGS IN THE 225010 SERIES.

KEY:

🟩 SEA COVERAGE AT MHWS

🟨 OVER WATER SITE BOUNDARY

COFFERDAM WALL SET OUT COORDINATES				
	LAT	LONG	EASTING	NORTHING
01	N55:52:01.27	W4:19:26.79	254662	666203
02	N55:52:01.34	W4:19:31.51	254580	666208

OVER WATER SET OUT COORDINATES				
	LAT	LONG	EASTING	NORTHING
A	N55:52:03.67	W4:19:31.31	254586	666280
B	N55:52:03.19	W4:19:25.98	254678	666262
C	N55:52:02.87	W4:19:26.08	254676	666252
D	N55:52:01.06	W4:19:25.80	254679	666196
E	N55:52:00.83	W4:19:26.19	254672	666189
F	N55:51:54.51	W4:19:26.50	254660	665994
G	N55:51:54.57	W4:19:31.91	254566	665999

REV	DATE	REVISION DESCRIPTION	DRN	VER
P01	19.05.22	ISSUED FOR COMMENT	CAB	TR

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PROJECT :
BAE Surface Ships Limited - Govan
Wet Basin Infill

TITLE :
Site Boundaries

DRAWN :	DATE :	VERIFIED :	APPROVED :
CAB	19.05.22	TR	GB

SCALE : (A1) 1:25
DRAWING STATUS : D1

DO NOT SCALE

DRAWING No : 225010-BAE-AHN-ZZ-XX-DR-C-0007
REV : P01

Technical Appendix 3-2_Screening Opinion

marinescotland

Scottish Government
Riaghaltas na h-Alba
gov.scot

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E: ms.marinelicensing@gov.scot

Graeme Duff
EnviroCentre Limited
Craighall Business Park,
8 Eagle Street,
Glasgow,
ZG4 9XA

Date: 20 July 2022

Dear Mr. Duff,

Screening Opinion under The Marine Works (Environmental Impact Assessment) (Scotland) Regulations 2017

Thank you for the screening opinion request dated 20 May 2022 in regards to the proposed infilling of the existing wet basin, including land reclamation and piling at Govan shipyard, Glasgow ("the Proposed Works").

The Scottish Ministers consider the Proposed Works to fall under paragraph 1(e) of schedule 2 of the Marine Works (Environmental Impact Assessment) (Scotland) Regulations 2017 ("the 2017 MW Regulations") with the Proposed Works meeting the corresponding threshold described in column 2 of schedule 2. Consequently, the Scottish Ministers are obliged to adopt a screening opinion as to whether the Proposed Works are or are not, an Environmental Impact Assessment ("EIA") project under the 2017 MW Regulations.

Under regulation 10(5) of the 2017 MW Regulations, the Scottish Ministers have consulted with the relevant local planning authorities Glasgow City Council ("GCC"), NatureScot (operating name of Scottish Natural Heritage), Historic Environment Scotland ("HES") and the Scottish Environment Protection Agency ("SEPA") for their view on whether the Proposed Works are an EIA project. Copies of the consultation responses received are attached for your review (see Appendix 1).

When making a determination as to whether schedule 2 works are an EIA project, the Scottish Ministers must provide their reasons in a written statement, taking into account the selection criteria set out in schedule 3 of the 2017 MW Regulations, as are relevant to the Proposed Works. This is set out below.

Characteristics of the works

The Proposed Works involves the reclamation of approximately 1.7 hectares of land through infilling the existing wet basin to create a new working platform. The Proposed Works form part of a wider project to support the long-term future of ship building at Govan shipyard.

A silt curtain will be deployed across the entrance of the wet basin prior to the basin being infilled. The basin will be filled through the use of marine plant which will initially deposit material at the front of the basin and will then infill the rest of the basin. The material deposited at the front of the basin will help contain suspended sediment. This material will extend beyond the line of the proposed quay wall. An alternative method has also been proposed, this would involve a stone bund being constructed at the entrance of the basin and the infill being carried out using fluidised sand pumped from a barge over the bund.

The outer quay wall will then be constructed by land based piling through the infill material. Sheet piles will be installed and capped with a reinforced concrete beam. The fill in front of the new quay will be removed and dredged to design level. A carrier drain will be installed to allow discharge to be collected and directed to new outfalls fixed through the quay wall.

It is estimated that the Proposed Works will take 34 weeks, with the piling works to last around 14 weeks. Approximately 190,000 metres cubed of material will be required to infill the wet basin. This material will primarily be brought to site by barge, with a small amount being brought by road.

Location of the works

The Proposed Works are located to the southwest of Glasgow city centre, on the southern bank of the River Clyde, and do not lie within the vicinity of any designated sites. NatureScot confirmed that the location is sufficiently distant from the Inner Clyde European Special Protection Area and so there will be no likelihood of significant impacts on this, or any other, international designation. However, NatureScot advised that depending on the specific nature of the works, the impacts on marine mammals as European Protected Species may need to be considered.

HES highlighted that the Proposed Works are adjacent to the Category A listed building; 1048 Govan Road, Govan Shipbuilders' Store, Former Engine Works of Fairfield Shipbuilding and Engineering Company ("Fairfield shipyard"), and advised that infilling the wet basin could impact on the setting of the listed building and may cause significant impacts on historic environment interests. HES advised that an assessment should be undertaken which meets the requirements detailed in its response. The assessment should demonstrate a full understanding of the special interest of Fairfield shipyard, its setting, as well as the contribution made by the wet basin. Furthermore, HES recommend consulting with GCC's archaeology and conservation advisors on the impacts of the Proposed Works.

HES acknowledge that the screening report gives some consideration to measures for mitigating the impacts on the historic environment. These include documenting the wet basin prior to the commencement of construction, as well as introducing suitable protocols for the recording of previously unrecorded cultural heritage assets. However, HES advised that detailed descriptions of any mitigation measures to be applied should be included in the environmental assessment submitted in support of the Proposed Works. The Scottish Ministers advise the applicant to engage with HES to ensure all required information is included within any proposed mitigation.

GCC raised concerns over flood risk, specifically the potential significant impacts upon the functional flood plain and the loss of capacity during flood events, in the tidal reach of the upper Clyde caused by the Proposed Works. GCC advised that without more detailed information on this, the significance of the potential impact cannot be determined. In addition, SEPA advised that a Flood Risk Assessment should be undertaken.

Characteristics of the potential impact

GCC identified a lack of information provided regarding the potential impacts upon water quality and protected species as part of the new quay construction and infilling process. GCC advised that there is insufficient information to determine whether the Proposed Works will have a significant impact on the environment and therefore advised that an EIA is required.

GCC further advised that the Proposed Works form part of a wider project which includes terrestrial aspects, and confirmed that the applicant has moved straight to scoping for these terrestrial aspects. GCC advise that the Proposed Works should not be considered in isolation from the terrestrial aspects and advised that the project as a whole must be considered.

HES comment on the need for a greater understanding of the project as a whole, and whether the Proposed Works would allow for the retention of the Fairfield Shipyard A-listed building. It was therefore recommended that a full analysis of the alternatives for expanding the shipyard should be completed.

Conclusion

In view of the findings above, the Scottish Ministers are of the opinion that an EIA is required to be carried out in respect of the Proposed Works under the 2017 MW Regulations.

If you increase, alter or extend the Proposed Works, you are advised to contact Marine Scotland - Licensing Operations Team again to confirm if the screening opinion is still valid.

A copy of the screening opinion has been forwarded to Glasgow City Council. The screening opinion has also been made publicly available through the Marine Scotland Information website.

If you require any further assistance or advice on this matter, please do not hesitate to contact me.

Yours sincerely,

Kate Taylor
Marine Scotland - Licensing Operations Team

Glasgow City Council

From: Russell, David 2 (Planning, NRS)
To: MS Marine Licensing
Cc: Connelly, Susan (NRS); Neil.MacLeod[redacted] Dale, Andy (NRS)
Subject: RE: BAE Systems Surface Ships Ltd. (per EnviroCentre Ltd.) – Govan Basin Infill – Govan Shipyard - Port Ellen, Argyll and Bute - Screening Request - Consultation - Response Required by 30 June 2022 (OFFICIAL)
Date: 29 June 2022 12:51:29
Attachments: image001.png

OFFICIAL

THE MARINE WORKS (ENVIRONMENTAL IMPACT ASSESSMENT) (SCOTLAND) REGULATIONS 2017 ("the EIA Regulations")

CONSULTATION UNDER PART 2, REGULATION 10(5) OF THE EIA REGULATIONS

Good afternoon Kate/Neil,

We consider the infilling of the basin to form land for a shipyard that exceeds 1000m² to constitute Schedule 2 works under the Marine Works (Environmental Impact Assessment) (Scotland) Regulations 2017. In terms of the Schedule 2, we note that the proposed infill works could potentially be considered under several different categories however we consider 4(g) to be the most appropriate.

As local planning authority, we have concerns about potential significant impacts upon flood risk (both in terms of the impact upon the functional flood plain and also the loss of capacity during flood events) in the tidal reach of the upper River Clyde and potential impacts upon water quality/protected species as part of the coffer dam construction and infilling process. Without more detailed information on these aspects, at this time we can only conclude that the potential impacts could be significant and advise that, in terms of Regulation 10(5) we believe the infilling of the tidal basin to be an EIA project that merits formal environmental assessment.

Separate to the Marine Licensing process, Glasgow City Council have also been holding discussions with BAE Systems regarding the need for environmental assessment for this project. Whilst not a marine license issue, it quickly became clear in those discussions that, as the infilling of the basin is only required to facilitate the construction of a new SBOH building, the whole project (infilling and building) should be screened together in planning terms as a single development proposal. Taking into account Paragraph 46 of Planning Circular 1/2017 we are of the view that the partial infill of the tidal basin is the first phase of a larger project. The circular is clear that, in such circumstances, we should not be considering an application for tidal infill in isolation from the rest of the project (indeed in planning terms there is no argument for infilling a tidal basin that forms part of the River Clyde if you aren't then going to construct a building on top of that infill).

Based on the extent of the tidal infill and the scale of the proposed building and the potential environmental impacts of the scheme, we advised informally that this wider project should be a single application and that it was likely to constitute EIA development (we have yet to formally issue a screening opinion on the subject as the screening request we received related to the infilling of the basin only).

BAE Systems have accepted the single-application approach, and the likliehood that the whole project would require Environmental Impact Assessment, and rather than submit a screening request for the combined infill and SBOH have moved straight on to the scoping stage and are now in dialogue with the planning authority on the content of the Environmental Statement. We expect the submission of a formal Scoping Request for the site this week which we will register and then consult Marine Scotland on (along with other statutory consultees).

In due course, we anticipate the submission of an EIA application for infill of the tidal basin and construction of a new Ship Block Outfit Hall.

In order to avoid duplication of process, and acknowledging that the ES is likely to have to consider many matters outwith the scope of the Marine Licensing, we would have no objection to also asking the applicant to include any Environmental Statement sections required by Marine Scotland or to the consultation exercises within the planning application process inclusing Marine Scotland consultees to ensure that the EIA process required for the planning application would also be sufficient for a marine license (should Marine Scotland also consider the works to constitute an EIA project). As you are likely aware, the Council have accommodated Marine Scotland consultation requests into our planning procedures in the past when a dual-purpose EIA process has been deemed appropriate by both parties.

Trusting the above clarifies our position with regards to regulation 10(5) of the Marine Works (Environmental Impact Assessment) (Scotland) Regulations 2017 whilst also providing some useful context with regards to the planning situation for the project.

Please advise whether this email response is sufficient for your purposes or whether a formal letter is required by way of a response.

Regards

David

David Russell MRTPI | Planning Officer – City Centre and Clyde |Development Management | Neighbourhoods, Regeneration and Sustainability, Glasgow City Council, 231 George Street, Glasgow G1 1RX | Phone: [redacted]
[redacted]

Historic Environment Scotland

HISTORIC ENVIRONMENT SCOTLAND | ÀRAINNEACHD EACHDRAIDHEIL ALBA

Longmore House
Salisbury Place
Edinburgh
EH9 1SH

Enquiry Line: 0131-668-8716
HMConsultations@hes.scot

By email to: ms.marinelicensing@gov.scot

Neil Macleod
Marine Licensing Casework Officer
Marine Scotland (Aberdeen Office)
Marine Planning & Policy

Our case ID: 300059045
30 June 2022

Dear Neil Macleod

The Marine Works (Environmental Impact Assessment) (Scotland) Regulations 2017 Request for Screening Opinion in support of Proposal to Infill the Wet Basin and Maintenance Facility at Govan Shipyard

Thank you for your consultation which we received on 10 June 2022 seeking our comments on an Environmental Impact Assessment (EIA) screening opinion for the above proposed development.

This letter contains our comments for our historic environment interests. Our historic environment interests cover land-based heritage assets such as world heritage sites, scheduled monuments and their setting, category A-listed buildings and their setting, and gardens and designed landscapes (GDLs) and battlefields in their respective inventories. Our interests also cover marine heritage assets including Historic Marine Protected Areas (HMPAs) and undesignated marine cultural heritage features.

Glasgow City Council's archaeological and conservation advisors will also be able to offer advice for their interests. This may include unscheduled archaeology, category B- and C-listed buildings and conservation areas.

Proposed Development

We understand that the proposals involve infilling the existing wet basin at Govan shipyard to create a working platform. We note that it is anticipated that roughly 190,000m3 of material would be required to infill the wet basin. This material would be brought to the site primarily by barge, but also by road.

Our Advice

We have reviewed the EIA Screening Report (May 2022) submitted as part of this consultation and, based on the information provided, consider that there is potential for significant impacts on our historic environment interests that could usefully be evaluated and mitigatio [redacted] nto the design [redacted] h the Environmental Impact Assessment (EIA) process.

The proposed development is within the historic Fairfield shipyard, which was the biggest private shipyard in the world and is a notable part of Govan's shipbuilding heritage.

While not listed, the wet basin is broadly contemporary with the adjacent Category A listed **1048 Govan Road, Govan Shipbuilders' Store, Former Engine Works of Fairfield Shipbuilding and Engineering Company** (LB33357). Infilling the wet basin therefore has the potential to significantly impact on the setting of the Category A listed building and this should be assessed.

This assessment should be undertaken by a suitably experienced professional and meet the requirements of Scottish Planning Policy (SPP, 2014), the Historic Environment Policy for Scotland (HEPS, 2019) and associated Managing Change Guidance Notes. Guidance can also be found in the Cultural Heritage Appendix to the EIA Handbook (SNH, HES, 2018). It should demonstrate a full appreciation of the special interest of the Category A listed **1048 Govan Road, Govan Shipbuilders' Store, Former Engine Works of Fairfield Shipbuilding and Engineering Company** (LB33357) and its setting, including the contribution made by the wet basin. We also recommend you consult with Glasgow City Council's archaeology and conservation advisors regarding assessment of the wet basin itself and any impacts upon it.

We have recently engaged in discussions with the applicant (BAE Systems) about the expansion of their construction sheds and the possible demolition of the Category A listed **1048 Govan Road, Govan Shipbuilders' Store, Former Engine Works of Fairfield Shipbuilding and Engineering Company** (LB33357). We emphasised the importance of this building and encouraged them to consider alternatives. It would be useful to understand the wider context of the current proposal, particularly whether infilling the wet dock would allow for the retention of the A-listed building. We therefore recommend that an assessment should include a full analysis of alternatives for the expansion of the BAE's shipbuilding operation that puts the current proposal in context.

We note that the EIA Screening Report (May 2022) gives some consideration at Table 5.1 to measures for mitigating impacts on the historic environment. These include documenting the wet basin prior to construction commencing and, also, implementing suitable protocols for the recording of previously unrecorded cultural heritage assets. We recommend that an appropriately detailed description of any such mitigation measures should also be set out as part of an environmental assessment in support of the proposals. We would be happy to provide further advice on the detail of any such mitigation scheme as necessary.

We hope this is helpful. Please contact us if you have any questions about this response. The officer managing this case is Alison Baisden and they can be contacted by phone on [redacted] or by email on [redacted]

Yours sincerely

Historic Environment Scotland

NatureScot

From: Dave Lang
To: MacLeod N (Neil) (MARLAB)
Cc: hmconsultations@hes.scot; consultations; planningenquiry@glasgow.gov.uk; onlineplanning@glasgow.gov.uk; planning.sw@sepa.org.uk
Subject: RE: BAE Systems Surface Ships Ltd. (per EnviroCentre Ltd.) – Govan Basin Infill – Govan Shipyard - Port Ellen, Argyll and Bute - Screening Request - Consultation - Response Required by 30 June 2022
Date: 13 June 2022 13:02:38
Attachments: image001.png

Dear Mr MacLeod,

I can confirm that NatureScot do not believe that this development proposal needs to be screened in for EIA with respect solely to the interests for which we have a specific statutory responsibility. In particular, the location is sufficiently distant from the Inner Clyde European Special Protection Area that we can confirm that there will be no likelihood of significant impacts on this (or any other) international designation.

Depending on the specific nature of the works, it is possible that the impacts on marine mammals as European Protected Species may need to be considered, however this can be done outwith the full EIA process.

I hope that is sufficient to your current requirements, however please let me know if there is anything further that you require.

Yours,

Dave Lang
Operations Officer
Strathclyde & Ayrshire

Scottish Environmental Protection Agency

From: Planning SW
To: MacLeod N (Neil) (MARLAB); consultations@clydemarineplan.scot; onlineplanning@glasgow.gov.uk; MS Marine Licensing
Subject: 5563 SEPA response to BAE Systems Surface Ships Ltd. (per EnviroCentre Ltd.) – Govan Basin Infill – Govan Shipyard - Screening Request - Consultation - Response Required by 30 June 2022
Date: 23 June 2022 13:52:26
Attachments: image001.png

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Dear Marine Scotland

Thank you for consulting SEPA on the above proposal. We can confirm with respect to interests relevant to our remit we agree that EIA is not required for this proposal. Please refer to our standing advice on marine consultations for further advice and guidance.

However, we would like to emphasize that Flood Risk Assessment should be undertaken, as per the EIA Screening Report (dated May 2022). As per our recent pre-application advice to Glasgow City Council and the applicant, a Flood Risk Assessment should be provided with the future marine licence and planning applications.

If you have any queries regarding this response, please contact me by email via: planning.sw@sepa.org.uk

Yours faithfully

Peter Minting
SEPA Planning Officer

Technical Appendix 5-1_Flood Risk Assessment

envirocentre

Govan Basin Infill
Flood Risk Assessment

July 2022

Govan Basin Infill
Flood Risk Assessment

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1 INTRODUCTION

1.1 Terms of Reference

EnviroCentre Ltd has been appointed by Arch Henderson on behalf of BAE Systems Ltd to undertake a flood risk assessment in relation to the proposals to infill the wet basin at Govan Shipyard and Maintenance Facility (Govan shipyard) (Refer to Drawing No 175756-GIS001).

1.2 Scope of Report

The scope of works for the FRA is as follows:

- Obtain the updated River Clyde hydrodynamic model from Fairhurst Ltd, considered by Glasgow City Council (GCC) and SEPA to provide state-of-the-art representation of flood risk in the tidal reaches of the River Clyde.
- Conduct confirmatory runs of the model, establishing that the model version provided generates predicted flood depths/extents matching those published in Fairhurst's model report.
- Conduct revised baseline runs with improved model resolution in the area of the site.
- Modify the model geometry to account for proposed infilling of the wet basin.
- Re-run the model to assess the impact of infilling upon tidal-fluvial flood risk.
- Qualitatively assess flood risk from all other sources.
- Produce a Flood Risk Assessment report detailing the above, including recommendations for flood risk management, satisfying SEPA and GCC requirements, and including completion of the SEPA Flood Risk Assessment Checklist.

1.3 Report Usage

The information and recommendations contained within this report have been prepared in the specific context stated above and should not be utilised in any other context without prior written permission from EnviroCentre.

If this report is to be submitted for regulatory approval more than 12 months following the report date, it is recommended that it is referred to EnviroCentre for review to ensure that any relevant changes in data, best practice, guidance or legislation in the intervening period are integrated into an updated version of the report.

Whilst the Client has a right to use the information as appropriate, EnviroCentre Ltd retains ownership of the copyright and intellectual content of this report. Any distribution of this report should be controlled to avoid compromising the validity of the information or legal responsibilities held by both the Client and EnviroCentre Ltd (including those of third party copyright). EnviroCentre does not accept liability to any third party for the contents of this report unless written agreement is secured in advance, stating the intended use of the information.

EnviroCentre accepts no liability for use of the report for purposes other than those for which it was originally provided, or where EnviroCentre has confirmed it is appropriate for the new context.

1.4 Regulatory Framework

Scottish Government planning policy on flooding is provided by Scottish Planning Policy (SPP) paragraphs 254–268 (Scottish Government, 2014). This policy is based on the following principles:

- Developers and planning authorities must give consideration to the possibility of flooding from all sources;
- New development should be free from significant flood risk from any sources;
- In areas characterised as “medium to high” flood risk for watercourses (fluvial) and coastal (tidal) flooding new development should be focused on built up areas and all development must be safeguarded from the risk of flooding;
- The storage capacity of functional flood plains should be safeguarded from further development. The functional flood plains comprise areas generally subject to an annual probability of flooding greater than 0.5%;
- Drainage is a material consideration and the means of draining a development should be assessed. Any drainage measures proposed should have a neutral or better effect on the risk of flooding both on and off the site.

SPP proposes a Risk Framework approach which identifies flood risk in three main categories:

- **Little or no risk area** (annual probability of flooding less than 0.1%). No constraints to development due to flood risk.
- **Low to medium risk area** (annual probability of flooding between 0.1% and 0.5%). Suitable for most developments, excepting civil infrastructure (unless existing civil infrastructure within a low to medium risk area is being extended, or else if civil infrastructure must be placed within this risk area for operational reasons).
- **Medium to high risk area** (annual probability of flooding greater than 0.5%). Suitable for residential, institutional, commercial and industrial development within built-up areas (provided adequate flood protection is planned or already exists). Generally not suitable for civil infrastructure or most vulnerable uses (such as schools and care homes) or for general development in undeveloped or sparsely developed areas (unless essential for operational reasons and alternative locations at lower flood risk are not viable).

In this report the likelihood of a flood event with a certain magnitude is quantified using the concept of Return Period (RP). The other method that is often used to express flood risk is the concept of Annual Exceedance Probability (AEP). The relationship between RP and AEP is documented in Appendix A.

1.4.1 SEPA Guidance

SEPA issued guidance in relation to preparing FRAs (“Technical Flood Risk Guidance for Stakeholders”, v13, (SEPA, 2022a))[1]. Technical requirements for FRAs depend on the complexity of the site with more complex or high risk sites requiring detailed assessments. In summary, FRAs must include the following:

- Background site data, including suitable plans and/or photographs;
- Historic flood information;
- Description of methodologies used;
- Identification of relevant flood sources;
- In case of river flooding: assessment of river flows, flood levels, depths, extents, displaced flood storage volumes, etc.;
- Assessment of culverts, sewers or other structures affecting flood risk;
- Consideration of climate change impacts;
- Details of required flood mitigation measures; and
- Conclusions on flood risk related to relevant national and local policies.

In addition to reporting requirements, the document also provides technical guidance on Flood Estimation Handbook (FEH) (CEH, 2008) methodologies and on land raising and compensatory storage.

SEPA provide a summary checklist to be completed to accompany Flood Risk Assessment reporting; this is included in Appendix B.

---

[1] https://www.sepa.org.uk/media/594270/technical-flood-risk-guidance-for-stakeholders.pdf

2 PREVIOUS FLOODING STUDIES

2.1 River Clyde Flood Management Strategy Model (and Precursors)

The foundational 1D hydrodynamic modelling of the River Clyde was developed between the late 1980s and 2001, primarily by the Babtie Group, for GCC and South Lanarkshire Council (SLC). GCC appointed Halcrow Group Ltd and W.A. Fairhurst & Partners to undertake a major upgrade between 2003-5 to inform the River Clyde Flood Management Strategy (RCFMS). This entailed updates to design tidal and fluvial input, as well as use of updated bathymetric and topographic data to represent the river and its floodplain. Outcomes from the RCFMS model were used until recently as the basis for setting flood risk requirements for development within the River Clyde corridor.

2.2 Updates to the RCFMS Model

A 2018 update to the model incorporated updated bathymetry, additional cross-sections and additional representation of Tradeston Bridge, while a 2019 update added 2D representation of the tidal floodplain.

2.3 Tidal River Clyde Flood Model Update

The 2020 model update was commissioned following discussions between GCC and SEPA, with the aim of:

- Lengthening the period of tidal data on which extreme still water levels and tidal surges at Greenock are based.
- Accounting for the impact of developments within the floodplain since the 2003 LiDAR (on which floodplain representation is based in the RCFMS model) was flown.
- Updating bathymetry in the tidal mudflats between Greenock and Bowling, which was found to influence tidal propagation up the estuary in the RCFMS model, but which was based on 1960s and 1970s surveying in the model.
- Updating fluvial inflows to account for additional river gauge data in the intervening years since that use to inform design inflows in the RCFMS model (which was based on data to 2003).

While described as an “update”, Fairhurst’s 2020 model update entailed a re-basis of the model; a 1D representation of the river was replaced with a full 2D representation of the river and tidal floodplain based on up-to-date bathymetry and topographic data. The intention is that the model is managed, maintained and updated going forward to account for all consented development and any other changes impacting the river or floodplain.

The Fairhurst 2020 model update is focussed on the tidal reaches of the River Clyde; an updated flood model for the fluvial reaches of the river is being separately progressed by SLC, and is not considered further within this report.

3 FLOOD RISK SCREENING

SEPA's technical guidance (SEPA, 2022a) advises that a site-specific FRA should be undertaken where any available information indicates there may be a risk of flooding (from any source) to the site, and/or where proposed works may increase flood risk elsewhere. Where a site-specific FRA may be required, screening will determine the scope of the assessment and may also be used to inform an appropriate and proportionate approach for the assessment.

3.1 Land Use Vulnerability Classification

The existing and proposed land use for the site determines the threshold flood risk likelihood that is compliant with SPP and SEPA's *Flood Risk and Land Use Vulnerability Guidance* (SEPA, 2018b). The proposed works will comprise infilling of a wet basin to create a flat platform for subsequent development for a water compatible usage. Water compatible usage is suitable without condition for sites with low to medium flood risk. For sites with medium to high flood risk, water compatible usage is generally suitable, although appropriate evacuation procedures must be in place where job related accommodation is proposed.

3.2 Screening By Source

3.2.1 Tidal-Fluvial Flood Risk

SEPA Flood Maps (SEPA, 2021)[2] do not indicate fluvial flood risk to the wet basin and surrounding areas. While the site is indeed at fluvial flood risk, being immediately adjacent to a major river, overall flood risk in this tidally-impacted reach of the river is determined by the combination of fluvial and tidal conditions, and is therefore assessed in terms of joint probability.

For the tidal reaches of the River Clyde, analysis undertaken by HR Wallingford in 2002 for the River Clyde Flood Management Strategy identified that a combination of 2 year inflow conditions in combination with 200 year tidal conditions resulted in conservative flood predictions relative to any other joint probability realisation; this outcome is retained in the 2020 model update and is applied for all return periods of interest (i.e. worst-case tidal-fluvial flood predictions for *x* year return period conditions are based on *x* year tidal conditions in combination with 2 year inflow conditions).

Table 3.1 summarises predicted tidal-fluvial flood levels from the tidal River Clyde Model Update, noting that climate change is predicted to cause a sea level rise of 850 mm in the River Clyde by 2100 based on UKCP18 outputs. These compare to ground levels in the landward areas immediately bordering the wet basin which vary between approximately 4.7 mAOD (around the northern end of the wet basin) and 5.8 mAOD (at the south-eastern corner of the wet basin), indicating that areas adjacent to the northern end of the wet basin are at medium to high flood risk, while areas adjacent to the southern end of the wet basin are at low to medium flood risk or little flood risk. Further site-specific assessment of tidal-fluvial flood risk is therefore warranted to assess the impact of infilling of the wet basin.

---

[2] https://map.sepa.org.uk/floodmaps

Table 3.1: Predicted design coastal flood levels in the river section adjacent to the wet basin (obtained from the River Clyde Model Update Technical Report December 2021; Fairhurst)

Design Event	Predicted Flood Level at River Centre (mAOD)
1 in 200 year	4.85
1 in 200 year (+850 mm sea level rise)	5.56
1 in 500 year	5.05
1 in 500 year (+850 mm sea level rise)	5.74
1 in 1,000 year	5.20
1 in 1,000 year (+850 mm sea level rise)	5.88

3.2.2 Surface Water Flood Risk

SEPA Flood Maps indicate surface water flood risk along the eastern and western perimeter of the wet basin, but this is assumed to be an artefact of modelling used to create these maps; there is no bund/embankment separating the wet basin from surrounding ground, and the mapped flooding is within the wet basin itself. The current site and surrounding areas is therefore concluded to not be at risk of surface water flooding.

Proposals entail creation of a flat infilled platform behind a combi wall with an approximately 0.8 m higher crest level at the river interface, although the infilled platform may be subsequently raised. If the platformed area remains below the combi wall crest level, it may be at elevated risk of surface water flooding, depending upon the infiltration characteristics of the infill material. The provision of outfall orifices within the combi wall, fitted with flap valves to prevent backflow from the river, should be sufficient to manage this risk.

3.2.3 Asset Failure Flood Risk

The SEPA Reservoirs Inundation Map[3] indicates that river levels in the local reach of the River Clyde could be impacted by breach/failure of any of the Gryffe 1, Mugdock, Hillend, Roughrigg or Balgray reservoirs, or by breach/failure at Loch Thom.

There is no expected correlation between the risk of breach/failure at any of these reservoirs and tidal surge at Greenock, such that this asset failure flood risk should be regarded as a separate, rather than additive, risk to extreme tidal-fluvial flood risk. Available information from SEPA mapping is limited, but asset failure flood risk extents appear to be less extensive than coastal flood extents, such that tidal-fluvial flood risk is the primary design constraint.

3.2.4 Groundwater Flood Risk

Groundwater flooding, as a primary source, is uncommon in Scotland, due to the nature of the underlying geology. For a site in immediate proximity to a major river, groundwater levels will correspond strongly with water levels in the adjacent watercourse. On this basis, groundwater flood risk does not need to be considered separately from tidal-fluvial flood risk.

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[3] https://map.sepa.org.uk/reservoirsfloodmap/Map.htm

3.3 Scoping Summary

Table 3.2 presents the scoping outcomes for flood risk to the site.

Table 3.2: Summary of Flood Risk Scoping

Flooding Source	Preliminary Risk Classification	Comments/Explanation	Scoping Outcome
Tidal-Fluvial (Coastal-River)	Medium to High Risk	Parts of the perimeter area surrounding the wet basin to be infilled have ground elevations below latest estimates of 1 in 200 year tidal-fluvial flood risk from the River Clyde.	Site-specific assessment required
Surface Water	Low or No Risk	The perimeter area surrounding the wet basin is not at risk of surface water flooding, with no barriers to discharge into the wet basin or adjacent river. The infilled wet basin will itself be lower than surrounding ground, with the combi wall preventing discharge into the river. While the infill material may have sufficient infiltration to manage this risk, flap valved outfalls should be integrated into the combi wall as a contingency against surface water flood risk to the infilled platform.	Not considered further.
Infrastructure	Low or No Risk	Breach or failure of any of a number of reservoirs in the catchment area of this reach of the River Clyde may impact water levels in the river, but this risk will be trivial in comparison to tidal-fluvial risk and is unlikely to be concurrent with tidal-fluvial flooding.	Not considered further.
Groundwater	Low or No Risk	Groundwater levels will correspond with water levels in the adjacent reach of the River Clyde. There is no risk of groundwater flooding independent of tidal-fluvial flooding.	Not considered further.

4 TIDAL-FLUVIAL FLOOD RISK ASSESSMENT

The reader is referred to the River Clyde Model Update Technical Report (Fairhurst; December 2021) for full details of the model construction, input and calibration. The model developed by Fairhurst (version 129384_M02_008; July 2021) is used as-is, with the exception of amendments described in Sections 4.6.1 and 4.7.1. A summary description is provided in the sections to follow.

4.1 Hydrology

The model includes inflows from 8 main rivers (River Clyde, North Calder, Rotten Calder, River Kelvin, White Cart Water, Black Cart Water, River Gryfe, River Leven) plus distributed urban and rural inflows.

Each of the main rivers has maintained flow gauging at or near the model boundary location, with AMAX data obtained for the full gauged record for each gauge. Enhanced Single Site statistical analyses were undertaken, with all gauges determined to be suitable for inclusion in the pooling group used. Recorded flow hydrographs from the flood event which occurred on 10th December 1994 (the largest event on record for a majority of the gauges) were scaled to fit the derived peaks, consistent with the approach used in the RCFMS.

Urban inflows were calculated using the Modified Rational Method, with a C_v of 0.5 used to account for attenuation in the pipe drainage networks upstream of river discharge points, as per the RCFMS approach. The timing of the urban runoff response is likely to be faster than that for rural areas or for the large catchment of the River Clyde; in the absence of information to quantify and assess the impact of the difference in response time, a conservative approach has therefore been taken in which the peak flow values are applied as a constant inflow for the duration of each simulation run.

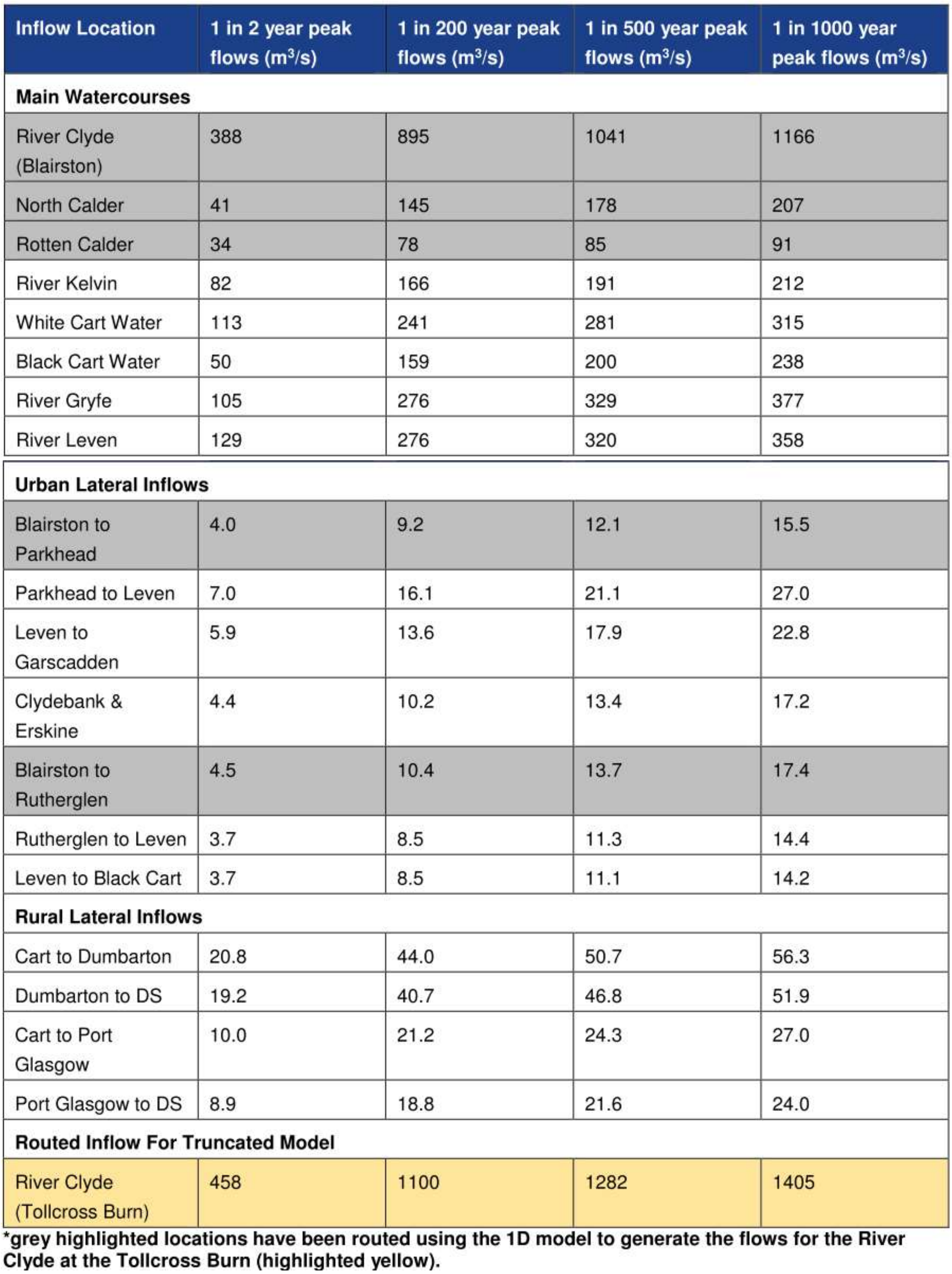
Rural inflows from areas west of Glasgow not represented within the main river catchment areas have been assessed using the ReFH2 rainfall-runoff method using FEH13 design rainfall. Catchment descriptors were based on a representative rural catchment at NGR [234750, 677250]. A storm duration of 72 hrs, matching the 1994 event hydrographs used for the main river inflows, was used to derive inflow hydrographs, with area scaling applied for each rural area represented.

The updated 2D model does not extend as far upstream as the RCFMS model, such that fluvial routing was performed for all inflows upstream of the Clyde/Tollcross Burn confluence using the 2018 model update version (referred to as the Custom House Quay Update model). This was used to derive a singular inflow hydrograph from the following inflows corresponding to locations upstream of the updated model extent:

- River Clyde (at Blairston)
- North Calder
- Rotten Calder
- Blairston to Parkhead (lateral urban inflow, north bank)
- Blairston to Rutherglen (lateral urban inflow, south bank)

Design inflows for selected return period events are summarised in Table 4.1.

Table 4.1: Summary of peak inflows (reproduced from the River Clyde Model Update Technical Report; Fairhurst, 2021)



Inflow Location	1 in 2 year peak flows (m³/s)	1 in 200 year peak flows (m³/s)	1 in 500 year peak flows (m³/s)	1 in 1000 year peak flows (m³/s)
Main Watercourses				
River Clyde (Blairston)	388	895	1041	1166
North Calder	41	145	178	207
Rotten Calder	34	78	85	91
River Kelvin	82	166	191	212
White Cart Water	113	241	281	315
Black Cart Water	50	159	200	238
River Gryfe	105	276	329	377
River Leven	129	276	320	358
Urban Lateral Inflows				
Blairston to Parkhead	4.0	9.2	12.1	15.5
Parkhead to Leven	7.0	16.1	21.1	27.0
Leven to Garscadden	5.9	13.6	17.9	22.8
Clydebank & Erskine	4.4	10.2	13.4	17.2
Blairston to Rutherglen	4.5	10.4	13.7	17.4
Rutherglen to Leven	3.7	8.5	11.3	14.4
Leven to Black Cart	3.7	8.5	11.1	14.2
Rural Lateral Inflows				
Cart to Dumbarton	20.8	44.0	50.7	56.3
Dumbarton to DS	19.2	40.7	46.8	51.9
Cart to Port Glasgow	10.0	21.2	24.3	27.0
Port Glasgow to DS	8.9	18.8	21.6	24.0
Routed Inflow For Truncated Model				
River Clyde (Tollcross Burn)	458	1100	1282	1405

***grey highlighted locations have been routed using the 1D model to generate the flows for the River Clyde at the Tollcross Burn (highlighted yellow).**

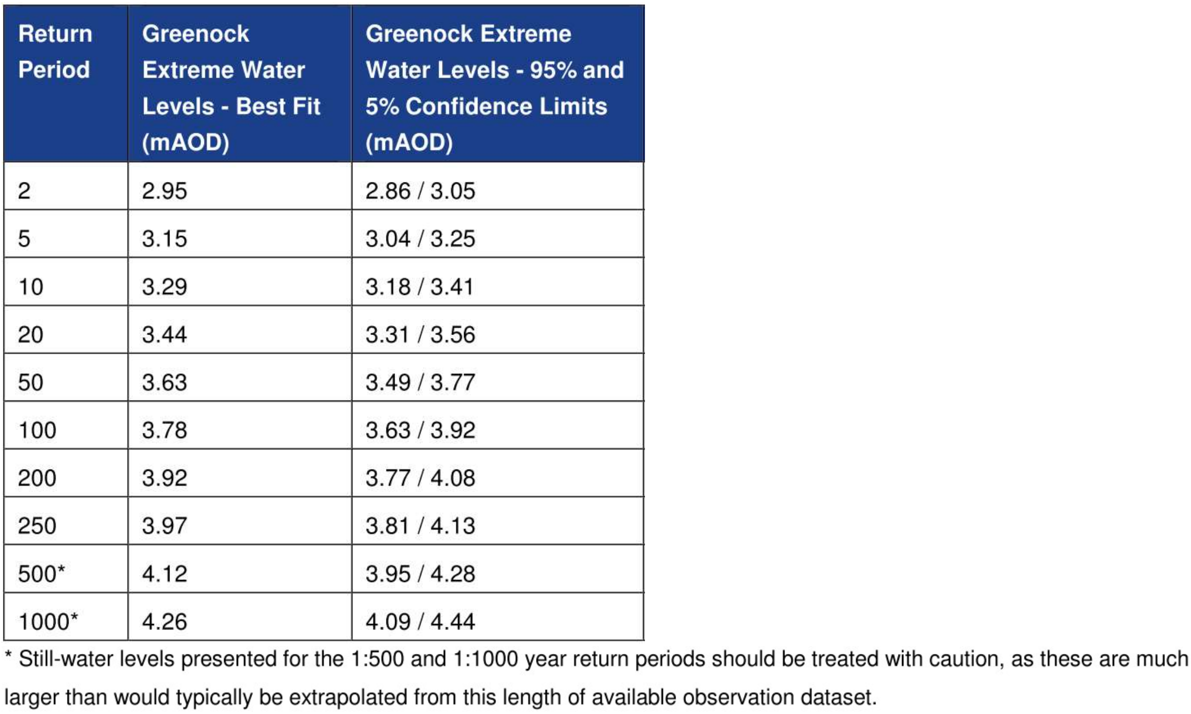
4.2 Design Tide Estimation

The updated model retains the original tidal stage hydrograph employed in the RCFMS model, based on the recorded hydrograph from December 1999, scaled to the appropriate return period still water level. The updated model uses updated extreme still water level estimates obtained from joint probability extreme value analysis of 7.5 (non-continuous) years of tidal gauge data between 1979 and 2020.

Noting that model simulations extend over multiple tidal cycles, the tidal surge profile is applied to a single peak, with normal tidal cycles before and after this surge. The timing of the peak is set to coincide with peak fluvial flow.

Extreme tidal peak values are summarised in Table 4.2.

Table 4.2: Summary of peak still water tidal levels at Greenock (reproduced from the River Clyde Model Update Technical Report; Fairhurst, 2021)



Return Period	Greenock Extreme Water Levels - Best Fit (mAOD)	Greenock Extreme Water Levels - 95% and 5% Confidence Limits (mAOD)
2	2.95	2.86 / 3.05
5	3.15	3.04 / 3.25
10	3.29	3.18 / 3.41
20	3.44	3.31 / 3.56
50	3.63	3.49 / 3.77
100	3.78	3.63 / 3.92
200	3.92	3.77 / 4.08
250	3.97	3.81 / 4.13
500*	4.12	3.95 / 4.28
1000*	4.26	4.09 / 4.44

* Still-water levels presented for the 1:500 and 1:1000 year return periods should be treated with caution, as these are much larger than would typically be extrapolated from this length of available observation dataset.

4.3 Joint Probability

A joint probability study of sea levels and fluvial flows was carried out by HR Wallingford in 2002 prior to development of the RCFMS model. This identified that a combination of 2 year flow and 200 year tide resulted in the highest water levels in the tidal reach and a combination of the 200 year flow and mean high water springs (MHWS) tide resulted in the highest water levels in the fluvial reach. Analysis undertaken by Fairhurst using the updated model confirms that this finding still applies.

The updated model for the tidal reach of the River Clyde therefore considers design tidal surge of the required return period in combination with 2 year design fluvial inflows.

4.4 Climate Change

SEPA have issued update climate change guidance (SEPA, 2022b)[4] for land use planning, based on UK Climate Projections 2018 (UKCP18). This specifies the following recommended uplifts to account for the predicted impacts of climate change to the year 2100:

- A 49% uplift should be applied to design peak river flows for catchments of greater than 30 km^2 area located in the Clyde River Basin Region.
- A 0.85 m cumulative rise in sea levels should be applied in the assessment of tidal flood risk for locations within the Clyde River Basin Region.

The updated model applies an 850 mm sea level rise for climate change scenarios, and therefore remains current with respect to latest climate change guidance.

No uplift is applied to peak river flows in climate change runs undertaken for the River Clyde Model Update Technical Report, with this approach accepted by GCC and SEPA as appropriate for the tidal reaches of the River Clyde. However, an uplift to peak river flows is considered as a sensitivity scenario in this study. It is beyond the scope of this study to repeat 1D flow routing to accurately update upper boundary inflows (see Section 4.1) or to account for the impact of climate change on the highly attenuated inflows from the River Leven; instead, and noting that flow uplift is only assessed as a sensitivity case, a simple 49% uplift is applied to all model inflows.

4.5 Model Development

4.5.1 Model Extents

The updated model extends from a point upstream of the Clyde/Tollcross Burn confluence near Dalbeth downstream to Greenock, and includes representation of the tidal reaches of major tributaries within this extent (Figure 4.1).

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[4] https://www.sepa.org.uk/media/594168/climate-change-guidance.pdf

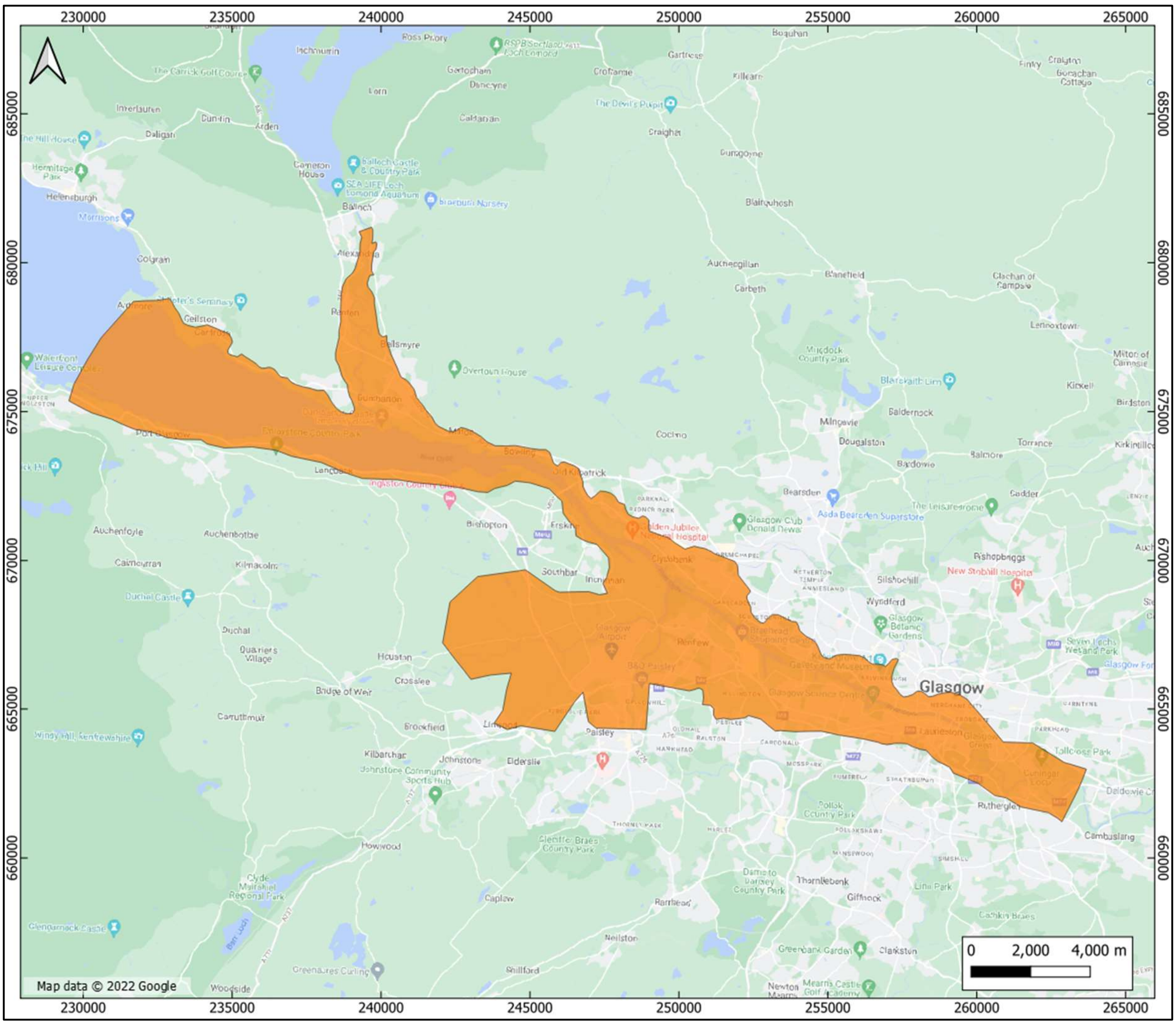


Figure 4.1: Model extents

4.5.2 2D Model Domain

The updated model was constructed using the TUFLOW Quadtree Solver. Bed levels within modelled rivers, and ground levels within the floodplain areas, are based on multiple digital terrain models (DTMs), including:

- Infoterra Glasgow 1 m LiDAR (2003). This older DTM is used to inform floodplain ground levels for a small area (between the model upstream boundary and Tollcross Burn confluence) at the most upstream (fluvial) end of the model.
- Bluesky 0.5 m LiDAR (2020). This LiDAR was commissioned by GCC to replace older LiDAR DTMs used in the RCFMS, and extends from the Tollcross Burn confluence to Greenock, including coverage of the tidal reaches of the White Cart Water, Black Cart Water, River Gryfe, River Kelvin and River Leven.
- SEPA/Scottish Water Bathymetric Survey (2016). This survey covers the reach between the Tollcross Burn confluence and Erskine Harbour.
- Aspect Clyde Estuary Bathymetric Survey (2020). This survey covers the reach between Erskine Harbour to the downstream boundary of the model at Greenock.

The 2020 LiDAR and 2016 and 2020 bathymetric survey DTMs were merged together for use in modelling, to avoid any potential issues where the extents of these surveys overlap.

Model elevations have been altered at specific locations using Z shape lines, to correct for errors in LiDAR processing (i.e. inaccurate removal of bridges, inaccurate truncation of bridge abutments, other minor triangulation issues), as well as other localised amendments to avoid model instability/initial condition artefacts. The flood walls between the Kingston Bridge and Finnieston Street Bridge were also explicitly represented based on as-built drawings using “wide” Z shape lines to ensure the wall crests are accounted for in the model. The reader is referred to the River Clyde Model Update Technical Report (Fairhurst; December 2021) for full details.

TUFLOW Quadtree permits variable grid resolutions within the 2D domain, through use of “nesting” (where grid cells within an area of interest can be subdivided one or more times to achieve improved accuracy in these locations). The model employs a default cell resolution of 40 m, with a finer (20 m) resolution used between the White Cart Water/Clyde Confluence and Longhaugh Point, as well as for the floodplains and channels of the River Leven, White Cart Water, Black Cart Water and River Gryfe. Upstream of the White Cart Water/Clyde Confluence, a 10 m grid resolution has been used, excepting for a corridor along the river centre where a 20 m resolution has been retained to improve runtimes. Grid nesting used in modelling is presented in Figure 4.2.

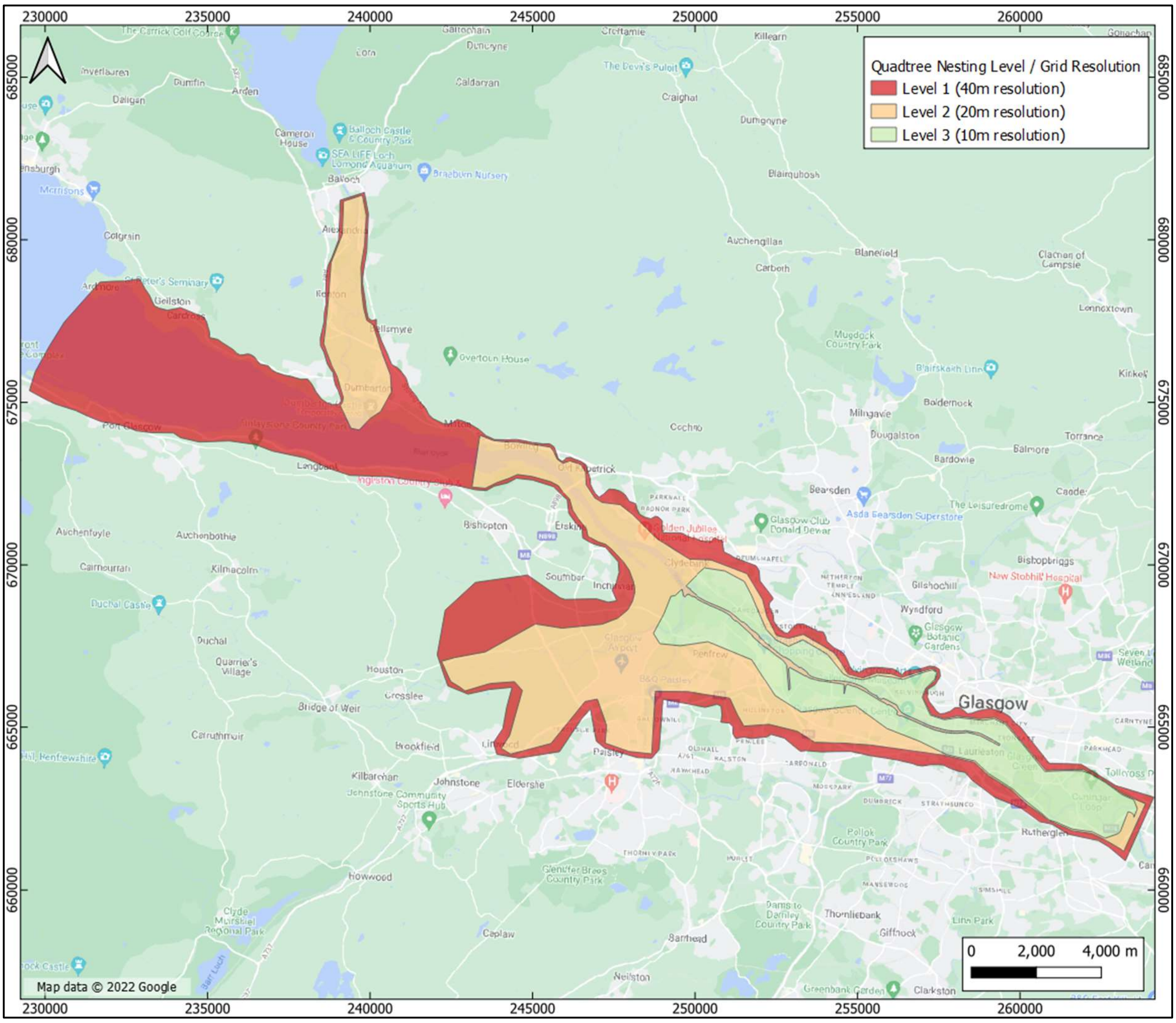


Figure 4.2: Model nesting levels

4.5.3 Model Boundaries

Design tidal stage hydrographs are input as a head-time boundary condition at the downstream end of the model, at Greenock. The boundary location is adjacent to a tidal gauge operated by Peel Ports, the data from which has been used for design tide estimation.

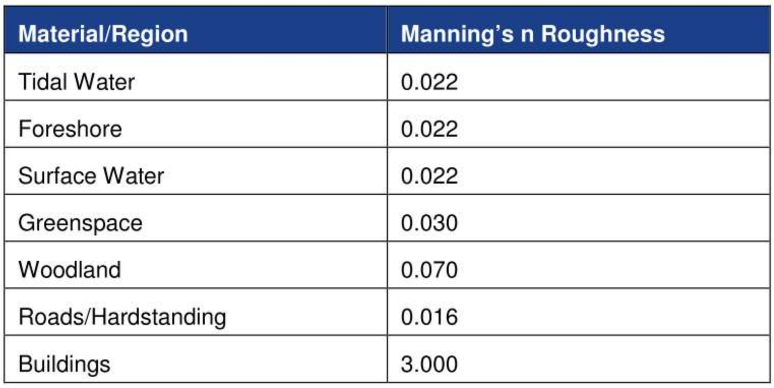
Design flow hydrographs are input as flow-time boundary conditions at multiple boundary locations within the model domain.

4.5.4 Model Schematic

4.5.5 Roughness

OS Open Local Map shapefiles were used to define the land use type for all locations within the model domain. Roughnesses were then applied for each land use, as summarised in Table 4.3. Shapefile information and Manning’s n values were manually checked and corrected as appropriate for locations within 100 m of the River Clyde.

Table 4.3: Manning’s n assigned to each land use (reproduced from the River Clyde Model Update Technical Report; Fairhurst, 2021)

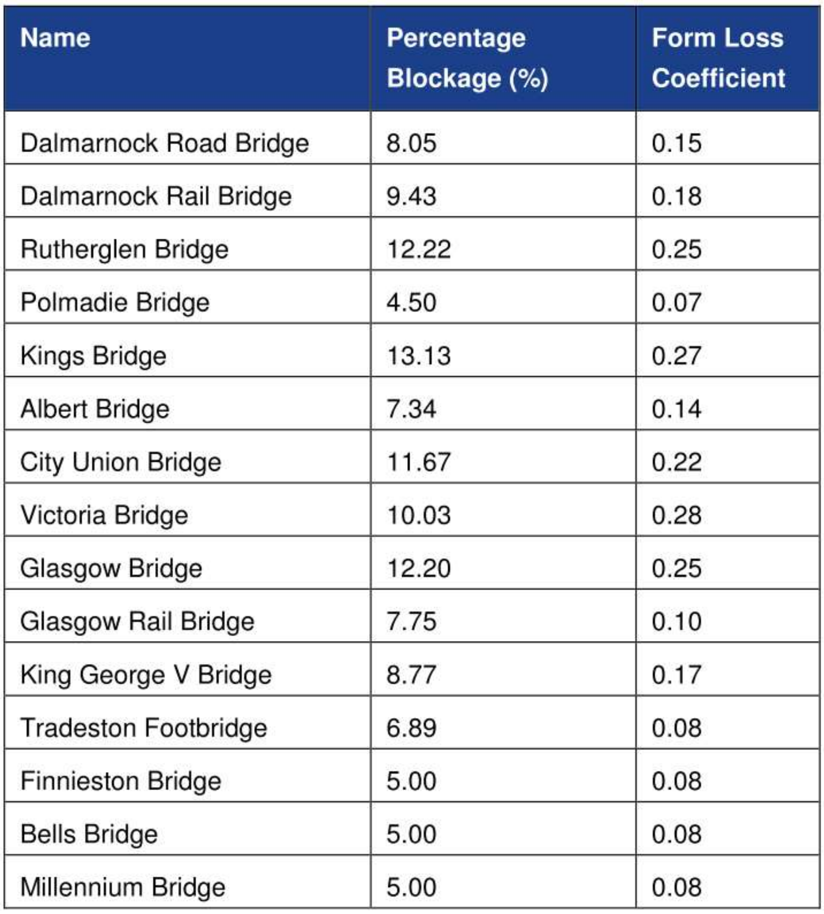


Material/Region	Manning’s n Roughness
Tidal Water	0.022
Foreshore	0.022
Surface Water	0.022
Greenspace	0.030
Woodland	0.070
Roads/Hardstanding	0.016
Buildings	3.000

4.5.6 Representation of River Structures

Bridges within the modelled reach are represented based on form loss coefficients and percentage blockage values which in turn are based on guidance provided by TUFLOW taken from *Hydraulics of Bridge Waterways* (FHA, 1978). Parameter values used for each bridge are presented in Table 4.4.

Table 4.4: Modelled bridge parameterisation (reproduced from the River Clyde Model Update Technical Report; Fairhurst, 2021)



Name	Percentage Blockage (%)	Form Loss Coefficient
Dalmarnock Road Bridge	8.05	0.15
Dalmarnock Rail Bridge	9.43	0.18
Rutherglen Bridge	12.22	0.25
Polmadie Bridge	4.50	0.07
Kings Bridge	13.13	0.27
Albert Bridge	7.34	0.14
City Union Bridge	11.67	0.22
Victoria Bridge	10.03	0.28
Glasgow Bridge	12.20	0.25
Glasgow Rail Bridge	7.75	0.10
King George V Bridge	8.77	0.17
Tradeston Footbridge	6.89	0.08
Finnieston Bridge	5.00	0.08
Bells Bridge	5.00	0.08
Millennium Bridge	5.00	0.08

The Tidal Weir is represented using a 1D Estry Operational Weir channel dynamically linked to the 2D model domain, with gate opening and closing controlled by operational rules based on upstream and downstream water levels. Representation of the weir is not equivalent to that used in the RCFMS, due to software differences, but is found by sensitivity analysis to have a localised impact on peak water level predictions of 99 mm or less. The reader is referred to the River Clyde Model Update Technical Report (Fairhurst; December 2021) for full details.

4.5.7 Run Parameters/Options

The model is run using the sub-grid sampling (SGS) option within TUFLOW, which accounts for variation in topography and water surface elevation within the grid by representing the grading or curvature in both along each face of each cell. Amongst other benefits, this improves representation of cell storage and conveyance between cells (especially for larger grid resolutions) in comparison to approaches without SGS.

A 40 m grid resolution is used for the coarsest nesting level (see Section 4.5.2 for more information).

4.5.8 Model Calibration

Calibration was performed by applying observed tidal and fluvial hydrographs to the model and adjusting roughness parameterisation to achieve a good fit between predicted and observed water levels and hydrograph shapes at the Glasgow Harbour Tidal Gauge and Renfrew Tidal Gauge. The model is considered to provide a good fit to observed data within the reach between the tidal weir and the downstream boundary at Greenock. The reader is referred to the River Clyde Model Update Technical Report (Fairhurst; December 2021) for full details.

4.5.9 Sensitivity Testing

Extensive sensitivity testing of the updated model was undertaken by Fairhurst in relation to the 1 in 200 year event; the reader is referred to the River Clyde Model Update Technical Report (Fairhurst; December 2021) for full details. In summary:

- Representation of operational rules for the tidal weir has an associated sensitivity of up to 99 mm upon 1 in 200 year predicted peak water levels, with the impact extending throughout the tidal reach of the model. At the location of the site, tidal weir operation has an associated sensitivity of up to 48 mm.
- A 20% global increase in Manning's roughness value is predicted to reduce peak water levels by up to 86 mm in the tidal reach of the model, while a 20% global decrease causes an increase in peak water levels of up to 92 mm in the tidal reach of the model, noting that roughness parameterisation impacts the timing of tidal propagation up the estuary, such that this sensitivity assessment also reflects sensitivity to the timing of the tidal surge relative to the fluvial inflow peak.
- For the default cell resolution used in modelling (i.e. 40 m resolution at the coarsest nesting level), sensitivity analysis found that employing the sub-grid sampling option had a small impact upon peak water level predictions (between 7 mm reduction and 12 mm increase).
- Altering the cell sizes used in modelling (by varying the resolution of the coarsest nesting level) had a small impact upon peak water level predictions (between 10 mm reduction and 11 mm increase).
- Increasing bridge blockage by 50% had a small impact upon peak water level predictions (± 5 mm).
- Increasing the bridge form loss coefficients by 50% or altering the assumed water density (between fresh water and saline water values) had a negligible impact (± 1 mm).

The baseline model does not account for the impact of wind upon peak water levels, which was assessed separately via sensitivity analysis. Extreme wind speeds and extreme sea levels are likely to be correlated, but the correlation is unknown for the River Clyde. The Defra/Environment Agency Joint Probability: Dependence Mapping and Best Practice approach was therefore used to assess the potential return period of wind for 1 in 200 year extreme sea level conditions based on dependency factors between 0.1 and 0.8. A dependency factor of 0.8 would be associated with a 1 in 4 year wind speed occurring concurrently with 1 in 200 year extreme sea level conditions, with a dependency factor of 0.7 associated with a 1 in 1 year wind speed, and lower dependency factors resulting in sub-annual wind speed return periods. Wind blowing into the estuary from the west (i.e. 270°) was found to cause the largest uplift in predicted peak water levels, with wind emanating from other directions causing a weaker uplift or in some cases (e.g. from the east or south) causing a reduction in predicted peak water levels. The impact of extreme westerly winds upon peak water level predictions can be summarised as follows:

- A 3 hr duration, 1 in 5 year westerly wind peaking 1 hr after the tidal peak at Greenock is predicted to increase 1 in 200 year peak water level predictions by 0.77 m at Glasgow Harbour, with more severe increases upstream of the harbour (up to 0.80 m) and less severe increases downstream of the harbour. At the location of the site, this wind event is predicted to increase peak 1 in 200 year water levels by between 0.65 and 0.70 m.
- A less extreme 3 hr duration 1 in 1 year westerly wind peaking 1 hr after the tidal peak at Greenock is predicted to increase 1 in 200 year peak water level predictions by 0.65 m at Glasgow Harbour, with increases of up to 0.67 m upstream of the harbour. At the location of the site, this wind event is predicted to increase peak 1 in 200 year water levels by between 0.55 and 0.60 m.
- The predicted sensitivity to wind is itself very sensitive to wind event duration and peak timing; a wind peak occurring at the same time as or before the tidal peak at Greenock, and/or a shorter or longer duration wind event, will have a lesser impact upon increasing peak water level predictions, and may in some instances cause a reduction in peak water level predictions.

Fairhurst assert that these sensitivity analysis predictions should be considered when deriving appropriate freeboard allowances, noting that the impact of wind (for critical wind event duration, timing and direction and relatively high assumed dependency) is predicted to exceed the general standard freeboard value of 600 mm.

4.6 Baseline Model Simulations

All simulations were conducted using TUFLOW Version 2020-10-AD with HPC Quadtree Version 1.23.0 (Sep 1 2021) (single precision, 64-bit solver). Tabulated predictions focus on the local reach of the River Clyde, between the Govan Graving Docks (SEC_25) and Braehead Shopping Centre (YARROWS) (Figure 4.3). The site is located between model result locations FAIR_BAS and SEC_36, with these locations shown in bold in all results tables.

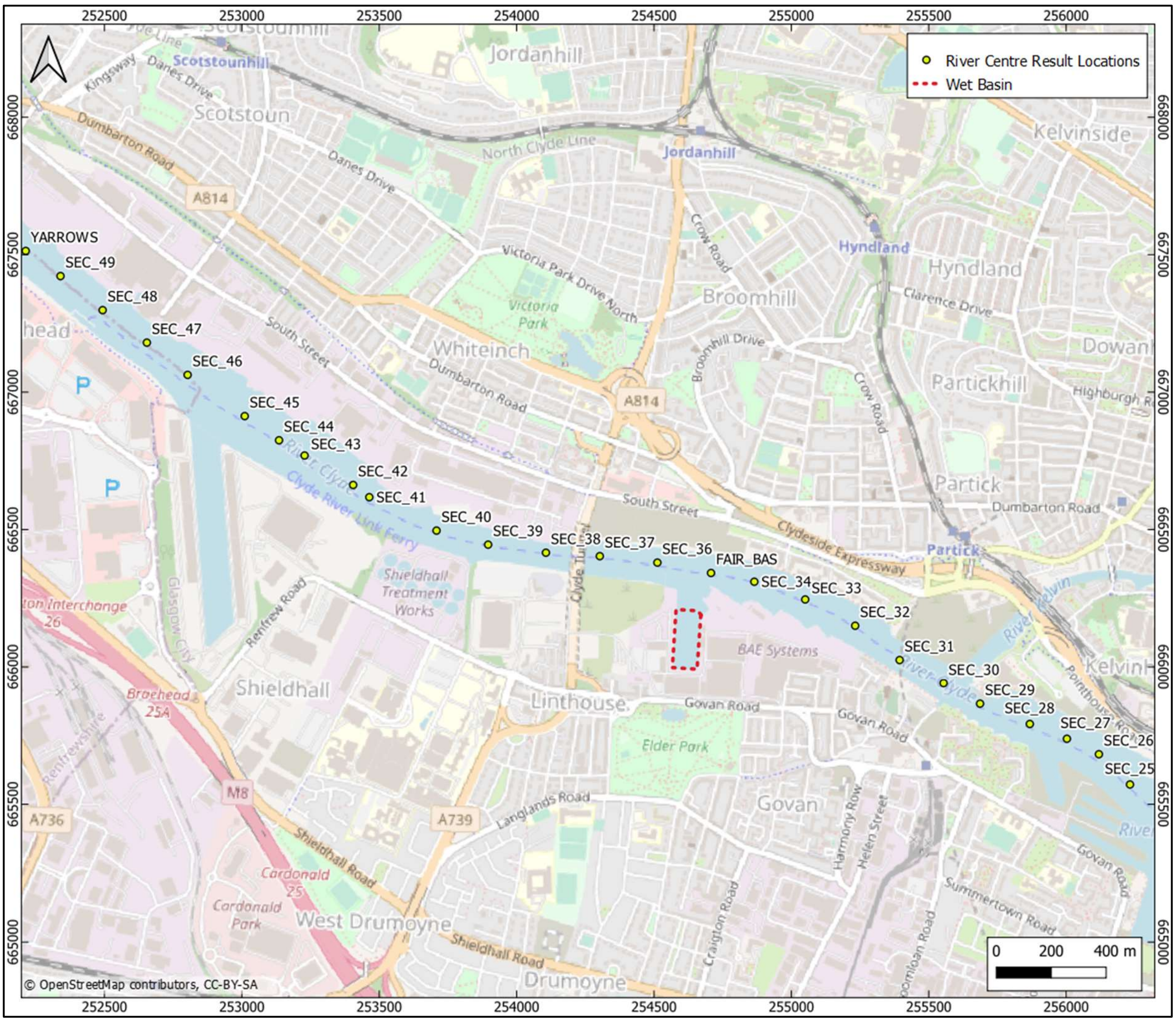


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Figure 4.3: Tabulated results locations

4.6.1 Model Amendments

To better suit flood prediction for the current study, model nesting polygons were locally altered to improve grid resolution for the wet basin as well as for the King George V Dock downstream of the site, as illustrated in Figure 4.4.

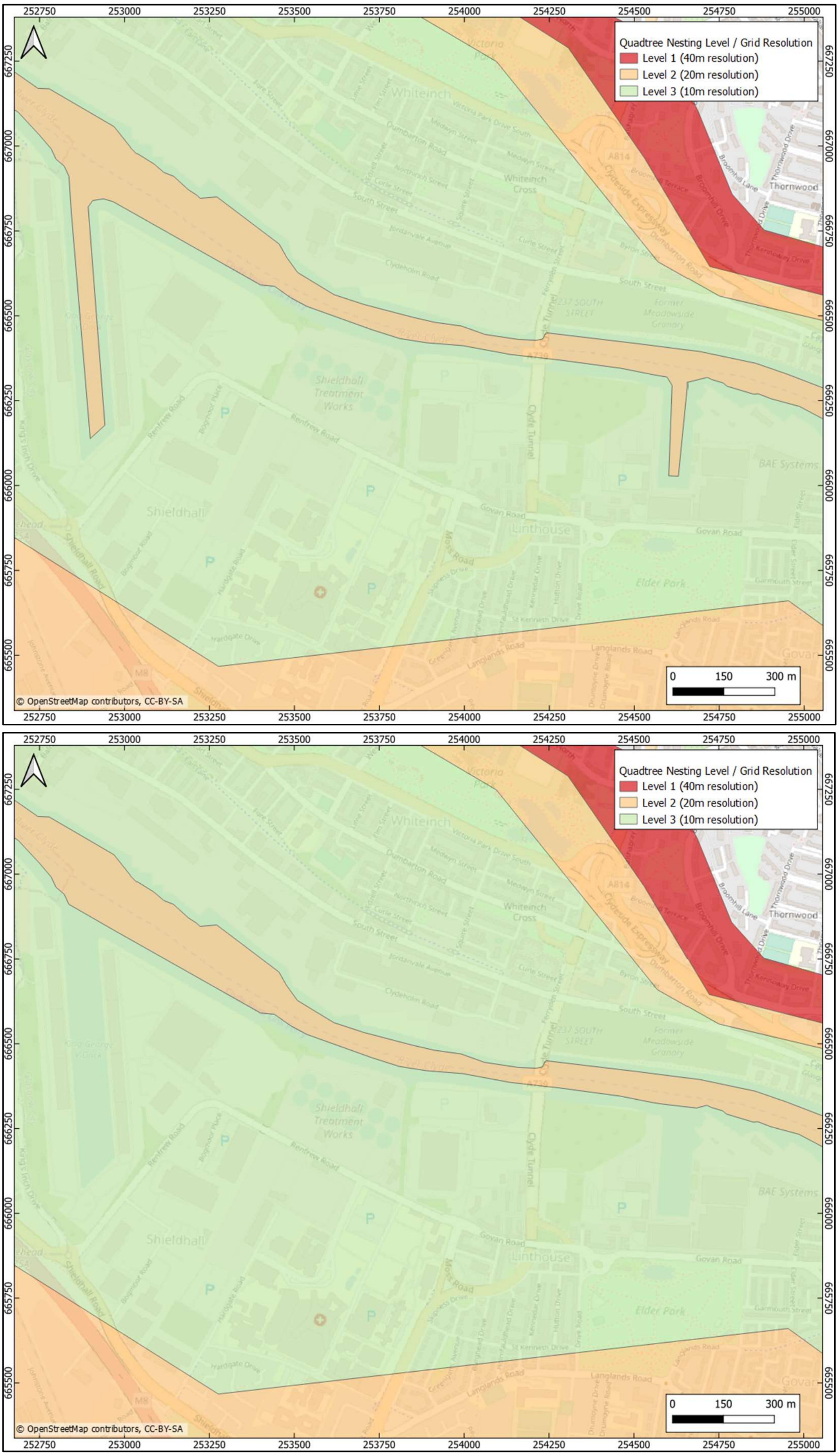

Figure 4.4: Local nesting levels; as per Fairhurst model (upper) versus amended (lower) extents

4.6.2 Model Predictions

Table 4.5 presents predicted peak water levels at river centre locations in the local reach of the River Clyde for the 1 in 200 year event, 1 in 200 year event including (850 mm) sea level rise, and 1 in 200 year event including climate change (i.e. sea level rise and fluvial inflow uplift). Predictions obtained from the unamended Fairhurst model are also presented for the 1 in 200 year event, for reference, confirming that local changes to grid nesting have negligible impact upon model predictions (a 1 mm variation at SEC_41 being the only local difference).

Table 4.5: Predicted baseline peak water levels (in mAOD) at river centre locations in the local river reach

Location	1 in 200 year (Unamended)	1 in 200 year	1 in 200 year + sea level rise	1 in 200 year + climate change
SEC_25	4.876	4.876	5.589	5.617
SEC_26	4.874	4.874	5.586	5.615
SEC_27	4.873	4.873	5.584	5.613
SEC_28	4.871	4.871	5.582	5.611
SEC_29	4.865	4.865	5.577	5.604
SEC_30	4.861	4.861	5.573	5.597
SEC_31	4.856	4.856	5.568	5.590
SEC_32	4.856	4.856	5.564	5.589
SEC_33	4.854	4.854	5.561	5.586
SEC_34	4.851	4.851	5.558	5.582
FAIR_BAS	**4.848**	**4.848**	**5.555**	**5.579**
SEC_36	**4.845**	**4.845**	**5.552**	**5.575**
SEC_37	4.841	4.841	5.548	5.570
SEC_38	4.834	4.834	5.542	5.561
SEC_39	4.830	4.830	5.538	5.557
SEC_40	4.826	4.826	5.534	5.554
SEC_41	4.821	4.820	5.531	5.549
SEC_42	4.820	4.820	5.532	5.549
SEC_43	4.818	4.818	5.530	5.548
SEC_44	4.817	4.817	5.531	5.546
SEC_45	4.815	4.815	5.533	5.548
SEC_46	4.811	4.811	5.529	5.543
SEC_47	4.805	4.805	5.519	5.533
SEC_48	4.801	4.801	5.513	5.528
SEC_49	4.797	4.797	5.508	5.523
YARROWS	4.794	4.794	5.504	5.520

Predicted baseline flood extents for each modelled event are presented in Figure 4.5. For the 1 in 200 year event, floodwaters remain mostly contained within the wet basin, with limited low depth inundation of a narrow corridor of land at the eastern edge of the wet basin. Sea level rise due to climate change increases local peak 1 in 200 year water levels by between 707-718 mm, which significantly increases the extent of local flooding beyond the southern bank of the Clyde upstream of the wet basin. The additional impact of increased fluvial flows due to climate change amounts, locally, to a 14-29 mm increase in peak 1 in 200 year water levels, relative to the 1 in 200 year plus sea level rise scenario; this small increase in peak water levels has a negligible impact upon predicted local flood extents.

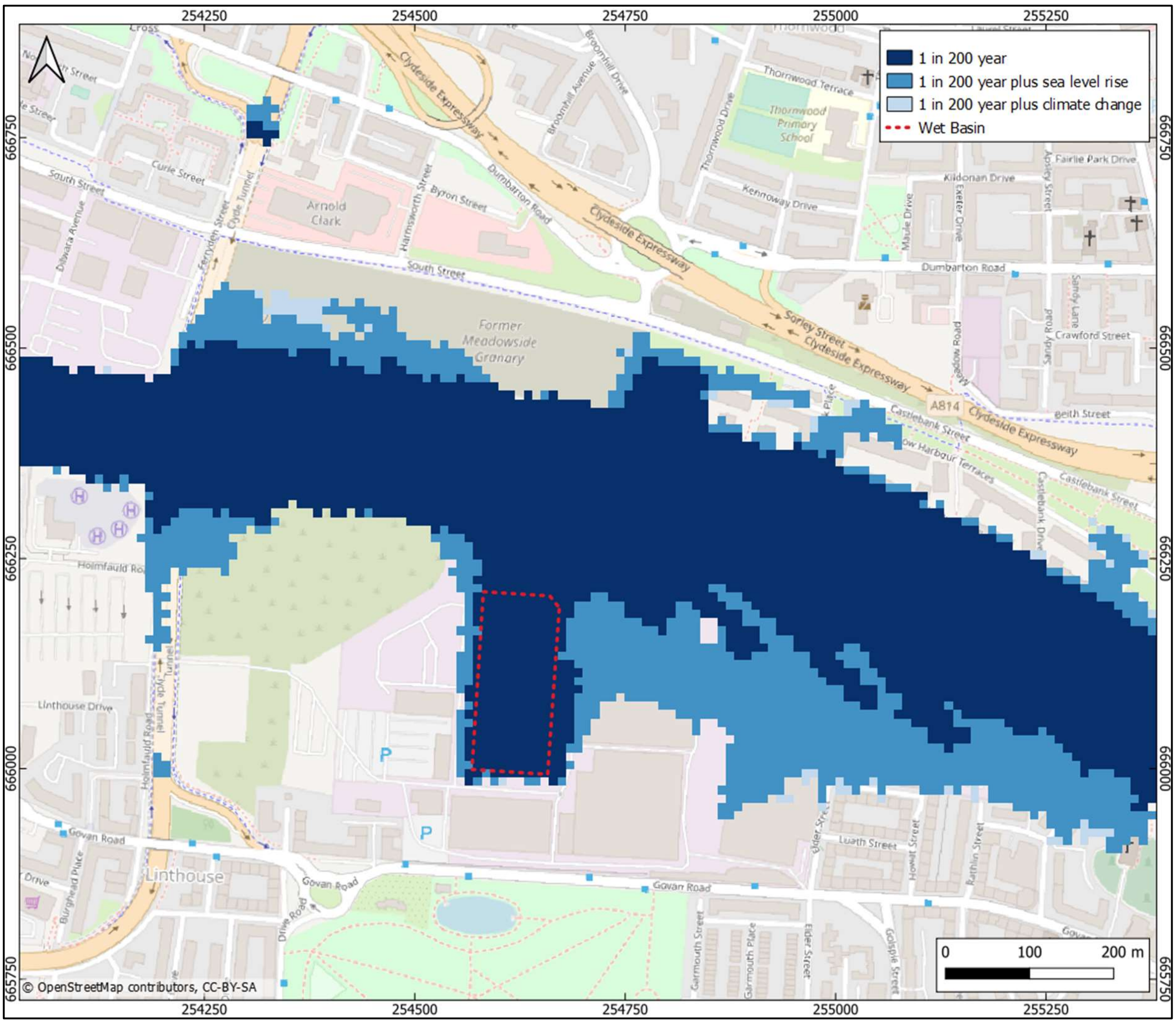

Figure 4.5: Predicted local baseline flood extents in the vicinity of the wet basin

4.7 Wet Basin Infilling Model Simulations

4.7.1 Model Amendments

The local ground model was modified to account for infilling of the wet basin. The modifications made are as follows:

- A DTM was created to represent the infilled platform (6.5 mCD; equivalent to 4.1 mAOD), and added to the end of the DTM list in the TUFLOW geometry control file (to ensure it overwrites elevations from other LiDAR-bathymetric DTMs within the model).
- A second DTM was created to represent the crest of the combi wall between the infilled platform and river (7.30 mCD; equivalent to 4.9 mAOD). The crest was defined with a width of 30 m (to ensure the crest level is consistently sampled in model gridding) and mosaicked with the LiDAR-bathymetric DTM using the "maximum of" option, to ensure the crest ties into surrounding ground to the west and east.

4.7.2 Model Predictions

Table 4.6 presents predicted peak water levels at river centre locations in the local reach of the River Clyde for the 1 in 200 year event, 1 in 200 year event including (850 mm) sea level rise, and 1 in 200 year event including climate change (i.e. sea level rise and fluvial inflow uplift). Predicted post-infilling flood extents for each modelled event are presented in Figure 4.6.

The platform level of the infilled wet basin is below adjacent 1 in 200 year water level predictions, but the platform is protected from flooding due to this event by the higher crest level of the combi wall, which is marginally (55-58 mm) above the adjacent 1 in 200 year peak water levels (although, noting that simulations do not account for wind action, there is a risk the wall crest will be overtopped by this event). Otherwise, with inclusion of sea level rise / climate change, predicted flood extents following infilling of the basin are essentially the same as for baseline conditions.

Table 4.6: Predicted post-infilling peak water levels (in mAOD) at river centre locations in the local river reach

Location	1 in 200 year	1 in 200 year + sea level rise	1 in 200 year + climate change
SEC_25	4.873	5.589	5.615
SEC_26	4.872	5.586	5.613
SEC_27	4.870	5.585	5.612
SEC_28	4.869	5.582	5.609
SEC_29	4.863	5.577	5.602
SEC_30	4.858	5.573	5.595
SEC_31	4.853	5.568	5.588
SEC_32	4.853	5.565	5.587
SEC_33	4.851	5.562	5.584
SEC_34	4.848	5.558	5.580
FAIR_BAS	**4.845**	**5.556**	**5.577**
SEC_36	**4.842**	**5.552**	**5.573**
SEC_37	4.838	5.547	5.568
SEC_38	4.832	5.543	5.559
SEC_39	4.828	5.539	5.555
SEC_40	4.825	5.536	5.552
SEC_41	4.819	5.531	5.547
SEC_42	4.819	5.531	5.548
SEC_43	4.817	5.531	5.549
SEC_44	4.815	5.529	5.547
SEC_45	4.813	5.532	5.549
SEC_46	4.809	5.525	5.542
SEC_47	4.803	5.515	5.531
SEC_48	4.799	5.508	5.525
SEC_49	4.794	5.505	5.520
YARROWS	4.792	5.501	5.517

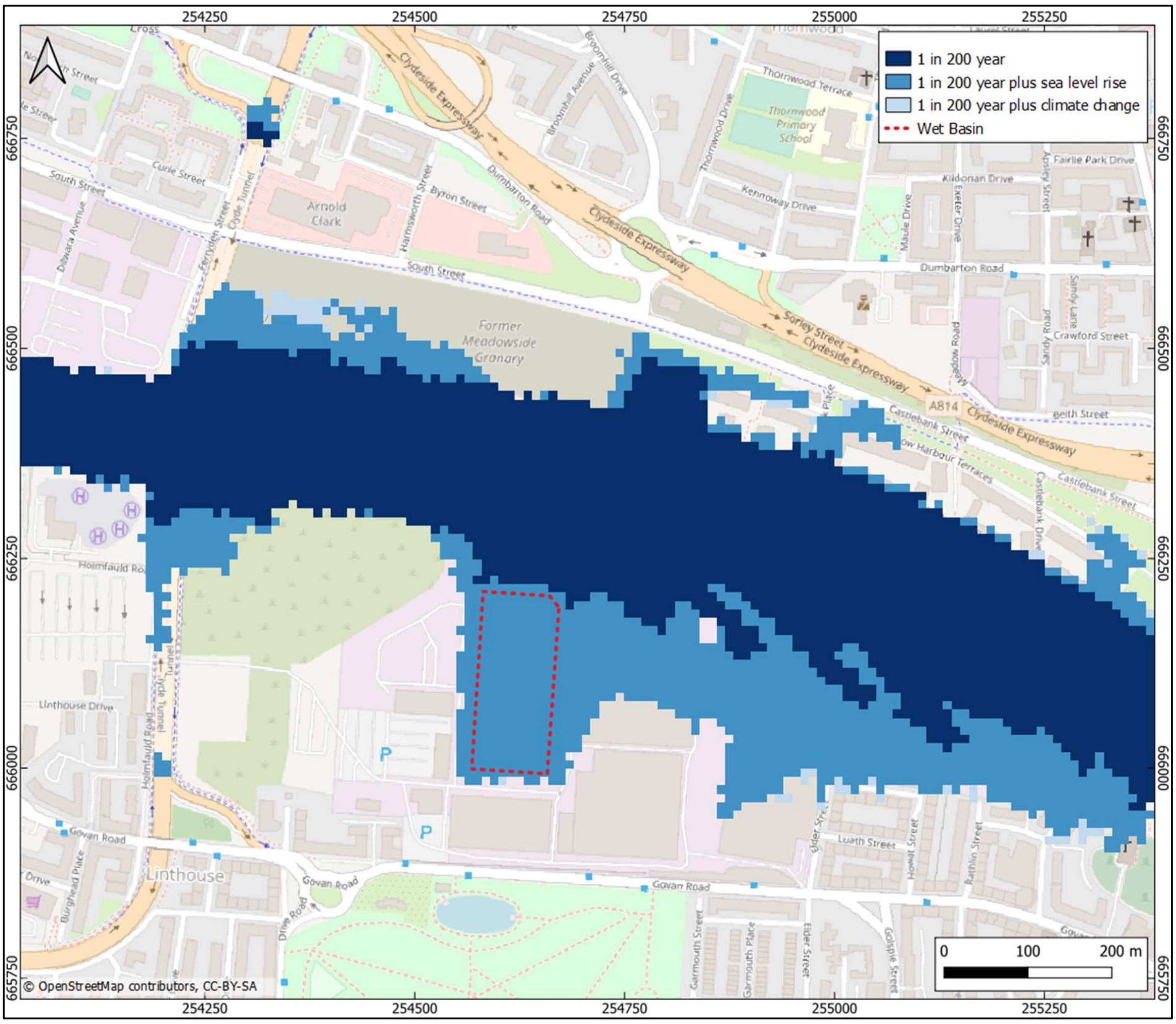

Figure 4.6: Predicted local flood extents in the vicinity of the wet basin following wet basin infilling

4.7.3 Impact of Infilling Upon Flood Predictions

Infilling of the wet basin is predicted to have a negligible impact upon flooding behaviour for the 1 in 200 year event, with or without climate change impacts (Table 4.7). The range of predicted local impact varies between a 5 mm reduction in peak water levels (at SEC_48 for the 1 in 200 year plus sea level rise event) and a 1 mm increase in peak water levels (upstream and downstream of the site for the 1 in 200 year plus sea level rise and plus climate change events). Figure 4.7 through Figure 4.9 present difference maps, showing the impact of basin infilling upon predicted peak water levels for all local 2D cells for the 1 in 200 year, 1 in 200 year plus sea level rise and 1 in 200 year plus climate change scenarios, respectively. Adjacent to the basin, river centre peak water levels are predicted to reduce by 3 mm for the 1 in 200 year event, be unchanged for the 1 in 200 year plus sea level rise event (with increases of up to 6 mm within the infilled basin itself), and reduce by 2 mm for the 1 in 200 year plus climate change event.

The mechanism for these minor predicted changes in peak water level is unclear. Basin infilling may slightly alter attenuation of tidal propagation, resulting in very minor changes in the predicted flood peak. Alternatively, or additionally, these changes may be model artefacts associated with localised instabilities which are observable throughout the model domain in isolated river edge cells (which can be seen in Figure 4.7, for example) and also within King George V Dock; these may cause slight changes in the adaptive timestep employed by the solver at any point during the simulation (which is controlled by the model software, based on convergence criteria, and therefore may slightly change between simulations). It is noted that increases in peak water levels of up to 3 mm are predicted towards the downstream end of the model (below Erskine Bridge), separated from the site by similar reductions in peak water level, which cannot be logically associated with basin infilling, giving further weight to the conclusion that such minor changes in peak water level predictions may be artefacts associated with the numerical solver.

Noting that the events simulated account for what should be the worst-case impact (i.e. the events at which river water levels are just below and just above that necessary to flood the infilled basin), the impact of infilling for higher or lower return periods will, logically, also be negligible.

Table 4.7: Predicted change in peak water levels (in mAOD) at river centre locations in the local river reach due to wet basin infilling. Negative values indicate reduction due to infilling.

Location	1 in 200 year	1 in 200 year + sea level rise	1 in 200 year + climate change
SEC_25	-0.003	0.000	-0.002
SEC_26	-0.002	0.000	-0.002
SEC_27	-0.003	0.001	-0.001
SEC_28	-0.002	0.000	-0.002
SEC_29	-0.002	0.000	-0.002
SEC_30	-0.003	0.000	-0.002
SEC_31	-0.003	0.000	-0.002
SEC_32	-0.003	0.001	-0.002
SEC_33	-0.003	0.001	-0.002
SEC_34	-0.003	0.000	-0.002
FAIR_BAS	**-0.003**	**0.001**	**-0.002**
SEC_36	**-0.003**	**0.000**	**-0.002**
SEC_37	-0.003	-0.001	-0.002
SEC_38	-0.002	0.001	-0.002
SEC_39	-0.002	0.001	-0.002
SEC_40	-0.001	0.002	-0.002
SEC_41	-0.001	0.000	-0.002
SEC_42	-0.001	-0.001	-0.001
SEC_43	-0.001	0.001	0.001
SEC_44	-0.002	-0.002	0.001
SEC_45	-0.002	-0.001	0.001
SEC_46	-0.002	-0.004	-0.001
SEC_47	-0.002	-0.004	-0.002
SEC_48	-0.002	-0.005	-0.003
SEC_49	-0.003	-0.003	-0.003
YARROWS	-0.002	-0.003	-0.003

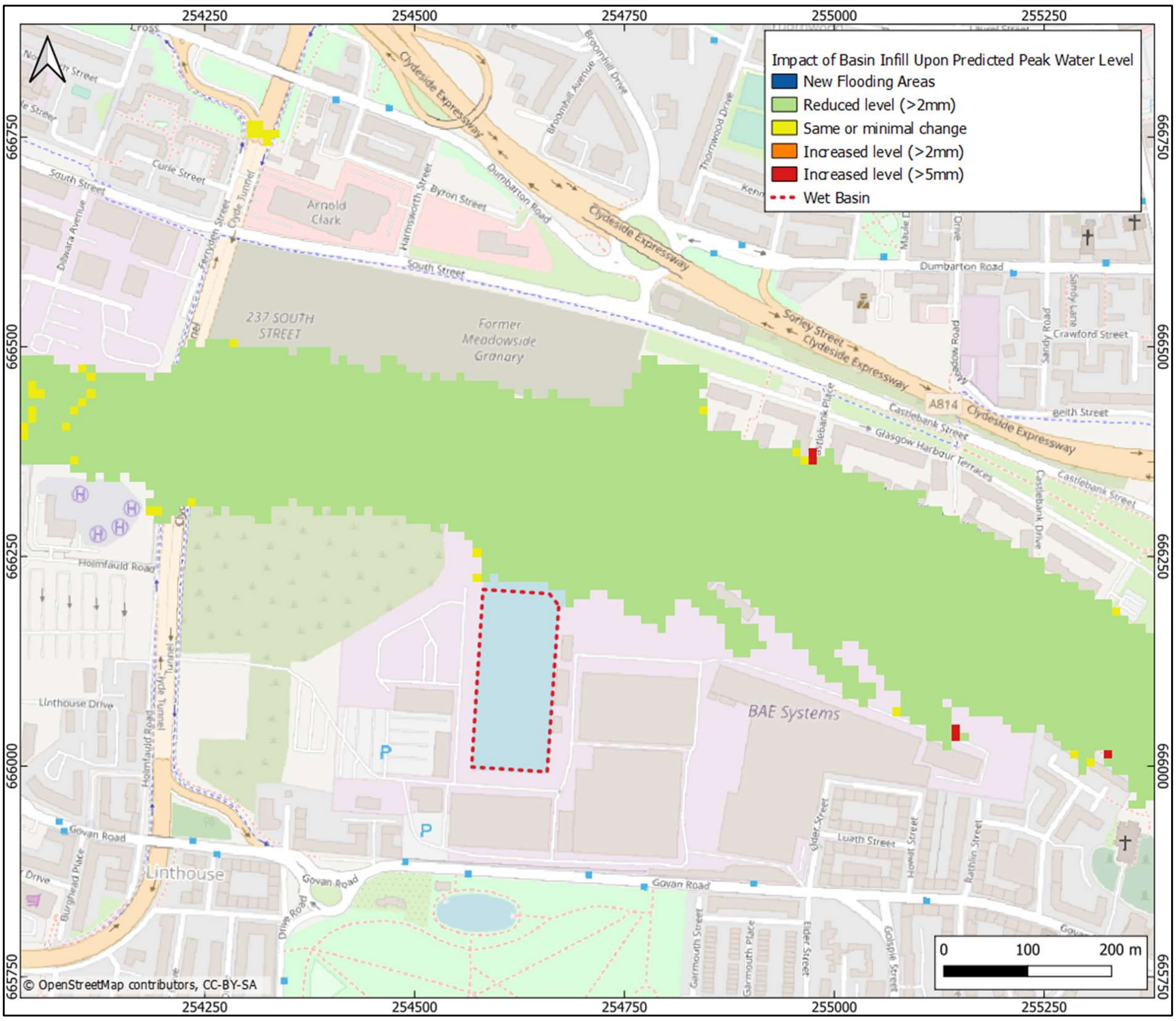

Figure 4.7: Change in predicted peak water levels due to wet basin infilling (1 in 200 year event)

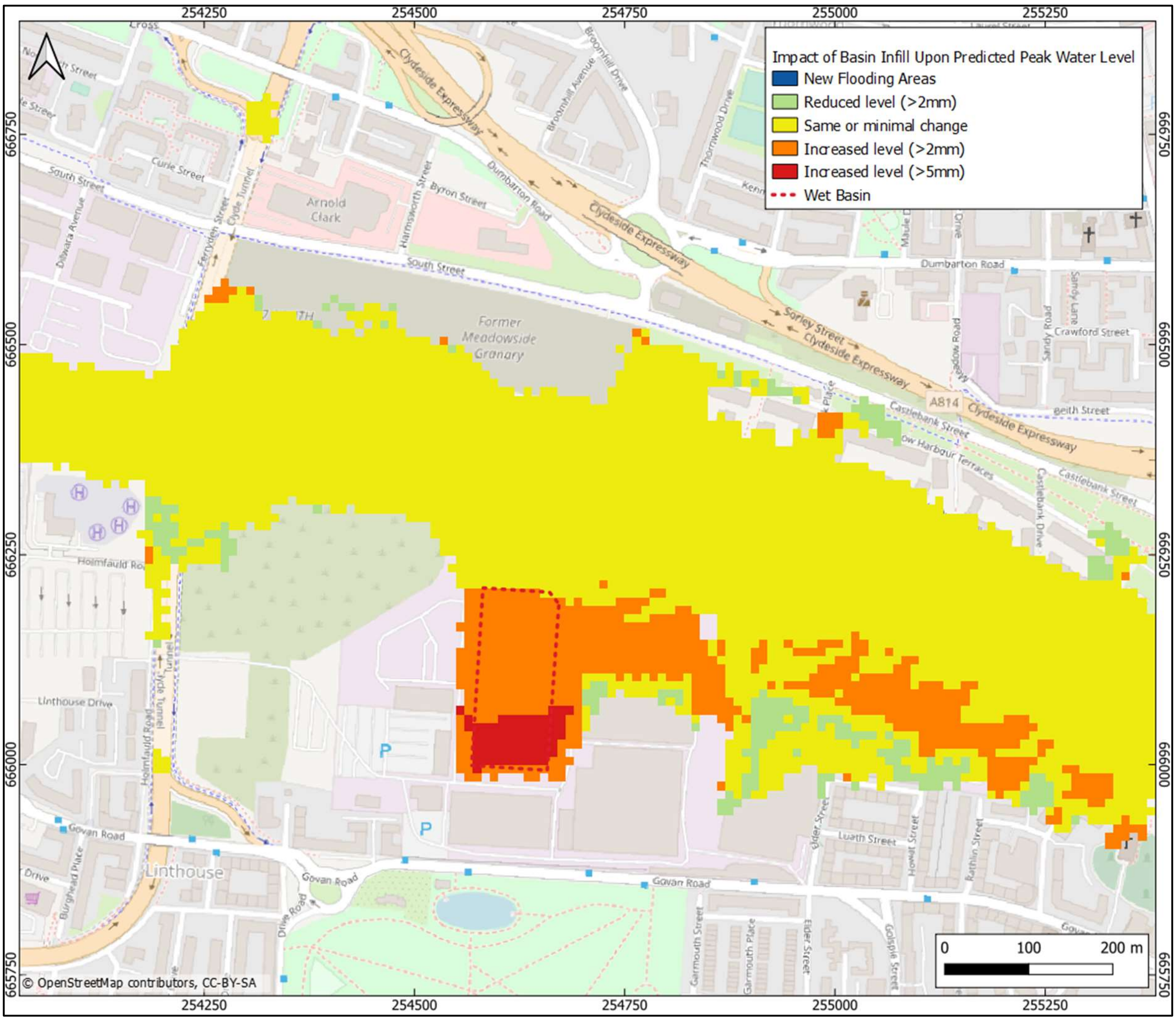

Figure 4.8: Change in predicted peak water levels due to wet basin infilling (1 in 200 year plus sea level rise event)

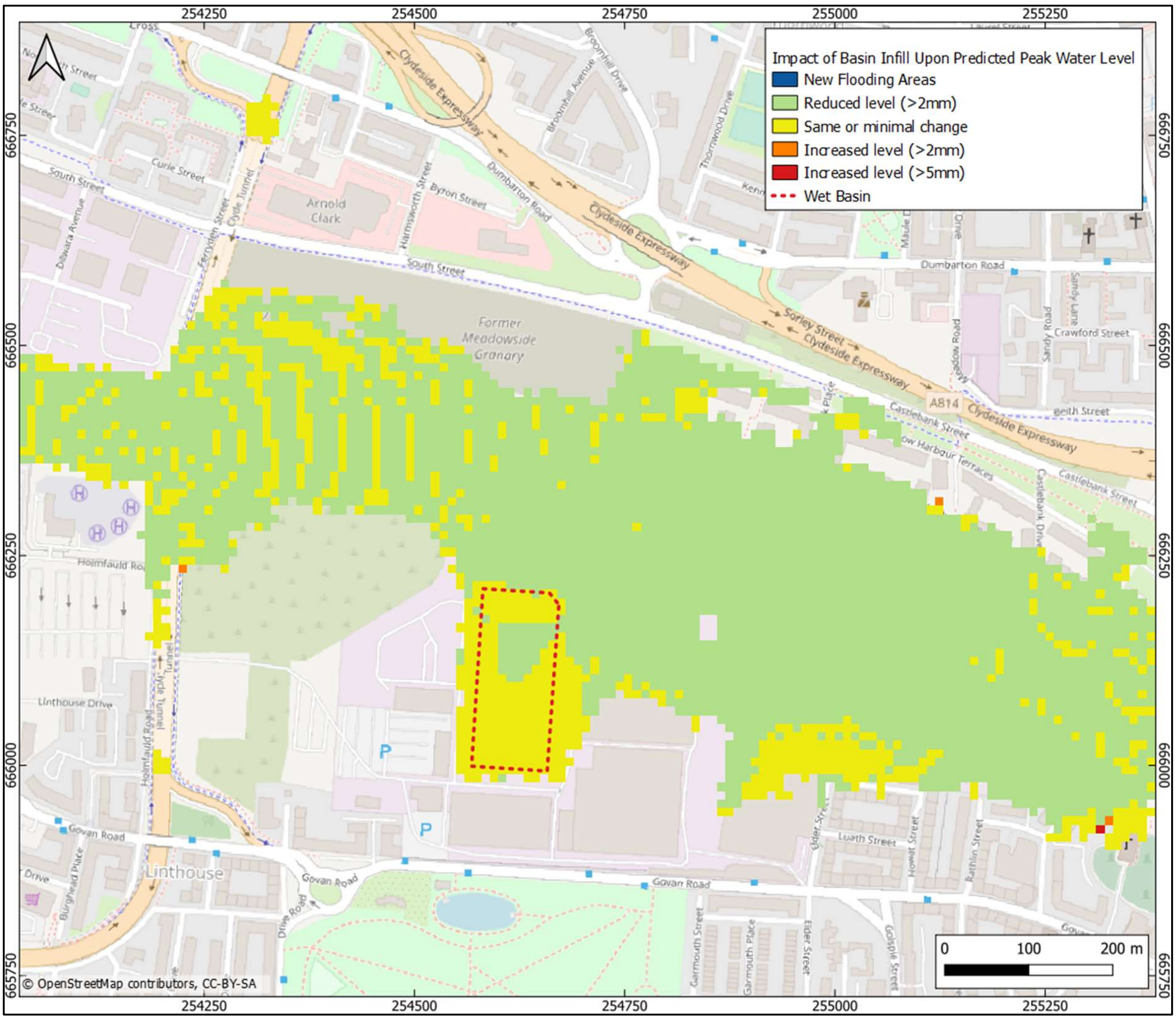

Figure 4.9: Change in predicted peak water levels due to wet basin infilling (1 in 200 year plus climate change event)

4.8 Volume Balance

For all simulations, the volume balance error is less than 0.01% of either cumulative inflow, cumulative outflow or initial volume.

5 FLOOD RISK IMPACT & MANAGEMENT

5.1 Impact of Flood Risk Upon the Site

Table 5.1 provides a summary of flood risk from all sources, inclusive of proposed mitigation and management measures.

Table 5.1: Summary of flood risk

Flood source or mechanism	Risk Classification (with mitigation & management)	Proposed Management Measures
Tidal-Fluvial (Coastal-River)	Medium to High Risk	The infilled basin will be subsequently developed for water compatible usage; flood management measures for this development should be considered separately, accounting for the fact that the combi wall crest level is predicted to provide only marginal protection against flooding of the infilled platform for the 1 in 200 year extreme tidal event; it may be overtopped if there is significant wind coincident with the tidal surge peak, and will be at increased risk of overtopping in the future due to sea level rise associated with climate change.
Surface Water	Low or No Risk	The infilled wet basin will itself be lower than surrounding ground, with the combi wall preventing discharge into the river. In the interim period until the site is fully developed, and while the infill material may have sufficient infiltration to manage this risk, it is recommended that one or more flap valved outfalls should be integrated into the combi wall as a contingency to allow rapid drainage of any surface water flooding (as well as any tidal-fluvial overtopping of the combi wall crest) from the site.
Infrastructure	Low or No Risk	None.
Groundwater	Low or No Risk	None.

5.2 Compliance with Development Management Guidance

5.2.1 Flood Risk Context

This assessment considers infilling of the wet basin only, noting that the platform created by infilling will subsequently be developed for water compatible usage. While the site is predicted to be at medium to high tidal-fluvial flood risk, this usage is appropriate at such a location.

5.2.2 Flood Impacts

Comparison between baseline and post-infilling flood predictions confirms that the proposed wet basin infilling has no detrimental impact upon increasing flood risk elsewhere.

5.2.3 Access and Egress

The site is predicted to be marginally protected against flooding from the 1 in 200 year event (without sea level rise / climate change), although wind action coincident with the flood peak (not accounted for in this prediction) may cause flooding of the site. While flooding may therefore impact access and egress, this is generally acceptable for water compatible usages.

5.2.4 Freeboard

Freeboard provision is not required for water compatible usages. It is nonetheless recommended that subsequent development of the site gives due consideration to predictive uncertainties as well as potential increases to flood levels due to coincident wind action when setting design levels, etc.

5.2.5 Summary

The proposed wet basin infilling is compliant with SEPA's Development Management Guidance on Flood Risk (2018a), and therefore compliant with Scottish Planning Policy in terms of flood risk.

REFERENCES

Fairhurst Ltd (2021). *River Clyde Model Update Technical Report*. (Fairhurst Document Number 129384/G/W/001)

Scottish Government (2014). *Scottish Planning Policy*.

SEPA (2018a). *Development Management Guidance on Flood Risk*. Version 2, LUPS-DM-GU2a.

SEPA (2018b). *Flood Risk and Land Use Vulnerability Guidance*. Version 4, LUPS-GU24.

SEPA (2022a). *Technical Flood Risk Guidance for Stakeholders*. Version 13, June 2022.

SEPA (2022b). *Climate change allowances for flood risk assessment in land use planning.* LUPS-CC1 Version 2, Scottish Environment Protection Agency.

APPENDICES

A ANNUAL EXCEEDANCE PROBABILITY – RETURN PERIOD CONVERSION

Flood Frequency Statistics

The magnitudes of flood flows are typically expressed in terms of their long-term average frequency of recurrence, as ‘return periods’ (e.g. 1 in 200 year flood) or ‘annual exceedance probabilities’ (e.g. 0.5% AEP).

The return period (or recurrence interval) of a flood is the long-term average period between flood conditions of such magnitude (or greater). The annual exceedance probability of particular flood conditions is the chance these conditions (or more severe) occur in any given year.

Relationship between return periods and annual exceedance probability

Return period, T (year)	Annual exceedance probability, AEP (%)	Probability of occurrence over a 50 year period (%)	Comment
2	50	100	Median annual flood (also known as **QMED**). In the long-term this occurs every other year, on average. As a rule of thumb, this flow generally equates to ‘bankfull’ conditions in most natural channels.
5	20	100	
10	10	99	
20	5	92	
30	3.3	82	Typical design standard for urban drainage systems.
50	2	64	
100	1	39	
200	0.5	22	Typical design standard for river or coastal flooding for most developments. Defines “functional floodplain” under Scottish Planning Policy.
500	0.2	10	
1,000	0.1	4.9	Typical design conditions standard for sensitive or vulnerable developments/contexts.

Lifetime Probabilities, or Design Life Probabilities

The probability of a flood event occurring at least once over a set period of time (e.g. an individual’s lifetime or the design life of a built structure) can be evaluated against the following table.

Age, or Design Period (years)	Flood Return period (years)				
	2	10	30	200	1000
10	100%	65%	29%	5%	1%
25	100%	93%	57%	12%	2%
80	100%	100%	93%	33%	8%
100	100%	100%	97%	39%	10%

B SEPA CHECKLIST

Flood Risk Assessment (FRA) Checklist

(SS-NFR-F-001 - Version 16 - Last updated 27/08/2019)

This document must be attached within the front cover of any Flood Risk Assessments issued to Local Planning Authorities (LPA) in support of a development proposal which may be at risk of flooding. The document will take only a few minutes to complete and will assist SEPA in reviewing FRAs, when consulted by LPAs. This document should not be a substitute for a FRA.

Development Proposal Summary

Site Name:		Govan Wet Basin		
Grid Reference:	Easting:	254625	Northing:	666130
Local Authority:		Glasgow City Council		
Planning Reference number (if known):				
Nature of the development:		Other	If residential, state type:	
Size of the development site:			Ha	
Identified Flood Risk:	Source:	Tidal	Source name:	River Clyde

Land Use Planning

Is any of the site within the functional floodplain? (refer to SPP para 255)	No	If yes, what is the net loss of storage?		m^3	
Is the site identified within the local development plan?	No	Local Development Plan Name:	▨	Year of Publication:	▨
		Allocation Number / Reference:	▨		
If yes, what is the proposed use for the site as identified in the local plan?	▨	If Other please specify:	▨		
Does the local development plan and/or any pre-application advice, identify any flood risk issues with or requirements for the site.	Select from List	If so, please specify:	▨		
What is the proposed land use vulnerability?	Water Compatible	Do the proposals represent an increase in land use vulnerability?	No		

Supporting Information

Have clear maps / plans been provided within the FRA (including topographic and flood inundation plans)?	Yes		
Has sufficient supporting information, in line with our Technical Guidance, been provided? For example: site plans, photos, topographic information, structure information and other site specific information.	Yes	*(Within the FRA, other EIA reporting, and in River Clyde Model Update information already held by SEPA/GCC)*	
Has a historic flood search been undertaken?	No	If flood records in vicinity of the site please provide details:	(Site is currently within river)
Is a formal flood prevention scheme present?	No	If known, state the standard of protection offered:	
Current / historical site use:	Dock / wet basin		
Is the site considered vacant or derelict?	No		

Development Requirements

Freeboard on design water level:			m			
Is safe / dry access and egress available?		Neither	*(Water compatible usage)*	Min access/egress level:		m AOD
Design levels:	Ground level:		m AOD	Min FFL:		mAOD

Mitigation

Can development be designed to avoid all areas at risk of flooding?	No
Is mitigation proposed?	Yes
If yes, is compenstory storage necessary?	No
Demonstration of compensatory storage on a "like for like" basis?	No
Should water resistant materials and forms of construction be used?	Yes

Flood Risk Assessment (FRA) Checklist

(SS-NFR-F-001 - Version 16 - Last updated 27/08/2019)

Hydrology

Is there a requirement to consider fluvial flooding?		Yes	***USING UPDATED (TIDAL) RIVER CLYDE MODEL, PREPARED FOR GCC/SEPA BY FAIRHURST***		
Area of catchment:			km^2	Is a map of catchment area included in FRA?	
Estimation method(s) used (please select all that apply):		Pooled Analysis ☐		If Pooled analysis have group details been included?	
		Single Site Analysis ☐			
		Enhanced Single Site ☑	***REFER TO FAIRHURST REPORTING FOR FURTHER DETAILS***		
		ReFH2 ☑			
		FEH RRM ☐			
		Other ☑		If other (please specify methodology used):	
Estimate of 200 year design flood flow:			m^3/s		
Qmed estimate:			m^3/s	Method:	
Statistical Distribution Selected:				Reasons for selection:	

Hydraulics

Hydraulic modelling method:		2D		Software used:	TuFlow
				If other please specify:	
Number of cross sections:		N/A			
Source of data (i.e. topographic survey, LiDAR etc):		LIDAR + Bathymetry		Date obtained / surveyed:	Predominantly 2016-2020
Modelled reach length:			m		
Any changes to default simulation parameters?		None		If yes please provide details:	(No changes relative to Fairhurst model control file)
Model timestep:		(Adaptive)			
Model grid size:		40/20/10m	(Nested grid)		
Any structures within the modelled length?		Combination		Specify, if combination:	Bridges, tidal weir (no changes relative to Fairhurst model)
Maximum observed velocity:			m/s		
Brief summary of sensitivity tests, and range:					
variation on flow (%)		49	%	Please specify climate change scenario considered:	49% (Clyde River Basin)
variation on channel roughness (%)		20	%		
blockage of structure (range of % blocked)		50	%		
boundary conditions:		**Upstream**			**Downstream**
(1) type		Routed fluvial			Tidal
	Specify if other			Specify if other:	
(2) does it influence water levels at the site?		Yes			Yes
Has model been calibrated (gauge data / flood records)?		Yes	(Refer to Fairhurst report)		
Is the hydraulic model available to SEPA?		Yes			
Design flood levels:	200 year	(see Coastal section)	m AOD	200 year plus climate change	m AOD
Cross section results provided?		No	*(No cross-sections)*		
Long section results provided?		No			
Cross section ratings provided?		No	*(No cross-sections)*		
Tabular output provided (i.e. levels, velocities)?		Yes	*(River centre levels in the local reach only; refer to Fairhurst report for full tables)*		
Mass balance error:		<0.01	%		

Coastal

Is there a requirement to consider coastal / tidal flooding?		Yes	***USING UPDATED (TIDAL) RIVER CLYDE MODEL, PREPARED FOR GCC/SEPA BY FAIRHURST***		
Estimate of 200 year design flood level:		4.85	m AOD		
Estimation method(s) used:		Other		If other please specify methodology used:	Updated (Tidal) River Clyde Model
Allowance for climate change (m):		0.85	m		
Allowance for wave action etc (m):		N/A	m		
Overall design flood level:		5.56	m AOD		

Comments

Any additional comments:	Hydrology and hydraulics maintained from Updated (Tidal) River Clyde Model, prepared by Fairhurst for GCC and SEPA, and purchased for this project. It is reasonably assumed that detailed model build and output information is not required for this reviewed model.
Approved by:	**Dr Iain Struthers**
Organisation:	**EnviroCentre Ltd**
Date:	**26/07/2022**

Note: Further details and guidance is provided in 'Technical Flood Risk Guidance for Stakeholders' which can be accesssed here:- CLICK HERE

Technical Appendix 5-2_Water Framework Directive Assessment

Govan Wet Basin Infill
Water Framework Directive Assessment

July 2022

Govan Wet Basin Infill
Water Framework Directive Assessment

Client: Arch Henderson

Document number: 10197
Project number: 175756
Status: Final

Author: Graeme Duff
Reviewer: Campbell Stewart

Date of issue: 27 July 2022
Filename: WFD Assessment

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This report has been prepared by EnviroCentre Limited with all reasonable skill and care, within the terms of the Contract with Arch Henderson ("the Client"). The report is confidential to the Client, and EnviroCentre Limited accepts no responsibility of whatever nature to third parties to whom this report may be made known.

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VAT no. GB 348 6770 57.

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1 INTRODUCTION

1.1 Terms of Reference

EnviroCentre Ltd has been appointed by Arch Henderson on behalf of BAE Systems Ltd to produce a Water Framework Directive(WFD) Assessment in relation to the proposals to infill the wet basin at Govan Shipyard and Maintenance Facility (Govan shipyard) (Refer to Drawing No 175756-GIS001 provided in Appendix A).

The following report details the assessment and its findings.

1.2 Report Usage

The information and recommendations contained within this report have been prepared in the specific context stated above and should not be utilised in any other context without prior written permission from EnviroCentre.

If this report is to be submitted for regulatory approval more than 12 months following the report date, it is recommended that it is referred to EnviroCentre for review to ensure that any relevant changes in data, best practice, guidance or legislation in the intervening period are integrated into an updated version of the report.

EnviroCentre accepts no liability for use of the report for purposes other than those for which it was originally provided, or where EnviroCentre has confirmed it is appropriate for the new context.

2 WATER FRAMEWORK DIRECTIVE

The Water Framework Directive (WFD) arose from the European Community (EC)'s Water Framework Directive (WFD) becoming law in Scotland as the Water Environment and Water Services (Scotland) Act 2003 (WEWS Act) and further implemented through Water Environment (Controlled Activities) (Scotland) Regulations 2011 – more commonly known as the Controlled Activity Regulations (CAR) – and their further amendments of 2013 and 2017.

These apply regulatory controls over activities which may affect Scotland's water environment.

The regulations cover rivers, lochs, transitional waters (estuaries), coastal waters groundwater, and groundwater dependant wetlands.

The main aims of the Water Framework Directive (WFD) are to:

- prevent deterioration and enhance status of aquatic ecosystems, including groundwater;
- promote sustainable water use;
- reduce pollution;
- contribute to the mitigation of floods and droughts.

The WFD aim is for all water bodies to be at good status. Consideration of the WFD requirements is considered necessary for developments which may result in:

- cause or contribute to deterioration of status;
- jeopardise the water body achieving good status.

In the absence of guidance in Scotland in relation to WFD assessment the Environment Agency's *Clearing the Water For All*[1] guidance has been adopted for the process of this assessment.

The assessment incorporates 3 stages:

- Screening – Allows for exclusion of any activities that do not need to go through the scoping or impact assessment stages;
- Scoping – identifies the receptors that are potentially at risk from the activity and need for impact assessment;
- Impact assessment – considers the potential impacts of the activity, identifies ways to avoid or minimise impacts, and shows if the activity may cause deterioration or jeopardise the water body achieving good status.

The following report details the findings of the noted assessment stages.

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[1] https://www.gov.uk/guidance/water-framework-directive-assessment-estuarine-and-coastal-waters

3 SCREENING

The following activities are identified as activities that do no require to progress to scoping stage:

- a self-service marine licence activity or an accelerated marine licence activity that meets specific conditions;
- maintaining pumps at pumping stations – if you do it regularly, avoid low dissolved oxygen levels during maintenance and minimise silt movement when restarting the pumps;
- removing blockages or obstacles like litter or debris within 10m of an existing structure to maintain flow;
- replacing or removing existing pipes, cables or services crossing over a water body – but not including any new structure or supports, or new bed or bank reinforcement;
- ‘over water’ replacement or repairs to, for example bridge, pier and jetty surfaces – if you minimise bank or bed disturbance.

It is considered that the wet basin infill works does not fall under these noted categories and therefore requires to be further assessed under the Scoping Stage.

4 SCOPING

On the basis of the location of the proposed works at Govan Wet Basin the following potential key receptor has been identified:

Surface Water

- Clyde Estuary - Inner (inc Cart).

Groundwater assessment is not considered a requirement in relation to the marine infilling works.

Table 4-1 provides a summary of relevant data for the Clyde Estuary Inner (inc Cart):

Table 4-1 Summary of Water Body Information[2]

Parameter	Description
Water Body Name	Clyde Estuary – Inner (Inc Cart)
Water Body ID	200510
Water Body Type	Transitional
Water Body Total Area	4.4 km^2
Overall Water Body Status	Moderate (2020)
Ecological Status	Poor (2020)
Chemical Status	Poor (2020)
Hydromorphological Status	Poor - The water body has been designated as a heavily modified water body on account of physical alterations that cannot be addressed without a significant impact on navigation and from an increased risk of subsidence or flooding.
Other Parameters Rated at Good Status	Biological Elements, Fish, Copper and Unionised Ammonia
Other Parameters Rated Below Good Status	Dissolved Inorganic Nitrogen, Chromium, Morphology

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[2] https://www.sepa.org.uk/data-visualisation/water-environment-hub/

The scoping stage identification of activity's potential risks to each receptor within the identified water bodies that may be impacted. The receptors to be considered are:

- hydromorphology;
- biology – habitats;
- biology – fish;
- water quality;
- protected areas.

The following section details the findings of the Scoping Stage.

4.1 Hydromorphology

Hydromorphology is the physical characteristics of estuaries and coasts. It includes the size, shape and structure of the water body, and the flow and quantity of water and sediment.

The following table summarises the key considerations at scoping stage with respect to potential for impact to hydromorphology associated with the development.

Table 4-2 Hydromorphology Scoping Assessment

Consider if the activity	Yes	No	Hydromorphology Risk Issue
Could impact on the hydromorphology (for example morphology or tidal patterns) of a water body at high status		No, Clyde Inner Estuary is rated as Poor for hydromorphology	No
Could significantly impact the hydromorphology of any water body	There is potential in change to localised hydromorphology		To be further assessed
Is in a water body that is heavily modified for the same use as your activity	Yes, the water body is heavily modified, the proposed use is related to an existing harbour facility		To be further assessed

As noted above, the potential for impact to the hydromorphology will be taken further for discussion in the Impact Assessment section,

4.2 Biology

4.2.1 Habitat

At the initial stage of the assessment there is a requirement for consideration of presence of high risk habitats within the receiving water. High risk habitats include:

- chalk reef
- clam, cockle and oyster beds
- intertidal seagrass
- maerl
- mussel beds, including blue and horse mussel
- polychaete reef
- saltmarsh
- subtidal kelp beds
- subtidal seagrass

In addition, the assessment considers potential for impact to lower sensitivity habitats which include:

- cobbles, gravel and shingle
- rocky shore
- subtidal boulder fields
- subtidal rocky reef
- subtidal soft sediments like sand and mud

The following table summarises the findings of the scoping assessment.

Table 4-3 Biology - Habitat Scoping Summary

Consider if the footprint of your activity is	Yes	No	Biology Habitats Risk Issue
0.5km^2 or higher		No, the area of the basin is 4.57 Ha (0.0045km^2)	No
1% or more of the water body's area		No the area of the basin is 0.0045 km^2 (the Clyde Estuary – Inner is 4.4 km^2)	No
Within 500m of any higher sensitivity habitat		Whilst the wider Clyde Estuary – Inner does incorporate areas that would be deemed higher sensitivity habitats none are considered to be within 500m of the wet basin (see Figure 1 below)	No

1% or more of any lower sensitivity habitat		On the basis of the overall Clyde Estuary predominantly representing an area of lower sensitivity the wet basin (and any potential associated sediment plumes from the works) is considered to be less than 1% in area	No

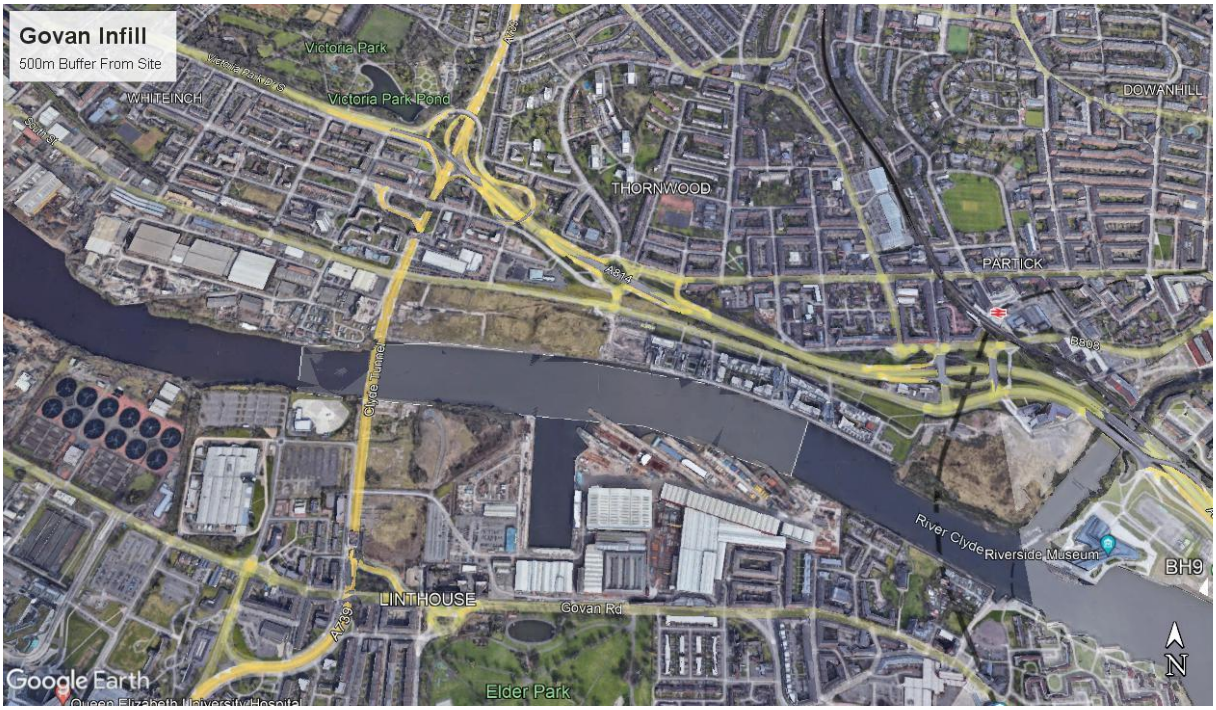

Figure 4-1 500m Buffer From Wet Basin Infill

Figure 4-1 shows an approximate 500m buffer along the Clyde Estuary Inner (upstream and downstream) from the Wet Basin. Both sides of the Clyde in this area are heavily modified incorporating the existing Govan BAE shipyard, derelict land and housing. There are no identified highly sensitive habitats considered to be associated with this section of the Clyde Estuary.

On the basis of the scoping assessment it is considered that the proposed development works do not represent a significant risk of impact to Biology-Habitat.

4.2.2 Fish

The Clyde catchment supports 33 species of freshwater fish and valuable fisheries for Atlantic salmon, sea trout, resident brown trout, grayling (an introduced species) and ‘coarse’ species (those types of freshwater fish other than game fish). A number of scientifically important and endangered species are also present (sea lamprey, river lamprey, brook lamprey and European eel). Those recorded in the River Clyde include: river lamprey, European eel, barbel (non-native; the River Clyde catchment represents the most northerly population in the world), common minnow, three-spined stickleback, stone loach, Atlantic salmon, brown trout/sea trout and grayling.

The following table summarises the scoping assessment in relation to the potential for risk to fish associated with the proposed development.

Table 4-4 Biology -Fish Scoping Summary

Consider if the activity	Yes	No	Biology Fish Risk Issue
Is in an estuary and could affect fish in the estuary, outside the estuary but could delay or prevent fish entering it or could affect fish migrating through the estuary	Yes, the site form part of the Clyde Estuary – Inner		See next question
Could impact on normal fish behaviour like movement, migration or spawning (for example creating a physical barrier, noise, chemical change or a change in depth or flow)	Yes, the basin infill itself will result in impact and there is potential for associated short term impact to water quality during the infill works		Take forward to impact assessment
Could cause entrainment or impingement of fish	Yes, the basin infill could result in entrainment of fish		Take forward to impact assessment

Following completion of Biology scoping assessment, Biology-Habitat has not been identified for further impact assessment on the basis of the current site location and surrounding habitat type. Biology-Fish has been identified for further impact assessment.

4.3 Water Quality

4.3.1 Phytoplankton Status and Harmful Algae

The following table details the summary with respect to Water Quality- Phytoplankton risks.

Table 4-5 Water Quality - Phytoplankton Scoping Summary

Consider if the activity	Yes	No	Water Quality Risk Issue
Could affect water clarity, temperature, salinity, oxygen levels, nutrients or microbial patterns continuously for longer than a spring neap tidal cycle (about 14 days)	Yes, the works has potential to impact on water clarity and oxygen level in relation to potential for release of suspended solids during the infill works. These works will carry on beyond 14 days		To be taken forward to impact assessment
Is in a water body with a phytoplankton status of moderate, poor or bad		No, phytoplankton not assessed	No impact assessment required
Is in a water body with a history of harmful algae		No, no known history of harmful algae	No impact assessment required

4.3.2 Water Quality Impact Through Chemical Release

For the purposes of the scoping assessment in relation to potential for chemical release existing information on the sediment quality within the Govan Wet Basin has been reviewed,

Sediment cores were recovered from the Govan Wet Basin and tested for the Marine Scotland Suite to assess suitability with respect to disposal at sea. A copy of the analytical results for these two cores are provided in Appendix B. The results sheet identify that this historic sediment within the basin exceeded Marine Scotland Action Level 1 concentrations for a range of contaminants including heavy metals, poly aromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs). It is noted that this material has since been dredged and disposed of, however on the basis of conservative assessment itis assumed that current sediment within the basin may also have chemicals of concern present.

The table below summarises the scoping assessment.

Table 4-6 Water Quality - Chemical Impact Summary Scope

If your activity uses or releases chemicals (for example through sediment disturbance or building works) consider if:	Yes	No	Water Quality Risk Issue
The chemicals are on the Environmental Quality Standards Directive (EQSD) list	The exact source of infill material is not known at stage of assessment. The historic sediment testing within the basin confirmed that sediment contains chemicals of the EQSD list.		Taken forward to impact assessment
It disturbs sediment with contaminants above Marine Scotland Action Level 1	As noted above, sediment within the basin has historically been identified as containing chemical concentrations which exceed Marine Scotland Action Level 1.		Taken forward to impact assessment

Following scoping review in relation to risks from water quality impact various elements have been taken forward to impact assessment.

4.4 WFD Protected Areas

Designated sites of note are described in Table 4-7.

Table 4-7 Statutory Designated Sites

Site Name	Designation	Distance & Orientation at Closest Point	Reason for Designation	Level of Importance
Internationally Designated Sites within 10km of the site boundary				
Black Cart	SPA	6.2km west	Non-breeding whooper swan (*Cygnus cygnus*)	International
Inner Clyde	Ramsar	6.4km northwest	Non-breeding redshank (*Tringa totanus*)	International
Inner Clyde	SPA	6.4km northwest	Non-breeding redshank	International
Nationally designated sites within 5km of the site boundary				
Possil Marsh	SSSI	5.0km north	Mesotrophic loch	National
Locally designated sites within 5km of the site boundary				
Dawsholm	LNR	3.0km north	Plantation woodland and the associated populations of birds	Local

*SAC (Special Area of Conservation); SSSI (Site of special Scientific Interest); NNR (National Nature Reserve).

The following table summarises the findings of the Protected Area scoping assessment.

Table 4-8 Protected Area Scoping Summary

Consider if your activity is:	Yes	No	WFD Protected Area Risk Issue
Within 2km of any WFD protected area		No statutorily designated sites within 2km of the wet basin	No impact assessment required

4.5 Invasive Non-Native Species (INNS)

Risks of introducing or spreading INNS include:

- materials or equipment that have come from, had use in or travelled through other water bodies
- activities that help spread existing INNS, either within the immediate water body or other water bodies

The following table summarises the scoping assessment in relation to INNS.

Table 4-9 INNS Scoping Summary

Consider if your activity could:	Yes	No	WFD Protected Area Risk Issue
Introduce or spread INN	The site works will incorporate the use of a dredger which may have mobilised through other water bodies. There is potential for reuse of dredge arisings from elsewhere within the Clyde Estuary within the basin infilling,		Taken forward to impact assessment

4.6 Summary

The following table summarises the findings of the scoping assessment.

Table 4-10 Scoping Summary Table

Receptor	Potential Risk To Receptor	Risk Identified
Hydromorphology	Yes	The development works could impact on water hydromorphology and is located in an area that is already heavily modified for similar use
Biology- Habitats	No	
Biology-Fish	Yes	There is potential for impact to fish associated with chemical change in the water body and entrainment of fish during the basin infill stage of the works.
Water Quality	Yes	There is potential for impact to water clarity and dissolved oxygen that may extend over a 14 week period. There is potential for impact to chemical quality associated with use of materials to infill the basin and disturbance of the existing sediment.
Protected Areas	No	

INNS	Yes	There is potential for spread of INNS associated with mobilisation of plant coming from other water bodies and potential for spread of INNS from elsewhere in the Clyde Estuary associated with reuse of dredge arisings to infill the basin.

5 IMPACT ASSESSMENT

5.1 Hydromorphology

The local reach of the River Clyde is classified by SEPA as a transitional water (Clyde Estuary – Inner; ID: 200510) and is tidally influenced. The reach is designated as a heavily modified water body on account of physical alterations that cannot be addressed without a significant impact on navigation and from an increased risk of subsidence or flooding. It is classified as having poor hydromorphology rating.

The banks of the River Clyde in the vicinity of the project site are heavily engineered, with dock and quay structures present on either bank and the channel is disconnected from surrounding floodplains. The navigation channel is subject to routine dredging to maintain depth of water for shipping. A number of weir and bridge structures are present, further impacting sediment transport processes. The site is currently located in an active ship building facility.

It is considered on the basis of the current site use and its surrounds that the proposed infilling of the wet basin will not lead to further deterioration in the hydromorphological status of the Clyde Estuary – Inner (Inc Cart). It is also not considered to result in an impact that would prevent the water body from meeting these objectives in the future.

5.2 Biology Fish

The Clyde Estuary -Inner (inc Cart) is currently classified as Good in relation to fish.

The proposed development works has potential to impact fish both in relation to impact to water quality from release of suspended sediment (including potentially contaminated sediment) during the infilling works, and entrainment of fish during the basin infill.

A Marine Mammal and Fish Risk Assessment has been developed for the project and is provided in Appendix C. The assessment reviewed risks related to underwater noise, suspended sediment release and entrainment once the basin is isolated from the main stem of the river.

An underwater noise risk assessment concluded that the risk to fish was very low from the proposed development works.

The risk assessment did identify potential for impact in relation to release of suspended sediment and entrainment, The following mitigation measures were identified with respect to protection of fish.

- Fish rescues and translocations will take place at the outset of construction to reduce fish mortality. This will commence following installation of a silt curtain/bubble screen or barrier across the wet basin to prevent fish re-entering the wet basin infill area.
- A Fish Rescue Method Statement will be agreed in advance with the relevant Statutory Nature Conservation Bodies (SNCBs) to target fish species which may inhabit the basin.
- The presence of the silt curtain/bubble screen or barrier will also restrict the potential for release of suspended sediment outwith the construction area.

It is considered that implementation of the identified mitigation measures will ensure that the development does not result in a deterioration of the Good status of the Clyde Estuary Inner (Inc Cart). Following completion of the site works the development is not considered to pose a risk that will impact the water body from retaining the classification of Good going forward.

5.3 Water Quality

The construction phase for the basin infill will incorporate placement of imported materials (potentially incorporating dredge arisings from other areas of the Clyde Estuary) directly onto the existing sediment within the basin. During these works there is therefore potential for an increase in suspended solids in the basin and immediate surrounds related to release from both the infill material and potential for disturbance of the existing sediment.

An increase in suspended solids within the water column can have the potential to decrease dissolved oxygen concentrations, primarily if the suspended material is rich in organic material which is likely to be the case for the existing sediment. The Clyde Estuary – Inner (Inc Cart) is currently classified as Moderate with respect to dissolved oxygen.

As noted previously, historic sampling of the wet basin has identified concentrations of contaminants that exceed Marine Scotland Action Level 1. The parameters of concern included heavy metals, PAHs and PCBs. The key contaminants with potential to impact water quality are considered to be metals as these have the potential to dissolve/desorb from sorption sites, whereas the organic contaminants (PAHs and PCBs) have a greater affinity for the organic materials which they are bound to, and are more likely to remain strongly bound to the sediment, or if they become dissolved, quickly adsorbed onto organic matter. With respect to the contaminants of concern there are limited existing WFD classifications with the exception of Copper (currently rated as Good) and Chromium (currently rated as Fail). The historic sediment results indicate that both copper and chromjum exceed Action Level 1 within the sediment.

As noted in the Impact Assessment for fish, the proposed construction works will incorporate mitigation measures to restrict the release of suspended solids during the infilling works. This will incorporate installation of a silt curtain, bubble screen or barrier at the outset of the works which will be present during the infilling exercise. These barriers will result in restricting the potential for release of suspended sediment outwith the infill area (should a bubble screen be adopted then there will also be an increase in dissolved oxygen in the water column).

Based on the implementation of the mitigation measures it is considered that the infilling of the wet basin will not result in deterioration of the Clyde Estuary – Inner with respect to Water Quality. Once the basin infill is completed the development will not have any future impact on Water Quality that would impact on the Clyde Estuary – Inner meeting the WFD targets.

5.4 Invasive Non Native Species

The Clyde Estuary – Inner (Inc Cart) was recorded as having a High classification in relation to freedom from invasive species in 2014 and 2021. Other areas of the Clyde Estuary are known to have been impacted by INNS historically, the Firth of Clyde Forum developed a Biosecurity Plan[3] in 2012-2016 identifying existing and potential INNS issues to be considered going forward. At the time of the report the carpet sea squirt *Didemnum vexillum* was identified as a high environmental risk within the Clyde Estuary.

The works will incorporate use of a dredge vessel that may have been mobilised from other water bodies. The Clyde is regularly dredged for maintenance requirements and as such the risks related to the wet basin infill are not considered to be different to current routine operation within the river.

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[3] Firth of Clyde Forum Biosecurity Plan 2012-2016

Adoption of best practice in line with existing Biosecurity Plans and guidance and appropriate equipment maintenance would result in the risk from INNS introduction to be low.

The works may involve dredging from one area of the Clyde Estuary with the material subsequently forming part of the infill material for the basin. As such there is potential for transfer of benthic INNS from one area of the Clyde to the basin. Given that during the basin infill a silt curtain, bubble screen or barrier will be present to isolate the basin from the river (primarily to restrict release of suspended sediment and entrance of fish into the basin) then any INNS that may be transferred will be entrained within the basin during the infill operation.

The wet basin infill is therefore not considered to result in a deterioration with respect to INNS, and following completion of the project it is not considered to represent a future risk to the water body for meeting its WFD targets.

6 CONCLUSION

The development work at the BAE Govan site incorporating infilling of the existing wet basin has been assessed with respect to potential for impact on WFD parameters. The assessment has concluded that the proposed works will not have any significant impact to the Clyde Estuary – Inner (Inc Cart) which would result in a deterioration of its current condition as long as proposed mitigation measures are adopted during the works. Following the development completion, it is also not considered to represent a risk to the water body from achieving WFD targets in the future.

7 REFERENCES

Environment Agency (July 2022) Clearing the Waters for All - https://www.gov.uk/guidance/water-framework-directive-assessment-estuarine-and-coastal-waters

Firth of Clyde Forum Biosecurity Plan 2012-2016

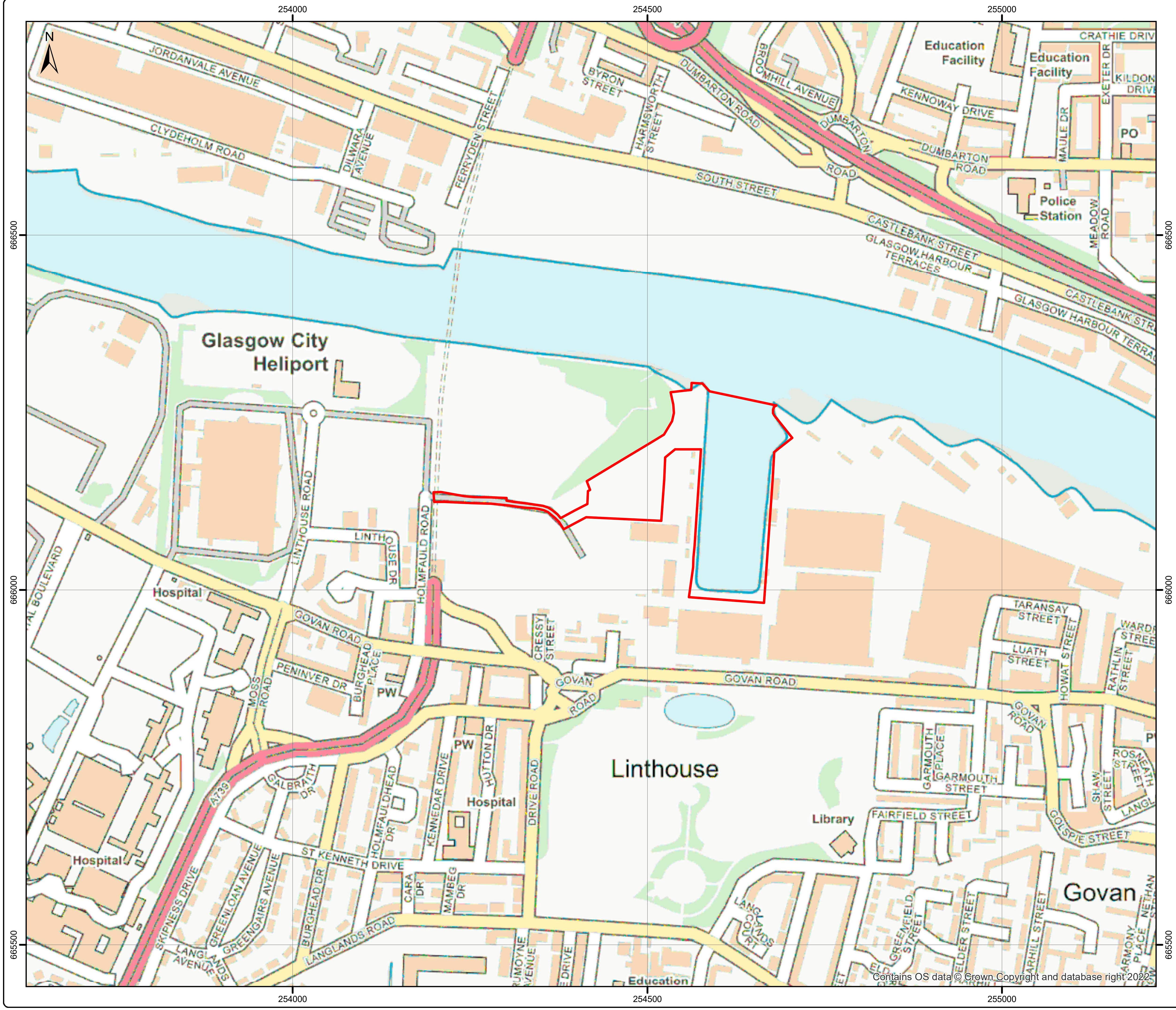
SEPA Water Environment Hub (July 2022) https://www.sepa.org.uk/data-visualisation/water-environment-hub/

Marine Scotland Pre-disposal Sampling Guidance Version 2 – November 2017

Marine Scotland Information Hub (July 2022) https://marine.gov.scot/

APPENDICES

A FIGURES



Legend

🟥 Site Boundary

Do not scale this map

Client
Arch Henderson

Project
Govan Facilities Investment

Title
Site Location Plan

Status
Final

Drawing No.	Revision	Date
175756-GIS001	-	18 May 2022
Drawn	**Checked**	**Approved**
AH	GD	GD

Scale
1:5,000 @A3

0 25 50 100 150 Metres

Rev	Date	Amendment	Initials

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B HISTORIC SEDIMENT SAMPLE RESULTS

Summary Table - Govan

	AL1	AL2	BAC	<ERL	ISQG/TEL	PEL	SS4 0-0.5	SS4-0.5-1.0	SS5 0-0.5	SS5 1.25-1.75	SS5 2.0-2.5	Average	No. Exceed Al1?	No. Exceed Al 2?	No.Exceed BAC?	No. Exceed ERL	No. Exceed PEL?
Source			**CSEMP**	**CSEMP**	**Canada**												
Arsenic	20	70	25	-	7.2	41.6	4	3.2	14.5	14.9	16.2	10.6	0	0	0	N/A	0
Cadmium	0.4	4	0.31	1.2	0.7	4.2	0.17	0.09	1.23	1.42	1.12	0.8	5	0	5	2	0
Chromium	50	370	81	81	52.3	160	24	18.5	161.8	202.7	165.9	114.6	5	0	4	4	**3**
Copper	30	300	27	34	18.7	108	21.2	17.1	103	125.4	100.5	73.4	5	0	5	5	1
Mercury	0.25	1.5	0.07	0.15	0.13	0.7	0.06	<0.015	0.65	0.61	0.65	0.5	3	0	5	5	0
Nickel	30	150	36	-	-	-	18.2	17.7	40.8	44.5	38.4	31.9	3	0	3	N/A	-
Lead	50	400	38	47	30.2	112	19.4	8.4	176.4	193.5	201.3	119.8	5	0	5	3	**3**
Zinc	130	600	122	150	124	271	48.3	34.9	392.9	446	379.9	260.4	5	0	5	5	**3**
Napthalene	0.1		0.08	0.16	-	0.319	0.19	0.00	0.25	0.37	2.42	0.6	5	-	5	5	2
Acenaphthylene	0.1		-	-	0.00587	0.128	<0.02	<0.001	0.05	0.11	0.06	0.1	2	-	-	-	1
Acenaphthene	0.1		-	-	0.00671	0.0889	0.28	0.01	0.17	0.52	0.87	0.4	5	-	-	-	5
Fluorene	0.1		-	-	0.0212	0.144	0.20	<0.001	0.24	0.52	1.10	0.5	5	-	-	-	5
Phenanthrene	0.1		0.032	0.24	0.0867	0.544	0.37	0.00	0.73	1.48	2.22	1.0	6	-	6	6	4
Anthracene	0.1		0.05	0.085	0.0469	0.245	0.14	<0.001	0.28	0.51	0.87	0.4	5	-	6	5	4
Fluoranthene	0.1		0.039	0.6	0.113	1.494	0.66	0.0014	1.45	2.73	2.06	1.4	6	-	6	6	2
Pyrene	0.1		0.024	0.665	0.153	1.398	0.62	0.0020	1.40	2.45	1.98	1.3	6	-	7	4	3
Benzo(a)anthracene	0.1		0.016	0.261	0.0748	0.693	0.35	0.0013	0.78	1.45	0.94	0.7	6	-	6	5	3
Chrysene	0.1		0.02	0.384	0.108	0.846	0.42	0.0025	0.86	1.62	1.00	0.8	6	-	6	0	3
Benzo(b)fluoranthene	0.1				-	-	0.36	0.0023	0.93	1.55	0.87	0.7	6	-	-	-	-
Benzo(k)fluoranthene	0.1				-	-	0.23	<0.001	0.37	0.71	0.38	0.4	5	-	-	-	-
Benzo(a)pyrene	0.1		0.03	0.384	0.0888	0.763	0.37	0.001	0.88	1.71	0.94	0.8	6	-	6	3	3
Indeno(1,2,3cd)pyrene	0.1		0.103	0.24	-	-	0.25	<0.001	0.61	1.22	0.61	0.7	5	-	5	4	-
Benzo(ghi)perylene	0.1		0.08	0.085	-	-	0.28	0.003	0.69	1.27	0.68	0.6	5	-	5	33	-
Dibenzo(a,h)anthracene	0.01				0.00622	0.135	0.05	<0.001	0.12	0.25	0.12	0.1	3	-	-	-	1
					-	-								-	-	-	-
PCBs (Total)	0.02	0.18			0.0215	0.189	0.001	0.001	0.928	0.175	0.080	0.24	4	0	-	-	2
TBT	0.1	0.5			-	-	<0.005	<0.005	0.01	<0.005	<0.005	0.01	0	0	-	-	-
Units mg/kg												0.31	0.15				

C MARINE MAMMAL AND FISH RISK ASSESSMENT

BAE Govan
Wet Basin Infill EPS and Fish Risk Assessment

July 2022

BAE Govan
Wet Basin Infill EPS and Fish Risk Assessment

Client: Arch Henderson

Document number: 10124
Project number: 175756
Status: Final

Author: Graeme Duff
Reviewer: Campbell Stewart

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1 INTRODUCTION

EnviroCentre were contracted to produce a European Protected Species (EPS) and Fish Risk Assessment document in relation to the proposed infill of the wet basin located in the BAE Govan facility. A site location plan and design drawings for the infill are provided in Appendix A.

This risk assessment has been produced in line with the Chapter 2 of Marine Scotland's The protection of Marine European Protected Species from injury and disturbance Guidance for Scottish Inshore Waters (July 2020).

1.1 Report Usage

The information and recommendations contained within this report have been prepared in the specific context stated above and should not be utilised in any other context without prior written permission from EnviroCentre.

If this report is to be submitted for regulatory approval more than 12 months following the report date, it is recommended that it is referred to EnviroCentre for review to ensure that any relevant changes in data, best practice, guidance or legislation in the intervening period are integrated into an updated version of the report.

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2 BASELINE INFORMATION

2.1.1 Marine Mammals

The site lies approximately 50km upstream of the Firth of Clyde, a marine environment known to support cetaceans and pinnipeds. Though cetaceans and pinnipeds are recorded to navigate the River Clyde with historic records of common dolphin (Delphinus delphis), white-beaked dolphin (Lagenorhynchus albirostris), and harbour seal (Phoca vitulinav) and a recent record of grey seal (Halichoerus grypus) all identified within the desk study within 2km of the site.

As there is no physical barrier between the wet basin on site and the River Clyde, there is potential for aquatic and semi-aquatic mammals to utilise the site for foraging and commuting purposes.

All cetaceans found in Scottish territorial waters on the on the Scottish Biodiversity List, and all are protected under the Conservation (Natural Habitats) Regulations 1994 (as amended in Scotland) against damage destruction to breeding or rest sites, harm and disturbance to individuals.

Whilst in Scottish waters, seals are protected under the Marine (Scotland) Act 2010 from intentional or reckless killing / injury, they are also protected from disturbance at significant haul-out sites under the Protection of Seal (Designation of Haul-out Sites) (Scotland) Order 2014. Common seal are also on the Scottish Biodiversity List.

Aquatic and semi-aquatic mammals are considered be of up to International importance. However, the value of the site to support cetaceans and pinnipeds is local. With respect to EPS the Firth of Clyde area is populated by both resident and visiting cetaceans. The most common species in the River Clyde area is considered to the harbour porpoise, however there is also one solitary common dolphin . Sightings of them as far upstream as Govan are considered rare.

Table 2-1 below details the furthest recorded upstream sightings of cetaceans in the River Clyde. It is noted that the majority of the sightings are downstream of the Govan area, principally in the Greenock and Erskine Bridge section of the River.

Table 2-1 EPS Sightings in Clyde

Date		Common Name	Scientific Name	Location Sighted	Passed Govan
Oct 2020		Bottlenose Whale	Hyperoodon ampullatus	Glasgow Harbour Area (Partick)	Yes
Feb 2011/July 2021		Harbour Porpoise	Phocoena phocoena	Tidal weir at Glasgow Green	Yes
August 2020		Bottlenose Dolphin	Tursiops truncatus	Off Greenock Esplanade	No
April 2018		Killer Whale	Orcinus orca	Erskine Bridge	No

2018		Short-beaked Common Dolphin	Delphinus delphis	Between Fairlie and Cumbrae	No

Only two EPS species were recorded in an area of the river beyond Govan. They include a record of a single harbour porpoise trapped at the weir at Glasgow Green in 2011.

In 2020 a pod of bottlenose whales were recorded as far up the Clyde as Glasgow Harbour. Given that these species feed on deep dwelling prey their presence was considered an anomaly as a result of disorientation. Unfortunately, 2 of the pod became stranded and perished which indicates the unsuitability of this portion of the River Clyde for this species. Bottlenose whales are therefore not considered a significant species in relation to the general baseline of the Govan area.

Given the urban nature of the upper stretches of the River Clyde it is considered that the presence of EPS within the river would generally be recorded, with the aforementioned sightings being reported in the national press.

On the basis of the available information it is considered that there is unlikely to be a significant presence of EPS within the proposed development area however on a precautionary basis there may be a low potential for presence of transitory/disoriented harbour porpoise and as such further assessment of risk to this species is considered.

The available information for harbour porpoise indicates that the frequency of occurrence in this area of the River Clyde is rare, on this basis there is no clear seasonality or spatial pattern in relation to their presence. It is considered that the most likely reason for the presence of EPS in the shallow and narrow upper stretches of the River Clyde is due to prey movement and/or loss of orientation.

2.1.2 Fish

The nearest Special Area of Conservation (SAC) designated for fish species (Atlantic salmon, brook lamprey and river lamprey) is the River Endrick, which discharges via the River Leven approximately 20km downstream within the Clyde estuary.

Desk study has identified European eel (*Anguilla Anguilla*), Atlantic salmon (*Salmo salar*), grayling (*Thymallus thymallus*), brown trout (Salmo trutta), brook lamprey (*Lampetra planeri*), sea lamprey (*Petromyzon marinus),* river lamprey (*Lampetra fluviatilis*), Smelt (*Osmerus eperlanus*), common minnow (*Phoxinus phoxinus*), stone loach (*Barbatula barbatula*), and three-spined stickleback (*Gasterosteus Aculaeatus)* within the River Clyde. In addition, the Marine Scotland National Marine Plan Interactive Map highlights the River Clyde as a salmonid river .

Atlantic salmon, brown (sea) trout, European eel, river lamprey and sea lamprey will all be present in the area with different life stages and species are likely to be present at different times of year and possibly at different states of the tide, etc.

The wet basin provides opportunities for migrating spawning fish, though due to the heavy modification of the river spawning habitat is likely to be limited.

Atlantic salmon, smelt, sea trout, brown trout, Arctic charr, brook lamprey, river lamprey, sea lamprey and eel are all listed as priority species on the SBL. Atlantic salmon and brook lamprey and both also listed on Annex II of the Habitats Directive. Therefore, all species aforementioned are of National (Scotland) importance.

3 DEFINING IMPACTS

It is envisaged that construction works will involve the activities listed below. A visual description of the works is provided in Drawing No 225010-BAE-AHN-ZZ-XX-DR-C-0004.

1. Enabling works including:
    a. Area to west of the site to be cleared of all debris to set up the contractor compound;
    b. Separate contractor access to be created from entrance roadway to allow construction traffic to be segregated from operational shipyard traffic;
2. Deployment of a silt curtain/ bubble curtain or isolating barrier across the wet basin entrance (including a demountable section to allow passage of the barge if required);
3. Initial infill by long reach excavator from a barge which will place a 2 m layer of fill to cover existing sediment on the basin bed;
4. Infilling continuing using a combination of barge and excavators or self-discharging vessels. The infill material will extend beyond the line of the proposed quay wall;
5. Installation of a carrier drain around the existing basin quay wall to collect discharge from existing outfalls and direct to new outfalls protruding through the coffer dam;
6. Hydraulic compaction of infill material below mean sea level and dynamic compaction using rollers above mean sea level;
7. Land based piling through the infill material to create the outer quay wall. The work entails:
    a. Tubular piles being driven/vibrated into deep strata. These piles may need anchored by using a concrete pile toe bored into the rock through the tubular pile section;
    b. Sheet piles installed between the steel tubular piles. Sheet piles expected to be driven to shallower depths than the tubular piles;
    c. Reinforced concrete capping beam is installed to complete the quay wall.
8. Existing quayside at tie locations will be broken out and new tie ins installed between existing quay and the new cofferdam;
9. Basin infill taken up to design level by barged material placed over the new cofferdam and pushed into place by dozers;
10. Fill in front of cofferdam wall removed and berth pocket dredged to current maintenance dredge level.

It is anticipated that construction works will take a total of circa 34 weeks. Within this period piling to create the outer quay wall is estimated to last circa 14 weeks.

The majority of the above activities are considered to be similar in nature to typical activity in the River Clyde, incorporating the use of vessels and dredging activity. These are not considered any different to activities such as the regular maintenance dredging on the river to maintain the navigation channel or berthing. Given that as noted in the previous section that presence of harbour porpoise in the Govan area is rare (i.e. it is not an important area of porpoise/cetacean/marine mammal activity) the majority of the works are not considered to represent a significant risk of impact to the receptor.

3.1 Likelihood of Potential Impact to Harbour Porpoise and Fish

3.1.1 Impact from Underwater Noise

The piling works required as part of the basin infill are identified as a potential source of anthropogenic sound. It should be noted that the approach to construction incorporates the piles being driven through the infill material (i.e. the surface water will not be in direct contact with the piles during installation). As such the infill material itself is considered to provide a degree of sound absorption.

An underwater noise assessment was undertaken by Irwin Carr in July 2022, a copy of the assessment report is provided in Appendix B.

The report incorporated assessment of potential impact to harbour porpoise, grey and harbour seal, otter and salmon related to the proposed impact and vibratory piling to be undertaken as part of basin infill and development of new quay wall.

The assessment concluded that the overall risk of direct acoustic impact on the assessed species from the piling works to be very low

Given that harbour porpoise are rarely present in the River Clyde in the Govan area, and the findings of the underwater noise assessment it is considered that the potential for potential impact to occur is low.

In relation to potential impact to fish, again on the basis of the underwater noise impact assessment it is considered the likelihood of potential impact is low.

3.1.2 Habitat Disturbance

Habitat disturbance will occur as a result of the infilling process. As previously noted, the presence of harbour porpoise is rare in the Govan area, as such the infilling of the wet basin is not considered to result in a significant likelihood of potential of impact with respect to harbour porpoise habitat.

Fish species such as the Atlantic salmon, brown (sea) trout, European eel, river lamprey and sea lamprey are known to be present in the River Clyde area, as such the infilling of the dock may present some localised habitat disturbance for these species.

The banks of the River Clyde in the vicinity of the project site are heavily engineered, with dock and quay structures present on either bank and the channel is disconnected from surrounding floodplains. The navigation channel is subject to routine dredging to maintain depth of water for shipping. A number of weir and bridge structures are present, further impacting sediment transport processes. The site is currently located in an active ship building facility. The WFD assessment for the site has not identified that impact to habitat to be a significant issue related to the development.

3.1.3 Suspended Sediment

There is potential for an increased suspended sediment concentration within the water column associated with the infilling and construction works, with potential for mobilisation of existing sediment during placing infill material or release from the proposed infill material itself.

As per habitat disturbance given that harbour porpoise are rare in the Govan area there is considered to be low likelihood of significant impact related to suspended sediment. Fish species are known to be present in the River Clyde as such there is a likelihood of localised impact associated with an increase of suspended sediment.

3.2 Magnitude of Impact, Spatial Extent and Intensity

Given that presence of harbour porpoise in the Govan area is considered rare it is not considered that there will not be any significant impact on distribution and abundance of the species associated with any of the identified sources of impact.

On this basis the magnitude of the impact is low. There is considered to be a very low chance of presence of harbour porpoise in the area of impact during the works. As noted previously the most likely reason for presence would be as a result of following of prey and disorientation.

With respect to impact to fish the key source of concern with respect to impact and impact from suspended solids. The impact from suspended solids will be focussed to within the basin and potential for release to the main river channel with impact extending beyond the basin.

3.3 Duration and Frequency of Impact

The duration of the impact will be limited to the period of the dock infilling

3.4 Timing of Impact

The programme of works is still to be confirmed, as such the works may occur any period.

3.5 Location of Impact

The impact will be focussed to the wet basin and river channel in close proximity to the wet basin

3.6 Temporal Changes of Impact

The infilling of the basin will result in a permanent loss of this area as habitat, the impact from suspended sediment will be limited to the construction period only.

3.7 Cumulative Impacts

There are no known nearby works which are considered to result in potential for cumulative impacts.

4 MITIGATION MEASURES

Fish rescues and translocations will take place during construction to reduce fish mortality. This will commence following installation of a silt curtain/bubble screen or barrier across the wet basin to prevent fish re-entering the wet basin infill area.

A Fish Rescue Method Statement will be agreed in advance with the relevant Statutory Nature Conservation Bodies (SNCBs) to target fish species which may inhabit the basin.

The presence of the silt curtain/bubble screen or barrier will also restrict the potential for release of suspended solids outwith the infill area.

5 RISK TO EPS AND FISH

On the basis of the above information, the following information can be concluded:

The presence of EPS within or close to the proposed construction site at Govan is considered to be very rare. The most common EPS in the River Clyde is the harbour porpoise (generally located further downstream of the river) and on this basis, whilst their presence is considered to be very rare, from a precautionary point of view their presence cannot be completely discounted and they are therefore identified for a very low risk of impact.

The proposed works at Govan are generally not considered to represent a significant risk of disturbance or injury to harbour porpoise.

There is potential for impact to fish related to localised increase in suspended solids during the infill

On the basis of the use of the mitigation measures detailed in Section 4 the significance of the impact to fish is considered to be low.

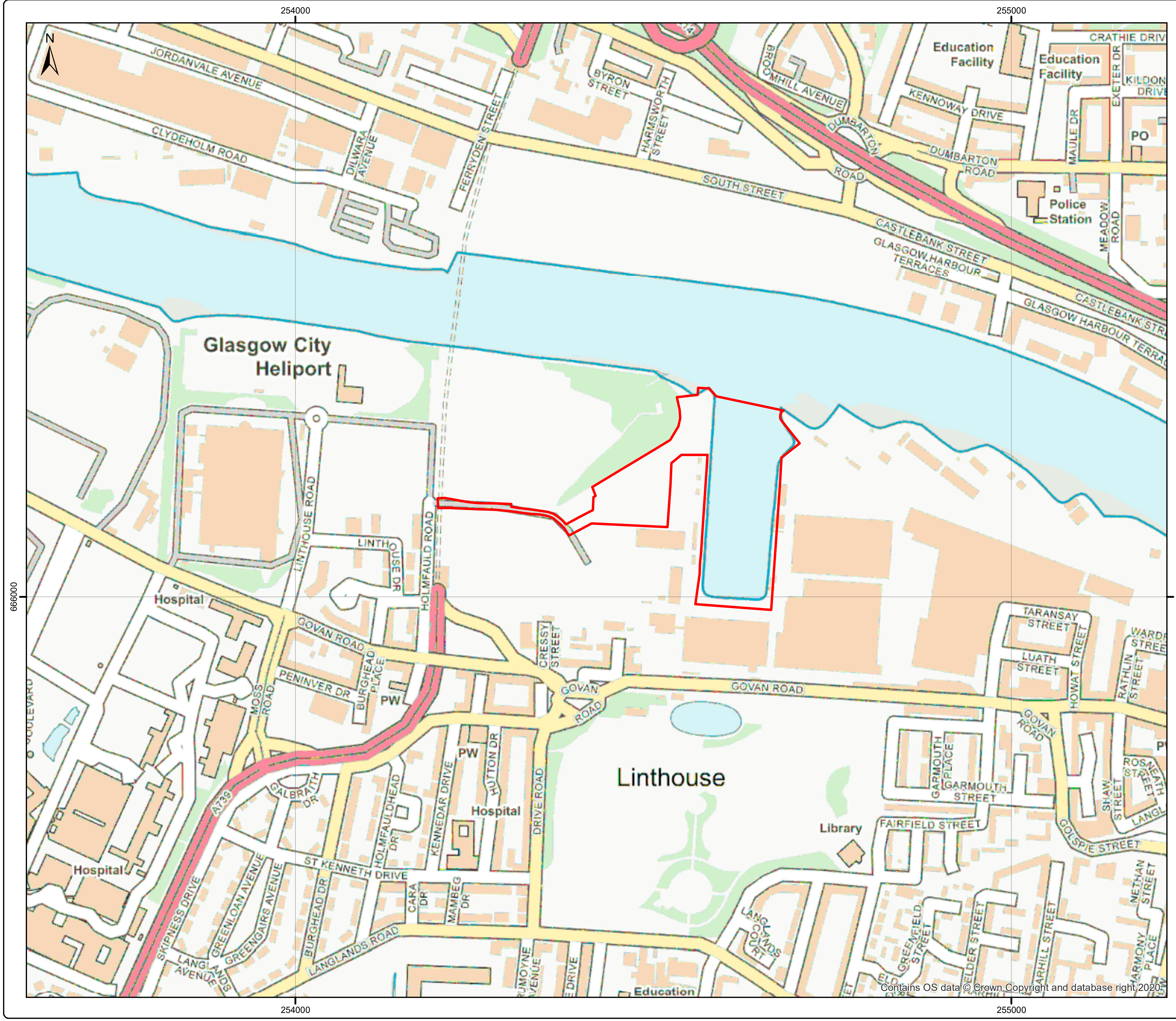
REFERENCES

Marine Scotland (July 2020) The protection of Marine European Protected Species from injury and disturbance Guidance for Scottish Inshore Waters

Statutory nature conservation agency protocol for minimising the risk of injury to marine mammals from piling noise JNCC (August 2010.

APPENDICES

A FIGURES



Legend

🟥 Site Boundary

Do not scale his map

Client
Arch Henderson

Project
Govan Facilities Investment

Title
Site Location Plan

Status
Final

Drawing No.	Revision	Date
175756-GIS001	-	18 May 2022
Drawn	**Checked**	**Approved**
AH	GD	GD

Scale
1:5,000 @A3

0 25 50 100 150 Metres

Rev	Date	Amendment	Initials

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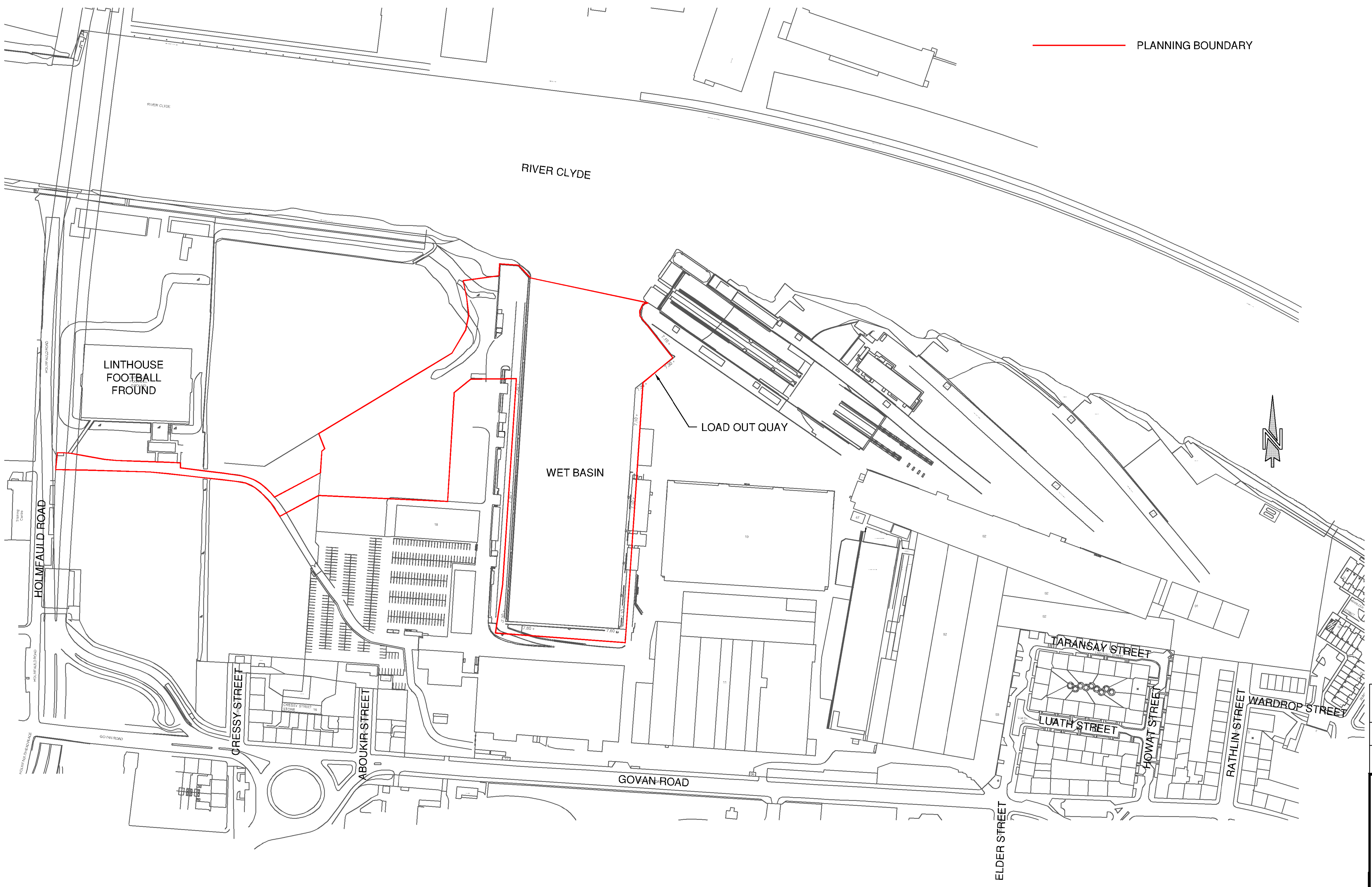

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PROJECT :
BAE Surface Ships Limited - Govan
Wet Basin Infill

TITLE :
Location Plan

DRAWN :	DATE :	VERIFIED :	APPROVED :
CAB	17.05.22	TR	GB

SCALE : (A1) 1:2500

DRAWING STATUS : S0

DRAWING No : 225010-BAE-AHN-ZZ-XX-DR-C-0001

REV : P01

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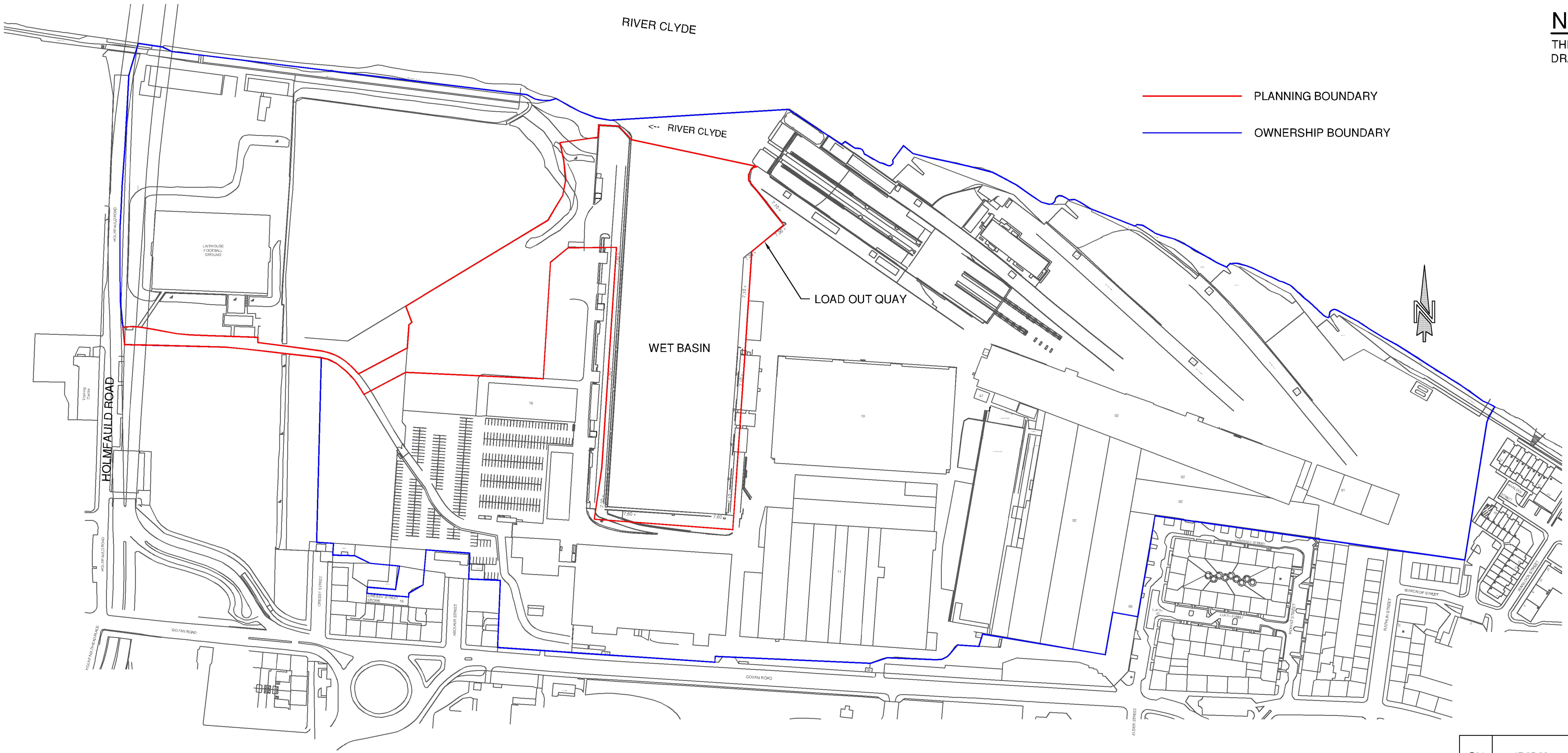

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🟥 PLANNING BOUNDARY
🟦 OWNERSHIP BOUNDARY

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PROJECT :
BAE Surface Ships Limited - Govan
Wet Basin Infill

TITLE :
Site Ownership Boundary

DRAWN : CAB	DATE : 17.05.22	VERIFIED : TR	APPROVED : GB
SCALE : (A1) 1:2500		DRAWING STATUS : S0	

DRAWING No : 225010-BAE-AHN-ZZ-XX-DR-C-0002
REV : P01

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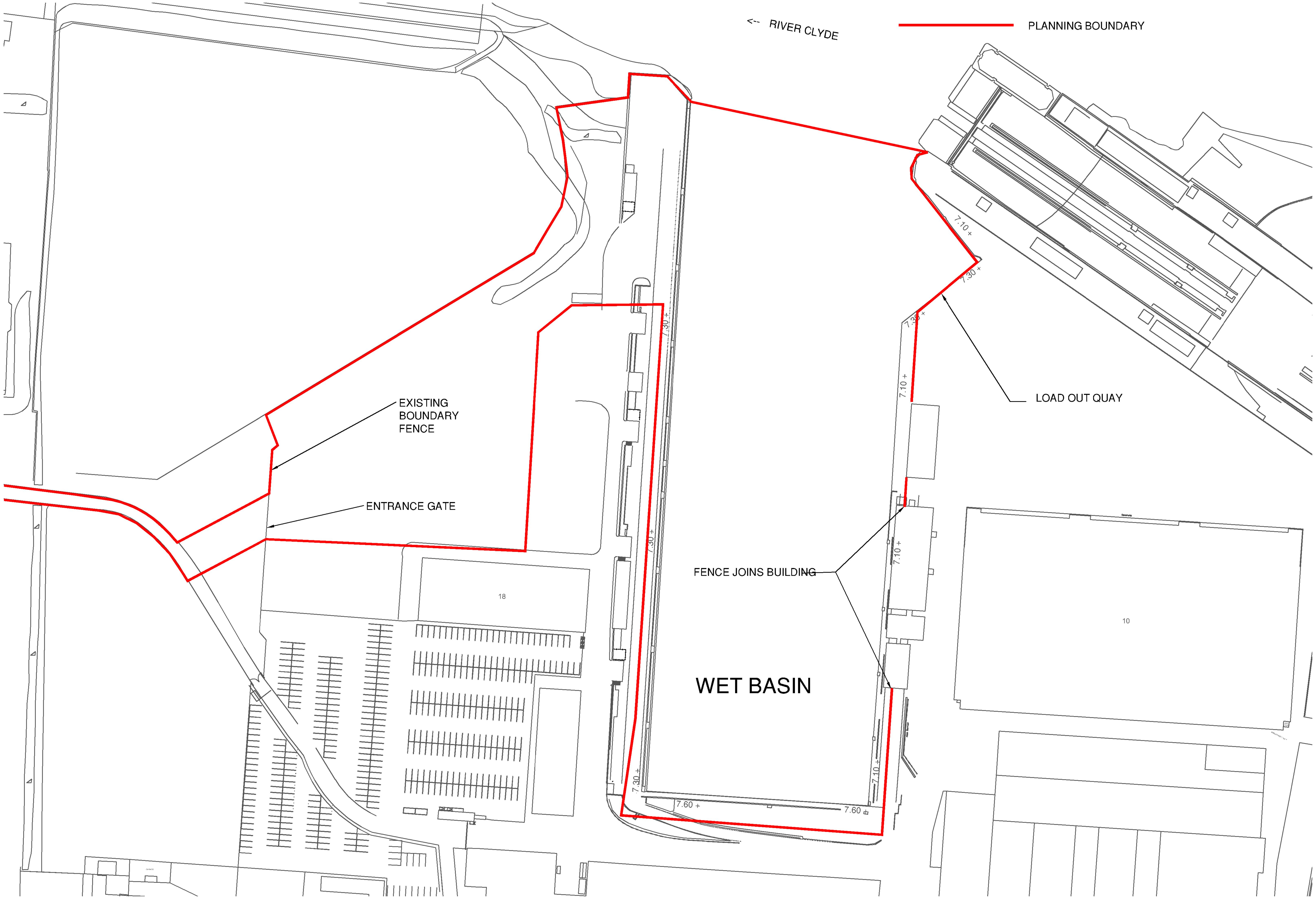

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REV	DATE	REVISION DESCRIPTION	DRN	VER

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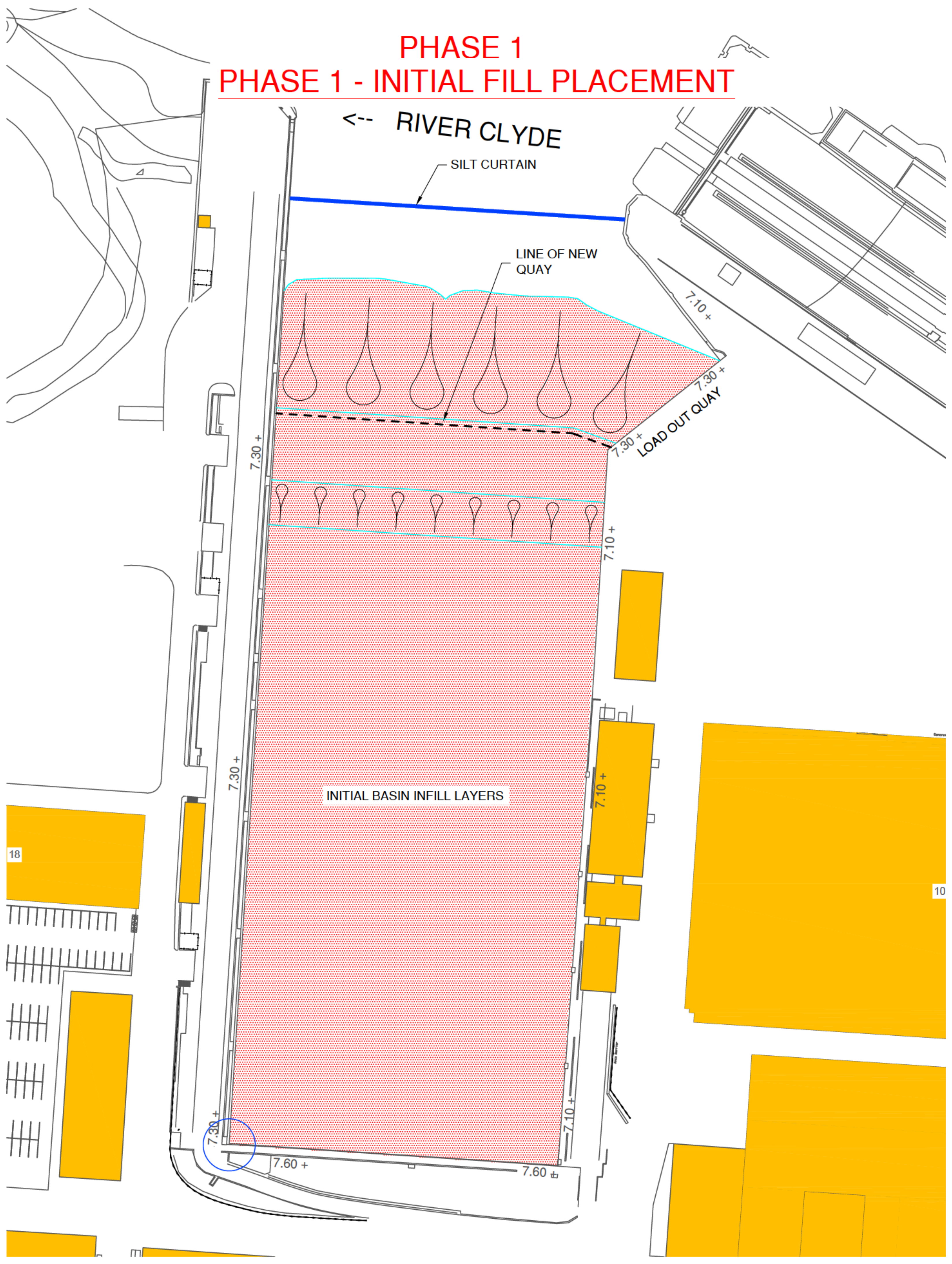
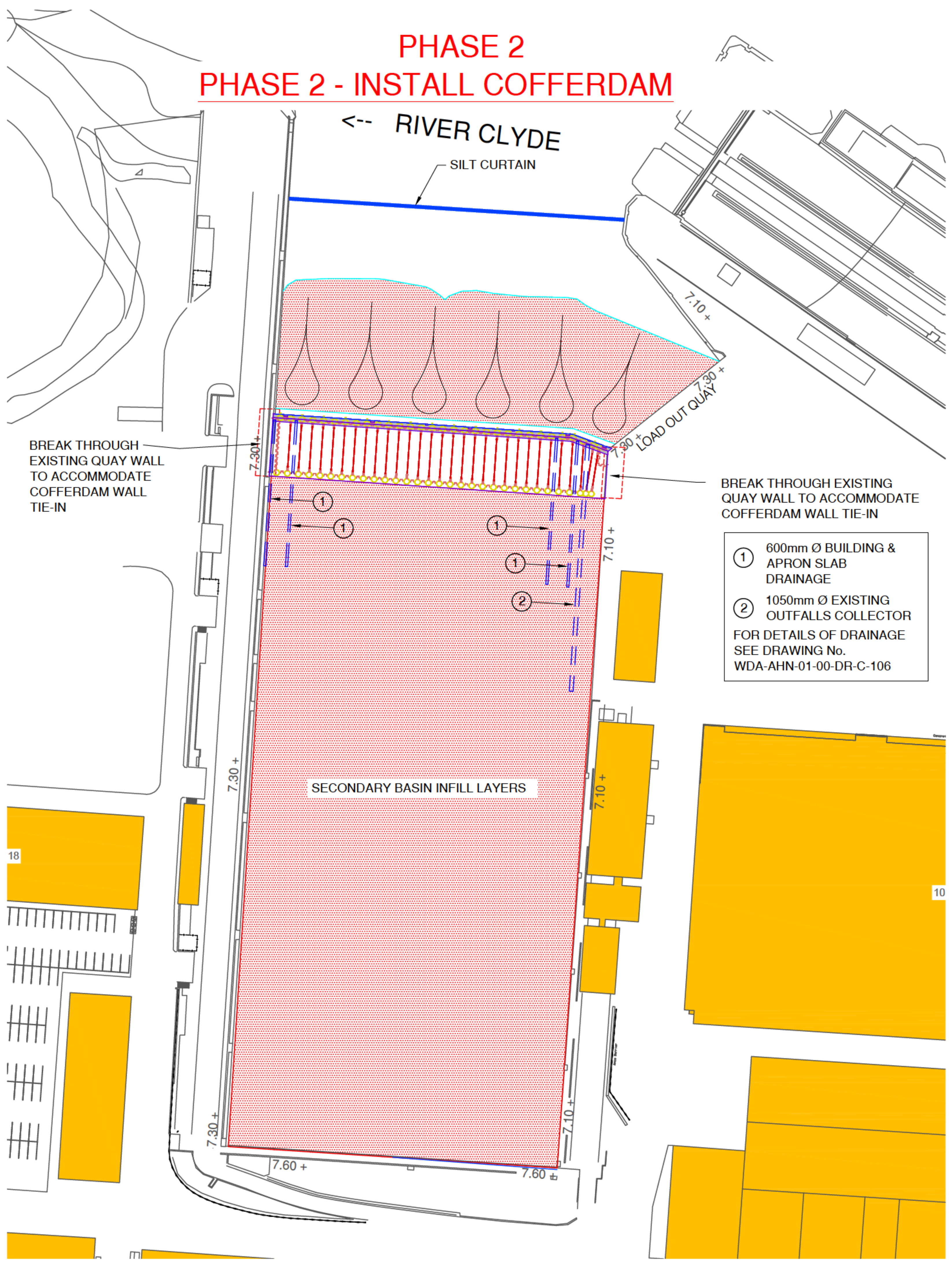
PROJECT :
BAE Surface Ships Limited - Govan
Wet Basin Infill

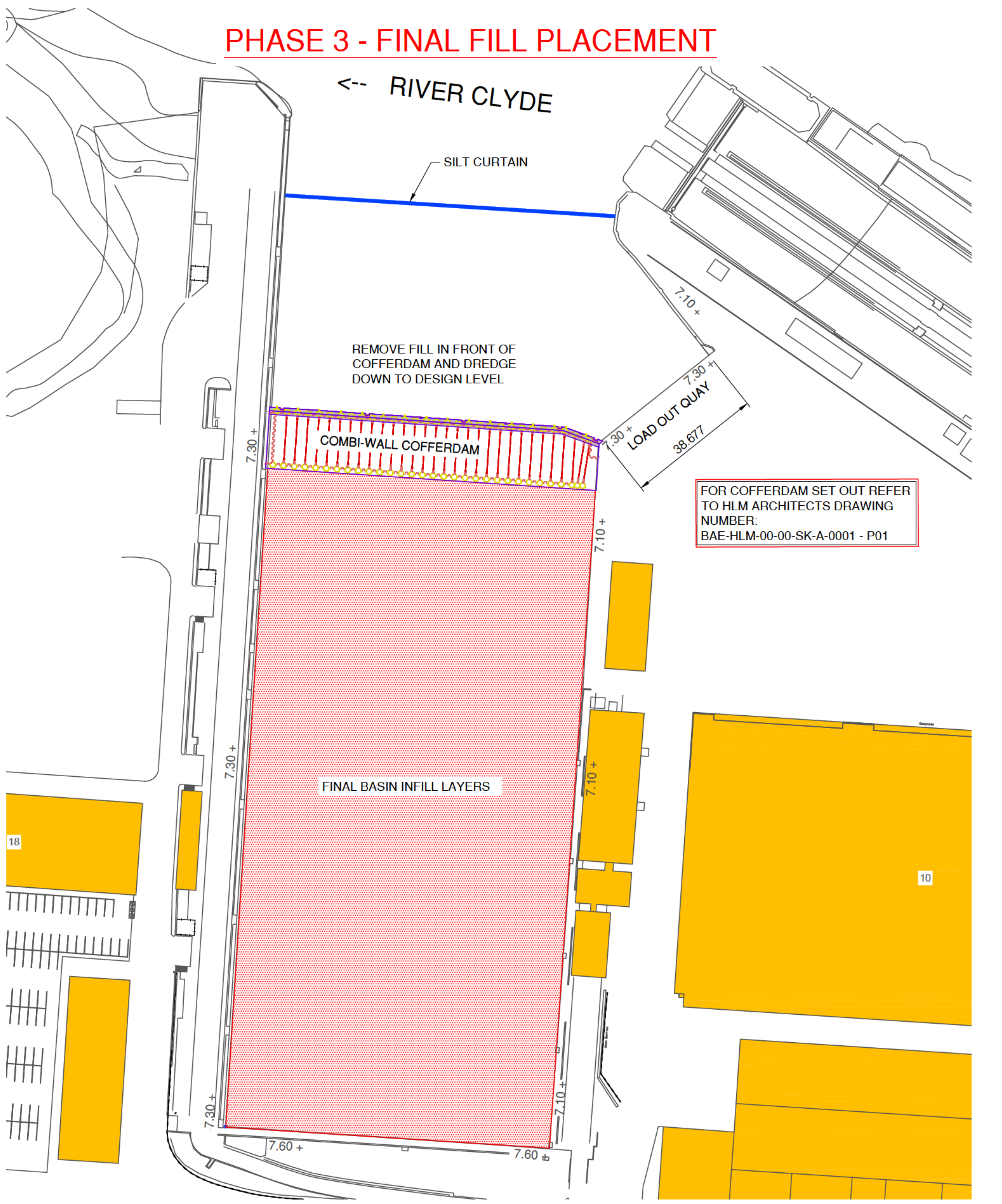
TITLE :
Site Compound and Access

DRAWN : CAB
DATE : 17.05.22
VERIFIED : TR
APPROVED : GB
SCALE : (A1) 1:1250
DRAWING STATUS : S0
DRAWING No : 225010-BAE-AHN-ZZ-XX-DR-C-0003
REV : P01

DO NOT SCALE







1. INSTALL SILT CURTAIN AND / OR BUBBLE CURTAIN AT ENTRANCE TO GOVAN BASIN.
2. BERM OF MATERIAL PLACED AT FRONT OF BASIN TO HELP CONTAIN ANY SUSPENDED SEDIMENT. HEIGHT TO BE DETERMINED BASED ON FINAL METHODOLOGY.
3. UP TO 2m INFILL PLACEMENT TO COVER EXISTING BASIN SEDIMENT.
4. CONTINUE TO FILL USING BARGE AND EXCAVATOR OR SPLIT HOPPER BARGE, OR HYDRAULIC DISCHARGE FROM PIPELINE.
5. PLACE MATERIAL, PLACEMENT BY BARGE AND EXCAVATOR AND PUSHING MATERIAL ACROSS BASIN USING DOZER IF NECESSARY.

1. INFILL TO PRE DETERMINED LEVEL AND INFILL WEDGE VOID BEHIND EXISTING SHEET PILE WALL CONCURRENTLY. THIS MAY REQUIRE LOCAL DEMOLITION OF THE EXISTING COPE BEAM AND CUTTING DOWN OR EXTRACTION OF SHEET PILES.
2. INSTALL COFFERDAM

1. REMOVE STONE BUND FROM FRONT OF COFFERDAM.
2. INFILL TO +6.5m.

P05	25.08.22	REVISED AS PER CLIENT COMMENTS.	GB	TR
P04	24.08.22	COFFERDAM LOCATION REVISED. CONSTRCTION SEQUENCE REVISED. MARINE LICENCE APPLICATION.	GB	TR
P03	26.05.22	CONSENT ISSUE	CAB	TR
P02	26.05.22	ISSUED FOR DESIGN BRIEF	CAB	TR
P01	19.05.22	ISSUED FOR COMMENT	CAB	TR
REV	DATE	REVISION DESCRIPTION	DRN	VER

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GENERAL NOTES

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PROJECT :
BAE Surface Ships Limited - Govan
Wet Basin Infill

TITLE :
Draft Phasing Plans

DRAWN : CAB
DATE : 11.05.22
VERIFIED : TR
APPROVED : GB
SCALE : (A1) AS SHOWN
DRAWING STATUS : LICENCE
DRAWING No : 225010-BAE-AHN-ZZ-XX-DR-C-0004
REV : P05

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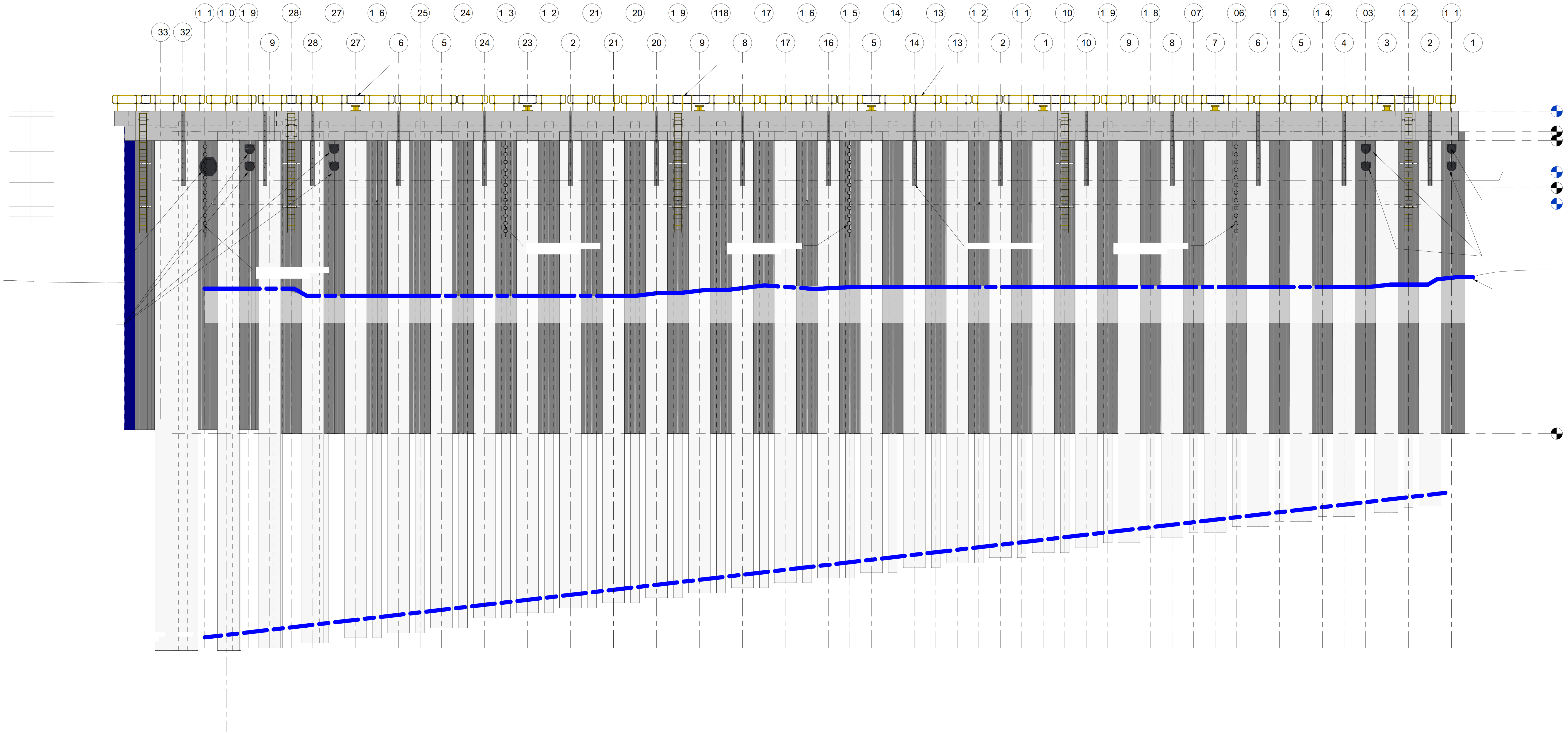

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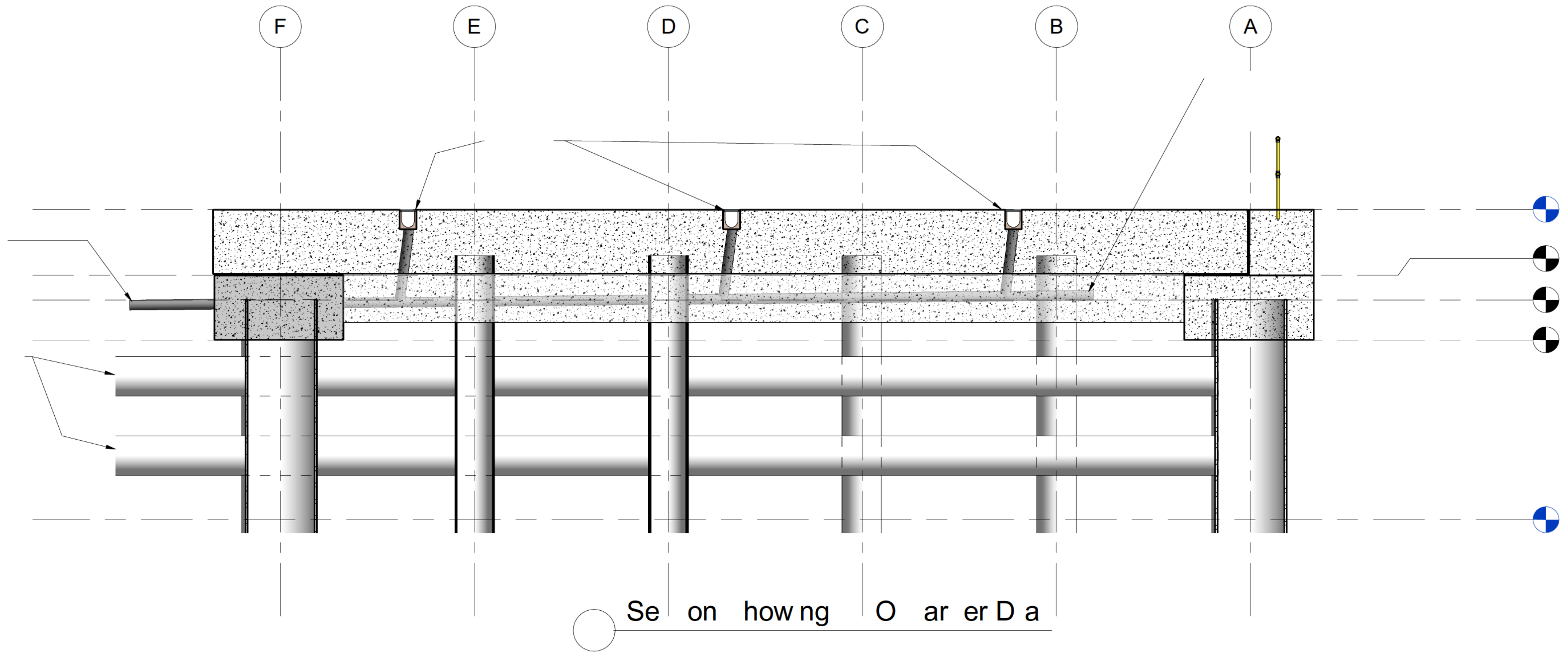

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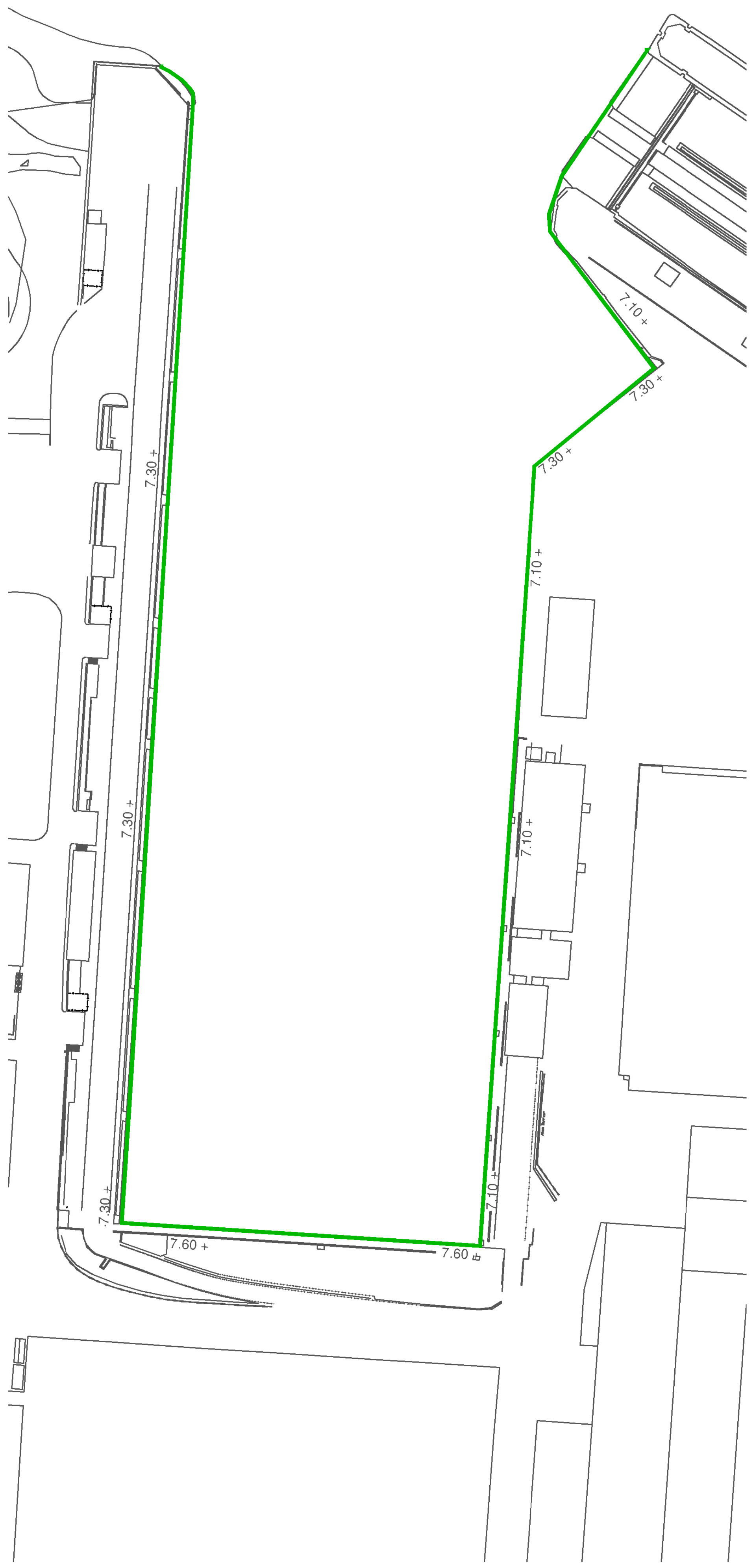
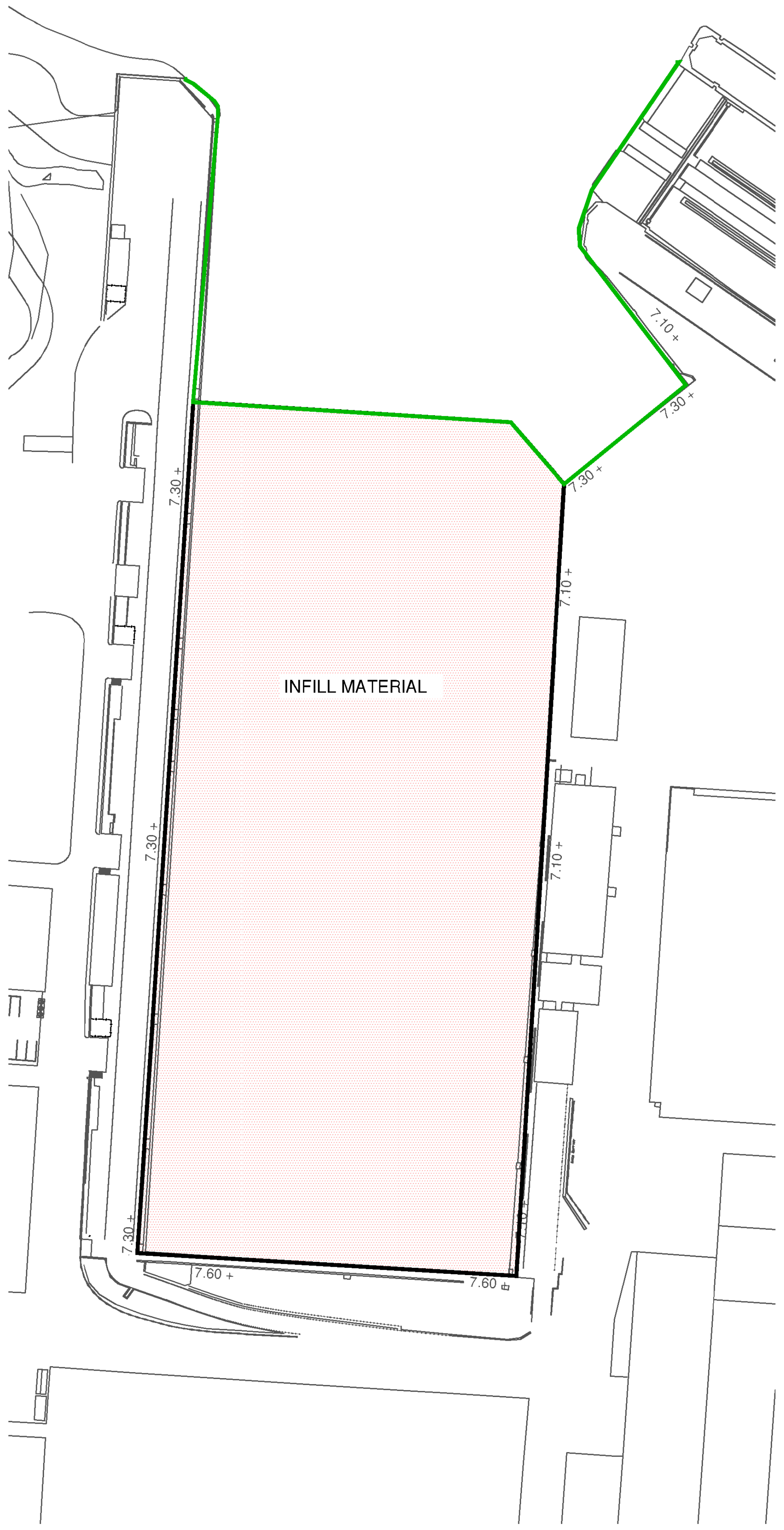


EXISTING EXTENTS OF MHWS
SCALE 1:1250



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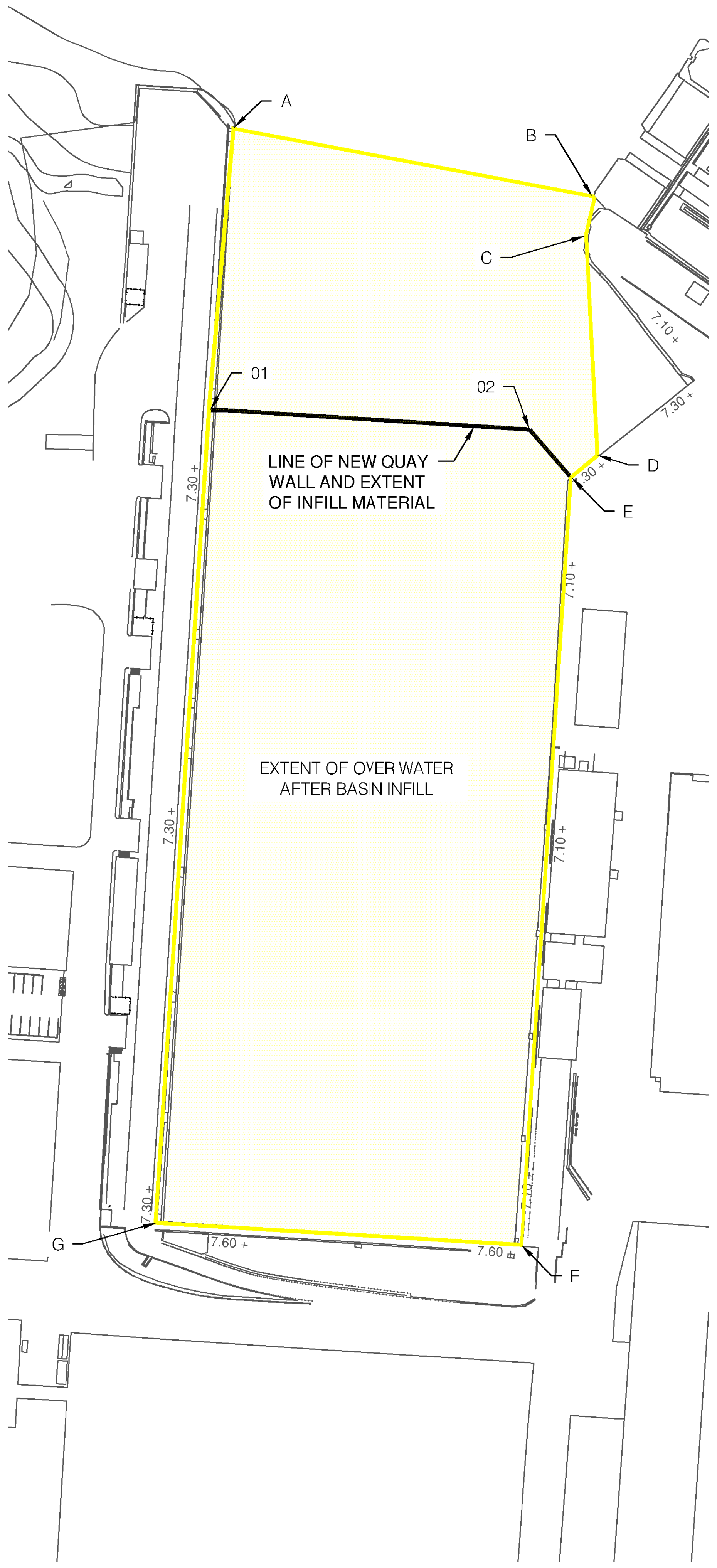

OVER WATER SITE BOUNDARY
SCALE 1:1250

NOTES

THIS DRAWING TO BE READ IN CONJUNCTION WITH ALL DRAWINGS IN THE 225010 SERIES.

KEY:

- 🟩 SEA COVERAGE AT MHWS
- 🟨 OVER WATER SITE BOUNDARY

COFFERDAM WALL SET OUT COORDINATES				
	LAT	LONG	EASTING	NORTHING
01	N55:52:01.27	W4:19:26.79	254662	666203
02	N55:52:01.34	W4:19:31.51	254580	666208

OVER WATER SET OUT COORDINATES				
	LAT	LONG	EASTING	NORTHING
A	N55:52:03.67	W4:19:31.31	254586	666280
B	N55:52:03.19	W4:19:25.98	254678	666262
C	N55:52:02.87	W4:19:26.08	254676	666252
D	N55:52:01.06	W4:19:25.80	254679	666196
E	N55:52:00.83	W4:19:26.19	254672	666189
F	N55:51:54.51	W4:19:26.50	254660	665994
G	N55:51:54.57	W4:19:31.91	254566	665999

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PROJECT :
BAE Surface Ships Limited - Govan
Wet Basin Infill

TITLE :
Site Boundaries

DRAWN :	DATE :	VERIFIED :	APPROVED :
CAB	19.05.22	TR	GB

SCALE : (A1) 1:25
DRAWING STATUS : D1

DRAWING No : 225010-BAE-AHN-ZZ-XX-DR-C-0007
REV : P01

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B UNDERWATER NOISE ASSESSMENT

IRWIN CARR
CONSULTING

Govan Piling

Glasgow, Scotland

Rp001 2022157 (Govan Piling, Glasgow)

14 July 2022

PROJECT: GOVAN PILING, GLASGOW

PREPARED FOR: ENVIROCENTRE
GLASGOW (REGISTERED OFFICE)
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ATTENTION: GRAEME DUFF

REPORT NO.: Rp001 2022157 (Govan Piling, Glasgow)

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Status:	Rev:	Comments	Date:	Author:	Reviewer:
Draft	1.0		14 July 2022	Rasmus Sloth Pedersen	Shane Carr
				[redacted]	[redacted]

EXECUTIVE SUMMARY

BRIEF DESCRIPTION OF WORK

- Describe environment of the site in terms of modelling relevant parameters (water and sediment properties).
- Model the sound source (impact and vibro piling) from reasonable pile dimensions and hammer characteristics.
- Model transmission losses for a single installation, both for single blows and multiple blows as relevant to local fauna impact.
- Show results on maps for both unweighted noise and weighted noise (local species).
- Contextualise results by including background noise and moving receivers.

CONCLUSION

We conclude that the overall risk of direct acoustic impact on assessed species following the piledriving is very low.

The main reasons are:

- A conservative approach: Using upper 90th percentile source levels & and mean high water spring tide (MHWS), leading to elevated received levels.

- The results show some risk of hearing injury (PTS) only at prolonged exposure (>10 min) in a very confined area (immediately outside the berth).

- Slow-moving (0.5 m/s) receivers are not expected to experience PTS.

Additionally, the confined nature of the site means that acoustic masking is limited to a relatively short section of the river; ~2 km over background noise level and ~1500 m >120 dB SPL.

We note that the noise might deter an animal from moving past the site while its active, meaning the activity could lead to other, not directly acoustic, impacts on animals' fecundity.

RESULTS SUMMARY

Impact Piling

L_P – Peak pressure

For the acute injury risk from peak pressure the VHF-group (Harbour Porpoise) has the largest risk range, 65 m to TTS risk (ignoring range into the berth), coinciding spatially with the mouth of the berth.

All other groups have negligible risk ranges for TTS and PTS (both <25 m).

L_E – Exposure level

For groups VHF and PW (Harbour porpoise, Harbour Seal and Grey Seal) there is possible PTS after ~10 min exposure if animals remain in the area directly outside the berth, keeping in mind that for a moving animal this is an overestimate of the impact. From the received levels from a moving animal (section 7.3.2, p. 44 & 7.3.3, p. 45) it seems that for the worst-case source level some TTS is likely at low swimming speeds (0.5 m/s), while it's unlikely for the mean-case, where the source level is ~12 lower.

For group OW (Otter) there is low risk of TTS after >10 min of piling, but even after 40 minutes, the risk of PTS remains low (section 7.2.4, p. 35). For a slow-moving animal (0.5 m/s) there is little to no risk of auditory injury (section 7.3.4, p. 45).

The P- group (Salmon), might experience some TTS after ~10 min with a little risk of PTS after ~40 min (section 7.2.5, p. 39). For a moving animal this risk of any auditory injury is low (section 7.3.1, p. 44).

Vibratory Piling

Given the substantially lower levels estimated for the vibro piling we have not included a separate assessment for this activity.

The SPL for vibro piling is 189 dB SPL, this is 19 dB below the assessed 208 dB SPL of the Impact piling and would lead to negligible risk zones.

The L_P for vibro piling is likewise significantly below the L_P for impact piling (218 versus 245) and is not of concern in relation to direct acoustic impact o the assessed species.

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Abbreviations and Definitions:

SSP	Sound Speed Profile
Hearing group	Refers to the Southall 2019 hearing groups (Southall, et al., 2019).
“,” and “.”	Comma “,” is used as thousands separator, while dot “.” Is used as decimal separator.
TL, PL	Transmission Loss, Propagation Loss. Used interchangeably in this document.
Psu	Practical salinity unit, equivalent to parts per thousand as g/kg, mass of salts per mass of water.
Noise	Sound that causes, or is assumed to cause, annoyance or disadvantage. No automatic significance of impact is associated with this term.
Solver	Mathematical algorithm for calculating sound transmission losses in water.
[]	Square brackets are used throughout to denote units, e.g.: “Pressure [Pa]” means pressure in Pascals.
Degrees	Either angular degrees (0-360) or degrees Celsius
3rd octave, decidecade	Refers to the subdivision of octaves (doublings of frequency) and decades (10x frequency). Using the appropriate base frequency, the two are identical for practical purposes.
Worst case	Used as “reasonable worst case”. E.g. use of MHWS instead of historical maximum for max water level. Or 90th percentile as representative of worst-case.
Mean case	The expected case, both median and mean values will inform this.
Signature	When in relation to a sound, this refers to the time-pressure signal associated with that sound, normally as a time-series of pressures relative to ambient pressure, in pascals.
Vibro	Vibration pile driving

1 INTRODUCTION

In connection with the infilling in of a berth in Govan Area of Galway a “combi-wall” consisting of tubular piles and sheet piles will be installed to restrain and protect the infill from erosion from the river Clyde. The installation of the piles will be noisy, and potentially have negative impact on local fauna. We note that the piling installation for this project will be done *through* a bund/mound of material constructed prior to the piling. This means that piling noise will be attenuated significantly as it passes from the pile through the bund and into the river water. After the piling is complete the bund material on the river side of the pile wall will be removed.

This report presents the source modelling, underwater noise propagation modelling and noise impact modelling of the pile installation.

The impact modelling will be based on “mean-case” and “worst-case” scenarios for the activity.

1.1 Underwater Acoustics Basics

Underwater acoustics modelling is the application of physical models to characterise the behaviour of sound in environments under the surface of the sea and in the top layers of the seabed. As some familiarity with in-air acoustics is assumed the focus here is on key differences between in-air acoustics and underwater acoustics, making waterborne propagation more efficient than airborne propagation.

This chapter only gives reader a quick overview, please see APPENDIX B – Underwater Acoustics Basics APPENDIX *for more detail.*

1.1.1 SOUND SPEED

Water is much harder to compress than air, and a soundspeed of 1500 m/s is often used as a standard soundspeed in water[1] much as 340 m/s is in air.

The soundspeed changes with depth, “sound speed profile”, this is quite important in sound propagation, as refraction (changes in propagation angle) will occur when sound moves between layers of water with varying sound speed. These effects can lead to profoundly inhomogeneous sound fields and SOFAR channels.

The same relationships are valid in the sediment, though sediments commonly have soundspeeds higher than water. Soundspeeds from 1700 m/s (fine sand/silt) to 2500 m/s (gravel) are common for non-solid sediments, with solid sediments (rocks) having much higher soundspeeds 2800 m/s (Calcarenite) to 6000 m/s (some granite).

1.1.2 SPREADING LOSS

Most of the propagation loss (loss in dB from source to receiver, “PL”) that occurs initially is governed by “spreading loss”. It is the simple “thinning out” of acoustic energy as it spreads away from the source, usually in all directions – spherically. This means a reduction in received level of 6 dB per doubling of distance

At longer ranges the medium is no longer unbounded. We reach ranges where the sound has interacted with the surface (near perfect acoustic reflector) or the seabed (lossy acoustic reflector). Here we expect spreading loss to be ~3 dB per doubling of distance.

1.1.3 ABSORPTION

Besides the “thinning out” of the sound energy as described above, the sound is also dissipated into heat by the way the pressure changes interact with water, molecules and particles in its path. This absorption is salinity dependant. Frequencies under 1 kHz experiences almost no absorption, while high frequencies, over 10 kHz, can be attenuated by over 10 dB / km.

Small bubbles, wind or wave induced, will further attenuate especially the high frequencies.

1.1.4 SEDIMENT

Depending on the incident angle of the sound, the frequency and the acoustic properties of the sediment, sound can either mostly penetrate the sediment or mostly be reflected by it.

---

[1] Varies from 1450 m/s at 0° to 1550 m/s at 30° at salinity of 35 psu.

In shallow areas with soft sediment (acoustically similar to water), it is typical to find that close to the source, at high incidence angles and at low frequencies (<250 Hz) the sound will penetrate into the sediment and dissipate there, leading to very high transmission losses for these frequencies.

1.1.5 SOUND LEVEL UNITS

All references to sound pressure levels, peak pressure levels and sound exposure levels refer to a logarithmic ratio between a reported/measured pressure or exposure and a reference pressure or exposure. As an example, a level of 220 L_p (decibel zero-to-peak) is equal to a peak pressure of 100000 Pascals (Pa) over ambient pressure, while 120 L_p is equal to 1 Pa over ambient pressure.

To avoid dealing with these large numbers as pascals (as a linear scale), they are converted to a decibel ratio (Table 1 for definitions). Besides compressing large numbers to a smaller scale this also corresponds better to how animals are thought to perceive sound, namely as relative steps. This means that an increase from 1 to 2 Pa *sounds like* the same increase as from 100 to 200 Pa, even though the first step was only 1 Pa, while the second was 100 Pa. This is better reflected in a logarithmic scale based on ratios, where both steps are equal, here 3 dB.

However, while dBs are practical, they can be hard to compare between studies, due to vague definitions, and so we have adopted the standards set by ISO 18405-2017 (Table 1 below).

For ease of reference please see following overview for unit definition.

Table 1: Definitions.

Unit	Definition	Comments
SPL (dB_{RMS}) ISO 18405- 2017: 3.2.1.1	$SPL = 10 \cdot Log_{10}\left(\frac{\frac{1}{t_2 - t_1} \cdot \int_{t_1}^{t_2} p(t)^2 dt}{1 \cdot 10^{-12} Pa}\right)$	Functionally equivalent to deprecated $20 \cdot Log_{10}\left(\frac{RMS}{1 \cdot 10^{-6} Pa}\right)$
L_p ($dB_{z\text{-}p}$) ISO 18405- 2017: 3.2.2.1	$L_p = 20 \cdot Log_{10}\left(\frac{Pa_{max}}{1 \cdot 10^{-6} Pa}\right)$	This assumes that Pa_{max} is equal or greater than $\sqrt{Pa_{min}}^2$
$L_{p\text{-}p}$ ($dB_{p\text{-}p}$)	$L_{p-p} = 20 \cdot Log_{10}\left(\frac{Pa_{max} - Pa_{min}}{1 \cdot 10^{-6} Pa}\right)$	Often[2] equivalent to $L_P + 6.02\ dB$
L_E (dB_{SEL}) ISO 18405- 2017: 3.2.1.5	$L_E = 10 \cdot Log_{10}\left(\frac{\int_{t_1}^{t_2} p(t)^2 dt}{1 \cdot 10^{-12} Pa}\right)$	For continuous sound this is equivalent to $SPL + 10 \cdot Log_{10}(t_2 - t_1)$ “t” is seconds

Unless otherwise stated SPL has an averaging period of 1 second, and L_E for the duration of the specified event, sometimes indicated as $L_{E\text{-“time”}}$ or $L_{E\text{-single blow}}$.

If the averaging period for SPL is equal to the total even duration then SPL is equal to “Leq” the “equivalent constant level”.

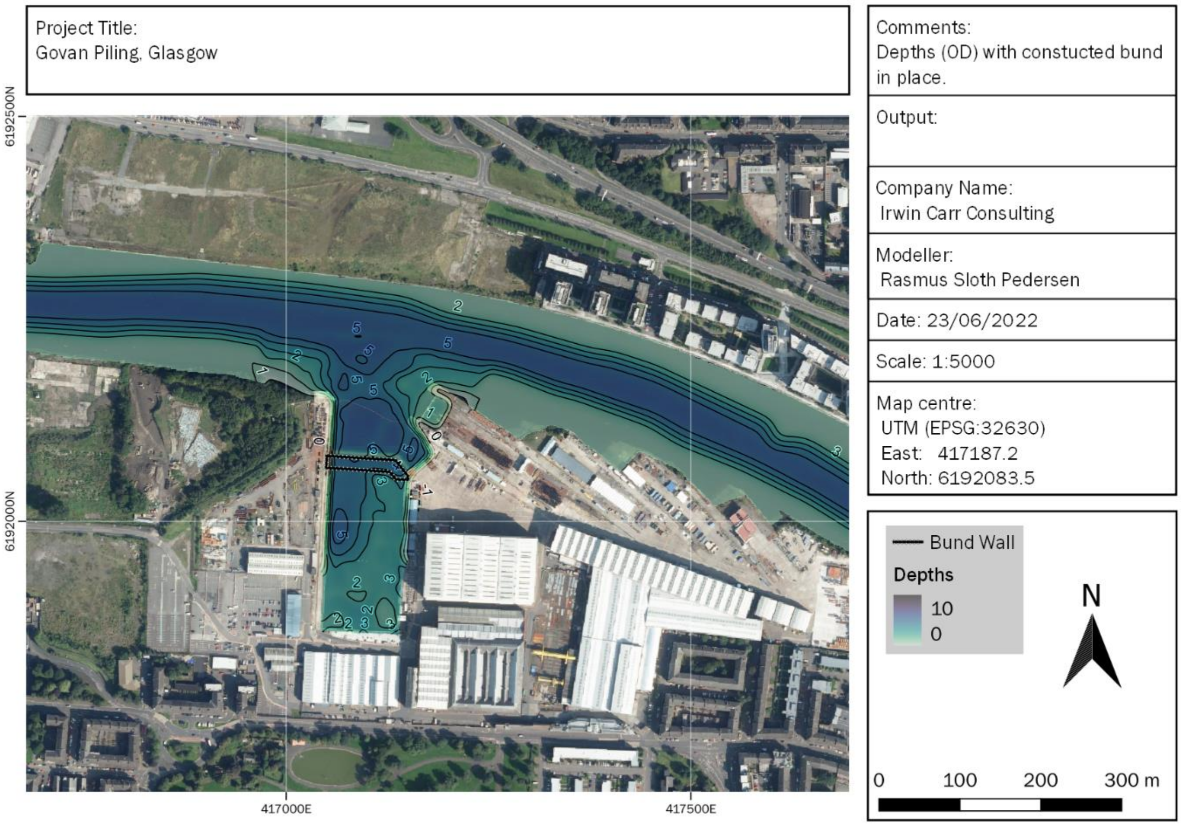
When source levels are presented, the same units are used, and it is implicit that all source levels are given as if recorded 1 m from an omnidirectional mono-point source, unless otherwise specified.

---

[2] If maximum pulse rarefaction is below ambient pressure and compression and rarefaction phases are of equal size.

2 Site and local environment

The site is located in Govan, Glasgow at Lat: 55.86701601, Lon: -4.32469555, (6192072 N, 417101 E, UTM 30N), in the mouth of the berth. Mean water depths 2-6 m.



2.1 Depth, Bathymetry

The depths in the berth are from a multibeam survey carried out by “Aspect Surveys” in February 2022. It was converted from an xyz point file to a 0.5 m resolution raster files by converting the point vector layer to an area layer (Voronoi method), and then smoothing over the depths with a gaussian filter, to avoid shar discontinuities present in the original point data.

Depths in the river Clyde are interpolated from nautical charts such as http://fishing-app.gpsnauticalcharts.com

The two data sources’ depths were first converted to a common depth reference, OD[3] (Ordnance datum), before they were merged to one dataset.

For the “worst case” scenario the MHWS (Mean High Water Spring) level is used (deeper water decreases noise transmission loss). MHWS is assumed equal to OD+2.17 m at this site.

2.2 Water properties

The site is located in Glasgow, Scotland, and is part of the estuarine part of the river Clyde (the weir at Glasgow Green is seen as inner limit of estuary).

Given the confined nature of this site the water properties will have comparatively little effect on the final conclusion as TL from spreading and sediment absorption/scattering will dominate.

---

[3] Functionally equivalent to mean sea level, MSL.

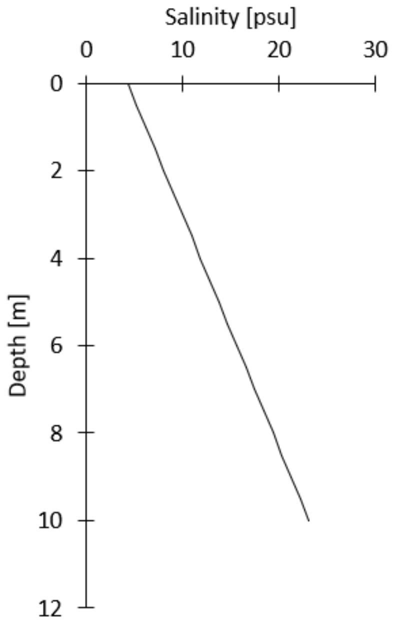
2.2.1 TEMPERATURE

We have used the online resource: https://www.seatemperature.org/europe/united-kingdom/erskine.htm to estimate water temperature for the site. According to this data source common minimal temperature for this site 6.3 °C in March and maximal temperature of 15.4 °C in July. As higher water temperatures generally favour sound transmission we have assumed a water temperature of **15.4 °C** throughout.

2.2.2 SALINITY

This part of the river is estuarine as displays a layering of water, with less saline water on the surface and denser more saline water closer to the bottom. We have relied on a local model (Chen, 2001) to generate a salinity profile for the site. The salinity is important for absorption and the sound speed.

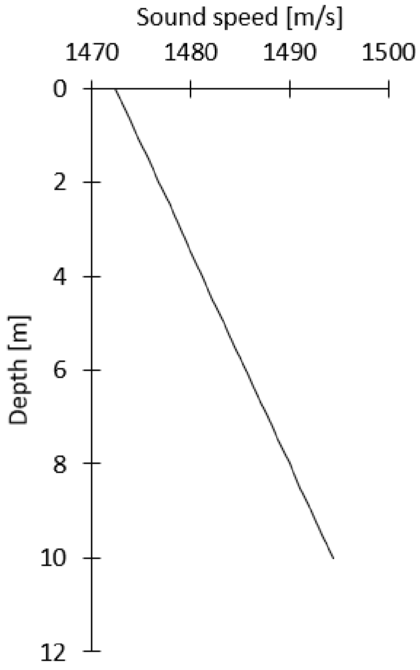
Figure 1. Varying salinity with depth at site.



2.2.3 SOUNDSPEED PROFILE

The sound speed profile is based on a widely used model for sound speed in water (Leroy, Robinson, & Goldsmith, 2008), with input of temperature, depth and salinity.

Figure 2. Sound speed profile at site.



2.3 Sediment properties

Based on sediment cores from the site the sediment is a layered combination of silt, sand and gravel with significant components of clay mixed in. Two borehole location are available, but one (BH9) contains significant amounts of "made ground" (manmade substrate) and has been discarded as not representative for the sediment profile in general.

Figure 3. Acoustic properties of the sediment. Values have been smoothed (requirement for model).

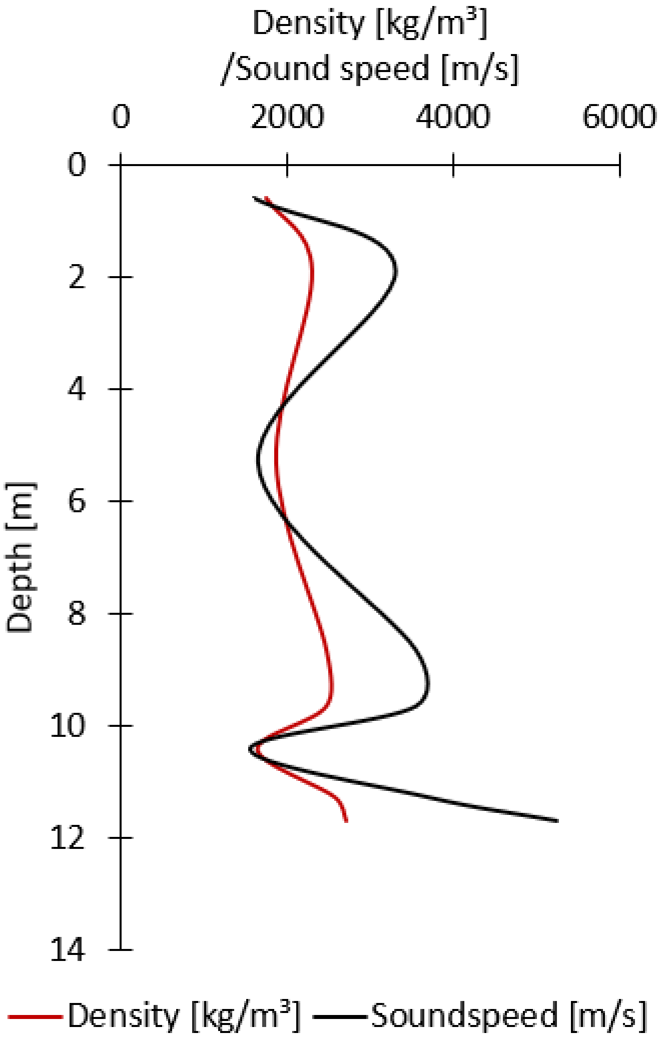


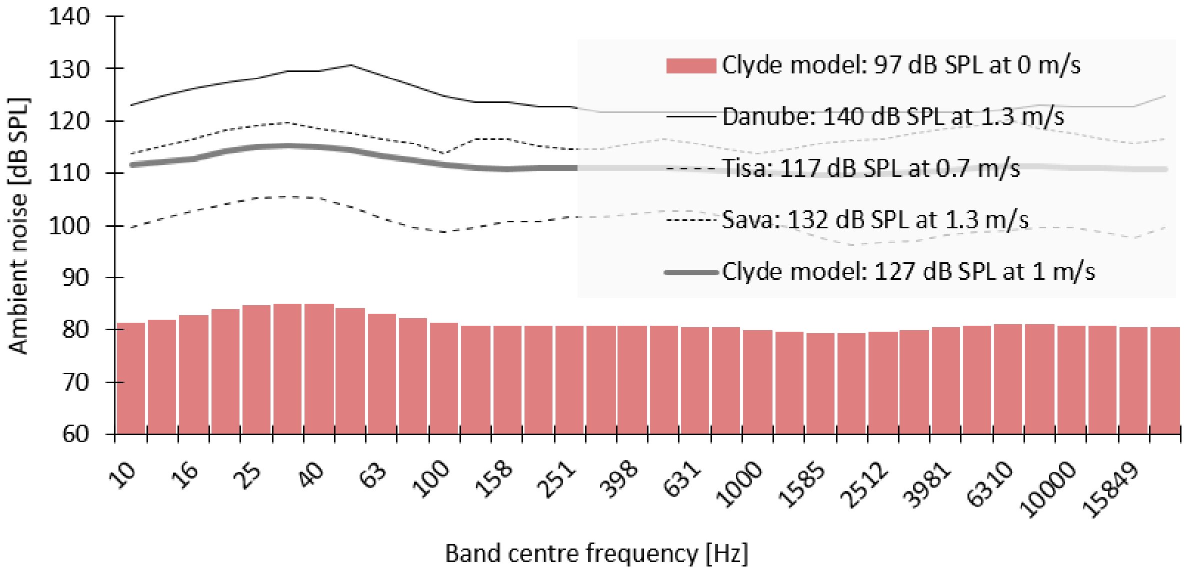
Figure 4. Sediment profile for borehole in berth.

Depth below bottom [m]	Sediment type PRIMARY (secondary)	Sound speed [m/s] (compressional)	Density [kg/m^3]	Absorption [dB/wavelength] (compressional)
0-1.15	SILT (sand)	1597	1749	1.2
1.15-2.6	SAND (some gravel)	3309	2294	1.6
2.6-8	SAND (clay)	1648	1866	1.1
8-10	SAND (gravel)	3556	2465	1.6
10-10.85	CLAY (gravel)	1553	1645	0.4
10.85-11.7	GRAVEL (some sand)	3695	2562	1.7
>11.7	Rock/boulder SANDSTONE assumed	5250	2700	0.1

2.4 Background/Ambient Noise

Due to the site's placement, relatively far into the Clyde estuary we don't expect that there will be excessive background noise from large vessels (there are very few docking points further upriver). The occasional fast light vessel might be present, but we expect the site to be dominated by flow noise. In an effort to find reasonable ambient noise levels we use measurements from other large rivers (Vracar & Mijic, 2011) as well as the flow rate in the Clyde (Chen, 2001) (here set to "0 m/s" as a conservative measure), to estimate the likely ambient noise level.

Figure 5. Various river ambient noise level at various flow speeds. Columns are the band levels used here for the Clyde when there is no flow (0 m/s)



3 SOUND SOURCE MODELLING

The impact piling is modelled considering multiple factors, presented in Table 2 below in column "Round piles".

The source model also uses the water and sediment properties, see section 2 p. 9 for details.

The vibration piling model is simpler as we don't have good source models for the kind of piling (section 3.2 below)

Table 2. Input values to impact piling source model. Water and sediment properties listed in sections above.

Item	Round piles	Sheet piles
Length [m]	25-35 (30 assumed)	
Radius/largest dimension [m]	1.575	0.86
Installation length/final penetration depth [m]	Length-2.5 m (27.5 assumed)	
Steel Young's modulus [GPa]	210	210
Wall thickness [mm]	25	12.5
Hammer type/model	CG300	ICE 1412C
Hammer rating [kJ]/[kN]	294 kJ	2300 kN
Blow rate [Hz]	0.57	Up to 23
Hammer blow energy, first blow [kJ]	30	-

3.1 Impact Piling Model

Our impact piling model uses a combination of analytical models and empirical data fitting to generate broad band single blow level, 3rd octave bands and time-pressure impulse for every blow during the installation (source levels change during installation, with pile free length and blow energy).

Additionally, being a partially empirical model, we know the uncertainty of the result as this has been established for a large variety of hammer ratings, pile sizes and sediment types.

The general structure is:

1. Model required blow energy using models for soil resistance and pile carrying capacity. (Alm, 1998; Maynard, 2019; Li, Wu, Liu, & Lehane, 2021; Fang, Wang, & Fang, 2020; Gregg Drilling & Testing, Inc., 2008; Knut H. Andersen & Schjetne, 2013; P. Doherty BE, 2010; RANDOLPH, DOLWIN, & BECK, 1994; White, 2002; Yan & Yuen, 2010).
2. Account for hammer size (energy rating) and calculate forcing function.
3. Appy sediment and water properties to calculate a transmission factor from the hammer to the water (via the pile and sediment) and sediment (via the pile), by combing relations from APPENDIX B – Underwater Acoustics BasicsAPPENDIX with fitting to empirical data to estimate source signature.
4. Use pile dimensions to account for dominant frequencies and spectra content of emitted noise.
5. Determine frequency content in decidecade bands.

For this report we will use two source levels. These will be the median level from the source model, 199 dB L_E broadband, and the 90th percentile level, 210 dB L_E broadband.

Table 3. Impact piling source levels summary.

	Mean case [dB]	Worst case [dB]
L_P	233	245
L_E (broadband)	199	210
SPL_{90} (duration of 90 % of energy in signature)	211	239
$SPL_{1\ sec}$	196	208

Figure 6. Source time-series signature for a single blow at range of 1 m in the source model.

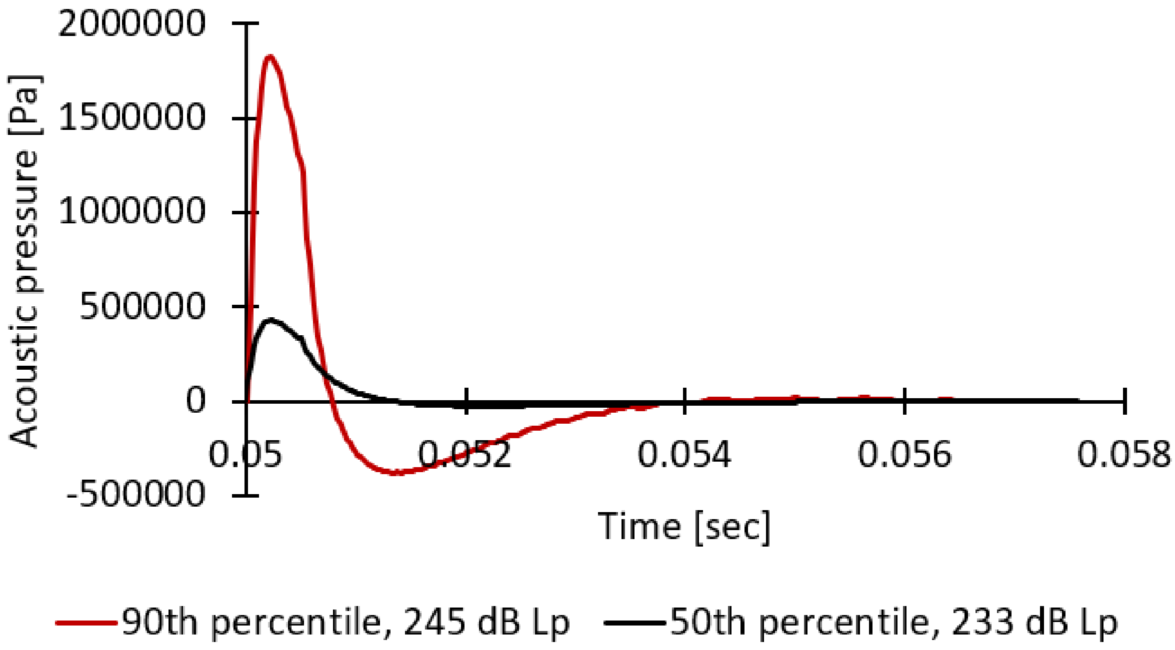
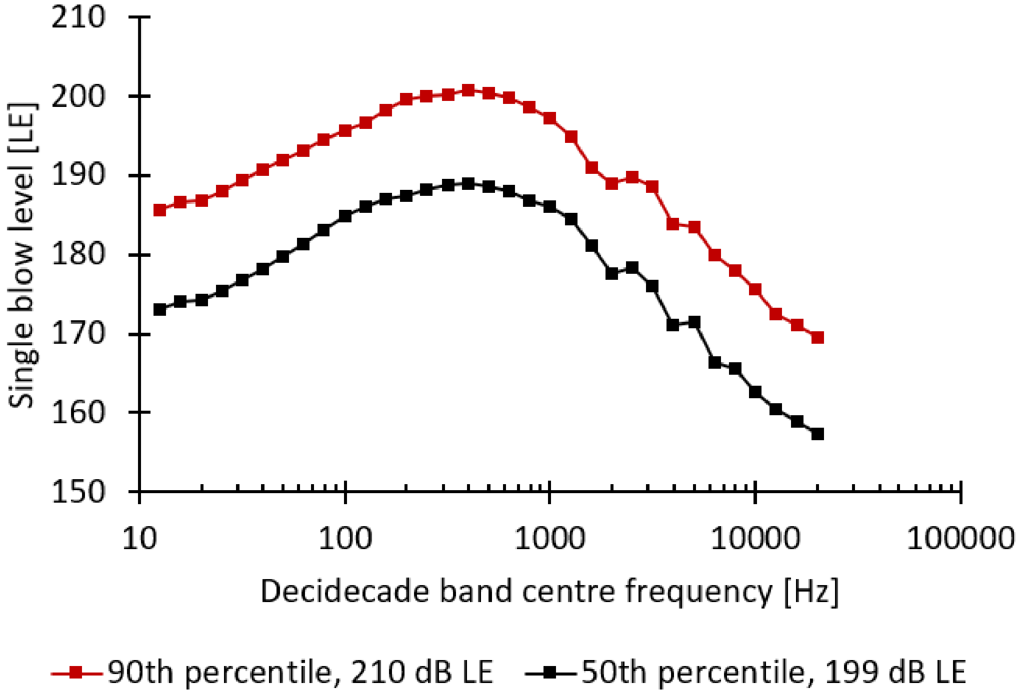


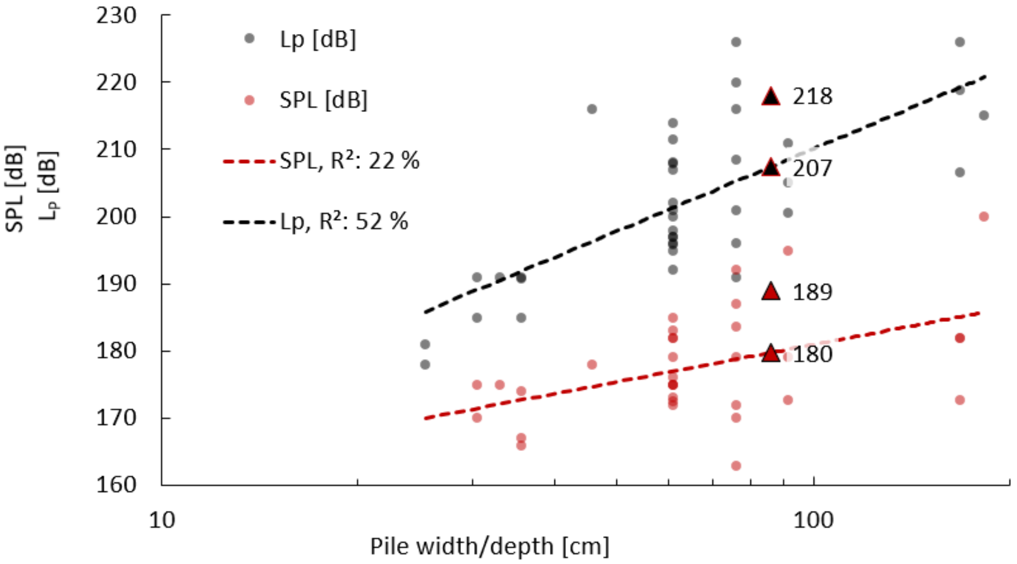
Figure 7. Decidecade band levels of the 90th percentile band levels (red) and median band levels (black).



3.2 Vibration Piling Model

We only have a few recordings from vibration piling and have no dedicated source model for this type of piling. Instead, we rely on published recorded levels as from CalTrans (CalTrans, 2015).

Figure 8. Basis of vibro piling broad band source level as a function of pile size.



Given the low confidence we have in this approach (low R² values) we use the 90th percentile level as the broadband source level. L_P is estimated to be 218 dB and SPL 189 dB. The frequency content is assumed to be identical to that of the impact piling.

Table 4. Vibro piling source levels summary.

	Mean case [dB]	Worst case [dB]
L_P	207	218
$SPL_{1\ sec}$	180	189

4 TRANSMISSION LOSS MODELLING

Transmission loss modelling is done using dBSea underwater noise modelling software.

This software is partially developed by us and is fully capable of carrying out all the requested modelling tasks. The dBSea software can model frequencies from 10 Hz to 168 kHz, normally as 3rd octave bands, but any logarithmic band-spacing can be used. All solvers are range dependent (meaning all conditions can change with range not just depth).

Further details of this modelling software package can be found in APPENDIX A - dBSea.

5 ASSESSMENT CRITERIA

5.1 Reporting units

All references to sound pressure levels, peak pressure levels and sound exposure levels refer to a logarithmic ratio between a reported/measured pressure or exposure and a reference pressure or exposure. As an example, a level of 220 L_p (decibel zero-to-peak) is equal to a peak pressure of 100000 Pascals (Pa) over ambient pressure, while 120 L_p is equal to 1 Pa over ambient pressure.

To avoid dealing with such large numbers as pascals (as a linear scale), they are converted to a decibel ratio (Table 5 for definitions). Besides compressing large numbers to a smaller scale this also corresponds better to how animals are thought to perceive sound, namely as relative steps. This means that an increase from 1 to 2 Pa *sounds like* the same increase as from 100 to 200 Pa, even though the first step was only 1 Pa, while the second was 100 Pa. This is better reflected in a logarithmic scale based on ratios, where both steps are equal, here 3 dB.

However, while dBs are practical, they can be hard to compare between studies, due to vague definitions, and so we have adopted the standards set by ISO 18405-2017 (Table 5 below).

For ease of reference please see following overview for unit definition.

Table 5: Definitions.

Unit	Definition	Comments
SPL (dB$_{\text{RMS}}$) ISO 18405- 2017: 3.2.1.1	$SPL = 10 \cdot Log_{10}\left(\frac{\frac{1}{t_2 - t_1} \cdot \int_{t_1}^{t_2} p(t)^2 dt}{1 \cdot 10^{-12} Pa}\right)$	Functionally equivalent to deprecated $20 \cdot Log_{10}\left(\frac{RMS}{1 \cdot 10^{-6} Pa}\right)$
L$_{\text{p}}$ (dB$_{\text{z-p}}$) ISO 18405- 2017: 3.2.2.1	$L_p = 10 \cdot Log_{10}\left(\frac{Pa_{max}{}^2}{1 \cdot 10^{-12} Pa}\right)$	This assumes that Pa_{max} is equal or greater than $\sqrt{Pa_{min}{}^2}$
L$_{\text{p-p}}$ (dB$_{\text{p-p}}$)	$L_{p-p} = 20 \cdot Log_{10}\left(\frac{Pa_{max} - Pa_{min}}{1 \cdot 10^{-6} Pa}\right)$	Often[4] equivalent to $L_P + 6.02\ dB$
L$_{\text{E}}$ (dB$_{\text{SEL}}$) ISO 18405- 2017: 3.2.1.5	$L_E = 10 \cdot Log_{10}\left(\frac{\int_{t_1}^{t_2} p(t)^2 dt}{1 \cdot 10^{-12} Pa}\right)$	For continuous sound this is equivalent to $SPL + 10 \cdot Log_{10}(t_2 - t_1)$ "t" is seconds. "SEL" is often used, but is deprecated as ISO unit.

Unless otherwise stated SPL has an averaging period of 1 second, and L$_{\text{E}}$ for the duration of the specified event, sometimes indicated as L$_{\text{E-"time"}}$ or L$_{\text{E-single blow}}$.

If the averaging period for SPL is equal to the total event duration then SPL is equal to "Leq", the "equivalent constant level".

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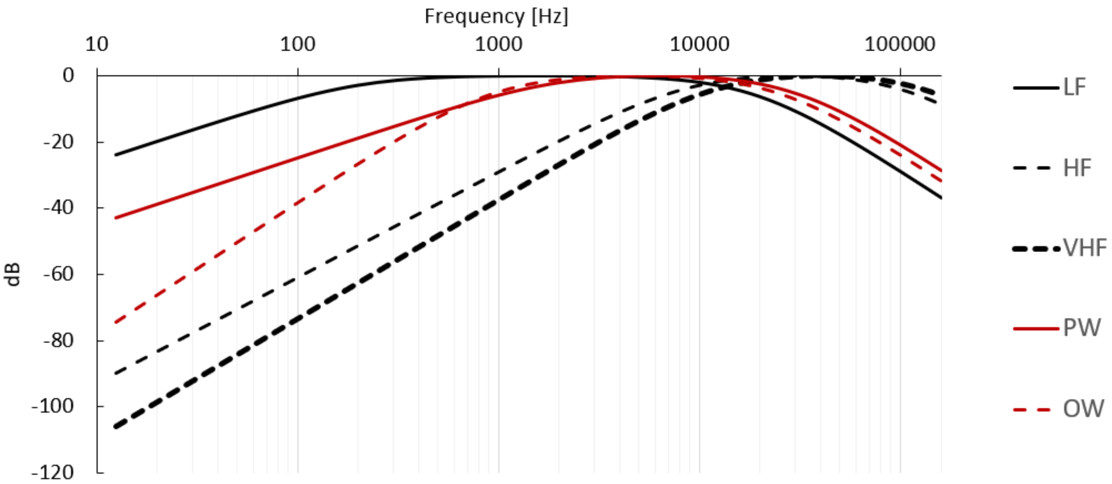
[4] If maximum pulse rarefaction is below ambient pressure and compression and rarefaction phases are of equal size.

When source levels are presented, the same units are used, and it is implicit that all source levels are given as if recorded 1 m from an omnidirectional mono-point source, unless otherwise specified.

5.2 Weighting of Noise Levels

When not reporting L_p or $L_{p\text{-}p}$ levels, the noise levels are often weighted according to a generalised hearing sensitivity profile for up to ten different hearing groups. This is done to better reflect the actual impact on the species in question, much like dB(C) level unit for humans.

Figure 9. Weightings for various hearing groups. For L_E levels, the weightings are applied to the noise level to give the weighted noise level (similar to dB(A) or dB(C)-weighted noise for humans).
See Table 6, p.18 for full group names and limits.



5.2.1 MARINE MAMMAL WEIGHTINGS

For the marine/aquatic mammals present we will adhere to the thresholds described in "Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing" (National Marine Fisheries Service, 2018), which determines impact from an assessment of area wherein the noise will induce either "Temporary Threshold Shift" (TTS) or "Permanent Threshold Shift" (PTS)[5] as judged by the weighted SEL level ($L_{E\text{-}24}$) over a typical 24-hour period or by L_P levels, for the different hearing groups.

Please note that the Southall 2019 thresholds and weightings are identical to the NMFS 2018 criteria, only the nomenclature has changed (Southall, et al., 2019; National Marine Fisheries Service, 2018).

Were relevant we might use the thresholds for behavioural disruption as set by NOAA fisheries[6]. These are 120 dB RMS[7] for continuous noise and 160 dB SPL[8] for impulsive noise.

The hearing groups from the Southall 2019 and the NMFS 2018 guidance were specified by collating available information on marine mammal hearing and generalising their hearing sensitivity into representative groups. This grouping represents a significant research effort and are reviewed by the leading experts (academic, industrial and conservation) on the topic. Because of the large amount of work this represents and the widespread acceptance of the method, the thresholds and the methodology associated, have become de-facto standards for assessing noise impact on marine mammals and represents best available knowledge and practise.

Along with weighting curves, similar in function to the human dB(C) curves, a set of thresholds for hearing impact and injury is associated with the framework and allows for conversion of threshold

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[5] TTS/PTS. A temporary/permanent change in hearing sensitivity caused by acoustic stimuli.

[6] Available from: https://archive.fisheries.noaa.gov/wcr/protected_species/marine_mammals/threshold_guidance.html

[7] Here taken as meaning "SPL"

[8] Assumed to be SPL of 90 % of energy in one impulse or SPL of total duration (L_{EQ}).

exceedance into ranges with risk of impact. E.g. we might see that the PW group (true seals) has a risk of PTS at ranges shorter than 50 meters, and a risk of TTS at ranges shorter than 200 meters.

All marine mammal species are covered by the hearing groups and a full list of species in the different groups can be found in the "Marine Mammal Noise Exposure Criteria: Updated Scientific Recommendations for Residual Hearing Effects" (Southall, et al., 2019), but in general the groups cover the following species:

Table 6. Summary of Southall 2019 thresholds and groups with species examples. For full species list see source (National Marine Fisheries Service, 2018; Southall, et al., 2019)

Hearing group	Species examples	Non-impulsive TTS/PTS threshold [$L_{E\text{-}24\ hours}$]	Impulsive TTS/PTS threshold [$L_{E\text{-}24\ hours}$]	Impulsive TTS/PTS threshold [L_p]
PW	Weddell Seal, Leopard Seal, Harbour Seal, Grey Seal	181/201	170/185	212/218
OW	Fur seals, Sea Lions, Otters, Polar Bear	199/219	188/203	226/232
LF	Fin Whale, Minke whale, Humpback whale, Right Whale	179/199	168/183	213/219
HF	Sperm Whale, Common dolphin, Bottlenose Dolphin, Killer Whale, Beaked Whales, Pilot Whales	178/198	170/185	224/230
VHF	Porpoises, Hourglass Dolphin	153/173	140/155	196/202

It's important to note that the assessment is thus based on the received level of receptors with the above-described auditory sensitivity and not based on the sensitivity of the individual species.

5.3 Fishes etc.

Impacts of noise on fishes is less well established than for marine mammals, but a review from 2014 (Popper, et al., 2014) provides guidelines on exposure limits for fish and turtles. The report does not directly use the PTS nomenclature (as above for mammals) as many fish have the capacity to repair structural damage to their ear, and even structural damage then cannot be said to be "permanent".

We use "PTS" here to cover the categories "Mortality and potential mortal injury" and "Recoverable injury".

TTS is directly used in the report, and we use it in the same way here.

Table 7. Overview of Impact piling thresholds from (Popper, et al., 2014) (Table 7.3 in report)

Hearing group	Species examples	Impulsive TTS/PTS threshold [$L_{E\text{-}24\ hours}$]	Impulsive TTS/PTS threshold [L_p]
P* (Fish with no swim bladder)	Sharks, Rays	186/216	TTS not specified/213
P- (Fish with swim-bladder, but not involved in hearing)	Salmon, Trout, Cod, Herring	186/203	TTS not specified/207
P+ (swim-bladder used in hearing)	Carp, Catfish	186/203	TTS not specified/207

5.4 Threshold Interpretation

5.4.1 THRESHOLD TYPES

The three threshold types refer to different ways that sound can affect the hearing of an animal and are ***important to keep in mind*** when evaluating the results of this report:

5.4.1.1 Non-impulsive, $L_{E\text{-}24\ hours}$

The threshold, over which an effect (TTS/PTS) occurs, taking into account ***continuous***[9] sound received by the animal over a typical 24-hour period as sound exposure, L_E.

When presented as a zone on a map, this refers to the area, within which, an animal would suffer the effect, if it stayed there for 24 hours (or the full duration of the activity or as otherwise specified). We thus identify areas given by this limit as areas of TTS-**risk** or PTS-**risk** respectively, i.e., an animal within the area has a risk of suffering from either TTS or PTS within the zone.
Alternatively this can be thought of as the total sound-dose limit over 24 hours.
Weightings are applied for non-impulsive L_E (for mammals only[10]).

5.4.1.2 Impulsive, $L_{E\text{-}24\ hours}$

The threshold, over which an effect (TTS/PTS) occurs, taking into account ***impulsive*** sound received by the animal over a typical 24-hour period as sound exposure, L_E.
When presented as a zone on a map, this refers to the area, within which, an animal would suffer the effect, if it stayed there for 24 hours (or the full duration of the activity or as otherwise specified). We thus identify areas given by this limit as areas of TTS-**risk** or PTS-**risk** respectively, i.e., an animal within the area has a risk of suffering from either TTS or PTS within this zone.
Alternatively this can be thought of as the total sound-dose limit over 24 hours.

5.4.1.2.1 Impulsive $L_{E\ single\ impulse}$ / $L_{E\ \#\ impulses}$

It is sometimes useful to assess the impact of a single/a number of impulse(s). When we do this, we will refer to it as “LE single impulse / LE # impulses”.
Like for the Lp, when single-impulse LE is presented as an impact zone, this refers to the area, within which, an animal would suffer the effect acutely/instantly.

Weightings are applied for Impulsive L_E (for mammals only).

---

[9] Please see (National Marine Fisheries Service, 2018) for definitions of “non-impulsive” and “impulsive”. For quick reference, if a sound is shorter than 1 second and is clearly intermittent in nature, it is impulsive – otherwise, it’s continuous.

[10] When assessing for fish groups levels are not weighted.

5.4.1.3 Impulsive, L_p

The threshold over which an effect (TTS/PTS) occurs, taking into account ***impulsive*** sound received by the animal at any instant as maximal peak pressure.
When presented as a zone on a map, this refers to the area, within which, an animal would suffer the effect acutely/instantly and from just one exposure.
Weightings are ***not*** applied for Impulsive L_P.

5.4.2 MASKING

Levels that are not over threshold can still cause significant impact, if that noise makes foraging, navigation or communication harder due to masking or where biologically relevant sounds are “drowned out” by the anthropogenic noise. Continuous noise is more likely than impulsive noise to cause this form of impact.

5.4.3 DISPERSAL

Many animals can recognise sounds and might be dispersed from an area at noise levels well below TTS limits. Quantifying a level of dispersal from desk-spaced studies is very challenging and not done here.

6 CONCLUSION

We conclude that the overall risk of direct acoustic impact on assessed species following the piledriving is very low.

The main reasons are:

- A conservative approach: Using upper 90th percentile source levels & and mean high water spring tide (MHWS), leading to elevated received levels.
- The results show some risk of hearing injury (PTS) only at prolonged exposure (>10 min) in a very confined area (immediately outside the berth).
- Slow-moving (0.5 m/s) receivers are not expected to experience PTS.

Additionally, the confined nature of the site means that acoustic masking is limited to a relatively short section of the river; ~2 km over background noise level and ~1500 m >120 dB SPL.

We note that the noise might deter an animal from moving past the site while its active, meaning the activity could lead to other, not directly acoustic, impacts on animals’ fecundity.

7 RESULTS

The reader should note that the “risk zones” are to be interpreted as areas where, if the receiver is within that zone for the prescribed number of blows/duration of time, the impact is likely to occur. Thus, a moving receiver (animal) might not spend e.g., 10 minutes in the same area, and therefore receive lower noise exposure than pictured in the maps.

7.1 Summary

7.1.1 IMPACT PILING

7.1.1.1 L_P – Peak pressure

For the acute injury risk from peak pressure the VHF-group (Harbour Porpoise) has the largest risk range, 65 m to TTS risk (ignoring range into the berth), coinciding spatially with the mouth of the berth.

All other groups have negligible risk ranges for TTS and PTS (both <25 m).

7.1.1.2 L_E – Exposure level

For groups VHF and PW (Harbour porpoise, Harbour Seal and Grey Seal) there is possible PTS after ~10 min exposure if animals remain in the area directly outside the berth, keeping in mind that for a moving animal this is an overestimate of the impact. From the received levels from a moving animal (section 7.3.2, p. 44 & 7.3.3, p. 45) it seems that for the worst-case source level some TTS is likely at low swimming speeds (0.5 m/s), while it’s unlikely for the mean-case, where the source level is ~12 lower.

For group OW (Otter) there is low risk of TTS after >10 min of piling, but even after 40 minutes, the risk of PTS remains low (section 7.2.4, p. 35). For a slow-moving animal (0.5 m/s) there is little to no risk of auditory injury (section 7.3.4, p. 45).

The P- group (Salmon), might experience some TTS after ~10 min with a little risk of PTS after ~40 min (section 7.2.5, p. 39). For a moving animal this risk of any auditory injury is low (section 7.3.1, p. 44).

7.1.2 VIBRATORY PILING

Given the substantially lower levels estimated for the vibro piling we have not included a separate assessment for this activity.

The SPL for vibro piling is 189 dB SPL, this is 19 dB below the assessed 208 dB SPL of the Impact piling and would lead to negligible risk zones.

The L_P for vibro piling is likewise significantly below the L_P for impact piling (218 versus 245) and is not of concern in relation to direct acoustic impact o the assessed species.

7.2 Impact Piling

As well as the “mean-case” and “worst-case” scenarios, the impact piling has been split into 3 different durations/blow-counts:

- A single blow - think of this as the acute injury risk.
- 10 minutes, assumed to be ~340 blows. This is the time it would take an animal swimming at 0.5 m/s to pass the site.
- 40 minutes, assumed to be 1334 blows and the full installation of a single pile[11].

Note that all results assume water depth as Mean-High-Water-Spring (MHWS) tide level, this is a conservative measure as shallower water will lead to higher transmission losses, for this type of scenario.

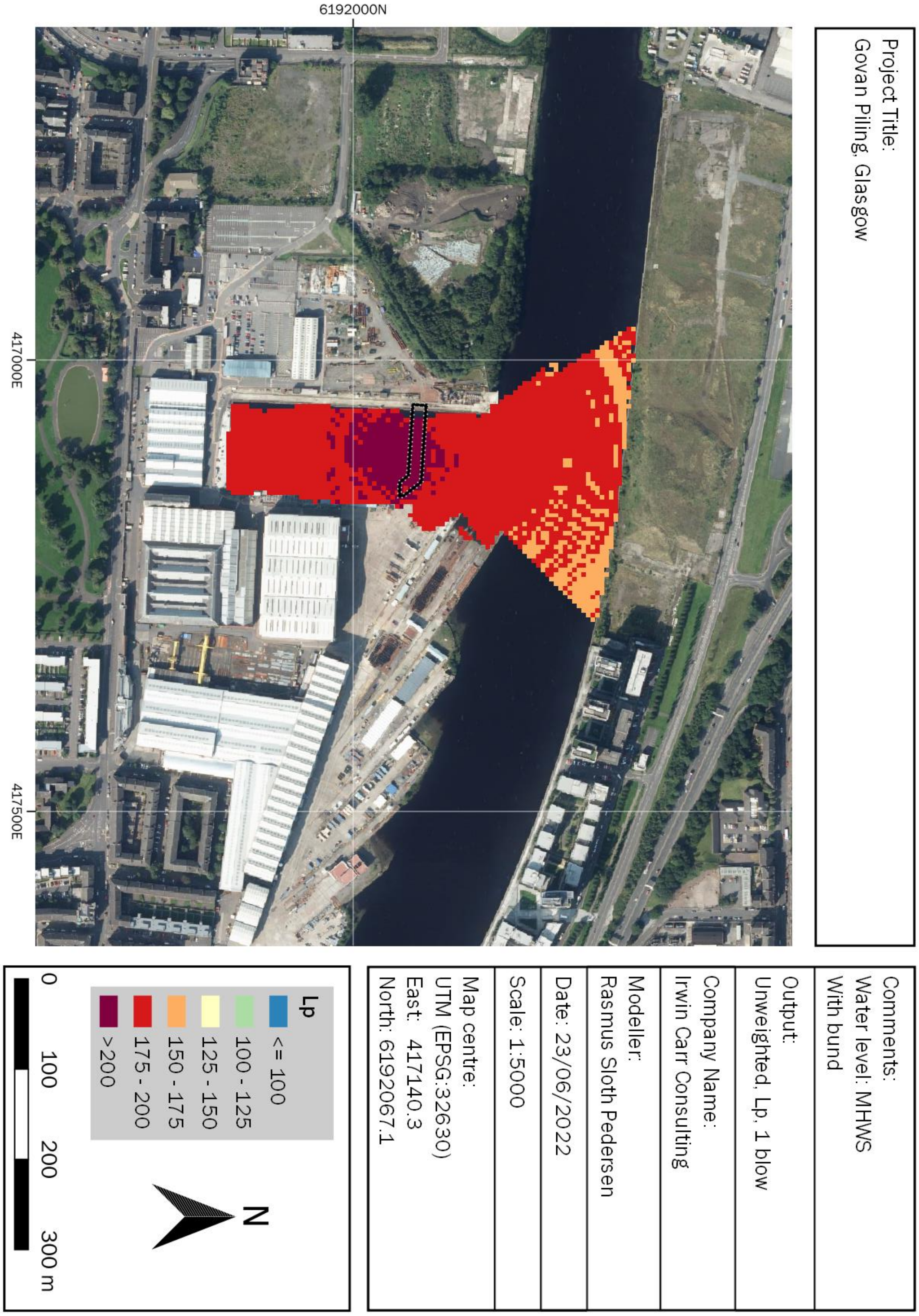
---

[11] It’s the blow count that matters for the exposure, so if the final installation time is longer per pile, but the blow count is similar, the results maps are still appropriate.

7.2.1 UNWEIGHTED

For unweighted noise levels the minimal level that it makes sense to display is the SPL of the background noise level, 97 dB[12] (Figure 5, p. 12)). For 40 minutes the background noise is thus equivalent to 131 dB L_E.

7.2.1.1 L_P



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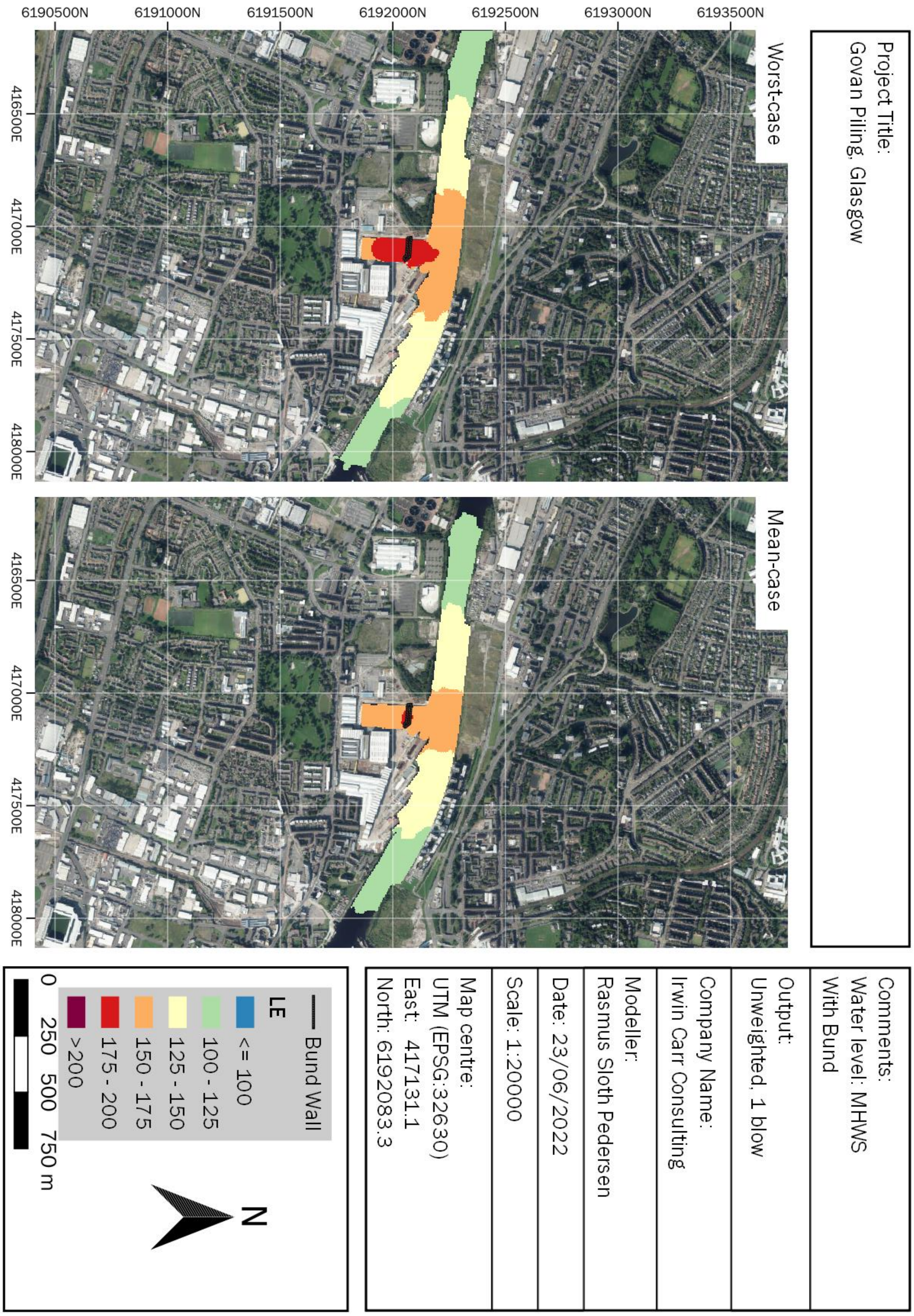
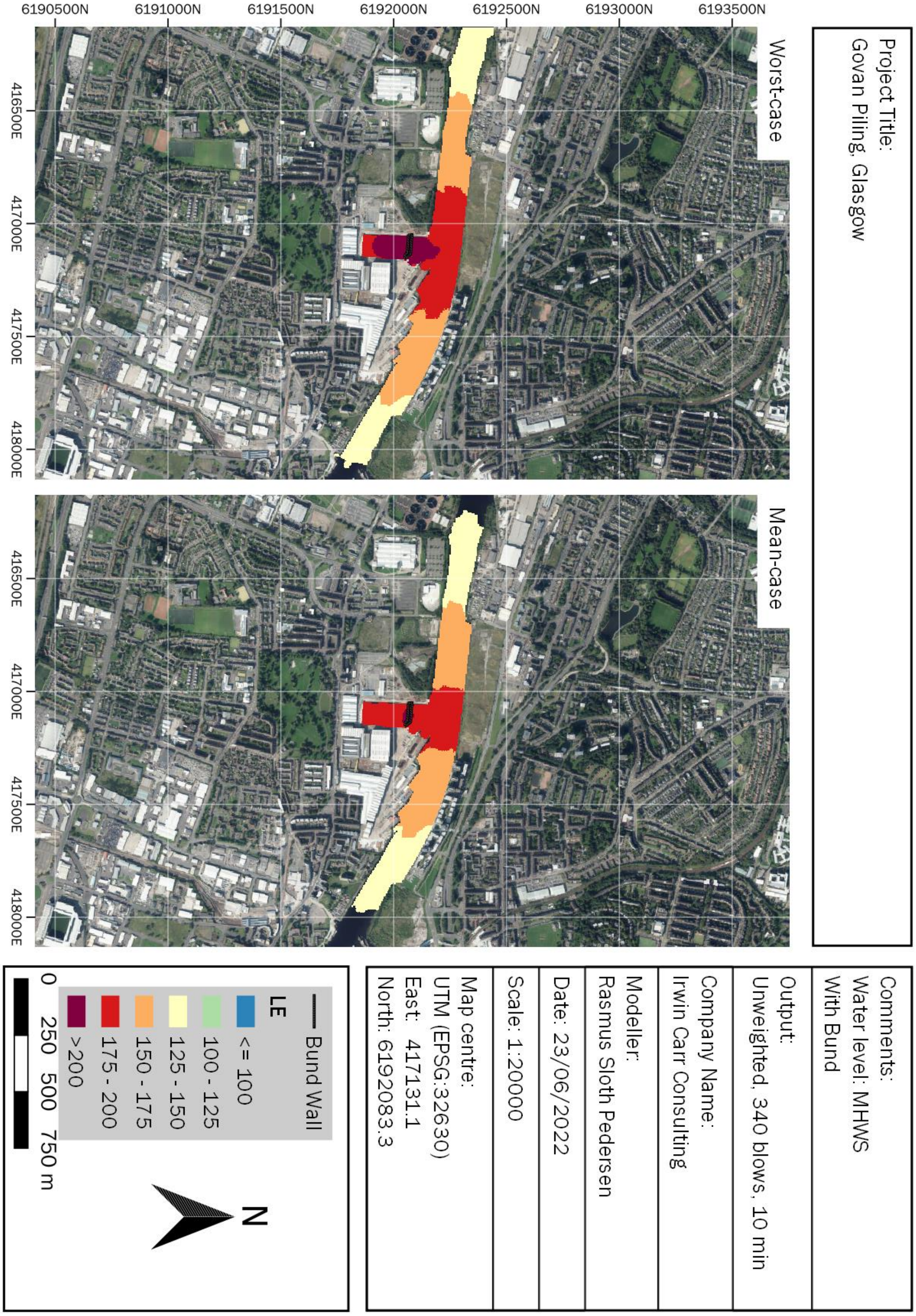
[12] The SPL of the impact pile driving is $L_E + 10\text{Log}_{10}(\text{blow rate}) = L_E + 10\text{Log}_{10}(0.57) = L_E - 3$ dB.

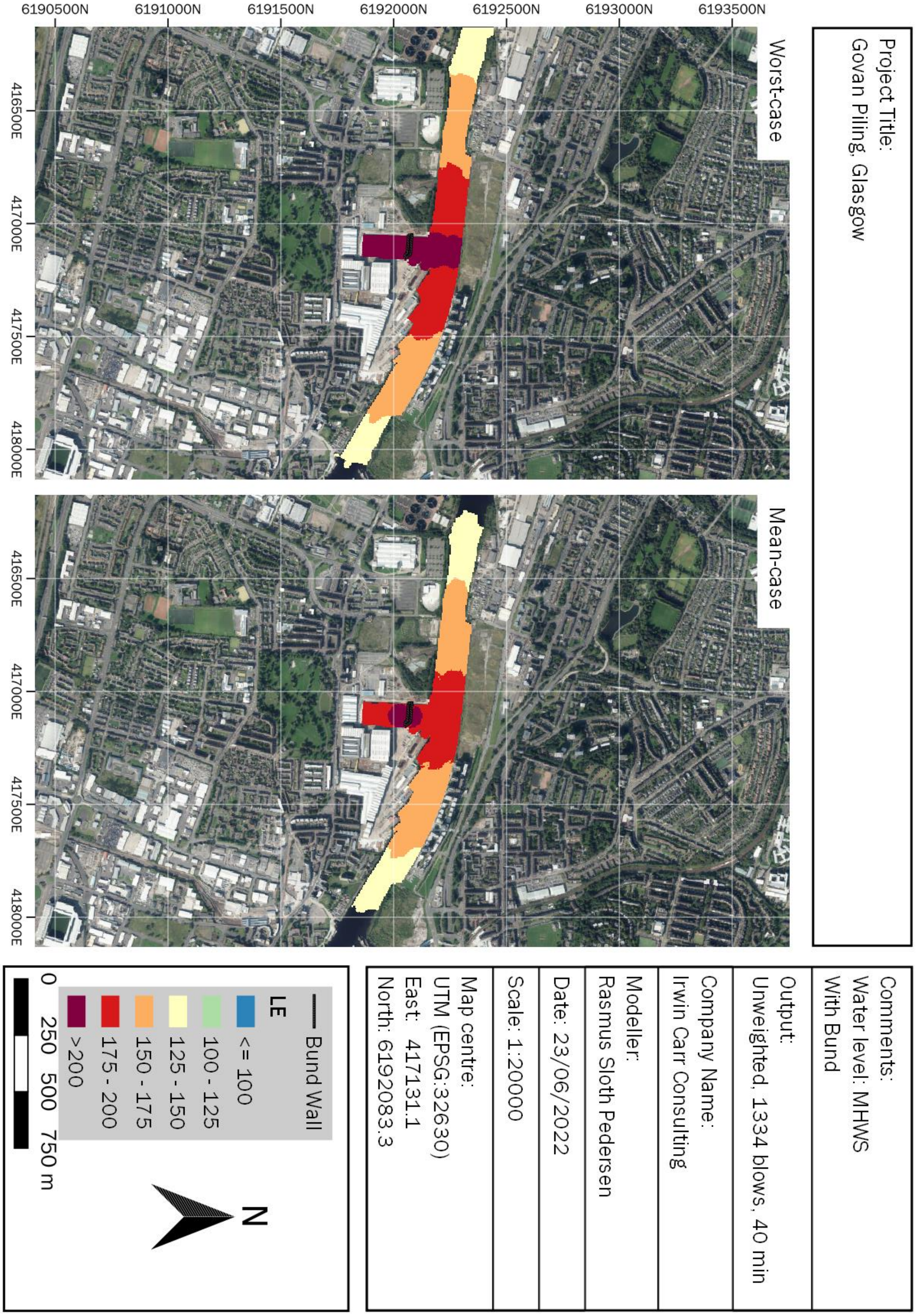
7.2.1.2 L_E Single blow



7.2.1.3 *L_E 340 blows, 10 minutes*



7.2.1.4 L$_E$ 1334 blows, 40 minutes



Project Title:
Govan Piling, Glasgow

Comments:
Water level: MHWS
With Bund

Output:
Unweighted, 1334 blows, 40 min

Company Name:
Irwin Carr Consulting

Modeller:
Rasmus Sloth Pedersen

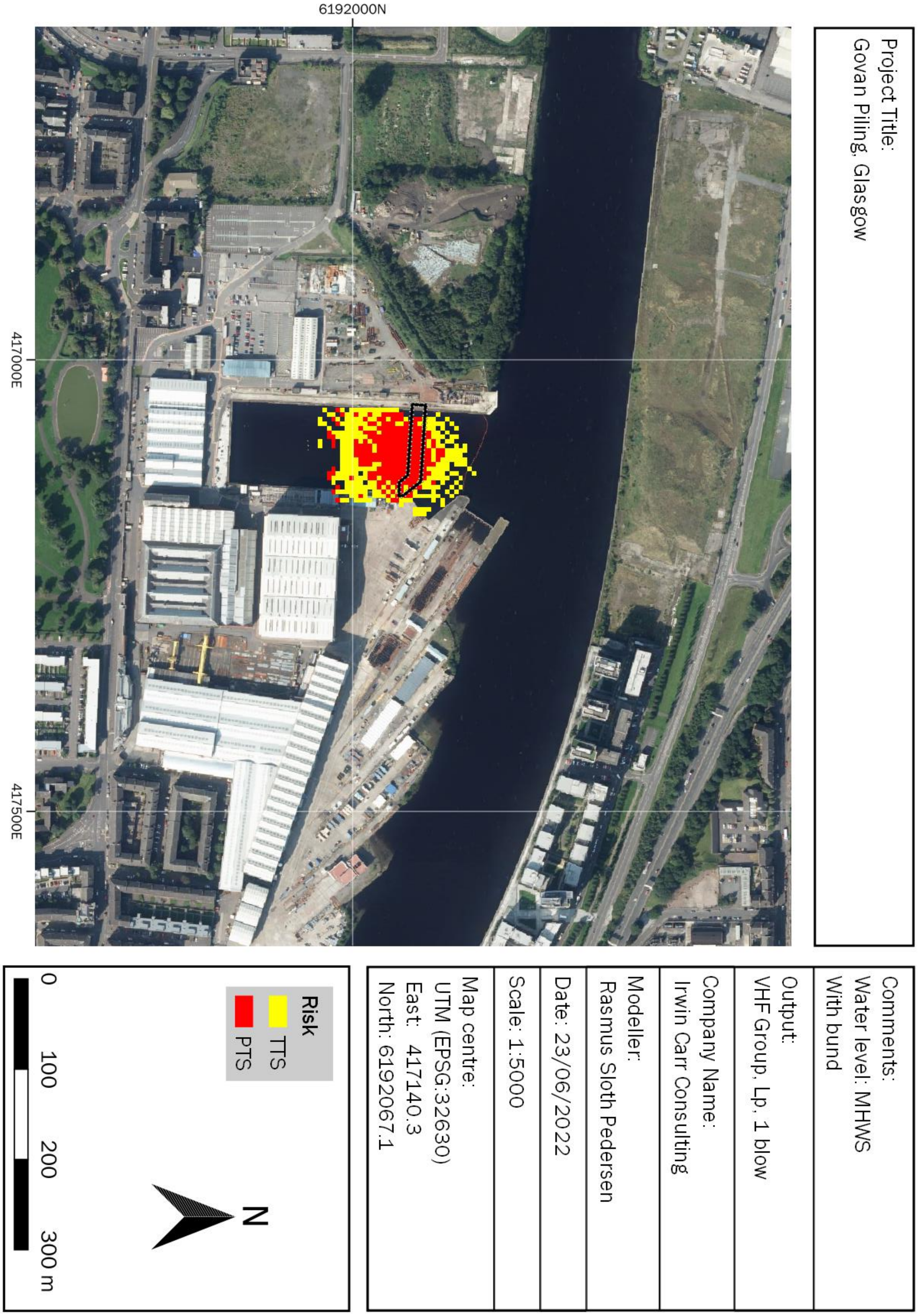
Date: 23/06/2022

Scale: 1:20000

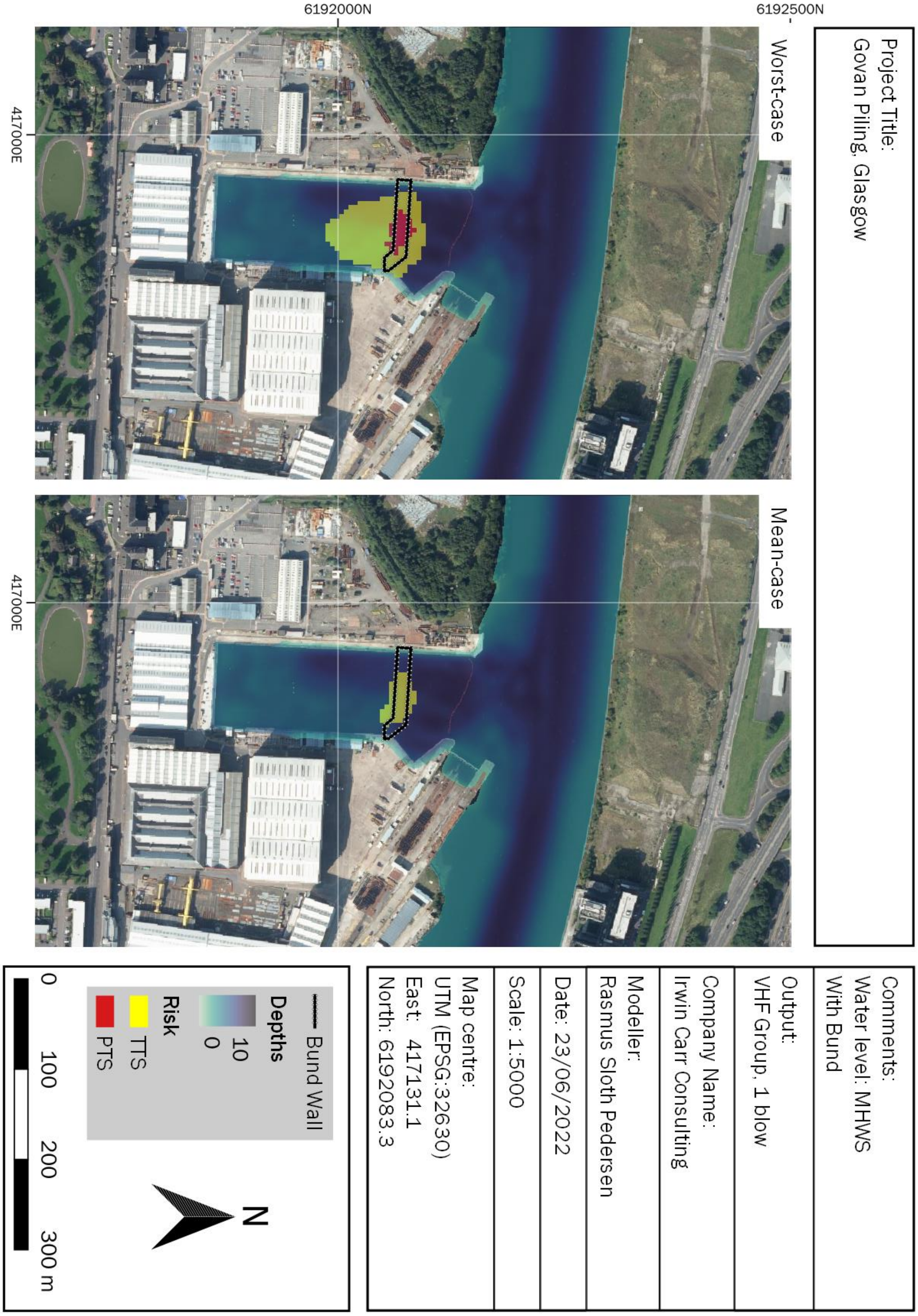
Map centre:
UTM (EPSG:32630)
East: 417131.1
North: 6192083.3

7.2.2 WEIGHTED (VHF) – HARBOUR PORPOISE

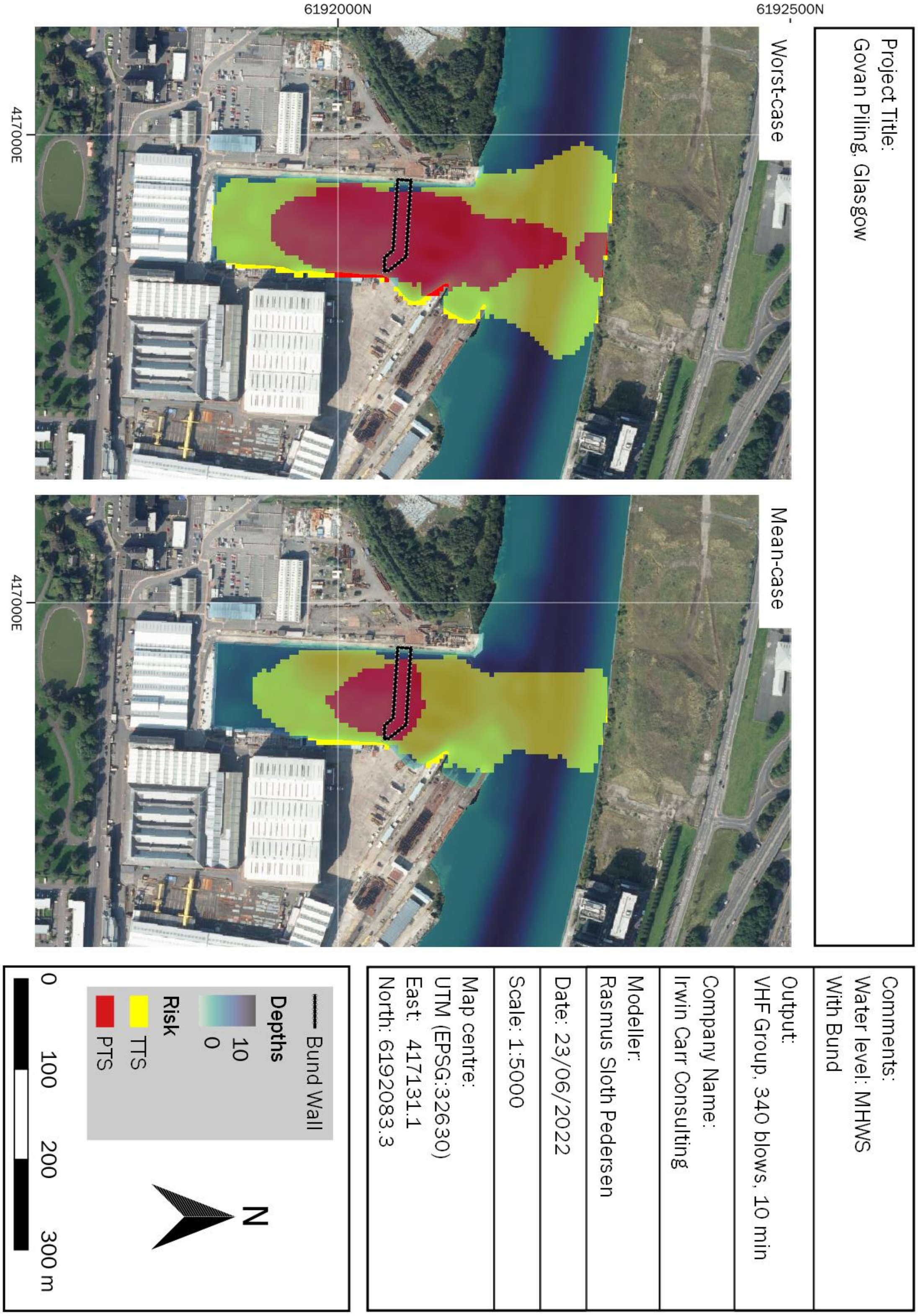
7.2.2.1 L_P



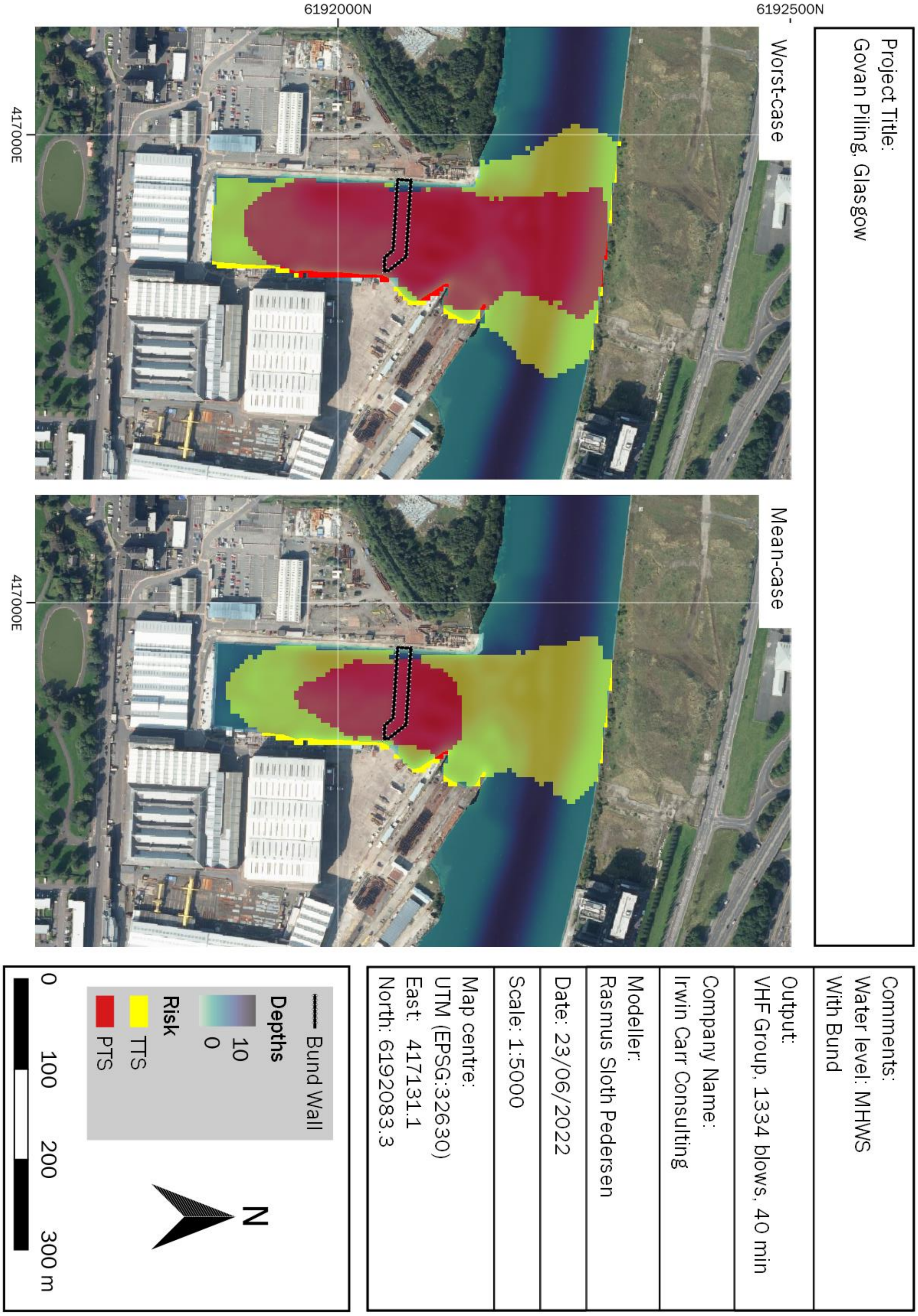
7.2.2.2 L_E Single blow



7.2.2.3 L_E 340 blows, 10 minutes



7.2.2.4 L_E 1334 blows, 40 minutes



Project Title:
Govan Piling, Glasgow

Comments:
Water level: MHWS
With Bund

Output:
VHF Group. 1334 blows, 40 min

Company Name:
Irwin Carr Consulting

Modeller:
Rasmus Sloth Pedersen

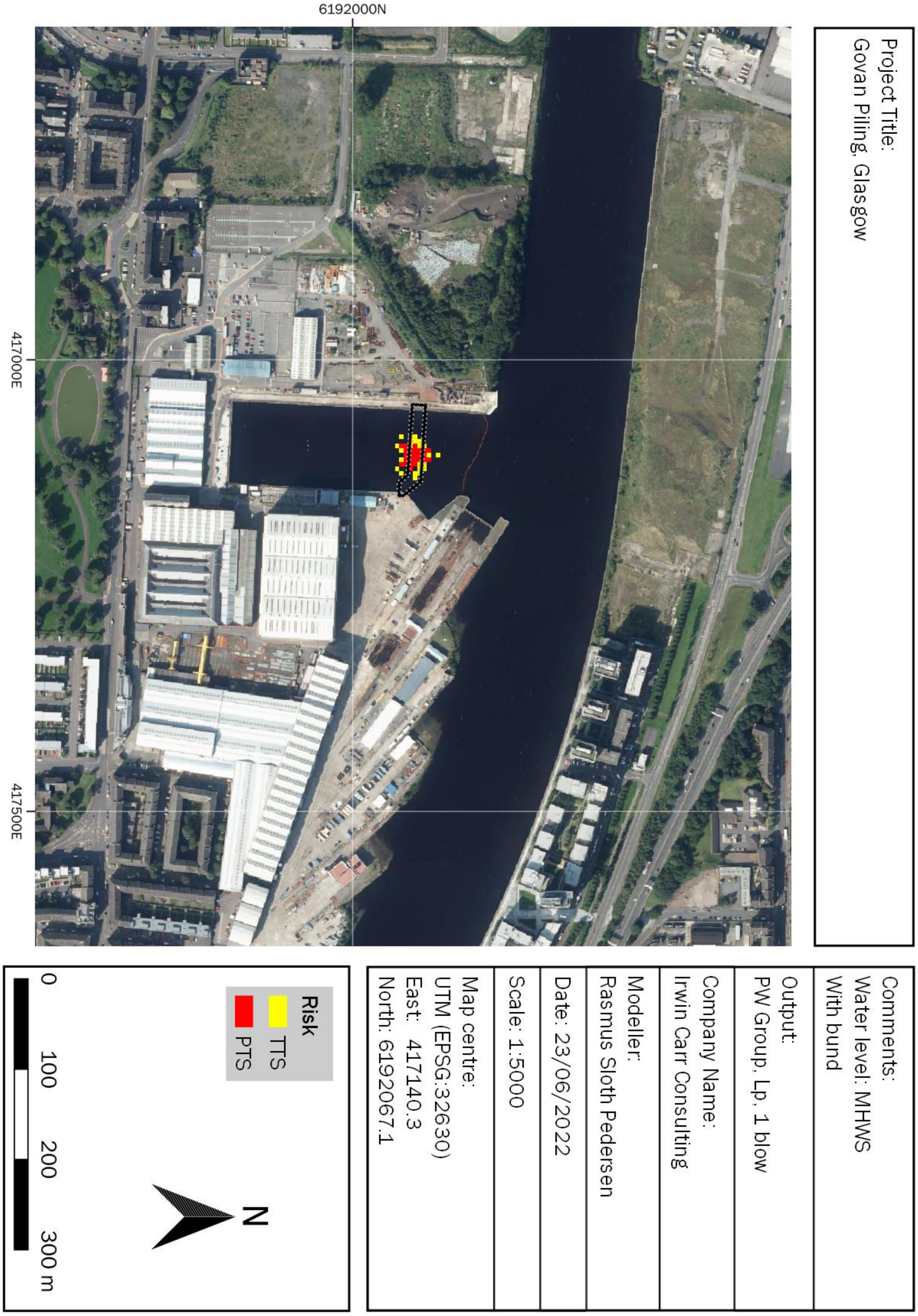
Date: 23/06/2022

Scale: 1:5000

Map centre:
UTM (EPSG:32630)
East: 417131.1
North: 6192083.3

7.2.3 WEIGHTED (PW) - SEALS

7.2.3.1 L_P



Project Title:
Govan Piling, Glasgow

Comments:
Water level: MHWS
With bund

Output:
PW Group, Lp, 1 blow

Company Name:
Irwin Carr Consulting

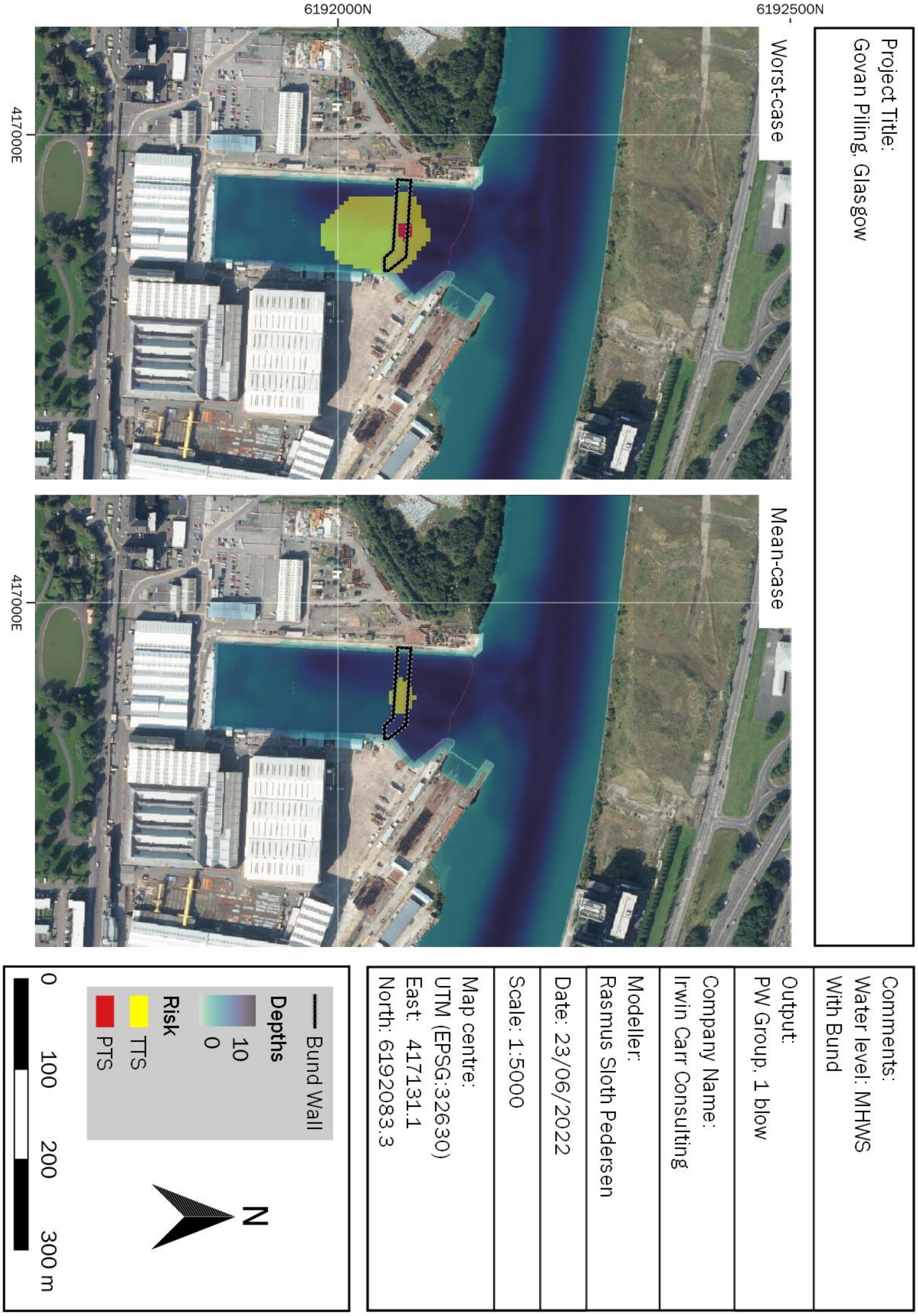
Modeller:
Rasmus Sloth Pedersen

Date: 23/06/2022

Scale: 1:5000

Map centre:
UTM (EPSG:32630)
East: 417140.3
North: 6192067.1

7.2.3.2 L_E Single blow



Project Title:
Govan Piling, Glasgow

Comments:
Water level: MHWS
With Bund

Output:
PW Group, 1 blow

Company Name:
Irwin Carr Consulting

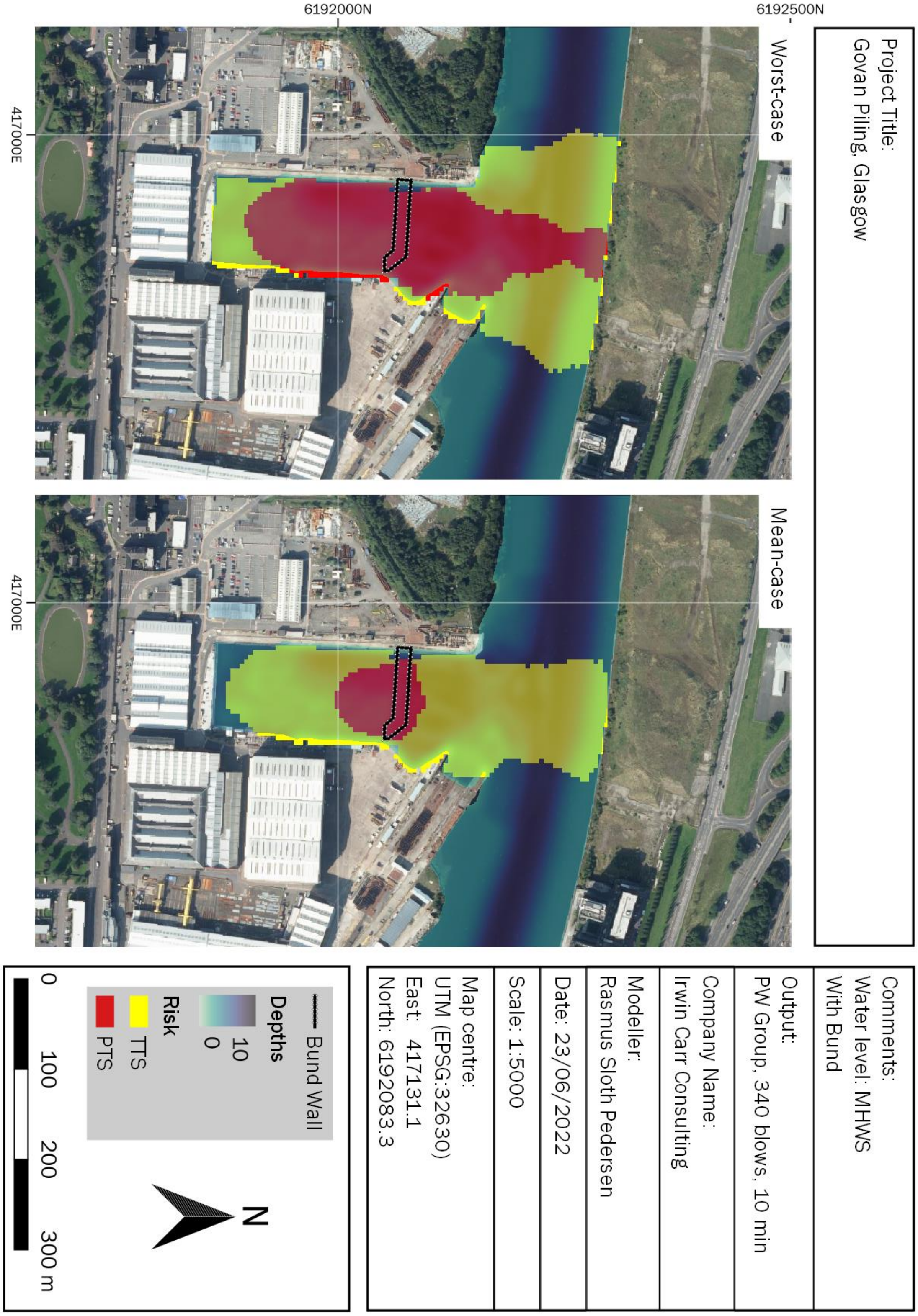
Modeller:
Rasmus Sloth Pedersen

Date: 23/06/2022

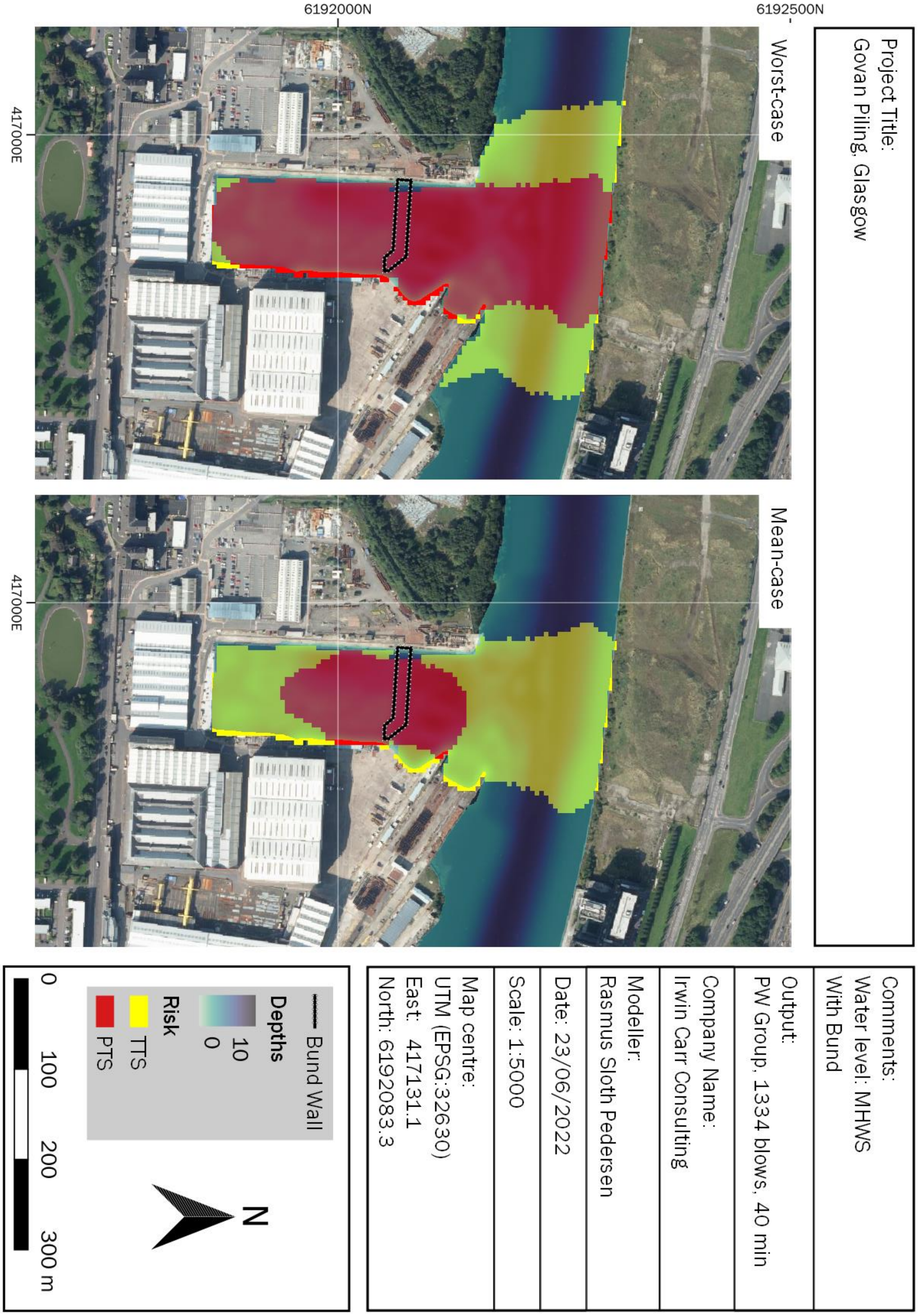
Scale: 1:5000

Map centre:
UTM (EPSG:32630)
East: 417131.1
North: 6192083.3

7.2.3.3 L_E 340 blows, 10 minutes

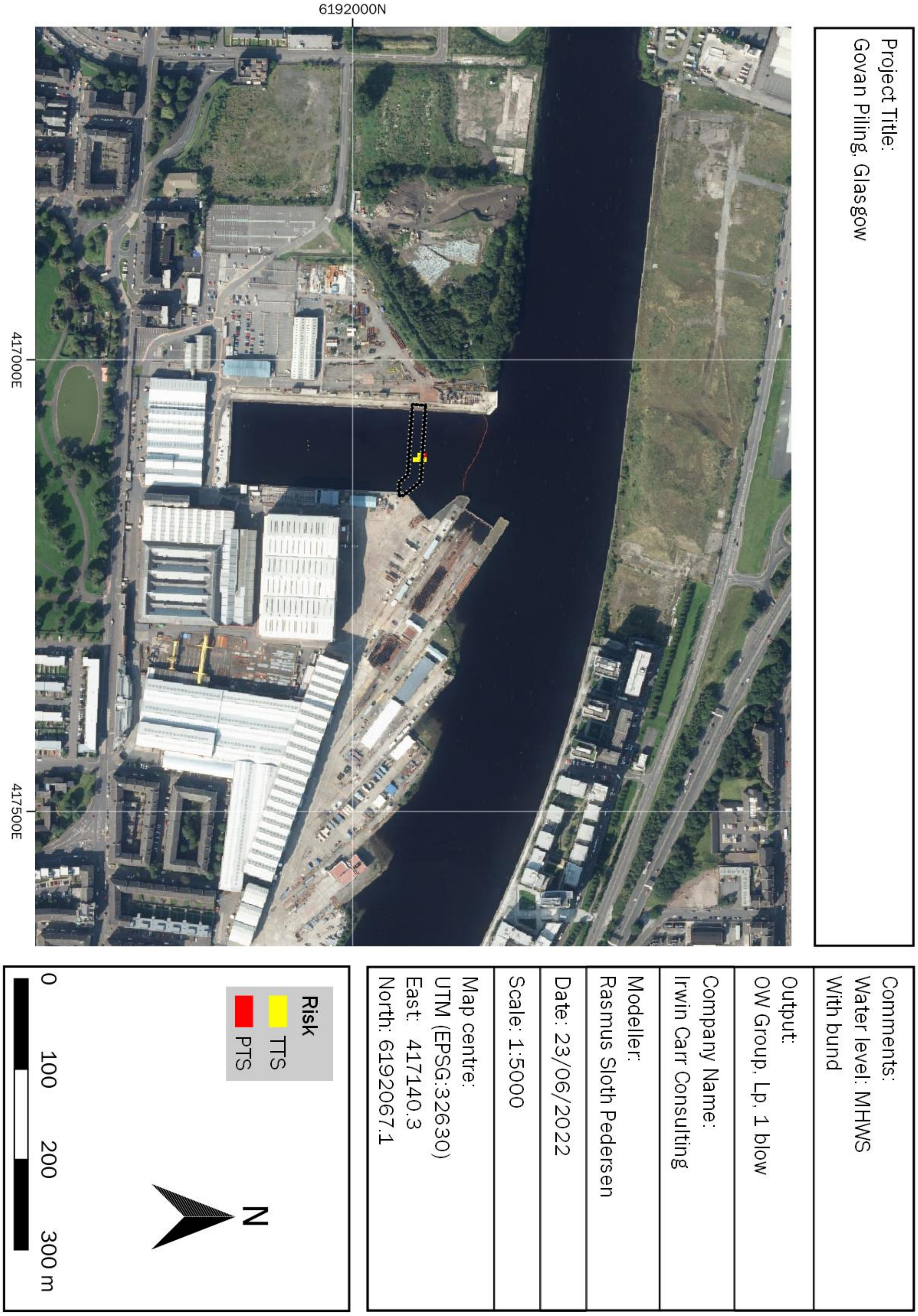


7.2.3.4 L$_E$ 1334 blows, 40 minutes

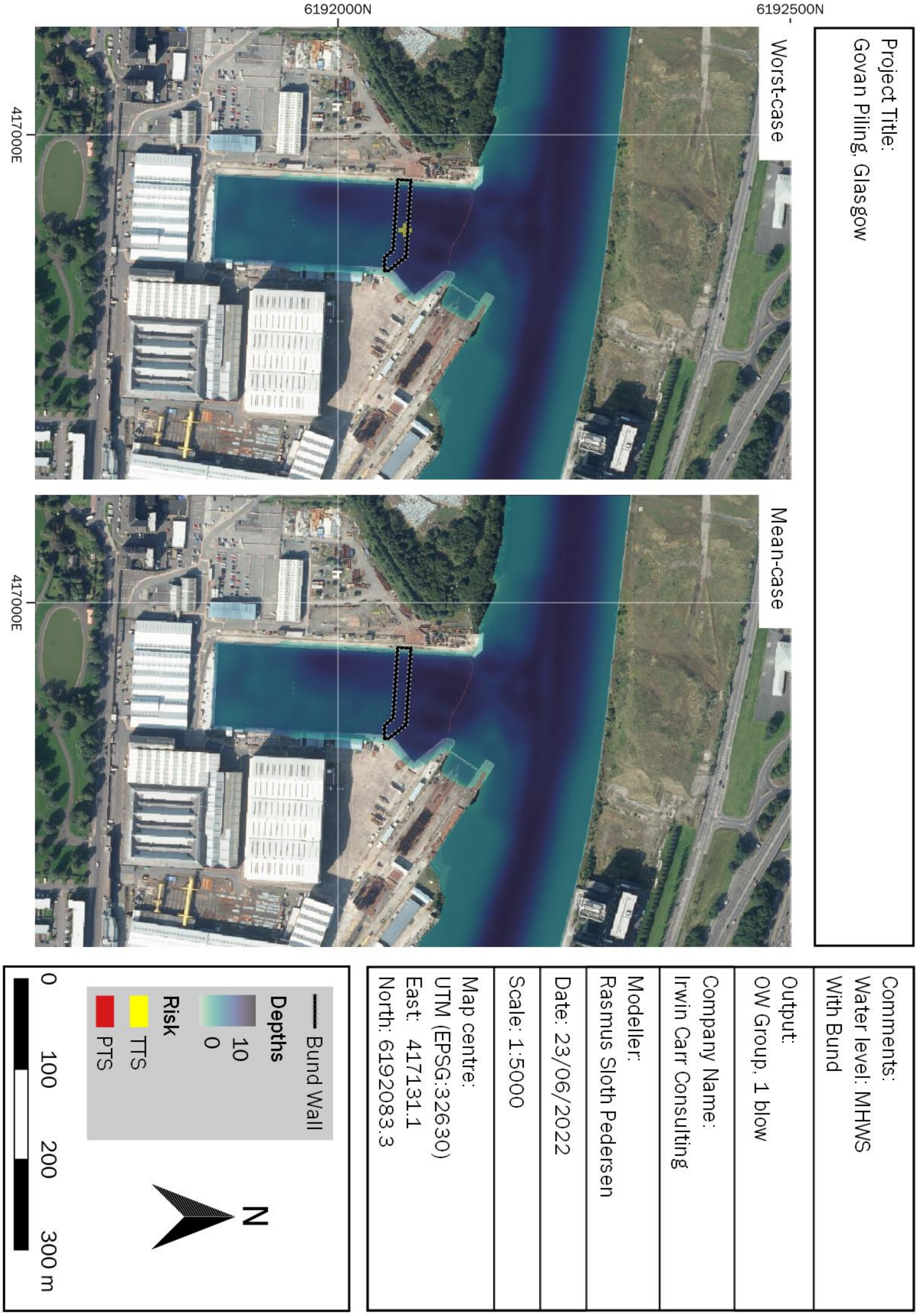


7.2.4 WEIGHTED (OW) - OTTER

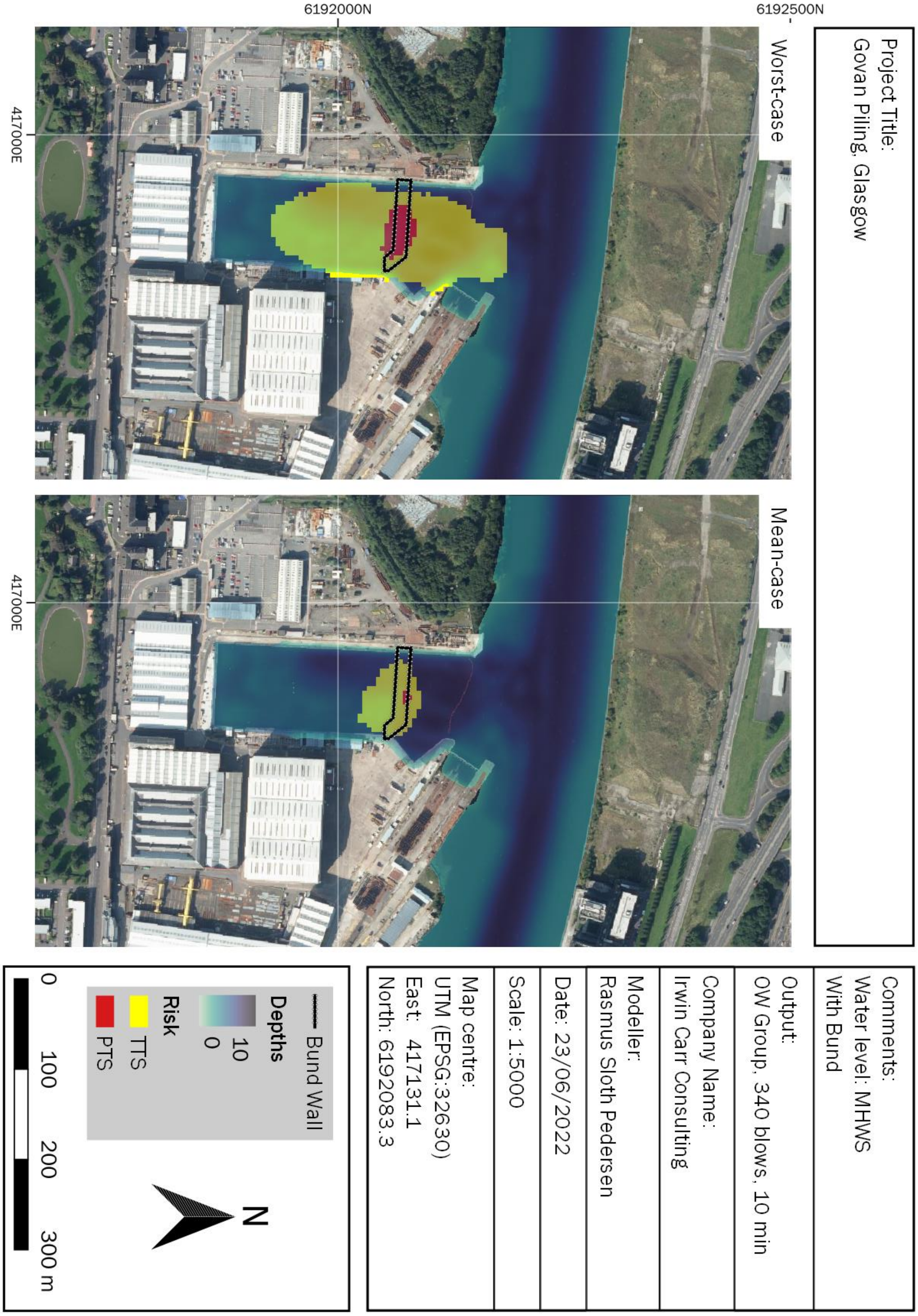
7.2.4.1 *L_P*



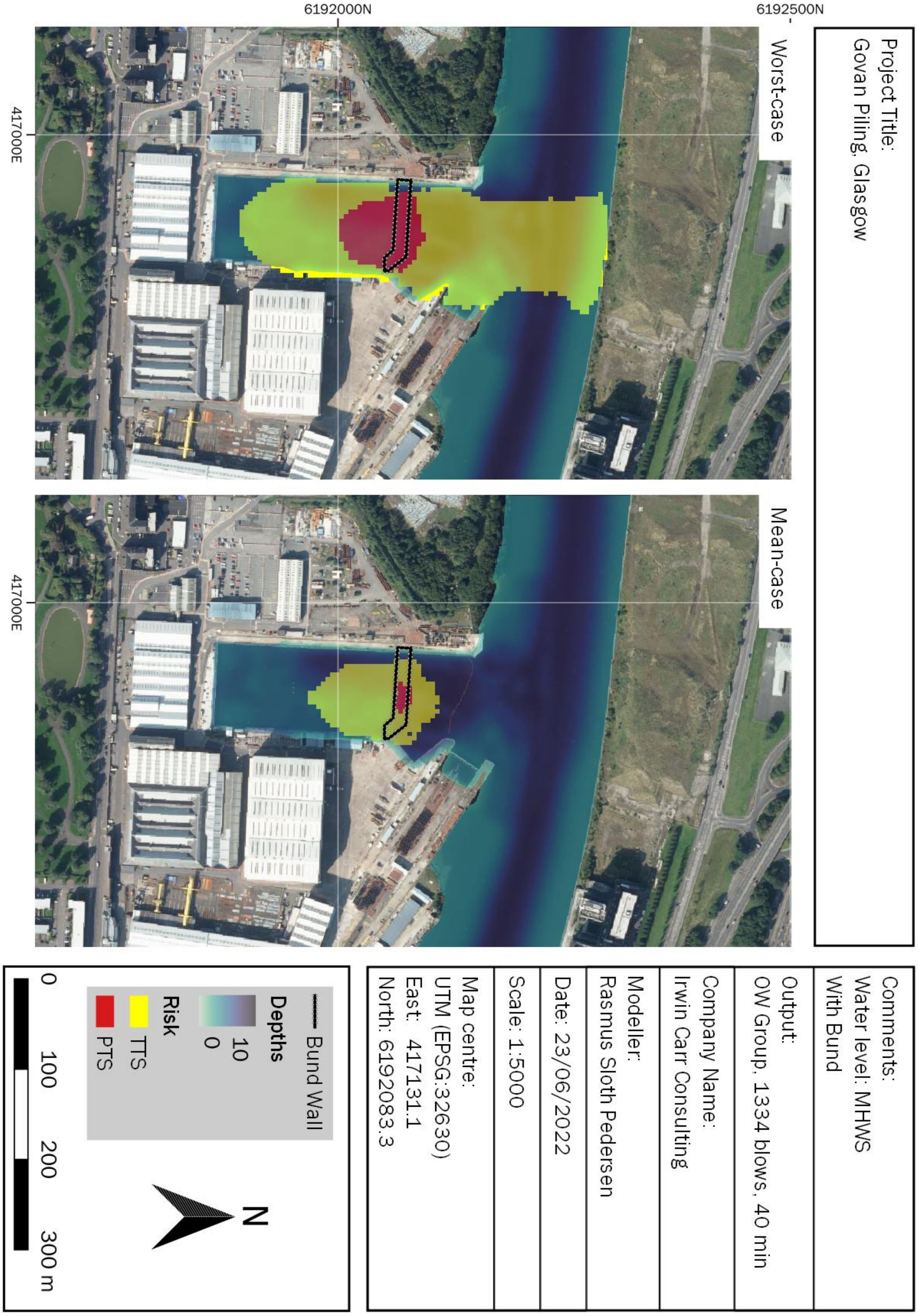
7.2.4.2 L_E Single blow



7.2.4.3 L_E 340 blows, 10 minutes



7.2.4.4 L_E 1334 blows, 40 minutes



Project Title:
Govan Piling, Glasgow

Comments:
Water level: MHWS
With Bund

Output:
OW Group, 1334 blows, 40 min

Company Name:
Irwin Carr Consulting

Modeller:
Rasmus Sloth Pedersen

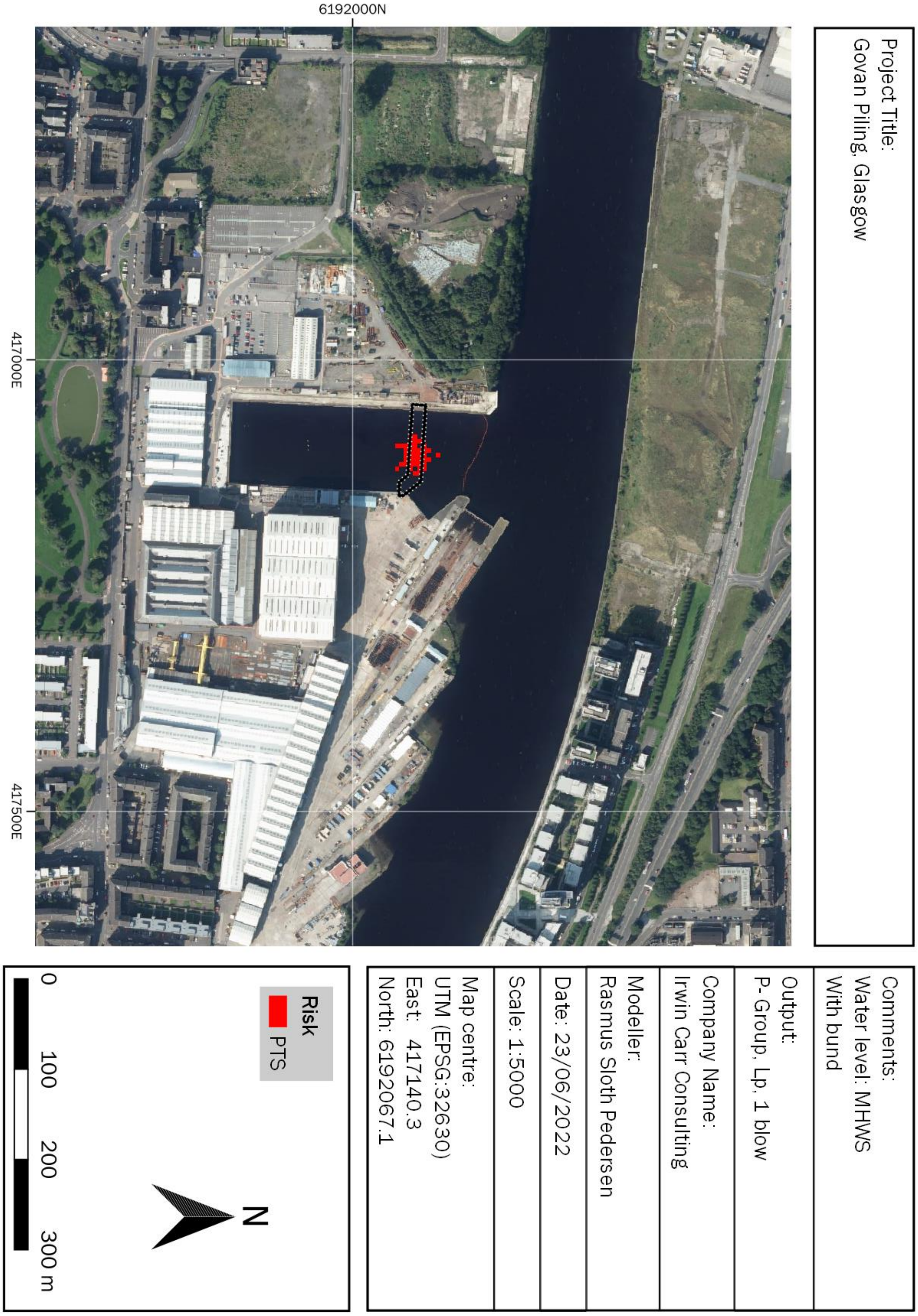
Date: 23/06/2022

Scale: 1:5000

Map centre:
UTM (EPSG:32630)
East: 417131.1
North: 6192083.3

7.2.5 UNWEIGHTED (P-) - SALMON

7.2.5.1 L_P



Project Title:
Govan Piling, Glasgow

Comments:
Water level: MHWS
With bund

Output:
P- Group, Lp, 1 blow

Company Name:
Irwin Carr Consulting

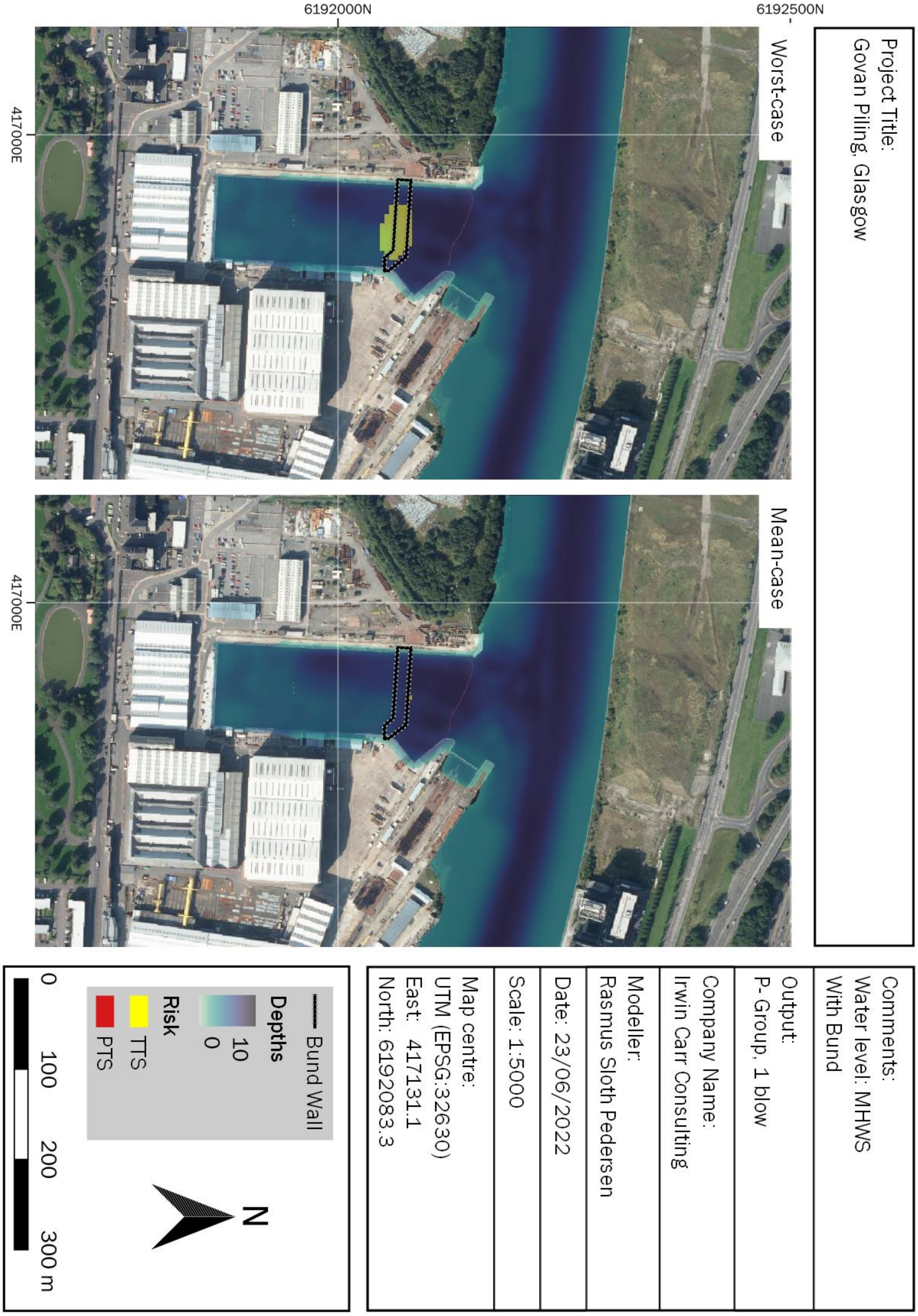
Modeller:
Rasmus Sloth Pedersen

Date: 23/06/2022

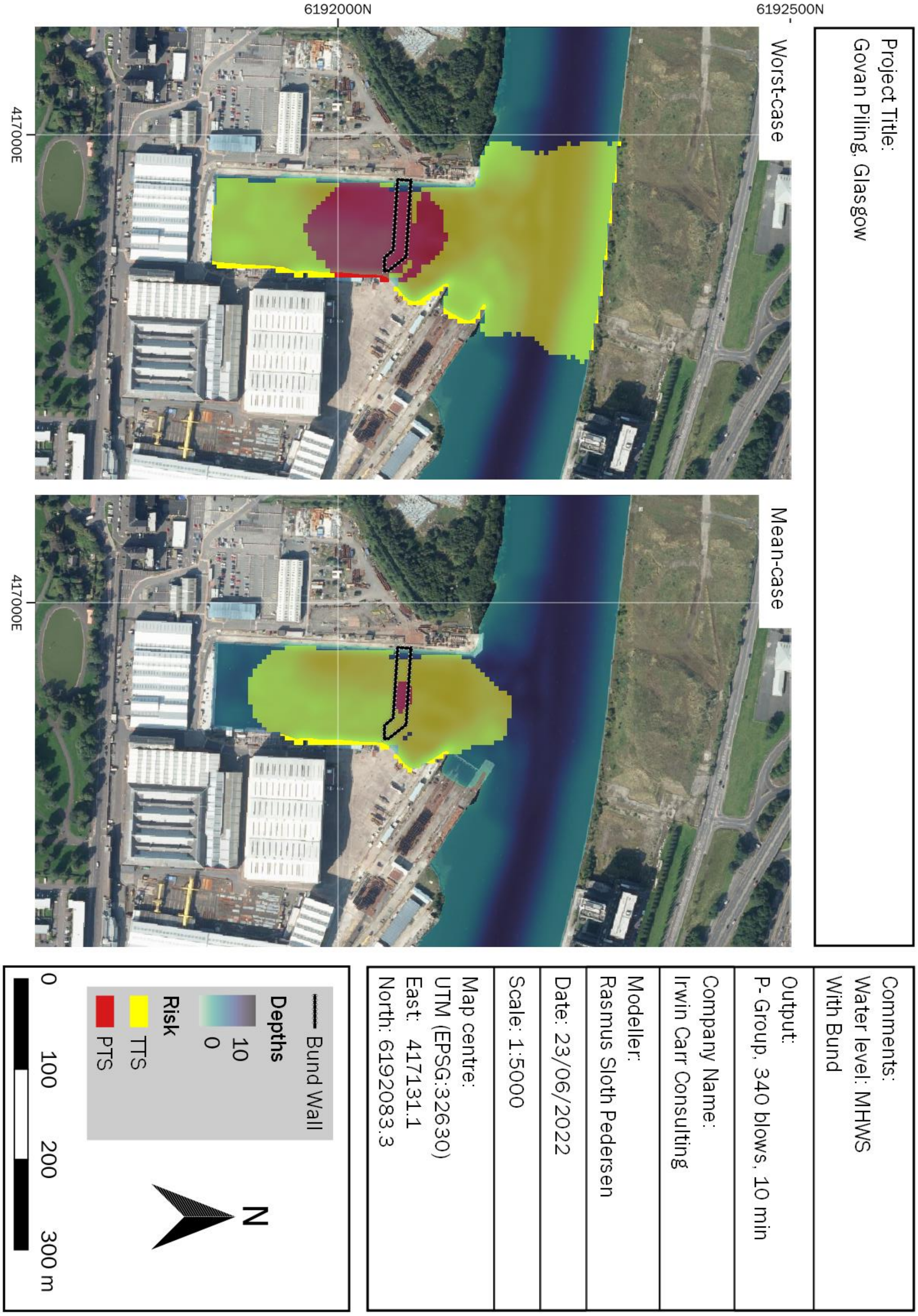
Scale: 1:5000

Map centre:
UTM (EPSG:32630)
East: 417140.3
North: 6192067.1

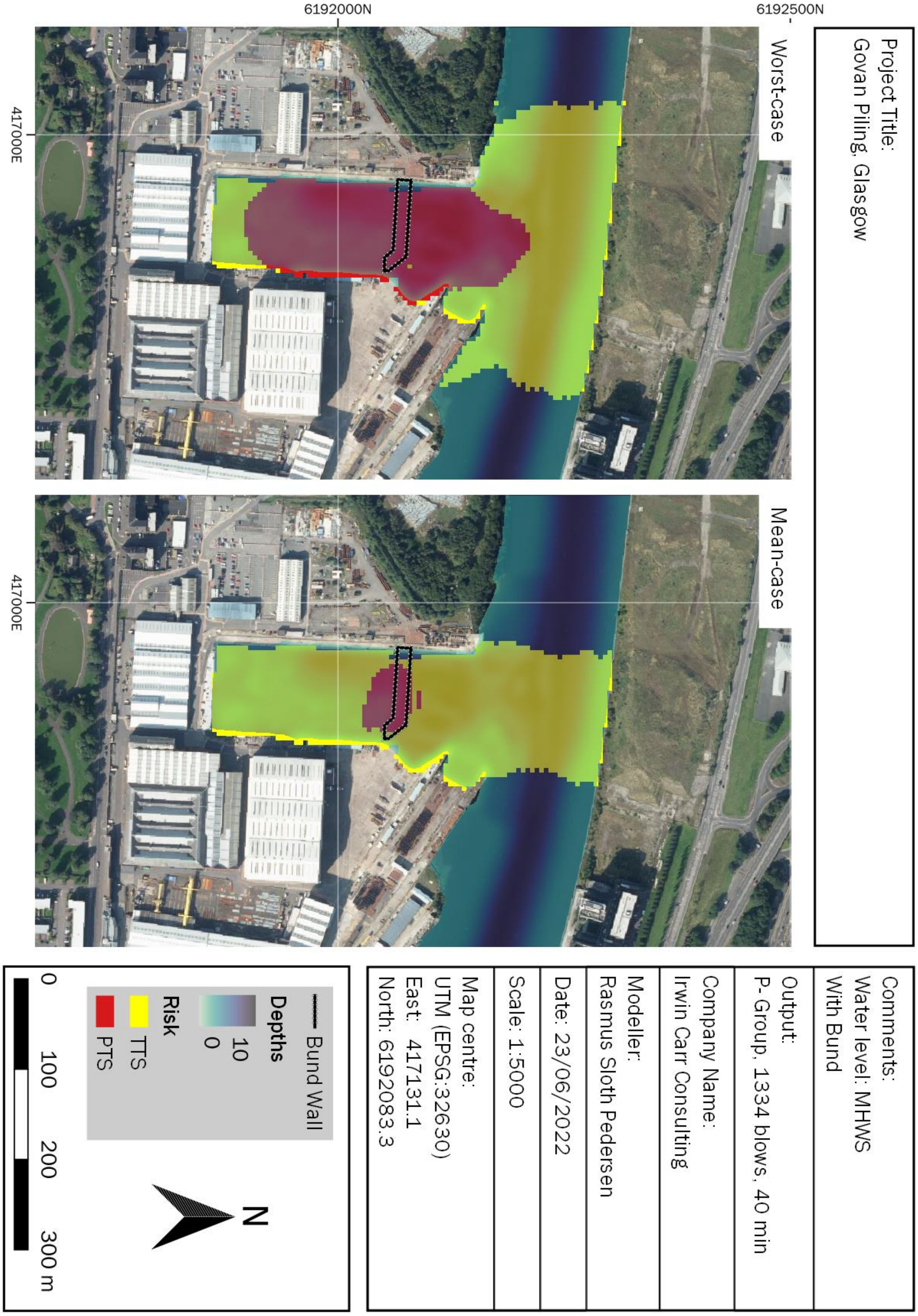
7.2.5.2 L_E Single blow



7.2.5.3 L_E 340 blows, 10 minutes



7.2.5.4 *LE 1334 blows, 40 minutes*



Project Title:
Govan Piling, Glasgow

Comments:
Water level: MHWS
With Bund

Output:
P-Group, 1334 blows, 40 min

Company Name:
Irwin Carr Consulting

Modeller:
Rasmus Sloth Pedersen

Date: 23/06/2022

Scale: 1:5000

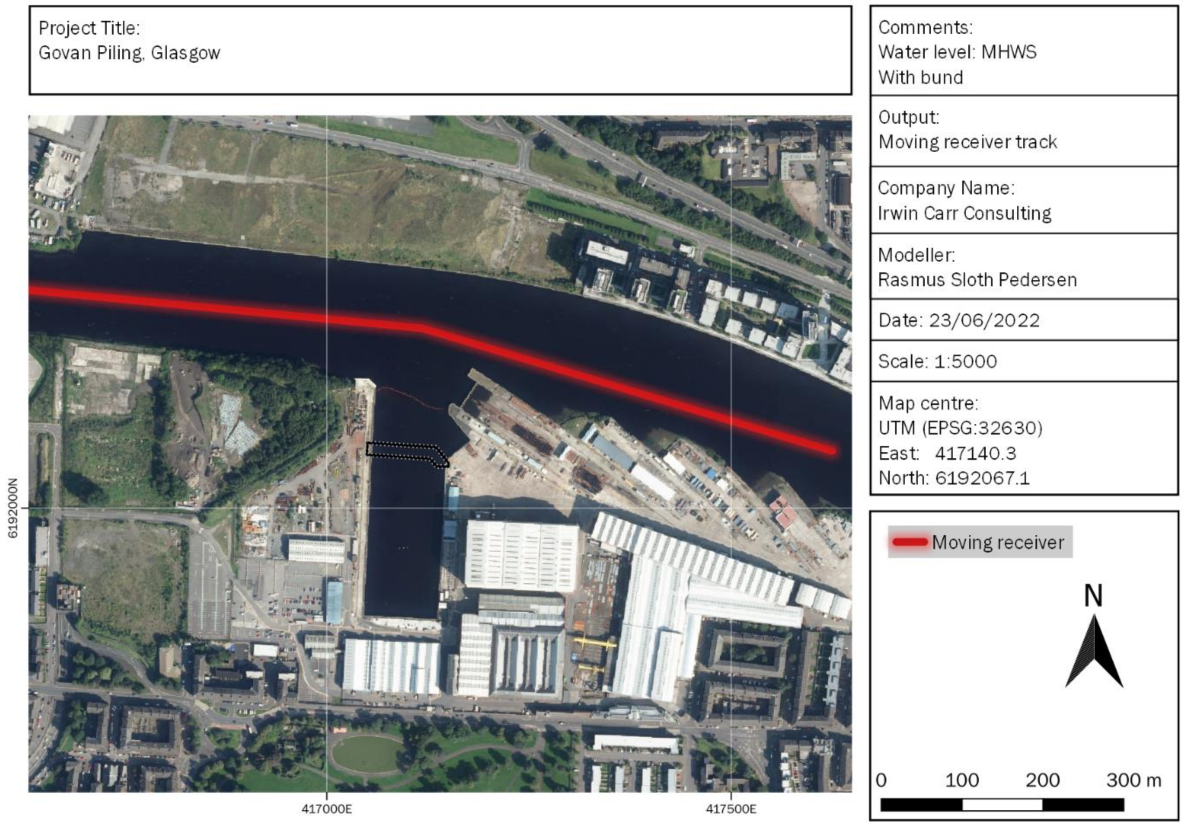
Map centre:
UTM (EPSG:32630)
East: 417131.1
North: 6192083.3

7.3 Moving Receivers

To better understand the results in the context of non-stationary receivers we include an example of a moving receiver passing the active site at a swimming speed of 0.5 m/s. We have used the max level at any depth on the track to avoid ambiguity over dive profiles. The chosen track follows the middle of the river, a track closer to the site would have higher received level, while one following the opposite shore will have lower received levels. Surface tracks tend to have lower received levels than deeper tracks.

This example uses the worst-case source level and water depth of MHWS. Using the mean-case would have lowered all received levels by ~12 dB.

Figure 10. Track of moving receiver passing active site.



Project Title:
Govan Piling, Glasgow

Comments:
Water level: MHWS
With bund

Output:
Moving receiver track

Company Name:
Irwin Carr Consulting

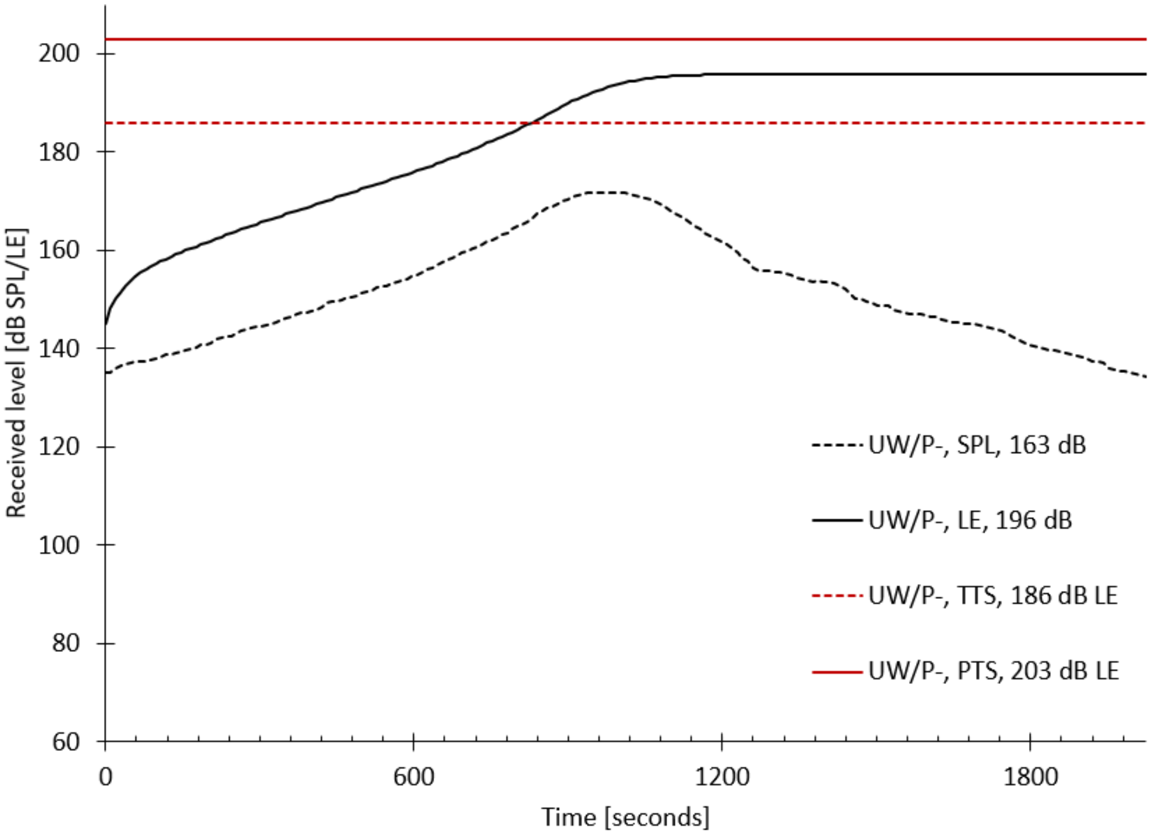
Modeller:
Rasmus Sloth Pedersen

Date: 23/06/2022

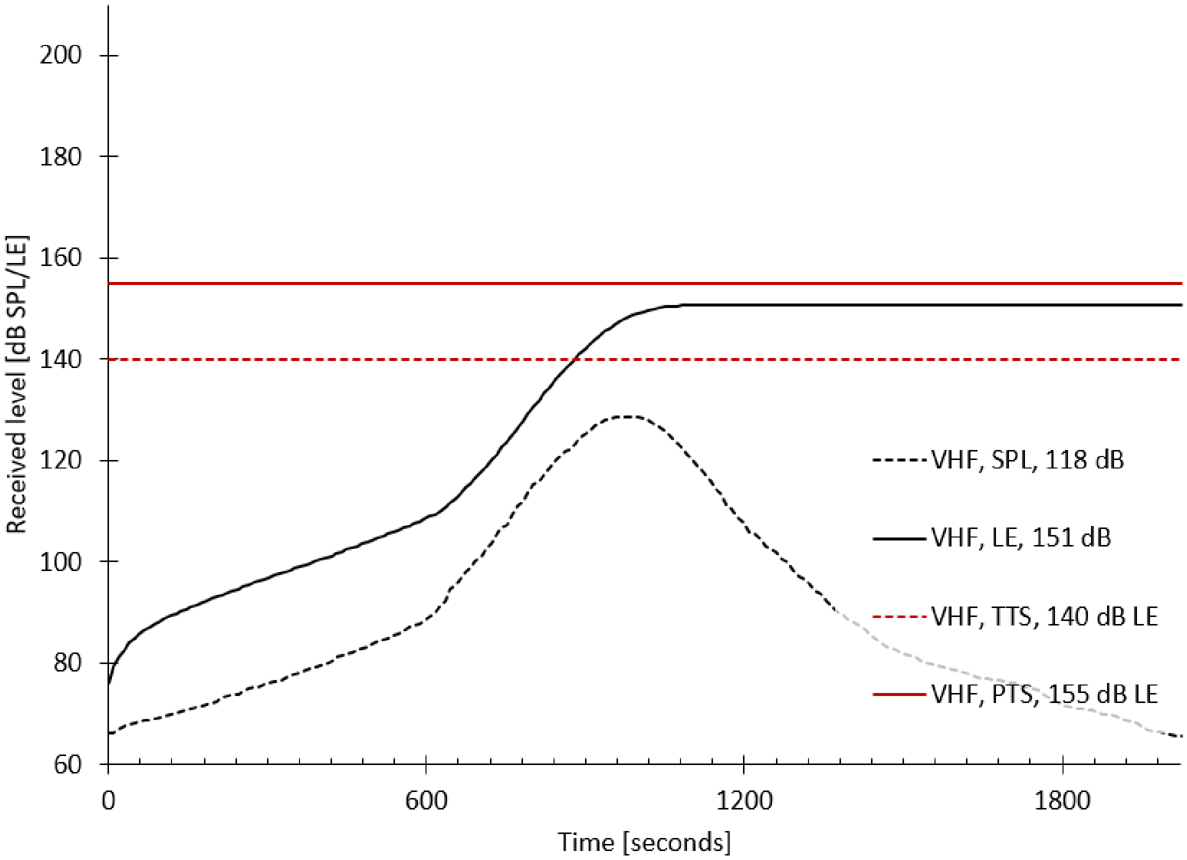
Scale: 1:5000

Map centre:
UTM (EPSG:32630)
East: 417140.3
North: 6192067.1

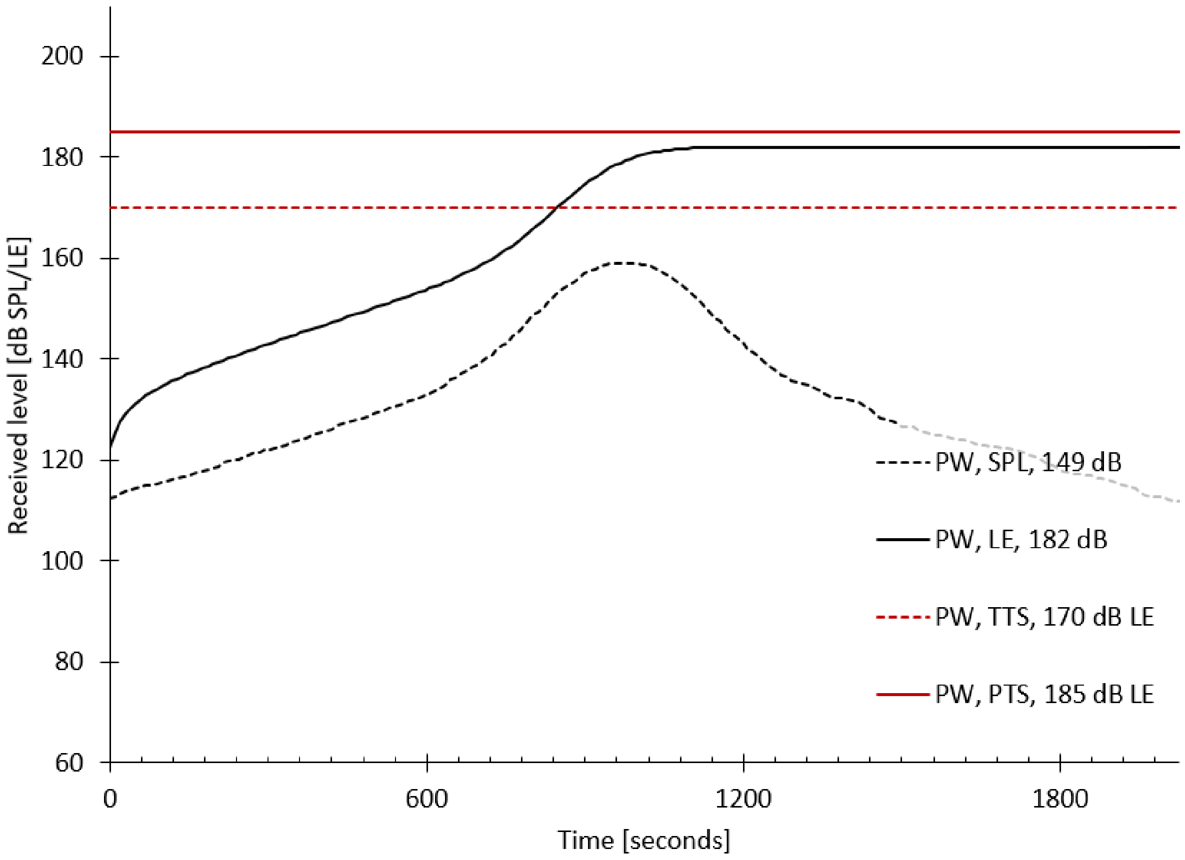
7.3.1 UNWEIGHTED (P-) – SALMON



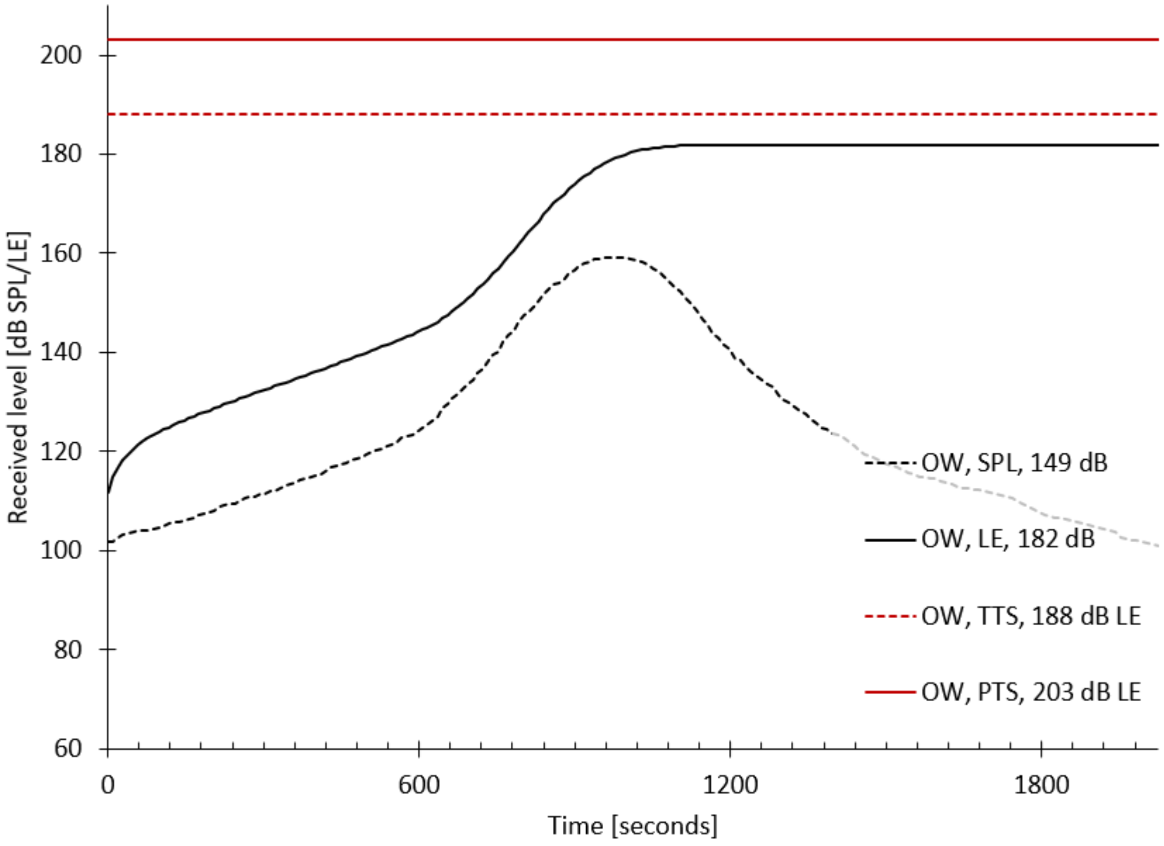
7.3.2 WEIGHTED (VHF) – HARBOUR PORPOISE



7.3.3 WEIGHTED (PW) – SEALS



7.3.4 WEIGHTED (OW) – OTTER



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APPENDIX A - DBSEA

A summary of dBSea's models in standard scenarios can be found in the document (online):
http://www.dbsea.co.uk/media/30782/dBSea-Benchmark-Testing.pdf
(also see Figure 13, p. 49 for one example).

All solvers in dBSea are based on Jensen et al. 2011 (Jensen, Kuperman, Porter, & Schmidt, 2011)

dBSea has four primary models of calculation:

- **Range dependent Parabolic Equation model - dBSeaPE**
  dBSeaPE uses a split-step, wide angle parabolic equation method. It uses either Greene's approximation or several Padé terms (as set by user) to get very wide propagation with low phase error.

  dBSeaPE is best suited to deeper scenarios (>50 m) or where sediment interaction is not dominant relative to sound speed profile. The model is very efficient for low frequencies and only suffers a small efficiency penalty for higher frequencies.

  dBSeaPE will generally be used for deeper/long range scenarios in the frequency interval 10-1000 Hz.
- **Range dependent Normal Modes model - dBSeaModes**
  dBSeaModes is especially suited to shallower and sediment dependent scenarios and will typically be used where water is shallower than 50 m and depth changes are a large proportion of the total depth, or where sediment effects are thought to play a significant role. dBSeaModes incurs a significant efficiency-penalty at high frequencies and will normally be used in the frequency range 10-1000 Hz.
- **Ray tracing**
  dBSea uses a Gaussian raytracing method, dBSeaRay, to calculate transmission losses for higher frequencies (scenario dependent, but normally from 500 Hz). dBSeaRay compares favourably with the opensource BELLHOP model, in that it is accurate to lower frequencies and agrees well with PE and NM models.
- **Full waveform propagation**
  dBSeaRay also supports full waveform propagation in the frequency range 10 Hz to 168 kHz (limited by the waveform sample rate). Used in this way dBSeaRay takes into account all scenario range dependence (as models above) as well as the arrival time, phase information and transmission loss of all significant paths to any number of receivers in the scenario (the results grid).

General notes:

- dBSea is an "Nx2D" solver, meaning it models transmission losses in "N" number of vertical radial slices from the source (Figure 12, p. 48). There is no backwards propagation towards the source, and no sideways reflection/refraction (We're testing dBSea with full 3D solvers currently).

- dBSea models the sediment propagation only for compressional waves, not for shear waves. This generally means that the transmission loss will be slightly underestimated as no energy is transferred into shear waves, and also means that dBSeaRay does not propagate into the sediment, but relies on a complex reflection coefficient (calculated from the sediment layers) to calculate the reflection/refraction properties of the sediment. Given that dBSeaRay is generally only used for higher frequencies, this has very little practical effect, as higher frequencies will only interact weakly with deeper layers of the sediment.

- The individual sources in a scenario are modelled radially (radial coordinates) from the source at several depths. In post-processing levels are transferred to a cartesian "results grid". This results grid stores levels from all sources so that the cumulative level at any point in the scenario can be investigated immediately.

- Levels can be, and are often post-processed to apply a conservative margin and smooth results (Figure 11, p. 48). Radial smoothing (triangular kernel of variable width) is carried out to mitigate modelling artefacts arising from low environment sampling density or chance occurrences. Levels are often made to decrease monotonically from the source to make general trends more visible and decrease the risk of misinterpreting impact ranges.

- When refereeing to a level at a certain range, this usually refers to the greatest level at any depth at that range (unless specifically mentioned otherwise).

Figure 11. Post-processing to eliminate artefacts and ease interpretation. Level are radially smoothed by default, and are made to be monotonically decreasing with increasing range from the source.

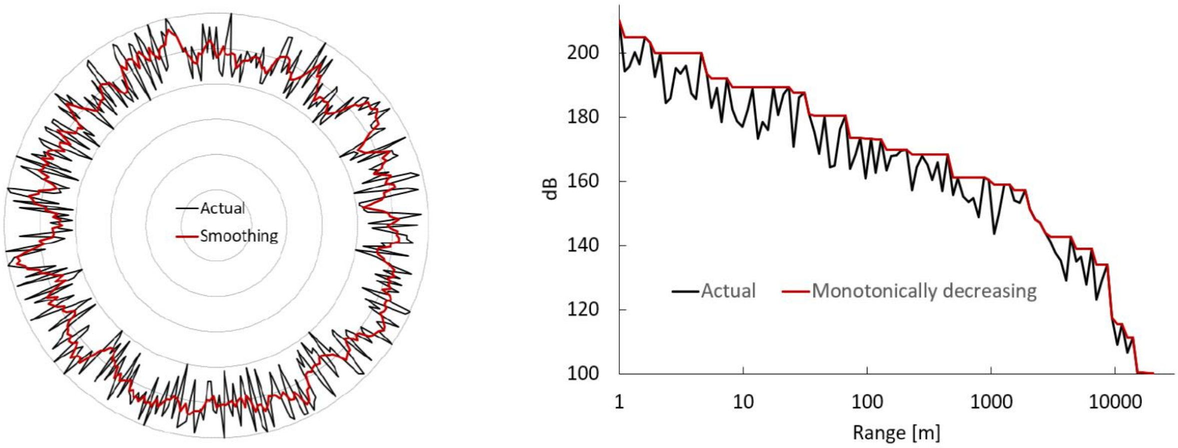


Figure 12. Low resolution schematic of the dBSea modelling space. Source transmission loss is modelled radially from the sources at a number of depths. Results are extracted from a "square" 3D grid that hold cumulative levels from all sources in the scenario.

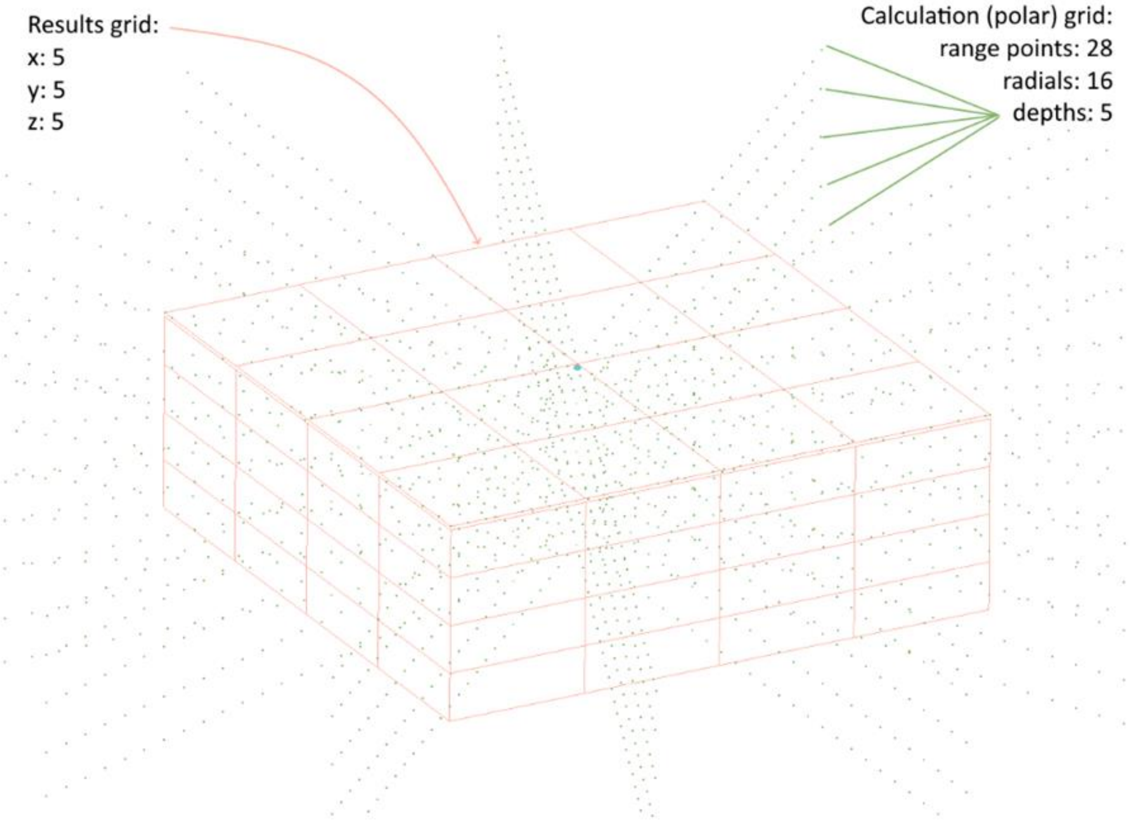
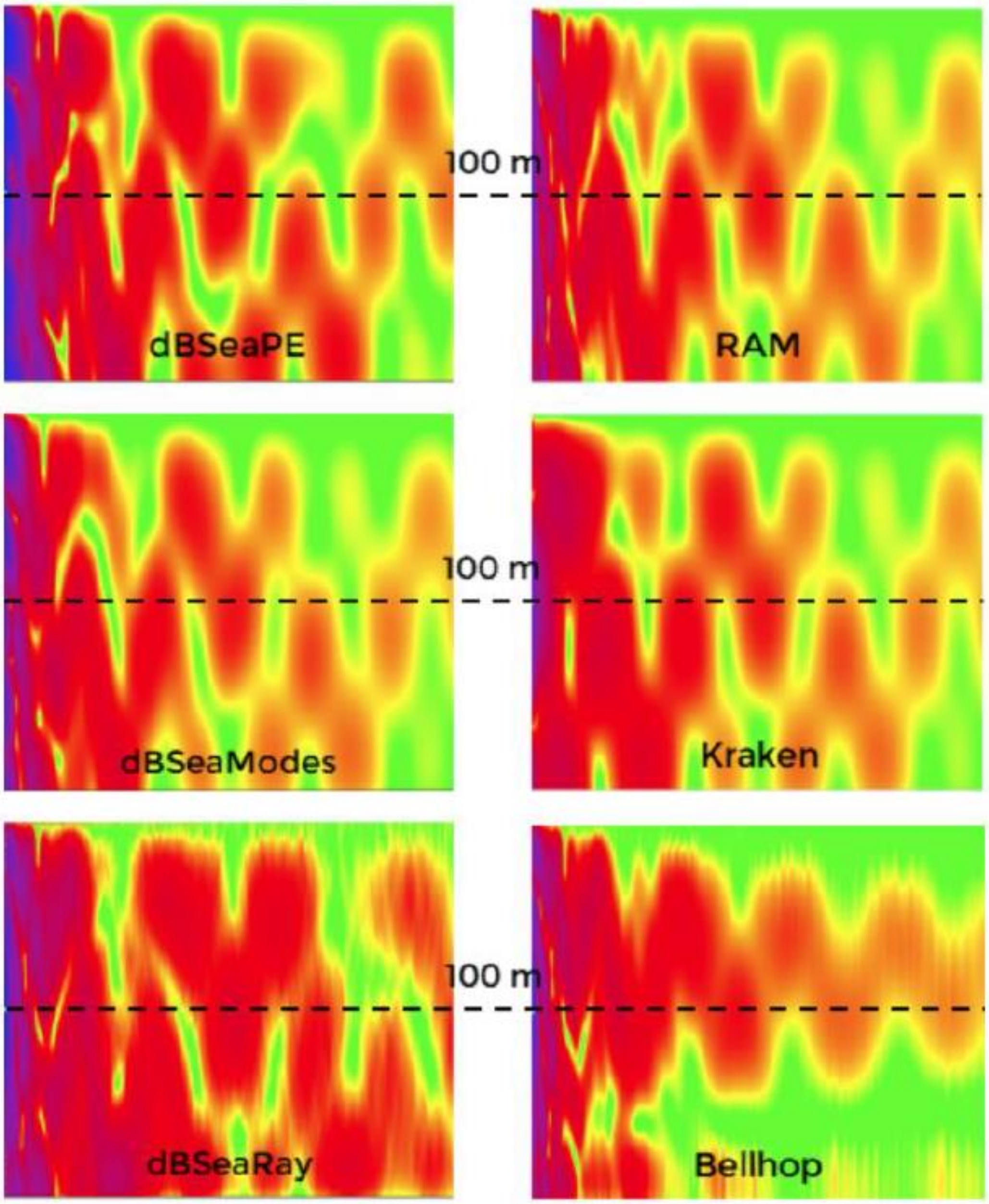


Figure 13. the “Pekeris” standard problem, a low frequency problem. Note that due to sediment effects, neither dBSeaRay nor Bellhop should be relied upon for low frequency problems, and are only include for completeness.



APPENDIX B – UNDERWATER ACOUSTICS BASICS

Sound Speed

Water is much harder to compress than air, and a soundspeed of 1500 m/s is often used as a standard soundspeed in water[13] much as 340 m/s is in air. Soundspeed is given by the following equation:

$$c = \frac{Z}{\rho}$$

$$Soundspeed\ [m/s] = \frac{Acoustic\ impedance\ \left[\frac{kg}{m^2 \cdot s}\right]}{Specific\ density\ [kg/m^3]}$$

Because changes to pressure, salinity and temperature occur with changes in depth, the specific density and acoustic impedance of water changes with depth, and thus the soundspeed changes as well.

The soundspeed profile is quite important in sound propagation, as refraction (changes in propagation angle) will occur when sound moves between layers of water with varying sound speed. This change is quantified in "Snell's Law" and results in sound being "bent" towards the depth of minimal soundspeed. These effects can lead to profoundly inhomogeneous sound fields and SOFAR channels.

The same relationships are valid in the sediment, though sediments commonly have soundspeeds higher than water. Soundspeeds from 1700 m/s (fine sand/silt) to 2500 m/s (gravel) are common for non-solid sediments, with solid sediments (rocks) having much higher soundspeeds 2800 m/s (Calcarenite) to 6000 m/s (some granite).

Spreading loss

Most of the propagation loss (loss in dB from source to receiver, "PL") that occurs initially is governed by "spreading loss". It is the simple "thinning out" of acoustic energy as it spreads away from the source, usually in all directions – spherically.

For a sound source in an unbound medium the initial PL will be dominated by spherical PL:

$$Received\ level = Source\ level_{at\ reference\ range} - 20 \cdot \log_{10}\left(\frac{range}{reference\ range}\right)$$

This means a reduction in received level of 6 dB per doubling of distance and explains the rapid reduction in received levels often seen close to the source, e.g.: with a reference range of 1 m, at 16 meters range, there has been 4 doublings of distance, and thus 24 dB loss (4×6 dB).

At longer ranges the medium is no longer unbounded. We reach ranges where the sound has interacted with the surface (near perfect acoustic reflector) or the seabed (lossy acoustic reflector). Also, at greater ranges a doubling of distance is no longer trivial as the PL from spherical spreading loss from 500 m to 1000 m is also just 6 dB.

Sound Channels and Wave guides

In bounded mediums where the sound energy is confined to cylindrical spreading, the PL (ignoring absorption) is often well-characterised by:

$$Received\ level = Source\ level_{at\ reference\ range} - 10 \cdot \log_{10}\left(\frac{range}{reference\ range}\right)$$

This means a reduction of received level of 3 dB per doubling of distance. Depending on the sediment this kind of "waveguide" can sustain efficient transmission of sound over long ranges, provided the sediment is acoustically hard and there is low absorption (such as is the case for low frequencies or in low salinity).

In absence of a bounding from the surface or the seabed, a soundspeed profile with a clear low-speed region, surrounded by higher soundspeeds can act a sound channel, by focusing the sound towards a single depth (with lower soundspeed), limiting the PL from spherical to cylindrical (a SOFAR channel is formed).

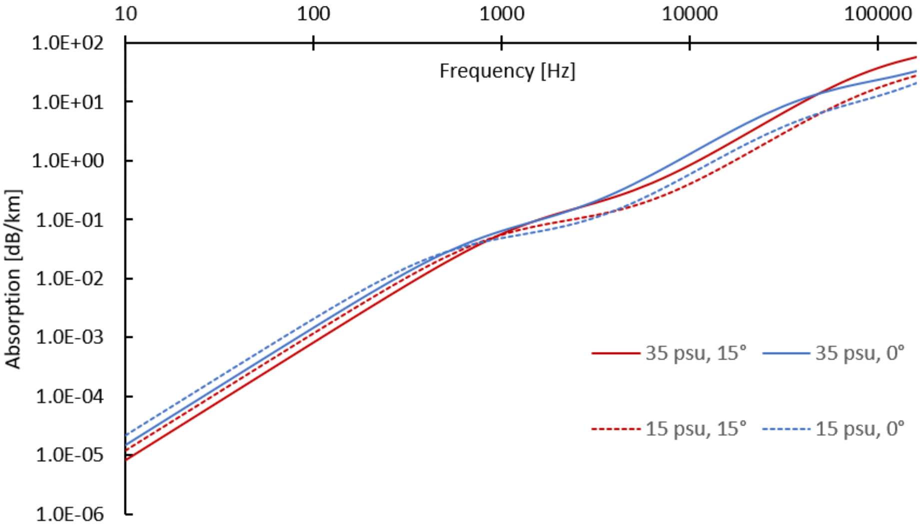
---

[13] Varies from 1450 m/s at 0° to 1550 m/s at 30° at salinity of 35 psu.

Absorption

Besides the “thinning out” of the sound energy as described above, the sound is also dissipated into heat by the way the pressure changes interact with water, molecules and particles in its path. This absorption is mostly governed by the concentration of boric acid and magnesium sulphate and is very dependent on the frequency, with lower frequencies, <1 kHz, experiencing almost no absorption, while high frequencies, > 10 kHz, can be attenuated by over 10 dB / km.

Figure 14. Absorption comparison at salinities of 35 psu & 15 psu and temperatures of 0° and 15°. Both scales are logarithmic. Note how increased salinity increases high-frequency absorption (solid v dashed lines), while a decrease in temperature increases absorption at lower frequencies (red v blue lines).



Small bubbles, wind or wave induced, will further attenuate especially the high frequencies, but as modelling is often done to estimate a worst-reasonable case, or for weather sensitive activities, fair weather with little wind and waves are assumed, thus ignoring this attenuation effect.

Sediment

Depending on the incident angle of the sound, the frequency and the acoustic properties of the sediment, sound can either mostly penetrate the sediment or mostly be reflected by it.

In shallow areas with soft sediment (acoustically similar to water), it is typical to find that close to the source, at high incidence angles and at low frequencies (<250 Hz) the sound will penetrate into the sediment and dissipate there, leading to very high transmission losses for these frequencies. This effect coupled with the high absorption at high frequencies often leads to the soundscape being dominated by frequencies from a few hundred hertz to a few thousand hertz. In deeper water, or with an upward refracting soundspeed profile, low frequencies will tend to dominate the soundscape away from sound sources, as there is no efficient mechanism for attenuating them.

A “cut-off[14]” frequency, below which, there will be high sediment-associated attenuation can be approximated by:

$$f_{cut-off} = \frac{c_{water}}{4 \cdot D \cdot \sqrt{1 - \left(\frac{c_{water}}{c_{sediment}}\right)^2}}$$

With “C_{water}” and “$C_{sediment}$” being the soundspeed in the water and the sediment respectively, and “D” the local depth (Jensen, Kuperman, Porter, & Schmidt, 2011).

---

[14] The cut-off is not an immediate loss of energy in frequencies under this frequency, but rather something like a high pass, 1st-order, Butterworth filter (Audoly, 2020).

In water with lower salinity and less absorption, the soundscape will tend to have a relatively higher content of high frequencies as these are absorbed much less efficiently when the salinity is lower.

Sound transmission Across Interfaces

Sound waves are reflected and refracted (Snell's law) as they travel through interfaces. Also, depending on acoustic impedance and interface angles only a proportion of the incident acoustic energy is transmitted through that interface (the rest is reflected).

In the following: W: Watt; Pa: Pascal; s: second; m: metre; N: Newton; J: Joule; θ: angle; v: soundspeed; Z: acoustic impedance; p: pressure from ambient;

Snell's law:

$$\frac{\sin\theta_{in}}{\sin\theta_{out}} = \frac{v_{in}}{v_{out}}$$

- rearranged to give transmission angle from incidence angle and soundspeeds:

$$\sin^{-1}\left(\frac{\sin\theta_{in}}{\frac{v_{in}}{v_{out}}}\right) = \theta_{out}$$

Transmission fraction of sound pressure for plane waves (part of the Fresnel equations):

$$\frac{p_{out}}{p_{in}} = \frac{2\cdot Z_{out}\cdot\cos\theta_{in}}{Z_{out}\cdot\cos\theta_{in} + Z_{in}\cdot\cos\theta_{out}}$$

Reflection fraction of sound pressure for plane waves (part of the Fresnel equations):

$$\frac{p_{out}}{p_{in}} = \frac{Z_{out}\cdot\cos\theta_{in} - Z_{in}\cdot\cos\theta_{out}}{Z_{out}\cdot\cos\theta_{in} + Z_{in}\cdot\cos\theta_{out}}$$

It follows from these relations that for transmission from an acoustically relatively slow medium like water to an acoustically faster medium here exists an incident angle above which there is total reflection, and thus no transmission of acoustic energy through the interface (real interfaces are rugged and lumpy, and perfect reflection is not realistic).

For the water/sediment interface presented here (sediment is sand with a soundspeed of 2000 m/s) this occurs at 0.84 radians (~48.5 degrees) from normal incidence.

The fraction of pressure transmission from water (soundspeed 1500 m/s) to sediment (2000 m/s) is around 146 % at normal incidence and drops as the incidence angle increases away from normal, much faster for water-to-sediment than for sediment-to-water.

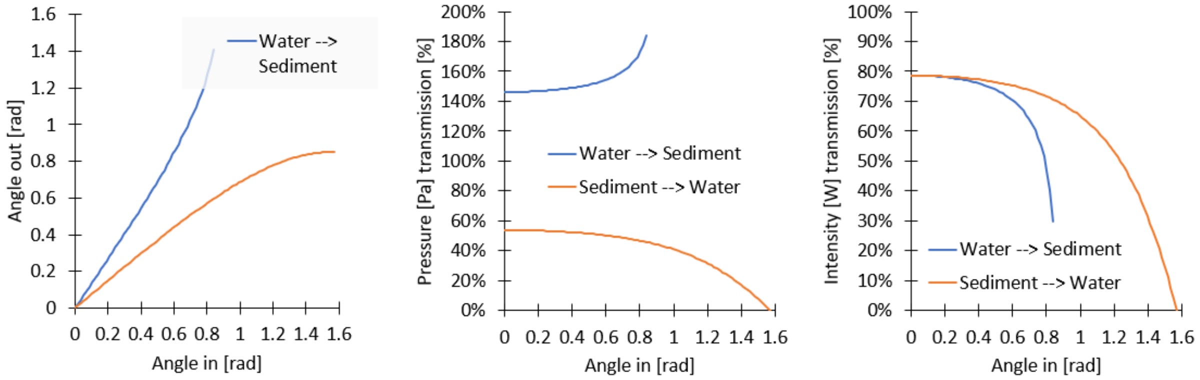
While it may seem counter-intuitive that pressure can increase after transmission over an interface, remember that the energy in the sound is a function of pressure *and* acoustic impedance:

$$I = \frac{p^2}{Z}$$

$$With\ units\colon [W] = \frac{[Pa]^2}{\left[\frac{Pa\cdot s}{m^3}\right]} = \frac{\frac{N^2}{m^4}}{\frac{\frac{N}{m^2}\cdot s}{m^3}} = \frac{N^2\cdot m^3}{m^4\cdot\frac{N}{m^2}\cdot s} = \frac{N}{m\cdot m^{-2}\cdot s} = \frac{J\cdot m}{m^{-1}\cdot s} = \frac{J}{s} = W$$

Thus, if the transmitted intensity fraction is 80 % then the reflected intensity is 20 %; there is energy conservation.

Figure 15. Transmission angles [radians] and fractions as function of incident angle between water and sediment (sand). Note that total reflection from water to sediment occurs around incident angle of 0.84 [rad] (48.5 degrees), meaning there is no transmission of sound at greater incidence angles.



Sound Level Units

All references to sound pressure levels, peak pressure levels and sound exposure levels refer to a logarithmic ratio between a reported/measured pressure or exposure and a reference pressure or exposure. As an example, a level of 220 L_p (decibel zero-to-peak) is equal to a peak pressure of 100000 Pascals (Pa) over ambient pressure, while 120 L_p is equal to 1 Pa over ambient pressure.

To avoid dealing with these large numbers as pascals (as a linear scale), they are converted to a decibel ratio (Table 1 for definitions). Besides compressing large numbers to a smaller scale this also corresponds better to how animals are thought to perceive sound, namely as relative steps. This means that an increase from 1 to 2 Pa *sounds like* the same increase as from 100 to 200 Pa, even though the first step was only 1 Pa, while the second was 100 Pa. This is better reflected in a logarithmic scale based on ratios, where both steps are equal, here 3 dB.

However, while dBs are practical, they can be hard to compare between studies, due to vague definitions, and so we have adopted the standards set by ISO 18405-2017 (Table 1 below).

For ease of reference please see following overview for unit definition.

Table 8: Definitions.

Unit	Definition	Comments
SPL (dB$_{RMS}$) ISO 18405- 2017: 3.2.1.1	$SPL = 10 \cdot Log_{10}\left(\frac{\frac{1}{t_2 - t_1} \cdot \int_{t_1}^{t_2} p(t)^2 dt}{1 \cdot 10^{-12} Pa}\right)$	Functionally equivalent to deprecated $20 \cdot Log_{10}\left(\frac{RMS}{1 \cdot 10^{-6} Pa}\right)$
L$_p$ (dB$_{z\text{-}p}$) ISO 18405- 2017: 3.2.2.1	$L_p = 20 \cdot Log_{10}\left(\frac{Pa_{max}}{1 \cdot 10^{-6} Pa}\right)$	This assumes that Pa_{max} is equal or greater than $\sqrt{{Pa_{min}}^2}$
L$_{p\text{-}p}$ (dB$_{p\text{-}p}$)	$L_{p-p} = 20 \cdot Log_{10}\left(\frac{Pa_{max} - Pa_{min}}{1 \cdot 10^{-6} Pa}\right)$	Often[15] equivalent to $L_P + 6.02\ dB$
L$_E$ (dB$_{SEL}$) ISO 18405- 2017: 3.2.1.5	$L_E = 10 \cdot Log_{10}\left(\frac{\int_{t_1}^{t_2} p(t)^2 dt}{1 \cdot 10^{-12} Pa}\right)$	For continuous sound this is equivalent to $SPL + 10 \cdot Log_{10}(t_2 - t_1)$ “t” is seconds

Unless otherwise stated SPL has an averaging period of 1 second, and L$_E$ for the duration of the specified event, sometimes indicated as L$_{E\text{-“time”}}$ or L$_{E\text{-single blow}}$.

If the averaging period for SPL is equal to the total even duration then SPL is equal to “Leq” the “equivalent constant level”.

When source levels are presented, the same units are used, and it is implicit that all source levels are given as if recorded 1 m from an omnidirectional mono-point source, unless otherwise specified.

---

[15] If maximum pulse rarefaction is below ambient pressure and compression and rarefaction phases are of equal size.

Technical Appendix 5-3_Flood Risk Assessment – Basin Infill and Building Development

Govan Basin Infill & Development
Flood Risk Assessment

August 2022

Govan Basin Infill & Development
Flood Risk Assessment

Client: BAE Systems Ltd

Document number: 10242
Project number: 175756
Status: FOR ISSUE

Author: Dr Iain Struthers
Reviewer: Neil Gordon

Date of issue: 19 August 2022
Filename: 175756 Govan Basin Infill & Development - Flood Risk Assessment.docx

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VAT no. GB 348 6770 57.

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1 INTRODUCTION

1.1 Terms of Reference

EnviroCentre Ltd has been appointed by Arch Henderson on behalf of BAE Systems Ltd to undertake a flood risk assessment (FRA) in relation to the proposals to infill the wet basin at Govan Shipyard and Maintenance Facility (Govan shipyard) and place a building upon the final platform.

This assessment amounts to a reissue of the initial FRA report, which was prepared as a separate report (EnviroCentre Document Number 10193; June 2022) and assessed the infilling of the wet basin to an interim platform level only. This report has been prepared as a stand-alone report, and can be read without reference to the initial FRA report.

1.2 Scope of Report

The scope of works for the original FRA was as follows:

- Obtain the updated River Clyde hydrodynamic model from Fairhurst Ltd, considered by Glasgow City Council (GCC) and SEPA to provide state-of-the-art representation of flood risk in the tidal reaches of the River Clyde.
- Conduct confirmatory runs of the model, establishing that the model version provided generates predicted flood depths/extents matching those published in Fairhurst's model report.
- Conduct revised baseline runs with improved model resolution in the area of the site.
- Modify the model geometry to account for proposed infilling of the wet basin.
- Re-run the model to assess the impact of infilling (to an interim platform level) upon tidal-fluvial flood risk.
- Qualitatively assess flood risk from all other sources.
- Produce a Flood Risk Assessment report detailing the above, including recommendations for flood risk management, satisfying SEPA and GCC requirements, and including completion of the SEPA Flood Risk Assessment Checklist.

This is supplemented with the following scope of works for preparation of the current report:

- Amend representation of the infilled wet basin platform to reflect the proposed final platform level (i.e. 7.3 mCD, equivalent to 4.91 mAOD). Assess the flood risk impact of this platform.
- Add representation of the proposed Wet Basin Hall building (and adjoining accommodation building). Assess flood risk impact for the platform with building, considering two variations: (i) the hall with external doors closed during flooding, representing a worst-case in terms of potential floodwater displacement, and (ii) the hall with external doors open, in which only the concrete walls and structures within the hall are considered as solid obstacles to the movement of flood water.
- Produce a supplementary FRA report detailing the above, including recommendations for flood risk management, satisfying SEPA and GCC requirements, and including completion of the SEPA Flood Risk Assessment Checklist.

1.3 Report Usage

The information and recommendations contained within this report have been prepared in the specific context stated above and should not be utilised in any other context without prior written permission from EnviroCentre.

If this report is to be submitted for regulatory approval more than 12 months following the report date, it is recommended that it is referred to EnviroCentre for review to ensure that any relevant changes in data, best practice, guidance or legislation in the intervening period are integrated into an updated version of the report.

Whilst the Client has a right to use the information as appropriate, EnviroCentre Ltd retains ownership of the copyright and intellectual content of this report. Any distribution of this report should be controlled to avoid compromising the validity of the information or legal responsibilities held by both the Client and EnviroCentre Ltd (including those of third party copyright). EnviroCentre does not accept liability to any third party for the contents of this report unless written agreement is secured in advance, stating the intended use of the information.

EnviroCentre accepts no liability for use of the report for purposes other than those for which it was originally provided, or where EnviroCentre has confirmed it is appropriate for the new context.

1.4 Regulatory Framework

Scottish Government planning policy on flooding is provided by Scottish Planning Policy (SPP) paragraphs 254–268 (Scottish Government, 2014). This policy is based on the following principles:

- Developers and planning authorities must give consideration to the possibility of flooding from all sources;
- New development should be free from significant flood risk from any sources;
- In areas characterised as “medium to high” flood risk for watercourses (fluvial) and coastal (tidal) flooding new development should be focused on built up areas and all development must be safeguarded from the risk of flooding;
- The storage capacity of functional flood plains should be safeguarded from further development. The functional flood plains comprise areas generally subject to an annual probability of flooding greater than 0.5%;
- Drainage is a material consideration and the means of draining a development should be assessed. Any drainage measures proposed should have a neutral or better effect on the risk of flooding both on and off the site.

SPP proposes a Risk Framework approach which identifies flood risk in three main categories:

- **Little or no risk area** (annual probability of flooding less than 0.1%). No constraints to development due to flood risk.
- **Low to medium risk area** (annual probability of flooding between 0.1% and 0.5%). Suitable for most developments, excepting civil infrastructure (unless existing civil infrastructure within a low to medium risk area is being extended, or else if civil infrastructure must be placed within this risk area for operational reasons).
- **Medium to high risk area** (annual probability of flooding greater than 0.5%). Suitable for residential, institutional, commercial and industrial development within built-up areas (provided adequate flood protection is planned or already exists). Generally not suitable for civil infrastructure or most vulnerable uses (such as schools and care homes) or for general development in undeveloped or sparsely developed areas (unless essential for operational reasons and alternative locations at lower flood risk are not viable).

In this report the likelihood of a flood event with a certain magnitude is quantified using the concept of Return Period (RP). The other method that is often used to express flood risk is the concept of Annual Exceedance Probability (AEP). The relationship between RP and AEP is documented in Appendix A.

1.4.1 SEPA Guidance

SEPA issued guidance in relation to preparing FRAs (“Technical Flood Risk Guidance for Stakeholders”, v13, (SEPA, 2022a))[1]. Technical requirements for FRAs depend on the complexity of the site with more complex or high risk sites requiring detailed assessments. In summary, FRAs must include the following:

- Background site data, including suitable plans and/or photographs;
- Historic flood information;
- Description of methodologies used;
- Identification of relevant flood sources;
- In case of river flooding: assessment of river flows, flood levels, depths, extents, displaced flood storage volumes, etc.;
- Assessment of culverts, sewers or other structures affecting flood risk;
- Consideration of climate change impacts;
- Details of required flood mitigation measures; and
- Conclusions on flood risk related to relevant national and local policies.

In addition to reporting requirements, the document also provides technical guidance on Flood Estimation Handbook (FEH) (CEH, 2008) methodologies and on land raising and compensatory storage.

SEPA provide a summary checklist to be completed to accompany Flood Risk Assessment reporting; this is included in Appendix B.

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[1] https://www.sepa.org.uk/media/594270/technical-flood-risk-guidance-for-stakeholders.pdf

2 PREVIOUS FLOODING STUDIES

2.1 River Clyde Flood Management Strategy Model (and Precursors)

The foundational 1D hydrodynamic modelling of the River Clyde was developed between the late 1980s and 2001, primarily by the Babtie Group, for GCC and South Lanarkshire Council (SLC). GCC appointed Halcrow Group Ltd and W.A. Fairhurst & Partners to undertake a major upgrade between 2003-2005 to inform the River Clyde Flood Management Strategy (RCFMS). This entailed updates to design tidal and fluvial input, as well as use of updated bathymetric and topographic data to represent the river and its floodplain. Outcomes from the RCFMS model were used until recently as the basis for setting flood risk requirements for development within the River Clyde corridor.

2.2 Updates to the RCFMS Model

A 2018 update to the model incorporated updated bathymetry, additional cross-sections and additional representation of Tradeston Bridge, while a 2019 update added 2D representation of the tidal floodplain.

2.3 Tidal River Clyde Flood Model Update

The 2020 model update was commissioned following discussions between GCC and SEPA, with the aim of:

- Lengthening the period of tidal data on which extreme still water levels and tidal surges at Greenock are based.
- Accounting for the impact of developments within the floodplain since the 2003 LiDAR (on which floodplain representation is based in the RCFMS model) was flown.
- Updating bathymetry in the tidal mudflats between Greenock and Bowling, which was found to influence tidal propagation up the estuary in the RCFMS model, but which was based on 1960s and 1970s surveying in the model.
- Updating fluvial inflows to account for additional river gauge data in the intervening years since that use to inform design inflows in the RCFMS model (which was based on data to 2003).

While described as an “update”, Fairhurst’s 2020 model update entailed a re-basis of the model; a 1D representation of the river was replaced with a full 2D representation of the river and tidal floodplain based on up-to-date bathymetry and topographic data. The intention is that the model is managed, maintained and updated going forward to account for all consented development and any other changes impacting the river or floodplain.

The Fairhurst 2020 model update is focussed on the tidal reaches of the River Clyde; an updated flood model for the fluvial reaches of the river is being separately progressed by SLC, and is not considered further within this report.

3 FLOOD RISK SCREENING

SEPA's technical guidance (SEPA, 2022a) advises that a site-specific FRA should be undertaken where any available information indicates there may be a risk of flooding (from any source) to the site, and/or where proposed works may increase flood risk elsewhere. Where a site-specific FRA may be required, screening will determine the scope of the assessment and may also be used to inform an appropriate and proportionate approach for the assessment.

3.1 Site Location & Proposed Development

Proposals entail infilling the existing Govan wet basin to create a development platform upon which a Wet Basin Hall will be erected for shipbuilding usage. An accommodation block will adjoin the hall, with a raised floor level relative to the hall to protect it against flood risk from the adjacent River Clyde. Further details of development proposals are provided in documents accompanying this report. A provisional site layout is included for reference purposes as Appendix C.

3.2 Land Use Vulnerability Classification

The existing and proposed land use for the site determines the threshold flood risk likelihood that is compliant with SPP and SEPA's *Flood Risk and Land Use Vulnerability Guidance* (SEPA, 2018b). The proposed works will comprise infilling of a wet basin to create a flat platform, upon which will be placed a Wet Basin Hall, for shipbuilding, and adjoining accommodation building. Ship building, repair and dismantling is considered a water compatible usage. Water compatible usage is suitable without condition for sites with low to medium flood risk. For sites with medium to high flood risk, water compatible usage is generally suitable, although appropriate evacuation procedures must be in place where job related accommodation is proposed.

3.3 Screening By Source

3.3.1 Tidal-Fluvial Flood Risk

SEPA Flood Maps (SEPA, 2021)[2] do not indicate fluvial flood risk to the wet basin and surrounding areas. While the site is indeed at fluvial flood risk, being immediately adjacent to a major river, overall flood risk in this tidally-impacted reach of the river is determined by the combination of fluvial and tidal conditions, and is therefore assessed in terms of joint probability.

For the tidal reaches of the River Clyde, analysis undertaken by HR Wallingford in 2002 for the RCFMS identified that a combination of 2 year inflow conditions in combination with 200 year tidal conditions resulted in conservative flood predictions relative to any other joint probability realisation; this outcome is retained in the 2020 model update and is applied for all return periods of interest (i.e. worst-case tidal-fluvial flood predictions for *x* year return period conditions are based on *x* year tidal conditions in combination with 2 year inflow conditions).

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[2] https://map.sepa.org.uk/floodmaps

Table 3.1 summarises predicted tidal-fluvial flood levels from the tidal River Clyde Model Update, noting that climate change is predicted to cause a sea level rise of 850 mm in the River Clyde by 2100 based on UKCP18 outputs. These compare to ground levels in the landward areas immediately bordering the wet basin which vary between approximately 4.7 mAOD (around the northern end of the wet basin) and 5.8 mAOD (at the south-eastern corner of the wet basin), indicating that areas adjacent to the northern end of the wet basin are at medium to high flood risk, while areas adjacent to the southern end of the wet basin are at low to medium flood risk or little flood risk. Further site-specific assessment of tidal-fluvial flood risk is therefore warranted to assess the impact of infilling of the wet basin.

Table 3.1: Predicted design coastal flood levels in the river section adjacent to the wet basin (obtained from the River Clyde Model Update Technical Report December 2021; Fairhurst)

Design Event	Predicted Flood Level at River Centre (mAOD)
1 in 200 year	4.85
1 in 200 year (+850 mm sea level rise)	5.56
1 in 500 year	5.05
1 in 500 year (+850 mm sea level rise)	5.74
1 in 1,000 year	5.20
1 in 1,000 year (+850 mm sea level rise)	5.88

3.3.2 Surface Water Flood Risk

SEPA Flood Maps indicate surface water flood risk along the eastern and western perimeter of the wet basin, but this is assumed to be an artefact of modelling used to create these maps; there is no bund/embankment separating the wet basin from surrounding ground, and the mapped flooding is within the wet basin itself. The current site and surrounding areas is therefore concluded to not be at risk of surface water flooding.

Proposals entail creation of a flat infilled platform with a Wet Basin Hall occupying a majority of the created platform, with an accommodation block adjoining the western side of the hall. Provided appropriate site drainage is incorporated into the design, the adjacent River Clyde provides a suitable point of discharge for surface water drainage from the site. In an exceedence event, excess surface water flows can discharge directly into the river. Surface water flooding occurring independently of tidal-fluvial flooding is therefore not considered a risk.

3.3.3 Asset Failure Flood Risk

The SEPA Reservoirs Inundation Map[3] indicates that river levels in the local reach of the River Clyde could be impacted by breach/failure of any of the Gryffe 1, Mugdock, Hillend, Roughrigg or Balgray reservoirs, or by breach/failure at Loch Thom.

There is no expected correlation between the risk of breach/failure at any of these reservoirs and tidal surge at Greenock, such that this asset failure flood risk should be regarded as a separate, rather than additive, risk to extreme tidal-fluvial flood risk. Available information from SEPA mapping is limited, but asset failure flood risk extents appear to be less extensive than coastal flood extents, such that tidal-fluvial flood risk is the primary design constraint.

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[3] https://map.sepa.org.uk/reservoirsfloodmap/Map.htm

3.3.4 Groundwater Flood Risk

Groundwater flooding, as a primary source, is uncommon in Scotland, due to the nature of the underlying geology. For a site in immediate proximity to a major river, groundwater levels will correspond strongly with water levels in the adjacent watercourse. On this basis, groundwater flood risk does not need to be considered separately from tidal-fluvial flood risk.

3.4 Scoping Summary

Table 3.2 presents the scoping outcomes for flood risk to the site.

Table 3.2: Summary of Flood Risk Scoping

Flooding Source	Preliminary Risk Classification	Comments/Explanation	Scoping Outcome
Tidal-Fluvial (Coastal-River)	Medium to High Risk	Parts of the perimeter area surrounding the wet basin to be infilled have ground elevations below latest estimates of 1 in 200 year tidal-fluvial flood risk from the River Clyde.	Site-specific assessment required
Surface Water	Low or No Risk	The perimeter area surrounding the wet basin is not at risk of surface water flooding, with no barriers to discharge into the wet basin or adjacent river. The infilled wet basin platform will be flat, with any exceedance flows discharging into the river. Appropriate site drainage will protect the developed site against surface water flood risk.	Not considered further.
Infrastructure	Low or No Risk	Breach or failure of any of a number of reservoirs in the catchment area of this reach of the River Clyde may impact water levels in the river, but this risk will be trivial in comparison to tidal-fluvial risk and is unlikely to be concurrent with tidal-fluvial flooding.	Not considered further.
Groundwater	Low or No Risk	Groundwater levels will correspond with water levels in the adjacent reach of the River Clyde. There is no risk of groundwater flooding independent of tidal-fluvial flooding.	Not considered further.

4 TIDAL-FLUVIAL FLOOD RISK ASSESSMENT

The reader is referred to the River Clyde Model Update Technical Report (Fairhurst; December 2021) for full details of the model construction, input and calibration. The model developed by Fairhurst (version 129384_M02_008; July 2021) is used as-is, with the exception of amendments described in Sections 4.6.1 and 4.7.1. A summary description is provided in the sections to follow.

4.1 Hydrology

The model includes inflows from 8 main rivers (River Clyde, North Calder, Rotten Calder, River Kelvin, White Cart Water, Black Cart Water, River Gryfe, River Leven) plus distributed urban and rural inflows.

Each of the main rivers has maintained flow gauging at or near the model boundary location, with AMAX data obtained for the full gauged record for each gauge. Enhanced Single Site statistical analyses were undertaken, with all gauges determined to be suitable for inclusion in the pooling group used. Recorded flow hydrographs from the flood event which occurred on 10th December 1994 (the largest event on record for a majority of the gauges) were scaled to fit the derived peaks, consistent with the approach used in the RCFMS.

Urban inflows were calculated using the Modified Rational Method, with a C_v of 0.5 used to account for attenuation in the pipe drainage networks upstream of river discharge points, as per the RCFMS approach. The timing of the urban runoff response is likely to be faster than that for rural areas or for the large catchment of the River Clyde; in the absence of information to quantify and assess the impact of the difference in response time, a conservative approach has therefore been taken in which the peak flow values are applied as a constant inflow for the duration of each simulation run.

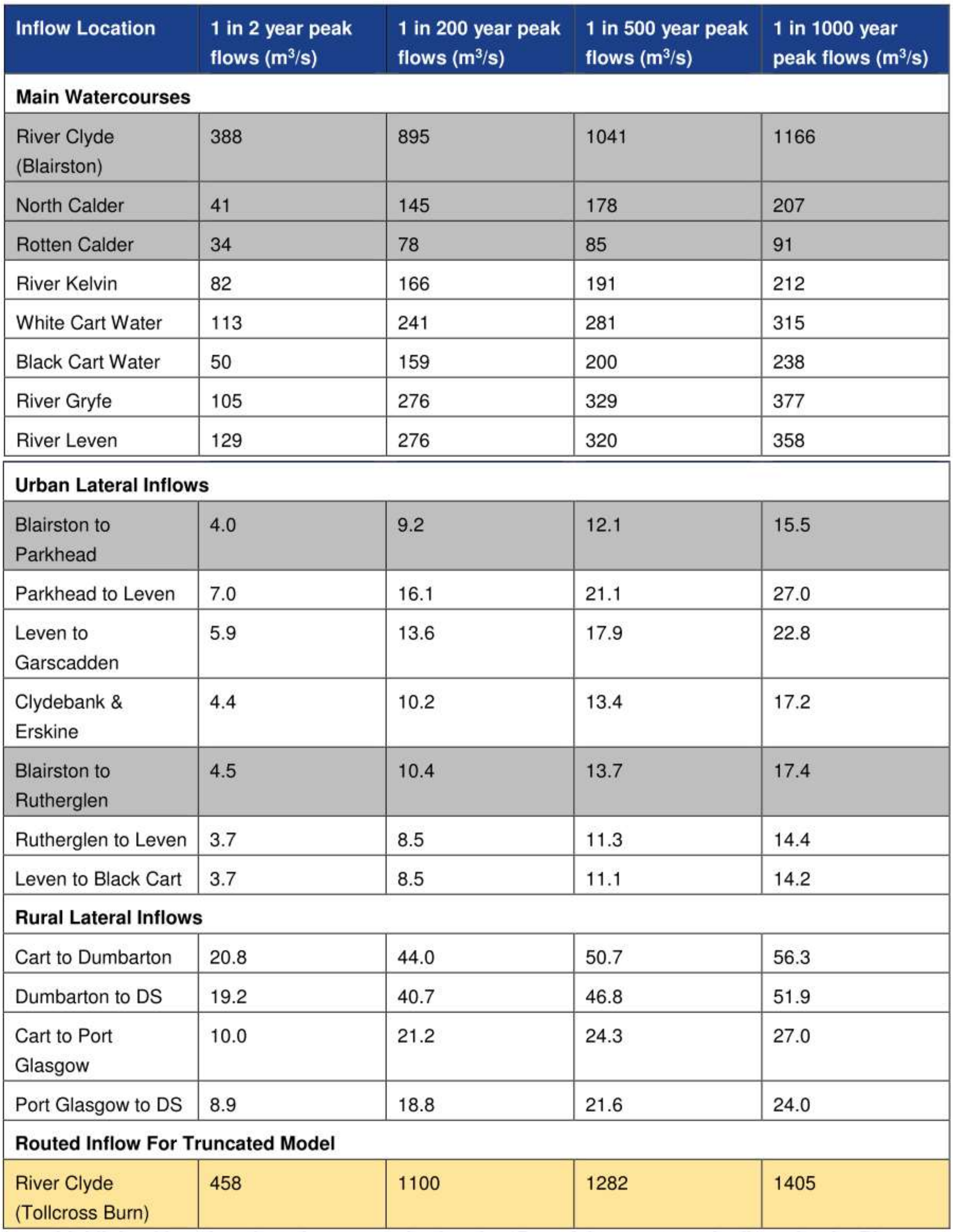
Rural inflows from areas west of Glasgow not represented within the main river catchment areas have been assessed using the ReFH2 rainfall-runoff method using FEH13 design rainfall. Catchment descriptors were based on a representative rural catchment at NGR [234750, 677250]. A storm duration of 72 hrs, matching the 1994 event hydrographs used for the main river inflows, was used to derive inflow hydrographs, with area scaling applied for each rural area represented.

The updated 2D model does not extend as far upstream as the RCFMS model, such that fluvial routing was performed for all inflows upstream of the Clyde/Tollcross Burn confluence using the 2018 model update version (referred to as the Custom House Quay Update model). This was used to derive a singular inflow hydrograph from the following inflows corresponding to locations upstream of the updated model extent:

- River Clyde (at Blairston)
- North Calder
- Rotten Calder
- Blairston to Parkhead (lateral urban inflow, north bank)
- Blairston to Rutherglen (lateral urban inflow, south bank)

Design inflows for selected return period events are summarised in Table 4.1.

Table 4.1: Summary of peak inflows (reproduced from the River Clyde Model Update Technical Report; Fairhurst, 2021)



Inflow Location	1 in 2 year peak flows (m^3/s)	1 in 200 year peak flows (m^3/s)	1 in 500 year peak flows (m^3/s)	1 in 1000 year peak flows (m^3/s)
Main Watercourses				
River Clyde (Blairston)	388	895	1041	1166
North Calder	41	145	178	207
Rotten Calder	34	78	85	91
River Kelvin	82	166	191	212
White Cart Water	113	241	281	315
Black Cart Water	50	159	200	238
River Gryfe	105	276	329	377
River Leven	129	276	320	358
Urban Lateral Inflows				
Blairston to Parkhead	4.0	9.2	12.1	15.5
Parkhead to Leven	7.0	16.1	21.1	27.0
Leven to Garscadden	5.9	13.6	17.9	22.8
Clydebank & Erskine	4.4	10.2	13.4	17.2
Blairston to Rutherglen	4.5	10.4	13.7	17.4
Rutherglen to Leven	3.7	8.5	11.3	14.4
Leven to Black Cart	3.7	8.5	11.1	14.2
Rural Lateral Inflows				
Cart to Dumbarton	20.8	44.0	50.7	56.3
Dumbarton to DS	19.2	40.7	46.8	51.9
Cart to Port Glasgow	10.0	21.2	24.3	27.0
Port Glasgow to DS	8.9	18.8	21.6	24.0
Routed Inflow For Truncated Model				
River Clyde (Tollcross Burn)	458	1100	1282	1405

***grey highlighted locations have been routed using the 1D model to generate the flows for the River Clyde at the Tollcross Burn (highlighted yellow).**

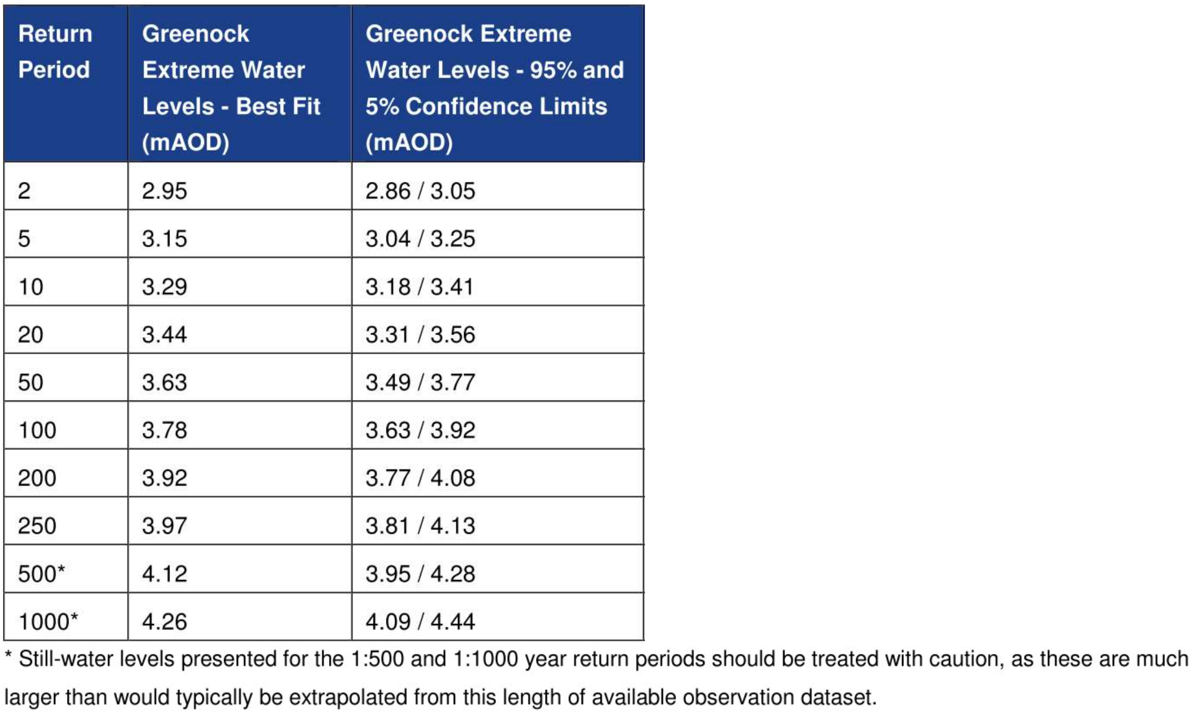
4.2 Design Tide Estimation

The updated model retains the original tidal stage hydrograph employed in the RCFMS model, based on the recorded hydrograph from December 1999, scaled to the appropriate return period still water level. The updated model uses updated extreme still water level estimates obtained from joint probability extreme value analysis of 7.5 (non-continuous) years of tidal gauge data between 1979 and 2020.

Noting that model simulations extend over multiple tidal cycles, the tidal surge profile is applied to a single peak, with normal tidal cycles before and after this surge. The timing of the peak is set to coincide with peak fluvial flow.

Extreme tidal peak values are summarised in Table 4.2.

Table 4.2: Summary of peak still water tidal levels at Greenock (reproduced from the River Clyde Model Update Technical Report; Fairhurst, 2021)



Return Period	Greenock Extreme Water Levels - Best Fit (mAOD)	Greenock Extreme Water Levels - 95% and 5% Confidence Limits (mAOD)
2	2.95	2.86 / 3.05
5	3.15	3.04 / 3.25
10	3.29	3.18 / 3.41
20	3.44	3.31 / 3.56
50	3.63	3.49 / 3.77
100	3.78	3.63 / 3.92
200	3.92	3.77 / 4.08
250	3.97	3.81 / 4.13
500*	4.12	3.95 / 4.28
1000*	4.26	4.09 / 4.44

* Still-water levels presented for the 1:500 and 1:1000 year return periods should be treated with caution, as these are much larger than would typically be extrapolated from this length of available observation dataset.

4.3 Joint Probability

A joint probability study of sea levels and fluvial flows was carried out by HR Wallingford in 2002 prior to development of the RCFMS model. This identified that a combination of 2 year flow and 200 year tide resulted in the highest water levels in the tidal reach and a combination of the 200 year flow and mean high water springs (MHWS) tide resulted in the highest water levels in the fluvial reach. Analysis undertaken by Fairhurst using the updated model confirms that this finding still applies.

The updated model for the tidal reach of the River Clyde therefore considers design tidal surge of the required return period in combination with 2 year design fluvial inflows.

4.4 Climate Change

SEPA have issued update climate change guidance (SEPA, 2022b)[4] for land use planning, based on UK Climate Projections 2018 (UKCP18). This specifies the following recommended uplifts to account for the predicted impacts of climate change to the year 2100:

- A 49% uplift should be applied to design peak river flows for catchments of greater than 30 km^2 area located in the Clyde River Basin Region.
- A 0.85 m cumulative rise in sea levels should be applied in the assessment of tidal flood risk for locations within the Clyde River Basin Region.

The updated model applies an 850 mm sea level rise for climate change scenarios, and therefore remains current with respect to latest climate change guidance.

No uplift is applied to peak river flows in climate change runs undertaken for the River Clyde Model Update Technical Report, with this approach accepted by GCC and SEPA as appropriate for the tidal reaches of the River Clyde. However, an uplift to peak river flows is considered as a sensitivity scenario in this study. It is beyond the scope of this study to repeat 1D flow routing to accurately update upper boundary inflows (see Section 4.1) or to account for the impact of climate change on the highly attenuated inflows from the River Leven; instead, and noting that flow uplift is only assessed as a sensitivity case, a simple 49% uplift is applied to all model inflows.

4.5 Model Development

4.5.1 Model Extents

The updated model extends from a point upstream of the Clyde/Tollcross Burn confluence near Dalbeth downstream to Greenock, and includes representation of the tidal reaches of major tributaries within this extent (Figure 4.1).

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[4] https://www.sepa.org.uk/media/594168/climate-change-guidance.pdf

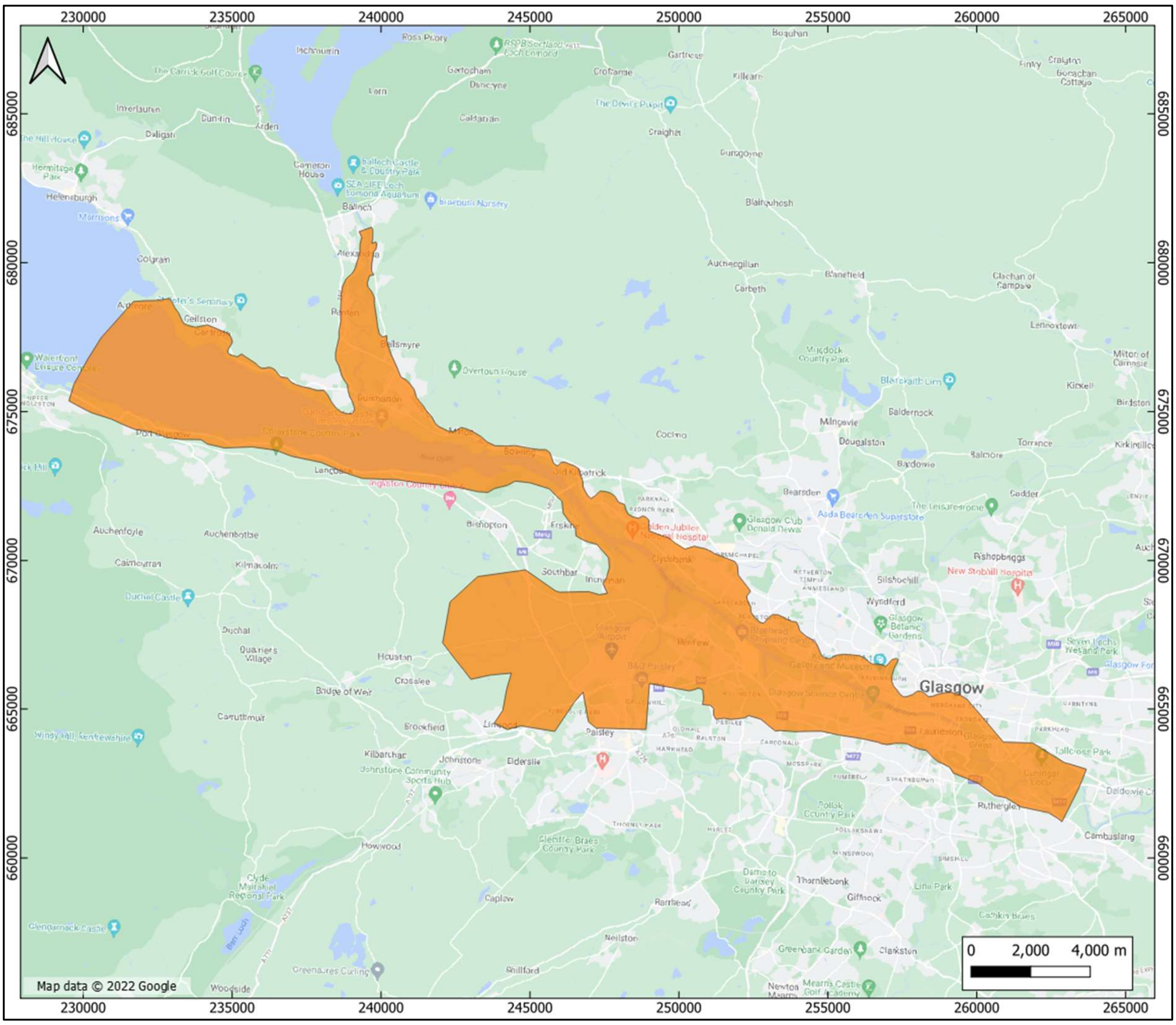


Figure 4.1: Model extents

4.5.2 2D Model Domain

The updated model was constructed using the TUFLOW Quadtree Solver. Bed levels within modelled rivers, and ground levels within the floodplain areas, are based on multiple digital terrain models (DTMs), including:

- Infoterra Glasgow 1 m LiDAR (2003). This older DTM is used to inform floodplain ground levels for a small area (between the model upstream boundary and Tollcross Burn confluence) at the most upstream (fluvial) end of the model.
- Bluesky 0.5 m LiDAR (2020). This LiDAR was commissioned by GCC to replace older LiDAR DTMs used in the RCFMS, and extends from the Tollcross Burn confluence to Greenock, including coverage of the tidal reaches of the White Cart Water, Black Cart Water, River Gryfe, River Kelvin and River Leven.
- SEPA/Scottish Water Bathymetric Survey (2016). This survey covers the reach between the Tollcross Burn confluence and Erskine Harbour.
- Aspect Clyde Estuary Bathymetric Survey (2020). This survey covers the reach between Erskine Harbour to the downstream boundary of the model at Greenock.

The 2020 LiDAR and 2016 and 2020 bathymetric survey DTMs were merged together for use in modelling, to avoid any potential issues where the extents of these surveys overlap.

Model elevations have been altered at specific locations using Z shape lines, to correct for errors in LiDAR processing (i.e. inaccurate removal of bridges, inaccurate truncation of bridge abutments, other minor triangulation issues), as well as other localised amendments to avoid model instability/initial condition artefacts. The flood walls between the Kingston Bridge and Finnieston Street Bridge were also explicitly represented based on as-built drawings using “wide” Z shape lines to ensure the wall crests are accounted for in the model. The reader is referred to the River Clyde Model Update Technical Report (Fairhurst; December 2021) for full details.

TUFLOW Quadtree permits variable grid resolutions within the 2D domain, through use of “nesting” (where grid cells within an area of interest can be subdivided one or more times to achieve improved accuracy in these locations). The model employs a default cell resolution of 40 m, with a finer (20 m) resolution used between the White Cart Water/Clyde Confluence and Longhaugh Point, as well as for the floodplains and channels of the River Leven, White Cart Water, Black Cart Water and River Gryfe. Upstream of the White Cart Water/Clyde Confluence, a 10 m grid resolution has been used, excepting for a corridor along the river centre where a 20 m resolution has been retained to improve runtimes. Grid nesting used in modelling is presented in Figure 4.2.

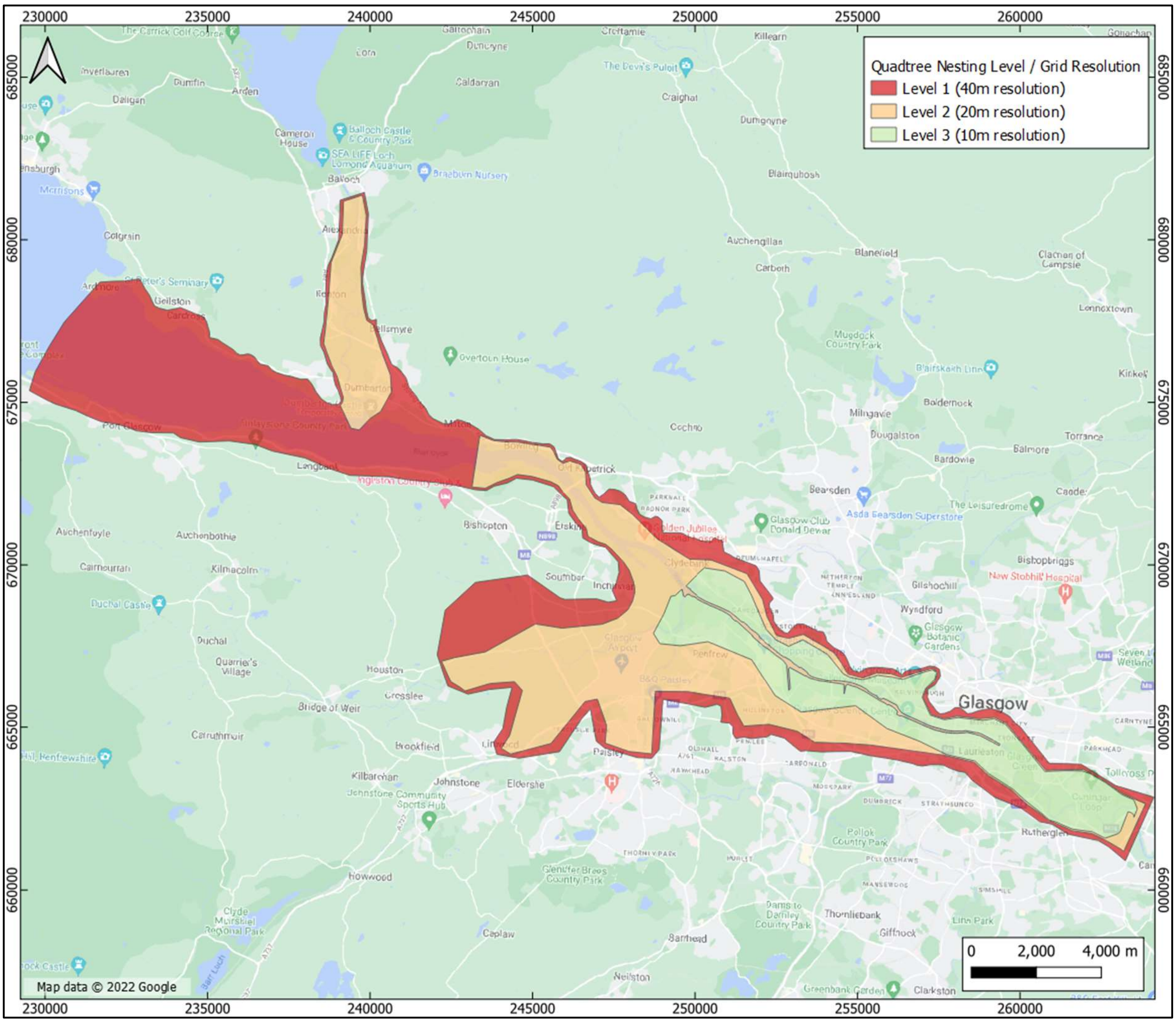


Figure 4.2: Model nesting levels

4.5.3 Model Boundaries

Design tidal stage hydrographs are input as a head-time boundary condition at the downstream end of the model, at Greenock. The boundary location is adjacent to a tidal gauge operated by Peel Ports, the data from which has been used for design tide estimation.

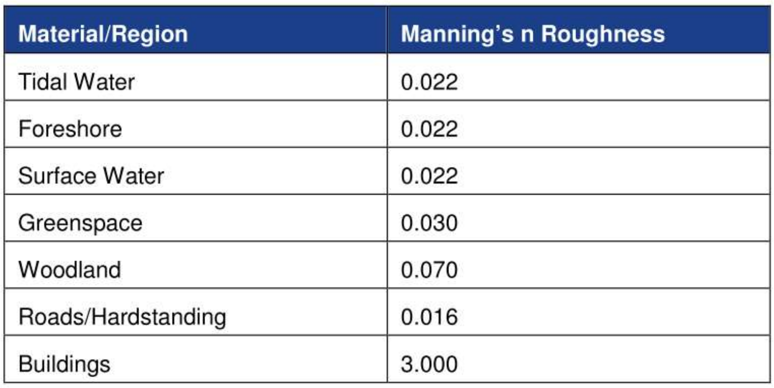
Design flow hydrographs are input as flow-time boundary conditions at multiple boundary locations within the model domain.

4.5.4 Model Schematic

4.5.5 Roughness

OS Open Local Map shapefiles were used to define the land use type for all locations within the model domain. Roughnesses were then applied for each land use, as summarised in Table 4.3. Shapefile information and Manning's n values were manually checked and corrected as appropriate for locations within 100 m of the River Clyde.

Table 4.3: Manning's n assigned to each land use (reproduced from the River Clyde Model Update Technical Report; Fairhurst, 2021)

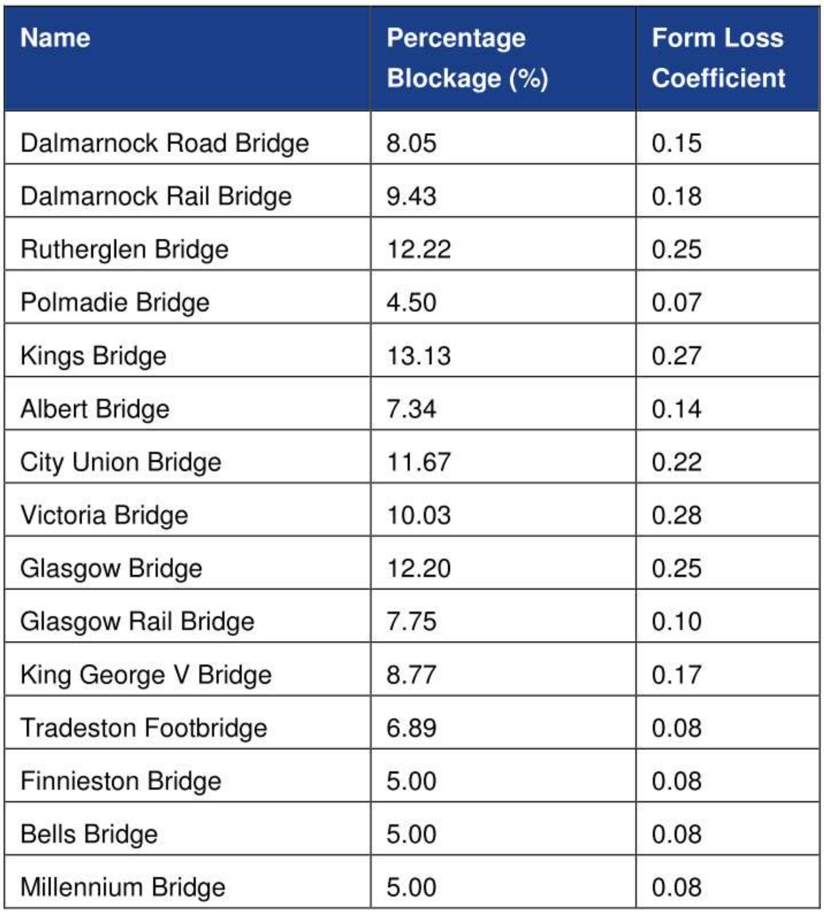


Material/Region	Manning's n Roughness
Tidal Water	0.022
Foreshore	0.022
Surface Water	0.022
Greenspace	0.030
Woodland	0.070
Roads/Hardstanding	0.016
Buildings	3.000

4.5.6 Representation of River Structures

Bridges within the modelled reach are represented based on form loss coefficients and percentage blockage values which in turn are based on guidance provided by TUFLOW taken from *Hydraulics of Bridge Waterways* (FHA, 1978). Parameter values used for each bridge are presented in Table 4.4.

Table 4.4: Modelled bridge parameterisation (reproduced from the River Clyde Model Update Technical Report; Fairhurst, 2021)



Name	Percentage Blockage (%)	Form Loss Coefficient
Dalmarnock Road Bridge	8.05	0.15
Dalmarnock Rail Bridge	9.43	0.18
Rutherglen Bridge	12.22	0.25
Polmadie Bridge	4.50	0.07
Kings Bridge	13.13	0.27
Albert Bridge	7.34	0.14
City Union Bridge	11.67	0.22
Victoria Bridge	10.03	0.28
Glasgow Bridge	12.20	0.25
Glasgow Rail Bridge	7.75	0.10
King George V Bridge	8.77	0.17
Tradeston Footbridge	6.89	0.08
Finnieston Bridge	5.00	0.08
Bells Bridge	5.00	0.08
Millennium Bridge	5.00	0.08

The Tidal Weir is represented using a 1D Estry Operational Weir channel dynamically linked to the 2D model domain, with gate opening and closing controlled by operational rules based on upstream and downstream water levels. Representation of the weir is not equivalent to that used in the RCFMS, due to software differences, but is found by sensitivity analysis to have a localised impact on peak water level predictions of 99 mm or less. The reader is referred to the River Clyde Model Update Technical Report (Fairhurst; December 2021) for full details.

4.5.7 Run Parameters/Options

The model is run using the sub-grid sampling (SGS) option within TUFLOW, which accounts for variation in topography and water surface elevation within the grid by representing the grading or curvature in both along each face of each cell. Amongst other benefits, this improves representation of cell storage and conveyance between cells (especially for larger grid resolutions) in comparison to approaches without SGS.

Fairhurst employed a 40 m grid resolution for the coarsest nesting level (see Section 4.5.2 for more information).

4.5.8 Model Calibration

Calibration was performed by applying observed tidal and fluvial hydrographs to the model and adjusting roughness parameterisation to achieve a good fit between predicted and observed water levels and hydrograph shapes at the Glasgow Harbour Tidal Gauge and Renfrew Tidal Gauge. The model is considered to provide a good fit to observed data within the reach between the tidal weir and the downstream boundary at Greenock. The reader is referred to the River Clyde Model Update Technical Report (Fairhurst; December 2021) for full details.

4.5.9 Sensitivity Testing

Extensive sensitivity testing of the updated model was undertaken by Fairhurst in relation to the 1 in 200 year event; the reader is referred to the River Clyde Model Update Technical Report (Fairhurst; December 2021) for full details. In summary:

- Representation of operational rules for the tidal weir has an associated sensitivity of up to 99 mm upon 1 in 200 year predicted peak water levels, with the impact extending throughout the tidal reach of the model. At the location of the site, tidal weir operation has an associated sensitivity of up to 48 mm.
- A 20% global increase in Manning’s roughness value is predicted to reduce peak water levels by up to 86 mm in the tidal reach of the model, while a 20% global decrease causes an increase in peak water levels of up to 92 mm in the tidal reach of the model, noting that roughness parameterisation impacts the timing of tidal propagation up the estuary, such that this sensitivity assessment also reflects sensitivity to the timing of the tidal surge relative to the fluvial inflow peak.
- For the default cell resolution used in modelling (i.e. 40 m resolution at the coarsest nesting level), sensitivity analysis found that employing the sub-grid sampling option had a small impact upon peak water level predictions (between 7 mm reduction and 12 mm increase).
- Altering the cell sizes used in modelling (by varying the resolution of the coarsest nesting level) had a small impact upon peak water level predictions (between 10 mm reduction and 11 mm increase).
- Increasing bridge blockage by 50% had a small impact upon peak water level predictions (± 5 mm).
- Increasing the bridge form loss coefficients by 50% or altering the assumed water density (between fresh water and saline water values) had a negligible impact (± 1 mm).

The baseline model does not account for the impact of wind upon peak water levels, which was assessed separately via sensitivity analysis. Extreme wind speeds and extreme sea levels are likely to be correlated, but the correlation is unknown for the River Clyde. The Defra/Environment Agency Joint Probability: Dependence Mapping and Best Practice approach was therefore used to assess the potential return period of wind for 1 in 200 year extreme sea level conditions based on dependency factors between 0.1 and 0.8. A dependency factor of 0.8 would be associated with a 1 in 4 year wind speed occurring concurrently with 1 in 200 year extreme sea level conditions, with a dependency factor of 0.7 associated with a 1 in 1 year wind speed, and lower dependency factors resulting in sub-annual wind speed return periods. Wind blowing into the estuary from the west (i.e. 270°) was found to cause the largest uplift in predicted peak water levels, with wind emanating from other directions causing a weaker uplift or in some cases (e.g. from the east or south) causing a reduction in predicted peak water levels. The impact of extreme westerly winds upon peak water level predictions can be summarised as follows:

- A 3 hr duration, 1 in 5 year westerly wind peaking 1 hr after the tidal peak at Greenock is predicted to increase 1 in 200 year peak water level predictions by 0.77 m at Glasgow Harbour, with more severe increases upstream of the harbour (up to 0.80 m) and less severe increases downstream of the harbour. At the location of the site, this wind event is predicted to increase peak 1 in 200 year water levels by between 0.65 and 0.70 m.
- A less extreme 3 hr duration 1 in 1 year westerly wind peaking 1 hr after the tidal peak at Greenock is predicted to increase 1 in 200 year peak water level predictions by 0.65 m at Glasgow Harbour, with increases of up to 0.67 m upstream of the harbour. At the location of the site, this wind event is predicted to increase peak 1 in 200 year water levels by between 0.55 and 0.60 m.
- The predicted sensitivity to wind is itself very sensitive to wind event duration and peak timing; a wind peak occurring at the same time as or before the tidal peak at Greenock, and/or a shorter or longer duration wind event, will have a lesser impact upon increasing peak water level predictions, and may in some instances cause a reduction in peak water level predictions.

Fairhurst assert that these sensitivity analysis predictions should be considered when deriving appropriate freeboard allowances, noting that the impact of wind (for critical wind event duration, timing and direction and relatively high assumed dependency) is predicted to exceed the general standard freeboard value of 600 mm.

4.6 Baseline Model Simulations

All simulations were conducted using TUFLOW Version 2020-10-AD with HPC Quadtree Version 1.23.0 (Sep 1 2021) (single precision, 64-bit solver). Tabulated predictions focus on the local reach of the River Clyde, between the Govan Graving Docks (SEC_25) and Braehead Shopping Centre (YARROWS) (Figure 4.3). The site is located between model result locations FAIR_BAS and SEC_36, with these locations shown in bold in all results tables.

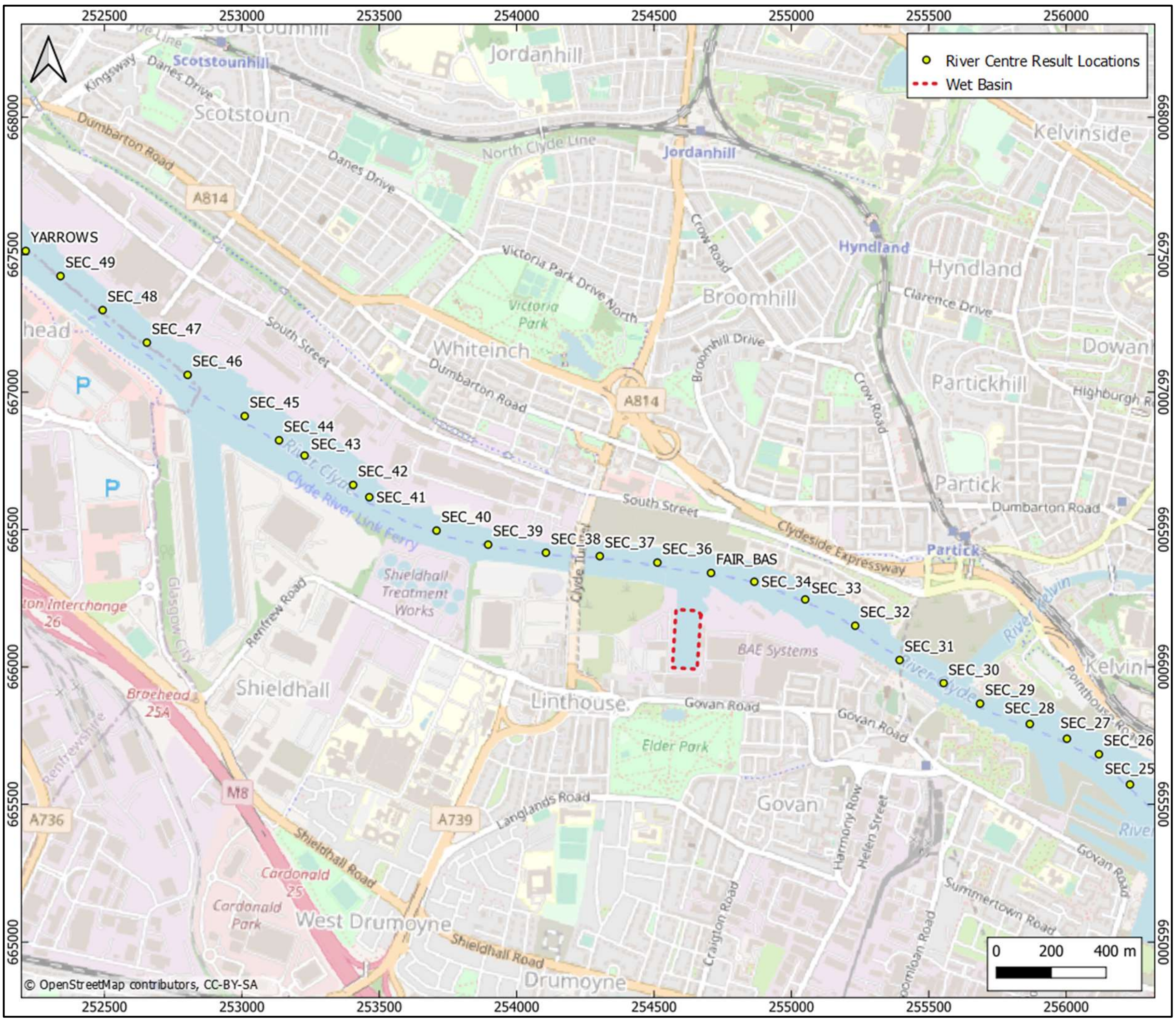


Figure 4.3: Tabulated results locations

4.6.1 Model Amendments

To better suit flood prediction for this study, model nesting polygons were locally altered to improve grid resolution for the wet basin as well as for the King George V Dock downstream of the site, as illustrated in Figure 4.4. Due to significant patches of instability in velocity and peak water level predictions in the reach of River Clyde downstream of the site (within the King George V Dock, as well as in the adjacent section of the river channel upstream and downstream of the dock) when using a 40/20/10 m grid resolution, based on both the original and amended nesting extents, the grid resolution was also reduced to 32/16/8 m for all analysis presented in this report, which was found to substantially reduce these instabilities and therefore improve confidence in model predictions.

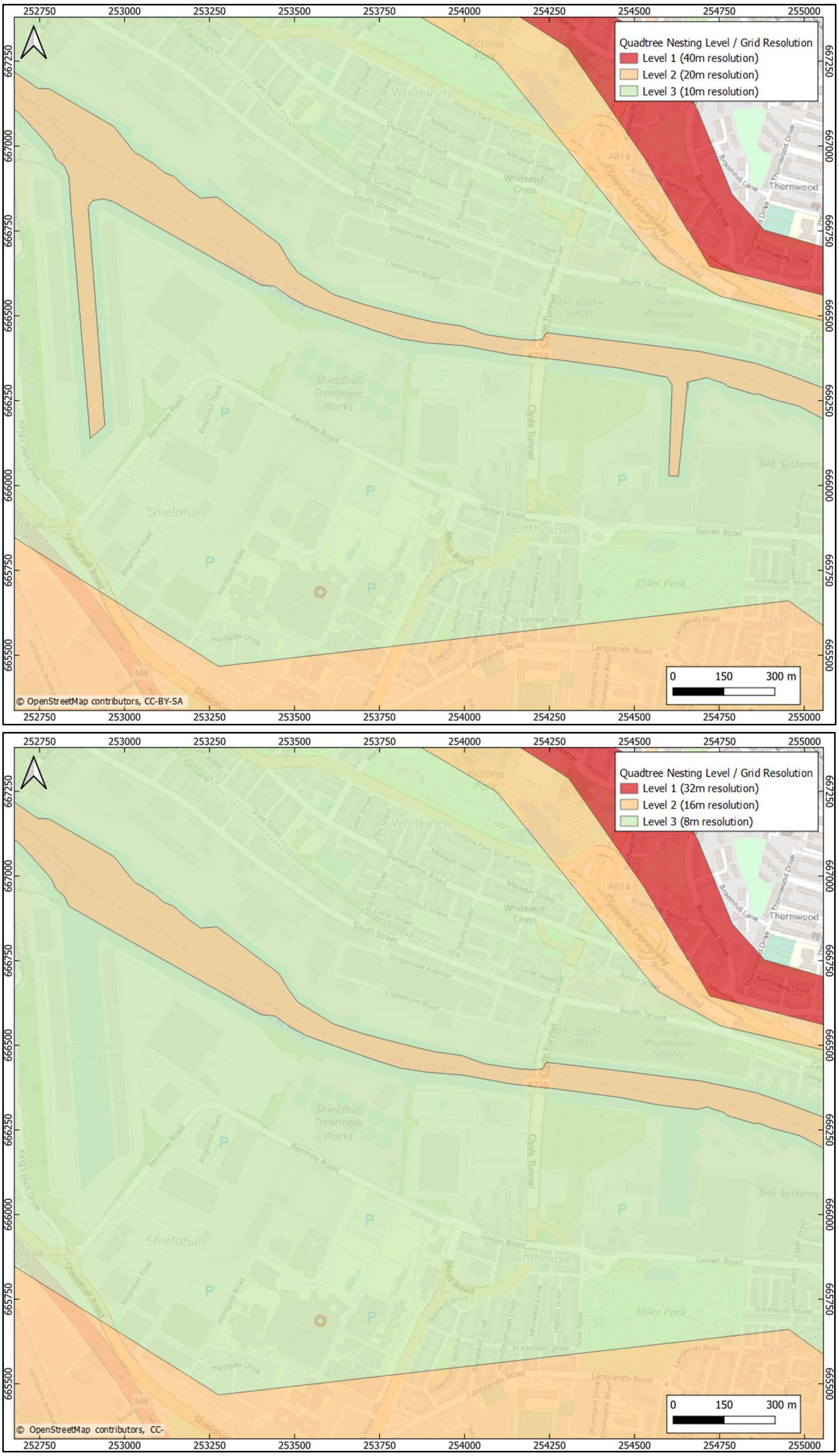


Figure 4.4: Local nesting extents; as per Fairhurst model (upper) versus amended (lower)

4.6.2 Model Precision Versus Reporting Precision

While Fairhust reporting for the model, in keeping with reporting for the original RCFMS, quotes peak water level predictions obtained from the model to 2 decimal places, preliminary analysis indicated that the impact of the proposals being considered in this assessment upon peak water level predictions is less than 10 mm. In order to discern and report on the potential impact of development upon flood risk, peak water level predictions are therefore presented to 3 decimal places in this report. However, it should be borne in mind that discrepancies in predictions at the third decimal place may be below the predictive precision of the model.

4.6.3 Model Predictions

Table 4.5 presents predicted peak water levels at river centre locations in the local reach of the River Clyde for the 1 in 200 year event, 1 in 200 year event including (850 mm) sea level rise, and 1 in 200 year event including climate change (i.e. sea level rise and fluvial inflow uplift). Predictions obtained from the unamended Fairhurst model are also presented for the 1 in 200 year event, for reference, indicating that changes to grid sizing and nesting extents used in the current assessment result in slightly more conservative peak water level predictions, between 2-6 mm higher than unamended predictions; further analysis indicates that use of a smaller grid resolution explains the majority of the difference, with changes to nesting extents alone accounting for 1 mm or less of predicted variations.

Table 4.5: Predicted baseline peak water levels (in mAOD) at river centre locations in the local river reach

Location	1 in 200 year (Unamended)	1 in 200 year	1 in 200 year + sea level rise	1 in 200 year + climate change
SEC_25	4.876	4.881	5.593	5.619
SEC_26	4.874	4.879	5.591	5.617
SEC_27	4.873	4.877	5.589	5.615
SEC_28	4.871	4.875	5.587	5.612
SEC_29	4.865	4.869	5.582	5.604
SEC_30	4.861	4.865	5.578	5.597
SEC_31	4.856	4.859	5.573	5.590
SEC_32	4.856	4.859	5.571	5.589
SEC_33	4.854	4.856	5.568	5.586
SEC_34	4.851	4.853	5.565	5.582
FAIR_BAS	**4.848**	**4.850**	**5.563**	**5.579**
SEC_36	**4.845**	**4.847**	**5.559**	**5.575**
SEC_37	4.841	4.843	5.555	5.571
SEC_38	4.834	4.837	5.550	5.562
SEC_39	4.830	4.833	5.546	5.558
SEC_40	4.826	4.830	5.543	5.555
SEC_41	4.821	4.825	5.538	5.550
SEC_42	4.820	4.825	5.537	5.550
SEC_43	4.818	4.823	5.535	5.548
SEC_44	4.817	4.822	5.533	5.547
SEC_45	4.815	4.820	5.532	5.545
SEC_46	4.811	4.816	5.528	5.541
SEC_47	4.805	4.811	5.523	5.535
SEC_48	4.801	4.807	5.518	5.530
SEC_49	4.797	4.802	5.514	5.526
YARROWS	4.794	4.800	5.511	5.524

Predicted baseline flood extents for each modelled event are presented in Figure 4.5. For the 1 in 200 year event, floodwaters remain mostly contained within the wet basin, with limited low depth inundation of a narrow corridor of land at the eastern edge of the wet basin. Sea level rise due to climate change increases local peak 1 in 200 year water levels by between 711-714 mm, which significantly increases the extent of local flooding beyond the southern bank of the Clyde upstream of the wet basin. The additional impact of increased fluvial flows due to climate change amounts, locally, to a modest 12-26 mm increase in peak 1 in 200 year water levels, relative to the 1 in 200 year plus sea level rise scenario; this small increase in peak water levels has a negligible impact upon predicted local flood extents.

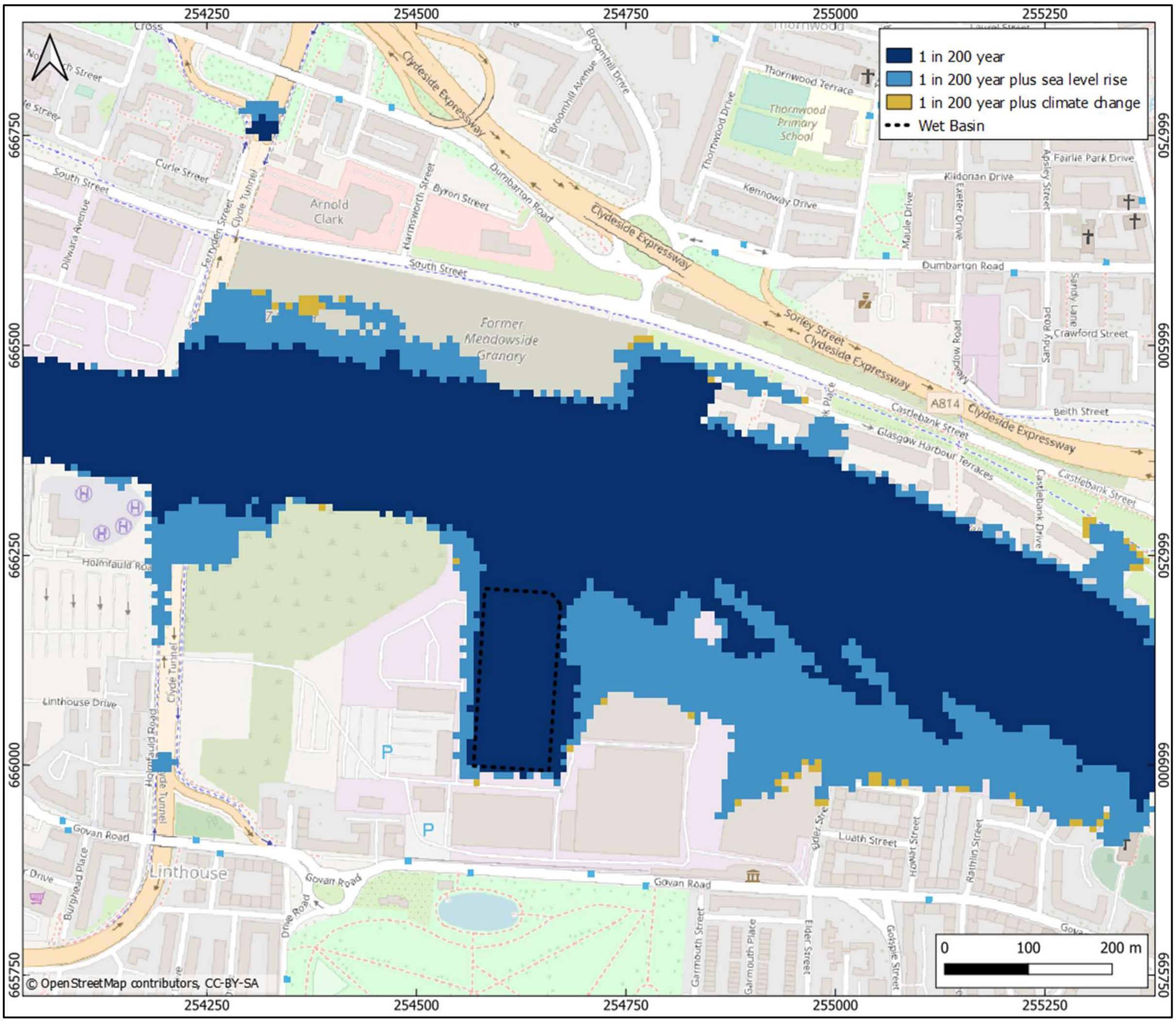


Figure 4.5: Predicted local baseline flood extents in the vicinity of the wet basin

4.7 Wet Basin Infilling Model Simulations

The flood impact of infilling of the wet basin to its final platform level was assessed separately from the impact of the proposed building.

4.7.1 Model Amendments

The local ground model was modified to account for infilling of the wet basin. The modifications made are as follows:

- A DTM was created to represent the infilled platform (7.3 mCD; equivalent to 4.91 mAOD), and added to the end of the DTM list in the TUFLOW geometry control file (to ensure it overwrites elevations from other LiDAR-bathymetric DTMs within the model).
- Roughness shapefile data was modified, with the infilled platform represented as a hardstand surface (Manning's n of 0.016) instead of tidal waters.

4.7.2 Model Predictions

Table 4.6 presents predicted peak water levels at river centre locations in the local reach of the River Clyde for the 1 in 200 year event, 1 in 200 year event including (850 mm) sea level rise, and 1 in 200 year event including climate change (i.e. sea level rise and fluvial inflow uplift) for the basin infilling scenario. Predicted post-infilling flood extents for each modelled event are presented in Figure 4.6.

Table 4.6: Predicted post-infilling peak water levels (in mAOD) at river centre locations in the local river reach

Location	1 in 200 year	1 in 200 year + sea level rise	1 in 200 year + climate change
SEC_25	4.878	5.592	5.617
SEC_26	4.876	5.589	5.615
SEC_27	4.874	5.588	5.613
SEC_28	4.872	5.585	5.611
SEC_29	4.866	5.581	5.602
SEC_30	4.862	5.577	5.596
SEC_31	4.856	5.572	5.588
SEC_32	4.856	5.569	5.587
SEC_33	4.853	5.566	5.584
SEC_34	4.850	5.564	5.580
FAIR_BAS	**4.847**	**5.561**	**5.577**
SEC_36	**4.844**	**5.558**	**5.573**
SEC_37	4.841	5.553	5.569
SEC_38	4.834	5.548	5.560
SEC_39	4.831	5.544	5.557
SEC_40	4.828	5.540	5.553
SEC_41	4.823	5.536	5.548
SEC_42	4.823	5.535	5.548
SEC_43	4.821	5.533	5.546
SEC_44	4.820	5.531	5.545
SEC_45	4.818	5.530	5.543
SEC_46	4.814	5.526	5.539
SEC_47	4.809	5.521	5.533
SEC_48	4.805	5.516	5.528
SEC_49	4.801	5.512	5.524
YARROWS	4.798	5.509	5.522

The platform level of the infilled wet basin is marginally above the adjacent 1 in 200 year water level predictions, by between 63-66 mm. Noting that simulations do not account for wind action, there is a risk the platform will be inundated by this event. Otherwise, with inclusion of sea level rise / climate change, predicted flood extents following infilling of the basin are essentially the same as for baseline conditions.

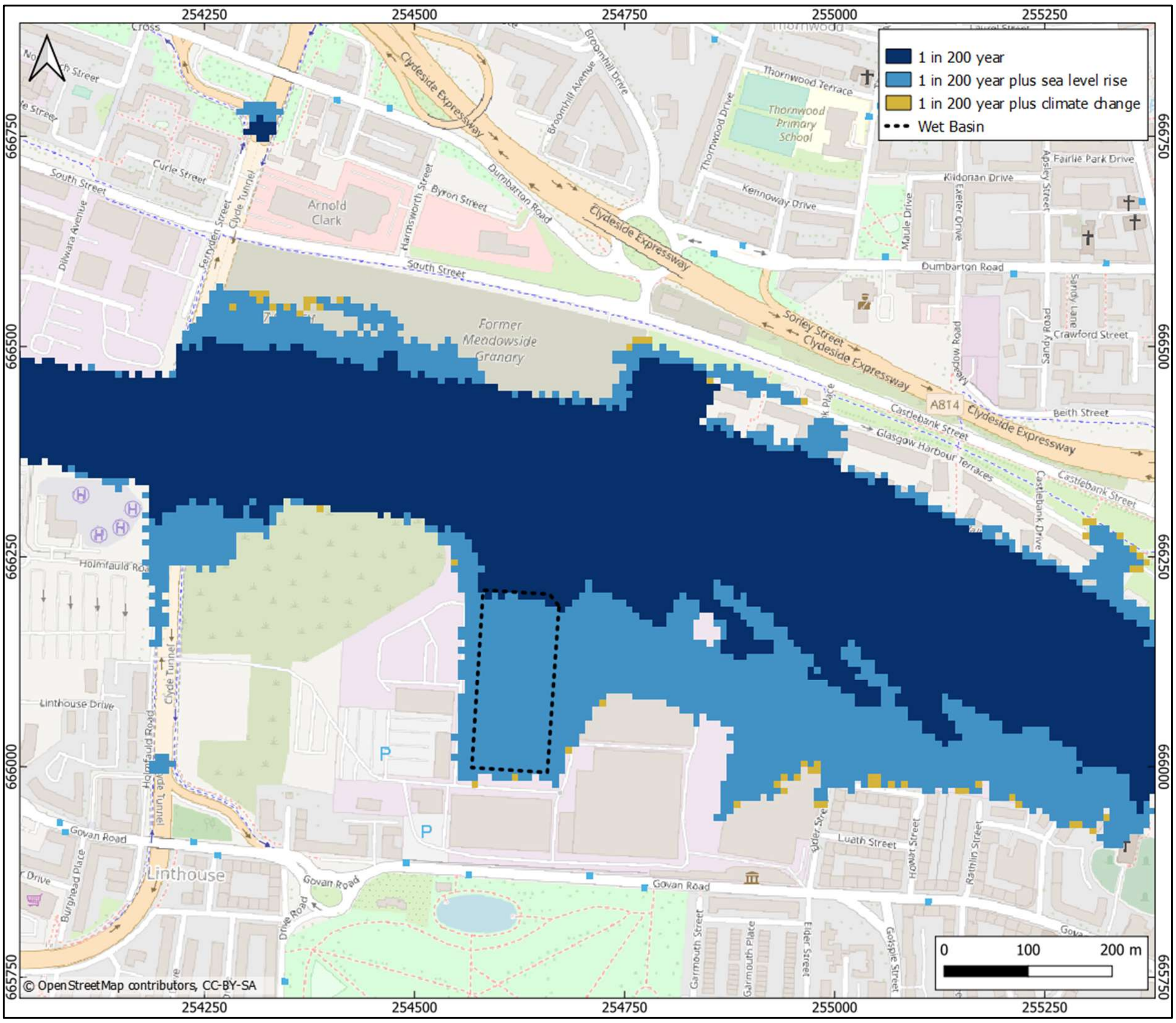


Figure 4.6: Predicted local flood extents in the vicinity of the wet basin following wet basin infilling

4.7.3 Impact of Infilling Upon Flood Predictions

Infilling of the wet basin is predicted to have a negligible impact upon flooding behaviour for the 1 in 200 year event, with or without climate change impacts (Table 4.7). Adjacent to the basin, river centre peak water levels are predicted to reduce by 3 mm for the 1 in 200 year event, with slightly smaller reductions of 1-2 mm for the 1 in 200 year plus sea level rise and plus climate change events.

Figure 4.7 through Figure 4.9 present difference maps, showing the impact of basin infilling upon predicted peak water levels for all local 2D cells for the 1 in 200 year, 1 in 200 year plus sea level rise and 1 in 200 year plus climate change scenarios, respectively. Predicted peak water levels are generally between 1-3 mm below baseline predictions.

Table 4.7: Predicted change in peak water levels (in mAOD) at river centre locations in the local river reach due to wet basin infilling. Negative values indicate reduction due to infilling.

Location	1 in 200 year	1 in 200 year + sea level rise	1 in 200 year + climate change
SEC_25	-0.003	-0.001	-0.002
SEC_26	-0.003	-0.002	-0.002
SEC_27	-0.003	-0.001	-0.002
SEC_28	-0.003	-0.002	-0.001
SEC_29	-0.003	-0.001	-0.002
SEC_30	-0.003	-0.001	-0.001
SEC_31	-0.003	-0.001	-0.002
SEC_32	-0.003	-0.002	-0.002
SEC_33	-0.003	-0.002	-0.002
SEC_34	-0.003	-0.001	-0.002
FAIR_BAS	**-0.003**	**-0.002**	**-0.002**
SEC_36	**-0.003**	**-0.001**	**-0.002**
SEC_37	-0.002	-0.002	-0.002
SEC_38	-0.003	-0.002	-0.002
SEC_39	-0.002	-0.002	-0.001
SEC_40	-0.002	-0.003	-0.002
SEC_41	-0.002	-0.002	-0.002
SEC_42	-0.002	-0.002	-0.002
SEC_43	-0.002	-0.002	-0.002
SEC_44	-0.002	-0.002	-0.002
SEC_45	-0.002	-0.002	-0.002
SEC_46	-0.002	-0.002	-0.002
SEC_47	-0.002	-0.002	-0.002
SEC_48	-0.002	-0.002	-0.002
SEC_49	-0.001	-0.002	-0.002
YARROWS	-0.002	-0.002	-0.002

The mechanism for these minor predicted reductions in peak water level due to basin infilling is unclear. Basin infilling may slightly alter attenuation of tidal propagation, resulting in very minor changes in the predicted flood peak.

Alternatively, or additionally, these minor predicted reductions in peak water level due to basin infilling may be model artefacts associated with localised instabilities, which are observable in isolated river edge cells and in larger patches towards the downstream end of the model, and which may cause slight changes in the adaptive timestep employed by the solver at any point during the simulation (which is controlled by the model software, based on convergence criteria, and therefore may change between simulations). Cells with instability have larger variations in predicted peak water levels exceeding 10 mm and in some cells exceeding 100 mm; analysis of predicted water levels and velocities in these and surrounding cells indicate that these larger variations are associated with local numerical instability in both the baseline and infilled predictions, usually associated with the transition between meshing resolutions and corresponding with velocity “hotspots” and peak water levels unexplainably higher or lower than that in surrounding cells. Employing a 32/16/8 m grid resolution results in a substantial reduction in the number and extent of unstable cells/patches for the events assessed, especially in the vicinity of the King George V Dock, compared to the 40/20/10 m grid resolution used in Fairhurst’s model version, but does not eliminate instability entirely.

It is noted that increases in peak water levels of up to 3 mm are predicted towards the downstream end of the model (below Erskine Bridge), separated by a significant distance from the development site with reductions in peak water level of between 1-3 mm in the intervening reach of the river; these predicted increases remote from the site cannot be logically associated with basin infilling, giving further weight to the conclusion that such minor changes in peak water level predictions are likely to be artefacts associated with the numerical solver, and are therefore below the predictive precision of the model.

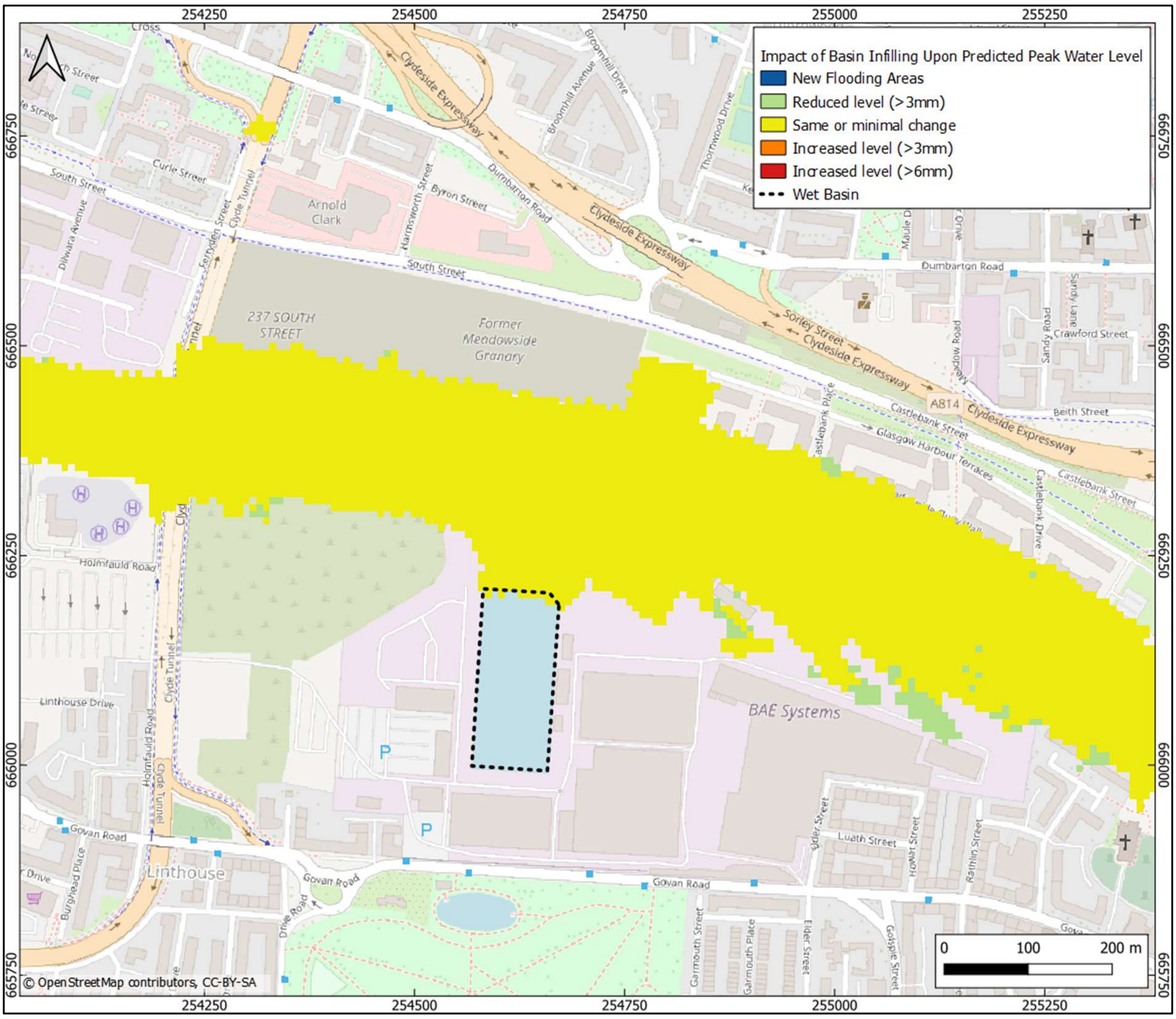


Figure 4.7: Change in predicted peak water levels due to wet basin infilling (1 in 200 year event)

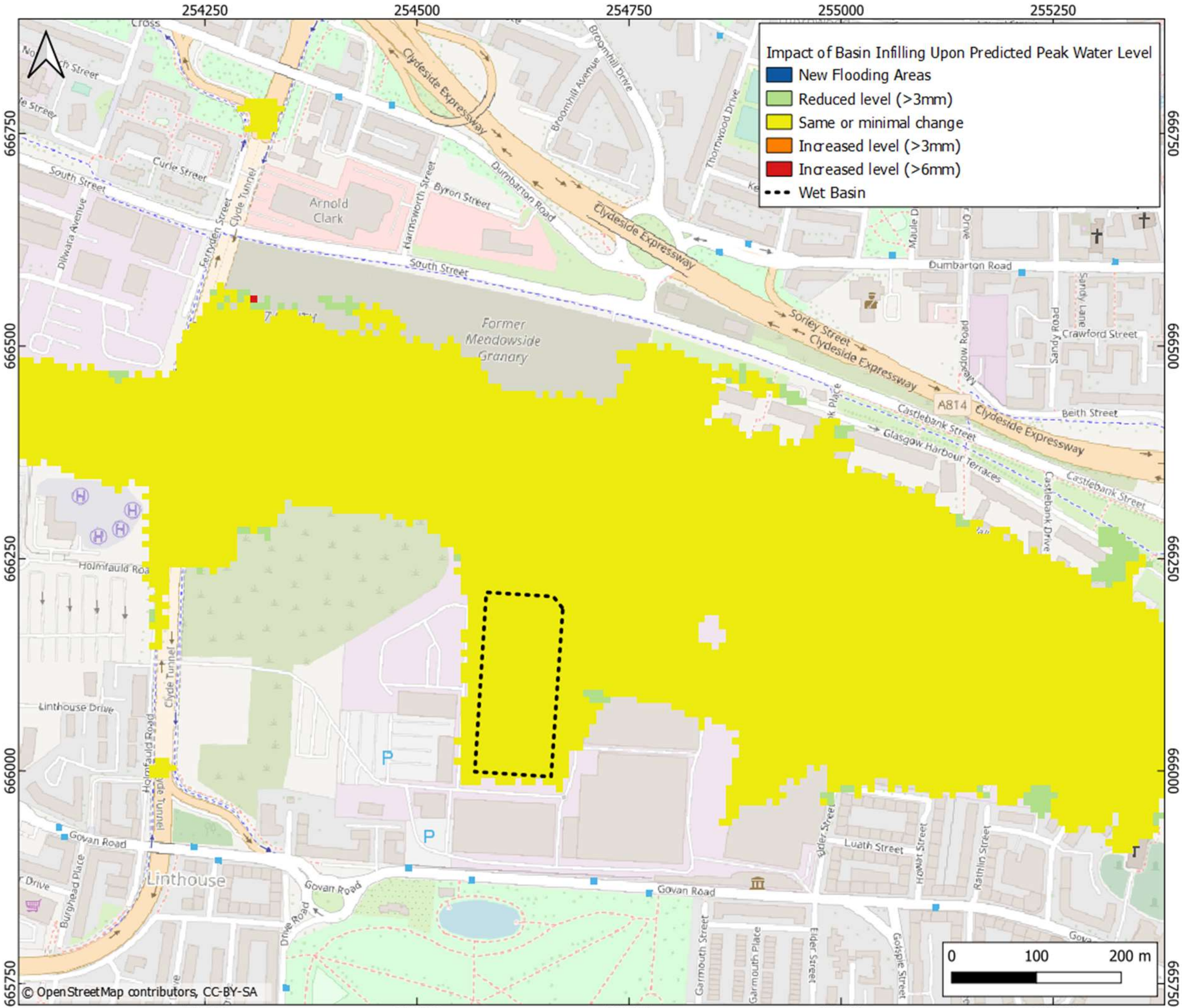


Figure 4.8: Change in predicted peak water levels due to wet basin infilling (1 in 200 year plus sea level rise event)

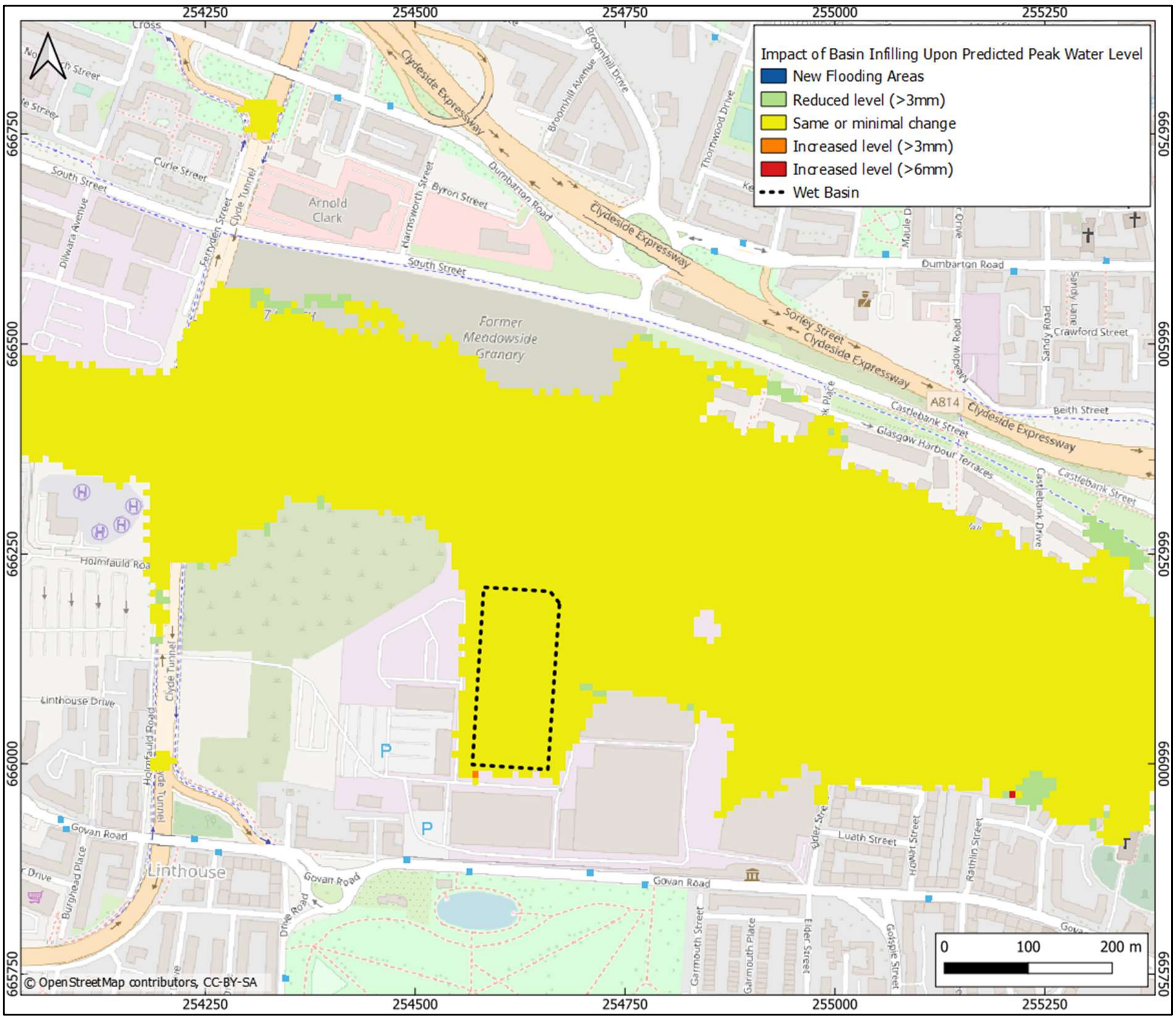


Figure 4.9: Change in predicted peak water levels due to wet basin infilling (1 in 200 year plus climate change event)

4.7.4 Flood Risk Impact for Higher Frequency Flood Events

Noting that the events simulated account for what should be the worst-case impact (i.e. the events at which river water levels are just below and just above that necessary to flood the infilled basin), the impact of infilling for higher or lower return periods will, logically, also be negligible. Other return period events have therefore not been considered as part of this assessment.

4.8 Post-Development Model Simulations

4.8.1 Model Amendments

Relative to the basin infilling model amendments described in Section 4.7.1, the following modifications were made to represent the proposed Wet Basin Hall and accommodation block building:

- “Open Building” – The building was represented in terms of its walls and permanent structures (the eastern and western sides of the hall, plus full accommodation block) only, which were raised to a nominal elevation of 10 mAOD to act as barriers to the movement of water onto the infilled platform. This represents a potential operational scenario in which the main and side doors of the hall are deliberately left in an open position in the event of a flood alert or warning.
- “Closed Building” – The building was represented in terms of its full footprint, raised to a nominal elevation of 10 mAOD. This represents an alternative potential operational scenario in which all external doors are closed in the event of a flood alert or warning; this represents a worst-case in terms of potential flood risk impact of the proposed development upon other receptors.

4.8.2 Model Predictions – Open Building

Table 4.8 presents predicted peak water levels at river centre locations in the local reach of the River Clyde for the 1 in 200 year event, 1 in 200 year event including (850 mm) sea level rise, and 1 in 200 year event including climate change (i.e. sea level rise and fluvial inflow uplift) for the “open building” scenario. Predicted flood extents for this scenario for each modelled event are presented in Figure 4.10.

Table 4.8: Predicted "open building" peak water levels (in mAOD) at river centre locations in the local river reach

Location	1 in 200 year	1 in 200 year + sea level rise	1 in 200 year + climate change
SEC_25	4.878	5.592	5.617
SEC_26	4.876	5.589	5.615
SEC_27	4.874	5.587	5.613
SEC_28	4.872	5.585	5.610
SEC_29	4.866	5.580	5.602
SEC_30	4.862	5.576	5.596
SEC_31	4.856	5.572	5.588
SEC_32	4.856	5.569	5.587
SEC_33	4.853	5.566	5.584
SEC_34	4.850	5.563	5.580
FAIR_BAS	**4.847**	**5.561**	**5.577**
SEC_36	**4.844**	**5.557**	**5.573**
SEC_37	4.841	5.553	5.569
SEC_38	4.834	5.548	5.561
SEC_39	4.831	5.544	5.557
SEC_40	4.828	5.541	5.553
SEC_41	4.823	5.536	5.548
SEC_42	4.823	5.535	5.548
SEC_43	4.821	5.533	5.546
SEC_44	4.820	5.532	5.545
SEC_45	4.818	5.530	5.543
SEC_46	4.814	5.526	5.539
SEC_47	4.809	5.521	5.533
SEC_48	4.805	5.517	5.529
SEC_49	4.801	5.512	5.524
YARROWS	4.798	5.509	5.522

Relative to the infilled basin predictions (Section 4.7), inclusion of the "open building" has no additional impact upon altering river centre peak water level predictions. Flood extents are also similar, excepting the reduction in the 1 in 200 year plus sea level rise and plus climate change event extents associated with the open building footprint of the hall and accommodation block.

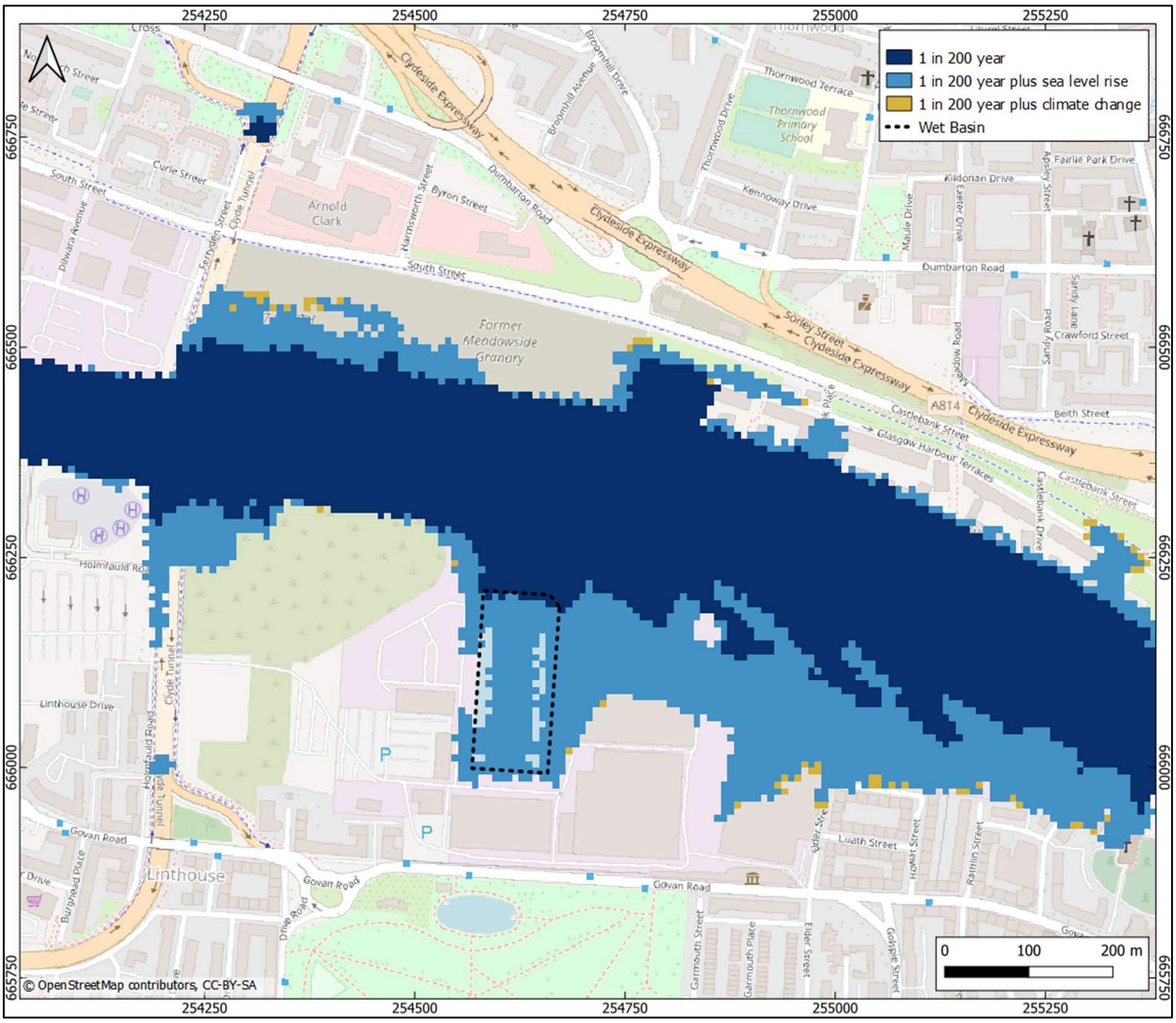


Figure 4.10: Predicted local flood extents in the vicinity of the wet basin for the "open building" scenario

The proposed development, with an "open building", is predicted to have a negligible impact upon flooding behaviour for the 1 in 200 year event, with or without climate change impacts (Table 4.9). As for the basin infilling predictions, the range of predicted local impact varies between a 1-3 mm reduction relative to baseline predictions; the addition of the open building therefore has no discernible impact upon river centre peak water level predictions.

Figure 4.11 and Figure 4.12 present difference maps, showing the impact of development (with "open building") upon predicted peak water levels for all local 2D cells for the 1 in 200 year plus sea level rise and 1 in 200 year plus climate change scenarios, respectively (noting that the 1 in 200 year difference map will be the same as for the basin infilling scenario, as flooding is not predicted to inundated the platform; Figure 4.7). As for the basin infilling scenario, the addition of the open building has no impact upon predicted 2D peak water levels, which remain within 3 mm of baseline predictions at all locations (other than locations impacted by numerical instability).

Table 4.9: Predicted change in peak water levels (in mAOD) at river centre locations in the local river reach for the "open building" scenario. Negative values indicate reduction.

Location	1 in 200 year	1 in 200 year + sea level rise	1 in 200 year + climate change
SEC_25	-0.003	-0.001	-0.002
SEC_26	-0.003	-0.002	-0.002
SEC_27	-0.003	-0.002	-0.002
SEC_28	-0.003	-0.002	-0.002
SEC_29	-0.003	-0.002	-0.002
SEC_30	-0.003	-0.002	-0.001
SEC_31	-0.003	-0.001	-0.002
SEC_32	-0.003	-0.002	-0.002
SEC_33	-0.003	-0.002	-0.002
SEC_34	-0.003	-0.002	-0.002
FAIR_BAS	**-0.003**	**-0.002**	**-0.002**
SEC_36	**-0.003**	**-0.002**	**-0.002**
SEC_37	-0.002	-0.002	-0.002
SEC_38	-0.003	-0.002	-0.001
SEC_39	-0.002	-0.002	-0.001
SEC_40	-0.002	-0.002	-0.002
SEC_41	-0.002	-0.002	-0.002
SEC_42	-0.002	-0.002	-0.002
SEC_43	-0.002	-0.002	-0.002
SEC_44	-0.002	-0.001	-0.002
SEC_45	-0.002	-0.002	-0.002
SEC_46	-0.002	-0.002	-0.002
SEC_47	-0.002	-0.002	-0.002
SEC_48	-0.002	-0.001	-0.001
SEC_49	-0.001	-0.002	-0.002
YARROWS	-0.002	-0.002	-0.002

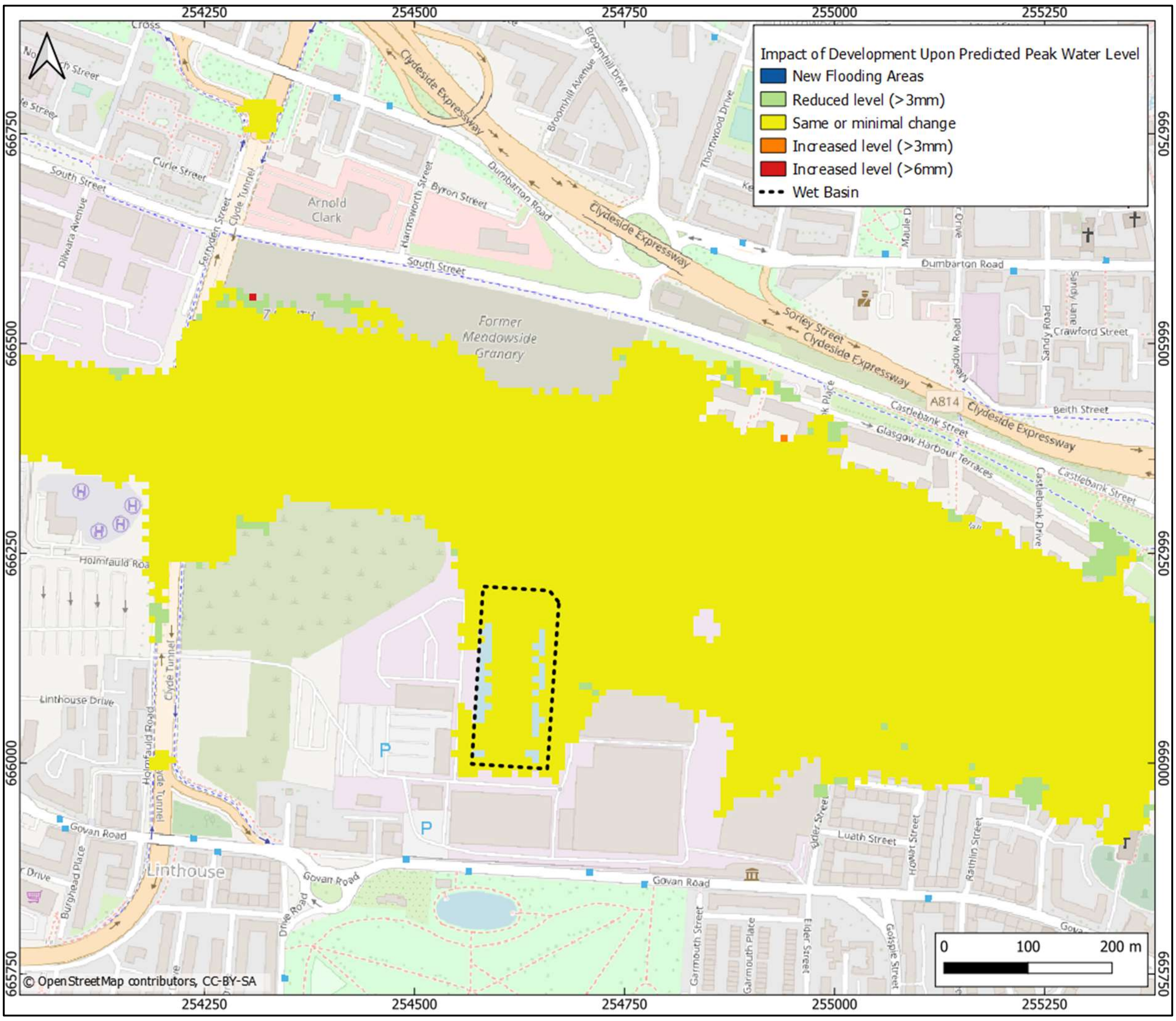


Figure 4.11: Change in predicted peak water levels due to proposed development, for "open building" scenario (1 in 200 year plus sea level rise event)

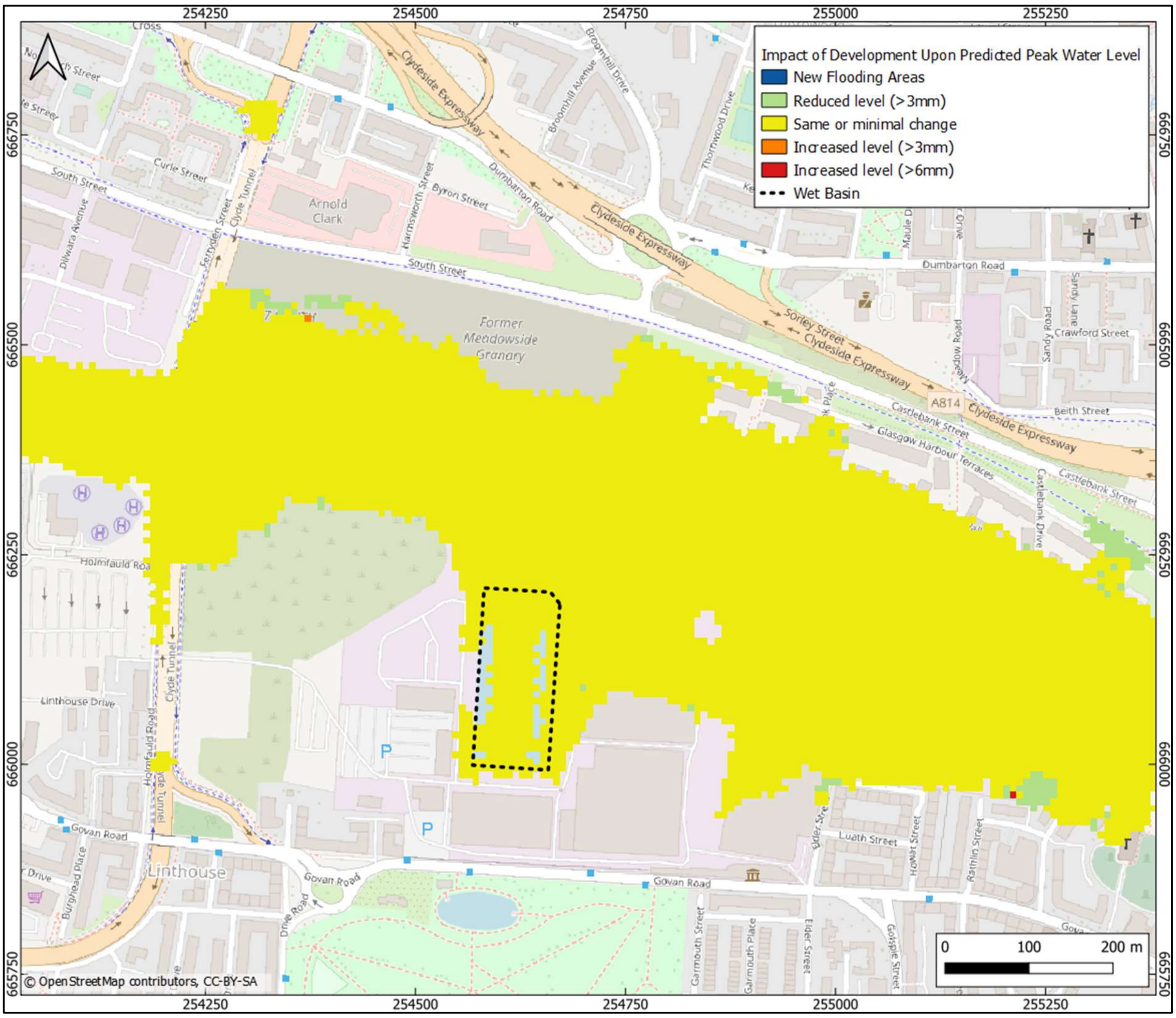


Figure 4.12: Change in predicted peak water levels due to proposed development, for "open building" scenario (1 in 200 year plus climate change event)

4.8.3 Model Predictions – Closed Building

Table 4.10 presents predicted peak water levels at river centre locations in the local reach of the River Clyde for the 1 in 200 year event, 1 in 200 year event including (850 mm) sea level rise, and 1 in 200 year event including climate change (i.e. sea level rise and fluvial inflow uplift) for the "closed building" scenario. Predicted flood extents for this scenario for each modelled event are presented in Figure 4.13.

Relative to the infilled basin predictions (Section 4.7), inclusion of the "closed building" has no additional impact upon altering river centre peak water level predictions. Flood extents are also similar, excepting the reduction in the 1 in 200 year plus sea level rise and plus climate change event extents associated with the footprint of the hall and accommodation block.

Table 4.10: Predicted "closed building" peak water levels (in mAOD) at river centre locations in the local river reach

Location	1 in 200 year	1 in 200 year + sea level rise	1 in 200 year + climate change
SEC_25	4.878	5.592	5.617
SEC_26	4.876	5.589	5.615
SEC_27	4.874	5.587	5.613
SEC_28	4.872	5.585	5.610
SEC_29	4.866	5.580	5.602
SEC_30	4.862	5.576	5.595
SEC_31	4.856	5.572	5.588
SEC_32	4.856	5.569	5.587
SEC_33	4.853	5.566	5.584
SEC_34	4.850	5.563	5.580
FAIR_BAS	**4.847**	**5.561**	**5.577**
SEC_36	**4.844**	**5.557**	**5.573**
SEC_37	4.841	5.553	5.569
SEC_38	4.834	5.548	5.560
SEC_39	4.831	5.544	5.557
SEC_40	4.828	5.541	5.553
SEC_41	4.823	5.536	5.548
SEC_42	4.823	5.535	5.548
SEC_43	4.821	5.533	5.546
SEC_44	4.820	5.532	5.545
SEC_45	4.818	5.530	5.543
SEC_46	4.814	5.526	5.539
SEC_47	4.809	5.521	5.533
SEC_48	4.805	5.517	5.529
SEC_49	4.801	5.512	5.524
YARROWS	4.798	5.509	5.522

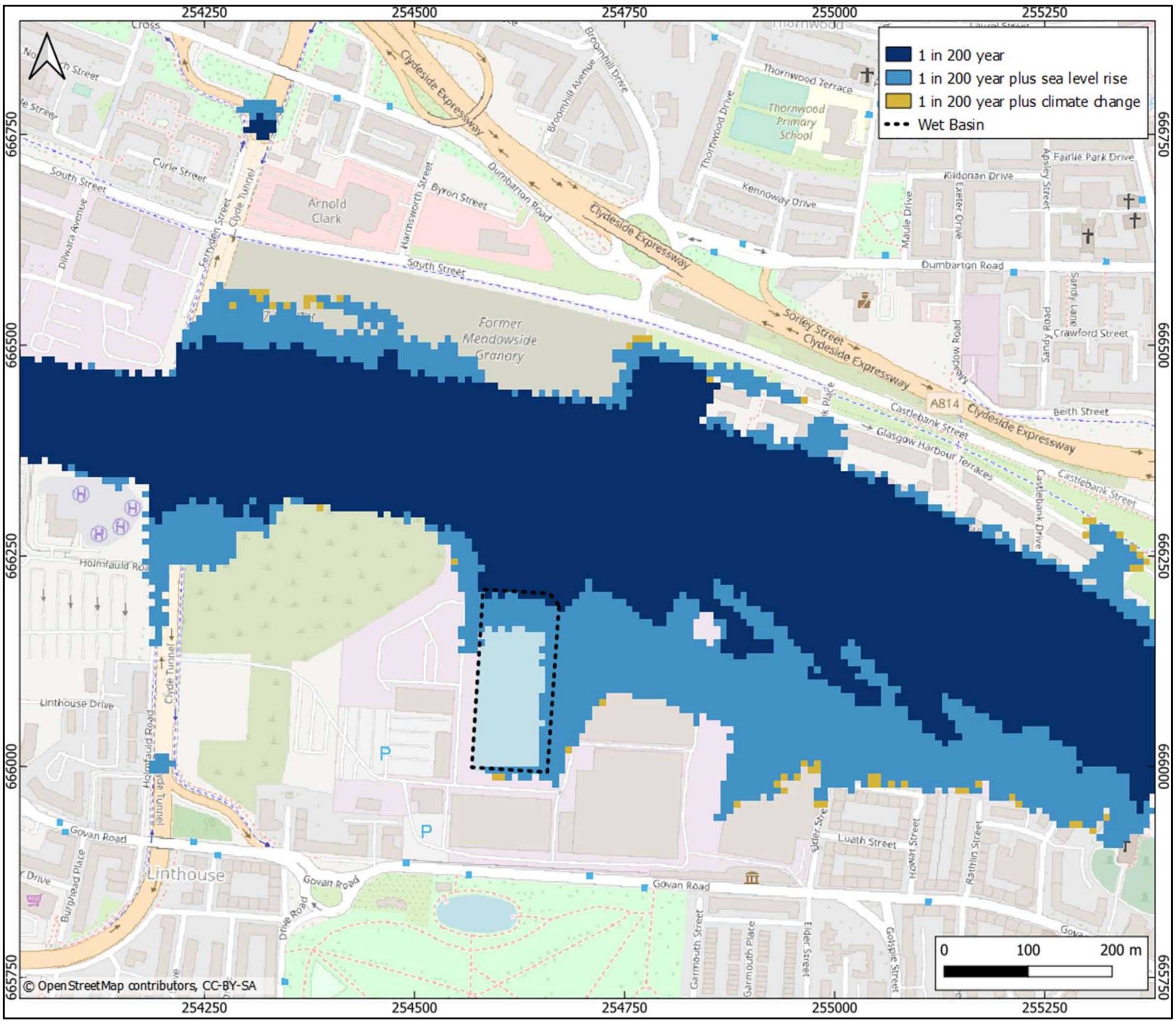


Figure 4.13: Predicted local flood extents in the vicinity of the wet basin for the "closed building" scenario

The proposed development, with a "closed building", is predicted to have a negligible impact upon flooding behaviour for the 1 in 200 year event, with or without climate change impacts (Table 4.11). As for the basin infilling predictions, the range of predicted local impact varies between a 1-3 mm reduction relative to baseline predictions; the addition of the closed building therefore has no discernible impact upon river centre peak water level predictions.

Figure 4.14 and Figure 4.15 present difference maps, showing the impact of development (with "closed building") upon predicted peak water levels for all local 2D cells for the 1 in 200 year plus sea level rise and 1 in 200 year plus climate change scenarios, respectively (noting that the 1 in 200 year difference map will be the same as for the basin infilling scenario, as flooding is not predicted to inundated the platform; Figure 4.7). As for the basin infilling scenario, the addition of the closed building has no impact upon predicted 2D peak water levels, which remain within 3 mm of baseline predictions at all locations (other than locations impacted by numerical instability). Difference maps showing the full model extent are presented for this scenario, demonstrating the lack of predicted impact throughout the model domain, as Appendix D.

Table 4.11: Predicted change in peak water levels (in mAOD) at river centre locations in the local river reach for the "closed building" scenario. Negative values indicate reduction.

Location	1 in 200 year	1 in 200 year + sea level rise	1 in 200 year + climate change
SEC_25	-0.003	-0.001	-0.002
SEC_26	-0.003	-0.002	-0.002
SEC_27	-0.003	-0.002	-0.002
SEC_28	-0.003	-0.002	-0.002
SEC_29	-0.003	-0.002	-0.002
SEC_30	-0.003	-0.002	-0.002
SEC_31	-0.003	-0.001	-0.002
SEC_32	-0.003	-0.002	-0.002
SEC_33	-0.003	-0.002	-0.002
SEC_34	-0.003	-0.002	-0.002
FAIR_BAS	**-0.003**	**-0.002**	**-0.002**
SEC_36	**-0.003**	**-0.002**	**-0.002**
SEC_37	-0.002	-0.002	-0.002
SEC_38	-0.003	-0.002	-0.002
SEC_39	-0.002	-0.002	-0.001
SEC_40	-0.002	-0.002	-0.002
SEC_41	-0.002	-0.002	-0.002
SEC_42	-0.002	-0.002	-0.002
SEC_43	-0.002	-0.002	-0.002
SEC_44	-0.002	-0.001	-0.002
SEC_45	-0.002	-0.002	-0.002
SEC_46	-0.002	-0.002	-0.002
SEC_47	-0.002	-0.002	-0.002
SEC_48	-0.002	-0.001	-0.001
SEC_49	-0.001	-0.002	-0.002
YARROWS	-0.002	-0.002	-0.002

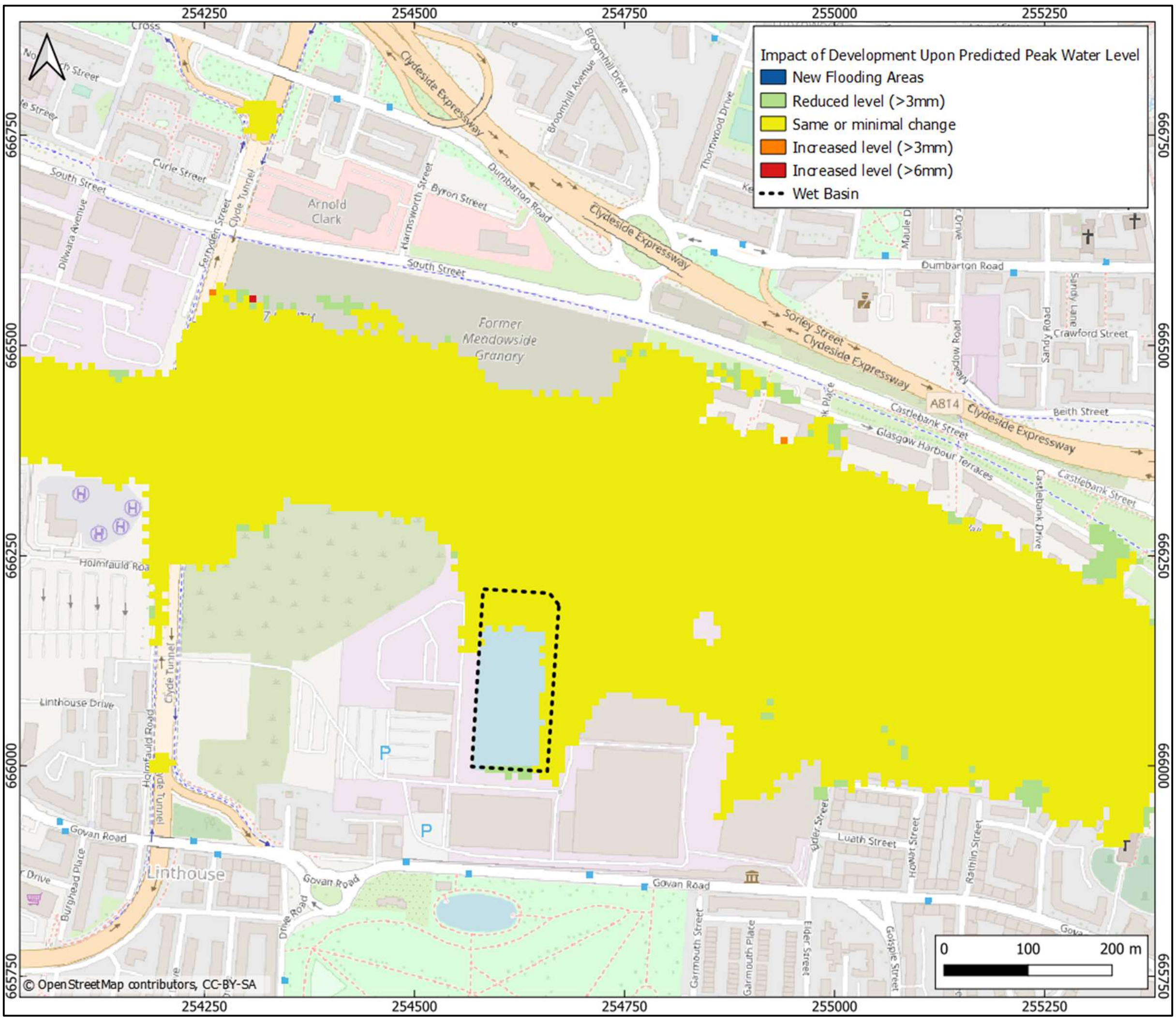


Figure 4.14: Change in predicted peak water levels due to proposed development, for "closed building" scenario (1 in 200 year plus sea level rise event)

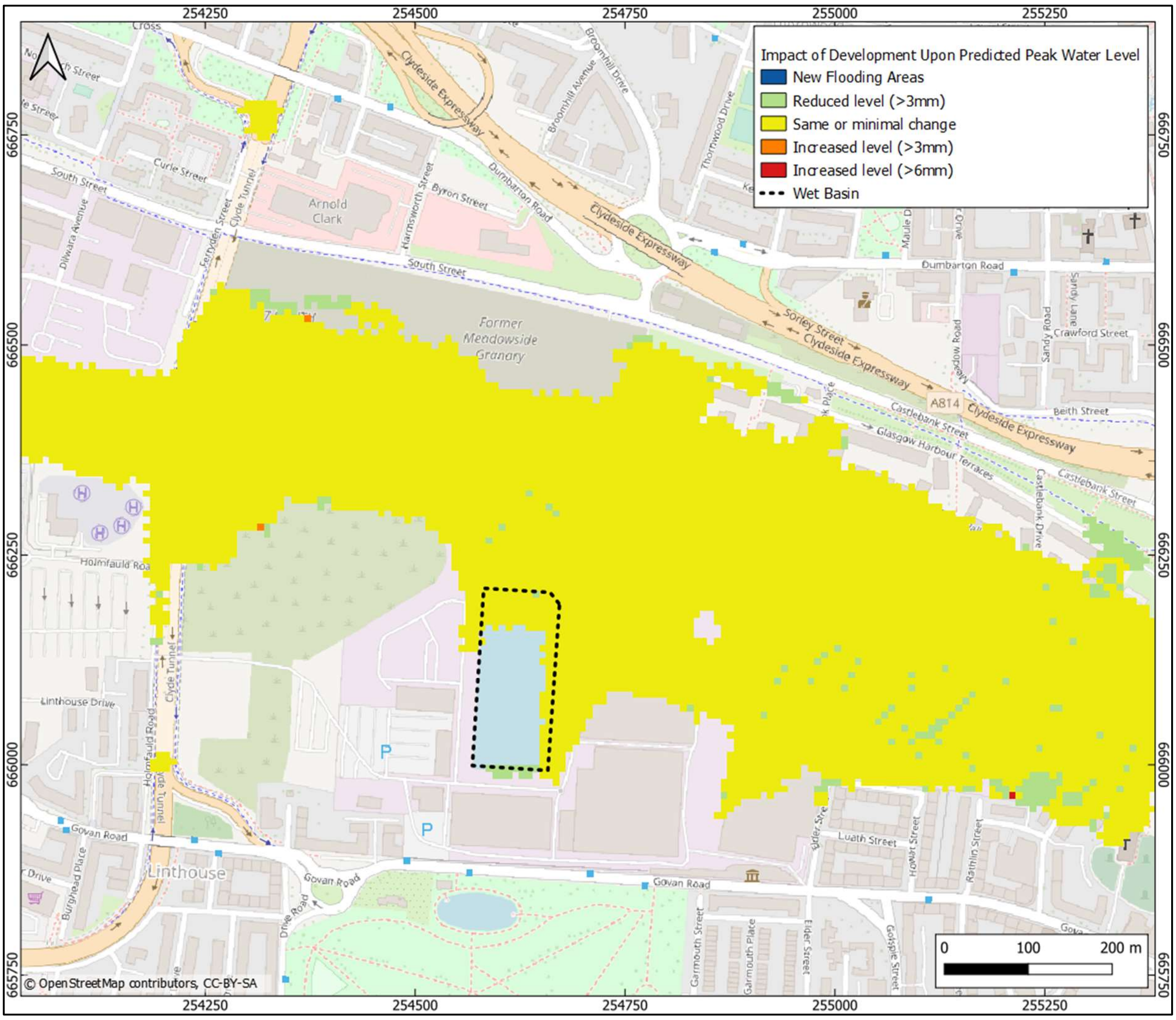


Figure 4.15: Change in predicted peak water levels due to proposed development, for "closed building" scenario (1 in 200 year plus climate change event)

4.8.4 Predicted Flood Risk to the Proposed Development

Predicted 1 in 200 year plus sea level rise flooding depths upon the infilled platform are typically 650 mm, and approximately 20 mm higher (670 mm) for the 1 in 200 year plus climate change event (predictions of maximum depth at native model resolutions and grid orientation are presented in Figure 4.16). Low depth predictions immediately at the edge of the building are model artefacts associated with TUFLOW's sampling of the ground model; high depths at the northern edge of the platform are similar sampling artefacts. The addition of the building has negligible (0-2 mm impact) upon altering predicted peak flooding depths at any given location upon the platform.

Predicted peak water velocities within the site are typically below 0.5 m/s, although higher velocities of up to 0.8 m/s are predicted along the eastern edge of the building (Figure 4.17). Analysis of time varying velocity and depth output indicate that peak velocities occur when the platform is “wetting” and “drying” rather than coincident with peak flood depths, such that maximum hazard ratings are not as severe as the maximum velocity and depth values would imply; based on the UK FD2320 method, hazard ratings vary between 0.5 and the southern end of the building (i.e. low hazard) to 1.4 to the north of the building (i.e. significant hazard) (Figure 4.18). Operational procedures for the site should account for this area of significant hazard, both in terms of flood response / evacuation procedures as well as avoiding using the area to the north of the building for the location/storage of equipment or material that may be mobilised by floodwater.

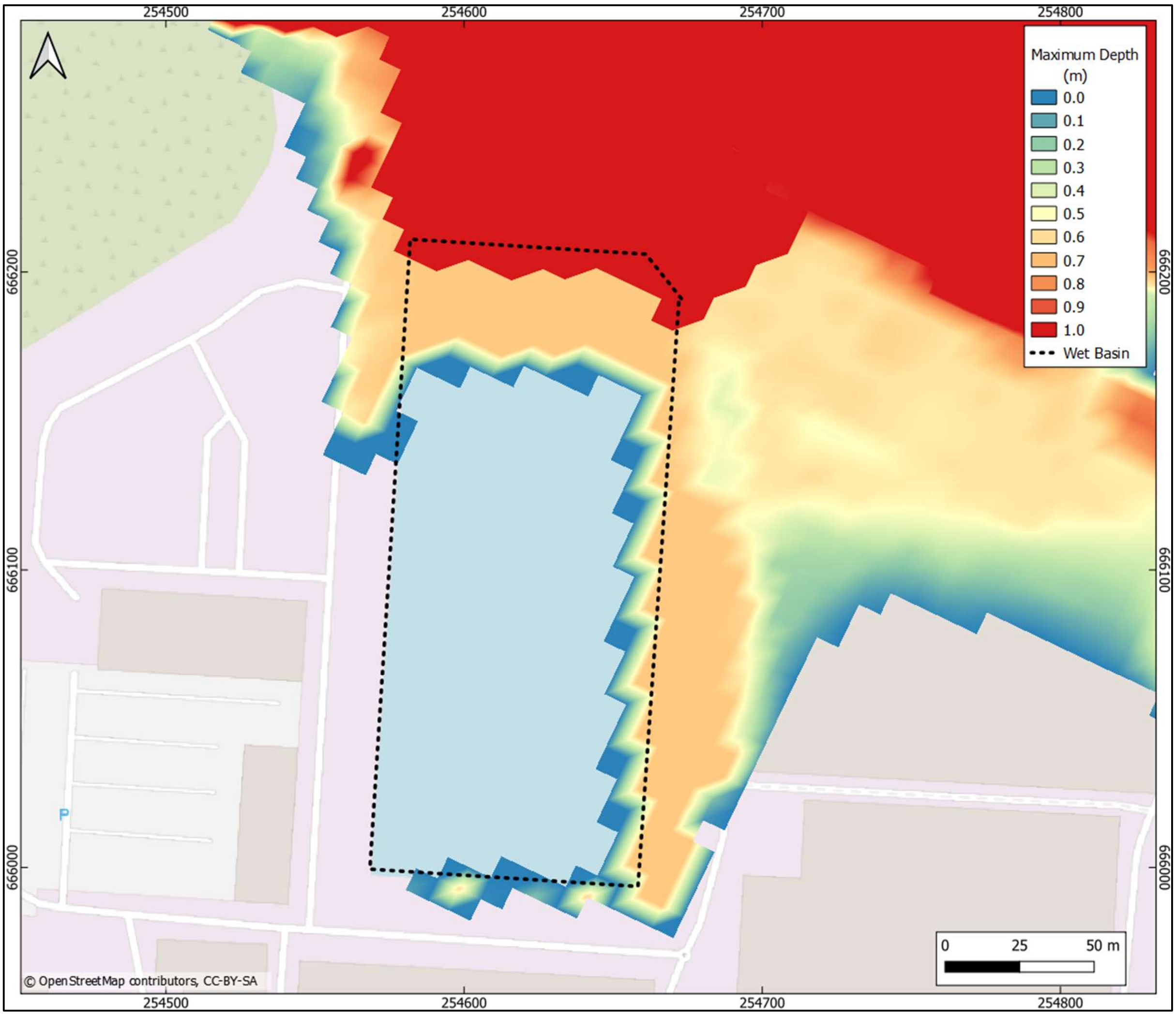


Figure 4.16: Maximum predicted depths in the vicinity of the development for “closed building” scenario (1 in 200 year plus climate change)

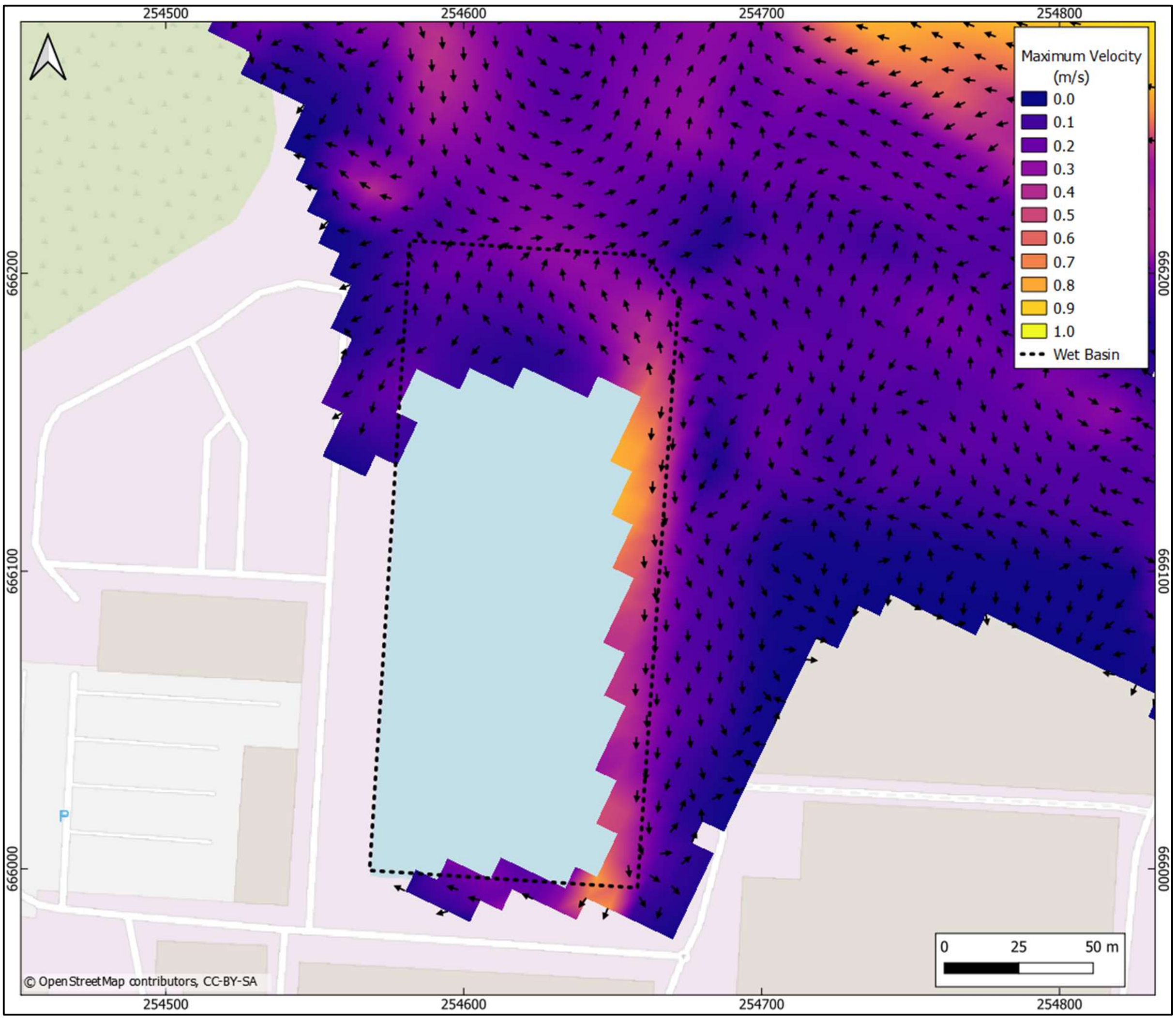


Figure 4.17: Maximum predicted velocities in the vicinity of the development for "closed building" scenario (1 in 200 year plus climate change)

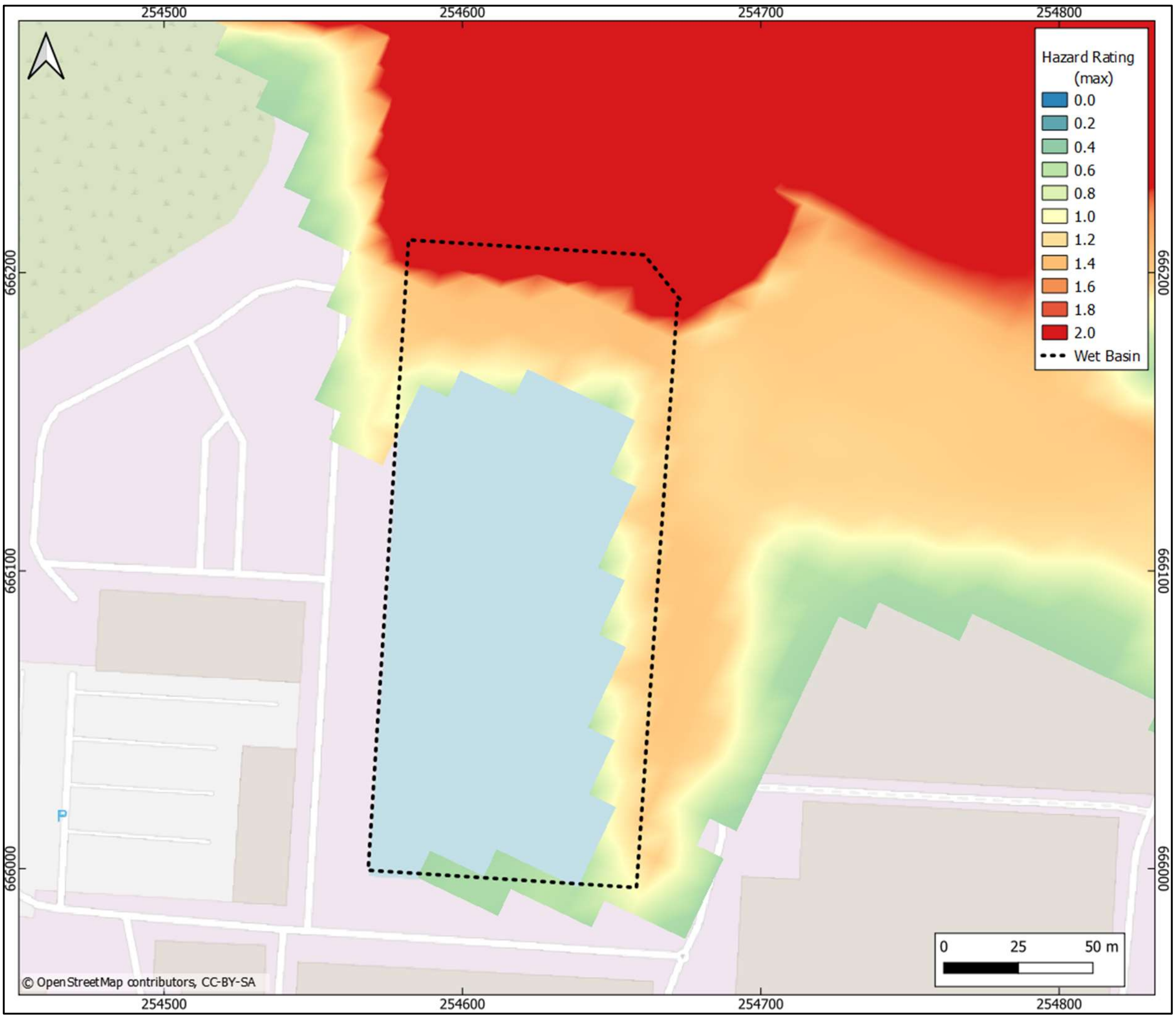


Figure 4.18: Maximum hazard rating in the vicinity of the development for "closed building" scenario (1 in 200 year plus climate change)

4.8.5 Impact of Proposed Development Upon Flood Risk Elsewhere

Post-development peak water level predictions are within approximately 3 mm of baseline predictions at all locations within the modelled extent (excluding locations impacted by numerical instability) for the 1 in 200 year event, and 1 in 200 year plus sea level rise and plus climate change events. The impact of the proposed development upon flood risk outwith the BAE site can therefore be summarised as negligible.

Noting that the events simulated account for what should be the worst-case impact (i.e. the events at which river water levels are just below and just above that necessary to flood the infilled basin), the impact of infilling for higher or lower return periods will, logically, also be negligible. Other return period events have therefore not been considered as part of this assessment.

4.9 Volume Balance

For all simulations, the volume balance error is less than 0.01% of either cumulative inflow, cumulative outflow or initial volume.

5 FLOOD RISK IMPACT & MANAGEMENT

5.1 Impact of Flood Risk Upon the Site

Table 5.1 provides a summary of flood risk from all sources, inclusive of proposed management measures and considerations

Table 5.1: Summary of flood risk

Flood source or mechanism	Risk Classification (with mitigation & management)	Proposed Management Measures
Tidal-Fluvial (Coastal-River)	Medium to High Risk	The infilled basin platform is predicted to be only marginally above the 1 in 200 year extreme tidal event; it may be overtopped if there is significant wind coincident with the tidal surge peak, and will be at increased risk of overtopping in the future due to sea level rise associated with climate change. The proposed Wet Basin Hall, as a water compatible usage, is appropriate for placement in a location of medium to high flood risk. The near-ground elements of the hall should be designed using construction methods and material which are resilient to water damage and to the pressure that may be exerted on the structure by floodwaters exceeding 600 mm in depth and 0.5 m/s in velocity. As the ground immediately north of the accommodation block is within the predicted flood extent, flood resilient construction methods and materials should also be used for the lower-lying elements of this building, noting that the main floor of this building will be raised above 1 in 200 year plus climate change predicted flood levels by more than 3.5 m. While evacuation of the accommodation building in the event of flooding may not be necessary, given the raised floor level, any evacuation should be westwards onto adjoining higher ground.
Surface Water	Low or No Risk	Drainage outfalls into the River Clyde must be fitted with non-return “flap” valves, to prevent backflow of the drainage system in the event of extreme high water levels in the river.
Infrastructure	Low or No Risk	None.
Groundwater	Low or No Risk	None.

5.2 Compliance with Development Management Guidance

5.2.1 Flood Risk Context

The site is nominally located just outwith the 1 in 200 year tidal-fluvial flood extent for current climate conditions, and therefore at low to medium flood risk. However, climate change and potential wind effects will likely result in the site being at medium to high tidal-fluvial flood risk over much of the operational life of the site. Regardless, the proposed water compatible usage is appropriate at such a location.

5.2.2 Flood Impacts

Comparison between baseline and post-infilling flood predictions confirms that the proposed development has no detrimental impact upon increasing flood risk elsewhere. Variations in predicted peak water levels between pre-development (baseline) and post-development are within 3 mm (with exception of isolated cells and patches exhibiting numerical instability), which is likely to be below the predictive precision of the model.

5.2.3 Access and Egress

The site is predicted to be marginally protected against flooding from the 1 in 200 year event (without sea level rise / climate change), although wind action coincident with the flood peak (not accounted for in this prediction) may cause flooding of the site. While flooding may therefore impact access and egress to the Wet Basin Hall, this is generally acceptable for water compatible usages.

The accommodation block adjoining the hall will be raised above flood risk, with a flood-free access/egress/evacuation route westwards from this building.

5.2.4 Freeboard

Freeboard provision is not required for water compatible usages. It is nonetheless recommended that site design and operation gives due consideration to predictive uncertainties as well as potential increases to flood levels due to coincident wind action. With this in mind, all habitable spaces within the Wet Basin Hall (including toilets and vending areas) will be set at least 1 m above floor level, as well as all service infrastructure. All other habitable accommodations including offices, lockers, canteen areas, etc, will be located 4.5 m above floor level (either within the upper level of the plinth or else within the accommodation block).

5.2.5 Summary

The proposed development is compliant with SEPA’s Development Management Guidance on Flood Risk (2018a), and therefore compliant with Scottish Planning Policy in terms of flood risk.

REFERENCES

Fairhurst Ltd (2021). *River Clyde Model Update Technical Report*. (Fairhurst Document Number 129384/G/W/001)

Scottish Government (2014). *Scottish Planning Policy*.

SEPA (2018a). *Development Management Guidance on Flood Risk*. Version 2, LUPS-DM-GU2a.

SEPA (2018b). *Flood Risk and Land Use Vulnerability Guidance*. Version 4, LUPS-GU24.

SEPA (2022a). *Technical Flood Risk Guidance for Stakeholders*. Version 13, June 2022.

SEPA (2022b). *Climate change allowances for flood risk assessment in land use planning.* LUPS-CC1 Version 2, Scottish Environment Protection Agency.

APPENDICES

A ANNUAL EXCEEDANCE PROBABILITY – RETURN PERIOD CONVERSION

Flood Frequency Statistics

The magnitudes of flood flows are typically expressed in terms of their long-term average frequency of recurrence, as ‘return periods’ (e.g. 1 in 200 year flood) or ‘annual exceedance probabilities’ (e.g. 0.5% AEP).

The return period (or recurrence interval) of a flood is the long-term average period between flood conditions of such magnitude (or greater). The annual exceedance probability of particular flood conditions is the chance these conditions (or more severe) occur in any given year.

Relationship between return periods and annual exceedance probability

Return period, T (year)	Annual exceedance probability, AEP (%)	Probability of occurrence over a 50 year period (%)	Comment
2	50	100	Median annual flood (also known as **QMED**). In the long-term this occurs every other year, on average. As a rule of thumb, this flow generally equates to ‘bankfull’ conditions in most natural channels.
5	20	100	
10	10	99	
20	5	92	
30	3.3	82	Typical design standard for urban drainage systems.
50	2	64	
100	1	39	
200	0.5	22	Typical design standard for river or coastal flooding for most developments. Defines “functional floodplain” under Scottish Planning Policy.
500	0.2	10	
1,000	0.1	4.9	Typical design conditions standard for sensitive or vulnerable developments/contexts.

Lifetime Probabilities, or Design Life Probabilities

The probability of a flood event occurring at least once over a set period of time (e.g. an individual’s lifetime or the design life of a built structure) can be evaluated against the following table.

Age, or Design Period (years)	Flood Return period (years)				
	2	10	30	200	1000
10	100%	65%	29%	5%	1%
25	100%	93%	57%	12%	2%
80	100%	100%	93%	33%	8%
100	100%	100%	97%	39%	10%

B SEPA CHECKLIST

Flood Risk Assessment (FRA) Checklist

(SS-NFR-F-001 - Version 16 - Last updated 27/08/2019)

This document must be attached within the front cover of any Flood Risk Assessments issued to Local Planning Authorities (LPA) in support of a development proposal which may be at risk of flooding. The document will take only a few minutes to complete and will assist SEPA in reviewing FRAs, when consulted by LPAs. This document should not be a substitute for a FRA.

Development Proposal Summary						
Site Name:		Govan Wet Basin Development				
Grid Reference:	Easting:	254625		Northing:	666130	
Local Authority:		Glasgow City Council				
Planning Reference number (if known):						
Nature of the development:		Other		If residential, state type:		
Size of the development site:			Ha			
Identified Flood Risk:	Source:	Tidal		Source name:	River Clyde	
Land Use Planning						
Is any of the site within the functional floodplain? (refer to SPP para 255)		No		If yes, what is the net loss of storage?		m^3
Is the site identified within the local development plan?		No		Local Development Plan Name: Allocation Number / Reference:	▨ ▨	Year of Publication: ▨
If yes, what is the proposed use for the site as identified in the local plan?		▨		If Other please specify:	▨	
Does the local development plan and/or any pre-application advice, identify any flood risk issues with or requirements for the site.		Select from List		If so, please specify:	▨	
What is the proposed land use vulnerability?		Water Compatible		Do the proposals represent an increase in land use vulnerability?	No	
Supporting Information						
Have clear maps / plans been provided within the FRA (including topographic and flood inundation plans)?		Yes				
Has sufficient supporting information, in line with our Technical Guidance, been provided? For example: site plans, photos, topographic information, structure information and other site specific information.		Yes	*(Within the FRA, other EIA reporting, and in River Clyde Model Update information already held by SEPA/GCC)*			
Has a historic flood search been undertaken?		No		If flood records in vicinity of the site please provide details:	(Site is currently within river)	
Is a formal flood prevention scheme present?		No		If known, state the standard of protection offered:		
Current / historical site use:		Dock / wet basin				
Is the site considered vacant or derelict?		No				
Development Requirements						
Freeboard on design water level:		>3.5	m (accommodation block only)			
Is safe / dry access and egress available?		Pedestrian Only	*(Accommodation block only)*	Min access/egress level:	9.41	mAOD (accommodation block only)
Design levels:	Ground level:	4.91	m AOD	Min FFL:	9.41	mAOD (accommodation block only)
Mitigation						
Can development be designed to avoid all areas at risk of flooding?		No				
Is mitigation proposed?		Yes				
If yes, is compenstory storage necessary?		No				
Demonstration of compensatory storage on a "like for like" basis?		No				
Should water resistant materials and forms of construction be used?		Yes				

Flood Risk Assessment (FRA) Checklist

(SS-NFR-F-001 - Version 16 - Last updated 27/08/2019)

Hydrology

Is there a requirement to consider fluvial flooding?		Yes		***USING UPDATED (TIDAL) RIVER CLYDE MODEL, PREPARED FOR GCC/SEPA BY FAIRHURST***		
Area of catchment:			km^2	Is a map of catchment area included in FRA?		
Estimation method(s) used (please select all that apply):		Pooled Analysis ☐		If Pooled analysis have group details been included?		
		Single Site Analysis ☐				
		Enhanced Single Site ☑		***REFER TO FAIRHURST REPORTING FOR FURTHER DETAILS***		
		ReFH2 ☑				
		FEH RRM ☐				
		Other ☑		If other (please specify methodology used):		
Estimate of 200 year design flood flow:			m^3/s			
Qmed estimate:			m^3/s	Method:		
Statistical Distribution Selected:				Reasons for selection:		

Hydraulics

Hydraulic modelling method:		2D		Software used:	TuFlow	
				If other please specify:		
Number of cross sections:		N/A				
Source of data (i.e. topographic survey, LiDAR etc):		LIDAR + Bathymetry		Date obtained / surveyed:	Predominantly 2016-2020	
Modelled reach length:			m			
Any changes to default simulation parameters?		None		If yes please provide details:	(No changes relative to Fairhurst model control file, excepting grid size; see below)	
Model timestep:		(Adaptive)				
Model grid size:		32/16/8	(Nested grid)			
Any structures within the modelled length?		Combination		Specify, if combination:	Bridges, tidal weir (no changes relative to Fairhurst model)	
Maximum observed velocity:			m/s			
Brief summary of sensitivity tests, and range:						
variation on flow (%)		49	%	Please specify climate change scenario considered:	49% (Clyde River Basin)	
variation on channel roughness (%)		20	%			
blockage of structure (range of % blocked)		50	%			
boundary conditions:		**Upstream**			**Downstream**	
(1) type		Routed fluvial			Tidal	
	Specify if other			Specify if other:		
(2) does it influence water levels at the site?		Yes			Yes	
Has model been calibrated (gauge data / flood records)?		Yes	(Refer to Fairhurst report)			
Is the hydraulic model available to SEPA?		Yes				
Design flood levels:	200 year	(see Coastal section)	m AOD	200 year plus climate change		m AOD
Cross section results provided?		No	*(No cross-sections; 2D only model)*			
Long section results provided?		No				
Cross section ratings provided?		No	*(No cross-sections; 2D only model)*			
Tabular output provided (i.e. levels, velocities)?		Yes	*(River centre levels in the local reach only; refer to Fairhurst report for full tables)*			
Mass balance error:		<0.01	%			

Coastal

Is there a requirement to consider coastal / tidal flooding?		Yes		***USING UPDATED (TIDAL) RIVER CLYDE MODEL, PREPARED FOR GCC/SEPA BY FAIRHURST***		
Estimate of 200 year design flood level:		4.85	m AOD			
Estimation method(s) used:		Other		If other please specify methodology used:	Updated (Tidal) River Clyde Model	
Allowance for climate change (m):		0.85	m			
Allowance for wave action etc (m):		N/A	m			
Overall design flood level:		5.56	m AOD			

Comments

Any additional comments:	Hydrology and hydraulics maintained from Updated (Tidal) River Clyde Model, prepared by Fairhurst for GCC and SEPA, and purchased for this project. It is reasonably assumed that detailed model build and output information is not required for this reviewed model.

Approved by: **Dr Iain Struthers**
Organisation: **EnviroCentre Ltd**
Date: **18/08/2022**

Note: Further details and guidance is provided in 'Technical Flood Risk Guidance for Stakeholders' which can be accesssed here:- CLICK HERE

C PROVISIONAL SITE LAYOUT

NORTH

0 10.0 20.0 30.0 40.0 50.0 100.0m

P-04	Updated coffer dam alignment	24.08.22	LG	DR
P-03	Updated Layout	24.08.22	LD	DR
P-02	Updated Planning Status	19.08.22	LD	DR
P-01	Issued for Stage 3 Information	12.08.22	LG	DR
Rev.	Description	Date	Drawn	Chk.

🟥 APPLICATION SITE BOUNDARY
🟦 OTHER LAND IN THE CONTROL OF THE APPLICANT
▨ PROPOSED NEW GREEN LUNG
🟦 PROPOSED NEW STRUCTURES
▬ ▬ PROPOSED PHOTOVOLTAIC ARRAY
▨ PROPOSED GAS TANK FARM

Client
McLaughlin & Harvey Ltd

Project
Wet Dock Hall

Drawing Title
Proposed
Site Plan

Drawing Status : S2 Suitable for Information
PLANNING

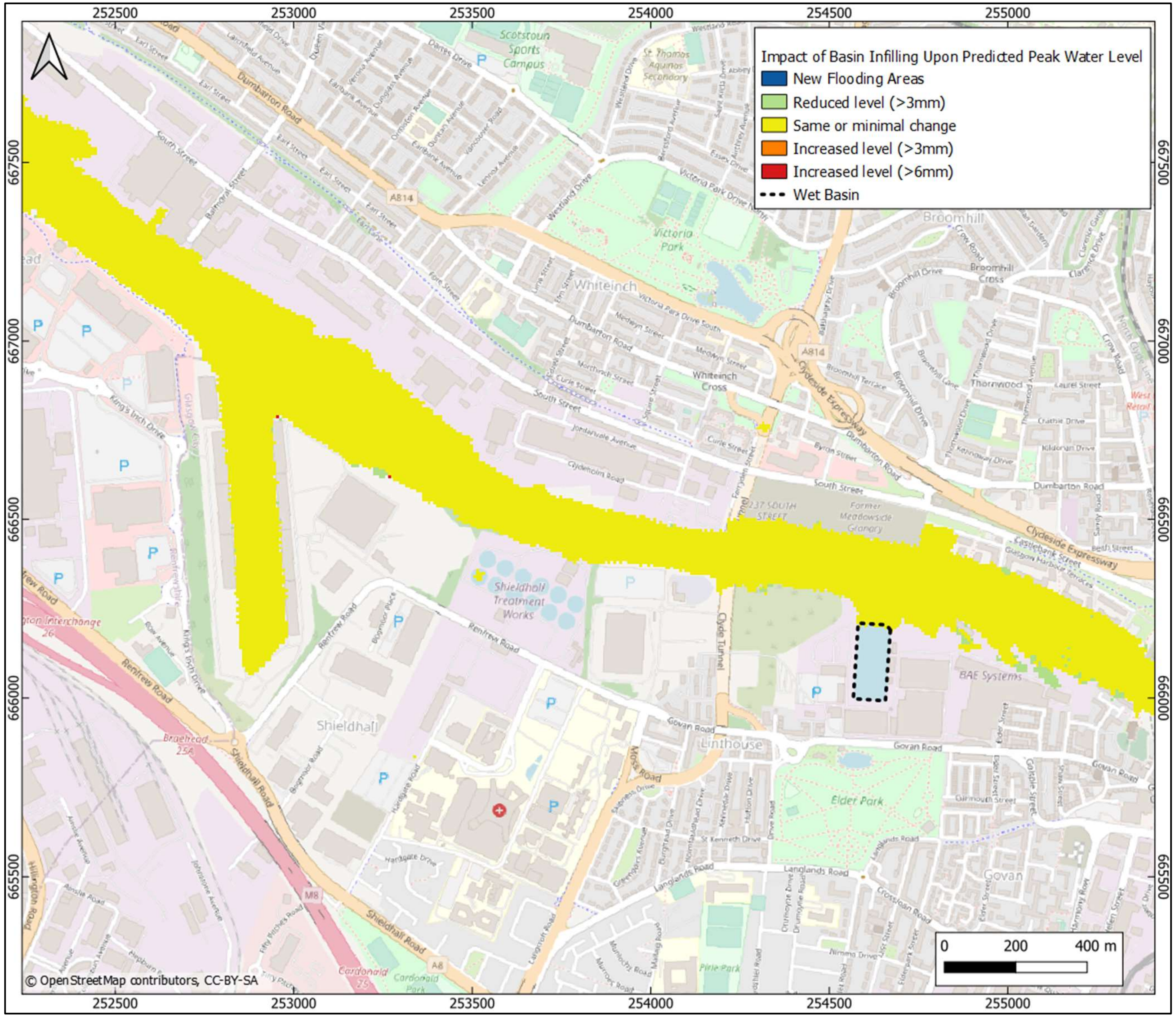
Corstorphine & Wright

Birmingham Studio
Alpha Building, Suffolk Street Queensway, Birmingham, B1 1TT
0121 737 8350

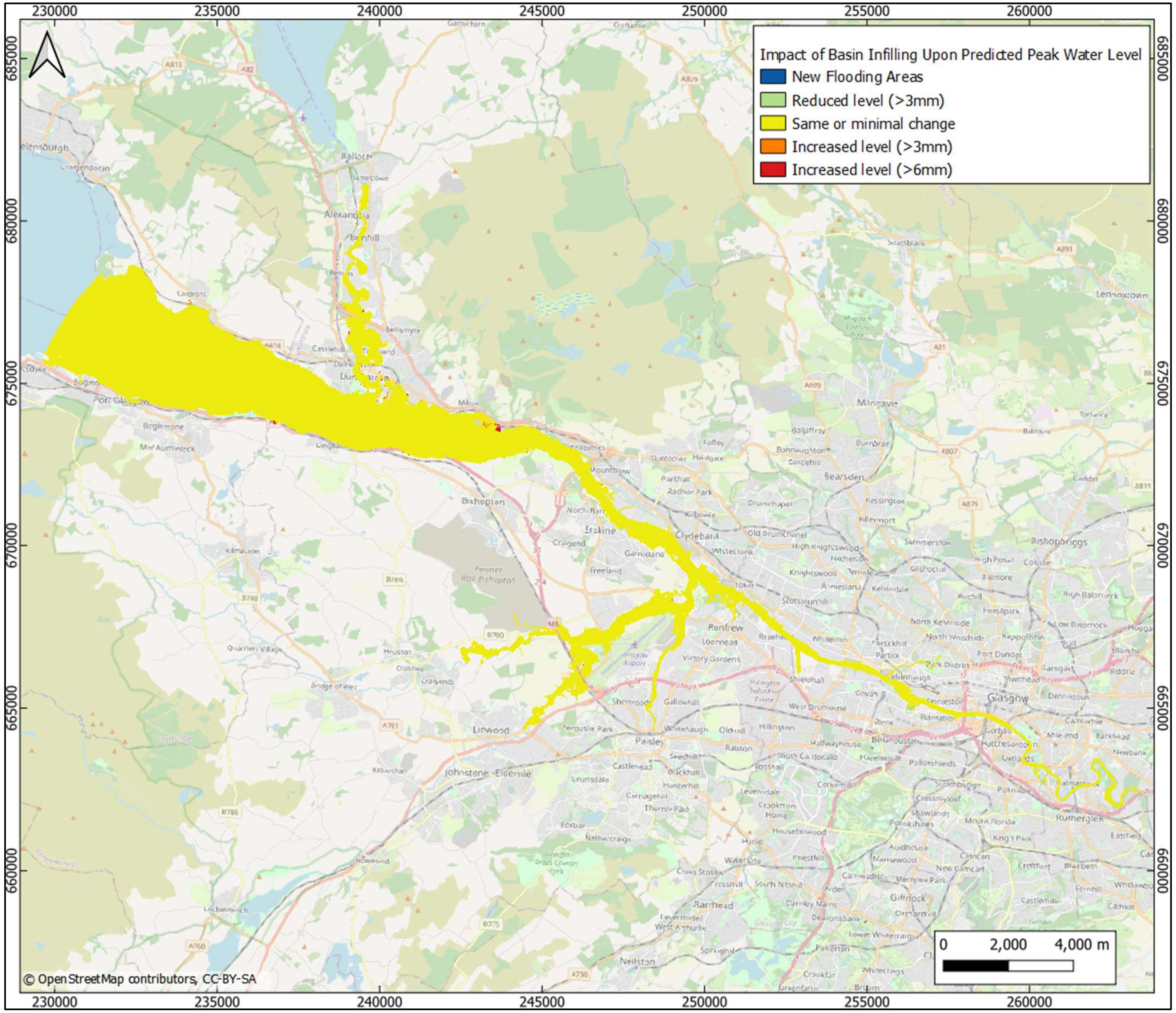
corstorphine-wright.com

Drawing No.				Revision
WDH-CWA-00-XX-DR-A-0215				P-04
Drawn	Checked	Paper Size	Scale	Date
LG	DR	A1	1:1000	12.08.2022

D FULL EXTENT DIFFERENCE MAPS



Change in predicted peak water levels due to proposed development, for "closed building" scenario (1 in 200 year event)



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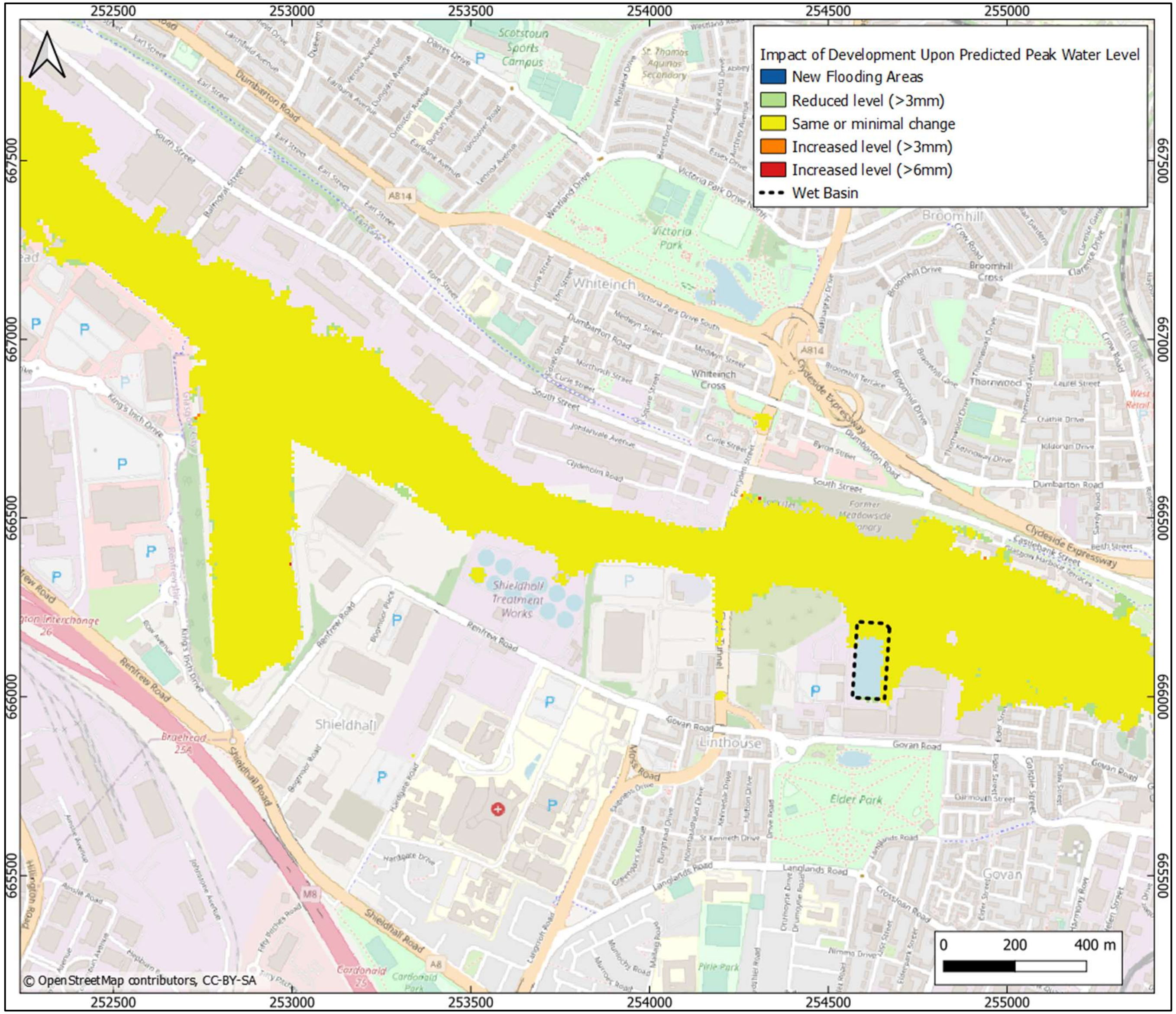
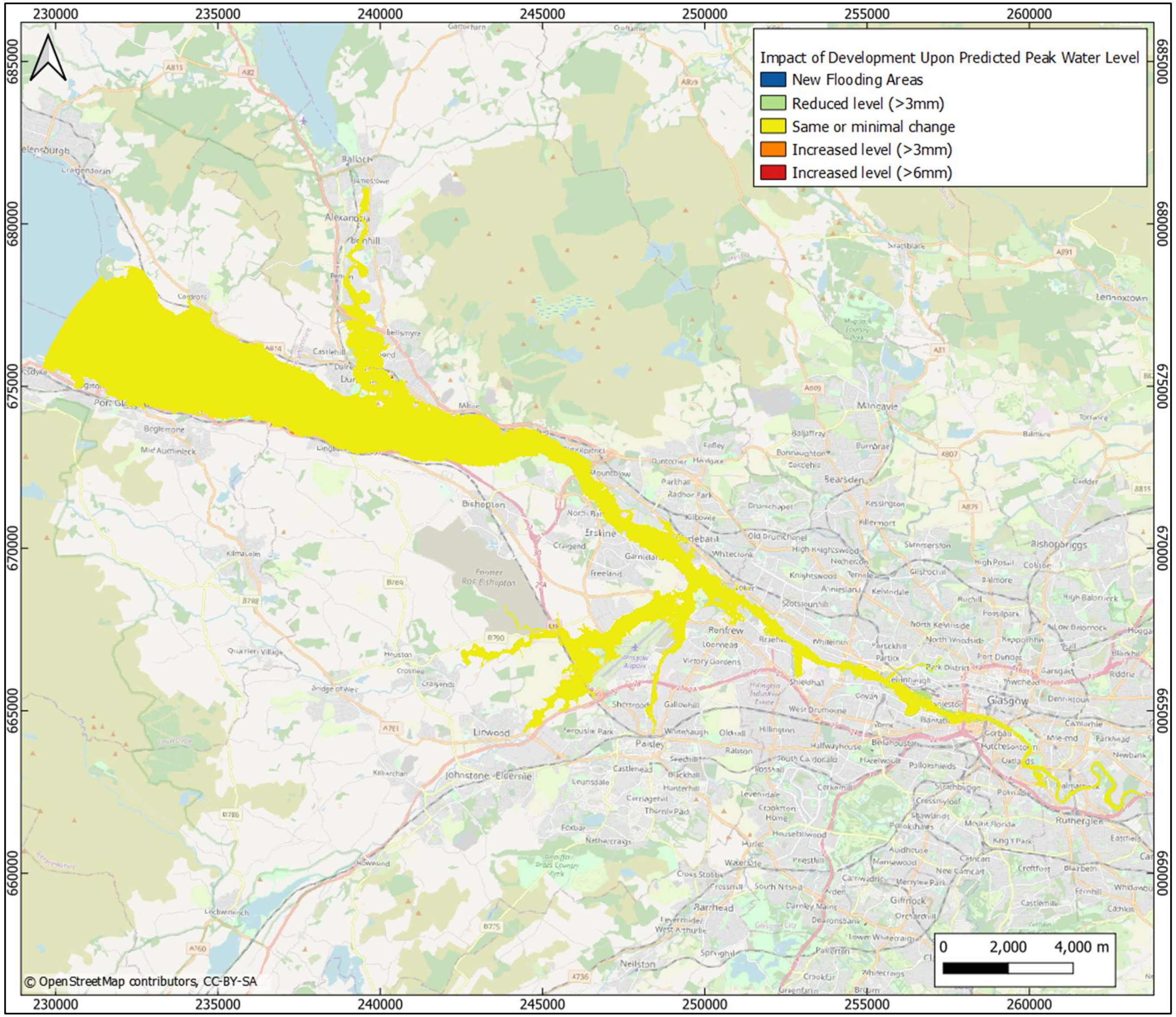
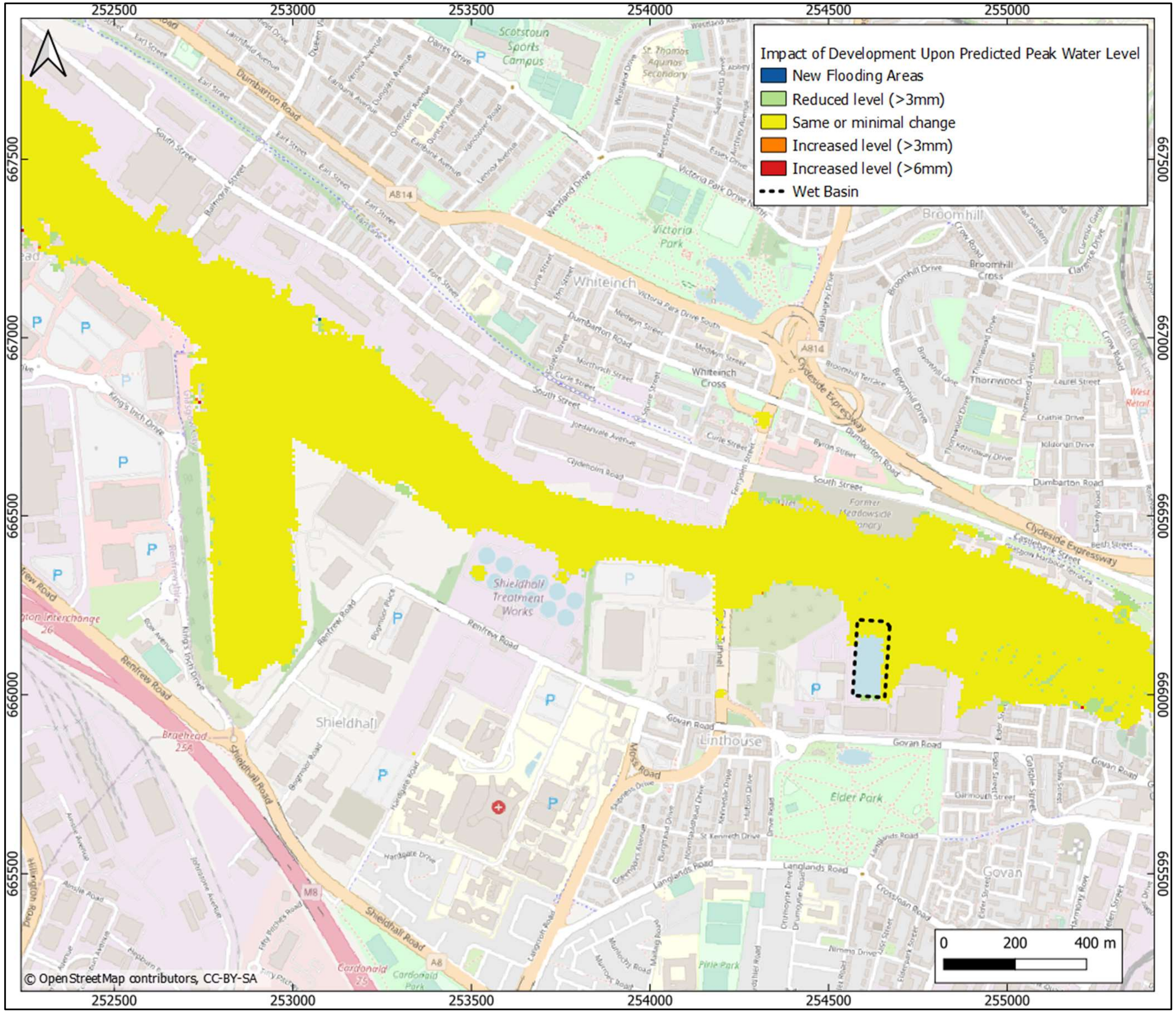
Change in predicted peak water levels due to proposed development, for "closed building" scenario (1 in 200 year event)



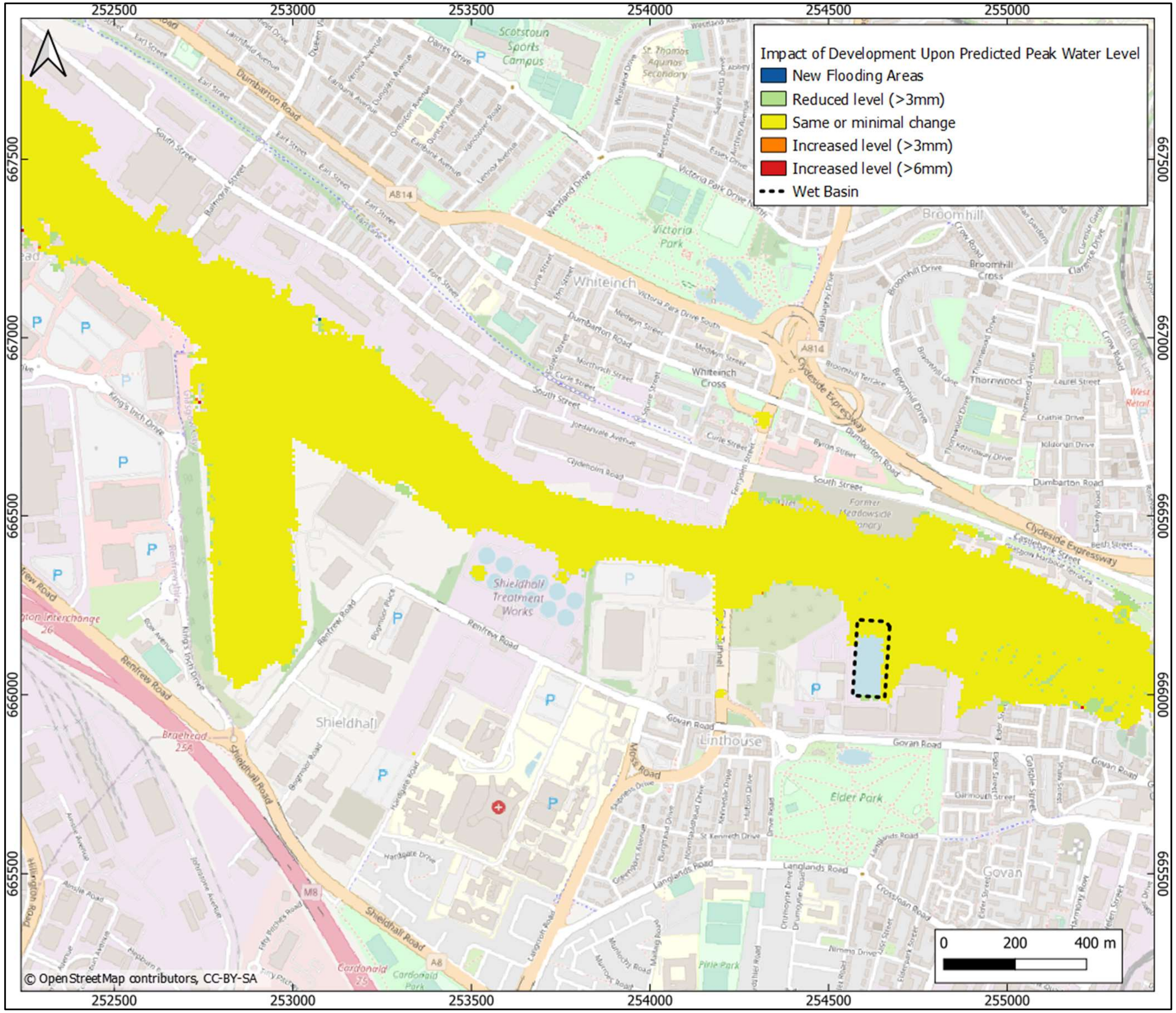
Change in predicted peak water levels due to proposed development, for “closed building” scenario (1 in 200 year plus sea level rise event)



Change in predicted peak water levels due to proposed development, for "closed building" scenario (1 in 200 year plus sea level rise event)



Change in predicted peak water levels due to proposed development, for "closed building" scenario (1 in 200 year plus climate change event)



Change in predicted peak water levels due to proposed development, for "closed building" scenario (1 in 200 year plus climate change event)

Technical Appendix 6-1_Noise Impact Assessment

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Govan Facilities Investment
Construction Noise Assessment

July 2022

Govan Facilities Investment
Construction Noise Assessment

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EXECUTIVE SUMMARY

A construction noise assessment has been carried to predict the impact at residential receptors surrounding the BAE Govan Shipyard during the proposed infill of the existing Wet Basin as part of the proposed Govan Facilities Investment.

1.1 Construction Noise

Worst case combined construction scenarios based on the proposed construction schedule have been modelled using CadnaA software. Details of construction activities and associated plant on which assessment assumptions are based have been provided by Arch Henderson.

1.1.1 Evening and Night-time Construction Noise

Evening and night-time noise will largely be due to infill of material via the rainbow spreading method from TSHD with shore side support from two dozers. During the shorter duration stage of dredging of the basin mouth by TSHD it is expected that the infill and spreading operations would be concurrently active during the evening and night-time.

Evening modelled levels are predicted to be below the thresholds of impact defined in the ABC method of BS 5228 at all receptors, with an associated Neutral impact during the evening.

The greatest impacts during night-time hours are predicted at receptors located on the opposite shore of the River Clyde with direct line of sight to the mouth of the Wet Basin and partial line of sight to the rest of the site. These receptors are predicted to experience Slight Adverse impact for both of the modelled worst-case night time scenarios. No adverse impact is predicted at all remaining NSRs, with an associated Neutral significance.

1.1.2 Weekday Daytime Construction Noise

The loudest noise generating activities for weekday daytime works are predicted to be a combination of impact piling, compaction of infill material on reclaimed land and noise from movements and tipping of dump trucks. Noise modelling has been carried out which considered scenarios with impact piling active and impact piling inactive. Dredging of the basin mouth by TSHD has been included in the scenario with piling inactive. Although piling is among the loudest contributing sources at most noise sensitive receptors, the reduction in modelled noise levels with piling inactive is typically around 1 dB or less, indicating that daytime construction noise is not dominated by a single source.

Similar to night-time works, the greatest impacts during weekday daytime hours are predicted at the closest receptors located on the opposite shore of the River Clyde with direct line of sight to the mouth of the Wet Basin and partial line of sight to the rest of the site. These receptors are predicted to experience impacts ranging from Slight to Moderate Adverse impact for both of the modelled worst-case day time scenarios. No adverse impact is predicted at all remaining NSRs, with an associated Neutral significance. As stated in TAN 1/2011, impacts of Slight and Moderate significance are not likely to be key decision making issues.

1.1.3 Weekend Daytime Construction Noise

The loudest noise generating activities for weekend daytime works are predicted to be the same as weekday daytime works, namely a combination of impact piling, compaction of infill material on reclaimed land and noise from movements and tipping of dump trucks.

Due to the increased ABC Threshold sensitivity for weekend daytime hours defined in BS5228-1:2009, greater impacts are predicted at the majority of receptors in comparison to weekday daytime hours.

The closest receptors on the opposite side of the River Clyde are predicted to experience Large Adverse impacts during this working period. One additional receptor which is located at the south eastern site boundary is also subject to a Large Adverse impact. This receptor has direct line of sight to the Basin over the southern boundary wall. Additionally, a Moderate impact is predicted at one receptor located to the west of the site due to the arrival and departure of HGVs and dump trucks delivering materials via the western gate on Holmfauld Road.

A Slight Adverse Impact is predicted at two additional receptors with partial line of sight to the Wet Basin. These receptors are located to the north of the site at distances ranging between 400 to 500 metres. A Neutral impact is predicted at all remaining NSRs.

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2 INTRODUCTION

2.1 Scope of Report

EnviroCentre Ltd has been appointed by Arch Henderson on behalf of BAE Systems Ltd to carry out a Construction Noise Impact Assessment (NIA) in relation to the proposals to infill the wet basin at Govan Shipyard and Maintenance Facility (Govan Shipyard).

This report presents the findings of the NIA, which considers the impact of construction noise at surrounding existing noise sensitive receptors.

2.2 Site Location and Proposed Development

The Govan Shipyard site is located to the north of Govan Road on the south bank of the River Clyde. The site is an active shipbuilding facility which can operate 24 hours, 7 days a week. This proposal involves the infill of much of the existing wet basin on the site in order to facilitate future development of the shipyard

The development site, which includes the wet basin, proposed laydown and working areas, contractors compound and access road via the western gate on Holmfauld Road is demarcated by the red line boundary shown on the Site Location Plan, Drawing No.175756-GIS001 in Appendix C. The wider BAE Complex is demarcated by the blue line boundary as shown together with the red line site boundary on the Noise Monitoring Locations Plan, Drawing No 175756-GIS002A in Appendix C.

2.3 Report Usage

The information and recommendations contained within this report have been prepared in the specific context stated above and should not be utilised in any other context without prior written permission from EnviroCentre.

If this report is to be submitted for regulatory approval more than 12 months following the report date, it is recommended that it is referred to EnviroCentre for review to ensure that any relevant changes in data, best practice, guidance or legislation in the intervening period are integrated into an updated version of the report.

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EnviroCentre accepts no liability for use of the report for purposes other than those for which it was originally provided, or where EnviroCentre has confirmed it is appropriate for the new context.

3 NOISE GUIDANCE

A brief description of noise assessment guidance specific to this assessment is provided in the sections below. Acoustic definitions are provided in Appendix A for reference.

3.1 BS5228-1:2009+A1:2014; Code of Practice for Noise and Vibration Control on Construction and Open Sites.

Methods for calculating noise and vibration produced by construction and open sites are provided in BS5228-1:2009+A1:2014[1]. Annexes C and D of Part 1 provide generic source data for different types of noise source, as well as methods for calculating noise from stationary and mobile plant. Specific advice on noise from sources such as piling is provided.

The ABC method of assessing construction noise impact, as detailed within Annex E.3.2 considers the existing ambient noise climate at the receptors.

3.2 PAN 1/2011 Planning and Noise

Advice on the role of the planning system in helping to prevent and limit the adverse effects of noise is provided in Planning Advice Note (PAN) 1/2011 – Planning and Noise[2]. PAN 1/2011 promotes the principles of good acoustic design and a sensitive approach to the location of both noise sensitive and noise generating developments. PAN 1/2011 promotes the avoidance of significant adverse noise impacts from new development while supporting sustainable economic growth. The input of environmental health officers and professional acousticians from an early stage is recommended to avoid unreasonable effects on quality of life. PAN 1/2011 promotes the application of reasonable criteria to assess noise impact but does not suggest specific target levels, allowing for consideration of contextual and non-acoustic factors.

3.3 Assessment of Noise: Technical Advice Note

Assessment of Noise: Technical Advice Note[3] (TAN) is supplementary guidance to PAN 1/2011 published by the Scottish Government. TAN recommends a five stage process to the assessment of noise, as detailed below

Stage 1: Initial Process

The development is categorised according to whether it has the potential to generate noise *i.e.* a Noise Generating Development (NGD) or be affected by the existing noise *i.e.* a Noise Sensitive Development (NSD). All Noise Sensitive Receptors (NSRs) that have the potential to be impacted by the proposed development are identified and prioritised according to their level of sensitivity. Residential NSRs are noted to be of high sensitivity.

Stage 2: Quantitative Assessment

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[1] British Standards Institute (2014), *Code of Practice for Noise and Vibration Control on Construction and Open Sites, Parts 1 & 2*.
[2] The Scottish Government (2011), *PAN 1/2011 Planning and Noise*.
[3] The Scottish Government (2011), *Assessment of Noise: Technical Advice Note.*

The quantitative assessment method depends on the type of development proposed *i.e.* Noise Sensitive Development (NSD) or Noise Generating Development (NGD). Typically the assessment will compare absolute levels (predicted or measured) with an agreed target. The magnitude of the impact is then defined by assessing the amount the predicted noise level exceeds the agreed assessment target criteria for either day or night time periods.

Stage 3: Qualitative Assessment

The qualitative assessment allows the magnitude of the impact established in Stage 2 to be adjusted accordingly to account for additional factors not addressed in the quantitative assessment.

Stage 4: Level of Significance

The level of significance of the noise impact at the NSR is obtained through the relationship of the receptor's sensitivity to noise and the magnitude of the noise impact. The prescribed level of significance is used to determine whether or not noise is a key decision making issue for the NSR in question.

Stage 5: The Decision Process.

Stages 2 to 4 are repeated for all identified NSRs and a Summary Table of Significance is completed which provides an overview of the level of significance of the noise impact on all NSRs. The recommendation from the environmental health officer to the planning officer should be informed by the distribution of levels of significance.

3.4 World Health Organization Guidelines for Community Noise

In *Guidelines for Community Noise*[4], 55 dB $L_{Aeq,16h}$ is indicated as a criterion threshold below which few people are seriously annoyed for an outdoor living area, during daytime and evening hours. A lower guideline value of 50 dB $L_{Aeq,16h}$ is provided as a criterion below which few people are annoyed. In addition, the guidance identifies that negative sleep impacts are avoided at 30 dB $L_{Aeq,8h}$ for continuous noise sources.

3.5 ISO 9613-2:1996 – Acoustics – Attenuation of Sound during Outdoor Propagation – Part 2: General Method of Calculation

ISO 9613-2:1996[5] presents a standardised methodology to calculate the propagation of outdoor sound levels based on source characteristics, environmental conditions and intervening features.

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[4] World Health Organization (1999), *Guidelines for Community Noise*.

[5] International Organization for Standardization (1996), *ISO 9613-2:1996 – Acoustics – Attenuation of Sound during Outdoor Propagation – Part 2: General Method of Calculation*.

4 CONSULTATION, METHODOLOGY AND TARGET CRITERIA

4.1 Consultation

EnviroCentre Ltd placed a noise consultation request with the Environmental Health Department at Glasgow City Council (GCC) in May 2022, with a follow up request in June 2022. At the time of writing no response has been received. The methodology presented in the following section outlines that proposed within the consultation request.

4.2 Methodology

The following methodology has been carried out;

- Attended monitoring of day and night-time baseline noise at a sample of 8 areas representing the most exposed residential receptors surrounding the site.
- Review proposed construction schedule, locations, associated noise generating activities and plant.
- Identify a sample of worst-case significant concurrent noise generating activities / phases.
- Digital 3D noise propagation modelling of construction noise at surrounding residential receptors.
- Assessment of construction noise impacts following ABC Method provided in BS5228, Part 1, in accordance with TAN 2011.
- Provide advice on noise mitigation and management techniques where appropriate.

4.3 Target Criteria: BS5228-1:2009+A1: 2014 – Methodology (ABC Method)

The assessment of construction noise is carried out in accordance with guidance provided in BS 5228-1:2009+A1:2014 ‘Code of Practice for Noise and Vibration Control on Construction and Open Sites – Part 1 Noise’. The standard describes methods for evaluating the potential significant effects of construction noise, one of which is the ‘ABC’ method which is based on exceedance of fixed noise limits. The ABC method, as detailed within Annex E.3.2 has been used within this noise assessment, as it considers the pre-existing industrial noise climate at the receptors.

The ABC method considers that a potential significant effect occurs when the total noise level at a dwelling, including construction activity, exceeds the appropriate category values shown in Table 4-1. The table is used as follows;

- The ambient noise is determined and rounded to the nearest 5dB.
- The rounded ambient noise level is then compared with the total noise level, including construction. A significant effect at a noise sensitive receptor is considered to occur when the total noise, including construction activity exceeds the appropriate category values, shown in Table 4-1.
- The ABC method of BS5228-1:2009+A1:2014 does not provide specific guidance on determining the magnitude and significance of noise impacts above the threshold values shown in Table 4-1. In order to determine the level of significance, guidance provided in the

Technical Advice Note (TAN) 1/2011 has been used. The significance criteria adopted within this noise assessment are shown in Table 4-2.

Table 4-1: Threshold of Significant Effect at Dwellings

Period	**Threshold Value, in Decibels (dB)**		
	Category A	**Category B**	**Category C**
Night-time (23:00 to 07:00)	45	50	55
Evenings weekday (19:00-23:00), Saturdays (13:00-23:00) and Sundays (07:00-23:00)	55	60	65
Daytime weekday (07:00-19:00) and Saturdays (07:00-13:00)	65	70	75
Note 1: A significant effect has been deemed to occur if the total L_{Aeq} noise level, including construction, exceeds the threshold level for the Category appropriate to the ambient noise level. Note 2: If the ambient noise level exceeds the Category C threshold values given in the table (i.e. the ambient noise level is higher than the above values), then a potential significant effect is indicated if the total L_{Aeq}, T noise level for the period increases by more than 3 dB due to site noise. Note 3: Applied to residential receptors only.			
Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are less than these values. Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are the same as category A values. Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are higher than category A values.			

Table 4-2: TAN 1/2011 Significance Criteria for the Assessment of Construction Noise

Significance	**Level Above Threshold Value dB(A)**	**Definition**
Neutral	< 0	No effect, not significant, noise need not be considered as a determining factor in the decision making process.
Slight adverse	≤ 0 to < 3	These effects may be raised but are unlikely to be of importance in the decision making process.
Moderate adverse	≤ 3 to < 5	These effects, if adverse, while important, are not likely to be key decision making issues.
Large adverse	≤ 5.0 to < 10	The effects are likely to be important considerations but where mitigation may be effectively employed such that resultant adverse effects are likely to have a moderate or slight significance.
Very large adverse	≥ 10	These effects represent key factors in the decision making process. They are generally, but not exclusively, associated with impacts where mitigation is not practical or would be ineffective.

5 NOISE MONITORING

A baseline noise survey at a sample of 8 locations surrounding the site were carried out over the course of multiple site visits during June and July 2022. The daytime baseline noise at each position was measured for one hour on two consecutive days on 20th and 21st June. The night time baseline noise was initially planned to be captured by completing two rounds of 15 minutes at each location over the course of the night of the 20th/21st June. The first round of 15 minute measurements was completed for all positions on this evening, however due to developing rain only 3 of the 8 positions were captured a second time. A second round of night time monitoring was completed on the night of the 07th/08th July in order to capture the second round of measurements at the remaining 5 positions.

The measurement locations are considered to be representative of the residential receptors with the greatest chance of disturbance from construction noise. The noise surveys were attended which allowed for detailed notes to be taken of the baseline ambient noise environment.

5.1 Baseline Sound Noise Survey

Measurements were conducted using a Norsonic Nor140 (serial number 1403301), Norsonic Nor 118 (serial number 11831675) and calibrated using a Nor-1251 calibrator (serial number 30796) before and after measurements, with a maximum drift of 0.2 dB noted. Calibration certificates are available on request. Measurements were conducted 1.3 m above ground using a fast time weighting.

5.1.1 Measurement Locations

The baseline sound measurement positions are described in Table 5-1, and shown in Drawing No.175756-GIS002A, Appendix C.

Table 5-1: Baseline Sound Monitoring Location

ID	Grid Reference	Location
01	254851 666390	On Meadowside Quay Walk. This position is directly opposite the primary ship assembly area and large Ship Build Outfit Hall (SBOH) at BAE on the northern bank of the River Clyde. The position is located approximately 200 metres east of a brownfield site which is directly opposite the Wet Basin. The position is located approximately 250 metres north east of the mouth of the Wet Basin.
02	254824 666656	At the southern end of Thornwood Drive. This position is located approximately 2 metres back from the pavement of Dumbarton Road and 4.9 metres from the wall of the building to the west. The position has limited line of sight to the BAE site across the roundabout and under the expressway and is approximately 450 metres north of the mouth of the Wet Basin.
03	254501 666700	On the corner of Byron Street and Harmsworth Street, at the north eastern corner of the Arnold Clark yard. This position is located approximately 95 metres north of South Street, has partial line of sight to the BAE site and is approximately 470 metres north of the mouth of the Wet Basin.

ID	Grid Reference	Location
04	254262 666684	On the grass, within the external amenity space of flats on the corner of Ferryden Street and Curle Street, across the street from the western boundary of the Arnold Clark yard. The position is approximately 35 metres north of South Street, has partial line of sight to the BAE site and is approximately 560 metres north west of the mouth of the Wet Basin.
05	254185 666170	On Holmfauld Road. This position is approximately 40 metres north of the gated access road on the western boundary of the BAE site. This position has partial line of sight to the large SBOH and is located approximately 400 metres west of the Wet Basin.
06	254468 665934	In the cul-de-sac at the north end of Aboukir Street. This position is located adjacent to the south western corner of the BAE site boundary in a residential parking area, approximately 45 metres north of Govan Road. There is no line of sight into the BAE sight at ground level due to the boundary wall. The position is located approximately 130 metres from the Wet Basin at its closest point.
07	254825 665776	On the grass adjacent to the western side of Garmouth Street, approximately 65 metres south of Govan Road. This position lies on the eastern boundary of Elder Park and has line of site to the buildings which form the southern BAE site boundary. The position is located approximately 460 metres from the mouth of the Wet Basin.
08	255248 666020	On the grass at the western end of Wanlock Street. This position is adjacent to the eastern BAE site boundary and lies within 100 metres of a laydown area and small fabrication sheds. This position has limited line of sight to the closest buildings within the BAE site due to the boundary wall, and lies approximately 580 metres east from the Wet Basin.

5.1.2 Meteorological Conditions and Observations

The weather conditions and observations noted during the monitoring are summarised in Table 5-2 and Table 5-3.

Table 5-2: Baseline Noise Monitoring Weather Conditions

Date	Monitoring Period	Meteorological Conditions
20/06/22	Daytime – Afternoon	Mostly clear skies, 1 – 2 oktas. Wind speed 4 to 5m/s westerly/north westerly, temperature 17°C.
20/06 to 21/06/22	Night-time	Partially cloudy, 3 – 4 oktas. Wind speed 3 to 4m/s westerly, temperature 9-10°C. Light rain developing around 01:35hrs, ending measurements.
21/06/22	Daytime – Morning / Early Afternoon	Overcast, 7 – 8 oktas but bright. Wind speed 1 to 3 m/s easterly, temperature 14°C.
07/07 to 08/07/22	Night-time	Partially cloudy, 3 – 4 oktas. Wind speed 2 to 3m/s variable, temperature circa 12°C.

Table 5-3: Baseline Monitoring Observations

NML ID	Date	Period	Start Time	Observations
1	20/06/22 21/06/22	Day	12:31 14:05	Constant mix of subjectively low and mid frequency broadband noise heard from BAE across the river, dominating the ambient noise environment. Also reverse alarms and other alert tones, some cutting noise and impulsive hammering/clattering. Some bird calls also heard, plus very faint noise from north assumed to be road traffic on Dumbarton Road. There was no difference in observations between both daytime monitoring periods.
	21/06/22 21/06/22	Night	00:06 01:29	The same mix of subjectively low and mid frequency broadband noise as heard during the day. Fewer reverse alarms and alert tones noted compared with daytime. There was no difference in observations between both night-time monitoring periods.
2	20/06/22 21/06/22	Day	16:30 15:12	Ambient noise was dominated by traffic on Dumbarton Road and the adjacent roundabout. There was no difference in observations between both daytime monitoring periods. The monitoring period on day 1 (20/06/22) was cut short by 13 minutes due to lack of battery in the SLM.
	20/06/22 21/06/22	Night	23:43 01:07	Traffic noise was dominant, similar to daytime during the first measurement. The second measurement was captured later on the same evening when traffic had reduced significantly. During this period there was some low and mid frequency broadband noise audible from BAE at low level between passing cars.
3	20/06/22 21/06/22	Day	15:13 12:58	Ambient noise was dominated by near and distant traffic noise from South Street, and the Clydeside Expressway/Dumbarton Road to the north east. During rare gaps in traffic it was just possible to discern some broadband noise from BAE across the river. During the first monitoring period, music and voices were heard at low level from the external radio speakers on the façade of the Arnold Clark building. This was not heard during the second monitoring period.
	21/06/22 07/07/22	Night	00:46 23:56	Some broadband noise from BAE across the river was faintly audible when no cars were passing nearby. Traffic noise from South Street and the Clydeside Expressway/Dumbarton Road to the north east was dominant when present. There was no difference in observations between both night-time monitoring periods.
4	20/06/22 21/06/22	Day	13:50 11:42	Ambient noise consisted of a mix of near and distant traffic, plus some bird calls and rustling trees and bushes. During the first monitoring period, music and voices were heard at low level from the external radio speakers on the façade of the Arnold Clark building. This measurement was paused several times to avoid unrepresentative noise from an 8 vehicle transport truck

NML ID	Date	Period	Start Time	Observations
				delivering vehicles to Arnold Clark approximately 13 metres from the SLM. During the second monitoring period, the Arnold Clark radio was not heard, and no vehicle deliveries occurred. No noise was heard from the BAE site during either measurement.
	21/06/22 08/07/22	Night	00:26 00:21	Some broadband noise from BAE across the river was faintly audible when no cars were passing nearby. Traffic noise from South Street and the Clydeside Expressway/Dumbarton Road to the north east was dominant when present. There was no difference in observations between both night-time monitoring periods.
5	20/06/22 21/06/22	Day	12:43 12:36	Ambient noise consisted of intermittent traffic on Holmfauld Road, plus some rustling trees and bushes. Additional distant traffic noise from the surrounding area was also hear along with some indistinct industrial noise from BAE to the east. There was no difference in observations between both daytime monitoring periods.
	20/06/22 21/06/22	Night	23:54 01:20	Ambient noise consisted of distant road traffic and distant broadband noise from BAE. There was no difference in observations between both night-time monitoring periods.
6	20/06/22 21/06/22	Day	13:54 16:02	Ambient noise was dominated by road traffic on Govan Road. Some indistinct industrial noise heard from BAE, in addition to noise from local traffic on Aboukir Street plus some bird calls and trees rustling. There was no difference in observations between both daytime monitoring periods.
	21/06/22 08/07/22	Night	00:55 00:42	Ambient noise consisted of indistinct industrial noise from BAE with contributions from occasional passing cars on Govan Road and bird calls. There was no difference in observations between both night-time monitoring periods.
7	20/06/22 21/06/22	Day	15:02 13:46	Ambient noise was dominated by traffic on Govan Road. Infrequent local traffic on Garmouth Street was also heard, along with bird calls and trees rustling.
	21/06/22 08/07/22	Night	00:14 01:02	Ambient noise consisted of industrial noise from BAE at low level, with tonal components faintly audible. Occasional passing cars and local voices on Govan Road were also hear. There was no difference in observations between both night-time monitoring periods.
8	20/06/22 21/06/22	Day	16:09 14:51	Ambient noise consisted of industrial noise from BAE. Other sources include local traffic on Wanlock Street, distant road traffic, local voices and additional contributions from bird calls and trees rustling. During the first monitoring period there was additional noise from a lawnmower and a dog barking.
	21/06/22	Night	00:34	

NML ID	Date	Period	Start Time	Observations
	08/07/22		01:22	Ambient noise consisted of a constant broadband hum from BAE, some impulsive bangs and clatters and distant road traffic. There was no difference in observations between both night-time monitoring periods.

5.1.3 Results

A summary of the day and night-time results can be found in Table 5-4 and Table 5-5.

Table 5-4: Daytime Baseline Sound Measured Results

ID	Date	Start time	Duration, T (hrs:mins)	$L_{Aeq,T}$ (dB)	$L_{A90,T}$ (dB)
1	20/06/2022	12:31	01:00	56.5	53.9
	21/06/2022	14:05	01:00	56.5	55.1
2	20/06/2022	16:30	00:47	65.1	62.5
	21/06/2022	15:12	01:00	64.4	61.9
3	20/06/2022	15:13	01:00	58.1	54.5
	21/06/2022	12:58	01:00	56.4	53.6
4	20/06/2022	13:50	01:00	60.5	50.3
	21/06/2022	11:42	01:00	55.6	47.5
5	20/06/2022	12:43	01:00	54.1	43.9
	21/06/2022	12:36	01:00	55.2	40.9
6	20/06/2022	13:54	01:00	51.2	46.4
	21/06/2022	16:02	01:00	51.8	46.5
7	20/06/2022	15:02	01:00	55.2	51.3
	21/06/2022	13:46	01:00	52.4	48.5
8	20/06/2022	16:09	01:00	53.1	45.1
	21/06/2022	14:51	01:00	49.1	43.8

Table 5-5: Night-time Baseline Sound Measured Results

ID	Date	Start time	Duration, T (hrs:mins)	$L_{Aeq,T}$ (dB)	$L_{A90,T}$ (dB)
1	21/06/2022	00:06	00:15	55.5	53.6
	21/06/2022	01:29	00:15	53.6	52.4
2	20/06/2022	23:43	00:15	58.0	51.7
	21/06/2022	01:07	00:15	53.9	44.3
3	21/06/2022	00:46	00:15	57.0	44.3
	07/07/2022	23:56	00:15	50.2	44.8
4	21/06/2022	00:26	00:15	46.9	40.3
	08/07/2022	00:21	00:15	47.4	38.1
5	20/06/2022	23:54	00:15	61.3	36.9
	21/06/2022	01:20	00:15	48.5	35.9
6	21/06/2022	00:55	00:15	63.6	38.6
	08/07/2022	00:42	00:15	43.5	40.5
7	21/06/2022	00:14	00:15	42.9	39.8
	08/07/2022	01:02	00:15	44.9	42.1

ID	Date	Start time	Duration, T (hrs:mins)	$L_{Aeq,T}$ (dB)	$L_{A90,T}$ (dB)
8	21/06/2022	00:34	00:15	44.9	40.8
	08/07/2022	01:22	00:15	42.0	40.2

6 NOISE MODELLING

6.1 Noise Sensitive Receptors

A sample of eight noise sensitive receptors have been chosen as being representative of those most exposed to noise from construction activities. The most exposed receptor height for the flats and houses has been utilised in the modelling and assessment, which was determined through considering the line of sight and angle of view to the noise sources. The NSRs are described in Table 6-1, and shown in Drawing No. 175756-GIS005, Appendix C.

Table 6-1: Noise Sensitive Receptor Locations; Construction Noise

NSR ID	Location	Grid Reference	Most Exposed Receptor Height (m)
NSR 1	Meadowside Quay Walk, Flats	254860 666394	4
NSR 2	Dumbarton Road, Flats	254812 666656	10
NSR 3	Byron Street, Flats	254401 666704	7
NSR 4	South Street, Flats	254251 666679	7
NSR 5	Holmfauld Road, Houses	254169 666058	4
NSR 6	Aboukir Street, Flats	254481 665929	10
NSR 7	Garmouth Street, Houses	254844 665741	7
NSR 8	Wanlock Street, Houses	255252 666033	7
NSR F1	Future Flats – Granary Quay	254763 666418	10

NSR F1 has been added in order to account for a new residential development currently under construction directly adjacent to the west of the existing flats on Meadowside Quay Walk. As the construction plan for the infill of the Wet Basin is projected to continue until July 2023, it is possible that this new residential development will be completed and at least partially occupied prior to the completion of the construction works on the Govan Shipyard site. It has therefore been included in order to represent a worst case NSR as this location is closer than any existing NSR and has clear line of sight to the Wet Basin.

As there is potential for the future apartment building at NSR F1 to reduce line of sight and therefore modelled levels at NSR 2, the modelled results for all scenarios at NSR 2 detailed in the following sections have been calculated without this future building included as this represents a worst-case scenario in terms of noise propagation.

All of the results presented for NSR F1 have been calculated with the future apartment building in place, using the same parameters and the associated building included in the model.

6.2 Construction Noise Model Input Parameters

6.2.1 Construction Schedule and Modelled Scenarios

Details of the proposed construction schedule at the Site have been supplied by Arch Henderson. A summary of the proposed construction schedule is shown in Table 6-2.

Table 6-2: East Quay, Proposed Construction Schedule

Ref	Construction Stage	Start Week	Finish Week
1	Infilling and Pile Wall (overall timescale)	36 (December 2022)	68 (July 2023)
2	Infilling	36 (December 2022)	53 (April 2023)
3	New Front Quay Wall	53 (April 2023)	68 (July 2023)

As can be seen in Table 6-2, construction of the new front quay wall is scheduled to occur after infilling works. Within both the infilling and construction of the new quay wall construction stages, several concurrent groups of activities and items of plant shall be operational, including impact piling. The concurrent groups of activities and plant have been identified through review of the construction details and schedules provided by Arch Henderson, and are outlined in the following sections.

Noise modelling scenarios have been set up to account for the cumulative impact of the concurrent stages. The scenarios have been set up to model the worst-case potential combination of construction activities for each set of months considered. Periods where fewer noisy activities are expected, or general site levels are expected to be lower have not been modelled. A summary of the worst case combined construction stages and relevant assessment periods for each of the modelled scenarios is shown in Table 6-3. It should be noted that while the modelling has predicted all operations within a scenario to be concurrent, this is a conservative assumption and some activities will in fact be contiguous. Note also that the majority of dredged material to be used for infill will be imported from an off-site location. Dredging of the basin mouth is a shorter duration activity following completion of the new front quay wall.

Table 6-3: Modelled Scenarios; Construction Noise

Modelled Scenario	Modelled Combination of Construction Stages (Worst Case)	Relevant Assessment Periods
1	Spreading from Dredger	Evening, Night, Weekend
	Night Infill	
2	Spreading from Dredger	Evening, Night, Weekend
	Night Infill	
	Dredging Basin Mouth	
3	Piling (worst case of impact assumed)	Weekday, Weekend
	Spreading from Dredger	
	Infill and Compaction	
	HGV Deliveries and Concrete Batching	
4	Dredging Basin Mouth	Weekday, Weekend
	Spreading from Dredger	
	Infill and Compaction	
	HGV Deliveries and Concrete Batching	

6.2.2 Evening and Night-time Construction Noise

With reference to the assessment periods included in Table 5-3, only in the cases of dredging and spreading infill material from barges are works scheduled to be carried out over a 24-hour period. In addition to the dredging vessel and spreading activities it has been confirmed that two 18T dozers will assist with overnight infill operations. All other activities are expected to have finished by 19:00hrs on Monday to Saturday, and by 14:00hrs on Sundays. Evening and night time construction noise levels are expected to be the same.

6.2.3 Weekend Construction Noise

The proposed construction schedule includes working during daytime hours during the week days and the weekends. The implication of this is that works associated with higher noise levels are likely to be carried out during weekend hours (Saturday 13:00 – 19:00hrs and Sunday 08:00 – 14:00hrs), which are subject to more stringent noise limits than during the weekdays (refer to Table 4-1).

6.2.4 Piling

This will comprise driving of piles at specified centres, with profiled sheet piles spanning between to form a retaining wall at the mouth of the Wet Basin. The piles will be initially driven using a vibrating pile hammer to the required depth. Where bedrock is encountered and hard driving is required, an impact hammer will be used to drive the pile into its final position. Impact piling typically generates higher noise levels than vibratory piling, therefore in order to present a conservative assessment, only impact piling has been considered within the model.

Piling will be carried out between the hours of 07:00 and 19:00hrs Monday to Saturday, and between 08:00 and 14:00hrs on Sundays. It has been confirmed that a single piling rig will be employed for these operations which will be manoeuvred into position using a crawler crane.

6.2.5 Dredging Vessels and Infill of Material

Dredging is anticipated to include the use of Trailing Hopper Suction Dredgers (TSHD). Up to 6 of these vessels per day are expected to deliver infill material and deposit material into the Wet Basin using their on-board rainbow spreading pump. The vessels will also be employed to dredge the excess material at the mouth of the Wet Basin during the formation of the quay wall.

When operational, the infill via rainbow spreading and dredging activities could be continuous over a 24 hour period, 7 days per week. Dredging of the Wet Basin mouth is scheduled to occur for a shorter portion of the construction schedule than infill operations and rainbow spreading. Scenarios 1 therefore considers the night time, evening and weekend impact of infill and spreading from the TSHD alone and Scenario 2 considers this in tandem with dredging activities for the same periods.

A single 90T long reach excavator is also to be employed from the shore to assist in dispersing infill material from the barges during daytime and weekend hours. Two 18T dozers will be employed for this during night time hours.

Additional infill material is to be delivered during daytime and weekend hours by 40T dump trucks. Further infill activities will be carried out by excavators on the reclaimed land with compaction undertaken by vibratory roller and compactor hammer.

6.2.6 Concrete Batching

Concrete batching is to be undertaken on the site on ground directly west of the Wet Basin. This activity is expected to be carried out during weekday and weekend daytime hours during the entire construction program and will be supported by HGV deliveries of raw materials plus dump trucks and dozers to transport and disperse the batched concrete.

6.2.7 Construction Noise Model Data

3D computer noise modelling of the various stages of construction activity at the site has been carried out using CadnaA software. Details on worst case construction activities, durations, operating times, and associated items of noise generating plant for each stage of construction used within the noise models have been supplied by Arch Henderson.

Calculations were carried out using noise data and guidance provided in BS5228-1:2009+A1:2014, to derive predicted noise levels at noise sensitive receptors. Where data was not available within BS5228, noise data has been sourced from the following publications;

- Rob Witte, *Noise From Moored Ships*, Internoise 2010.
- Royal Haskoning DHV, *Swansea Channel Noise Impact Assessment, Memo,* 25th June 2014.
- Tarbert Ferry Terminal - Subtidal Benthic Ecology Survey Report (January, 2018). APEM Scientific Report P000002178a. Aspect Land & Hydrographic Surveys Ltd.

Full details of the items of modelled construction plant, noise data (including data source), operating times, durations and source heights for each of the considered scenarios is shown in Table D-1, Appendix D.

6.2.8 Construction Noise Model Assumptions

A number of assumptions have been established during the CadnaA modelling exercise, as detailed below:

- The ground model uses Lidar 1m resolution Digital Terrain Model (DTM) height data obtained from the Scottish Remote Sensing Portal[6] for the BAE Complex and the surrounding area.
- The heights of buildings have been obtained using a Digital Surface Model (DSM) of the area from the Scottish Remote Sensing Portal;
- Predicted levels are calculated in the free-field environment;
- Ground absorption has been set to 0 for areas of soft ground, 0.5 for mixed soft/hard ground, and 1 for hard ground. The surface of the water is considered a reflective surface with an absorption of 0;
- Weekday evening noise levels generated by construction activities for scenarios 1 and 2 have been assumed to be the same as those generated during night time hours;
- Weekend daytime noise levels generated by construction activities for scenarios 3 and 4 have been assumed to be the same as those generated during weekday hours;
- The noise model assumes locations of plant based on descriptions of construction activities provided by Arch Henderson;
- Worst case scenario combinations of construction activities likely to occur during the considered assessment periods have been assumed;
- The following sources have been modelled as line sources within CadnaA;
    - Heavy goods vehicles (HGVs) and dump trucks;
    - Concrete trucks; and
    - Moving construction plant such as dozers and impact compaction rollers.

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[6] Scottish Remote Sensing Portal | Scottish Government (remotesensingdata.gov.scot)

- Noise associated with Sopsan Dau dredging barges delivering and placing infill material has been modelled within CadnaA as discrete point sources on a 14 x 72 x 2.5 metre block to represent:
    - Vessel engine noise;
    - Jet pump output; and
    - Pump ashore output/rainbow spreading.
- All remaining sources (not outlined above) have been modelled within CadnaA as point sources.
- Details of all sources included within the model and their operating times are provided in Table D-1, Appendix D.

6.2.9 ABC Category Thresholds

The appropriate ABC category thresholds above which there is considered to be a noise impact from construction noise have been calculated following guidance provided in BS5228-1:2009+A1:2014 (refer to Section 4.3). Details of the calculations of Threshold Levels are shown in Appendix B.

7 CONSTRUCTION NOISE MODEL RESULTS AND ASSESSMENT

The noise model results for each modelled scenario of construction activity, along with the BS5228 assessment at each of the considered noise sensitive receptors are summarised in Table 6-1 to Table 7-9. The results for NSR F1 for all four scenarios have been calculated using the same BS5228 ABC Category Threshold Levels as NSR 01. The predicted level within the tables is defined as the total construction and ambient noise level at each receptor location.

Table 7-1: Noise Model Results and BS5228 Assessment; Noise Sensitive Receptor No. 1

NSR 01	Weekday Daytime			Weekend Daytime			Evening			Night-time		
Scenario	Threshold Level dB(A)	Predicted Level dB(A)	Significance	Threshold Level dB(A)	Predicted Level dB(A)	Significance	Threshold Level dB(A)	Predicted Level dB(A)	Significance	Threshold Level dB(A)	Predicted Level dB(A)	Significance
1	N/A	N/A	N/A	60.0	56.7	Neutral	60.0	56.4	Neutral	55.0	55.2	Slight Adverse
2	N/A	N/A	N/A	60.0	57.5	Neutral	60.0	57.2	Neutral	55.0	56.2	Slight Adverse
3	65.0	66.5	Slight Adverse	60.0	66.4	Large Adverse	N/A	N/A	N/A	N/A	N/A	N/A
4	65.0	66.4	Slight Adverse	60.0	66.3	Large Adverse	N/A	N/A	N/A	N/A	N/A	N/A

Table 7-2: Noise Model Results and BS5228 Assessment; Noise Sensitive Receptor No. 2

NSR 02	Weekday Daytime			Weekend Daytime			Evening			Night-time		
Scenario	Threshold Level dB(A)	Predicted Level dB(A)	Significance	Threshold Level dB(A)	Predicted Level dB(A)	Significance	Threshold Level dB(A)	Predicted Level dB(A)	Significance	Threshold Level dB(A)	Predicted Level dB(A)	Significance
1	N/A	N/A	N/A	65.0	61.9	Neutral	65.0	61.9	Neutral	55.0	54.4	Neutral
2	N/A	N/A	N/A	65.0	61.9	Neutral	65.0	61.9	Neutral	55.0	54.5	Neutral
3	70.0	66.5	Neutral	65.0	65.1	Slight Adverse	N/A	N/A	N/A	N/A	N/A	N/A
4	70.0	66.4	Neutral	65.0	65.0	Slight	N/A	N/A	N/A	N/A	N/A	N/A

Table 7-3: Noise Model Results and BS5228 Assessment; Noise Sensitive Receptor No. 3

NSR 03	Weekday Daytime			Weekend Daytime			Evening			Night-time		
Scenario	Threshold Level dB(A)	Predicted Level dB(A)	Significance	Threshold Level dB(A)	Predicted Level dB(A)	Significance	Threshold Level dB(A)	Predicted Level dB(A)	Significance	Threshold Level dB(A)	Predicted Level dB(A)	Significance
1	N/A	N/A	N/A	60.0	55.2	Neutral	60.0	55.0	Neutral	55.0	51.8	Neutral
2	N/A	N/A	N/A	60.0	55.4	Neutral	60.0	55.2	Neutral	55.0	52.2	Neutral
3	65.0	63.4	Neutral	60.0	63.0	Moderate Adverse	N/A	N/A	N/A	N/A	N/A	N/A
4	65.0	63.0	Neutral	60.0	62.6	Slight Adverse	N/A	N/A	N/A	N/A	N/A	N/A

Table 7-4: Noise Model Results and BS5228 Assessment; Noise Sensitive Receptor No. 4

NSR 04	Weekday Daytime			Weekend Daytime			Evening			Night-time		
Scenario	Threshold Level dB(A)	Predicted Level dB(A)	Significance	Threshold Level dB(A)	Predicted Level dB(A)	Significance	Threshold Level dB(A)	Predicted Level dB(A)	Significance	Threshold Level dB(A)	Predicted Level dB(A)	Significance
1	N/A	N/A	N/A	60.0	53.3	Neutral	60.0	53.3	Neutral	50.0	47.5	Neutral
2	N/A	N/A	N/A	60.0	53.6	Neutral	60.0	53.6	Neutral	50.0	48.5	Neutral
3	65.0	59.9	Neutral	60.0	59.1	Neutral	N/A	N/A	N/A	N/A	N/A	N/A
4	65.0	59.8	Neutral	60.0	59.0	Neutral	N/A	N/A	N/A	N/A	N/A	N/A

Table 7-5: Noise Model Results and BS5228 Assessment; Noise Sensitive Receptor No. 5

NSR 05	Weekday Daytime			Weekend Daytime			Evening			Night-time		
Scenario	Threshold Level dB(A)	Predicted Level dB(A)	Significance	Threshold Level dB(A)	Predicted Level dB(A)	Significance	Threshold Level dB(A)	Predicted Level dB(A)	Significance	Threshold Level dB(A)	Predicted Level dB(A)	Significance
1	N/A	N/A	N/A	55.0	52.5	Neutral	55.0	52.4	Neutral	55.0	49.2	Neutral
2	N/A	N/A	N/A	55.0	52.7	Neutral	55.0	52.6	Neutral	55.0	49.5	Neutral
3	65.0	60.0	Neutral	55.0	59.6	Moderate Adverse	N/A	N/A	N/A	N/A	N/A	N/A

NSR 05	Weekday Daytime			Weekend Daytime			Evening			Night-time		
Scenario	Threshold Level dB(A)	Predicted Level dB(A)	Significance	Threshold Level dB(A)	Predicted Level dB(A)	Significance	Threshold Level dB(A)	Predicted Level dB(A)	Significance	Threshold Level dB(A)	Predicted Level dB(A)	Significance
4	65.0	59.7	Neutral	55.0	59.2	Moderate Adverse	N/A	N/A	N/A	N/A	N/A	N/A

Table 7-6: Noise Model Results and BS5228 Assessment; Noise Sensitive Receptor No. 6

NSR 06	Weekday Daytime			Weekend Daytime			Evening			Night-time		
Scenario	Threshold Level dB(A)	Predicted Level dB(A)	Significance	Threshold Level dB(A)	Predicted Level dB(A)	Significance	Threshold Level dB(A)	Predicted Level dB(A)	Significance	Threshold Level dB(A)	Predicted Level dB(A)	Significance
1	N/A	N/A	N/A	55.0	50.4	Neutral	55.0	50.0	Neutral	50.0	46.6	Neutral
2	N/A	N/A	N/A	55.0	50.6	Neutral	55.0	50.3	Neutral	50.0	47.2	Neutral
3	65.0	62.3	Neutral	55.0	62.2	Large Adverse	N/A	N/A	N/A	N/A	N/A	N/A
4	65.0	62.0	Neutral	55.0	61.8	Large Adverse	N/A	N/A	N/A	N/A	N/A	N/A

Table 7-7: Noise Model Results and BS5228 Assessment; Noise Sensitive Receptor No. 7

NSR 07	Weekday Daytime			Weekend Daytime			Evening			Night-time		
Scenario	Threshold Level dB(A)	Predicted Level dB(A)	Significance	Threshold Level dB(A)	Predicted Level dB(A)	Significance	Threshold Level dB(A)	Predicted Level dB(A)	Significance	Threshold Level dB(A)	Predicted Level dB(A)	Significance
1	N/A	N/A	N/A	55.0	52.4	Neutral	55.0	52.4	Neutral	50.0	43.1	Neutral
2	N/A	N/A	N/A	55.0	52.4	Neutral	55.0	52.4	Neutral	50.0	43.1	Neutral
3	65.0	55.6	Neutral	55.0	53.2	Neutral	N/A	N/A	N/A	N/A	N/A	N/A
4	65.0	55.6	Neutral	55.0	53.2	Neutral	N/A	N/A	N/A	N/A	N/A	N/A

Table 7-8: Noise Model Results and BS5228 Assessment; Noise Sensitive Receptor No. 8

NSR 08	Weekday Daytime			Weekend Daytime			Evening			Night-time		
Scenario	Threshold Level dB(A)	Predicted Level dB(A)	Significance	Threshold Level dB(A)	Predicted Level dB(A)	Significance	Threshold Level dB(A)	Predicted Level dB(A)	Significance	Threshold Level dB(A)	Predicted Level dB(A)	Significance
1	N/A	N/A	N/A	55.0	47.4	Neutral	55.0	47.2	Neutral	45.0	43.0	Neutral
2	N/A	N/A	N/A	55.0	47.7	Neutral	55.0	47.6	Neutral	45.0	43.8	Neutral
3	65.0	52.8	Neutral	55.0	52.0	Neutral	N/A	N/A	N/A	N/A	N/A	N/A
4	65.0	51.9	Neutral	55.0	50.9	Neutral	N/A	N/A	N/A	N/A	N/A	N/A

Table 7-9: Noise Model Results and BS5228 Assessment; Noise Sensitive Receptor No. F1

NSR F1	Weekday Daytime			Weekend Daytime			Evening			Night-time		
Scenario	Threshold Level dB(A)	Predicted Level dB(A)	Significance	Threshold Level dB(A)	Predicted Level dB(A)	Significance	Threshold Level dB(A)	Predicted Level dB(A)	Significance	Threshold Level dB(A)	Predicted Level dB(A)	Significance
1	N/A	N/A	N/A	60.0	57.5	Neutral	60.0	56.9	Neutral	55.0	55.8	Slight Adverse
2	N/A	N/A	N/A	60.0	58.5	Neutral	60.0	58.0	Neutral	55.0	57.2	Slight Adverse
3	65.0	69.4	Moderate Adverse	60.0	69.4	Large Adverse	N/A	N/A	N/A	N/A	N/A	N/A
4	65.0	68.8	Moderate Adverse	60.0	68.7	Large Adverse	N/A	N/A	N/A	N/A	N/A	N/A

7.1 Discussion of Scenarios

The worst case noise impacts for each of the modelled scenarios on concurrent construction stages and relevant assessment periods are summarised below (refer to Table 5-3).

Scenario 1: This scenario considers the noise impact of a TSHD spreading infill material via the rainbow method and two 18T dozers moving material at the edge of the Wet Basin and on reclaimed land within the Basin. The works modelled within this scenario have been assessed during evening, night time and weekend daytime hours.

This scenario is predicted to meet the evening and weekend threshold levels as defined using the ABC method of BS 5228 at all noise sensitive receptors resulting in a Neutral impact.

At NSR 1 and NSR F1, work during night time hours is predicted to result in a Slight Adverse impact. For all other receptors night time works are predicted to result in a Neutral impact.

Scenario 2: This scenario considers the noise impact of a TSHD spreading infill material via the rainbow method, dredging operations at the mouth of the Wet Basin using a TSHD, and two 18T dozers moving material at the edge of the Basin and on reclaimed land within the Basin. The works modelled within this scenario have been assessed during evening, night time and weekend daytime hours.

This scenario is predicted to meet the evening and weekend daytime threshold levels as defined using the ABC method of BS 5228 at all noise sensitive receptors resulting in a Neutral impact.

At NSR 1 and NSR F1, work during night time hours is predicted to result in a Slight Adverse impact. For all other receptors night time works are predicted to result in a Neutral impact.

Scenario 3: This scenario considers the noise impact of impact piling, spreading of infill material via the rainbow method from a TSHD, infill and compaction by earth moving vehicles on reclaimed land, concrete batching and HGV deliveries. The works modelled within this scenario have been assessed during weekday and weekend daytime hours.

Weekday daytime works are predicted to result in a Moderate Adverse impact at NSR F1 and a Slight Adverse impact at NSR 1. The impact is predicted to be Neutral at all other receptors.

Weekend daytime works are predicted to result in a Large Adverse impact at NSR 1, NSR 6 and NSR F1. A Moderate Adverse impact is predicted at NSR 3 & NSR 5, and a Slight Adverse impact is predicted at NSR 2. The impact is predicted to be Neutral at NSR 4, NSR 7 and NSR 8.

Scenario 4: This scenario considers the noise impact of dredging operations at the mouth of the Wet Basin using a TSHD, spreading of infill material via the rainbow method from a TSHD, infill and compaction by earth moving vehicles on reclaimed land, concrete batching and HGV deliveries. The works modelled within this scenario have been assessed during weekday and weekend daytime hours.

Weekday daytime works are predicted to result in a Moderate Adverse impact at NSR F1 and a Slight Adverse impact at NSR 1. The impact is predicted to be Neutral at all other receptors.

Weekend daytime works are predicted to result in a Large Adverse impact at NSR 1, NSR 6 and NSR F1. A Moderate Adverse impact is predicted at NSR 5, and a Slight Adverse impact is predicted at NSR 2 and NSR 3. The impact is predicted to be Neutral at NSR4, NSR 7 and NSR 8.

7.2 Discussion of Impacts

The modelled contributions of noise from individual items of plant and construction activities at each receptor have been interrogated in order to identify which plant and activities are predicted to result in the greatest impacts for the reference periods assessed.

7.2.1 Greatest Evening Noise Impacts

Evening noise will largely be due to infill of material from TSHD via the rainbow spreading method which has been conservatively assumed to be constantly operating with shore side support from two dozers. During the course of dredging the basin mouth with a TSHD it is expected that these operations would also be continuously active during the evening. Modelled levels are predicted to be below the thresholds defined in the ABC method of BS 5228 at all receptors and Neutral impact is therefore predicted at all receptors during the evening.

7.2.2 Greatest Night-time Noise Impacts

Night time noise will largely be due to infill of material from TSHD via the rainbow spreading method which has been conservatively assumed to be constantly operating with shore side support from two dozers. During the course of dredging the basin mouth with a TSHD it is expected that these operations would also be continuously active during night time hours.

The greatest impacts during night-time hours are predicted at NSR 1 and NSR F1. Both of these receptors are located on the opposite shore of the River Clyde with direct line of sight to the mouth of the Wet Basin and partial line of sight to the rest of the site. These receptors are predicted to experience Slight Adverse impact for both of the modelled night time scenarios. No impact is predicted at all remaining NSRs.

7.2.3 Greatest Weekday Daytime Noise Impacts

The loudest noise generating activities for weekday daytime works are predicted to be a combination of impact piling, compaction of infill material on reclaimed land and noise from movements and tipping of dump trucks. Impact piling is active in Scenario 3 and inactive in Scenario 4, which also includes dredging of the basin mouth with a TSHD. Although piling is among the loudest contributing sources at most noise sensitive receptors, the reduction in modelled noise levels with piling inactive and dredging of the basin mouth active is typically around 1 dB or less, indicating that daytime construction noise is not dominated by a single source.

Similar to night-time works, the greatest impacts during daytime hours are predicted at NSR 1 and NSR F1 on the opposite shore of the River Clyde with direct line of sight to the mouth of the Wet Basin and partial line of sight to the rest of the site. These receptors are predicted to experience Slight Adverse impact and Moderate Adverse respectively for both of the modelled day time scenarios. No impact is predicted at all remaining NSRs.

7.2.4 Greatest Weekend Daytime Noise Impacts

The loudest noise generating activities for weekend daytime works are predicted to be the same as weekday daytime works, namely a combination of impact piling, compaction of infill material on reclaimed land and noise from movements and tipping of dump trucks.

Due to the increased ABC Threshold sensitivity for weekend daytime hours defined in BS5228-1:2009 and shown in Table 4-1, greater impacts are predicted at the majority of receptors in comparison to weekday daytime hours.

NSR 1 and NSR F1 on the opposite side of the River Clyde are predicted to experience Large Adverse impacts during this working period. NSR 6 is located at the south eastern site boundary with direct line of sight to the Basin over the southern boundary wall and is also subject to a Large Adverse impact. A Moderate impact is predicted at NSR 5 due to the arrival and departure of HGVs and dump trucks delivering materials via the western gate on Holmfauld Road.

A Slight Adverse impact is predicted at NSR 2 and NSR 3, whilst a Neutral impact is predicted at NSR 4, NSR 7 and NSR 8.

7.3 Construction Noise Mitigation

Construction activities during evening hours are predicted to have a Neutral level of significance during evening hours at all receptors. NSRs 2 – 8 are also predicted to have a Neutral significance of impact during daytime and night time hours.

NSR 1 is predicted to have a Slight impact during daytime and night time hours, while NSR F1 is predicted to have a Slight impact during night time hours and a Moderate significance of impact during daytime hours.

As per Table 4-2, impacts of Slight and Moderate adverse impact are defined in Tan 2011 as undesirable, but not likely to be key decision making issues. It is therefore considered that mitigation of construction noise impacts during weekday daytime, evening and night time hours is not necessary. The existing noise environment at NSR 1 and NSR F1 is already dominated by noise from ship assembly from the BAE yard and fabrication sheds during typical operations. Therefore residents are less likely to be disturbed by a modest increase in noise levels which is similar in character to the typical existing ambient noise.

At the weekend, the worst case daytime impacts from construction activities are predicted to be of Large Adverse significance at NSR1, NSR 6 and NSR F1 with Neutral, Slight and Moderate significance of impact predicted at the remaining receptors. This impact is predicted due to concurrent piling, infill and ground compaction activities.

Impacts of Large adverse significance are defined in TAN 2011 as likely to be important considerations, however, mitigation may be effectively employed such that resultant adverse effects may have a Moderate or Slight significance (refer to Table 4-2). To reduce the level of impact from Large Adverse significance during the weekend daytime, noise mitigation measures are recommended in the following sections.

7.3.1 Piling and Compaction

As discussed previously, piling will be carried out initially using a vibratory hammer, with the impact hammer being used to drive the piles into their final position. The use of the impact hammer generates the greatest level of noise during this process. Compaction is also carried out using vibratory rollers in addition to the mobile rapid impact compactor which generates greater amounts of noise. In order to reduce the level of impact during the most sensitive weekend daytime period at receptors across the river, the following measures are recommended;

- The use of impact hammers on piles and rapid impact compaction hammering on reclaimed land should, where practicable, be scheduled for weekdays and avoided at weekends;
- The use of quiet hammer systems and acoustic shrouding techniques should be considered during impact piling.

7.3.2 Construction Noise Management

It is recommended that best practice construction noise management techniques should be employed following guidance provided in BS5228-1:2009. This includes Best Available Techniques (BAT) for reducing noise from vehicle movements and tipping of materials and upkeep of plant and machinery so as to prevent faults and minimise operational noise. The general principles of the Considerate Constructors Scheme should be followed where practicable.

8 CONCLUSIONS

A construction noise assessment has been carried to predict the impact at residential receptors surrounding the BAE Govan Shipyard during the proposed infill of the existing Wet Basin as part of the proposed Govan Facilities Investment.

8.1 Construction Noise

Worst case combined construction scenarios based on the proposed construction schedule have been modelled using CadnaA software. Details of construction activities and associated plant on which assessment assumptions are based have been provided by Arch Henderson.

8.1.1 Evening and Night-time Construction Noise

Evening and night-time noise will largely be due to infill of material via the rainbow spreading method from TSHD with shore side support from two dozers. During the shorter duration stage of dredging of the basin mouth by TSHD it is expected that the infill and spreading operations would be concurrently active during the evening and night-time.

Evening modelled levels are predicted to be below the thresholds of impact defined in the ABC method of BS 5228 at all receptors, with an associated Neutral impact during the evening.

The greatest impacts during night-time hours are predicted at receptors located on the opposite shore of the River Clyde with direct line of sight to the mouth of the Wet Basin and partial line of sight to the rest of the site. These receptors are predicted to experience Slight Adverse impact for both of the modelled worst-case night time scenarios. No adverse impact is predicted at all remaining NSRs, with an associated Neutral significance.

8.1.2 Weekday Daytime Construction Noise

The loudest noise generating activities for weekday daytime works are predicted to be a combination of impact piling, compaction of infill material on reclaimed land and noise from movements and tipping of dump trucks. Noise modelling has been carried out which considered scenarios with impact piling active and impact piling inactive. Dredging of the basin mouth by TSHD has been included in the scenario with piling inactive. Although piling is among the loudest contributing sources at most noise sensitive receptors, the reduction in modelled noise levels with piling inactive is typically around 1 dB or less, indicating that daytime construction noise is not dominated by a single source.

Similar to night-time works, the greatest impacts during weekday daytime hours are predicted at the closest receptors located on the opposite shore of the River Clyde with direct line of sight to the mouth of the Wet Basin and partial line of sight to the rest of the site. These receptors are predicted to experience impacts ranging from Slight to Moderate Adverse impact for both of the modelled worst-case day time scenarios. No adverse impact is predicted at all remaining NSRs, with an associated Neutral significance. As stated in TAN 1/2011, impacts of Slight and Moderate significance are not likely to be key decision making issues.

8.1.3 Weekend Daytime Construction Noise

The loudest noise generating activities for weekend daytime works are predicted to be the same as weekday daytime works, namely a combination of impact piling, compaction of infill material on reclaimed land and noise from movements and tipping of dump trucks.

Due to the increased ABC Threshold sensitivity for weekend daytime hours defined in BS5228-1:2009, greater impacts are predicted at the majority of receptors in comparison to weekday daytime hours.

The closest receptors on the opposite side of the River Clyde are predicted to experience Large Adverse impacts during this working period. One additional receptor which is located at the south eastern site boundary is also subject to a Large Adverse impact. This receptor has direct line of sight to the Basin over the southern boundary wall. Additionally, a Moderate impact is predicted at one receptor located to the west of the site due to the arrival and departure of HGVs and dump trucks delivering materials via the western gate on Holmfauld Road.

A Slight Adverse Impact is predicted at two additional receptors with partial line of sight to the Wet Basin. These receptors are located to the north of the site at distances ranging between 400 to 500 metres. A Neutral impact is predicted at all remaining NSRs.

APPENDICES

A NOISE DEFINITIONS

Ambient Sound Level: As defined in BS4142:2014; equivalent continuous A-weighted sound pressure level of the totally encompassing sound in a given situation at a given time, at the assessment location. The ambient sound level includes the contribution from the residual sound level and the specific sound level. Measured with $L_{Aeq,T}$.

Background Sound Level: The background sound level represents baseline conditions, filtering out intermittent noises, and can be thought of as a baseline over which a continuous noise would be heard. Defined in BS 4142 as the A-weighted sound pressure level that is exceeded by the residual sound at the assessment location for 90% of any given time interval, T, $L_{A90,T}$.

Free-field: Sound can propagate from a source to a receiver through a direct path as well as reflected paths. The free-field represents a scenario where there are no contributions from reflections. In environmental assessments this largely refers to the scenario where the contribution from reflections is negligible.

Façade Effect: When sound is reflected back towards its source, off a surface, such a wall, the reflected and incident sound waves sum. One metre from the façade of a building this typically results in an increase in level, compared to that of the free-field, by approximately 3 dB, referred to as the façade effect.

$L_{Aeq, T}$: Equivalent continuous A-weighted sound pressure level. This is the single number that represents the average sound energy over a given time period, T. It is the sound level of a notionally steady sound that has the same energy as a sound that fluctuates over the specified measurement period.

$L_{A90, T}$: The noise level exceeded for 90% of the measurement period.

L_{Amax}: The maximum A-weighted sound pressure level over the specified period.

Octave: A range of frequencies whose upper frequency limit is twice that of its lower frequency limit.

Octave Band: Sound pressure level is often measured in octave bands, the centre frequencies of the bands are defined by ISO – 31.5Hz, 63Hz, 125Hz, 250Hz, 500Hz, 1kHz, 2kHz, 4kHz, 8kHz, 16kHz to divide the audio spectrum into 10 equal parts. The sound pressure level of sound that has been passed through an octave band pass filter is termed the octave band sound pressure level. Additionally, sound is often represented by one-third octave bands, which divides each octave band into three.

Specific Sound Level: The continuous A-weighted sound pressure level at a given location of the isolated industrial noise source.

Weighting: Human hearing is most sensitive to frequencies between about 500Hz and 6kHz and less sensitive to frequencies above and below these. In order to measure noise levels representative of human hearing a filter is applied termed a Frequency Weighting which is a prescribed frequency filter provided in a sound level meter. An A-weighted sound pressure level in decibels (denoted as dB(A)) is designed to reflect the sharpness of the human ear, which does not respond equally to all frequencies

B ABC CATEGORY THRESHOLDS

The appropriate ABC category thresholds for each of the noise sensitive receptors has been calculated following guidance provided in Annex E of the standard (refer to Section 4.3 for assessment criteria).

Calculations for each of the noise sensitive receptors, based on measured day and night-time ambient noise levels in the absence of construction noise is shown in Table B-1 to Table B-8. Evening and Weekend ambient noise levels have been assumed to be the average of daytime and night-time measured noise levels.

Table B-1: ABC Category Thresholds, NSR 01

NSR 01	Lowest Measured Daytime dB(A)	Lowest Measured Night-time dB(A)	Evening dB(A)	Weekend dB(A)
Ambient Levels	56.5	53.6	55.3	55.3
Ambient Levels Rounded	55	55	55	55
BS5228 ABC Category	**A**	**C**	**B**	**B**
Threshold Value	65	55	60	60

Table B-2: ABC Category Thresholds, NSR 02

NSR 02	Lowest Measured Daytime dB(A)	Lowest Measured Night-time dB(A)	Evening dB(A)	Weekend dB(A)
Ambient Levels	64.4	53.9	61.8	61.8
Ambient Levels Rounded	65	55	60	60
BS5228 ABC Category	**B**	**C**	**C**	**C**
Threshold Value	70	55	65	65

Table B-3: ABC Category Thresholds, NSR 03

NSR 03	Lowest Measured Daytime dB(A)	Lowest Measured Night-time dB(A)	Evening dB(A)	Weekend dB(A)
Ambient Levels	56.4	50.2	54.3	54.3
Ambient Levels Rounded	55	50	55	55
BS5228 ABC Category	**A**	**C**	**B**	**B**
Threshold Value	65	55	60	60

Table B-4: ABC Category Thresholds, NSR 04

NSR 04	Lowest Measured Daytime dB(A)	Lowest Measured Night-time dB(A)	Evening dB(A)	Weekend dB(A)
Ambient Levels	55.6	46.9	53.1	53.1
Ambient Levels Rounded	55	45	55	55
BS5228 ABC Category	**A**	**B**	**B**	**B**

Threshold Value	65	50	60	60

Table B-5: ABC Category Thresholds, NSR 05

NSR 05	Lowest Measured Daytime dB(A)	Lowest Measured Night-time dB(A)	Evening dB(A)	Weekend dB(A)
Ambient Levels	54.1	48.5	52.1	52.1
Ambient Levels Rounded	55	50	50	50
BS5228 ABC Category	A	C	A	A
Threshold Value	65	55	55	55

Table B-6: ABC Category Thresholds, NSR 06

NSR 06	Lowest Measured Daytime dB(A)	Lowest Measured Night-time dB(A)	Evening dB(A)	Weekend dB(A)
Ambient Levels	51.2	43.5	48.9	48.9
Ambient Levels Rounded	50	45	50	50
BS5228 ABC Category	A	B	A	A
Threshold Value	65	50	55	55

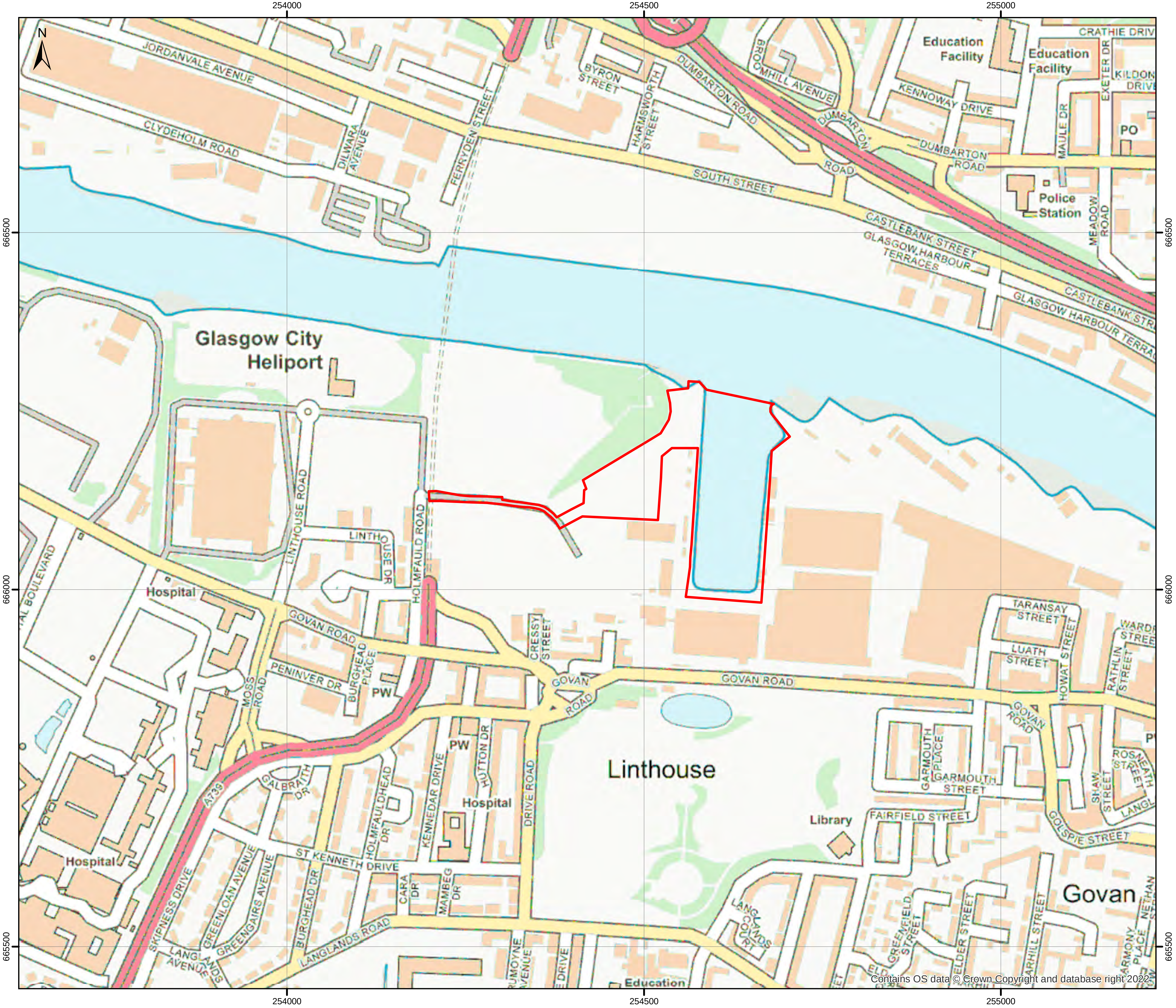
Table B-7: ABC Category Thresholds, NSR 07

NSR 07	Lowest Measured Daytime dB(A)	Lowest Measured Night-time dB(A)	Evening dB(A)	Weekend dB(A)
Ambient Levels	52.4	42.9	52.4	52.4
Ambient Levels Rounded	50	45	50	50
BS5228 ABC Category	A	B	A	A
Threshold Value	65	50	55	55

Table B-8: ABC Category Thresholds, NSR 08

NSR 08	Lowest Measured Daytime dB(A)	Lowest Measured Night-time dB(A)	Evening dB(A)	Weekend dB(A)
Ambient Levels	49.1	42	46.9	46.9
Ambient Levels Rounded	50	40	45	45
BS5228 ABC Category	A	A	A	A
Threshold Value	65	45	55	55

C DRAWINGS



Legend

🟥 Site Boundary

Do not scale this map

Client	Arch Henderson
Project	Govan Facilities Investment
Title	Site Location Plan
Status	Final

Drawing No.	**Revision**	**Date**
175756-GIS001	-	18 May 2022
Drawn	**Checked**	**Approved**
AH	GD	GD

Scale
1:5,000 @A3
0 25 50 100 150 Metres

Rev	Date	Amendment	Initials

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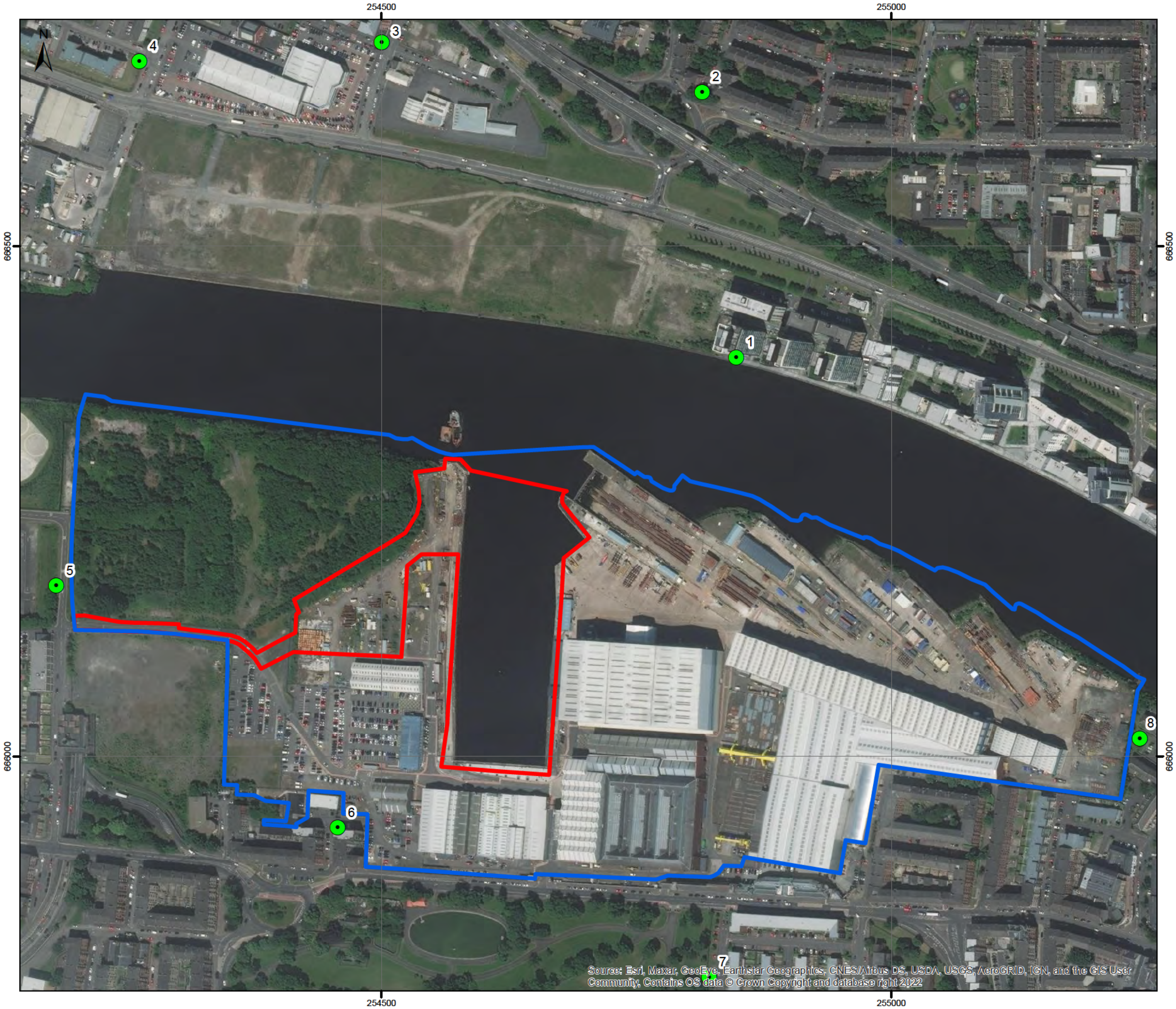

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Contains OS data © Crown Copyright and database right 2022

Legend

🟥 Site Boundary

🟦 BAE Complex Boundary

● Noise Monitoring Locations

Do not scale this map

Client
Arch Henderson

Project
Govan Facilities Investment

Title
Noise Monitoring Locations

Status
Final

Drawing No.	Revision	Date
175756-GIS002	A	07 June 2022
Drawn	**Checked**	**Approved**
AH	CC	CC

Scale
1:3,500 @A3

Rev	Date	Amendment	Initials
A	07/06/22	Revised NML Locations	AH

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Legend

🟥 Site Boundary
🟦 BAE Complex Boundary
🟩 Development Under Construction
● Existing Noise Sensitive Receptors
● Future Noise Sensitive Receptor

Do not scale this map

Client
Arch Henderson

Project
Govan Facilities Investment

Title
Noise Monitoring Locations

Status
Final

Drawing No.	Revision	Date
175756-GIS005		21 July 2022
Drawn	Checked	Approved
AH	CC	CC

Scale
1:4,000 @A3
0 20 40 80 120 Metres

Rev	Date	Amendment	Initials

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D CONSTRUCTION NOISE MODEL DATA

Table D-1: Construction Noise Model Data

Construction Activities	Individual Plant / Activities	No. of Units	Data Source	Lp at 10m dB(A)	LwA	Source Height (m)	Operating Periods				% On-time of Operating Hours	Operating Times (mins)
							D	W	E	N		
Spreading from dredger	Suction Dredger Vessel Engine	1	Internoise 2010, Noise From Moored Ships, Rob Witte	72	99.9	2	X	X	X	X	38 day / 25 night	360 day / 120 night
	Jet Pump Output	1	SET-T Module (Spec taken from Baskalis Argonaut dredger)	71	98.9	2	X	X	X	X	38 day / 25 night	360 day / 120 night
	Pump Ashore Output	1	SET-T Module (Spec taken from Baskalis Argonaut dredger)	78	105.8	0.1	X	X	X	X	38 day / 25 night	360 day / 120 night
Night / Weekend Day Infill	D6 Dozers - 18T	2	BS 5228 C.2 ref 12	81	109.0	1		X	X	X	80	720 day / 384 night
Dredging basin mouth	Trailing Hopper Suction Dredger (TSHD)	1	Royal Haskoning DHV; Swansea Channel NIA, Memo, dated 25th June 2014.	82	110.0	2	X	X	X	X	100	24 hours Steady State in Cadna
Impact Piling	100t crawler crane	1	BS 5228 C.3 ref 28	67	95.0	2	X	X			100	900
	Large capacity impact hammer	1	BS5228 D4 Ref 64b	90	118	2	X	X			100	900
	Drop hammer rig power pack	1	BS5228 C.3 ref 5	69	96.8	1	X	X			100	900
Infill and compaction	D6 Dozers - 18T	2	BS 5228 C.2 ref 12	81	109.0	1	X	X			80	720
	6 No. 40T Moxi Dump Trucks - movements	6	BS5228 C.9 ref 21	90	118.0	0.5	X	X			80	720

Construction Activities	Individual Plant / Activities	No. of Units	Data Source	Lp at 10m dB(A)	LwA	Source Height (m)	Operating Periods				% On-time of Operating Hours	Operating Times (mins)
							D	W	E	N		
	40T dump truck tipping		BS5228 C.1 ref 11	80	108.0	0.5	X	X			80	720
	1 No. 90T Excavator offloading Barge	1	BS 5228 C.2 ref 2	77	105.0	1	X	X			80	720
	2 No. 50T Excavators	2	BS 5228 C.2 ref 14	79	107.0	1	X	X			80	720
	2 No 16T Twin Drum Rollers	2	BS 5228 C.2 ref 38	73	101.0	0.5	X	X			80	720
	1 No. 26T High Energy Impact Compaction Roller (refer to attached data sheet)	1	BS5228 C.5 ref 19	80	108.0	0.5	X	X			80	720
	1 No. 9T Rapid Impact Compaction (compactor rammer)	1	BS5228 D.3 ref 121	91	119.0	0.5	X	X			80	720
HGV deliveries and concrete batching	HGV delivery full	1	BS5228 C.6 Ref 21	80	108.0	0.5	X	X			33	297
	HGV delivery empty	1	BS5228 C.6 Ref 22	83	111.0	0.5	X	X			33	297
	Dump truck tipping fill	2	BS 5228 D.3 ref 60	82	110.0	0.5	X	X			33	297
	Dozer spreading fill	1	BS 5228 D.3 ref 64	89	117.0	0.5	X	X			80	720
	Concrete mixer	1	BS 5228 D.6 ref 4	63	91.0	0.5	X	X			80	720
	Batching Plant	1	BS 5228 D.6 ref 10	78	106.0	0.5	X	X			100	900
	Truck mixer	1	BS 5228 D.5 ref 15	81	109.0	1	X	X			80	720
	Lorry mounted Concrete pump	1	BS 5228 D.5 ref 16	81	109.0	1	X	X			80	720

Technical Appendix 7-1_Geotechnical and Geo-Environmental Assessment

Technical Appendix 7-2_Dames and Moore Site Investigation Borehole Logs (2000)

URS

44701.002
16 October 2000

Refer current dredging file for sediment report for Govan

[redacted]

05/01/01

STAGE II ENVIRONMENTAL SITE INVESTIGATION

BAE SYSTEMS
GOVAN SHIPYARD
GLASGOW

FINAL INTERPRETATIVE REPORT FOR CLYDEPORT PLC AND BAE SYSTEMS MARINE YSL

Dames & Moore
26 Walker St
Edinburgh
EH3 7HR

Tel: 0131 225 5933

TRIAL PIT NO TPB

Page 1 of 1

START DATE: 08/05/00	ELEVATION (m AOD): 12.35
END DATE: 08/05/00	COORDINATES:E 254486.037
CONTRACTOR: Raeburn	N 666273.947
PLANT: JCB	
LOGGED BY: DN	
CHECKED BY: JM	

C AMINATION ASSESSMENT	SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS
							▨	MADE GROUND - medium to coarse gravelly sand matrix with bricks, pieces of concrete and brick fragments, pieces of timber, slag and coal fragments.	
						1	▨		
							▨	1.5m: more bricks, pieces of cloth and large pieces of concrete.	NC
						2	▨		
							▨	2.5m: possible asbestos containing materials and few pieces of coal.	
						3		Trial pit terminated at 3.0mbgl due to obstruction.	
						4			
						5			

LOCATION/NOTES

Grass surface, tip area. Trial pit terminated due to obstruction.

LEGEND

- ≋ Water Sample
- ☒ Disturbed Sample
- ▽ Perched Groundwater
- ▼ Groundwater
- * Headspace Analysis on Soil Sample

TRIAL PIT LOG

JOB TITLE: Stage II Environmental Site Investigation

LOCATION: Govan Shipyard Site, Glasgow

CLIENT: Clydeport / Marine

JOB NO: 44701-002

DAMES & MOORE

TRIAL PIT NO TPC

Page 1 of 1

START DATE: 08/05/00
END DATE: 08/05/00
CONTRACTOR: Raeburn
PLANT: JCB
LOGGED BY: DN
CHECKED BY: JM

ELEVATION (m AOD): 12.05
COORDINATES:E 254459.323
N 666255.908

...MINATION ASSESSMENT	SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS
						0	▨	MADE GROUND - brick and concrete rubble in sandy, gravelly soil matrix, pieces of metal and electrical cables, pieces of wooden boards and fence wire.	
						1	▨	1.0m: less brick and concrete rubble.	NC
						2	▨	2.0m: burnt black timber. More bricks below 2m and coarse slag with silvery particles.	
						3	▨	3.0m: white wooden board (possibly asbestos containing material) and a few pieces of glass.	
						3.5		Trial pit terminated at 3.5mbgl.	
						4			
						5			

LOCATION/NOTES

Grass surface, tip area. Trial pit terminated due to obstruction.

LEGEND

- ≋ Water Sample
- ⊠ Disturbed Sample
- ∇ Perched Groundwater
- ▼ Groundwater
- * Headspace Analysis on Soil Sample

TRIAL PIT LOG

JOB TITLE: Stage II Environmental Site Investigation

LOCATION: Govan Shipyard Site, Glasgow

CLIENT: Clydeport / Marine

JOB NO: 44701-002

DAMES & MOORE

TRIAL PIT NO TPD

Page 1 of 1

START DATE: 08/05/00
END DATE: 08/05/00
CONTRACTOR: Raeburn
PLANT: JCB
LOGGED BY: DN
CHECKED BY: JM

ELEVATION (m AOD): 11.75
COORDINATES:E 254409
N 666272.724

C TAMINATION ASSESSMENT	SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS
							▨	MADE GROUND - brick and concrete rubble in gravelly, sandy soil matrix.	
							▨	0.75m: possible asbestos containing materials.	
						1	▨	1.0m: plastic bags, pieces of concrete, lenses of clay and pieces of felt.	NC
						2	▨	2.0m: large pieces of concrete and brick structures/rubble, ash and fine sand matrix to 3.0m.	
						3		Trial pit terminated at 3mbgl.	
						4			
						5			

LOCATION/NOTES

Surface: Grass, young birch trees. Tip area.

LEGEND

▨ Water Sample
☒ Disturbed Sample
▽ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

TRIAL PIT LOG

JOB TITLE: Stage II Environmental Site Investigation
LOCATION: Govan Shipyard Site, Glasgow
CLIENT: Clydeport / Marine
JOB NO: 44701-002

DAMES & MOORE

TRIAL PIT NO TPE

Page 1 of 1

START DATE: 08/05/00
END DATE: 08/05/00
CONTRACTOR: Raeburn
PLANT: JCB
LOGGED BY: DN
CHECKED BY: JM

ELEVATION (m AOD): 11.93
COORDINATES:E 254379.105
N 666272.501

ASSESSMENT	SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS
						0	☒	MADE GROUND - light brown sandy soil matrix with pieces of bricks, concrete, metal fence and metal bars.	
						1	☒	1.0m: large amount of black cables at approximately 1m.	NC
					▽	2.5	☒	2.5m: some water ingress. 2.6: soil matrix with concrete/brick rubble as above.	
						3		Trial pit terminated at 3mbgl.	

LOCATION/NOTES

Grass surface, tip area. Trial pit terminated due to obstruction.

LEGEND

▨ Water Sample
☒ Disturbed Sample
▽ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

TRIAL PIT LOG

JOB TITLE: Stage II Environmental Site Investigation

LOCATION: Govan Shipyard Site, Glasgow

CLIENT: Clydeport / Marine

JOB NO: 44701-002

DAMES & MOORE

TRIAL PIT NO TPF

Page 1 of 1

START DATE: 08/05/00
END DATE: 08/05/00
CONTRACTOR: Raeburn
PLANT: JCB
LOGGED BY: DN
CHECKED BY: JM

ELEVATION (m AOD): 11.44
COORDINATES:E 254385
N 666239.26

CONTAMINATION ASSESSMENT	SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS
							▨	MADE GROUND - black clayey ash fill with pieces of bricks and concrete, metal bars, cables and coal fragments.	
							▨		NC
						1	▨		
					▽		▨	1.5: water ingress at 1.5m.	
						2	▨	2.0: pieces of timber. Slight odour (creosote).	LC
							▨	2.3m: more brick rubble, pieces of felt.	
							▨	2.5m: large concrete slab to one side of trial pit.	
						3		Trial pit terminated at 3mbgl.	
						4			
						5			

LOCATION/NOTES

Surface: Grass, young birch trees. Tip area.

LEGEND

- ▨ Water Sample
- ☒ Disturbed Sample
- ▽ Perched Groundwater
- ▼ Groundwater
- * Headspace Analysis on Soil Sample

TRIAL PIT LOG

JOB TITLE: Stage II Environmental Site Investigation

LOCATION: Govan Shipyard Site, Glasgow

CLIENT: Clydeport / Marine

JOB NO: 44701-002

DAMES & MOORE

TRIAL PIT NO TPG

Page 1 of 1

START DATE: 09/05/00
END DATE: 09/05/00
CONTRACTOR: Raeburn
PLANT: JCB
LOGGED BY: DS
CHECKED BY: DN

ELEVATION (m AOD): 7.03
COORDINATES:E 254274.024
N 666007.882

NTAMINATION ASSESSMENT	SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS	
							▨	MADE GROUND - whole brick rubble, large creosoted timber fragments, occasional timber sheeting (iron, steel) and metal strips (aluminium).	MC	
					▽	1	▨	MADE GROUND - reinforced concrete rubble with plain and creosoted timber fragments.	MC	
						2	▨			
								Trial pit terminated at 2.4mbgl.		2.4
						3				
						4				
						5				

LOCATION/NOTES

South west corner of site. Trial pit terminated at 2.4mbgl on concrete slab.

LEGEND

- ≋ Water Sample
- ☒ Disturbed Sample
- ▽ Perched Groundwater
- ▼ Groundwater
- * Headspace Analysis on Soil Sample

TRIAL PIT LOG

JOB TITLE:	Stage II Environmental Site Investigation
LOCATION:	Govan Shipyard Site, Glasgow
CLIENT:	Clydeport / Marine
JOB NO:	44701-002

DAMES & MOORE

CONTAMINATION ASSESSMENT	SAMPLE			SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	START DATE: 09/05/00	TRIAL PIT NO TPH
	DEPTH(m)	NUMBER	TYPE					END DATE: 09/05/00	Page 1 of 1
								CONTRACTOR: Raeburn	ELEVATION (m AOD): 7.03
								PLANT: JCB	COORDINATES:E 254274.296
								LOGGED BY: DS	N 666011.97
								CHECKED BY: DN	

GROUNDWATER	DEPTH (m)	DESCRIPTION	COMMENTS	
		MADE GROUND - whole brick rubble, large creosoted timber fragments with occasional timber sheeting (iron, steel).	MC	
▽	1	MADE GROUND - reinforced concrete rubble with plain and creosoted fragments of timber.	MC	
	2	Trial pit terminated at 2.1mbgl.		2.1
	3			
	4			
	5			

LOCATION/NOTES

South west corner of site. Trial pit terminated at 2.1mbgl on concrete slab.

LEGEND

- ▨ Water Sample
- ☒ Disturbed Sample
- ▽ Perched Groundwater
- ▼ Groundwater
- * Headspace Analysis on Soil Sample

TRIAL PIT LOG

JOB TITLE: Stage II Environmental Site Investigation

LOCATION: Govan Shipyard Site, Glasgow

CLIENT: Clydeport / Marine

JOB NO: 44701-002

DAMES & MOORE

TRIAL PIT NO TPI

Page 1 of 1

START DATE: 09/05/00
END DATE: 09/05/00
CONTRACTOR: Raeburn
PLANT: JCB
LOGGED BY: DS
CHECKED BY: DN

ELEVATION (m AOD): 7.09
COORDINATES:E 254280.435
N 666010.259

CC]. INATION ASSESSMENT	SAMPLE			SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS	
	DEPTH(m)	NUMBER	TYPE							
					∇	1	▨	MADE GROUND - whole brick rubble, large timber fragments, metal (iron) sheeting.	NC	1.3
						2	▨	MADE GROUND - reinforced concrete rubble with plain and creosoted timber fragments.	MC	2.8
						3 4 5		Trial pit terminated at 2.8mbgl.		

LOCATION/NOTES

South west corner of site. Trial pit terminated at 2.8mbgl on concrete slab.

LEGEND

≋ Water Sample
⊠ Disturbed Sample
∇ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

TRIAL PIT LOG

JOB TITLE: Stage II Environmental Site Investigation

LOCATION: Govan Shipyard Site, Glasgow

CLIENT: Clydeport / Marine

JOB NO: 44701-002

DAMES & MOORE

START DATE: 09/05/00
END DATE: 09/05/00
CONTRACTOR: Raeburn
PLANT: JCB
LOGGED BY: DS
CHECKED BY: DN

TRIAL PIT NO TPJ

Page 1 of 1

ELEVATION (m AOD): 7.09
COORDINATES:E 254282.114
N 666002.875

...ATIO N ASSESSMENT	SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS	
							▨	MADE GROUND - large aggregate (4cm - 8cm) with occasional timber and brick fragments.		
					▽	1	▨		NC	
						2	▨			
								Test pit terminated at 2.6mbgl.		2.6
						3				
						4				
						5				

LOCATION/NOTES

South west corner of site. Trial pit terminated at 2.6mbgl on concrete slab.

LEGEND

- Water Sample
- ☒ Disturbed Sample
- ▽ Perched Groundwater
- ▼ Groundwater
- * Headspace Analysis on Soil Sample

TRIAL PIT LOG

JOB TITLE: Stage II Environmental Site Investigation

LOCATION: Govan Shipyard Site, Glasgow

CLIENT: Clydeport / Marine

JOB NO: 44701-002

DAMES & MOORE

START DATE: 09/05/00
END DATE: 09/05/00
CONTRACTOR: Raeburn
PLANT: JCB
LOGGED BY: JM
CHECKED BY: DN

TRIAL PIT NO TPK

Page 1 of 1

ELEVATION (m AOD): 8.34
COORDINATES:E 254482.789
N 666039.71

ASSESSMENT	SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS	
							☒	MADE GROUND - dark brown gravelly sand.	NC	0.5
						1	☒	MADE GROUND - dark grey black, medium to coarse gravelly sand with coke gravel, ash, and occasional concrete boulders.	NC	1.8
						2	☒	MADE GROUND - red brown slag gravel and sand with large boulders of slag.	NC	2.5
						3 4 5		Trial pit terminated at 2.5mbgl.		

LOCATION/NOTES

Location: Raised building footprint to the south west of the basin. Surface: Building rubble from demolition - brick and concrete.

LEGEND

- ≋ Water Sample
- ☒ Disturbed Sample
- ∇ Perched Groundwater
- ▼ Groundwater
- * Headspace Analysis on Soil Sample

TRIAL PIT LOG

JOB TITLE: Stage II Environmental Site Investigation

LOCATION: Govan Shipyard Site, Glasgow

CLIENT: Clydeport / Marine

JOB NO: 44701-002

DAMES & MOORE

TRIAL PIT NO TPL

Page 1 of 1

START DATE: 09/05/00
END DATE: 09/05/00
CONTRACTOR: Raeburn
PLANT: JCB
LOGGED BY: JM
CHECKED BY: DN

ELEVATION (m AOD): 8.61
COORDINATES:E 254503.705
N 666020.956

MINATION ASSESSMENT	SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS	
								MADE GROUND - dark grey, black gravelly sand with much coke, sand and gravel.	NC	
						1				
								Brown soft CLAY with some silt.	NC	1.4
						2				
						3		Trial pit terminated at 3.0mbgl.		3
						4				
						5				

LOCATION/NOTES

Location: Raised building footprint to the south west of the basin. Surface: Building rubble from demolition - brick and concrete.

LEGEND

- ≋ Water Sample
- ☒ Disturbed Sample
- ▽ Perched Groundwater
- ▼ Groundwater
- * Headspace Analysis on Soil Sample

TRIAL PIT LOG

JOB TITLE: Stage II Environmental Site Investigation

LOCATION: Govan Shipyard Site, Glasgow

CLIENT: Clydeport / Marine

JOB NO: 44701-002

DAMES & MOORE

TRIAL PIT NO TPM

Page 1 of 1

START DATE: 09/05/00
END DATE: 09/05/00
CONTRACTOR: Raeburn
PLANT: JCB
LOGGED BY: JM
CHECKED BY: DN

ELEVATION (m AOD): 8.82
COORDINATES:E 254486.498
N 666006.639

ATION ASSESSMENT	SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS	
								MADE GROUND - dark grey black gravelly sand with some coke and ash.	NC	
						1		Yellowish brown medium SAND with some silt.	NC	1
								Brown soft CLAY with some silt.	NC	1.5
						3		Trial pit terminated at 3.0mbgl.		3
						4				
						5				

LOCATION/NOTES

Location: Raised building footprint to the south west of the basin. Surface: Building rubble from demolition - brick and concrete.

LEGEND

Water Sample
☒ **Disturbed Sample**
▽ **Perched Groundwater**
▼ **Groundwater**
* **Headspace Analysis on Soil Sample**

TRIAL PIT LOG

JOB TITLE: Stage II Environmental Site Investigation
LOCATION: Govan Shipyard Site, Glasgow
CLIENT: Clydeport / Marine
JOB NO: 44701-002

DAMES & MOORE

TRIAL PIT NO TPN

Page 1 of 1

START DATE: 09/05/00
END DATE: 09/05/00
CONTRACTOR: Raeburn
PLANT: JCB
LOGGED BY: JM
CHECKED BY: DN

ELEVATION (m AOD): 8.02
COORDINATES:E 254514.451
N 666035.253

C˙˙˙AMINATION ASSESSMENT	SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS	
								MADE GROUND - dark brown / black gravelly sand with much coke sand and gravel with occasional cobbles and boulders.	NC	1.5
								Brown medium SAND with some clay.	NC	2.8
								Dark brown stiff CLAY.	NC	3
								Trial pit terminated at 3.0mbgl.		

LOCATION/NOTES

Location: Raised building footprint to the south west of the basin. Surface: Building rubble from demolition - brick and concrete.

LEGEND

▨ Water Sample
☒ Disturbed Sample
▽ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

TRIAL PIT LOG

JOB TITLE: Stage II Environmental Site Investigation
LOCATION: Govan Shipyard Site, Glasgow
CLIENT: Clydeport / Marine
JOB NO: 44701-002

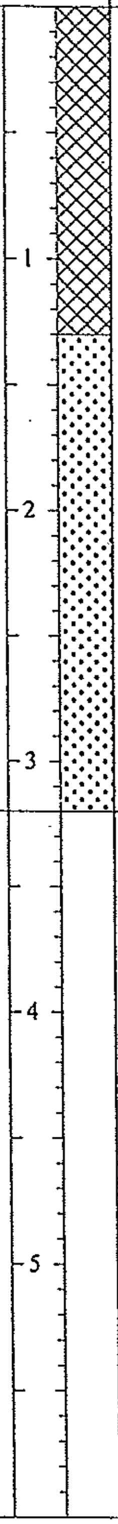
DAMES & MOORE

TRIAL PIT NO TPO

Page 1 of 1

START DATE: 09/05/00
END DATE: 09/05/00
CONTRACTOR: Raeburn
PLANT: JCB
LOGGED BY: JM
CHECKED BY: DN

ELEVATION (m AOD): 8.93
COORDINATES:E 254512.177
N 666001.325



C ITAMINATIO ASSESSMENT	SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS	
							☒	MADE GROUND - dark brown black gravelly sand with much coke sand and gravel and occasional cobbles of concrete and brick.	NC	1.3
							⁘	Yellow brown SAND with some subrounded gravel interbedded with thick grey brown CLAY layers.	NC	3.2
								Trial pit terminated at 3.2mbgl.		

LOCATION/NOTES

Location: Raised building footprint to the south west of the basin. Surface: Building rubble from demolition - brick and concrete.

LEGEND

- ▨ Water Sample
- ☒ Disturbed Sample
- ▽ Perched Groundwater
- ▼ Groundwater
- * Headspace Analysis on Soil Sample

TRIAL PIT LOG

JOB TITLE: Stage II Environmental Site Investigation

LOCATION: Govan Shipyard Site, Glasgow

CLIENT: Clydeport / Marine

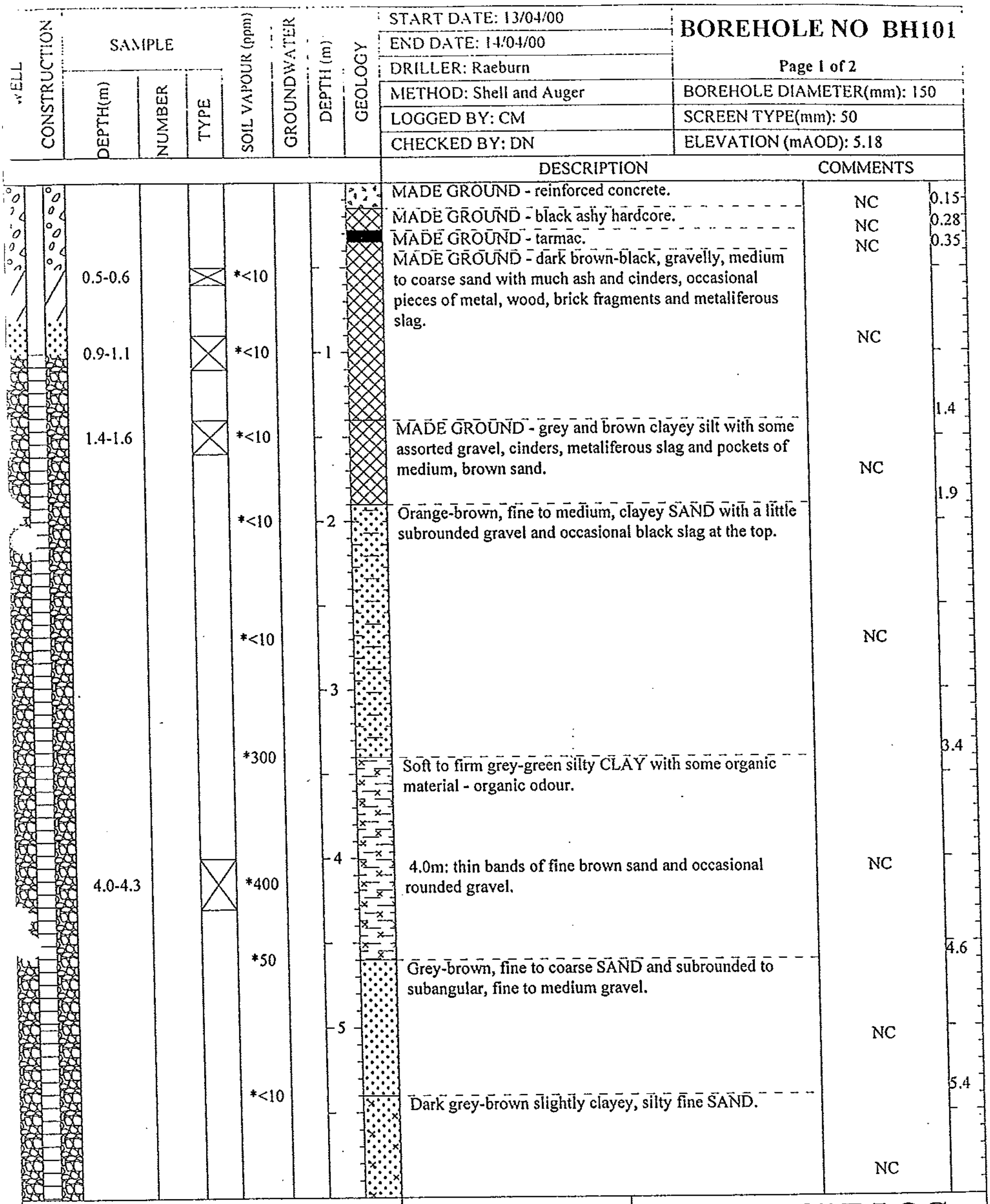
JOB NO: 44701-002

DAMES & MOORE

BOREHOLE NO BH101

Page 1 of 2

START DATE: 13/04/00
END DATE: 14/04/00
DRILLER: Raeburn
METHOD: Shell and Auger
LOGGED BY: CM
CHECKED BY: DN
BOREHOLE DIAMETER(mm): 150
SCREEN TYPE(mm): 50
ELEVATION (mAOD): 5.18



SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DESCRIPTION	COMMENTS	DEPTH
					MADE GROUND - reinforced concrete.	NC	0.15
					MADE GROUND - black ashy hardcore.	NC	0.28
					MADE GROUND - tarmac.	NC	0.35
0.5-0.6 0.9-1.1		☒ ☒	*<10 *<10		MADE GROUND - dark brown-black, gravelly, medium to coarse sand with much ash and cinders, occasional pieces of metal, wood, brick fragments and metaliferous slag.	NC	1.4
1.4-1.6		☒	*<10		MADE GROUND - grey and brown clayey silt with some assorted gravel, cinders, metaliferous slag and pockets of medium, brown sand.	NC	1.9
			*<10 *<10		Orange-brown, fine to medium, clayey SAND with a little subrounded gravel and occasional black slag at the top.	NC	3.4
4.0-4.3		☒	*300 *400		Soft to firm grey-green silty CLAY with some organic material - organic odour. 4.0m: thin bands of fine brown sand and occasional rounded gravel.	NC	4.6
			*50		Grey-brown, fine to coarse SAND and subrounded to subangular, fine to medium gravel.	NC	5.4
			*<10		Dark grey-brown slightly clayey, silty fine SAND.	NC	

LOCATION/NOTES

Located on concrete roadway in 'riverside' area of site. Near above ground storage tank and transformer/sub-station.

LEGEND

☒ Disturbed Sample
∇ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation
LOCATION: Govan Shipyard Site, Glasgow
CLIENT: Clydeport / Marine
JOB NO: 44701-002

DAMES & MOORE

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26/07/2000

START DATE: 13/04/00
END DATE: 14/04/00
DRILLER: Raeburn
METHOD: Shell and Auger
LOGGED BY: CM
CHECKED BY: DN

BOREHOLE NO BH101

Page 2 of 2

BOREHOLE DIAMETER(mm): 150
SCREEN TYPE(mm): 50
ELEVATION (mAOD): 5.18

CONSTRUCTION	SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS	
				*<10	▼			Grey-brown, silty fine SAND becoming very silty at 7.5m.		6.2
						7			NC	
				*<10				7.5m: becomes very silty.		
						8		Borehole terminated at 8.0mbgl.		8
						9				
						10				
						11				

LOCATION/NOTES

Located on concrete roadway in 'riverside' area of site. Near above ground storage tank and transformer/sub-station.

LEGEND

☒ Disturbed Sample
▽ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation
LOCATION: Govan Shipyard Site, Glasgow
CLIENT: Clydeport / Marine
JOB NO: 44701-002

DAMES & MOORE

BOREHOLE NO BH102

Page 1 of 1

START DATE: 08/05/00	BOREHOLE DIAMETER(mm): 150
END DATE: 08/05/00	SCREEN TYPE(mm):
DRILLER: Raeburn	ELEVATION (mAOD): 8.58
METHOD: Shell and Auger	
LOGGED BY: JD	
CHECKED BY: DN	

WELL CONSTRUCTION	SAMPLE			SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS
	DEPTH(m)	NUMBER	TYPE						
							▨	MADE GROUND - brown medium gravelly sand with trace fragments of metal, dry.	
	0.65		☒	*<10			▨		
				*<10		1	▨		
				*<10			▨		NC
				*<10		2	▨		
				*<10			▨		
									2.7
								Borehole terminated at 2.7mbgl.	
						3			
						4			
						5			

LOCATION/NOTES

Borehole located on football pitch. Borehole terminated at 2.7mbgl due to refusal on concrete.

LEGEND

☒	Disturbed Sample
∇	Perched Groundwater
▼	Groundwater
*	Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation

LOCATION: Govan Shipyard Site, Glasgow

CLIENT: Clydeport / Marine

JOB NO: 44701-002

DAMES & MOORE

BOREHOLE NO BH102A

Page 1 of 1

START DATE: 08/05/00	
END DATE: 08/05/00	
DRILLER: Raeburn	
METHOD: Shell and Auger	BOREHOLE DIAMETER(mm): 150
LOGGED BY: JD	SCREEN TYPE(mm):
CHECKED BY: DN	ELEVATION (mAOD): 8.58

WELL CONSTRUCTION	SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS	
	0.5-0.7		☒	*10			▨	MADE GROUND - dark brown gravelly sand with some concrete rubble and trace fragments of metal, dry.	NC	1.8
								No recovery - pushing cobble (0.8 to 2.0m.).		2
				*12		2	▨	MADE GROUND - as above with some glass fragments.	NC	2.6
				*<10			▨	MADE GROUND - dark grey/ brown gravelly sand with much metal, glass, ash and traces of coke and asbestos-like matting. Moist. (ash fill)	NC	2.9
						3		Borehole terminated at 2.9mbgl.		

LOCATION/NOTES

Flat grassed surface at north west edge of football pitch. Borehole terminated at 2.9mbgl due to refusal on concrete.

LEGEND

- ☒ Disturbed Sample
- ▽ Perched Groundwater
- ▼ Groundwater
- * Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation

LOCATION: Govan Shipyard Site, Glasgow

CLIENT: Clydeport / Marine

JOB NO: 44701-002

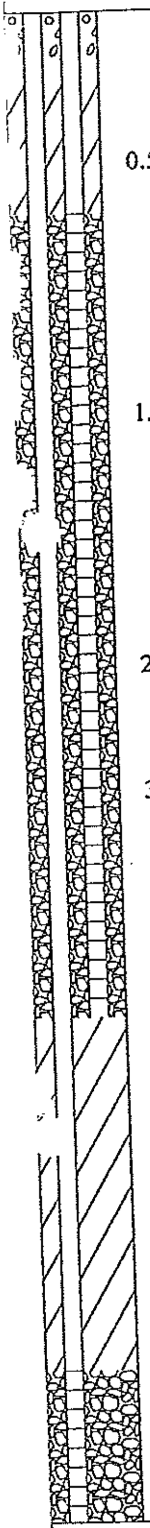
DAMES & MOORE

BOREHOLE NO BH103

Page 1 of 2

START DATE: 20/04/00
END DATE: 20/04/00
DRILLER: Raeburn
METHOD: Shell and Auger
LOGGED BY: JD
CHECKED BY: DN

BOREHOLE DIAMETER(mm): 150
SCREEN TYPE(mm): 50 and 19
ELEVATION (mAOD): 8.73



SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS
						▨	MADE GROUND - dark brown medium coarse gravelly sand with occasional fragments of blaes, brick, glass, and timber. Moist.	
0.5-0.7		☒	*18			▨		
			*60		1	▨	1.0m: grades similar with concrete boulders/cobbles and fragments of ceramic.	
1.5-1.7		☒	*<10			▨		NC
			*80		2	▨		
2.5-2.7		☒	*<10			▨		
3.0-3.2		☒	*<10 *<10		3	▨	3.0m: grades similar with some pieces of woven material - suspected asbestos containing material, much timber and scrap metal, moist.	
			*<10			▨		
					4		No recovery - pushing cobble (4.0-5.0m).	
					5	▨	MADE GROUND - reworked dark brown silty clayey sand with much angular fine to coarse mixed gravel and some metal fragments, moist.	NC
5.5-5.7		☒	*<10	∇		×	Light brown clayey SILT with some fine sand; wet.	

LOCATION/NOTES

Flat grassed surface at south edge of football pitch, western end of site.

LEGEND

☒ Disturbed Sample
∇ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation

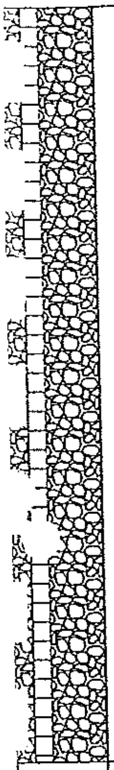
LOCATION: Govan Shipyard Site, Glasgow

CLIENT: Clydeport / Marine

JOB NO: 44701-002

DAMES & MOORE

START DATE: 20/04/00	**BOREHOLE NO BH103**
END DATE: 20/04/00	
DRILLER: Raeburn	**Page 2 of 2**
METHOD: Shell and Auger	BOREHOLE DIAMETER(mm): 150
LOGGED BY: JD	SCREEN TYPE(mm): 50 and 19
CHECKED BY: DN	ELEVATION (mAOD): 8.73



CONSTRUCTION	SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS
				*<10				6.0m: becoming saturated.	
				*<10					
				*<10		7			NC
				*<10					
				*<10		8			
				*<10					
						9		Borehole terminated at 9.0mbgl.	
						10			
						11			

LOCATION/NOTES

Flat grassed surface at south edge of football pitch, western end of site.

LEGEND

☒	Disturbed Sample
▽	Perched Groundwater
▼	Groundwater
*	Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation

LOCATION: Govan Shipyard Site, Glasgow

CLIENT: Clydeport / Marine

JOB NO: 44701-002

DAMES & MOORE

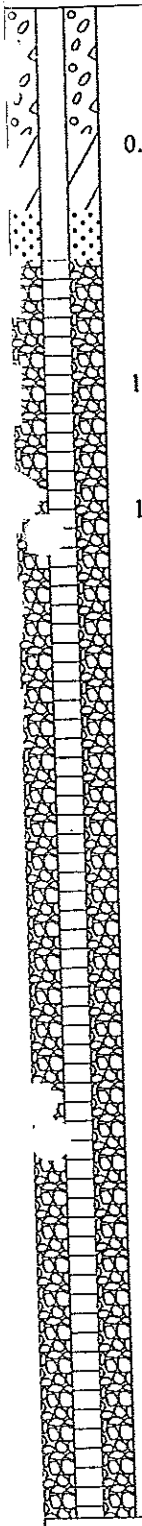
START DATE: 12/04/00
END DATE: 13/04/00
DRILLER: Raeburn
METHOD: Shell and Auger
LOGGED BY: CM
CHECKED BY: DN

BOREHOLE NO BH104

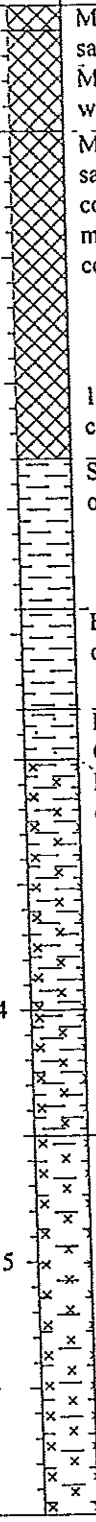
Page 1 of 2

BOREHOLE DIAMETER(mm): 150
SCREEN TYPE(mm): 50
ELEVATION (mAOD): 7.13

WELL CONSTRUCTION



GEOLOGY



SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	DESCRIPTION	COMMENTS	
						MADE GROUND - dark grey-black fine to coarse ashy sand and fine to medium gravel.	NC	0.1
						MADE GROUND - brown black, ashy sand and gravel with much masonry rubble to boulder size.	NC	0.5
0.5-0.6		☒	*200			MADE GROUND - dark grey-brown, ashy, fine to coarse sand and fine to medium gravel with a little brick, concrete and occasional wood fragments and pieces of metal with a piece of woven material - possible asbestos containing material.		
			*150		1			
							NC	
1.4-1.6		☒	*100			1.5m: with a little fibrous material - possible asbestos containing material.		
								1.8
1.9-2.1		☒	*600		2	Soft to firm grey brown, slightly silty CLAY with occasional fine gravel and bands of fine pale brown sand.		
							NC	
			*400			Firm, dark green-grey, slightly sandy CLAY with occasional sandstone gravel, ash and a piece of wood.		2.4
							NC	2.8
			*60			Firm, grey and orange-bown mottled, slightly sandy CLAY with traces of ash at the top.	NC	
			*20		3			3
						Firm to stiff, orange-brown-grey slightly silty CLAY with occasional bands of fine pale brown sand.		
							NC	
								4
			*<10		4	Firm to stiff, grey brown, silty CLAY with occasional thin bands of fine pale brown sand.		
							NC	4.5
						Soft to firm, grey brown, clayey SILT, moist.		
					5			
5.0-5.4		☒	*<10					
							NC	

LOCATION/NOTES

Heavy water ingress at 8m. South West Corner of site adjacent to sub station/transformer and backup generator.

LEGEND

☒ **Disturbed Sample**
▽ **Perched Groundwater**
▼ **Groundwater**
* **Headspace Analysis on Soil Sample**

BOREHOLE LOG

JOB TITLE: **Stage II Environmental Site Investigation**

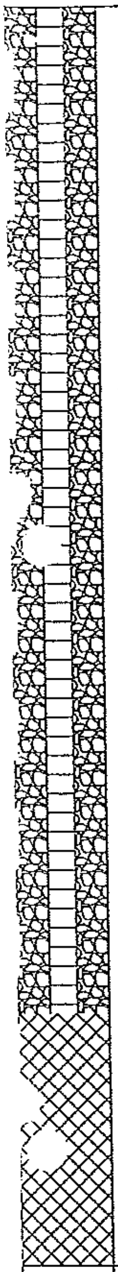
LOCATION: **Govan Shipyard Site, Glasgow**

CLIENT: **Clydeport / Marine**

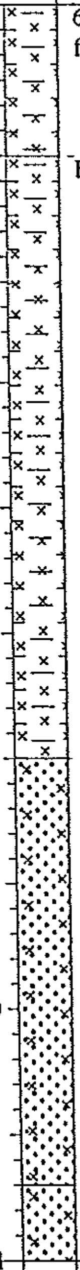
JOB NO: **44701-002**

DAMES & MOORE

START DATE: 12/04/00	**BOREHOLE NO BH104**
END DATE: 13/04/00	
DRILLER: Raeburn	**Page 2 of 2**
METHOD: Shell and Auger	BOREHOLE DIAMETER(mm): 150
LOGGED BY: CM	SCREEN TYPE(mm): 50
CHECKED BY: DN	ELEVATION (mAOD): 7.13



SAMPLE DEPTH(m)	NUMBER	TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	DESCRIPTION	COMMENTS	
			*<10			6.0m: with thin bands of fine grey-brown sand, becoming firm.		
						Firm, grey brown, slightly sandy, clayey SILT, moist.		6.6
			*<10		7			
							NC	
				▼	8	8.0m: with thin bands of fine grey sand		
					9	Grey-brown, slighly clayey, silty fine SAND, wet.		9
			*<10		10		NC	
						Running fine silty SAND.		10.7
					11		NC	11
						Borehole terminated at 11.0mbgl.		



LOCATION/NOTES

Heavy water ingress at 8m. South West Corner of site adjacent to sub station/transformer and backup generator.

LEGEND

- ☒ Disturbed Sample
- ▽ Perched Groundwater
- ▼ Groundwater
- * Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation

LOCATION: Govan Shipyard Site, Glasgow

CLIENT: Clydeport / Marine

JOB NO: 44701-002

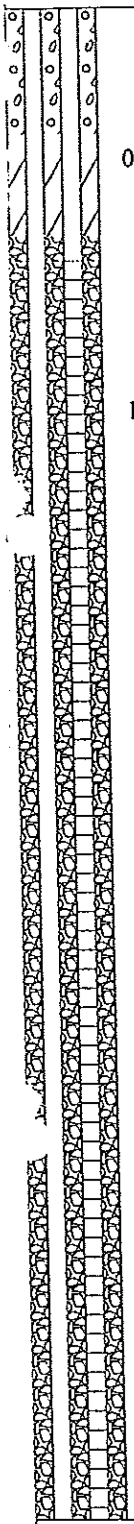
DAMES & MOORE

START DATE: 25/04/00
END DATE: 25/04/00
DRILLER: Raeburn
METHOD: Shell and Auger
LOGGED BY: JD
CHECKED BY: DN

BOREHOLE NO BH105

Page 1 of 2

BOREHOLE DIAMETER(mm): 150
SCREEN TYPE(mm): 50 and 19
ELEVATION (mAOD): 9.8



SAMPLE DEPTH(m)	NUMBER	TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)
0.5-0.7		☒	*12		
			*<10		1
1.5-1.7		☒	*10		
			*<10		2
			*12		
			*12		3
3.5-3.7		☒	*40		
			*<10		4
			*<10		
					5

DESCRIPTION	COMMENTS	
MADE GROUND - dark brown medium to coarse gravelly sand with some fragments of metal timber and glass, some ash and coal and traces of blaes. 1.5m: as above with suspected asbestos containing material (woven material). 2.0m: with some clay and some large concrete fragments, no suspected asbestos conatining material	NC	2.4
MADE GROUND - dark brown fine to medium silty sand with some to much mixed composition medium to coarse gravel. 3.5m: with some sandy clay.	NC	3.7
MADE GROUND - dark grey brown gravelly sand with some to much ash, coke, and slag.	NC	4.5
No recovery (4.5-6.0m)		6

LOCATION/NOTES

Minor water seepage noted at various depths in the made ground (heavy rain recently). Surface grass relatively flat North East centre of football pitch.

LEGEND

☒ Disturbed Sample
▽ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation
LOCATION: Govan Shipyard Site, Glasgow
CLIENT: Clydeport / Marine
JOB NO: 44701-002

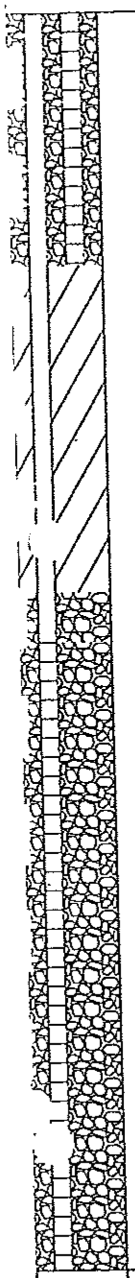
DAMES & MOORE

START DATE: 25/04/00
END DATE: 25/04.00
DRILLER: Raeburn
METHOD: Shell and Auger
LOGGED BY: JD
CHECKED BY: DN

BOREHOLE NO BH105

Page 2 of 2

BOREHOLE DIAMETER(mm): 150
SCREEN TYPE(mm): 50 and 19
ELEVATION (mAOD): 9.8



WELL CONSTRUCTION	SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS	
				*<10				MADE GROUND - dark grey brown gravelly sand with ash, coke and slag.		
				*<10						
				*<10		7				
								7.2m: becoming red brown with fragments of ceramic pipe and much red blaes.		
				*<10						
								7.6m: with some to much light brown medium sand.		7.7
								Light brown medium silty SAND with some clay.		
				*<10		8			NC	
	8.2-8.4		☒	*12						8.3
								Light grey brown very clayey SILT with some thin sand horizons, moist.		
				*<10		9				
									NC	
				*<10		10				
						11		Borehole terminated at 11.0m below ground level.		11

LOCATION/NOTES

Minor water seepage noted at various depths in the made ground (heavy rain recently). Surface grass relatively flat North East centre of football pitch.

LEGEND

☒ Disturbed Sample
▽ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation

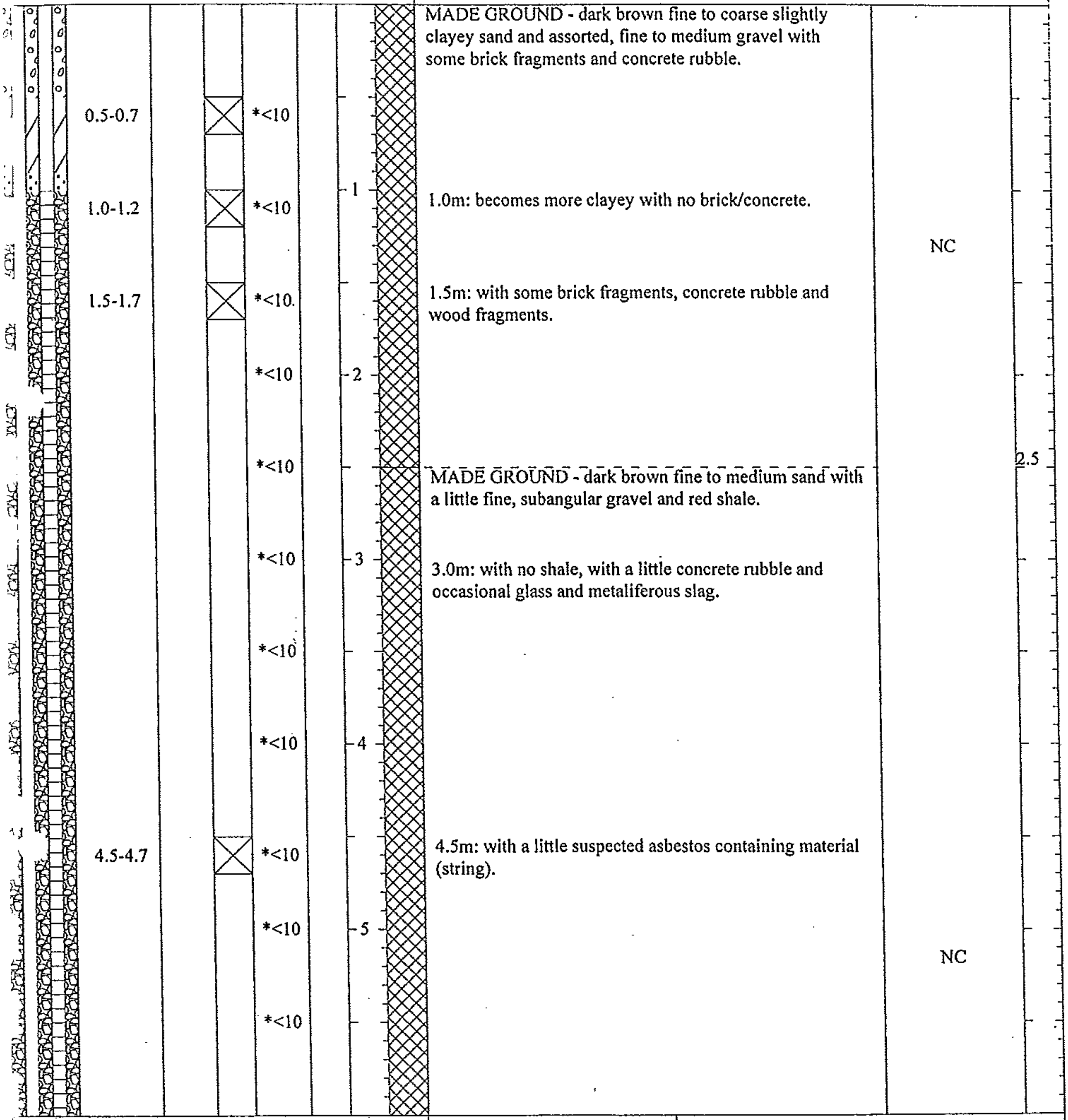
LOCATION: Govan Shipyard Site, Glasgow

CLIENT: Clydeport / Marine

JOB NO: 44701-002

DAMES & MOORE

START DATE: 04/05/00	**BOREHOLE NO BH106**
END DATE: 05/05/00	
DRILLER: Raeburn	Page 1 of 3
METHOD: Shell and Auger	BOREHOLE DIAMETER(mm): 150
LOGGED BY: CM	SCREEN TYPE(mm): 50 and 19
CHECKED BY: DN	ELEVATION (mAOD): 11.79



SAMPLE DEPTH(m)	NUMBER	TYPE	SOIL VAPOUR (ppm)	GROUNDWATER
0.5-0.7		☒	*<10	
1.0-1.2		☒	*<10	
1.5-1.7		☒	*<10	
			*<10	
			*<10	
			*<10	
			*<10	
			*<10	
4.5-4.7		☒	*<10	
			*<10	
			*<10	

DESCRIPTION	COMMENTS
MADE GROUND - dark brown fine to coarse slightly clayey sand and assorted, fine to medium gravel with some brick fragments and concrete rubble.	
1.0m: becomes more clayey with no brick/concrete.	NC
1.5m: with some brick fragments, concrete rubble and wood fragments.	
MADE GROUND - dark brown fine to medium sand with a little fine, subangular gravel and red shale.	
3.0m: with no shale, with a little concrete rubble and occasional glass and metaliferous slag.	
4.5m: with a little suspected asbestos containing material (string).	NC

LOCATION/NOTES

North west corner of tip area, surface comprised of grass, small trees and a little concrete rubble.

LEGEND

☒ Disturbed Sample
▽ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation

LOCATION: Govan Shipyard Site, Glasgow

CLIENT: Clydeport / Marine

JOB NO: 44701-002

DAMES & MOORE

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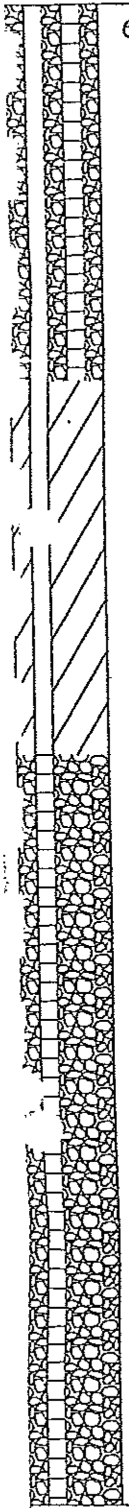
BOREHOLE NO BH106

Page 2 of 3

START DATE: 04/05/00
END DATE: 05/05/00
DRILLER: Raeburn
METHOD: Shell and Auger
LOGGED BY: CM
CHECKED BY: DN
BOREHOLE DIAMETER(mm): 150
SCREEN TYPE(mm): 50 and 19
ELEVATION (mAOD): 11.79



WELL CONSTRUCTION	SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS	
	6.0-6.2		☒	*<10				6.0m: with much dark grey ash and orange-brown cinders and a little metaliferous slag, slightly damp.		
				*<10				6.5m: with much brick rubble and some fine black ash and metalferous slag.		
				*<10		7		7.0m: with much fine to coarse, rounded to angular gravel, moist.		
				*<10						
								MADE GROUND - firm, grey-brown slightly silty, very sandy clay with a little assorted gravel and organic fibres.	NC	7.7
				*<10		8		MADE GROUND - soft grey-brown slightly silty, very sandy clay with a little subangular to subrounded gravel.	NC	8
				*<10				Fine greyish brown, clayey SAND with bands of soft grey clayey silt.	NC NC	8.3
	9.0-9.2		☒	*<10		9		Firm, grey very silty CLAY with bands of fine orange-brown sand. Damp.	NC	9
				*<10				Fine to coarse, mid-brown SAND with much fine to medium rounded to subangular gravel.		9.5
				*<10		10				
				*<10	▼			10.5m: with much fine rounded to subangular gravel and occasional black siltstone.		
				*<10		11			NC	
				*<10				11.5m: with a little siltstone.		

LOCATION/NOTES

North west corner of tip area, surface comprised of grass, small trees and a little concrete rubble.

LEGEND

☒ Disturbed Sample
▽ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation
LOCATION: Govan Shipyard Site, Glasgow
CLIENT: Clydeport / Marine
JOB NO: 44701-002

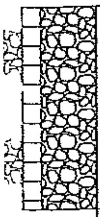
DAMES & MOORE

START DATE: 04/05/00
END DATE: 05/05/00
DRILLER: Raeburn
METHOD: Shell and Auger
LOGGED BY: CM
CHECKED BY: DN

BOREHOLE NO BH106

Page 3 of 3

BOREHOLE DIAMETER(mm): 150
SCREEN TYPE(mm): 50 and 19
ELEVATION (mAOD): 11.79

WELL CONSTRUCTION	SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS	
							▨			12.8
						13		Borehole terminated at 12.8mbgl.		
						14				
						15				
						16				
						17				

LOCATION/NOTES

North west corner of tip area, surface comprised of grass, small trees and a little concrete rubble.

LEGEND

☒ Disturbed Sample
▽ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation
LOCATION: Govan Shipyard Site, Glasgow
CLIENT: Clydeport / Marine
JOB NO: 44701-002

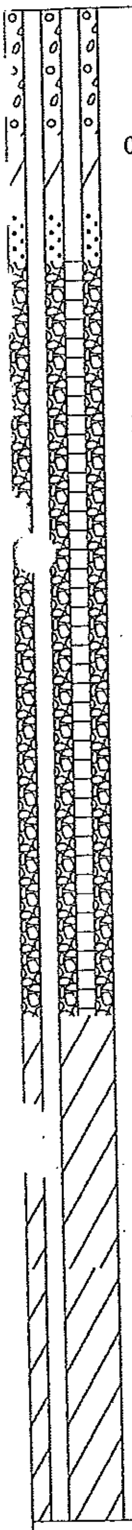
DAMES & MOORE

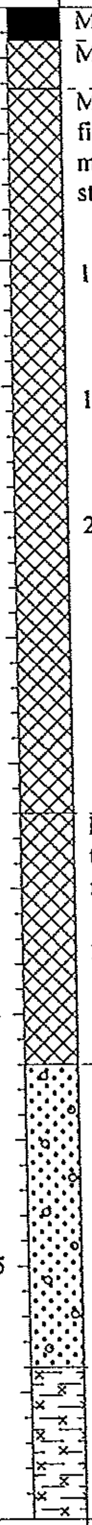
BOREHOLE NO BH107

Page 1 of 2

START DATE: 19/04/00
END DATE: 19/04/00
DRILLER: Raeburn
METHOD: Shell and Auger
LOGGED BY: CM
CHECKED BY: DN

BOREHOLE DIAMETER(mm): 150
SCREEN TYPE(mm): 19 and 50
ELEVATION (mAOD): 6.64





SAMPLE DEPTH(m)	NUMBER	TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	DESCRIPTION	COMMENTS	
						MADE GROUND - tarmac.	NC	0.13
						MADE GROUND - hardcore.	NC	0.32
0.5-0.6		☒	*<10			MADE GROUND - dark brown, fine to coarse sand and fine to medium subrounded to subangular gravel with much ash and cinders, occasional metaliferous slag and string (pos ACM) and few pieces of black siltstone.		
			*<10		1	1.0m: with occasional pieces of glass, no slag/string.		
1.5-1.8		☒	*<10			1.5m: with pieces of glass, lead and a little brick rubble.	NC	
			*<10		2	2.0m: with much brick and brick fragments.		
			*<10	▽	3			3.2
3.4-3.7		☒	*<10			MADE GROUND - grey-green, slightly clayey, medium to coarse sand and assorted fine to medium gravel with much wood and wood fragments and a little rubble. Wet.		
						3.7m: with a slight oily sheen.	LC	
				▼	4			4.2
4.2-4.7		☒	*20			Medium to coarse, brown SAND and medium subrounded to rounded GRAVEL.	NC	
					5			5.4
			*<10			Soft, grey-green-brown, slightly silty CLAY.		

LOCATION/NOTES

Located in the north of the former timber stacking yard adjacent to area of grass.

LEGEND

☒ Disturbed Sample
▽ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation
LOCATION: Govan Shipyard Site, Glasgow
CLIENT: Clydeport / Marine
JOB NO: 44701-002

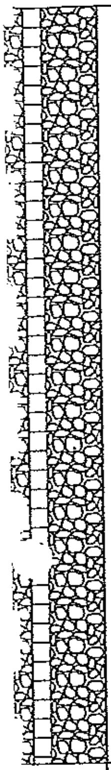
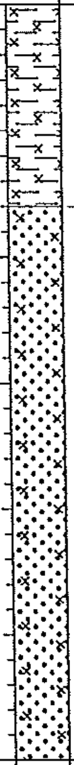
DAMES & MOORE

BOREHOLE NO BH107

Page 2 of 2

START DATE: 19/04/00
END DATE: 19/04/00
DRILLER: Raeburn
METHOD: Shell and Auger
LOGGED BY: CM
CHECKED BY: DN

BOREHOLE DIAMETER(mm): 150
SCREEN TYPE(mm): 19 and 50
ELEVATION (mAOD): 6.64

WELL CONSTRUCTION	SAMPLE			SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS	
	DEPTH(m)	NUMBER	TYPE							
									NC	
				*<10				Fine, grey green, slightly clayey, slightly silty SAND.		6.8
						7				
				*<10		8		8.0m: becomes very silty.	NC	
						9		Borehole terminated at 9.0mbgl.		9
						10				
						11				

LOCATION/NOTES

Located in the north of the former timber stacking yard adjacent to area of grass.

LEGEND

☒ Disturbed Sample
▽ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation
LOCATION: Govan Shipyard Site, Glasgow
CLIENT: Clydeport / Marine
JOB NO: 44701-002

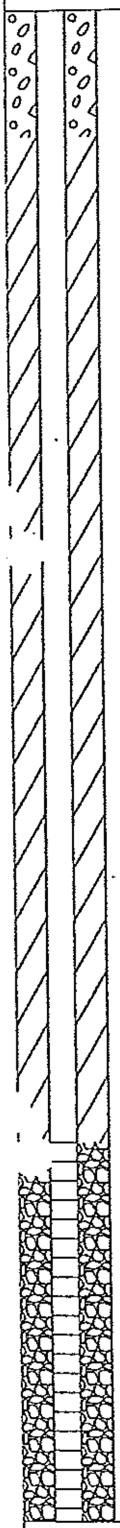
DAMES & MOORE

START DATE: 25/04/00
END DATE: 26/04/00
DRILLER: Raeburn
METHOD: Shell and Auger
LOGGED BY: JD
CHECKED BY: DN

BOREHOLE NO BH108

Page 1 of 2

BOREHOLE DIAMETER(mm): 150
SCREEN TYPE(mm): 50
ELEVATION (mAOD): 10.67



SAMPLE DEPTH(m)	NUMBER	TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	DESCRIPTION	COMMENTS	
						MADE GROUND - dark brown medium to coarse gravelly sand with fragments of timber and metal, moist.		
0.5-0.7		☒	*<10					
			*<10		1		NC	
			*<10					
						MADE GROUND - dark grey brown medium to coarse gravelly sand with much ash and coke gravel, moist.		1.8
			*<10		2			
			*<10				NC	
			*<10		3	3.0m: with some scrap metal fragments.		
			*<10			Light yellowish brown fine to medium silty SAND, moist.		3.5
			*<10		4			
4.5-4.7		☒	*<10			4.5m: with some pockets of dark grey brown silty CLAY with some coal.		
					5	5.0m: becoming a silty SAND (no clay).		
			*<10					

LOCATION/NOTES

Bramble and scrub vegetation relatively flat surface approximately 20m north of gatehouse (west end of site) at edge of tip area.

LEGEND

☒ Disturbed Sample
▽ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation
LOCATION: Govan Shipyard Site, Glasgow
CLIENT: Clydeport / Marine
JOB NO: 44701-002

DAMES & MOORE

START DATE: 25/04/00
END DATE: 26/04/00
DRILLER: Raeburn
METHOD: Shell and Auger
LOGGED BY: JD
CHECKED BY: DN

BOREHOLE NO BH108

Page 2 of 2

BOREHOLE DIAMETER(mm): 150
SCREEN TYPE(mm): 50
ELEVATION (mAOD): 10.67

WELL CONSTRUCTION	SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS
	6.0-6.2		☒	*<10	▽				NC
				*<10		7			
				*<10		8			
						9			
				*<10					
						10		Borehole terminated at 10.0mbgl.	10
						11			

LOCATION/NOTES

Bramble and scrub vegetation relatively flat surface approximately 20m north of gatehouse (west end of site) at edge of tip area.

LEGEND

☒ Disturbed Sample
▽ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation
LOCATION: Govan Shipyard Site, Glasgow
CLIENT: Clydeport / Marine
JOB NO: 44701-002

DAMES & MOORE

START DATE: 02/05/00
END DATE: 02/05/00
DRILLER: Raeburn
METHOD: Window Sampler
LOGGED BY: CM
CHECKED BY: DN

BOREHOLE NO BH109

Page 1 of 1

BOREHOLE DIAMETER(mm): 60/50
SCREEN TYPE(mm): 19
ELEVATION (mAOD): 9.34

WELL CONSTRUCTION	SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS	
	0.3-0.5		☒	*100				MADE GROUND - dark brown, medium to coarse, gravelly, ashy sand with a little metaliferous slag and occasional wood fragments.	NC	0.5
								MADE GROUND - pale brown, soft to firm slightly sandy clay.	NC	0.7
				*200				MADE GROUND - fine, orange brown and grey brown, clayey sand with a little black ash and fine to medium, angular to subangular gravel.	NC	1
	1.5-1.8		☒	*100		1		MADE GROUND - dark grey-black, fine to coarse ash with occasional brown/cream cinders, red-brown slag and fine metaliferous slag.	NC	2
				*300		2		MADE GROUND - fine, grey-brown sand with some fine to medium gravel of slag.	NC	2.8
				*<10 *<10		3 4		MADE GROUND - grey and red-brown fine to medium gravel of ash and cinders.	NC	4.5
								Fine, orange-red, slightly clayey SAND grading to soft, slightly sandy CLAY.	NC	4.75
	4.7-5.0		☒					Soft pale brown, slightly silty CLAY.	NC	5
						5		Borehole terminated at 5.0mbgl.		

LOCATION/NOTES

Located in the south west corner of the former timber stocking area. Bore hole collapsed at 4.8m.

LEGEND

☒ Disturbed Sample
▽ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation
LOCATION: Govan Shipyard Site, Glasgow
CLIENT: Clydeport / Marine
JOB NO: 44701-002

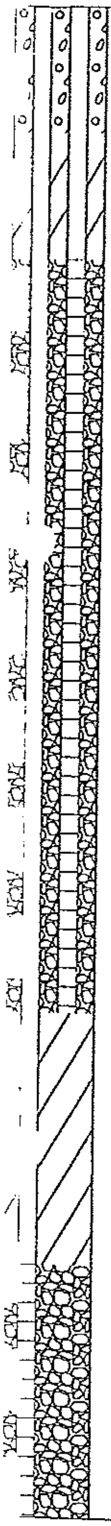
DAMES & MOORE

BOREHOLE NO BH110

Page 1 of 2

START DATE: 11/04/00
END DATE: 11/04/00
DRILLER: Raeburn
METHOD: Shell and Auger
LOGGED BY: CM
CHECKED BY: DN

BOREHOLE DIAMETER(mm): 150
SCREEN TYPE(mm): 50 and 19
ELEVATION (mAOD): 9.38



SAMPLE DEPTH(m)	NUMBER	TYPE	SOIL VAPOUR (ppm)
0.5-0.6		☒	*1000
			*900
1.5-1.7		☒	*600
			*900
			*600
2.9-3.2		☒	*1000
			*500
			*900
4.6-4.8		☒	*140
			*300
			*1000

DESCRIPTION	COMMENTS	
MADE GROUND - grey hardcore gravel.		0.12
MADE GROUND - dark brown, medium to coarse ashy sand and fine to medium gravel with a little concrete and brick rubble and occasional metaliferous slag and pieces of metal.	NC NC	1.9
MADE GROUND - medium brown slightly clayey, slightly silty, gravelly sand with occasional brown slag.	NC	2.4
MADE GROUND - grey-orange-brown mottled, slightly sandy, clayey silt with a little coarse subangular gravel and occasional brown slag.	NC	2.9
MADE GROUND - band of wood fragments.	NC	3.2
MADE GROUND - grey brown, slightly sandy, fine to medium gravel with much fine to coarse brown slag, fibrous material occasional wood fragments and metal fragments.	NC	4
MADE GROUND - stiff grey brown clay with some ash.	NC	4.6
Grey, brown and orange, fine to medium slightly silty SAND with a little subangular to subrounded gravel.	NC	5.8

LOCATION/NOTES

North of Timber Steel storage yard. Borehole dry on completion.

LEGEND

☒ Disturbed Sample
▽ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation
LOCATION: Govan Shipyard Site, Glasgow
CLIENT: Clydeport / Marine
JOB NO: 44701-002

DAMES & MOORE

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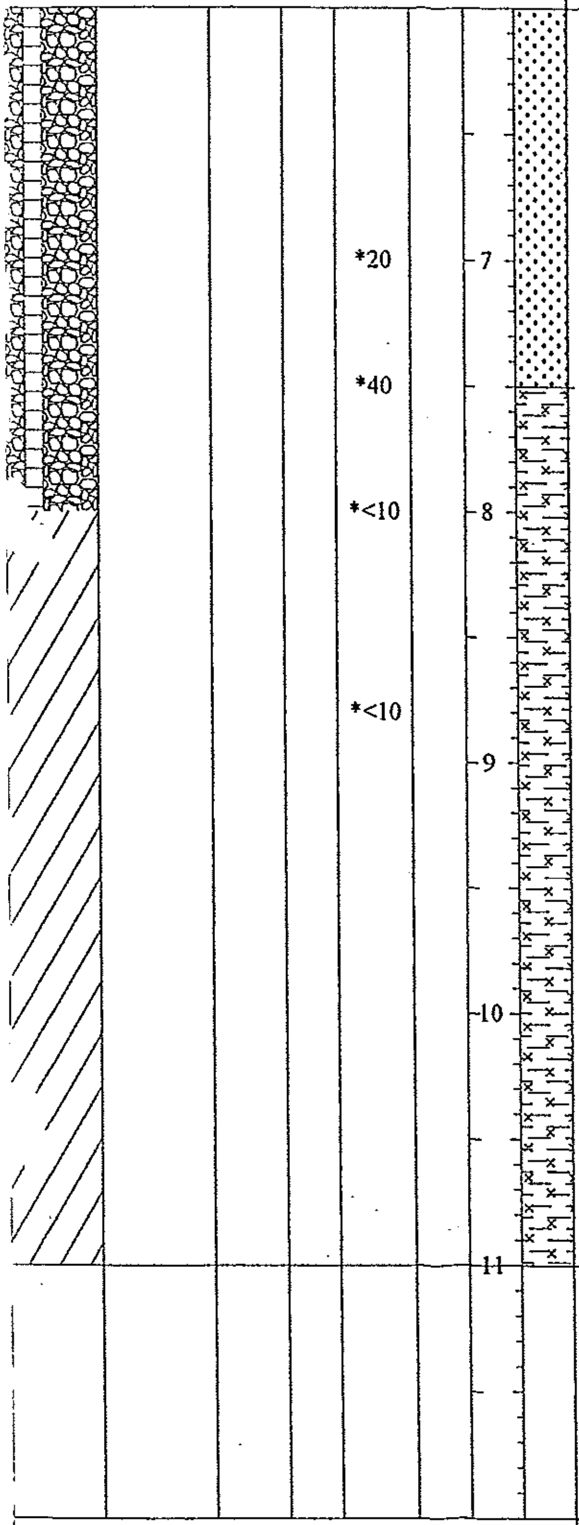
START DATE: 11/04/00
END DATE: 11/04/00
DRILLER: Raeburn
METHOD: Shell and Auger
LOGGED BY: CM
CHECKED BY: DN

BOREHOLE NO BH110

Page 2 of 2

BOREHOLE DIAMETER(mm): 150
SCREEN TYPE(mm): 50 and 19
ELEVATION (mAOD): 9.38



SOIL VAPOUR (ppm)	DEPTH (m)	DESCRIPTION	COMMENTS
		Grey brown, slightly silty fine to medium SAND with some subangular to subrounded gravel.	NC
*20	7		
*40	7.5	Soft to firm, grey brown silty CLAY with thin bands of fine pale brown silty sand.	
*<10	8		
*<10			
	9		
	10		NC
	11	Borehole terminated at 11mbgl.	

LOCATION/NOTES

North of Timber Steel storage yard. Borehole dry on completion.

LEGEND

☒ Disturbed Sample
▽ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation

LOCATION: Govan Shipyard Site, Glasgow

CLIENT: Clydeport / Marine

JOB NO: 44701-002

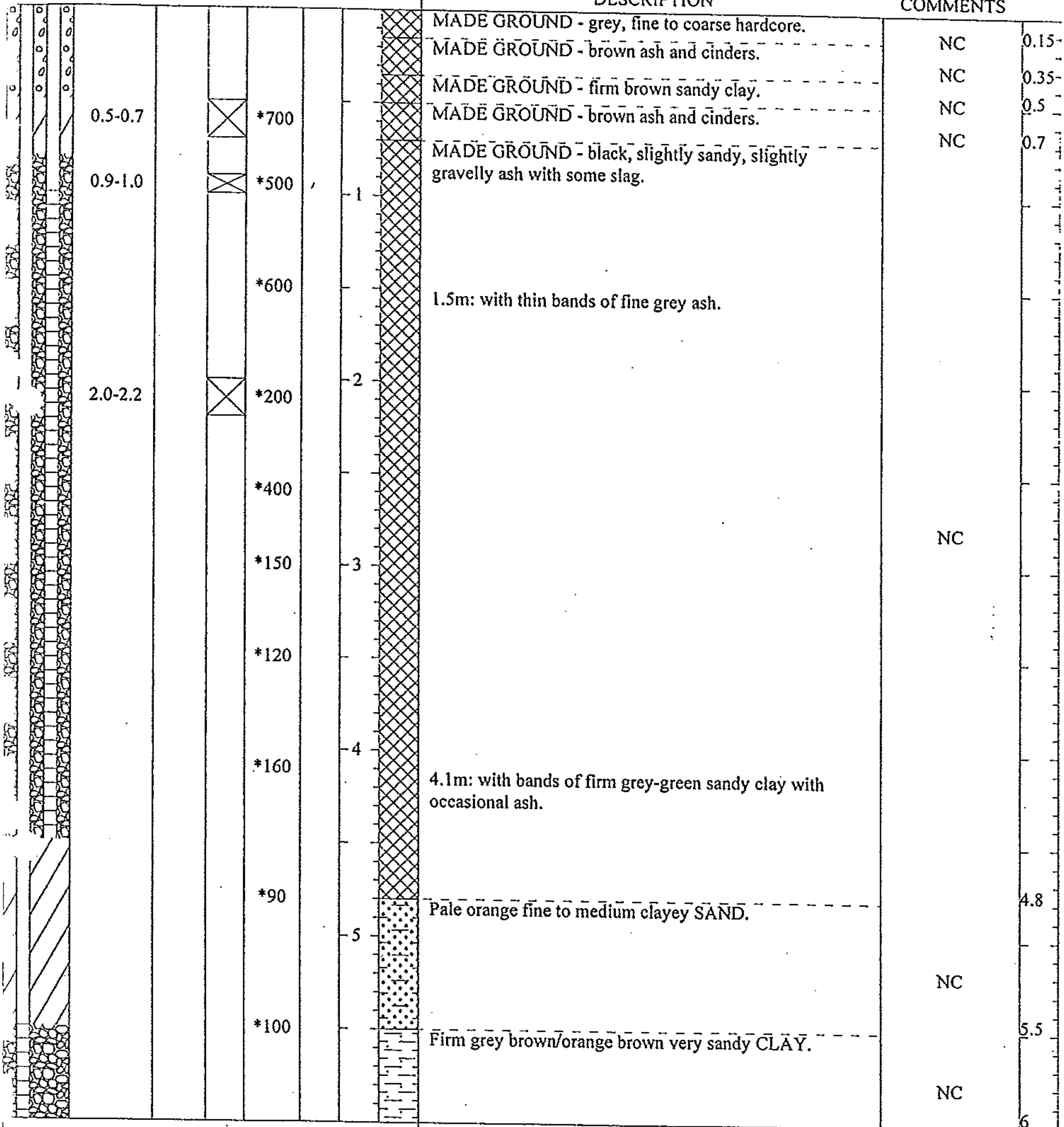
DAMES & MOORE

BOREHOLE NO BH111

Page 1 of 2

START DATE: 10/04/00
END DATE: 10/04/00
DRILLER: Raeburn
METHOD: Shell and Auger
LOGGED BY: CM
CHECKED BY: DN

BOREHOLE DIAMETER(mm):
SCREEN TYPE(mm): 50 and 19
ELEVATION (mAOD): 9.00



SAMPLE DEPTH(m)	NUMBER	TYPE	SOIL VAPOUR (ppm)	GROUNDWATER
0.5-0.7		☒	*700	
0.9-1.0		☒	*500	
			*600	
2.0-2.2		☒	*200	
			*400	
			*150	
			*120	
			*160	
			*90	
			*100	

DESCRIPTION	COMMENTS	
MADE GROUND - grey, fine to coarse hardcore.	NC	0.15
MADE GROUND - brown ash and cinders.	NC	0.35
MADE GROUND - firm brown sandy clay.	NC	0.5
MADE GROUND - brown ash and cinders.	NC	0.7
MADE GROUND - black, slightly sandy, slightly gravelly ash with some slag.		
1.5m: with thin bands of fine grey ash.		
	NC	
4.1m: with bands of firm grey-green sandy clay with occasional ash.		4.8
Pale orange fine to medium clayey SAND.	NC	5.5
Firm grey brown/orange brown very sandy CLAY.	NC	6

LOCATION/NOTES

South centre of west yard, north of main transformer / sub station.

LEGEND

☒	Disturbed Sample
▽	Perched Groundwater
▼	Groundwater
*	Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation

LOCATION: Govan Shipyard Site, Glasgow

CLIENT: Clydeport / Marine

JOB NO: 44701-002

DAMES & MOORE

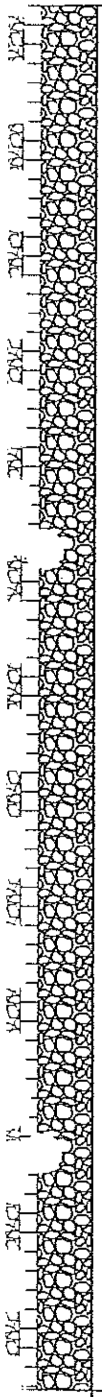
J:\40000~1\44701\44701.002\GINT\CLYDEL~1\LOGS.GPJ
26/07/2000

START DATE: 10/04/00
END DATE: 10/04/00
DRILLER: Raeburn
METHOD: Shell and Auger
LOGGED BY: CM
CHECKED BY: DN

BOREHOLE NO BH111

Page 2 of 2

BOREHOLE DIAMETER(mm):
SCREEN TYPE(mm): 50 and 19
ELEVATION (mAOD): 9.00




WELL CONSTRUCTION	SAMPLE			SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS	
	DEPTH(m)	NUMBER	TYPE							
				*15				Soft, grey brown, slightly sandy CLAY.		
									NC	
				*15		7		Soft to firm, grey brown, silty sandy CLAY.		7
				*<10	∇	8				
				*<10						
						9		9.0m: with thin bands of fine pale brown sand.		
									NC	
						10				
						11				
								Borehole terminated at 11.5mbgl.		11.5

LOCATION/NOTES

South centre of west yard, north of main transformer / sub station.

LEGEND

☒ Disturbed Sample
∇ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation
LOCATION: Govan Shipyard Site, Glasgow
CLIENT: Clydeport / Marine
JOB NO: 44701-002

DAMES & MOORE

START DATE: 02/05/00
END DATE: 02/05/00
DRILLER: Raeburn
METHOD: Window Sampler
LOGGED BY: CM
CHECKED BY: DN

BOREHOLE NO BH112

Page 1 of 1

BOREHOLE DIAMETER(mm): 60/50
SCREEN TYPE(mm):
ELEVATION (mAOD): 9.39

WELL CONSTRUCTION	SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS	
▨							▨	MADE GROUND - topsoil.		0.15
▨							▨	MADE GROUND - grey hardcore.		0.3
▨							▨	MADE GROUND - dark brown, fine to medium gravelly sand.		0.4
								Inspection pit terminated at 0.4m below ground level on concrete obstruction. Relocated approximately 2m to south, BH112A.		
						1				
						2				
						3				
						4				
						5				

LOCATION/NOTES

Terminated at 0.4mbgl due to obstruction and relocated 2m south to BH 112A.

LEGEND

☒	**Disturbed Sample**
▽	**Perched Groundwater**
▼	**Groundwater**
*	**Headspace Analysis on Soil Sample**

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation
LOCATION: Govan Shipyard Site, Glasgow
CLIENT: Clydeport / Marine
JOB NO: 44701-002

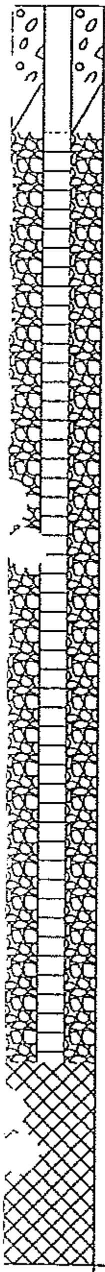
DAMES & MOORE

START DATE: 02/05/00
END DATE: 02/05/00
DRILLER: Raeburn
METHOD: Window Sampler
LOGGED BY: CM
CHECKED BY: DN

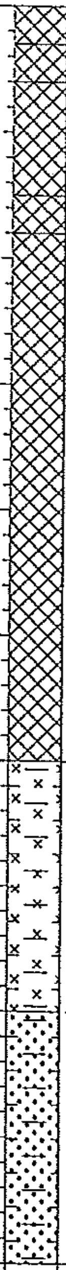
BOREHOLE NO BH112A

Page 1 of 1

BOREHOLE DIAMETER(mm): 60/50
SCREEN TYPE(mm): 19
ELEVATION (mAOD): 9.39



SAMPLE DEPTH(m)	NUMBER	TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	DESCRIPTION	COMMENTS	
						MADE GROUND - topsoil.		0.15
						MADE GROUND - grey hardcore.	NC	0.3
						MADE GROUND - dark grey ash and orange-brown cinders with much red-brown vesicular slag with hydrogen sulphide odour.	NC	
0.5-0.7		☒	*300				NC	0.75
					1	MADE GROUND - red-brown, fine to medium, sandy gravel of slag with occasional wood.	NC	0.9
						MADE GROUND - dark grey ash and orange-brown cinders with a little red-brown and pale yellow-grey slag and a little wood fragments.		
1.3-1.5		☒	*20					
			*500		2		NC	
			*300					
2.8-3.0		☒				2.8m: with a band of red-brown fibrous material.		
			*80		3	Soft to firm, dark grey clayey SILT wth some organic fibres and organic odour.		3
3.2-3.5		☒						
						3.5m: becomes grey-brown in colour with occasional fine to subangular to subrounded gravel.	NC	
			*<10		4	Fine, red-brown clayey SAND becoming less clayey with depth.		4
							NC	
						4.7m: grades to fine, light brown SAND.		
					5	Borehole terminated at 5.0mbgl.		5



LOCATION/NOTES

Located on grass to west of maintenance building and to south of tip.

LEGEND

☒ Disturbed Sample
∇ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation
LOCATION: Govan Shipyard Site, Glasgow
CLIENT: Clydeport / Marine
JOB NO: 44701-002

DAMES & MOORE

[illegible]
26/07/2000

START DATE: 08/05/00
END DATE: 09/05/00
DRILLER: Raeburn
METHOD: Shell and Auger
LOGGED BY: CM
CHECKED BY: DN

BOREHOLE NO BH113

Page 1 of 3

BOREHOLE DIAMETER(mm): 150
SCREEN TYPE(mm): 50
ELEVATION (mAOD): 10.74

SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)
0.5-0.7		☒	*10
			*10
1.5-1.7		☒	*30
			*20
			*30
			*30
			*<10
			*<10
5.5-5.7		☒	*<10

DESCRIPTION	COMMENTS	DEPTH
MADE GROUND - dark grey brown, fine to coarse sand with much assorted fine to coarse gravel and occasional wood fragments and few metaliferous slag.		
1.5m: with occasional brick fragments and woven material (suspected asbestos containing material).	NC	
2.5m: becomes ashy with occasional orange/brown cinders, metaliferous and red brown slag and a little brick rubble.		2.8
No recovery - pushing a piece of wood (2.8-3.6m).		3.6
MADE GROUND - dark grey brown, fine to coarse sand with much assorted fine to coarse gravel and occasional wood fragments and few metaliferous slag, with a piece of wood.	NC	4.5
Grey, soft to firm, slightly sandy, silty CLAY with a little fine to medium subrounded to angular gravel.	NC	5
Mid brown, fine, slightly clayey SAND with some fine to medium, subrounded to subangular gravel (occasionally weathered) and occasional bands of grey, soft to firm, silty clay.	NC	5.8

LOCATION/NOTES

Located in south of tip area between edge of tip and randomly tipped wood and scaffolding. Casing broken as withdrawn, 8.0 metres of casing left in base of borehole. Installation to base of borehole within casing.

LEGEND

☒ Disturbed Sample
▽ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation
LOCATION: Govan Shipyard Site, Glasgow
CLIENT: Clydeport / Marine
JOB NO: 44701-002

DAMES & MOORE

START DATE: 08/05/00
END DATE: 09/05/00
DRILLER: Raeburn
METHOD: Shell and Auger
LOGGED BY: CM
CHECKED BY: DN

BOREHOLE NO BH113

Page 2 of 3

BOREHOLE DIAMETER(mm): 150
SCREEN TYPE(mm): 50
ELEVATION (mAOD): 10.74

WELL CONSTRUCTION	SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	DESCRIPTION	COMMENTS	
				*<10			Grey, soft to firm CLAY with a little medium subangular to subrounded gravel.	NC	6.2
							Grey brown, midbrown and orange brown, fine to medium, clayey SAND.		
								NC	
				*<10		7			
							Mid brown, fine to medium, clayey SAND with occasional bands of midbrown, soft clay and occasional fine to medium subangular gravel.		7.1
						8		NC	
				*<10			Grey brown, soft, slightly silty CLAY with occasional bands of fine sand and a little fine angular gravel.		8.5
						9			
				*<10			9.5m: becoming soft to firm, no gravel and fewer sand beds.		
				*<10		10			
	10.5-10.7		☒	*<10					
						11			
				*<10					

LOCATION/NOTES

Located in south of tip area between edge of tip and randomly tipped wood and scaffolding. Casing broken as withdrawn, 8.0 metres of casing left in base of borehole. Installation to base of borehole within casing.

LEGEND

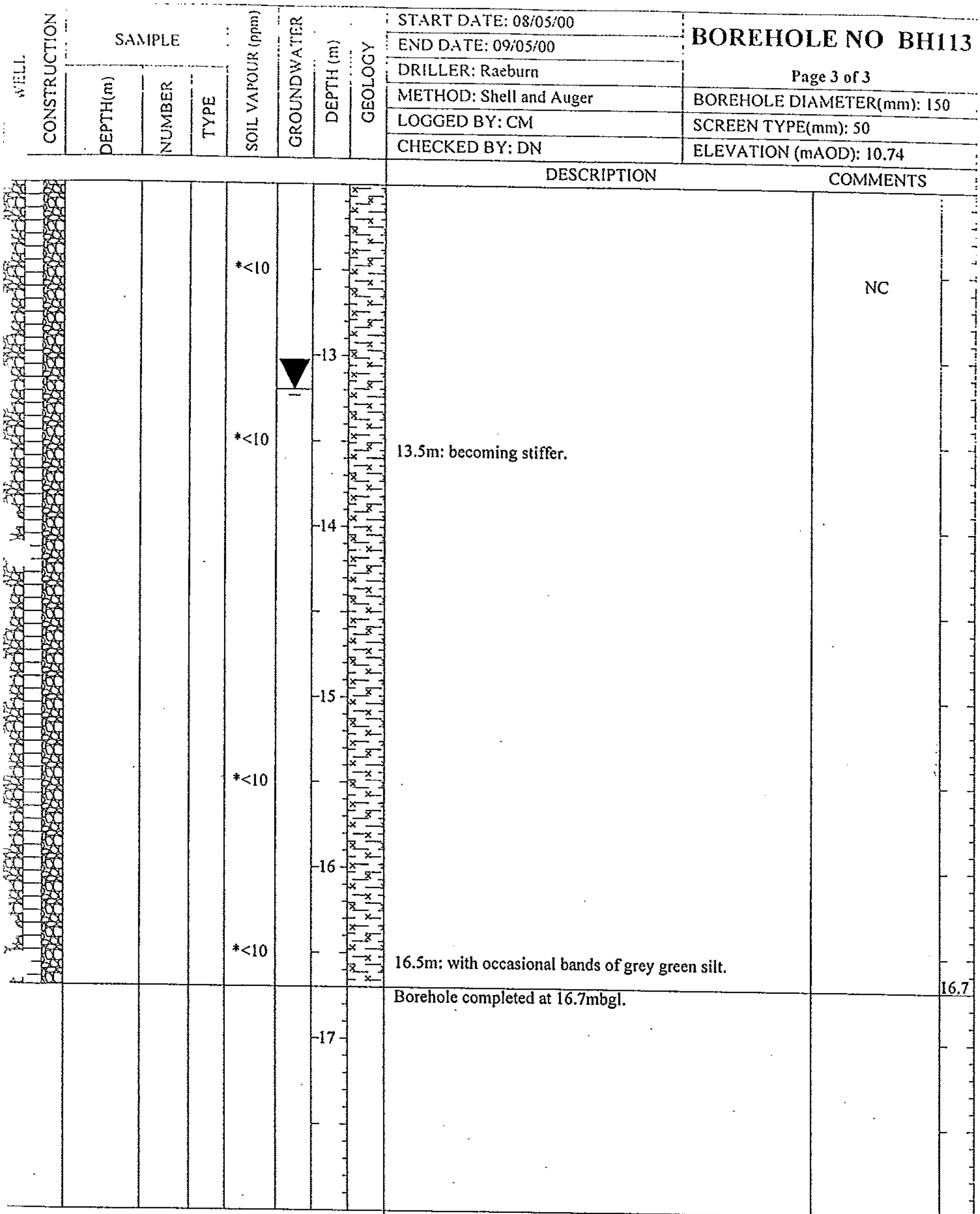
☒ Disturbed Sample
▽ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation
LOCATION: Govan Shipyard Site, Glasgow
CLIENT: Clydeport / Marine
JOB NO: 44701-002

DAMES & MOORE

START DATE: 08/05/00	**BOREHOLE NO BH113**
END DATE: 09/05/00	Page 3 of 3
DRILLER: Raeburn	
METHOD: Shell and Auger	BOREHOLE DIAMETER(mm): 150
LOGGED BY: CM	SCREEN TYPE(mm): 50
CHECKED BY: DN	ELEVATION (mAOD): 10.74



13.5m: becoming stiffer.

16.5m: with occasional bands of grey green silt.

Borehole completed at 16.7mbgl.

LOCATION/NOTES

Located in south of tip area between edge of tip and randomly tipped wood and scaffolding. Casing broken as withdrawn, 8.0 metres of casing left in base of borehole. Installation to base of borehole within casing.

LEGEND

- ☒ Disturbed Sample
- ▽ Perched Groundwater
- ▼ Groundwater
- * Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation

LOCATION: Govan Shipyard Site, Glasgow

CLIENT: Clydeport / Marine

JOB NO: 44701-002

DAMES & MOORE

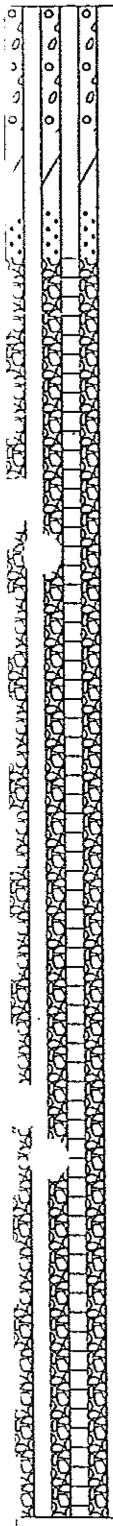
J:\40000~1\44701\44701.002\GINT\CLYDEL~1.GPJ 26/07/2000

START DATE: 19/04/00
END DATE: 20/04/00
DRILLER: Raeburn
METHOD: Shell and Auger
LOGGED BY: CM
CHECKED BY: DN

BOREHOLE NO BH114

Page 1 of 2

BOREHOLE DIAMETER(mm): 200/150
SCREEN TYPE(mm): 50 and 19
ELEVATION (mAOD): 11.73



SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS
						▩	MADE GROUND - dark grey-brown, slightly clayey, ashy, gravelly sand with some brick rubble, brick fragments, concrete rubble and occasional burnt wood.	
0.5-0.6		☒	*<10			▩		
			*<10			▩		
					1	▩		Adding water
1.5-1.7		☒	*<10			▩	1.5m: with much brick fragments and some wood with less rubble.	
			*30			▩		
					2	▩		
2.3-2.5		☒	*30			▩	2.3m: with possible asbestos containing fibres.	
2.9-3.1		☒	*20		3	▩	3.0m: with concrete rubble to cobble-size and a little copper wire, pieces of metal pipe and possible asbestos containing fibres throughout.	NC
			*50			▩		
					4	▩	4.0m: with clumps of suspected asbestos containing fibres and metal containers, bolts and washers and a little wood.	
4.1-4.3		☒	*70			▩		
			*20			▩		
			*30		5	▩		
			*10			▩	5.5m: becomes finer grained without wood/rubble.	
		☒				▩		5.9

LOCATION/NOTES

Located on grass in the tip area to west of main vehicle route.

LEGEND

☒ Disturbed Sample
▽ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation

LOCATION: Govan Shipyard Site, Glasgow

CLIENT: Clydeport / Marine

JOB NO: 44701-002

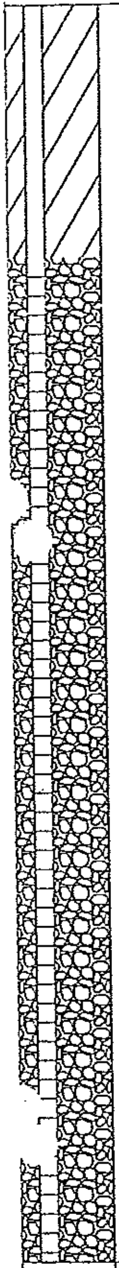
DAMES & MOORE

START DATE: 19/04/00
END DATE: 20/04/00
DRILLER: Raeburn
METHOD: Shell and Auger
LOGGED BY: CM
CHECKED BY: DN

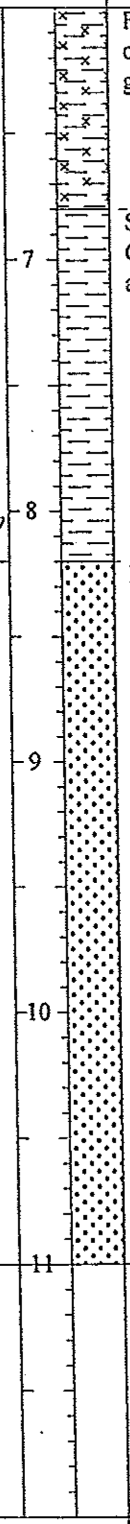
BOREHOLE NO BH114

Page 2 of 2

BOREHOLE DIAMETER(mm): 200/150
SCREEN TYPE(mm): 50 and 19
ELEVATION (mAOD): 11.73



SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DESCRIPTION	COMMENTS	
5.9-6.3		☒	*15		Firm, grey brown, silty CLAY with thin bands of fine orange/brown sand and occasional medium subrounded gravel.	NC	
			*40		Stiff, reddish brown and grey brown, slightly sandy, silty CLAY and occasional fine angular gravel. Little black ash and rare pockets of weathered red sandstone.	NC	6.8
			*<10	▽	Fine, greenish brown, silty SAND.		8.2
			*<10		9.2m: becomes slightly silty.	NC	
					10.2m: with some fine subangular gravel and thick bands of firm grey clayey silt.		
					Borehole terminated at 11.0m below ground level.		11



LOCATION/NOTES

Located on grass in the tip area to west of main vehicle route.

LEGEND

☒ Disturbed Sample
▽ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation

LOCATION: Govan Shipyard Site, Glasgow

CLIENT: Clydeport / Marine

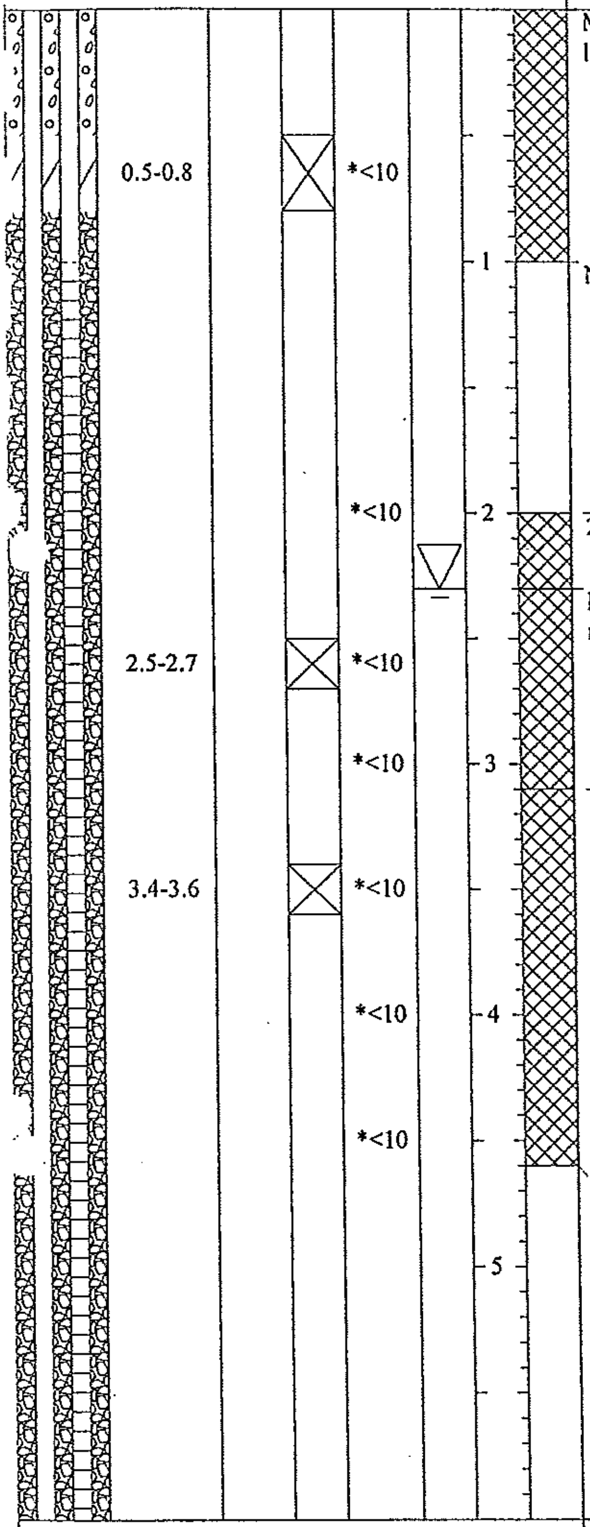
JOB NO: 44701-002

DAMES & MOORE

BOREHOLE NO BH115

Page 1 of 3

START DATE: 04/05/00	
END DATE: 05/05/00	
DRILLER: Raeburn	
METHOD: Shell and Auger	BOREHOLE DIAMETER(mm): 150
LOGGED BY: JD	SCREEN TYPE(mm): 50 and 19
CHECKED BY: DN	ELEVATION (mAOD): 11.96



SAMPLE DEPTH(m)	NUMBER	TYPE	SOIL VAPOUR (ppm)
0.5-0.8		☒	*<10
			*<10
2.5-2.7		☒	*<10
			*<10
3.4-3.6		☒	*<10
			*<10
			*<10

	DESCRIPTION	COMMENTS
	MADE GROUND - dark brown gravelly sand with much large cobbles of concrete and trace timber fragments, dry.	NC
1	No recovery - pushing concrete cobble (1.0-2.0m).	
2	2.0m: MADE GROUND - as above, becoming moist/wet.	NC
2.3	MADE GROUND - dark brown medium sand with much rounded gravel and trace coke gravel, wet.	NC
3.1	MADE GROUND- dark grey brown gravelly sand with much gravel of brick, coke and much ash, dry.	
	4.0m: grades with some metal fragments	NC
4.6	4.6m: becoming wet no recovery - pushing cobble	
6		

LOCATION/NOTES

Near centre area of tip. Relatively flat scrub grass surface.

LEGEND

☒ **Disturbed Sample**
▽ **Perched Groundwater**
▼ **Groundwater**
* **Headspace Analysis on Soil Sample**

BOREHOLE LOG

JOB TITLE: **Stage II Environmental Site Investigation**

LOCATION: **Govan Shipyard Site, Glasgow**

CLIENT: **Clydeport / Marine**

JOB NO: **44701-002**

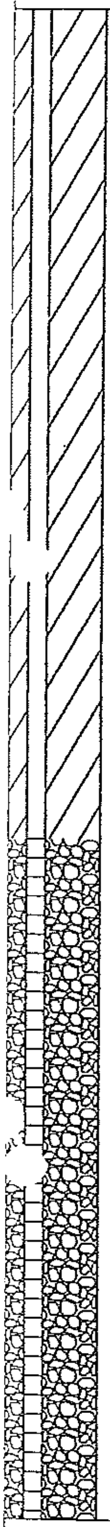
DAMES & MOORE

BOREHOLE NO BH115

Page 2 of 3

START DATE: 04.05/00
END DATE: 05/05/00
DRILLER: Raeburn
METHOD: Shell and Auger
LOGGED BY: JD
CHECKED BY: DN

BOREHOLE DIAMETER(mm): 150
SCREEN TYPE(mm): 50 and 19
ELEVATION (mAOD): 11.96



SAMPLE DEPTH(m)	NUMBER	TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	DESCRIPTION	COMMENTS	
6.0-6.3		☒	*<10			MADE GROUND- dark grey brown gravelly sand with much gravel of brick and coke, much ash, suspected asbestos containing matting, metal fragments, wire welding rods and other fibres.		
			*<10				NC	
			*<10		7	7.0m: with only trace asbestos like material.	Very little recovery 7.0-8.0m	
			*<10		8	8.0m: with some slag gravel, brick and rubber fragments.		
			*<10					
			*<10		9			
						MADE GROUND - light brown/dark brown fine silty sand with some ash and traces of metal fragments.		9.2
			*<10				NC	
9.8-10.0		☒	*<10			Light brown medium to fine silty SAND with traces of rounded fine to medium gravel, moist.		9.8
					10			
			*<10	▼				
			*<10		11		NC	
			*<10					

LOCATION/NOTES

Near centre area of tip. Relatively flat scrub grass surface.

LEGEND

☒ Disturbed Sample
▽ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation
LOCATION: Govan Shipyard Site, Glasgow
CLIENT: Clydeport / Marine
JOB NO: 44701-002

DAMES & MOORE

WELL CONSTRUCTION | SAMPLE: DEPTH(m), NUMBER, TYPE | SOIL VAPOUR (ppm) | GROUNDWATER | DEPTH (m) | GEOLOGY

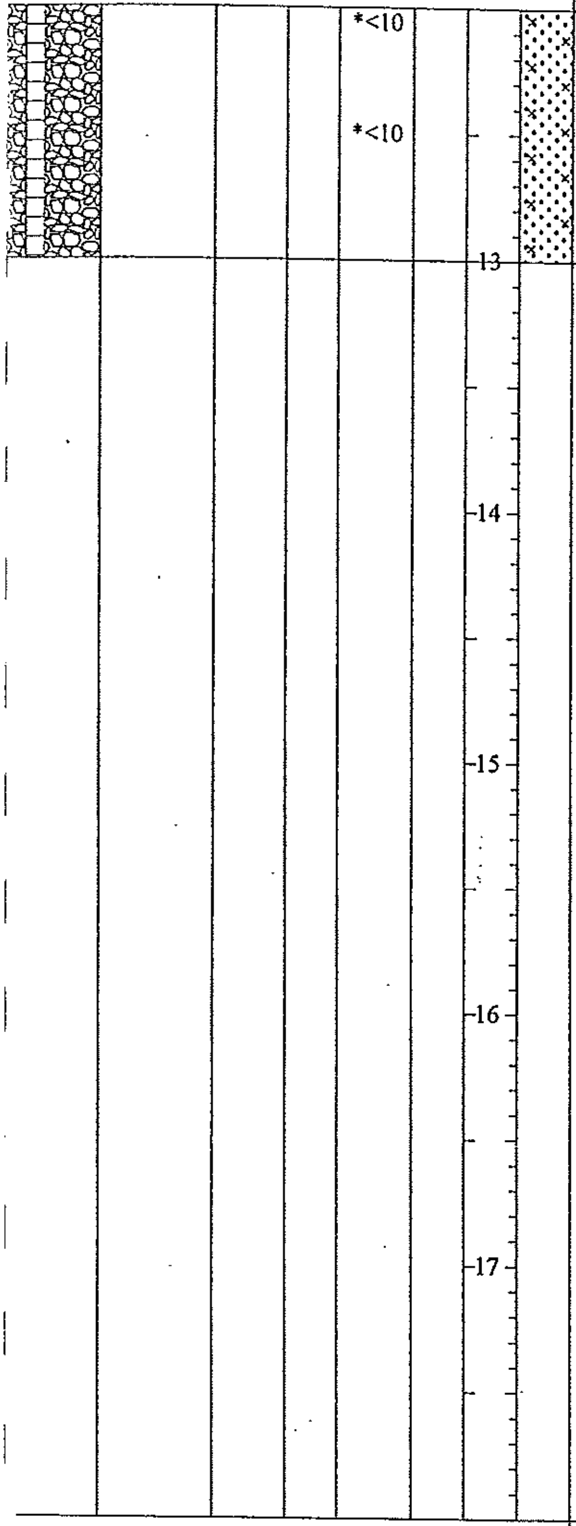
START DATE: 04/05/00
END DATE: 05/05/00
DRILLER: Raeburn
METHOD: Shell and Auger
LOGGED BY: JD
CHECKED BY: DN

BOREHOLE NO BH115

Page 3 of 3

BOREHOLE DIAMETER(mm): 150
SCREEN TYPE(mm): 50 and 19
ELEVATION (mAOD): 11.96

DESCRIPTION | COMMENTS



Borehole terminated at 13.0 mbgl.

13

LOCATION/NOTES

Near centre area of tip. Relatively flat scrub grass surface.

LEGEND

☒ Disturbed Sample
▽ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation
LOCATION: Govan Shipyard Site, Glasgow
CLIENT: Clydeport / Marine
JOB NO: 44701-002

DAMES & MOORE

BOREHOLE NO BH116

Page 1 of 1

START DATE: 04/04/00
END DATE: 04/04/00
DRILLER: Raeburn
METHOD: Shell and Auger
LOGGED BY: CM
CHECKED BY: DN

BOREHOLE DIAMETER(mm): 150
SCREEN TYPE(mm):
ELEVATION (mAOD): 12.15

WELL CONSTRUCTION	SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS	
							▨	MADE GROUND - dark brown to black, medium to coarse silty sand and assorted gravel with some brick and concrete rubble and occasional steel and wood fragments.		0.5
						1 2 3 4 5		Borehole terminated at 0.5m below ground level due to obstruction on steel bar - moved to BH116A.		

LOCATION/NOTES

North centre of tip. No well installation.

LEGEND

☒ Disturbed Sample
▽ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation
LOCATION: Govan Shipyard Site, Glasgow
CLIENT: Clydeport / Marine
JOB NO: 44701-002

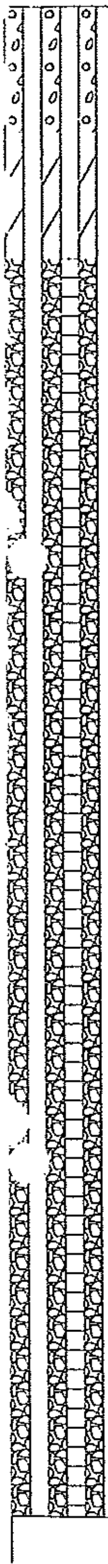
DAMES & MOORE

BOREHOLE NO BH116A

Page 1 of 3

START DATE: 04/04/00
END DATE: 04/04/00
DRILLER: Raeburn
METHOD: Shell and Auger
LOGGED BY: CM
CHECKED BY: DN

BOREHOLE DIAMETER(mm): 200/150
SCREEN TYPE(mm): 50 and 19
ELEVATION (mAOD): 12.26



WELL CONSTRUCTION	SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS
							▩	MADE GROUND - dark brown, slightly silty, gravelly sand with much brick and concrete rubble and a little plastic.	
	0.5-0.6		☒	*<10					
	0.9-1.1		☒	*<10		1			
				*<10					
						2			
								2.1m: with much red shale.	
				*<10					
				*<10		3			
								3.2m: with occasional pieces of wood.	
				*<10					
				*<10		4		4.0m: with occasional coal fragments and slag.	
				*<10					NC
						5		5.0m: with much brown slag and occasional wood fragments.	
								5.15m: with fragments of suspected asbestos containing sheet.	
	5.3-5.5		☒	*<10					
				*<10					

LOCATION/NOTES

North centre of tip. Casing broke when drillling at 17.2m below ground level. Sand/silt rose to 13m below ground level during casing retrieval.

LEGEND

☒ Disturbed Sample
∇ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation

LOCATION: Govan Shipyard Site, Glasgow

CLIENT: Clydeport / Marine

JOB NO: 44701-002

DAMES & MOORE

START DATE: 04/04/00
END DATE: 04/04/00
DRILLER: Raeburn
METHOD: Shell and Auger
LOGGED BY: CM
CHECKED BY: DN

BOREHOLE NO BH116A

Page 2 of 3

BOREHOLE DIAMETER(mm): 200/150
SCREEN TYPE(mm): 50 and 19
ELEVATION (mAOD): 12.26

WELL CONSTRUCTION	SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS	
								6.0m: with woven sheet of suspected asbestos containing material.		
				*<10						
						7		7.0m: with some fine to coarse slag and occasional wood fragments.		
				*<10						
						8		8.0m: with concrete rubble and suspected asbestos containing material (brown board).		
				*<10						
						9				
				*<10				MADE GROUND - soft, grey green, slightly sandy clay with a little ash and occasional ceramic fragments.		9.7
						10				
									NC	
	10.5-10.8	☒		*<10				Grey green silty, fine to medium SAND.		10.5
				*<10					NC	
						11		Dark brown, silty fine to coarse SAND with some gravel.		10.9
									NC	

LOCATION/NOTES

orth centre of tip. Casing broke when drillling
17.2m below ground level. Sand/silt rose to
3m below ground level during casing retrieval.

LEGEND

☒ Disturbed Sample
▽ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation

LOCATION: Govan Shipyard Site, Glasgow

CLIENT: Clydeport / Marine

JOB NO: 44701-002

DAMES & MOORE

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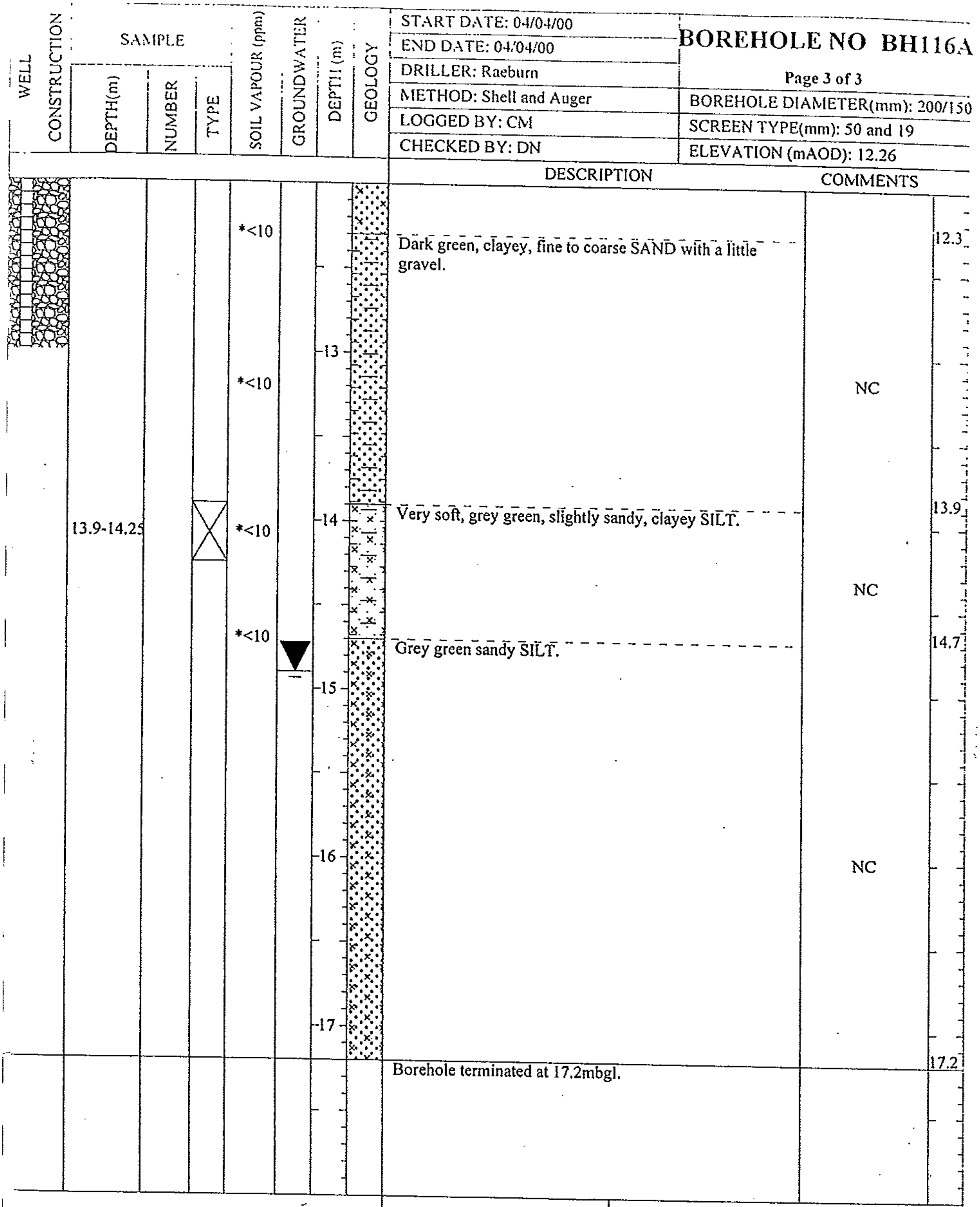
BOREHOLE NO BH116A

Page 3 of 3

START DATE: 04/04/00
END DATE: 04/04/00
DRILLER: Raeburn
METHOD: Shell and Auger
LOGGED BY: CM
CHECKED BY: DN

BOREHOLE DIAMETER(mm): 200/150
SCREEN TYPE(mm): 50 and 19
ELEVATION (mAOD): 12.26



Depth (m)	Description	Comments
12.3	Dark green, clayey, fine to coarse SAND with a little gravel.	NC
13.9	Very soft, grey green, slightly sandy, clayey SILT.	NC
14.7	Grey green sandy SILT.	NC
17.2	Borehole terminated at 17.2mbgl.	

LOCATION/NOTES

North centre of tip. Casing broke when drillling at 17.2m below ground level. Sand/silt rose to 13m below ground level during casing retrieval.

LEGEND

- ☒ Disturbed Sample
- ▽ Perched Groundwater
- ▼ Groundwater
- * Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation

LOCATION: Govan Shipyard Site, Glasgow

CLIENT: Clydeport / Marine

JOB NO: 44701-002

DAMES & MOORE

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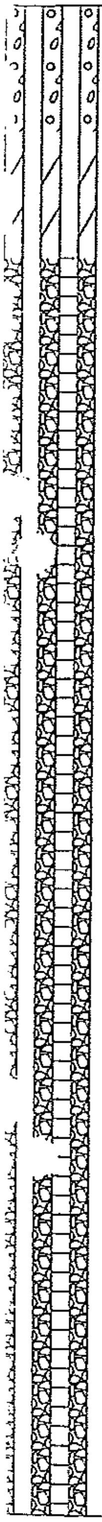
26/07/2000

BOREHOLE NO BH117

Page 1 of 5

START DATE: 06/04/00
END DATE: 06/06/00
DRILLER: Raeburn
METHOD: Shell and Auger
LOGGED BY: JD
CHECKED BY: DN

BOREHOLE DIAMETER(mm): 200
SCREEN TYPE(mm): 50 and 19
ELEVATION (mAOD): 12.25



SAMPLE DEPTH(m)	NUMBER	TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS	
						▨	MADE GROUND - brown sandy medium to coarse gravel with some silt, mixed composition gravel including concrete sandstone and brick, moist.	NC	0.5
0.5-0.7		☒	*<10 *<10		1	▨	MADE GROUND - brown very sandy silty clay with some to much angular fine to medium gravel of basalt and sandstone, with trace fragments of brick, moist.	NC	1
			*<10			▨	MADE GROUND - light brown/brown well graded silty sandy gravel with much brick and timber fragments and traces of coal, moist.	NC	1.8
					2		No recovery - obstruction on concrete boulder (1.8-2.3m).		2.3
2.3-2.5		☒	*<10 *<10 *<10		3 4	▨	MADE GROUND - as above with some glass and coke fragments. 3.5m: with some slag/ash.	NC	4
							No recovery (4.0-4.3m)		4.3
5.5-5.7		☒	*<10 *<10 *<10		5	▨	MADE GROUND - as above. 4.5m: with some string, glass, coke, slag. 5.5m: with metal and suspected asbestos containing material - webbed fabric material and string.		

LOCATION/NOTES

Tip area relatively flat. Coarse scrub vegetation. Scrap metal/plastic and other waste lying around. Groundwater depth approximately only.

LEGEND

☒ Disturbed Sample
▽ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation
LOCATION: Govan Shipyard Site, Glasgow
CLIENT: Clydeport / Marine
JOB NO: 44701-002

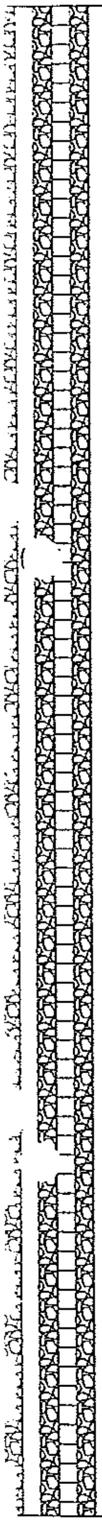
DAMES & MOORE

BOREHOLE NO BH117

Page 2 of 5

START DATE: 06/04/00
END DATE: 06/06/00
DRILLER: Raeburn
METHOD: Shell and Auger
LOGGED BY: JD
CHECKED BY: DN
BOREHOLE DIAMETER(mm): 200
SCREEN TYPE(mm): 50 and 19
ELEVATION (mAOD): 12.25

WELL CONSTRUCTION



SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS	
			*<10			▩	6.0m: with some ash and coke, no suspected asbestos containing material or metal.		
			*<10			▩			
						▩	MADE GROUND - dark brown gravelly sandy clay with some fragments of glass, brick, coke, and ash, moist.	NC	6.6
			*<10		7	▩			
						▩	MADE GROUND - light grey brown sandy silt with glass and coal/coke (possibly fall in), moist.	NC	7.1
						▩	MADE GROUND - yellow brown silty fine to medium sand with trace rounded fine diorite gravel (weathered) and one large fragment of metal.		7.3
			*<10			▩			
			*<10		8	▩	8.0m: with few nuts/bolts, becoming brown.	NC	
			*<10			▩	8.5m: with traces of coke and coal fragments.		
			*<10		9	▩	MADE GROUND - dark brown/grey/black fine silty sand with coke gravel and some ash, moist, clayey (ashy fill).		9
			*<10			▩		NC	
			*<10		10	░	Yellow brown/ brown medium SAND with some silt and some fine quartz and sandstone rounded gravel and trace coarse rounded quartzite gravel. Slightly moist, no odour.		10
			*<10			░	10.5m: black very light weight extremely fine grained hard material, possibly siltstone boulder rounded, elongated, tabular.		
			*<10		11	░	11.0m: becoming dark brown/grey with small rootlets and some silt.		
			*<10			░		NC	

LOCATION/NOTES

Tip area relatively flat. Coarse scrub vegetation.
Scrap metal/plastic and other waste lying around.
Groundwater depth approximately only.

LEGEND

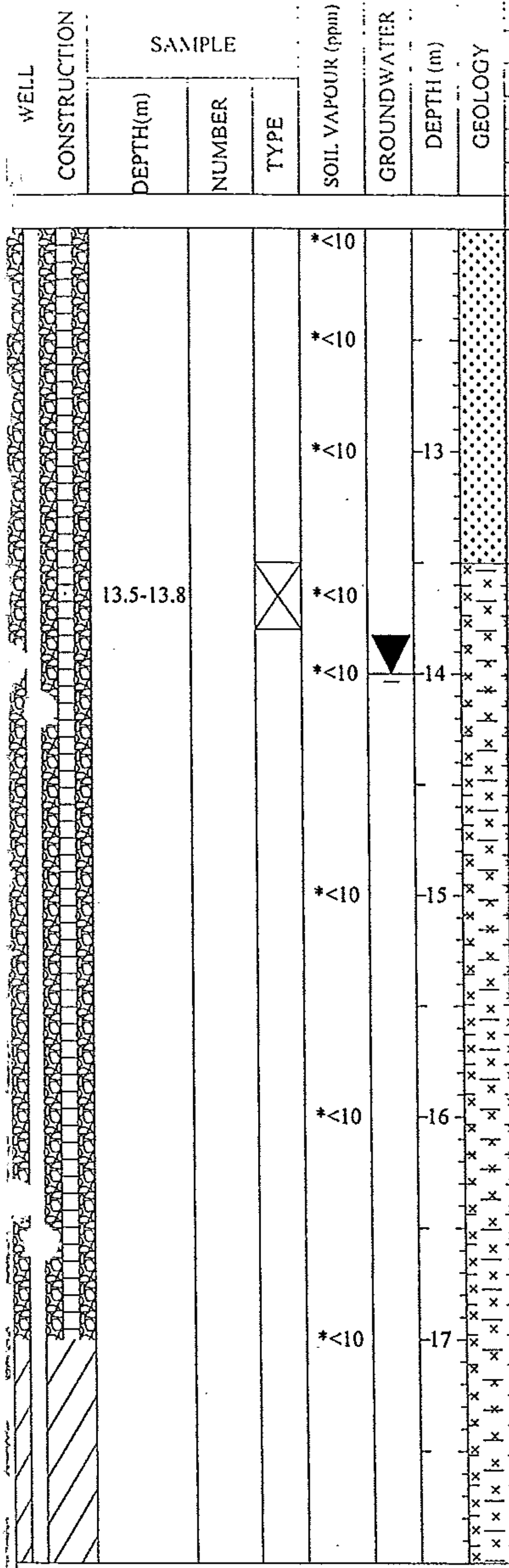
☒ Disturbed Sample
▽ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation
LOCATION: Govan Shipyard Site, Glasgow
CLIENT: Clydeport / Marine
JOB NO: 44701-002

DAMES & MOORE

START DATE: 06/04/00	**BOREHOLE NO BH117**
END DATE: 06/06/00	
DRILLER: Raeburn	Page 3 of 5
METHOD: Shell and Auger	BOREHOLE DIAMETER(mm): 200
LOGGED BY: JD	SCREEN TYPE(mm): 50 and 19
CHECKED BY: DN	ELEVATION (mAOD): 12.25



DESCRIPTION	COMMENTS
Grey clayey SILT with some fine sand.	13.5
14.5m: grades to SILT with traces of clay and some very fine sand.	

LOCATION/NOTES

Tip area relatively flat. Coarse scrub vegetation. Scrap metal/plastic and other waste lying around. Groundwater depth approximately only.

LEGEND

- ☒ Disturbed Sample
- ▽ Perched Groundwater
- ▼ Groundwater
- * Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation

LOCATION: Govan Shipyard Site, Glasgow

CLIENT: Clydeport / Marine

JOB NO: 44701-002

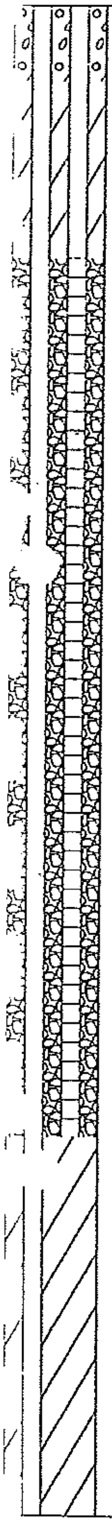
DAMES & MOORE

START DATE: 09/05/00
END DATE: 09/05/00
DRILLER: Raeburn
METHOD: Shell and Auger
LOGGED BY: JD
CHECKED BY: DN

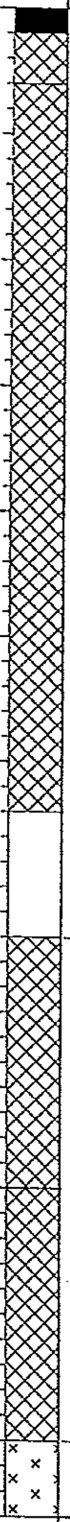
BOREHOLE NO BH119

Page 1 of 2

BOREHOLE DIAMETER(mm): 150
SCREEN TYPE(mm): 50 and 19
ELEVATION (mAOD): 7.30



SAMPLE DEPTH(m)	NUMBER	TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)
0.5-0.7		☒	*20		
			*12		1
			*10		
1.9-2.1		☒	*14		2
			*<10		
			*<10		3
			*<10		
			*<10		4
4.5-4.7		☒	*<10		
5.0-5.2		☒	*<10		5
		☒		▼	



DESCRIPTION	COMMENTS	
TARMAC.		
MADE GROUND - hardcore and sand.	NC	0.1
MADE GROUND - dark brown medium to coarse gravelly sand with some fragments of timber and metal (welding rods), moist.	NC	0.3
	NC	
No recovery - pushing cobble (3.2 to 3.7m.).		3.2
MADE GROUND - dark brown medium to coarse gravelly sand with some fragments of timber and metal (welding rods), moist. 4.35m: becoming silty and wet.	NC	3.7
MADE GROUND - dark brown silt with much medium sand, traces of metal fragments and traces of clay, moist to wet. 5.0m: some woven material, suspected asbestos.	NC	4.7
Dark grey soft SILT, wet.		5.7

LOCATION/NOTES

Flat tarmac car park south west of site.
Groundwater encountered at 6.0mbgl.

LEGEND

☒ Disturbed Sample
▽ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation
LOCATION: Govan Shipyard Site, Glasgow
CLIENT: Clydeport / Marine
JOB NO: 44701-002

DAMES & MOORE

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START DATE: 09/05/00	**BOREHOLE NO BH119**
END DATE: 09/05/00	Page 2 of 2
DRILLER: Raeburn	
METHOD: Shell and Auger	BOREHOLE DIAMETER(mm): 150
LOGGED BY: JD	SCREEN TYPE(mm): 50 and 19
CHECKED BY: DN	ELEVATION (mAOD): 7.30

WELL CONSTRUCTION	SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS
	5.9-6.1		☒	*<10					
								6.5m: saturated.	
				*<10		7			
									NC
				*<10		8			
						9		Borehole terminated at 9.0mbgl.	9
						10			
						11			

LOCATION/NOTES

Flat tarmac car park south west of site.
Groundwater encountered at 6.0mbgl.

LEGEND

☒ Disturbed Sample
∇ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation

LOCATION: Govan Shipyard Site, Glasgow

CLIENT: Clydeport / Marine

JOB NO: 44701-002

DAMES & MOORE

START DATE: 05/05/00	**BOREHOLE NO BH120**
END DATE: 06/05/00	
DRILLER: Raeburn	Page 1 of 2
METHOD: Shell and Auger	BOREHOLE DIAMETER(mm): 150
LOGGED BY: CM	SCREEN TYPE(mm): 50 and 19
CHECKED BY: DN	ELEVATION (mAOD): 11.40

WELL CONSTRUCTION	SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS
								MADE GROUND - dark grey-brown, fine to medium, slightly clayey, gravelly sand with much brick and brick fragments.	
	0.9-1.1		☒	*<10 *<10		1		1.0m: grades with no brick, equal quantities of sand and fine to medium assorted gravel and some red shale.	NC
	1.5-1.7		☒	*<10					
	2.0-2.2		☒	*<10		2		MADE GROUND - grey-brown, very sandy clay with a little fine to coarse gravel and occasional clumps of white fibrous material (suspect asbestos containing material)	
				*<10				2.5m: with pockets of firm, pale grey silt.	
				*<10		3		3.0m: with much wood and wood fragments and a little metal and a large bolt (metal).	NC
				*10				3.5m: with occasional cobbles.	
	4.0-4.2		☒	*40		4		MADE GROUND - fine to coarse, dark brown, slightly ashy sand with a little fine to medium gravel, some wood fragments, metal wire and a little softened fibrous board (suspected asbestos containing material).	
				*20				4.5m: with a little red-brown slag and metal, less asbestos containing material.	
				*15		5		5.0m: as above but becoming clayey and grey-brown in colour with no suspected asbestos containing material.	NC
				*<10				5.5m: with occasional wood and copper wire and few cinders but no slag.	

LOCATION/NOTES

Located on grass at edge of trees in south east of tip area. Randomly discarded rope, wood, scaffolding and portacabins located to north, west and south west.

LEGEND

☒	Disturbed Sample
▽	Perched Groundwater
▼	Groundwater
*	Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation

LOCATION: Govan Shipyard Site, Glasgow

CLIENT: Clydeport / Marine

JOB NO: 44701-002

DAMES & MOORE

START DATE: 05/05/00
END DATE: 06/05/00
DRILLER: Raeburn
METHOD: Shell and Auger
LOGGED BY: CM
CHECKED BY: DN

BOREHOLE NO BH120

Page 2 of 2

BOREHOLE DIAMETER(mm): 150
SCREEN TYPE(mm): 50 and 19
ELEVATION (mAOD): 11.40

WELL CONSTRUCTION	SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS	
				*<10				MADE GROUND - soft grey-brown and orange-brown mottled, silty clay with thin bands of orange-brown medium sand and occasional wood fragments.	NC	
	7.5-7.7		☒	*<10		7		MADE GROUND - soft to firm, grey-brown, slightly sandy, silty clay with a little fine to medium gravel.	NC	7
								Fine to medium, mid brown SAND with occasional bands of soft grey-brown silty clay.		7.5
				*<10	▽	8			NC	
				*<10		9		Fine to medium, mid brown SAND with a little fine subangular to rounded gravel.	NC	9
						10			NC	
						11		Borehole terminated at 11.0mbgl.		11

LOCATION/NOTES

Located on grass at edge of trees in south east of tip area. Randomly discarded rope, wood, scaffolding and portacabins located to north, west and south west.

LEGEND

☒ Disturbed Sample
▽ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

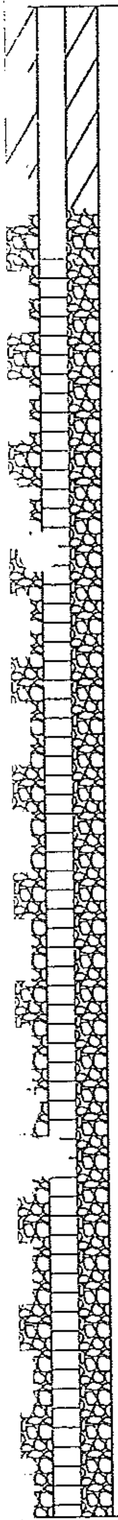
JOB TITLE: Stage II Environmental Site Investigation
LOCATION: Govan Shipyard Site, Glasgow
CLIENT: Clydeport / Marine
JOB NO: 44701-002

DAMES & MOORE

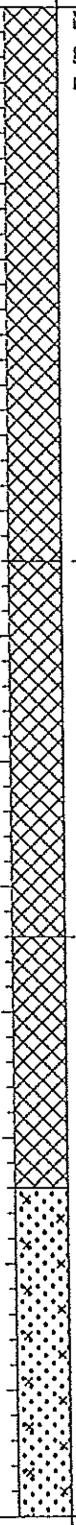
BOREHOLE NO BH121

Page 1 of 2

START DATE: 19/04/00
END DATE: 20/04/00
DRILLER: Raeburn
METHOD: Shell and Auger
LOGGED BY: JD
CHECKED BY: DN
BOREHOLE DIAMETER(mm): 150
SCREEN TYPE(mm): 50
ELEVATION (mAOD): 8.92



SAMPLE DEPTH(m)	NUMBER	TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)
			*<10		
0.8-1.0		☒	*<10		1
			*<10		
			*<10		2
2.7-3.0		☒	*<10		3
			*<10		
			*<10		4
			*<10		
4.8-5.0		☒	*<10		5
5.5-5.7		☒	*<10		



DESCRIPTION	COMMENTS	
MADE GROUND - dark grey/brown coarse to medium gravelly sand with well graded mixed gravel and some to much coke and ash, dry.	NC	2.2
MADE GROUND - light yellow brown medium to coarse clayey sand with some fine to medium coke and sandstone gravel and traces of brick and coal fragments, dry (possibly re-worked natural).	NC	3.7
MADE GROUND - light yellowish grey/brown sandy clay with traces of slag gravel and medium sand, moist (possibly re-worked natural).	NC	4.7
Light yellow brown fine SAND with some to much clay, dry.	NC	

LOCATION/NOTES

Soft uneven rubble and fill surface on razed building footprint south east of basin. No groundwater noted in casing left overnight at 6.0m below ground level. Slight groundwater seepage noted at 6.3m below ground level.

LEGEND

- ☒ Disturbed Sample
- ▽ Perched Groundwater
- ▼ Groundwater
- * Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation
LOCATION: Govan Shipyard Site, Glasgow
CLIENT: Clydeport / Marine
JOB NO: 44701-002

DAMES & MOORE

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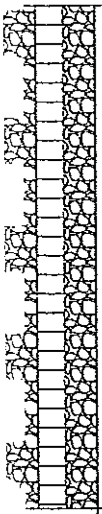
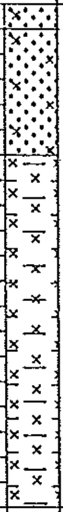
START DATE: 19/04/00	**BOREHOLE NO BH121** Page 2 of 2
END DATE: 20/04/00	
DRILLER: Raeburn	
METHOD: Shell and Auger	BOREHOLE DIAMETER(mm): 150
LOGGED BY: JD	SCREEN TYPE(mm): 50
CHECKED BY: DN	ELEVATION (mAOD): 8.92





SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	DESCRIPTION	COMMENTS	
			*<10	▼		Dark brown silty fine to medium SAND with traces of fine to medium rounded gravel. 6.3m: increasing gravel content.	NC	6.1
			*<10					
						Dark grey brown soft clayey SILT with some fine sand and occasional fine rounded gravel.		6.6
			*<10		7		NC	
7.5-7.7		☒	*<10			7.5m: as above without gravel.		
					8	Borehole terminated at 8.0mbgl.		8
					9			
					10			
					11			

LOCATION/NOTES

Soft uneven rubble and fill surface on razed building footprint south east of basin. No groundwater noted in casing left overnight at 6.0m below ground level. Slight groundwater seepage noted at 6.3m below ground level.

LEGEND

☒ Disturbed Sample
▽ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation
LOCATION: Govan Shipyard Site, Glasgow
CLIENT: Clydeport / Marine
JOB NO: 44701-002

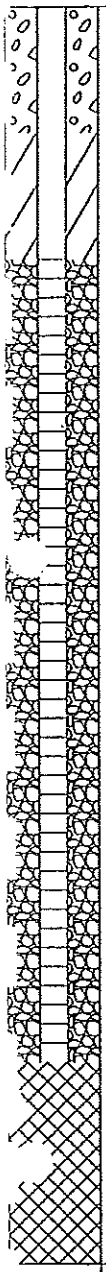
DAMES & MOORE

BOREHOLE NO BH122

Page 1 of 1

START DATE: 02/05/00
END DATE: 02/05/00
DRILLER: Raeburn
METHOD: Window Sampler
LOGGED BY: CM
CHECKED BY: DN

BOREHOLE DIAMETER(mm): 150
SCREEN TYPE(mm): 19
ELEVATION (mAOD): 9.03



SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	DESCRIPTION	COMMENTS	
						MADE GROUND - grey hardcore.	NC	0.3
0.5-0.7		☒	*<10			MADE GROUND - dark bown, medium to coarse, slightly gravelly, ashy sand with some black slag and occasional wood fragments.		
			*<10		1			
1.5-1.7		☒	*<10			1.5m: with much wood, less gravel.	NC	
					2			
			*<10					2.9
					3	Fine to medium, pale brown SAND with a little subrounded gravel at top and bands of soft to firm brown clay.		
3.3-3.6		☒	*<10				NC	
						3.8-4.0m: damp.		
			*<10		4			4
						Soft grey-brown CLAY.	NC	4.3
						Fine, orange-brown and pale brown SAND.	NC	
					5	Borehole terminated at 5.0mbgl.		5

LOCATION/NOTES

Hardcore surface north of transformer and electricity substation west of pipe store.

LEGEND

- ☒ Disturbed Sample
- ▽ Perched Groundwater
- ▼ Groundwater
- * Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation
LOCATION: Govan Shipyard Site, Glasgow
CLIENT: Clydeport / Marine
JOB NO: 44701-002

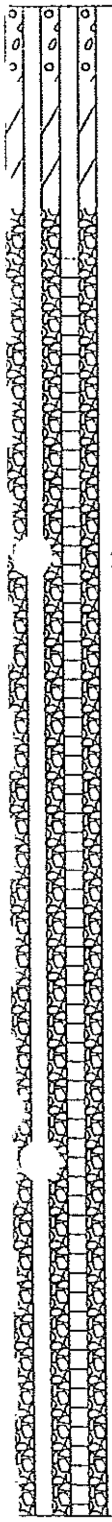
DAMES & MOORE

START DATE: 12/04/00
END DATE: 19/04/00
DRILLER: Raeburn
METHOD: Shell and Auger
LOGGED BY: JD
CHECKED BY: DN

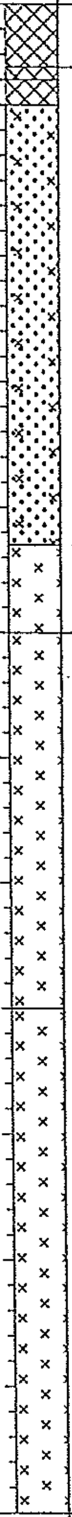
BOREHOLE NO BH123

Page 1 of 6

BOREHOLE DIAMETER(mm): 200/150
SCREEN TYPE(mm): 50 and 19
ELEVATION (mAOD): 8.00



SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	DESCRIPTION	COMMENTS	
						MADE GROUND - cobbles, tar sealant between cobbles emits faint tarry odour.	LC	0.25
						MADE GROUND - light brown medium sand	NC	0.3
						MADE GROUND - old concrete/brick foundation		0.4
0.4-0.7		☒	*<10			Light greyish brown silty SAND, moist.		
			*<10		1		NC	
			*<10					
1.8-2.0		☒	*25					
					2			
2.15-2.25		☒	*<10			Dark grey organic SILT with some fine sand and trace rounded gravel and much coal-like organic fragments.	NC	2.15
			*<10			Light brown mottled yellow brown soft thinly bedded sandy SILT with some to much clay.		2.5
			*<10		3		NC	
			*<10			3.5m: grades with occasional fine rounded highly weathered sandstone gravel		
			*<10		4	Grey SILT with some fine sand and some clay.		4
			*<10				NC	
			*<10		5			
			*<10					



LOCATION/NOTES

Relatively flat cobbled surface in outdoor pipe store area. Approximately 15m from southern boundary wall.

LEGEND

- ☒ Disturbed Sample
- ▽ Perched Groundwater
- ▼ Groundwater
- * Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation

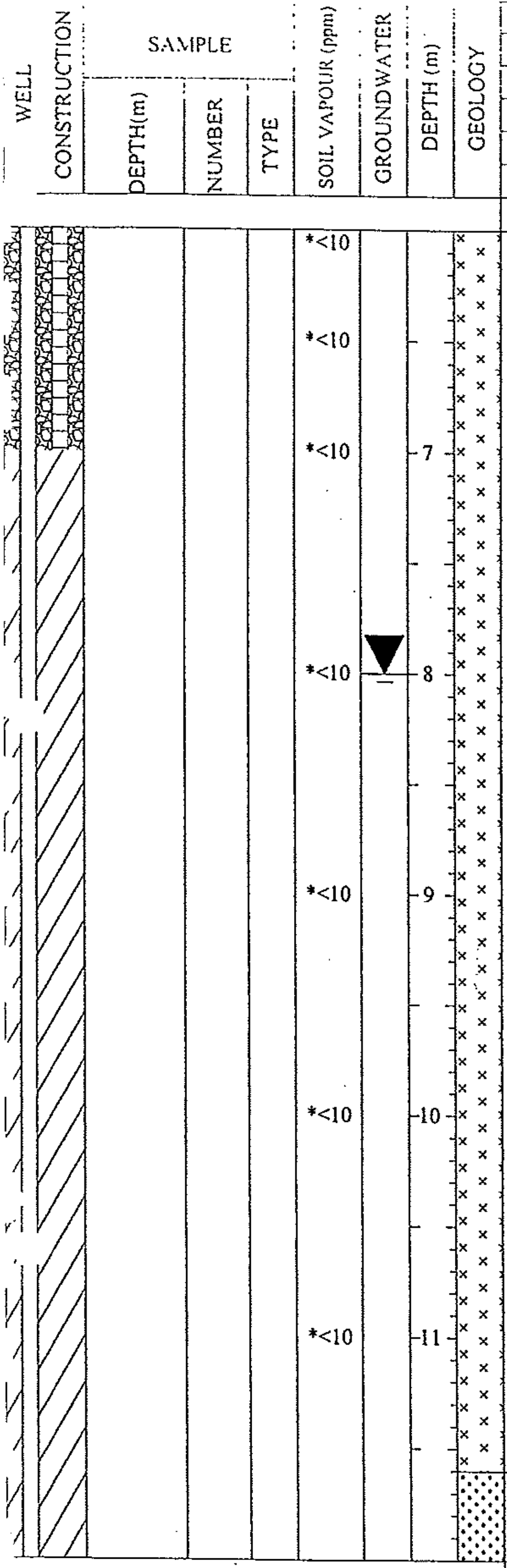
LOCATION: Govan Shipyard Site, Glasgow

CLIENT: Clydeport / Marine

JOB NO: 44701-002

DAMES & MOORE

START DATE: 12/04/00	**BOREHOLE NO BH123** Page 2 of 6
END DATE: 19/04/00	
DRILLER: Raeburn	
METHOD: Shell and Auger	BOREHOLE DIAMETER(mm): 200/150
LOGGED BY: JD	SCREEN TYPE(mm): 50 and 19
CHECKED BY: DN	ELEVATION (mAOD): 8.00



DESCRIPTION	COMMENTS	
	6.0m: Periodically adding water during drilling	
7.5m: becoming interbedded with thin greenish grey silt layers	NC	
8.5m: with thin (50-100mm thick) bands of light grey silt and occasional very thin sand horizons.	NC	
Light yellowish loose brown fine SAND with some silt.		11.6

LOCATION/NOTES

Relatively flat cobbled surface in outdoor pipe store area. Approximately 15m from southern boundary wall.

LEGEND

☒	Disturbed Sample
▽	Perched Groundwater
▼	Groundwater
*	Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation

LOCATION: Govan Shipyard Site, Glasgow

CLIENT: Clydeport / Marine

JOB NO: 44701-002

DAMES & MOORE

START DATE: 12/04/00
END DATE: 19/04/00
DRILLER: Raeburn
METHOD: Shell and Auger
LOGGED BY: JD
CHECKED BY: DN

BOREHOLE NO BH123

Page 3 of 6

BOREHOLE DIAMETER(mm): 200/150
SCREEN TYPE(mm): 50 and 19
ELEVATION (mAOD): 8.00

WELL CONSTRUCTION	SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS	
				*<10						
				*<10		13			NC	
				*<10		14				
				*<10		15				
								15.3m: becoming denser.		
				*<10		16		Light yellowish brown fine to medium gravelly SAND with well graded rounded fine to coarse sandstone gravel and trace silt.	NC	16
								Light yellowish brown fine SAND with trace silt.		16.5
				*<10		17				

LOCATION/NOTES

Relatively flat cobbled surface in outdoor pipe store area. Approximately 15m from southern boundary wall.

LEGEND

☒ Disturbed Sample
▽ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation
LOCATION: Govan Shipyard Site, Glasgow
CLIENT: Clydeport / Marine
JOB NO: 44701-002

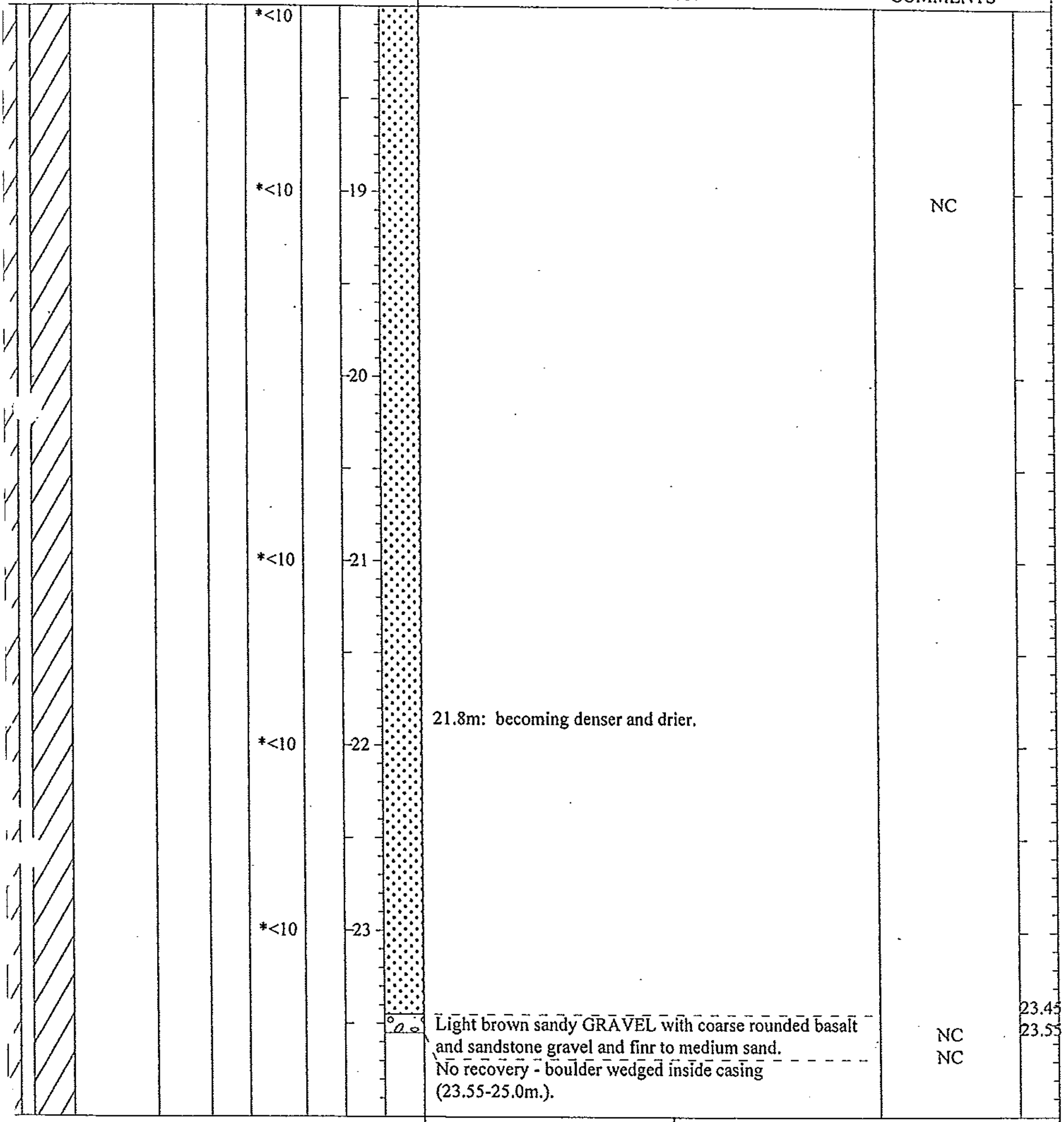
DAMES & MOORE

START DATE: 12/04/00
END DATE: 19/04/00
DRILLER: Raeburn
METHOD: Shell and Auger
LOGGED BY: JD
CHECKED BY: DN

BOREHOLE NO BH123

Page 4 of 6

BOREHOLE DIAMETER(mm): 200/150
SCREEN TYPE(mm): 50 and 19
ELEVATION (mAOD): 8.00



WELL CONSTRUCTION	SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS	
				*<10						
				*<10		19			NC	
						20				
				*<10		21				
								21.8m: becoming denser and drier.		
				*<10		22				
				*<10		23				
								Light brown sandy GRAVEL with coarse rounded basalt and sandstone gravel and finr to medium sand.	NC	23.45
								No recovery - boulder wedged inside casing (23.55-25.0m.).	NC	23.55

LOCATION/NOTES

Relatively flat cobbled surface in outdoor pipe store area. Approximately 15m from southern boundary wall.

LEGEND

☒ Disturbed Sample
▽ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation
LOCATION: Govan Shipyard Site, Glasgow
CLIENT: Clydeport / Marine
JOB NO: 44701-002

DAMES & MOORE

BOREHOLE NO BH123

Page 5 of 6

START DATE: 12/04/00
END DATE: 19/04/00
DRILLER: Raeburn
METHOD: Shell and Auger
LOGGED BY: JD
CHECKED BY: DN

BOREHOLE DIAMETER(mm): 200/150
SCREEN TYPE(mm): 50 and 19
ELEVATION (mAOD): 8.00

WELL CONSTRUCTION	SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS
				*<10					
						25		Light brown fine to medium silty SAND with occasional cobbles and coarse sandstone gravel.	
				*<10		26			
						27			NC
				*<10		28			
						29			

25

LOCATION/NOTES

Relatively flat cobbled surface in outdoor pipe store area. Approximately 15m from southern boundary wall.

LEGEND

☒ Disturbed Sample
▽ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation

LOCATION: Govan Shipyard Site, Glasgow

CLIENT: Clydeport / Marine

JOB NO: 44701-002

DAMES & MOORE

START DATE: 12/04/00
END DATE: 19/04/00
DRILLER: Raeburn
METHOD: Shell and Auger
LOGGED BY: JD
CHECKED BY: DN

BOREHOLE NO BH123

Page 6 of 6

BOREHOLE DIAMETER(mm): 200/150
SCREEN TYPE(mm): 50 and 19
ELEVATION (mAOD): 8.00

WELL CONSTRUCTION	SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS	
				*<10						
								Light brown dense coarse SAND with some rounded coarse gravel and basalt cobbles.	NC	30.5
				*<10		31		Dark grey silty fine SAND with much dark grey fine to medium highly weathered siltstone gravel.	NC	31
								Dark grey brown medium to coarse sandy GRAVEL with rounded gravel comprising white sandstone, quartzite and basalt, fine to medium sand.	NC	31.2
								31.76m: with cobbles and very coarse gravel. Borehole terminated at 31.8 mbgl.		31.8
						32				
						33				
						34				
						35				

LOCATION/NOTES

Relatively flat cobbled surface in outdoor pipe store area. Approximately 15m from southern boundary wall.

LEGEND

☒ Disturbed Sample
▽ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation

LOCATION: Govan Shipyard Site, Glasgow

CLIENT: Clydeport / Marine

JOB NO: 44701-002

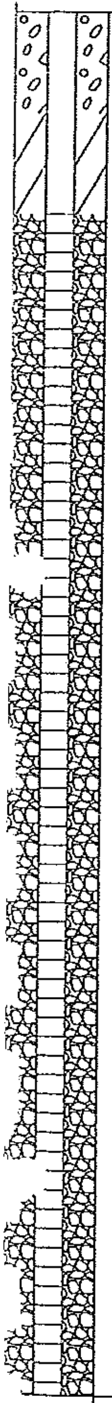
DAMES & MOORE

START DATE: 06/05/00
END DATE: 06/05/00
DRILLER: Raeburn
METHOD: Window Sampler
LOGGED BY: JD
CHECKED BY: DN

BOREHOLE NO BH124

Page 1 of 1

BOREHOLE DIAMETER(mm): 60/50
SCREEN TYPE(mm): 19
ELEVATION (mAOD): 8.48



SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	DESCRIPTION	COMMENTS	
						MADE GROUND - dark brown medium to coarse gravelly sand with some clay, ash, traces of glass fragments and traces of fibrous material (possible asbestos containing material), dry.		
0.5-0.8		☒	*<10				NC	
			*<10		1			
						MADE GROUND - light brown silt with much fine sand, dry.		1.1
			*<10					
			*<10		2		NC	
				▽				
2.5-3.0		☒	*<10					
			*<10		3			
						MADE GROUND - dark brown clay with some coke, gravel and blaes, dry.	NC	3
						Grey brown SILT, moist.		3.5
3.5-4.0		☒	*<10			Light yellowish brown fine to medium SAND, dry.	NC	3.65
			*<10		4		NC	
			*<10			Light reddish brown medium to coarse SAND with much fine to medium rounded gravel, dry.		4.4
					5			
5.0-5.5		☒	*<10				NC	
						Borehole terminated at 5.5m.		5.5

LOCATION/NOTES

Container park area. Hardcore gravel surface.
Perched groundwater encountered at 2.5m.

LEGEND

☒ Disturbed Sample
▽ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation
LOCATION: Govan Shipyard Site, Glasgow
CLIENT: Clydeport / Marine
JOB NO: 44701-002

DAMES & MOORE

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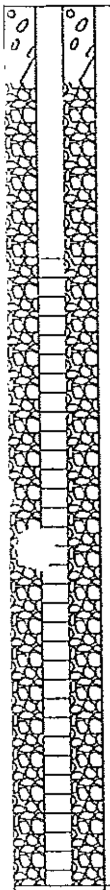
26/07/2000

BOREHOLE NO BH125

Page 1 of 1

START DATE: 05/05/00
END DATE: 05/05/00
DRILLER: Raeburn
METHOD: Window Sampler
LOGGED BY: JD
CHECKED BY: DN
BOREHOLE DIAMETER(mm): 60/50
SCREEN TYPE(mm): 19
ELEVATION (mAOD): 11.11

WELL CONSTRUCTION



SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS
						▨	MADE GROUND - dark brown medium to coarse gravelly sand with some concrete, brick and coke fragments and some coal, dry.	NC
0.1-0.9		☒	*<10			▨		
			*<10		1	▨		
			*<10			▨		
			*<10		2	▨	2.0m: with some timber fragments.	
2.2-2.9		☒	*210			▨		
			*<10		3	▨		
							Borehole terminated at 3.5mbgl.	3.5
					4			
					5			

LOCATION/NOTES

Tip area, relatively flat. Scrub grass vegetation.
No groundwater encountered.

LEGEND

☒ Disturbed Sample
▽ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation
LOCATION: Govan Shipyard Site, Glasgow
CLIENT: Clydeport / Marine
JOB NO: 44701-002

DAMES & MOORE

BOREHOLE NO BH126

Page 1 of 1

START DATE: 05/05/00
END DATE: 05/05/00
DRILLER: Raeburn
METHOD: Window Sampler
LOGGED BY: JD
CHECKED BY: DN

BOREHOLE DIAMETER(mm): 60
SCREEN TYPE(mm):
ELEVATION (mAOD): 11.39

WELL CONSTRUCTION	SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS	
	0.4-0.9		☒	*<10 *<10		1	▨	MADE GROUND - dark brown medium to coarse gravelly sand with much brick, concrete, rubble, some coke and occasional fragments of rubber tubing, dry.	NC	1.2
						2 3 4 5		Borehole terminated at 1.2mbgl.		

LOCATION/NOTES

Tip area, relatively flat with scrub grass vegetation. Relocated borehole five times - refusal at similar depths at each location. No groundwater encountered.

LEGEND

☒ Disturbed Sample
▽ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation
LOCATION: Govan Shipyard Site, Glasgow
CLIENT: Clydeport / Marine
JOB NO: 44701-002

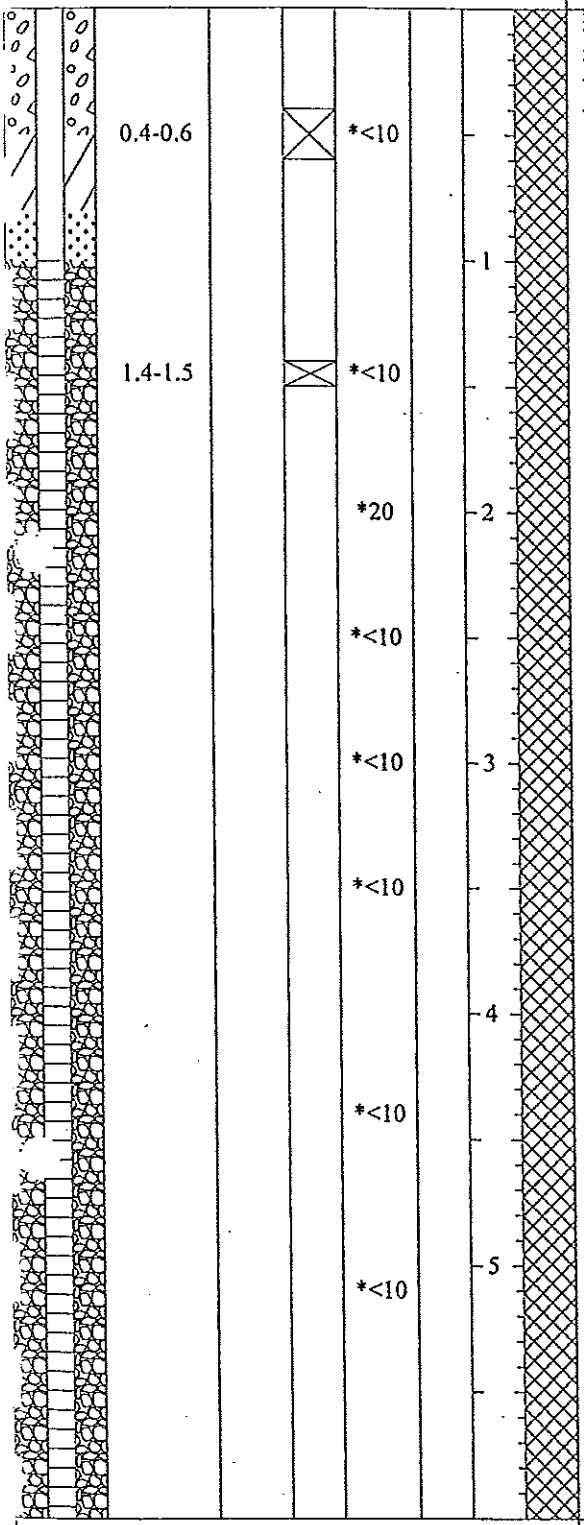
DAMES & MOORE

START DATE: 26/04/00
END DATE: 26/04/00
DRILLER: Raeburn
METHOD: Shell and Auger
LOGGED BY: CM
CHECKED BY: DN

BOREHOLE NO BH127C

Page 1 of 2

BOREHOLE DIAMETER(mm): 200/150
SCREEN TYPE(mm): 50
ELEVATION (mAOD): 12.33



SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	DESCRIPTION	COMMENTS
						MADE GROUND - dark brown fine to coarse sand and medium to coarse gravel with some brick, metal, and wood, and occasional cobbles (at top), glass and electrical wire.	
0.4-0.6		☒	*<10				
					1		
1.4-1.5		☒	*<10				
			*20		2		
			*<10			2.5m: with occasional brown cinders and coal fragments.	
			*<10		3		
			*<10				
					4		
			*<10			4.4m: with much concrete rubble.	
							NC
			*<10		5		

LOCATION/NOTES

Located in north east corner of tip area. Borehole terminated due to obstruction.

LEGEND

☒ Disturbed Sample
∇ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation
LOCATION: Govan Shipyard Site, Glasgow
CLIENT: Clydeport / Marine
JOB NO: 44701-002

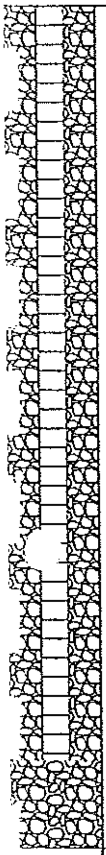
DAMES & MOORE

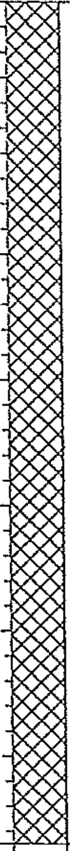
START DATE: 26/04/00
END DATE: 26/04/00
DRILLER: Raeburn
METHOD: Shell and Auger
LOGGED BY: CM
CHECKED BY: DN

BOREHOLE NO BH127C

Page 2 of 2

BOREHOLE DIAMETER(mm): 200/150
SCREEN TYPE(mm): 50
ELEVATION (mAOD): 12.33





WELL CONSTRUCTION	SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS	
				*<10						
	6.6-6.8		☒	*<10				6.6m: with a little suspected asbestos containing fibres at 6.6-6.8m.		
				*<10		7				
				*<10		8		7.9m: with much concrete rubble from 7.9m.		
				*<10						
						9				
										9.35
								Borehole terminated at 9.35mbgl.		
						10				
						11				

LOCATION/NOTES

Located in north east corner of tip area. Borehole terminated due to obstruction.

LEGEND

☒	Disturbed Sample
∇	Perched Groundwater
▼	Groundwater
*	Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation
LOCATION: Govan Shipyard Site, Glasgow
CLIENT: Clydeport / Marine
JOB NO: 44701-002

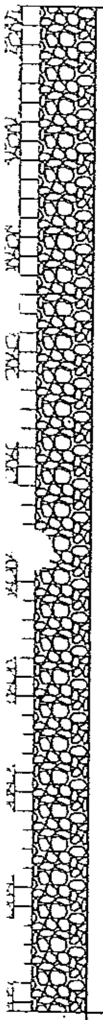
DAMES & MOORE

BOREHOLE NO BH128A

Page 2 of 2

START DATE: 09/05/00
END DATE: 10/05/00
DRILLER: Raeburn
METHOD: Shell and Auger
LOGGED BY: CM
CHECKED BY: DN

BOREHOLE DIAMETER(mm): 150
SCREEN TYPE(mm): 50 and 19
ELEVATION (mAOD): 4.91



WELL CONSTRUCTION	SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS
				*<10				6.0m: becomes only slightly silty and brown in colour. Becomes wet although no definite water strike.	
				*<10		7		7.0m: no longer silty.	NC
				*<10		8			
				*<10		9			
				*<10		10		Borehole completed at 10.0mbgl.	10
						11			

LOCATION/NOTES

Located on a gravelly surface adjacent to the bottom of the slope at the edge of the tip and south west of a substation.

LEGEND

☒ Disturbed Sample
∇ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation
LOCATION: Govan Shipyard Site, Glasgow
CLIENT: Clydeport / Marine
JOB NO: 44701-002

DAMES & MOORE

BOREHOLE NO BH128

Page 1 of 1

START DATE: 08/05/00
END DATE: 08/05/00
DRILLER: Raeburn
METHOD: Shell and Auger
LOGGED BY: JD
CHECKED BY: DN

BOREHOLE DIAMETER(mm): 150
SCREEN TYPE(mm):
ELEVATION (mAOD): 4.91

WELL CONSTRUCTION	SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS	
							▒	MADE GROUND - concrete.		0.25
	1.0-1.8		☒			1 2	▨	MADE GROUND - red blaes, gravel and sand, dry and very compacted. 2.4m: very hard	NC	2.5
						3 4 5		Borehole terminated at 2.5mbgl.		

LOCATION/NOTES

On wharf at north west corner of basin. Shallow refusal in dense red blaes.

LEGEND

- ☒ Disturbed Sample
- ▽ Perched Groundwater
- ▼ Groundwater
- * Headspace Analysis on Soil Sample

BOREHOLE LOG

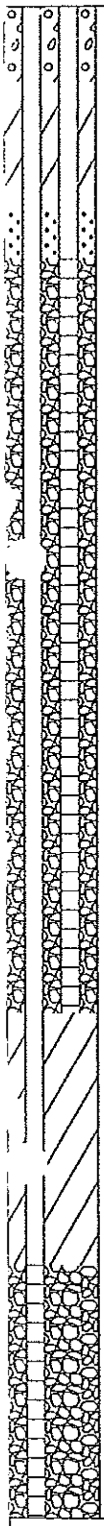
JOB TITLE: Stage II Environmental Site Investigation
LOCATION: Govan Shipyard Site, Glasgow
CLIENT: Clydeport / Marine
JOB NO: 44701-002

DAMES & MOORE

BOREHOLE NO BH128A

Page 1 of 2

START DATE: 09/05/00	
END DATE: 10/05/00	
DRILLER: Raeburn	
METHOD: Shell and Auger	BOREHOLE DIAMETER(mm): 150
LOGGED BY: CM	SCREEN TYPE(mm): 50 and 19
CHECKED BY: DN	ELEVATION (mAOD): 4.91



SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER
0.5-0.7		☒	*<10	
			*<10	
1.5-1.7		☒	*<10	
			*<10	
			*<10	
3.5-3.7		☒	*<10	
5.0-5.2		☒	*<10	

DEPTH (m)	DESCRIPTION	COMMENTS	
	MADE GROUND - Greyish brown fine to medium sand with some assorted medium gravel and occasional brick, glass and wood fragments.	NC	
1.5	MADE GROUND - Dark brown, slightly clayey, fine to medium sand with much brick and concrete rubble and occasional fibres (possible asbestos containing material) and a slight creosote odour.	LC	1.5
2.7	No recovery - pushing piece of wood (2.7-3.5m).		2.7
3.5	MADE GROUND - Greenish brown, fine to coarse, clayey sand with much glass and wood fragments and occasional fine to medium angular to sub angular gravel.	NC	3.5
3.9	MADE GROUND - Mid brown, fine to medium, slightly silty sand with occasional glass, wood and brick fragments and pockets of pale brown fine silty sand.	NC	3.9
4.5	Greenish brown, fine, silty SAND with a little fine subangular and subrounded gravel, becomes damp.	NC	4.5
5	Grey green fine silty SAND with bands of grey fine sand, damp.		5

LOCATION/NOTES

Located on a gravelly surface adjacent to the bottom of the slope at the edge of the tip and south west of a substation.

LEGEND

- ☒ Disturbed Sample
- ▽ Perched Groundwater
- ▼ Groundwater
- * Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation

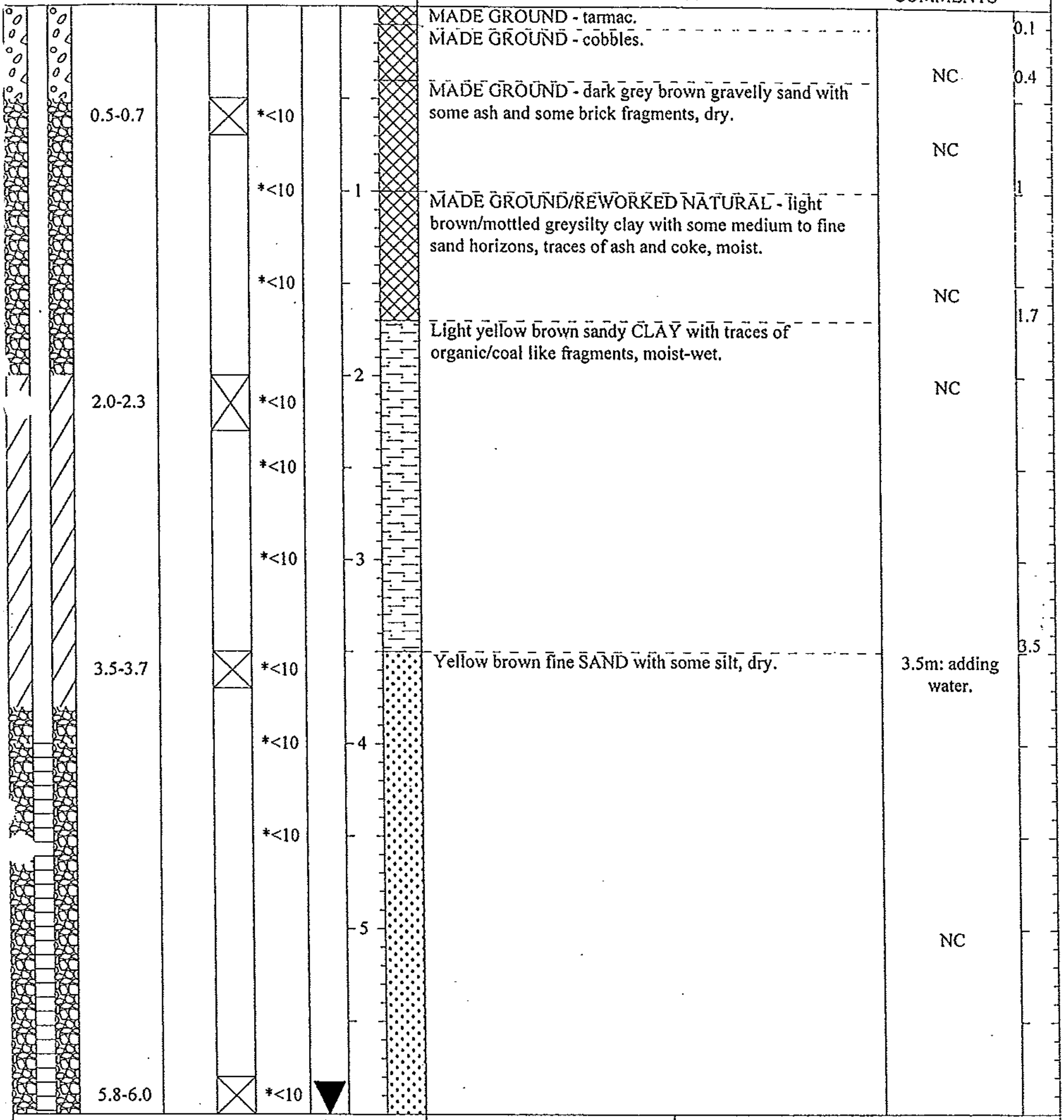
LOCATION: Govan Shipyard Site, Glasgow

CLIENT: Clydeport / Marine

JOB NO: 44701-002

DAMES & MOORE

START DATE: 08/05/00	**BOREHOLE NO BH129**
END DATE: 08/05/00	Page 1 of 2
DRILLER: Raeburn	
METHOD: Shell and Auger	BOREHOLE DIAMETER(mm): 150
LOGGED BY: JD	SCREEN TYPE(mm): 50
CHECKED BY: DN	ELEVATION (mAOD): 7.20



SAMPLE DEPTH(m)	NUMBER	TYPE	SOIL VAPOUR (ppm)	GROUNDWATER
0.5-0.7		☒	*<10	
			*<10	
			*<10	
2.0-2.3		☒	*<10	
			*<10	
			*<10	
3.5-3.7		☒	*<10	
			*<10	
			*<10	
5.8-6.0		☒	*<10	▼

DESCRIPTION	COMMENTS	
MADE GROUND - tarmac.		0.1
MADE GROUND - cobbles.	NC	0.4
MADE GROUND - dark grey brown gravelly sand with some ash and some brick fragments, dry.	NC	1
MADE GROUND/REWORKED NATURAL - light brown/mottled greysilty clay with some medium to fine sand horizons, traces of ash and coke, moist.	NC	1.7
Light yellow brown sandy CLAY with traces of organic/coal like fragments, moist-wet.	NC	3.5
Yellow brown fine SAND with some silt, dry.	3.5m: adding water. NC	

LOCATION/NOTES

Flat tarmac road adjcent to wharf on west side of basin. Groundwater encountered at 6.0mbgl.

LEGEND

- ☒ Disturbed Sample
- ▽ Perched Groundwater
- ▼ Groundwater
- * Headspace Analysis on Soil Sample

BOREHOLE LOG

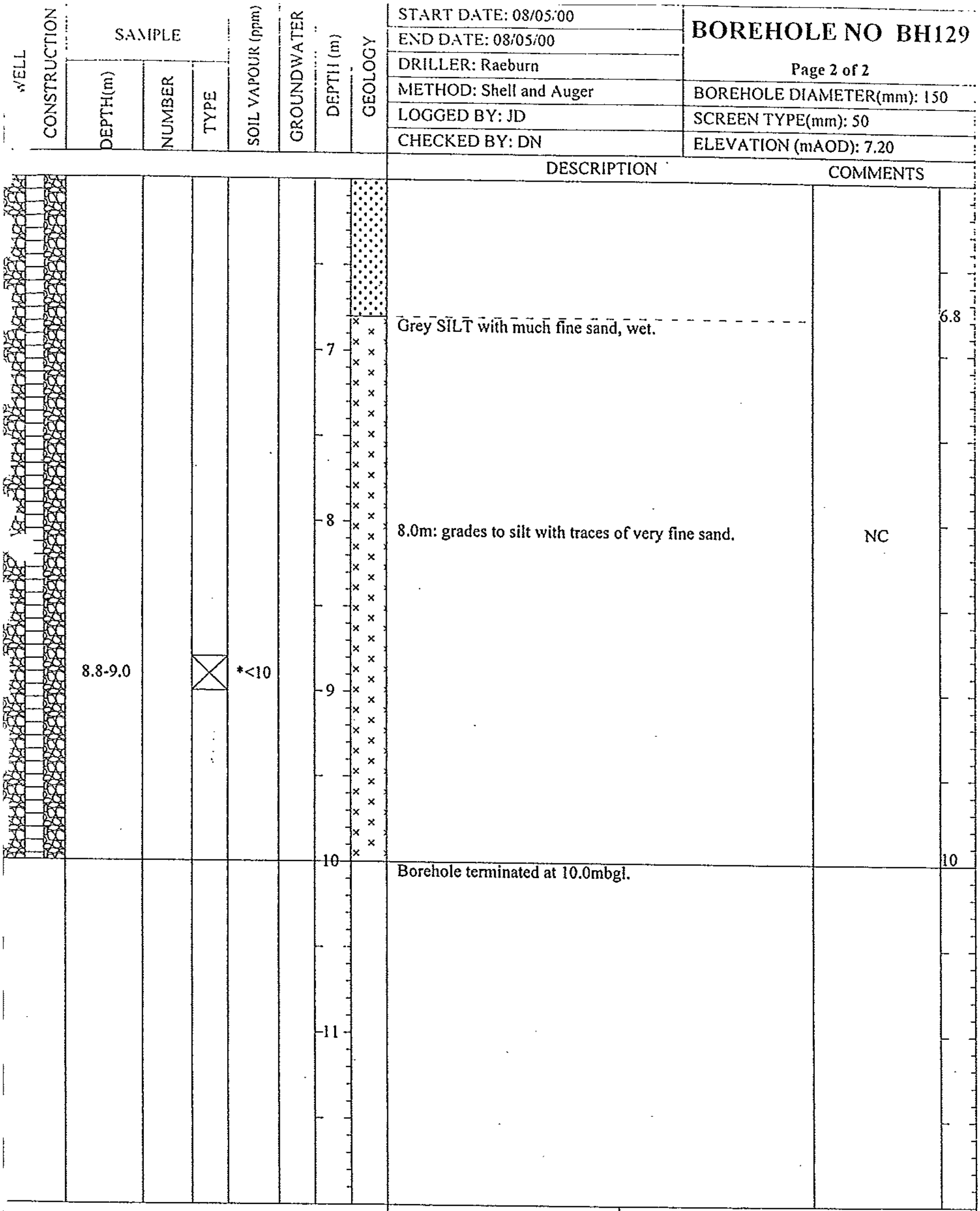
JOB TITLE: Stage II Environmental Site Investigation

LOCATION: Govan Shipyard Site, Glasgow

CLIENT: Clydeport / Marine

JOB NO: 44701-002

DAMES & MOORE



START DATE: 08/05/00
END DATE: 08/05/00
DRILLER: Raeburn
METHOD: Shell and Auger
LOGGED BY: JD
CHECKED BY: DN

BOREHOLE NO BH129

Page 2 of 2

BOREHOLE DIAMETER(mm): 150
SCREEN TYPE(mm): 50
ELEVATION (mAOD): 7.20

DEPTH(m)	NUMBER	TYPE	SOIL VAPOUR (ppm)	DESCRIPTION	COMMENTS
				Grey SILT with much fine sand, wet.	
				8.0m: grades to silt with traces of very fine sand.	NC
8.8-9.0		☒	*<10		
				Borehole terminated at 10.0mbgl.	

LOCATION/NOTES

Flat tarmac road adjcent to wharf on west side of basin. Groundwater encountered at 6.0mbgl.

LEGEND

☒ Disturbed Sample
▽ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation
LOCATION: Govan Shipyard Site, Glasgow
CLIENT: Clydeport / Marine
JOB NO: 44701-002

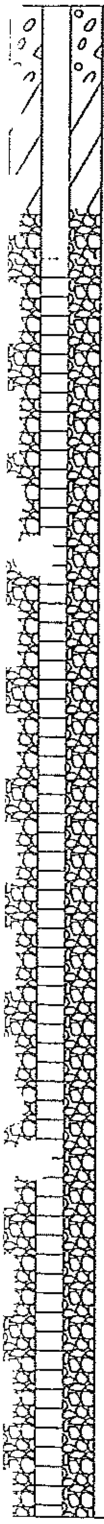
DAMES & MOORE

START DATE: 10/05/00
END DATE: 11/05/00
DRILLER: Raeburn
METHOD: Shell and Auger
LOGGED BY: CM
CHECKED BY: DN

BOREHOLE NO BH130A

Page 1 of 2

BOREHOLE DIAMETER(mm): 150
SCREEN TYPE(mm): 50
ELEVATION (mAOD): 7.87



SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS	
						▨	MADE GROUND - mid to dark brown, medium to coarse, clayey sand with much fine to medium sub angular to angular gravel and a little wood fragments, ash and brown black vesicular slag, occasional concrete rubble and cobbles of red brown - dark grey vesicular slag.		
0.5-0.7		☒	*<10						
								NC	
			*<10		1		1.0m: with only a little metaliferous slag and occasional pieces of wood, no rubble.		
1.5-1.7		☒	*<10			▨	MADE GROUND - dark grey - black, medium to coarse sand with some fine to medium, angular to sub angular gravel.		1.5
								NC	
			*<10		2	▨	MADE GROUND - dark grey and orange brown, fine to coarse , slightly clayey sand with a little fine to medium, angular to sub rounded gravel.		2
			*<10						
								NC	
			*<10		3		Firm, mid brown sandy CLAY with a little fine sub angular gravel, coal fragments and fine orange - brown and grey clayey sand.		3
								NC	
							Orange-brown fine to medium SAND with a little fine to medium, subangular to subrounded gravel.		3.3
3.5-3.7		☒	*<10						
								NC	
					4				
							Dark brown fine to coarse SAND with some fine to medium subrounded to rounded gravel.		4.4
			*<10						
					5				
			*<10						
								NC	

LOCATION/NOTES

Located within footprint of raised building, surface covered in demolition rubble. 1m inspection pit excavated prior to drilling.

LEGEND

☒ Disturbed Sample
▽ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation

LOCATION: Govan Shipyard Site, Glasgow

CLIENT: Clydeport / Marine

JOB NO: 44701-002

DAMES & MOORE

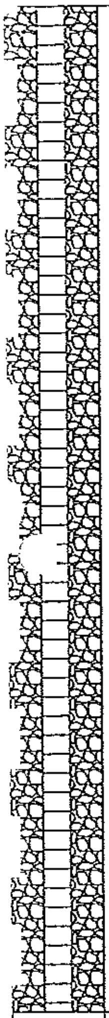
START DATE: 10/05/00
END DATE: 11/05/00
DRILLER: Raeburn
METHOD: Shell and Auger
LOGGED BY: CM
CHECKED BY: DN

BOREHOLE NO BH130A

Page 2 of 2

BOREHOLE DIAMETER(mm): 150
SCREEN TYPE(mm): 50
ELEVATION (mAOD): 7.87

WELL CONSTRUCTION	SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS
								6.0m: becomes damp.	
				*<10				Mid brown, fine, slightly silty SAND. Becomes saturated.	
						7			
				*<10				7.5m: becoming very slightly silty.	
						8			NC
				*<10					
						9			
				*<10					
						10		Borehole completed 10.0mbgl.	
						11			



6.5

10

LOCATION/NOTES

Located within footprint of raised building, surface covered in demolition rubble. 1m inspection pit excavated prior to drilling.

LEGEND

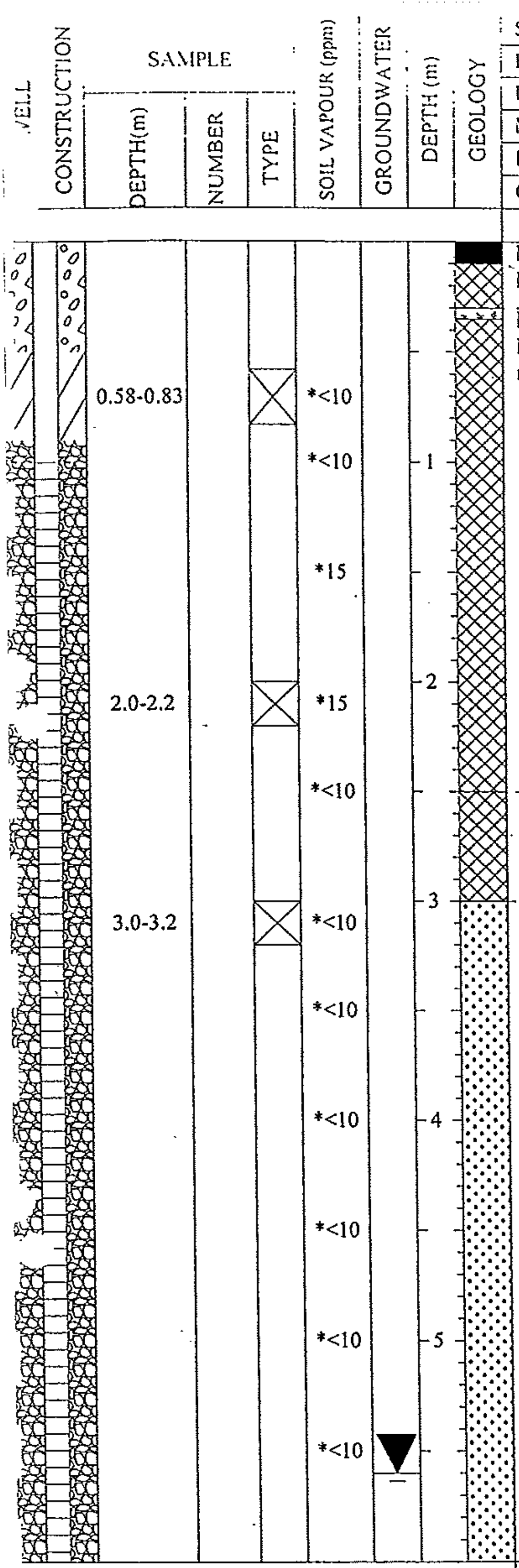
☒ Disturbed Sample
▽ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation
LOCATION: Govan Shipyard Site, Glasgow
CLIENT: Clydeport / Marine
JOB NO: 44701-002

DAMES & MOORE

START DATE: 03/05/00	**BOREHOLE NO BH131**
END DATE: 04/05/00	**Page 1 of 2**
DRILLER: Raeburn	
METHOD: Shell and Auger	BOREHOLE DIAMETER(mm): 150
LOGGED BY: JD	SCREEN TYPE(mm): 50
CHECKED BY: DN	ELEVATION (mAOD): 7.79



SAMPLE DEPTH(m)	NUMBER	TYPE	SOIL VAPOUR (ppm)
0.58-0.83		☒	*<10
			*<10
			*15
2.0-2.2		☒	*15
			*<10
3.0-3.2		☒	*<10
			*<10
			*<10
			*<10
			*<10
			*<10

DESCRIPTION	COMMENTS	
MADE GROUND - tarmac	NC	0.1
MADE GROUND - cobbles	NC	0.3
MADE GROUND - concrete		0.35
MADE GROUND - dark brown coarse gravelly sand with much ash and coke gravel and some brick fragments, dry.	NC	2.5
MADE GROUND - yellowish brown medium sand with much fine to medium rounded gravel and traces of slag, coke and ceramic fragments, dry.	NC	3
Yellowish brown fine SAND with some silt and traces of black coal-like flecks and traces of fine to medium rounded gravel.	3.2m: Adding water NC	

LOCATION/NOTES

Flat tarmac road south of pipe shop.

LEGEND

- ☒ Disturbed Sample
- ▽ Perched Groundwater
- ▼ Groundwater
- * Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation

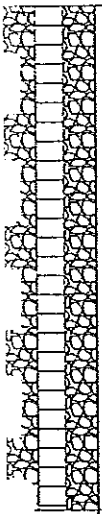
LOCATION: Govan Shipyard Site, Glasgow

CLIENT: Clydeport / Marine

JOB NO: 44701-002

DAMES & MOORE

START DATE: 03/05/00	**BOREHOLE NO BH131**
END DATE: 04/05/00	
DRILLER: Raeburn	**Page 2 of 2**
METHOD: Shell and Auger	BOREHOLE DIAMETER(mm): 150
LOGGED BY: JD	SCREEN TYPE(mm): 50
CHECKED BY: DN	ELEVATION (mAOD): 7.79



WELL CONSTRUCTION	SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS
				*<10			░		
				*<10			░		
				*<10		7	░		
						8		Borehole terminated at 8.0mbgl.	8
						9			
						10			
						11			

LOCATION/NOTES

Flat tarmac road south of pipe shop.

LEGEND

☒ Disturbed Sample
▽ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation

LOCATION: Govan Shipyard Site, Glasgow

CLIENT: Clydeport / Marine

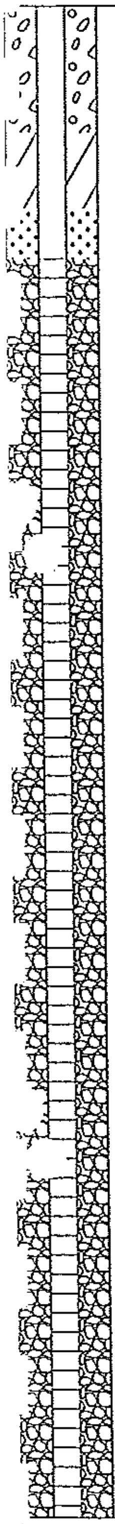
JOB NO: 44701-002

DAMES & MOORE

BOREHOLE NO BH132

Page 1 of 2

START DATE: 18/04/00
END DATE: 18/04/00
DRILLER: Raeburn
METHOD: Shell and Auger
LOGGED BY: CM
CHECKED BY: DN
BOREHOLE DIAMETER(mm): 150
SCREEN TYPE(mm): 50
ELEVATION (mAOD): 6.37



SAMPLE DEPTH(m)	NUMBER	TYPE	SOIL VAPOUR (ppm)	GROUNDWATER
1.3-1.7		☒	*<10	
1.7-2.1		☒	*<10	
			*<10	
3.0-3.2		☒	*<10	
			*<10	▼
			*<10	

DEPTH (m)	DESCRIPTION	COMMENTS
0.1	TARMAC	NC
0.7	MADE GROUND - hardcore.	NC
0.9	MADE GROUND - old 6" steel pipe and concrete.	NC
1.4	MADE GROUND - silty brown sand.	
1.7	MADE GROUND - mid brown fine to coarse clayey sand with traces of coal.	
2.4	MADE GROUND - obstruction pushed 1.7 to 2.4 metres (Very little sample recovered).	NC
	Pale brown fine SAND - weathered appearance at top. 3.0m: with ocassional fine to medium rounded - subangular gravel. 4.0m: becoming slightly silty.	NC

LOCATION/NOTES

South west corner of basin. TP excavated to 1.7mbgl to breakout concrete prior to drilling.

LEGEND

☒ Disturbed Sample
▽ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation
LOCATION: Govan Shipyard Site, Glasgow
CLIENT: Clydeport / Marine
JOB NO: 44701-002

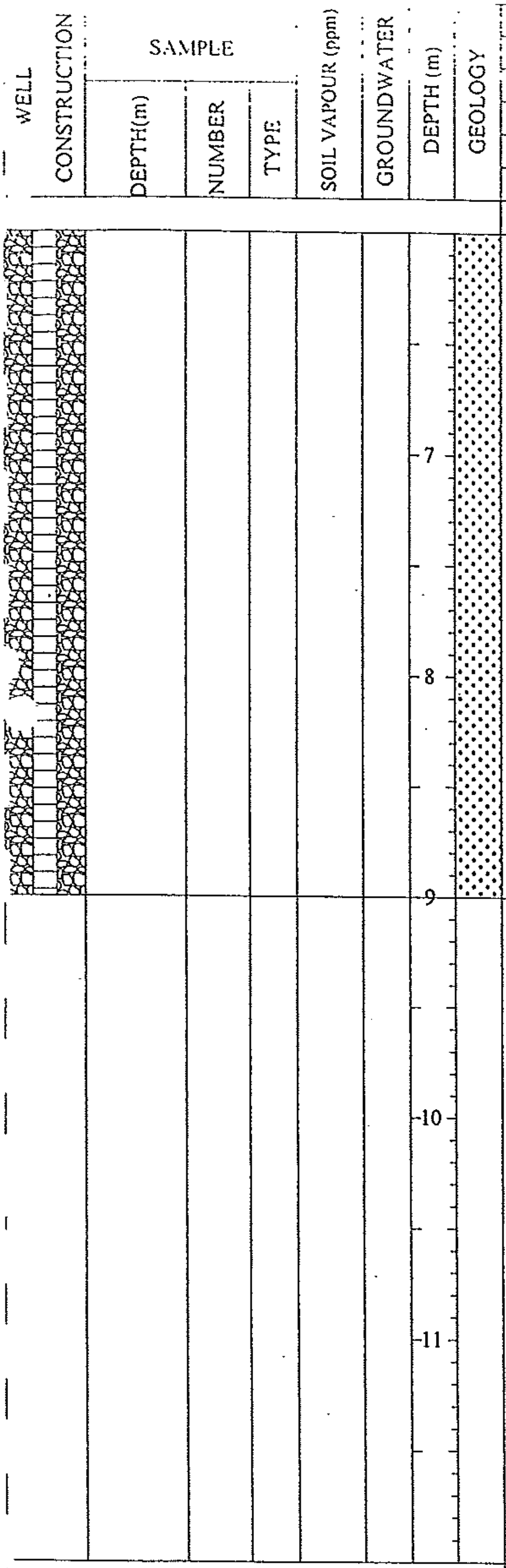
DAMES & MOORE

START DATE: 18/04/00
END DATE: 18/04/00
DRILLER: Raeburn
METHOD: Shell and Auger
LOGGED BY: CM
CHECKED BY: DN

BOREHOLE NO BH132

Page 2 of 2

BOREHOLE DIAMETER(mm): 150
SCREEN TYPE(mm): 50
ELEVATION (mAOD): 6.37



DESCRIPTION	COMMENTS
6.0m: becoming silty.	
Borehole complete at 9.0 mbgl.	

LOCATION/NOTES

South west corner of basin. TP excavated to 1.7mbgl to breakout concrete prior to drilling.

LEGEND

☒ Disturbed Sample
∇ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation

LOCATION: Govan Shipyard Site, Glasgow

CLIENT: Clydeport / Marine

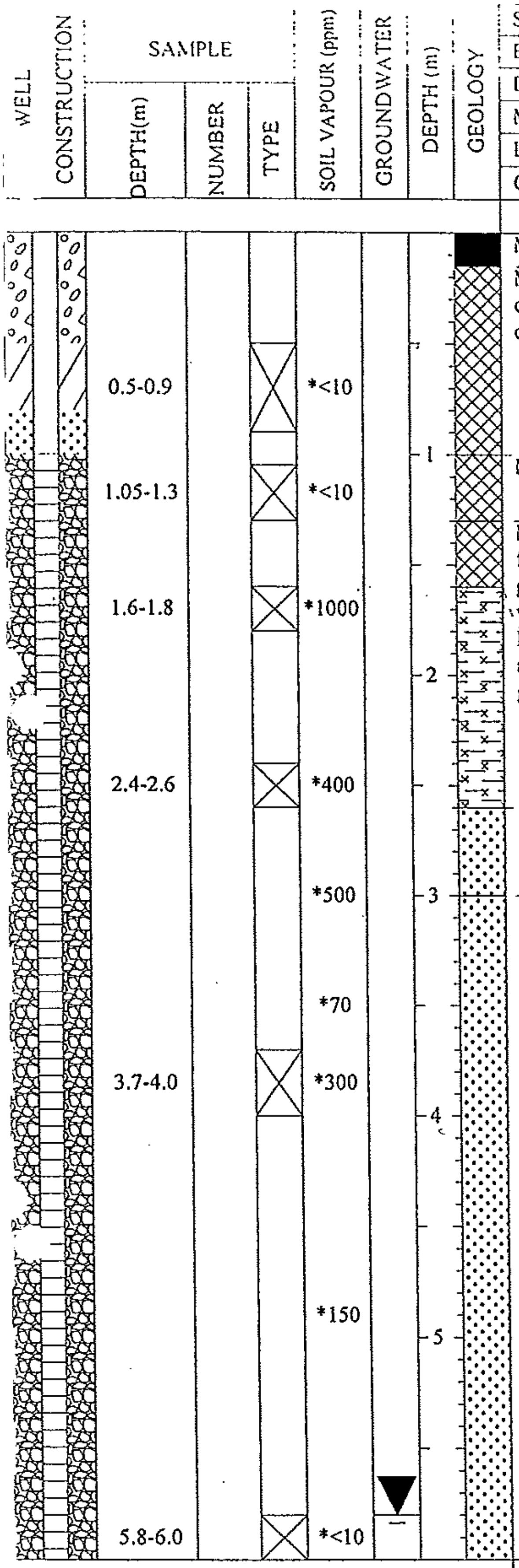
JOB NO: 44701-002

DAMES & MOORE

BOREHOLE NO BH133

Page 1 of 2

START DATE: 14/04/00
END DATE: 17/04/00
DRILLER: Raeburn
METHOD: Shell and Auger
LOGGED BY: CM
CHECKED BY: DN
BOREHOLE DIAMETER(mm): 150
SCREEN TYPE(mm): 50
ELEVATION (mAOD): 6.33



SAMPLE DEPTH(m)	NUMBER	TYPE	SOIL VAPOUR (ppm)
0.5-0.9		☒	*<10
1.05-1.3		☒	*<10
1.6-1.8		☒	*1000
2.4-2.6		☒	*400
			*500
			*70
3.7-4.0		☒	*300
			*150
5.8-6.0		☒	*<10

DESCRIPTION	COMMENTS	
MADE GROUND - tarmac	NC	0.15
MADE GROUND - brown gravelly sand with cobbles of concrete, brick and timber beams (general rubble). Slight creosote odour.	LC	1
MADE GROUND - brown silty sand with gravel.	NC	1.3
MADE GROUND - dark brown, ashy, slightly clayey, fine to medium sand with much assorted fine to medium gravel, some brick and concrete rubble and occasional wood fragments.	NC	1.6
Firm brown, slightly sandy, silty CLAY with some black ash and occasional fine rounded gravel (possible made ground).	NC	2.6
Pale brown and orange-brown, slightly clayey, fine to medium SAND with occasional subrounded gravel.	NC	3
Fine, pale brown SAND with occasional subrounded gravel and pockets of grey-orange mottled clayey sand.	NC	

LOCATION/NOTES

Located on tarmac roadway in south east corner of basin. Trial pit excavated to 1.3mbgl. prior to drilling. Drilled at high tide.

LEGEND

☒ Disturbed Sample
▽ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation
LOCATION: Govan Shipyard Site, Glasgow
CLIENT: Clydeport / Marine
JOB NO: 44701-002

DAMES & MOORE

START DATE: 14/04/00	**BOREHOLE NO BH133**
END DATE: 17/04/00	**Page 2 of 2**
DRILLER: Raeburn	
METHOD: Shell and Auger	BOREHOLE DIAMETER(mm): 150
LOGGED BY: CM	SCREEN TYPE(mm): 50
CHECKED BY: DN	ELEVATION (mAOD): 6.33

LL	CONSTRUCTION	SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS
					*<10					
							7			
					*<10					
							8			
							9		Borehole terminated at 9.0m below ground level.	9
							10			
							11			

LOCATION/NOTES

Located on tarmac roadway in south east corner of basin. Trial pit excavated to 1.3mbgl. prior to drilling. Drilled at high tide.

LEGEND

☒	Disturbed Sample
▽	Perched Groundwater
▼	Groundwater
*	Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation

LOCATION: Govan Shipyard Site, Glasgow

CLIENT: Clydeport / Marine

JOB NO: 44701-002

DAMES & MOORE

START DATE: 13/05/00
END DATE: 13/05/00
DRILLER: Raeburn
METHOD: Window Sampler
LOGGED BY: JD
CHECKED BY: DN

BOREHOLE NO BH134

Page 1 of 1

BOREHOLE DIAMETER(mm): 60/50
SCREEN TYPE(mm): 19
ELEVATION (mAOD): 6.61

SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)
0.5-1.0		☒	*<10		
			*<10		1
			*<10		
			*<10		2
			*<10		
			*<10		3
3.5-4.0		☒	*20		
			*20	▽	4
4.3-4.5		☒	*25		
					5

DESCRIPTION	COMMENTS	
MADE GROUND - concrete.	NC	0.2
MADE GROUND - brick foundation.	NC	0.5
MADE GROUND - brown/black medium to coarse gravelly sand with much coke and ash, dry.		
	LC	
4.2m: wet, very strong hydrocarbon odour and oily sheen.	MC	4.5
Borehole terminated at 4.5mbgl.		

LOCATION/NOTES

Borehole terminated on solid object/concrete.

LEGEND

☒ Disturbed Sample
▽ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation

LOCATION: Govan Shipyard Site, Glasgow

CLIENT: Clydeport / Marine

JOB NO: 44701-002

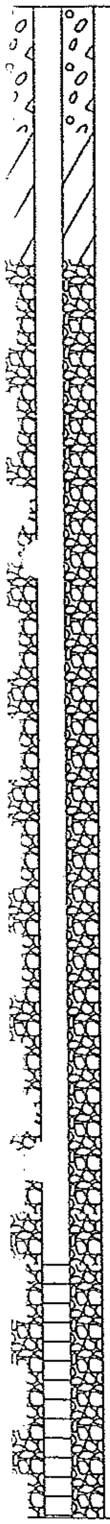
DAMES & MOORE

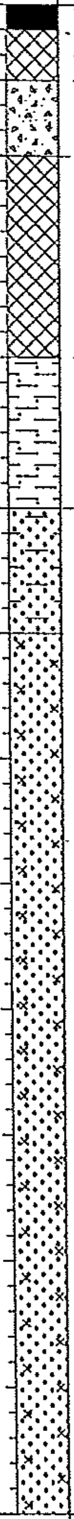
START DATE: 27/04/00
END DATE: 27/04/00
DRILLER: Raeburn
METHOD: Shell and Auger
LOGGED BY: JD
CHECKED BY: DN

BOREHOLE NO BH135

Page 1 of 2

BOREHOLE DIAMETER(mm): 150
SCREEN TYPE(mm): 50
ELEVATION (mAOD): 7.36





SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	DESCRIPTION	COMMENTS	
						MADE GROUND - tarmac		0.1
						MADE GROUND - sand and gravel	NC	0.3
			*<10			MADE GROUND - concrete	NC	0.6
0.7-1.0		☒	*<10			MADE GROUND - dark yellowish brown sandy clay with some fine gravel, slight oily texture and very slight hydrocarbon odour		
					1		MC	1.4
			*<10			dark yellow brown sandy CLAY with some fine rounded gravel, wet.	NC	
			*<10		2			2
						Yellow brown fine to medium clayey SAND with much silt and trace fine rounded gravel, moist.	NC	2.5
2.5-2.7		☒	*<10			Yellow brown fine to medium silty SAND with trace fine rounded gravel, dry.		
			*<10		3		3.0m: Adding water NC	
			*<10					
			*<10		4			
			*<10					
			*<10		5			

LOCATION/NOTES

Tarmac road slightly sloping to the north east, south side of pipe shop. Prior to drilling hand pit left overnight filled with water with slight oily sheen - likely to be surface run off after heavy rain.

LEGEND

☒	Disturbed Sample
∇	Perched Groundwater
▼	Groundwater
*	Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation

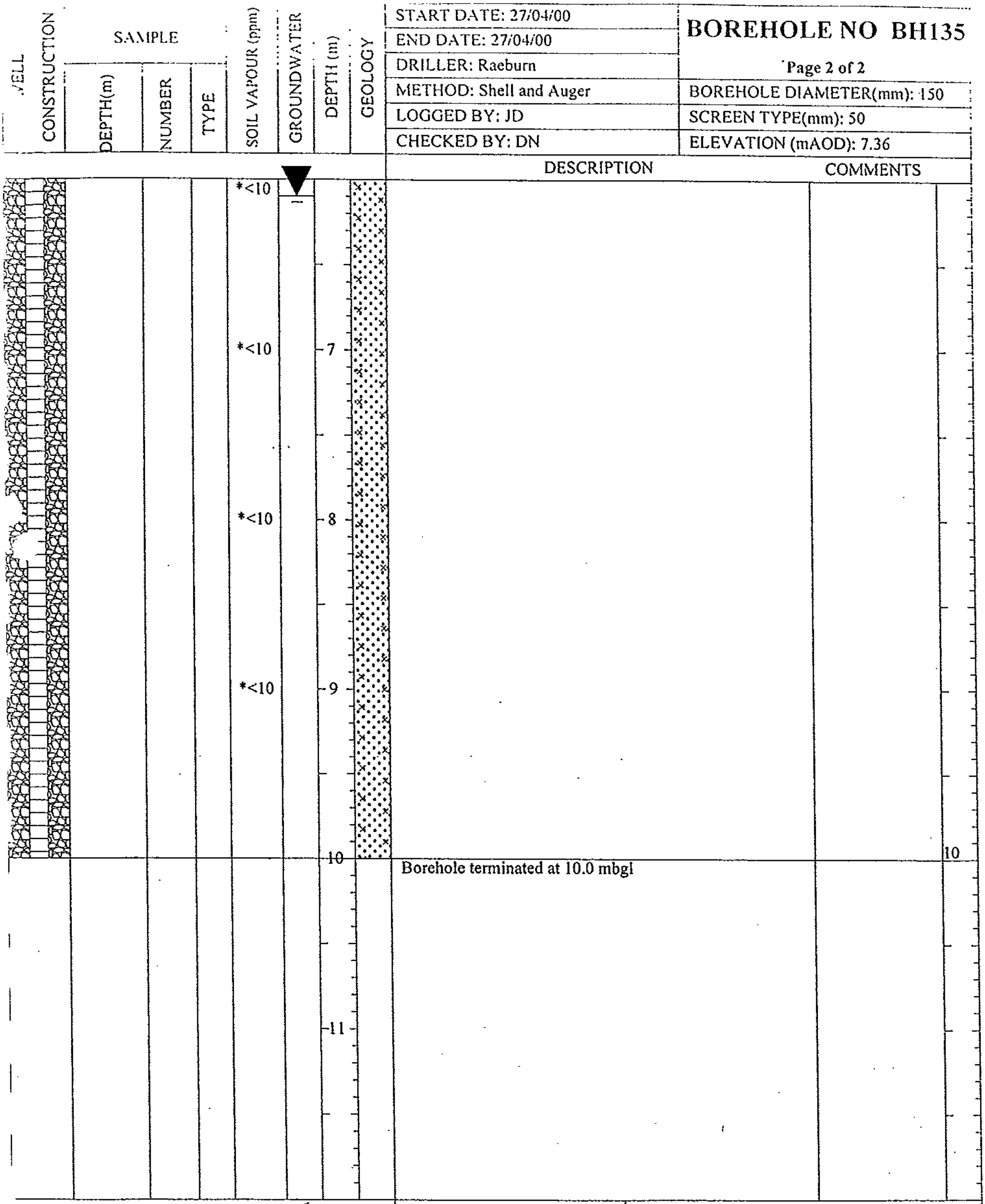
LOCATION: Govan Shipyard Site, Glasgow

CLIENT: Clydeport / Marine

JOB NO: 44701-002

DAMES & MOORE

START DATE: 27/04/00	**BOREHOLE NO BH135**
END DATE: 27/04/00	**Page 2 of 2**
DRILLER: Raeburn	
METHOD: Shell and Auger	BOREHOLE DIAMETER(mm): 150
LOGGED BY: JD	SCREEN TYPE(mm): 50
CHECKED BY: DN	ELEVATION (mAOD): 7.36



Borehole terminated at 10.0 mbgl

LOCATION/NOTES

Tarmac road slightly sloping to the north east, south side of pipe shop. Prior to drilling hand pit left overnight filled with water with slight oily sheen - likely to be surface run off after heavy rain.

LEGEND

☒ Disturbed Sample
▽ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation

LOCATION: Govan Shipyard Site, Glasgow

CLIENT: Clydeport / Marine

JOB NO: 44701-002

DAMES & MOORE

BOREHOLE NO BH136

Page 1 of 4

START DATE: 03/05/00
END DATE: 06/05/00
DRILLER: Raeburn
METHOD: Shell and Auger
LOGGED BY: JD
CHECKED BY: DN

BOREHOLE DIAMETER(mm): 200/150
SCREEN TYPE(mm): 50 and 19
ELEVATION (mAOD): 6.42

SAMPLE DEPTH(m)	NUMBER	TYPE	SOIL VAPOUR (ppm)	GROUNDWATER
1.5-1.7		☒	*<10	
2.0-2.2		☒	*400	
			*300	
3.4-3.8		☒	*250	
			*200	
			*250	
4.8-5.1		☒	*40	
				▼

DESCRIPTION	COMMENTS	
MADE GROUND - tarmac		0.15
MADE GROUND - type 1 hardcore gravel	NC	0.4
MADE GROUND - cobbles	NC	0.6
MADE GROUND - concrete	NC	0.8
MADE GROUND - red brick foundation	NC	1
MADE GROUND - brown medium to coarse gravelly sand with some brick fragments.	NC	1.5
MADE GROUND - brown sandy clay with some brick fragments, trace blaes and coal. 2.0m: grades with no brick fragments.	NC	2.5
No recovery - pushing boulder (2.5-3.0m).		3
MADE GROUND - as above.		3.2
Yellowish brown fine to medium silty SAND with much fine rounded gravel. 4.0m: with some angular to sub-rounded cobbles.	NC	
4.5m: with no cobbles and some fine to medium rounded gravel.	NC	

LOCATION/NOTES

Flat tarmac road at south end of basin. Sand rising between 150mm and 200mm casing. Both casings jammed together. Borehole re-drilled to 17.0m to install monitoring wells.

LEGEND

- ☒ Disturbed Sample
- ▽ Perched Groundwater
- ▼ Groundwater
- * Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation

LOCATION: Govan Shipyard Site, Glasgow

CLIENT: Clydeport / Marine

JOB NO: 44701-002

DAMES & MOORE

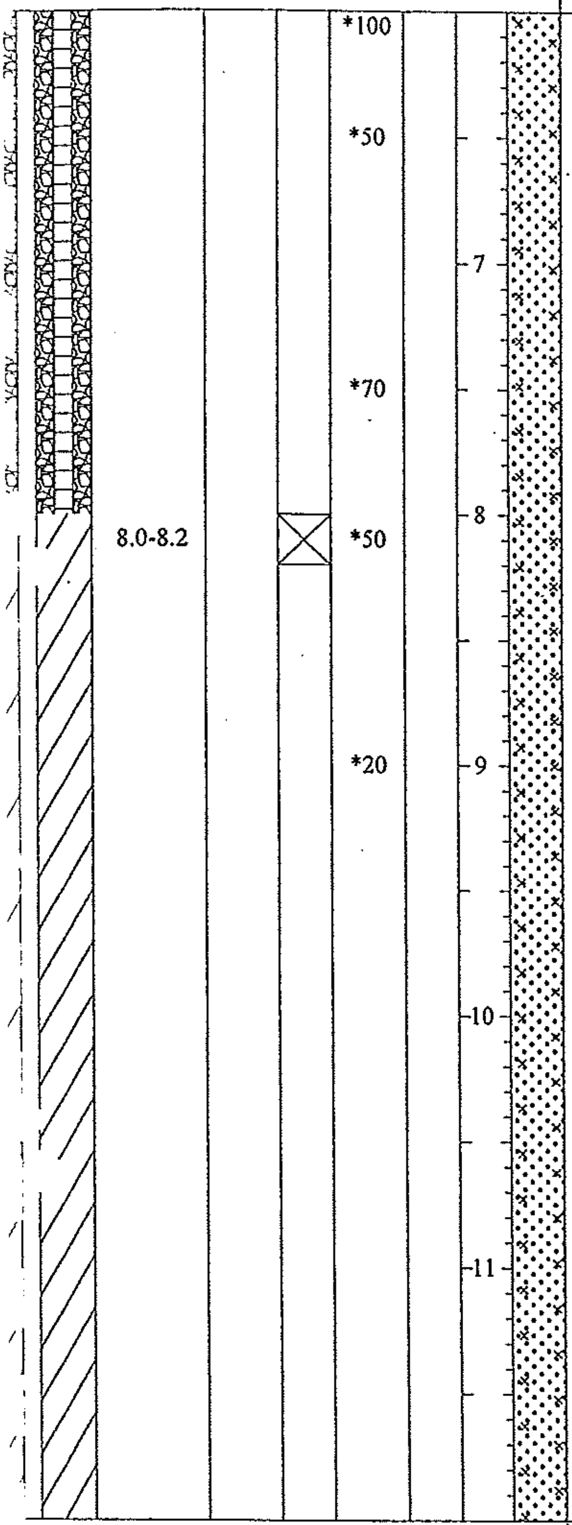
J:\44000-\44701\44701.002\GINT\CLYDEL~1\LOGS.GPJ 27/07/2000

START DATE: 03/05/00
END DATE: 06/05/00
DRILLER: Raeburn
METHOD: Shell and Auger
LOGGED BY: JD
CHECKED BY: DN

BOREHOLE NO BH136

Page 2 of 4

BOREHOLE DIAMETER(mm): 200/150
SCREEN TYPE(mm): 50 and 19
ELEVATION (mAOD): 6.42



SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	DESCRIPTION	COMMENTS
			*100			6.0m: with traces of wood fragments and traces of gravel.	NC
			*50				
					7	7.0m: with no gravel to become silty SAND.	NC
			*70				
8.0-8.2		☒	*50		8		
			*20		9		
					10		
					11		

LOCATION/NOTES

Flat tarmac road at south end of basin. Sand rising between 150mm and 200mm casing. Both casings jammed together. Borehole re-drilled to 17.0m to install monitoring wells.

LEGEND

- ☒ Disturbed Sample
- ▽ Perched Groundwater
- ▼ Groundwater
- * Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation

LOCATION: Govan Shipyard Site, Glasgow

CLIENT: Clydeport / Marine

JOB NO: 44701-002

DAMES & MOORE

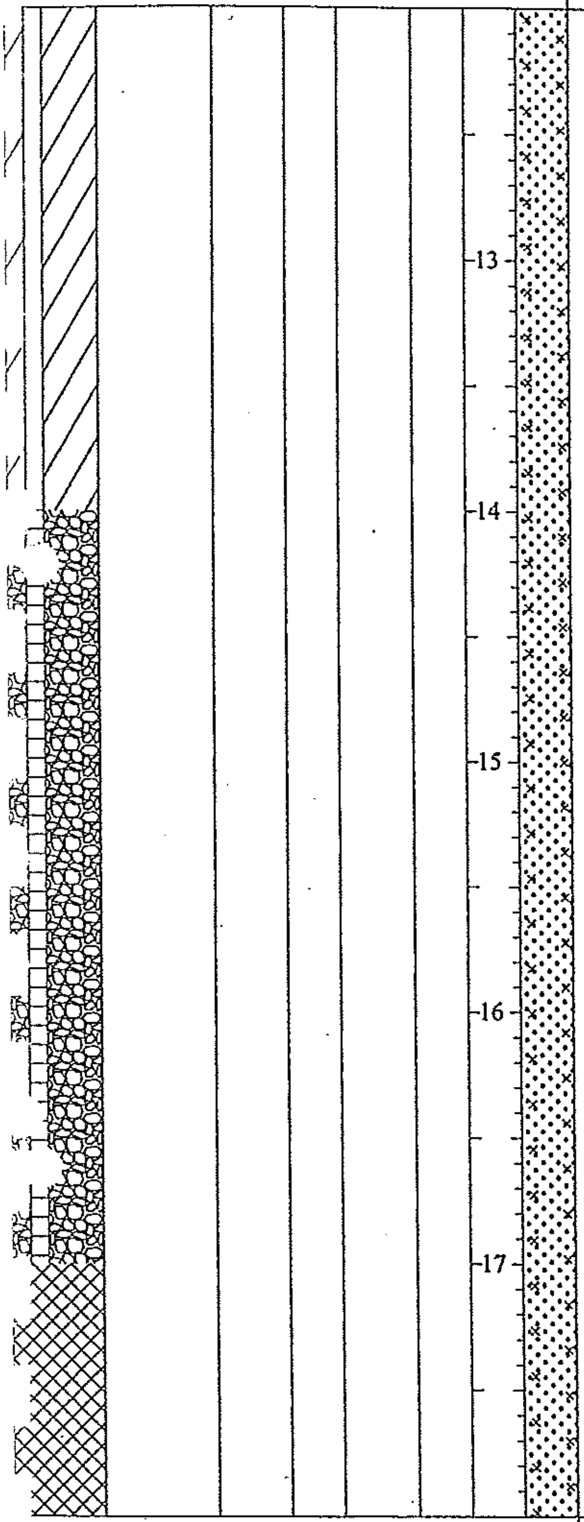
START DATE: 03/05/00
END DATE: 06/05/00
DRILLER: Raeburn
METHOD: Shell and Auger
LOGGED BY: JD
CHECKED BY: DN

BOREHOLE NO BH136

Page 3 of 4

BOREHOLE DIAMETER(mm): 200/150
SCREEN TYPE(mm): 50 and 19
ELEVATION (mAOD): 6.42

WELL CONSTRUCTION	SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS



LOCATION/NOTES

Flat tarmac road at south end of basin. Sand rising between 150mm and 200mm casing. Both casings jammed together. Borehole re-drilled to 17.0m to install monitoring wells.

LEGEND

☒ Disturbed Sample
∇ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation

LOCATION: Govan Shipyard Site, Glasgow

CLIENT: Clydeport / Marine

JOB NO: 44701-002

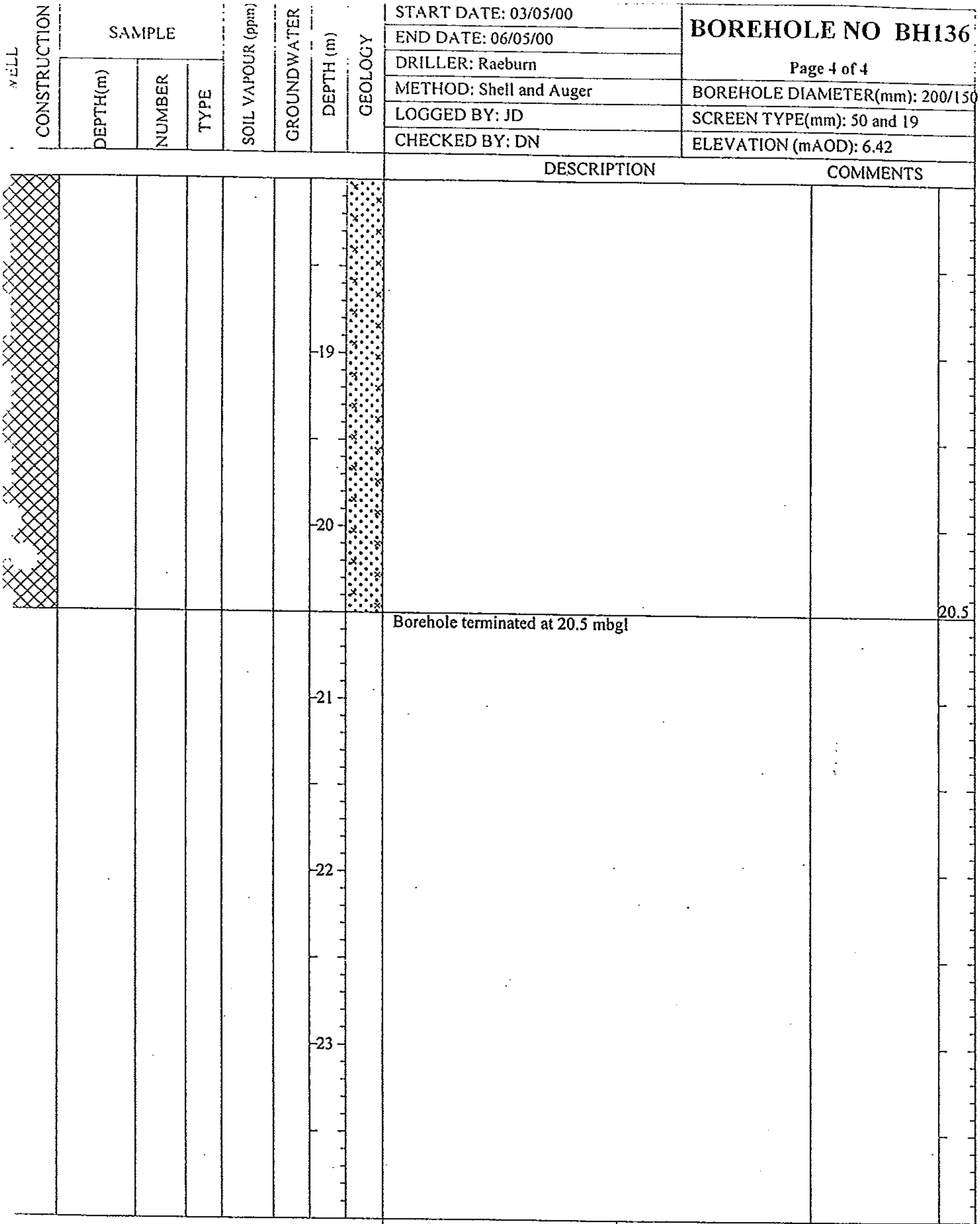
DAMES & MOORE

START DATE: 03/05/00
END DATE: 06/05/00
DRILLER: Raeburn
METHOD: Shell and Auger
LOGGED BY: JD
CHECKED BY: DN

BOREHOLE NO BH136

Page 4 of 4

BOREHOLE DIAMETER(mm): 200/150
SCREEN TYPE(mm): 50 and 19
ELEVATION (mAOD): 6.42



Borehole terminated at 20.5 mbgl

LOCATION/NOTES

Flat tarmac road at south end of basin. Sand rising between 150mm and 200mm casing. Both casings jammed together. Borehole re-drilled to 17.0m to install monitoring wells.

LEGEND

☒ Disturbed Sample
▽ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation
LOCATION: Govan Shipyard Site, Glasgow
CLIENT: Clydeport / Marine
JOB NO: 44701-002

DAMES & MOORE

J:\40000-~1\4470\44701.002\GINT\CLYDEL~1\LOGS.GPJ 27/07/2000

START DATE: 03/05/00
END DATE: 03/05/00
DRILLER: Raeburn
METHOD: Shell and Auger
LOGGED BY: JD
CHECKED BY: DN

BOREHOLE NO BH137

Page 1 of 1

BOREHOLE DIAMETER(mm): 150
SCREEN TYPE(mm):
ELEVATION (mAOD): 6.72

ELL CONSTRUCTION	SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS	
							⁙	MADE GROUND - concrete.		
							▨	MADE GROUND - dark brown gravelly sand with much medium to coarse gravel of brick, slag and sandstone, some fine coal fragments, dry.	NC	0.25
	0.6-0.8		☒	*<10			▨		NC	
						1		No recovery - pushing large cobble (1.0 to 1.8m.).		1
				*<10		2	▨	MADE GROUND - dark brown gravelly sand with much medium to coarse gravel of brick, slag and sandstone, some fine coal fragments, dry.	NC	1.8
							▤	Light brown mottled orange brown sandy CLAY with some black organic laminations, dry.		2
	2.5-2.7		☒	*<10		3	▤		NC	
						4 5		Borehole terminated at 3.1mbgl.		3.1

LOCATION/NOTES

Flat concrete surface within module hall. Target depth not achieved due to refusal on sandstone boulder, chiselled for 10 minutes - no progress. Borehole backfilled with gravel and surface re-instated with cement. Relocated to BH137A, approx. 2m east.

LEGEND

☒ Disturbed Sample
▽ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation
LOCATION: Govan Shipyard Site, Glasgow
CLIENT: Clydeport / Marine
JOB NO: 44701-002

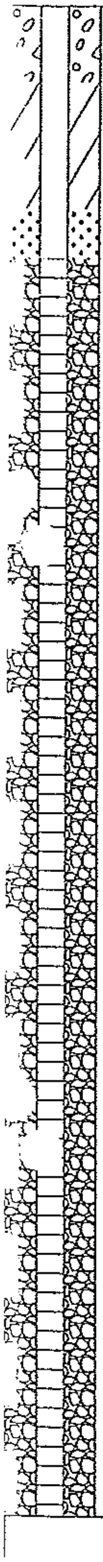
DAMES & MOORE

START DATE: 11/05/00
END DATE: 12/05/00
DRILLER: Raeburn
METHOD: Shell and Auger
LOGGED BY: CM
CHECKED BY: DN

BOREHOLE NO BH137A

Page 1 of 2

BOREHOLE DIAMETER(mm): 150
SCREEN TYPE(mm): 50
ELEVATION (mAOD): 6.76



SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS	
							MADE GROUND - concrete.		0.2
							MADE GROUND - hardcore gravel.		0.32
0.5-0.7		☒	*<10				MADE GROUND - dark brown slightly clayey, slightly gravelly, fine SAND with some brick and concrete fragments.	NC	
			*<10		1			NC	0.9
							Grey brown slightly clayey fine to medium SAND with a little fine to coarse rounded to sub-angular and occasional bands of soft brown clay.		
1.5-1.7		☒	*<10				1.5m: with occasional pockets of firm green brown SILT.	NC	
			*<10		2		Firm to stiff orange and light brown mottled and green brown slightly sandy CLAY with a little fine angular gravel and fine coal fragments.	NC	1.9
							Mid brown fine SAND with a little sub-angular to sub-rounded gravel.		2.7
3.0-3.2		☒	*<10		3				
			*<10		4		4.0m: becomes slightly silty with no gravel.	NC	
			*<10		5		5.0m: as above - fine brown slightly silty SAND.		
				▼					

LOCATION/NOTES

Located 4.1m west of end of internal wall which forms south side of internal roller door between unit hall and fabrication shop.

LEGEND

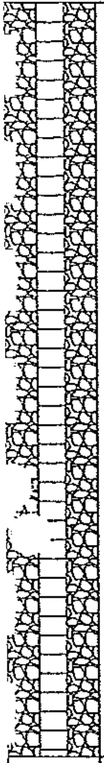
☒ Disturbed Sample
▽ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation
LOCATION: Govan Shipyard Site, Glasgow
CLIENT: Clydeport / Marine
JOB NO: 44701-002

DAMES & MOORE

START DATE: 11/05/00	**BOREHOLE NO BH137A**
END DATE: 12/05/00	**Page 2 of 2**
DRILLER: Raeburn	
METHOD: Shell and Auger	BOREHOLE DIAMETER(mm): 150
LOGGED BY: CM	SCREEN TYPE(mm): 50
CHECKED BY: DN	ELEVATION (mAOD): 6.76



ELL CONSTRUCTION	SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS
				*<10					6.0m: becomes saturated.
				*<10		7			
				*<10		8			
				*<10					
						9		Borehole terminated at 9.0mbgl.	
						10			
						11			

LOCATION/NOTES

Located 4.1m west of end of internal wall which forms south side of internal roller door between unit hall and fabrication shop.

LEGEND

☒	Disturbed Sample
∇	Perched Groundwater
▼	Groundwater
*	Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation

LOCATION: Govan Shipyard Site, Glasgow

CLIENT: Clydeport / Marine

JOB NO: 44701-002

DAMES & MOORE

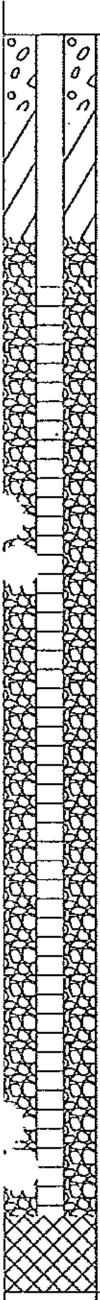
BOREHOLE NO BH138

Page 1 of 1

START DATE: 12/05/00
END DATE: 12/05/00
DRILLER: Raeburn
METHOD: Window Sampler
LOGGED BY: CM
CHECKED BY: DN

BOREHOLE DIAMETER(mm): 60/50
SCREEN TYPE(mm): 19
ELEVATION (mAOD): 6.58

WELL CONSTRUCTION



GEOLOGY

SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	DESCRIPTION	COMMENTS	
						MADE GROUND - concrete.	NC	
			*<10			MADE GROUND - mid brown, fine to coarse, gravelly sand with some brick fragments at the top.	NC	0.35
0.7-1.0		☒	*<10			MADE GROUND - fine to medium gravel of black ash with a little red brown slag and metaliferous slag.	NC	0.65
					1	MADE GROUND - soft, dark grey and mid brown, sandy clay with a little fine angular gravel.	NC	1
						Mid brown, soft to firm sandy CLAY.		1.2
1.5-1.9		☒	*<10			1.5m: grades to grey brown and orange brown, slightly clayey fine sand.		
			*<10		2	2.0m: grades to pale brown and orange brown fine to medium SAND.		
2.5-2.9		☒	*<10			2.5m: becomes medium grained with occasional weathered, medium subrounded gravel.		
			*<10		3		NC	
			*<10		4	4.0m: with occasional bands of firm grey silt.		
						4.5m: band of firm grey SILT over soft brown CLAY.		
						Pale brown fine SAND, moist.		4.6
						4.9m: becomes wet.	NC	
					5	Borehole terminated at 5.0mbgl.		5

LOCATION/NOTES

Located on tarmac outside Medical Centre and Unit Hall.

LEGEND

☒ Disturbed Sample
▽ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation
LOCATION: Govan Shipyard Site, Glasgow
CLIENT: Clydeport / Marine
JOB NO: 44701-002

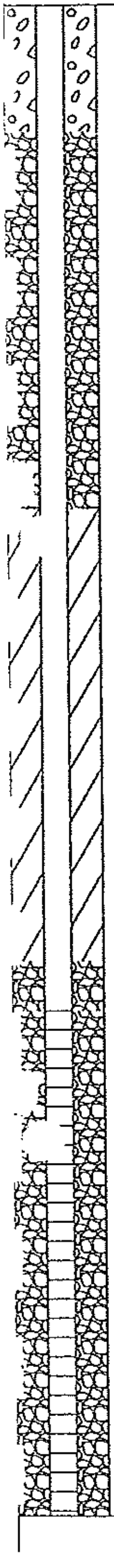
DAMES & MOORE

BOREHOLE NO BH139

Page 1 of 2

START DATE: 26/04/00
END DATE: 26/04/00
DRILLER: Raeburn
METHOD: Shell and Auger
LOGGED BY: JD
CHECKED BY: DN

BOREHOLE DIAMETER(mm): 150
SCREEN TYPE(mm): 50
ELEVATION (mAOD): 5.33



SAMPLE DEPTH(m)	NUMBER	TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	DESCRIPTION	COMMENTS	
						MADE GROUND - concrete.	NC	
						MADE GROUND - type 1 hardcore gravel.		0.5
			*<10		1	1.0m: with some sand and traces of clay.	NC	
1.3-1.5		☒	*<10					
			*<10			MADE GROUND - dark yellow brown fine sandy clay with much angular medium to coarse gravel (hardcore) and traces of clay.		1.4
			*<10		2	2.0m: with traces of fine angular gravel (no hardcore, reworked natural).	NC	
2.5-2.7		☒	*<10			Light yellow brown mottled grey CLAY with some silt, dry to moist, no odour.	NC	2.5
			*<10		3	Light yellow brown fine sandy CLAY, dry, no odour.		3
			*<10				NC	
						Light yellow brown very silty SAND, moist, no odour.		3.6
4.0-4.2		☒	*<10		4			
			*<10			4.5m: becoming greyish brown, wet.		
				▼	5			
			*<10					

LOCATION/NOTES

Inside tank assembly shop. Centre of building, bay 2.

LEGEND

☒ Disturbed Sample
▽ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation
LOCATION: Govan Shipyard Site, Glasgow
CLIENT: Clydeport / Marine
JOB NO: 44701-002

DAMES & MOORE

START DATE: 26/04/00
END DATE: 26/04/00
DRILLER: Raeburn
METHOD: Shell and Auger
LOGGED BY: JD
CHECKED BY: DN

BOREHOLE NO BH139

Page 2 of 2

BOREHOLE DIAMETER(mm): 150
SCREEN TYPE(mm): 50
ELEVATION (mAOD): 5.33

WELL CONSTRUCTION	SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS	
				*<10					NC	
				*<10						
				*<10		7				
				*<10						
						8		Borehole terminated at 8.0mbgl.		8
						9				
						10				
						11				

LOCATION/NOTES

Inside tank assembly shop. Centre of building, bay 2.

LEGEND

- ☒ Disturbed Sample
- ▽ Perched Groundwater
- ▼ Groundwater
- * Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation

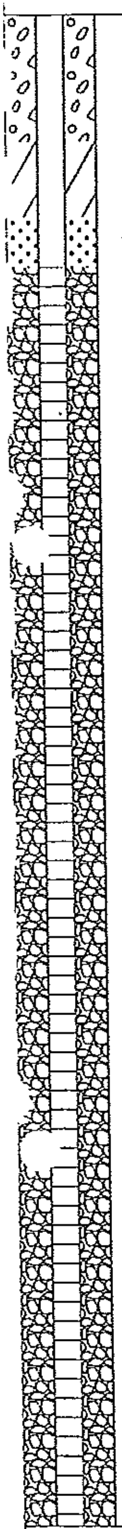
LOCATION: Govan Shipyard Site, Glasgow

CLIENT: Clydeport / Marine

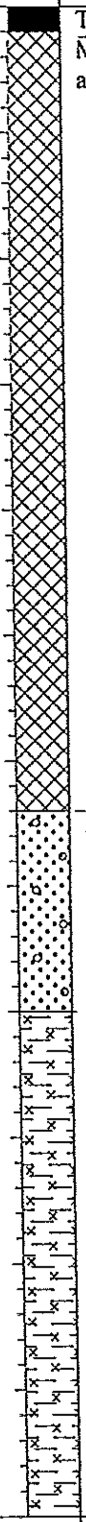
JOB NO: 44701-002

DAMES & MOORE

START DATE: 17/04/00	**BOREHOLE NO BH140**
END DATE: 18/04/00	Page 1 of 2
DRILLER: Raeburn	
METHOD: Shell and Auger	BOREHOLE DIAMETER(mm): 150
LOGGED BY: CM	SCREEN TYPE(mm): 50
CHECKED BY: DN	ELEVATION (mAOD): 5.00



SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	DESCRIPTION	COMMENTS	
						TARMAC MADE GROUND - fine to coarse, medium brown sand and subrounded to angular fine to coarse gravel.	NC	0.1
0.7-1.1		☒	*<10					
					1			
1.5-1.7		☒	*<10				NC	
1.9-2.2		☒	*<10		2			
			*<10					
					3			
						Fine, brown and orange brown SAND and fine to medium rounded to subrounded GRAVEL.		3.2
3.4-3.8		☒	*<10				NC	
			*<10	▼	4	Soft, grey-green, silty CLAY with thin bands of fine, pale brown sand.		4
			*<10		5			
						5.1m: becomes firm.		



LOCATION/NOTES

Water stuck at 4.0m. Located adjacent to north west corner of new building and approx 20m east of bunded diesel above ground storage tank.

LEGEND

☒ **Disturbed Sample**
▽ **Perched Groundwater**
▼ **Groundwater**
* **Headspace Analysis on Soil Sample**

BOREHOLE LOG

JOB TITLE: **Stage II Environmental Site Investigation**
LOCATION: **Govan Shipyard Site, Glasgow**
CLIENT: **Clydeport / Marine**
JOB NO: **44701-002**

DAMES & MOORE

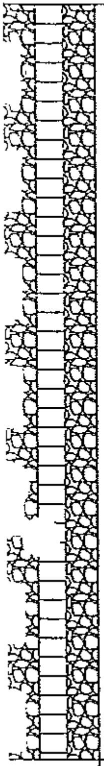
LL	CONSTRUCTION	SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY

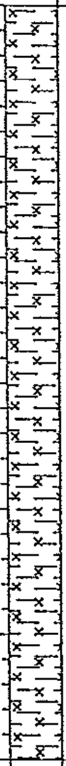
START DATE: 17/04/00
END DATE: 18/04/00
DRILLER: Raeburn
METHOD: Shell and Auger
LOGGED BY: CM
CHECKED BY: DN

BOREHOLE NO BH140

Page 2 of 2

BOREHOLE DIAMETER(mm): 150
SCREEN TYPE(mm): 50
ELEVATION (mAOD): 5.00





DEPTH (m)	DESCRIPTION	COMMENTS
	6.0m: becoming very silty.	NC
7		
8		
9	Borehole terminated at 9.0mbgl.	
10		
11		

LOCATION/NOTES

Water stuck at 4.0m. Located adjacent to north west corner of new building and approx 20m east of bunded diesel above ground storage tank.

LEGEND

☒ Disturbed Sample
∇ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation
LOCATION: Govan Shipyard Site, Glasgow
CLIENT: Clydeport / Marine
JOB NO: 44701-002

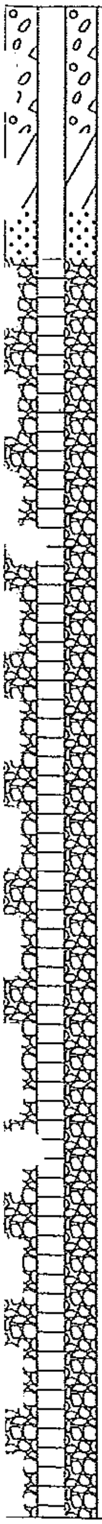
DAMES & MOORE

START DATE: 27/04/00
END DATE: 27/04/00
DRILLER: Raeburn
METHOD: Shell and Auger
LOGGED BY: CM
CHECKED BY: DN

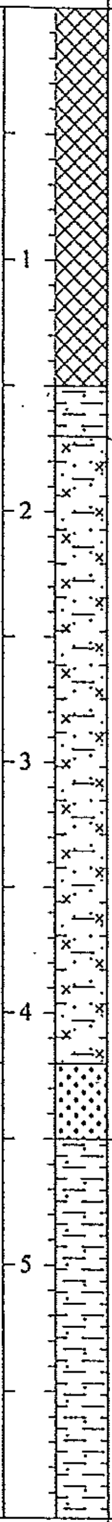
BOREHOLE NO BH141

Page 1 of 2

BOREHOLE DIAMETER(mm): 150
SCREEN TYPE(mm): 50
ELEVATION (mAOD): 5.22



SAMPLE DEPTH(m)	NUMBER	TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DESCRIPTION	COMMENTS	
					MADE GROUND - dark brown fine to medium sand with much brick fragments and a little fine to medium gravel and occasional ash and brick.		
0.5-0.6		☒	*<10				
			*<10			NC	
1.5-1.7		☒	*<10		Soft medium brown sandy CLAY with a little ash, fine gravel and brick fragments.	NC	1.5
					Firm brown slightly sandy, silty CLAY with a little black ash.		1.7
			*<10				
2.5-2.7		☒	*<10				
			*<10			NC	
			*<10	▼			
					Fine, grey brown and medium brown, clayey silty SAND.	NC	4.2
					Soft, grey brown CLAY with thin bands of fine grey silty SAND.		4.5
			*<10				



LOCATION/NOTES

Becomes damp from 3.0m, wet at 4.2m.

LEGEND

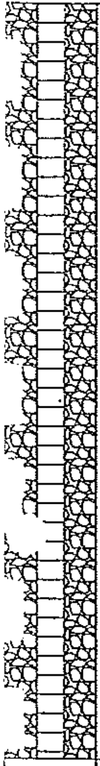
☒ Disturbed Sample
▽ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation
LOCATION: Govan Shipyard Site, Glasgow
CLIENT: Clydeport / Marine
JOB NO: 44701-002

DAMES & MOORE

START DATE: 27/04/00	**BOREHOLE NO BH141**
END DATE: 27/04/00	**Page 2 of 2**
DRILLER: Raeburn	
METHOD: Shell and Auger	BOREHOLE DIAMETER(mm): 150
LOGGED BY: CM	SCREEN TYPE(mm): 50
CHECKED BY: DN	ELEVATION (mAOD): 5.22



..ELL CONSTRUCTION	SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS
				*<10					NC
				*<10		7			
				*<10		8			
				*<10		9		Borehole terminated at 9.0mbgl.	9
						10			
						11			

LOCATION/NOTES

Becomes damp from 3.0m, wet at 4.2m.

LEGEND

☒ Disturbed Sample
▽ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation

LOCATION: Govan Shipyard Site, Glasgow

CLIENT: Clydeport / Marine

JOB NO: 44701-002

DAMES & MOORE

START DATE: 15/05/00
END DATE: 15/05/00
DRILLER: Raeburn
METHOD: Window Sampler
LOGGED BY: CM
CHECKED BY: DN

BOREHOLE NO BH142

Page 1 of 1

BOREHOLE DIAMETER(mm): 60/50
SCREEN TYPE(mm): 19
ELEVATION (mAOD): 4.70

SAMPLE DEPTH(m)	NUMBER	TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DESCRIPTION	COMMENTS	
					MADE GROUND - cobbles.	NC	0.2
					MADE GROUND - brick/ concrete/ clayey sand.	NC	0.4
					MADE GROUND - concrete.	NC	0.6
0.7-0.9		☒			MADE GROUND - dark brown/ blackgravelly sand with medium gravel of coke, some ash, coal and brick.	NC	1.05
1.0-1.2		☒	*<10		MADE GROUND - dark grey brown, fine to medium SAND with a little fine rounded to subangular gravel (possibly reworked natural).	NC	1.5
1.5-1.7		☒	*<10		Orange brown fine to coarse SAND with much fine to medium rounded to subrounded gravel.	NC	2.5
			*10		Grades to grey brown and orange brown mottled, soft very sandy CLAY with a little fine subangular gravel, becomes damp.	NC	3.2
3.2-3.7		☒	*100		Grey, soft, slightly sandy SILT with a organic odour. 3.7m: becomes very sandy with a little fine angular gravel.	LC	3.8

Borehole terminated at 3.8mbgl.

LOCATION/NOTES

Located approx. 9m north east of electrical substation and beneath large crane. Borehole terminated due to obstruction.

LEGEND

☒ Disturbed Sample
▽ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation
LOCATION: Govan Shipyard Site, Glasgow
CLIENT: Clydeport / Marine
JOB NO: 44701-002

DAMES & MOORE

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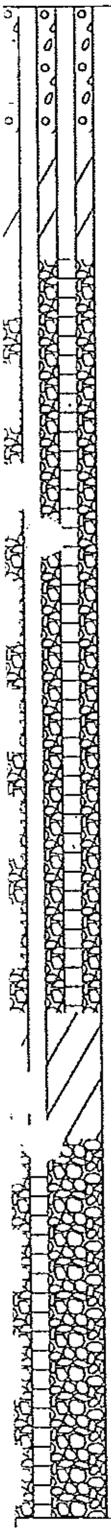
BOREHOLE NO BH143

Page 1 of 2

START DATE: 27/04/00	BOREHOLE DIAMETER(mm): 150
END DATE: 02/05/00	SCREEN TYPE(mm): 50 and 19
DRILLER: Raeburn	ELEVATION (mAOD): 4.47
METHOD: Shell and Auger	
LOGGED BY: DN	
CHECKED BY: JD	



SAMPLE DEPTH(m)	NUMBER	TYPE	SOIL VAPOUR (ppm)	GROUNDWATER
0.4-0.6		☒	*<10	
1.5-1.7		☒	*<10	
1.9-2.1		☒	*20	
2.4-2.7		☒	*200	
3.0-3.4		☒	*<10	
4.5-4.7		☒	*<10	
5.4-5.8		☒	*<10	▼

DESCRIPTION	COMMENTS	
MADE GROUND - brown/red moist silty-clayey sand and gravel with few pieces of blaes.	NC	1.9
MADE GROUND - dense brown/black timber, some medium sand.	NC	2.4
MADE GROUND - grey/brown moist silty, slightly clayey fine to medium sand and gravel. 3.5m: as above with few pieces of wood and blaes and possibly few small pieces of coal.	NC	4.3
Grey brown slightly coarse sandy SILT. 5.5m: as above, slightly coarse sandy SILT.	NC	6

LOCATION/NOTES

Groundwater rose to 2.8mbgl after 30 minutes.

LEGEND

☒ Disturbed Sample

▽ Perched Groundwater

▼ Groundwater

* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation

LOCATION: Govan Shipyard Site, Glasgow

CLIENT: Clydeport / Marine

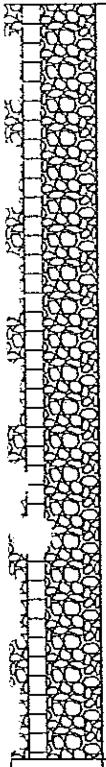
JOB NO: 44701-002

DAMES & MOORE

BOREHOLE NO BH143

Page 2 of 2

START DATE: 27/04/00	BOREHOLE DIAMETER(mm): 150
END DATE: 02/05/00	SCREEN TYPE(mm): 50 and 19
DRILLER: Raeburn	ELEVATION (mAOD): 4.47
METHOD: Shell and Auger	
LOGGED BY: DN	
CHECKED BY: JD	



SAMPLE DEPTH(m)	NUMBER	TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	DESCRIPTION	COMMENTS	
						Slightly fine sandy SILT.	NC	6.9
7.1-7.3		☒	*<10		7	Grey silty fine SAND. 7.65m: clay lense.	NC	
8.5-8.7		☒	*30		8	Dark grey/brown slightly fine sandy SILT.	NC	8
					9	Borehole terminated at 9.0mbgl.		9
					10			
					11			

LOCATION/NOTES

Groundwater rose to 2.8mbgl after 30 minutes.

LEGEND

☒ Disturbed Sample

▽ Perched Groundwater

▼ Groundwater

* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation

LOCATION: Govan Shipyard Site, Glasgow

CLIENT: Clydeport / Marine

JOB NO: 44701-002

DAMES & MOORE

START DATE: 10/05/00		**BOREHOLE NO BH144**	
END DATE: 10/05/00			
DRILLER: Raeburn		**Page 1 of 1**	
METHOD: Shell and Auger		BOREHOLE DIAMETER(mm): 150	
LOGGED BY: JD		SCREEN TYPE(mm):	
CHECKED BY: DN		ELEVATION (mAOD): 6.70	

ELL CONSTRUCTION	SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS	
							■	MADE GROUND - tarmac.	NC	0.11
							▨	MADE GROUND - hardcore.		0.21
							▨	MADE GROUND - concrete, brick, ash, blaes and clay.	NC	0.52
	0.5-1.1		☒	*<10			▨	MADE GROUND - dark brown very sandy clay with much gravel, dry.		
				*25		1	▨	1.0m: strong hydrocarbon odour, slight oily sheen, moist.	MC	
					▽		▨	1.5m: grades wet.		
	1.5-1.8		☒	*25			▨			
				*30		2	▨			
				*30			▨			2.3
								Borehole terminated 2.3mbgl.		
						3				
						4				
						5				

LOCATION/NOTES

Flat tarmac. North of transformer. Refusal on concrete and relocated approx. 15m. north east to BH144A.

LEGEND

☒ **Disturbed Sample**
▽ **Perched Groundwater**
▼ **Groundwater**
* **Headspace Analysis on Soil Sample**

BOREHOLE LOG

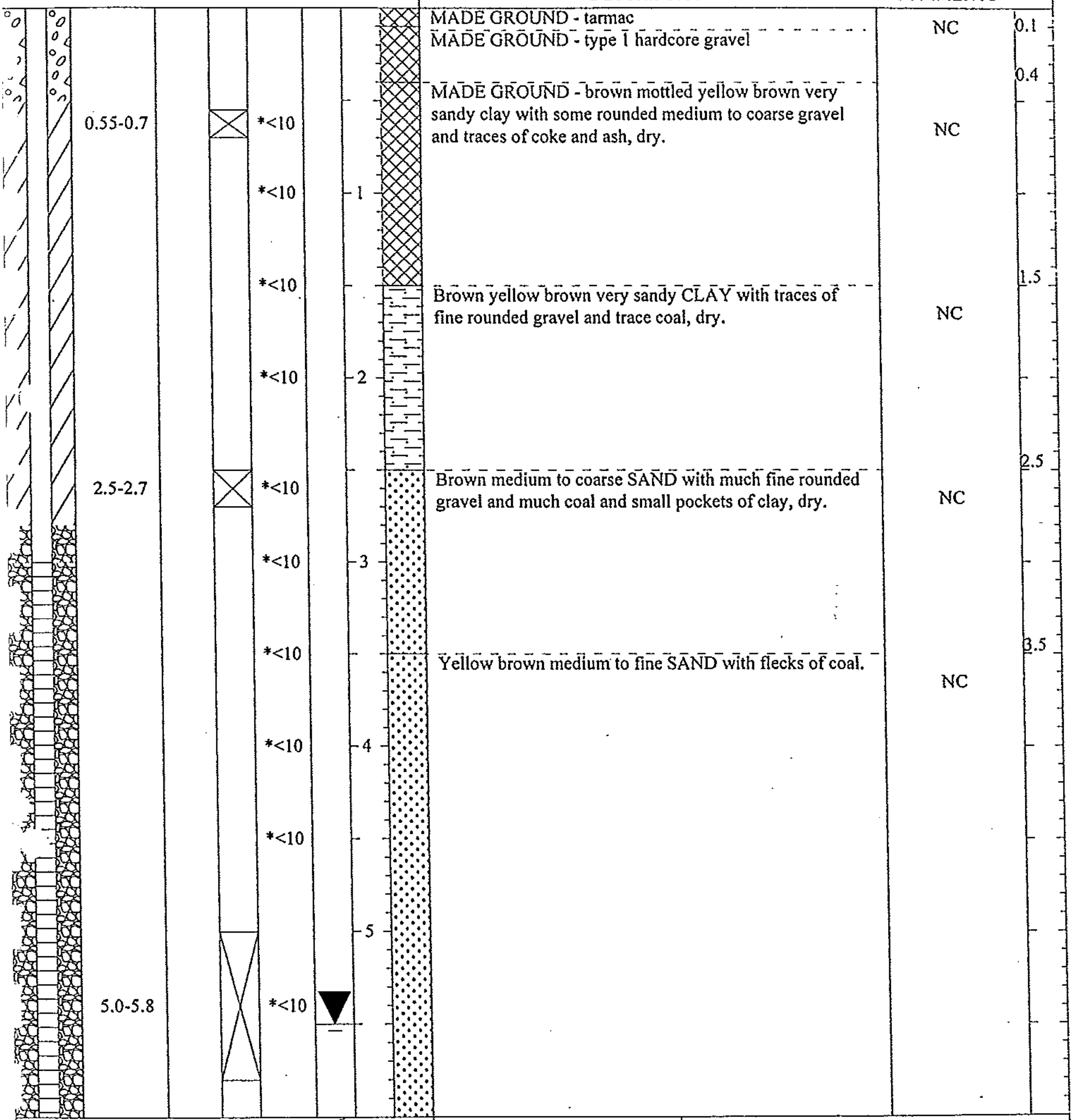
JOB TITLE: Stage II Environmental Site Investigation
LOCATION: Govan Shipyard Site, Glasgow
CLIENT: Clydeport / Marine
JOB NO: 44701-002

DAMES & MOORE

BOREHOLE NO BH144A

Page 1 of 2

START DATE: 10/05/00	
END DATE: 10/05/00	
DRILLER: Raeburn	
METHOD: Shell and Auger	BOREHOLE DIAMETER(mm): 150
LOGGED BY: JD	SCREEN TYPE(mm): 50
CHECKED BY: DN	ELEVATION (mAOD): 6.69



DESCRIPTION	COMMENTS	
MADE GROUND - tarmac	NC	0.1
MADE GROUND - type 1 hardcore gravel		0.4
MADE GROUND - brown mottled yellow brown very sandy clay with some rounded medium to coarse gravel and traces of coke and ash, dry.	NC	1.5
Brown yellow brown very sandy CLAY with traces of fine rounded gravel and trace coal, dry.	NC	2.5
Brown medium to coarse SAND with much fine rounded gravel and much coal and small pockets of clay, dry.	NC	3.5
Yellow brown medium to fine SAND with flecks of coal.	NC	

SAMPLE DEPTH(m)	NUMBER	TYPE	SOIL VAPOUR (ppm)
0.55-0.7		☒	*<10
			*<10
			*<10
			*<10
2.5-2.7		☒	*<10
			*<10
			*<10
			*<10
			*<10
5.0-5.8		☒	*<10

LOCATION/NOTES

Flat tarmac surface approximately 25m north east of BH144. Adjacent to south west corner of the steel stocking yard.

LEGEND

☒ Disturbed Sample
▽ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation

LOCATION: Govan Shipyard Site, Glasgow

CLIENT: Clydeport / Marine

JOB NO: 44701-002

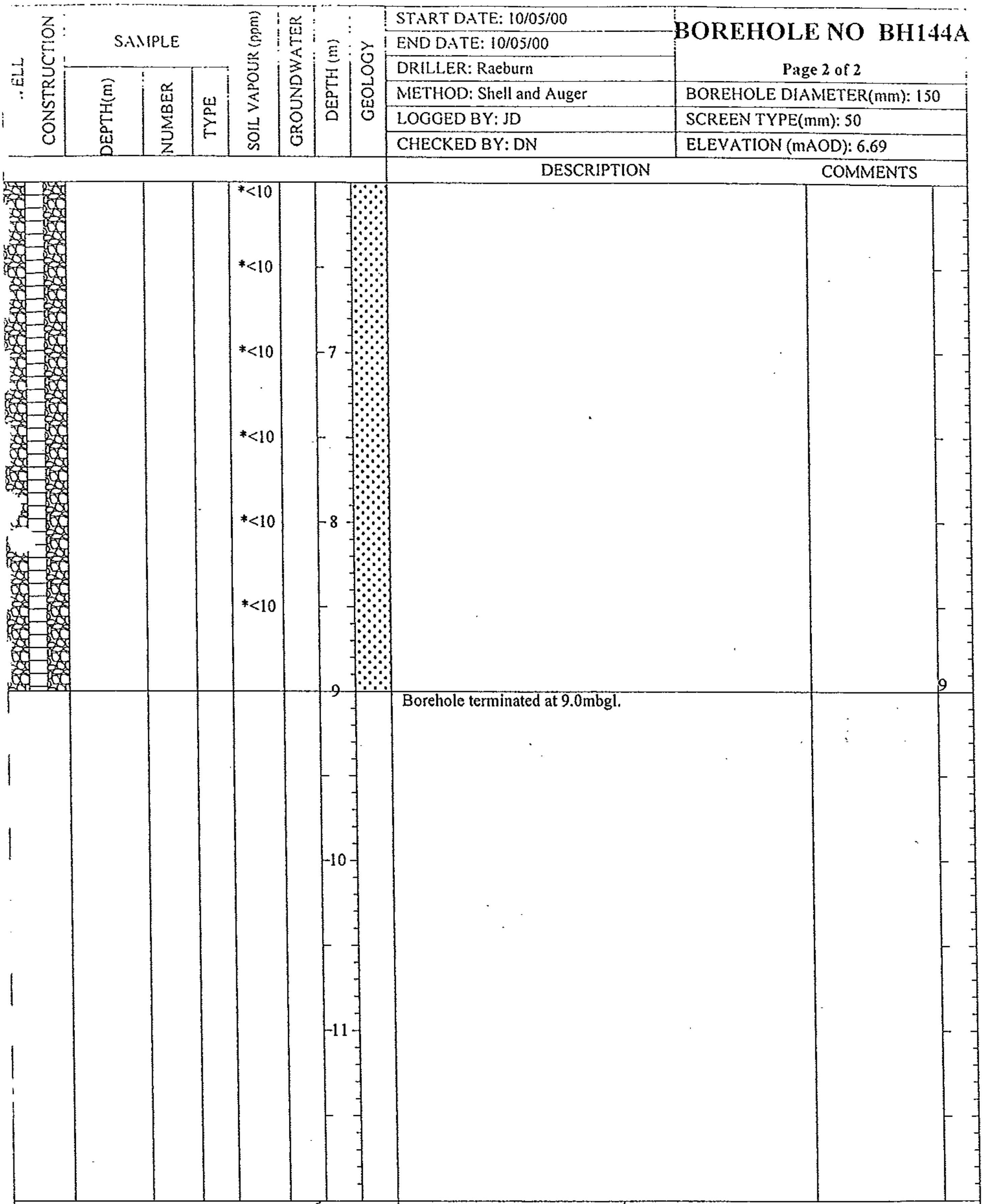
DAMES & MOORE

BOREHOLE NO BH144A

Page 2 of 2

START DATE: 10/05/00
END DATE: 10/05/00
DRILLER: Raeburn
METHOD: Shell and Auger
LOGGED BY: JD
CHECKED BY: DN

BOREHOLE DIAMETER(mm): 150
SCREEN TYPE(mm): 50
ELEVATION (mAOD): 6.69



Borehole terminated at 9.0mbgl.

LOCATION/NOTES

Flat tarmac surface approximately 25m north east of BH144. Adjacent to south west corner of the steel stocking yard.

LEGEND

☒ Disturbed Sample
▽ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation

LOCATION: Govan Shipyard Site, Glasgow

CLIENT: Clydeport / Marine

JOB NO: 44701-002

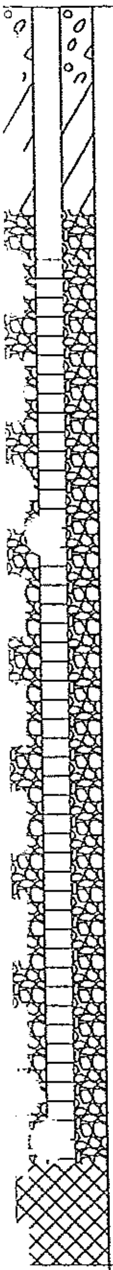
DAMES & MOORE

BOREHOLE NO BH144B

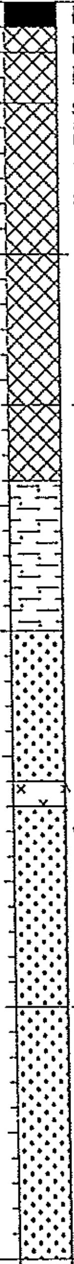
Page 1 of 1

START DATE: 15/05/00
END DATE: 15/05/00
DRILLER: Raeburn
METHOD: Window Sampler
LOGGED BY: CM
CHECKED BY: DN

BOREHOLE DIAMETER(mm): 60/50
SCREEN TYPE(mm): 19
ELEVATION (mAOD): 6.7



SAMPLE DEPTH(m)	NUMBER	TYPE	SOIL VAPOUR (ppm)	GROUNDWATER
0.5-0.7		☒	*<10	
			*<10	
1.6-1.9		☒	*100	
			*<10	
2.1-2.4		☒	*<10	
			*<10	
			*<10	
			*<10	



DESCRIPTION	COMMENTS	DEPTH (m)
MADE GROUND - tarmac.	NC	0.1
MADE GROUND - hardcore.	NC	0.2
MADE GROUND - pale brown, fine to medium, gravelly sand.	NC	0.4
MADE GROUND - pale brown fine sand with bands of firm grey silt and soft to firm, brown clay with a little fine subangular gravel.	NC	1
MADE GROUND - grey brown firm silt with few medium, subrounded gravel, bands of soft brown clay at 1.3m.	NC	1.6
MADE GROUND - grey brown, soft to firm, silty clay with a little fine angular gravel and occasional red/ brown/ black vitreous, vesicular slag and wood fragments.	NC	1.9
Orange brown, soft, slightly sandy CLAY.	NC	2.5
Grey brown, fine to medium SAND with a little fine to medium subrounded gravel at top.	NC	
3.0m: becomes medium to coarse with some fine to medium subrounded to subangular gravel.		3.1
Grey firm SILT.	NC	3.2
Grey brown and red brown fine to coarse SAND with a little fine to medium subrounded gravel.	NC	4
Pale brown fine SAND.	NC	5
Borehole completed at 5.0mbgl.		

LOCATION/NOTES

Located north of substation and 3.5m south of BH144.

LEGEND

☒ Disturbed Sample
▽ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

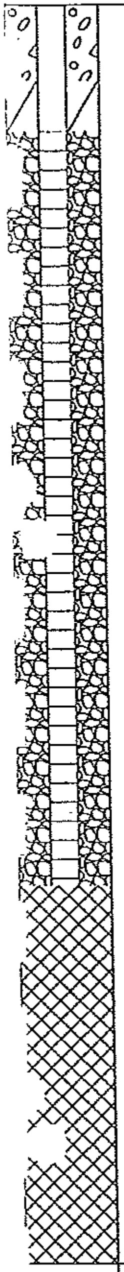
JOB TITLE: Stage II Environmental Site Investigation
LOCATION: Govan Shipyard Site, Glasgow
CLIENT: Clydeport / Marine
JOB NO: 44701-002

DAMES & MOORE

START DATE: 28/04/00
END DATE: 28/04/00
DRILLER: Raeburn
METHOD: Window Sampler
LOGGED BY: CM
CHECKED BY: DN

BOREHOLE NO BH145

Page 1 of 1
BOREHOLE DIAMETER(mm): 60/50
SCREEN TYPE(mm): 19
ELEVATION (mAOD): 6.08



SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	DESCRIPTION	COMMENTS	
						MADE GROUND - tarmac.	NC	0.1
						MADE GROUND - grey hardcore.	NC	0.35
						MADE GROUND - blaes.	NC	0.5
0.6-0.8		☒	*<10			MADE GROUND - dark brown fine to coarse gravelly sand with some ash, slag and brick and concrete rubble.	NC	
					1			1.1
1.1-1.5		☒	*<10			MADE GROUND - brown, fine to medium, ashy sand with some brick and fine to coarse, weathered gravel and occasional wood and coal.	NC	1.8
						Firm, grey brown, slightly sandy CLAY.	NC	1.9
					2	Soft to firm medium brown, slightly sandy, silty CLAY with a little fine gravel.		
2.3-2.45		☒	*<10			2.25m: with rare bands of grey brown-orange brown, medium SAND.		
						2.5m: grades into orange and grey medium SAND. 2.6m: becomes pale brown in colour.	NC	
					3			
			*<10			Fine to medium, mid brown SAND with much fine to medium subrounded gravel.		3.5
					4		NC	
			*<10			Soft, grey, slightly sandy, clayey SILT.	NC	4.5
					5	Borehole terminated at 5.0mbgl.		5

LOCATION/NOTES

Located in unloading area of steel stocking yard.
Bore hole collapsed at 3.5m.

LEGEND

- ☒ Disturbed Sample
- ▽ Perched Groundwater
- ▼ Groundwater
- * Headspace Analysis on Soil Sample

BOREHOLE LOG

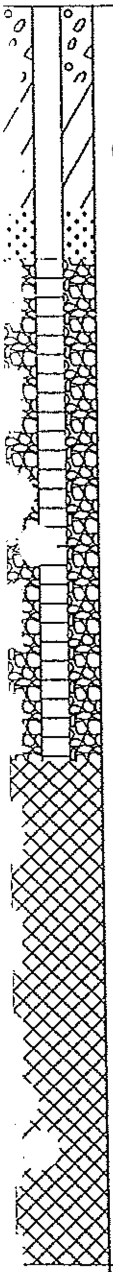
JOB TITLE: Stage II Environmental Site Investigation
LOCATION: Govan Shipyard Site, Glasgow
CLIENT: Clydeport / Marine
JOB NO: 44701-002

DAMES & MOORE

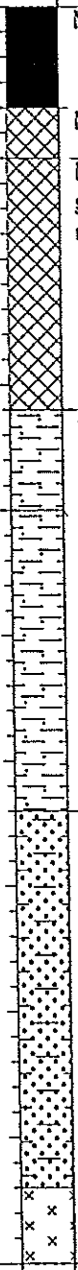
BOREHOLE NO BH146

Page 1 of 1

START DATE: 12/05/00
END DATE: 12/05/00
DRILLER: Raeburn
METHOD: Window Sampler
LOGGED BY: CM
CHECKED BY: DN
BOREHOLE DIAMETER(mm): 60/50
SCREEN TYPE(mm): 19
ELEVATION (mAOD): 5.10



SAMPLE DEPTH(m)	NUMBER	TYPE	SOIL VAPOUR (ppm)	GROUNDWATER
0.5-0.65		☒	*<10	
1.4-1.6		☒	*<10	
2.0-2.2		☒	*60	
			*30	
			*40	
			*10	
			*10	



DESCRIPTION	COMMENTS	
MADE GROUND - tarmac.	NC	0.4
MADE GROUND - red blaes.	NC	0.6
MADE GROUND - fine to medium subrounded, sandy gravel with much red blaes and a little brick and concrete rubble.	NC	1.6
Grey green to dark brown, soft sandy CLAY with a little fine, black angular gravel and occasional fine black ash gravel. 1.8m: grades with a little degraded ash material.	NC	2
Grey green, soft, slightly sandy CLAY with occasional medium, subangular gravel. 2.5m: becomes sandy.	NC	3.2
Green brown fine clayey SAND with a little medium subangular gravel, becomes damp.	NC	4.7
Grey green soft but becoming firm SILT.	NC	5
Borehole completed at 5.0mbgl.		

LOCATION/NOTES

On tarmac adjacent to transformer room.
Borehole collapsed at 3.0mbgl.

LEGEND

☒ Disturbed Sample
▽ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation

LOCATION: Govan Shipyard Site, Glasgow

CLIENT: Clydeport / Marine

JOB NO: 44701-002

DAMES & MOORE

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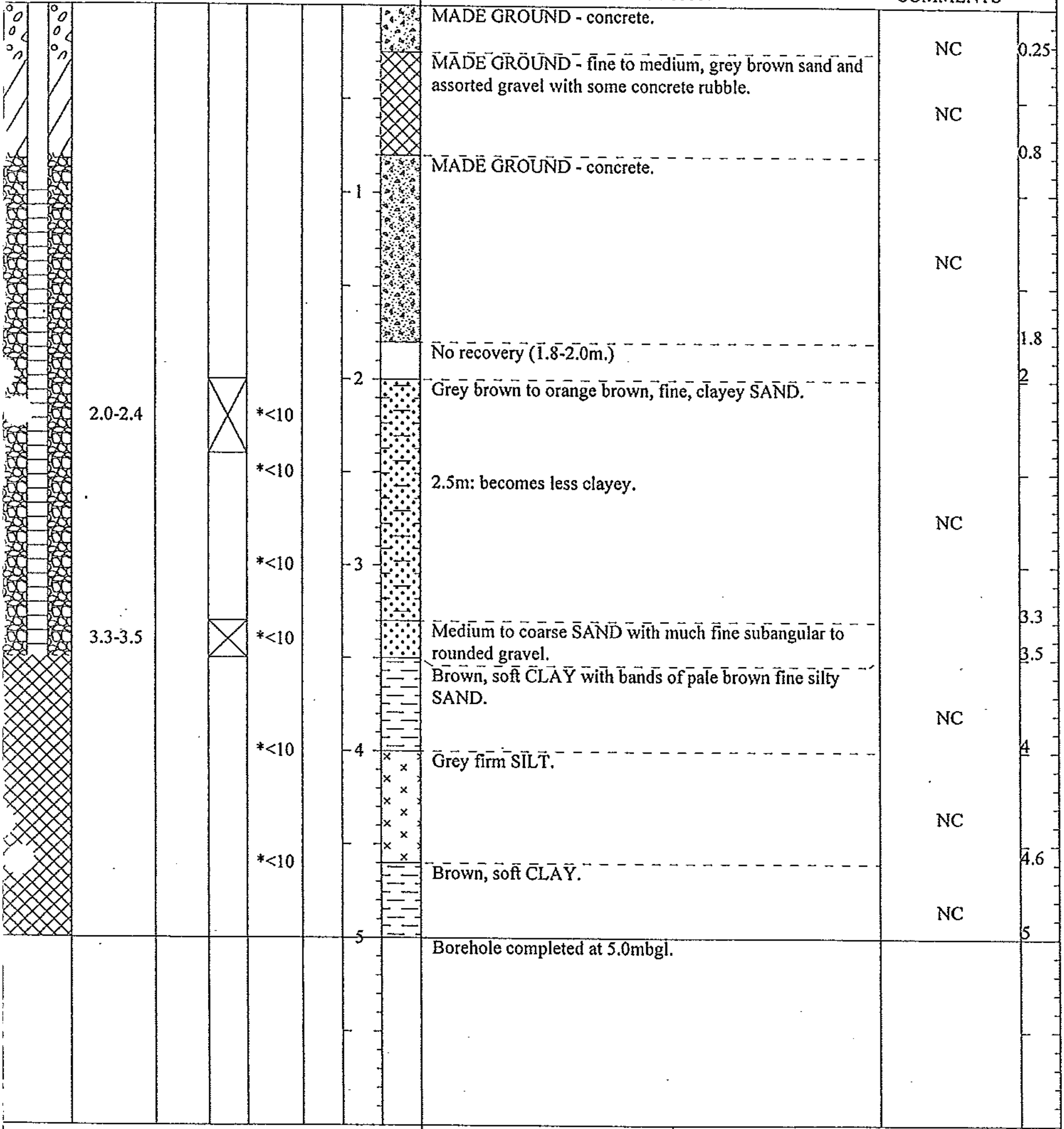
BOREHOLE NO BH147

Page 1 of 1

START DATE: 12/05/00
END DATE: 12/05/00
DRILLER: Raeburn
METHOD: Window Sampler
LOGGED BY: CM
CHECKED BY: DN

BOREHOLE DIAMETER(mm): 60/50
SCREEN TYPE(mm): 19
ELEVATION (mAOD): 5.18



SAMPLE DEPTH(m)	NUMBER	TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DESCRIPTION	COMMENTS	
					MADE GROUND - concrete.		0.25
					MADE GROUND - fine to medium, grey brown sand and assorted gravel with some concrete rubble.	NC NC	0.8
					MADE GROUND - concrete.	NC	1.8
					No recovery (1.8-2.0m.)		2
2.0-2.4		☒	*<10 *<10 *<10		Grey brown to orange brown, fine, clayey SAND. 2.5m: becomes less clayey.	NC	3.3
3.3-3.5		☒	*<10		Medium to coarse SAND with much fine subangular to rounded gravel.		3.5
					Brown, soft CLAY with bands of pale brown fine silty SAND.	NC	4
			*<10		Grey firm SILT.	NC	4.6
			*<10		Brown, soft CLAY.	NC	5
					Borehole completed at 5.0mbgl.		

LOCATION/NOTES

Located on concrete adjacent to doorway at west end of main fabrication shed. Borehole collapsed at 3.5m.

LEGEND

☒ Disturbed Sample
▽ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation

LOCATION: Govan Shipyard Site, Glasgow

CLIENT: Clydeport / Marine

JOB NO: 44701-002

DAMES & MOORE

START DATE: 15/05/00	**BOREHOLE NO BH148** **Page 1 of 1**
END DATE: 15/05/00	
DRILLER: Raeburn	
METHOD: Window Sampler	BOREHOLE DIAMETER(mm): 60/50
LOGGED BY: CM	SCREEN TYPE(mm): 19
CHECKED BY: DN	ELEVATION (mAOD): 4.8

WELL CONSTRUCTION	SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS	
								MADE GROUND - hardcore.	NC	0.2
	0.5-0.8		☒	*20				MADE GROUND - dark brown, fine to medium, slightly clayey sand with a little subangular to angular gravel, metaliferous slag and black ash.		
				*20		1			NC	
	1.4-1.9		☒	*15						1.9
						2		Borehole terminated 1.9mbgl.		
						3				
						4				
						5				

LOCATION/NOTES

Borehole terminated at 1.9mbgl on obstruction. Relocated approximately 2.0m north to BH148A but obstruction encountered at 1.0mbgl therefore no installation at BH148A.

LEGEND

- ☒ **Disturbed Sample**
- ▽ **Perched Groundwater**
- ▼ **Groundwater**
- * **Headspace Analysis on Soil Sample**

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation

LOCATION: Govan Shipyard Site, Glasgow

CLIENT: Clydeport / Marine

JOB NO: 44701-002

DAMES & MOORE

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26/07/2000

START DATE: 28/04/00	**BOREHOLE NO BH149**
END DATE: 28/04/00	
DRILLER: Raeburn	**Page 1 of 1**
METHOD: Window Sampler	BOREHOLE DIAMETER(mm): 60/50
LOGGED BY: CM	SCREEN TYPE(mm): 19
CHECKED BY: DN	ELEVATION (mAOD): 5.37

WELL CONSTRUCTION	SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS	
								MADE GROUND - concrete.	NC	0.18
								MADE GROUND - red blaes.	NC	0.45
								MADE GROUND - fine to medium, mid brown ashy sand with much brick fragments and a little medium sandstone gravel.	NC	0.7
	0.7-0.9		☒	*<10 *<10		1		MADE GROUND - dense, dark brown, clayey gravelly sand with some brick fragments.		
								1.2m: with much brick rubble and a slight organic odour.	NC	
				*<10				1.5m: with much red shale.		1.7
	1.7-1.9		☒	*<10		2		MADE GROUND - Soft, grey-brown and pale brown, sandy clay with a little fine to medium gravel and few brick fragments.	NC	
				*<10						2.7
								MADE GROUND - fine to medium, grey-brown sand with broken concrete.	NC	2.8
						3		Borehole terminated at 2.8mbgl.		
						4				
						5				

LOCATION/NOTES

Located in west of main fabrication shed adjacent to panel cutting line. Borehole terminated on concrete slab.

LEGEND

- ☒ Disturbed Sample
- ▽ Perched Groundwater
- ▼ Groundwater
- * Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation

LOCATION: Govan Shipyard Site, Glasgow

CLIENT: Clydeport / Marine

JOB NO: 44701-002

DAMES & MOORE

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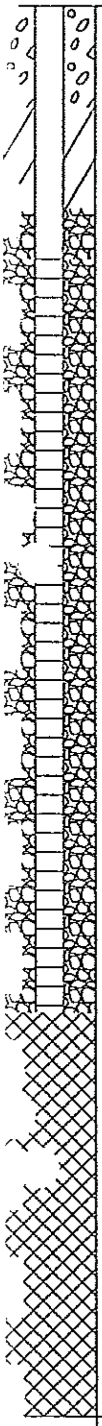
26/07/2000

BOREHOLE NO BH150

Page 1 of 1

START DATE: 13/05/00
END DATE: 13/05/00
DRILLER: Raeburn
METHOD: Window Sampler
LOGGED BY: JD
CHECKED BY: DN

BOREHOLE DIAMETER(mm): 60/50
SCREEN TYPE(mm): 19
ELEVATION (mAOD): 4.89



SAMPLE DEPTH(m)	NUMBER	TYPE
0.5-1.0		☒
2.3-2.6		☒
4.5-5.0		☒

DEPTH (m)	SOIL VAPOUR (ppm)
0.5	*<10
1	*<10
1.5	*<10
2	*<10
2.5	*<10
3	*<10
3.5	*<10
4	*<10
4.5	*<10
5	*<10

DESCRIPTION	COMMENTS	
MADE GROUND - concrete.	NC	0.4
MADE GROUND - yellow brown fine to medium, silty sand with traces of clay, moist.	NC	2
Yellow brown medium SAND with some silt, moist.	NC	2.4
Yellow brown medium to coarse gravelly SAND with fine to medium rounded gravel, wet.	NC	2.6
Light grey brown SILT with some very fine sand, wet.	NC	5.6
Borehole terminated at 5.6mbgl.		

LOCATION/NOTES

Borehole collapsed to 4.0mbgl.

LEGEND

☒ Disturbed Sample
▽ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation
LOCATION: Govan Shipyard Site, Glasgow
CLIENT: Clydeport / Marine
JOB NO: 44701-002

DAMES & MOORE

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START DATE: 26/04/00
END DATE: 26/04/00
DRILLER: Reaburn
METHOD: Window Sampler
LOGGED BY: JD
CHECKED BY: DN

BOREHOLE NO BH151

Page 1 of 1

BOREHOLE DIAMETER(mm): 60/50
SCREEN TYPE(mm): 19
ELEVATION (mAOD): 5.35

ELL CONSTRUCTION	SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS	
								MADE GROUND - concrete.	NC	0.2
								MADE GROUND - dark red/ brown medium to coarse gravelly sand with much blaes, dry.	NC	0.6
	0.6-0.75		☒	*<10				MADE GROUND - dark brown angular gravelly clay with much sand and coal fragments.		
				*<10		1			NC	
				*<10						
				*<10		2				
				*<10						
						3		Dark brown fine SAND with some silt, dry.		3
	3.35		☒	*<10					NC	3.35
						4		Borehole terminated at 3.35mbgl.		
						5				

LOCATION/NOTES

South end of main fabrication shed (interior).
Groundwater not encountered during drilling.

LEGEND

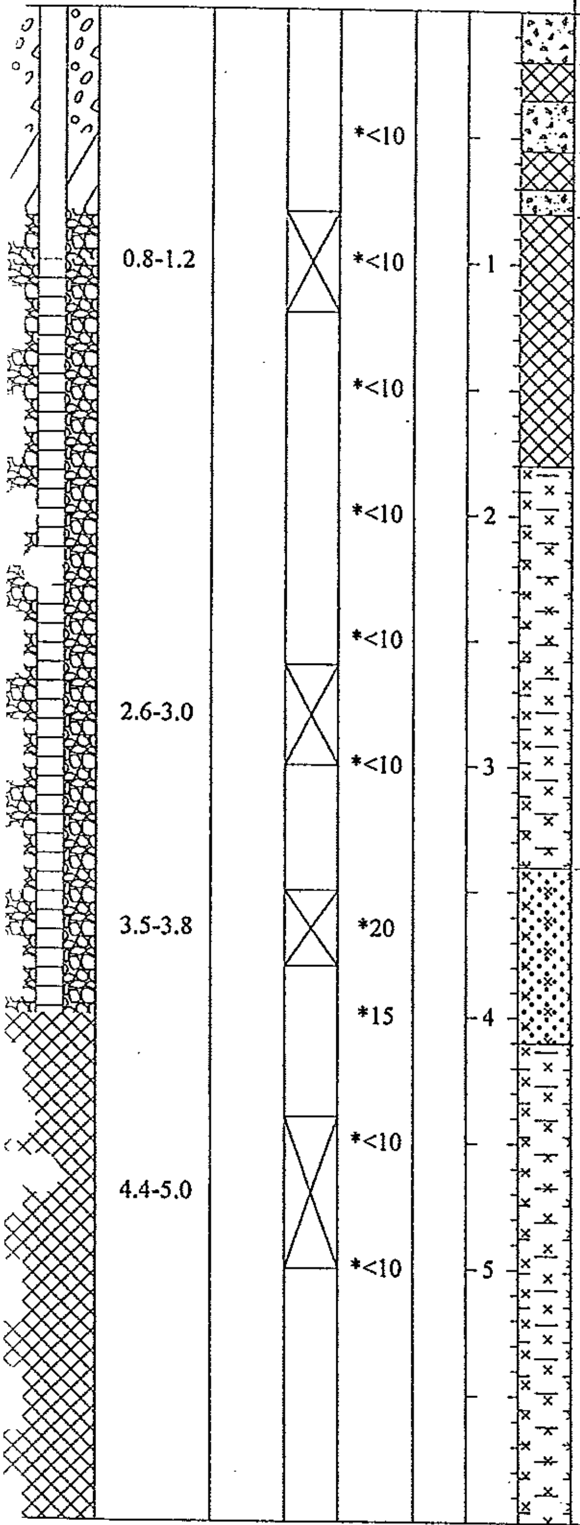
☒ Disturbed Sample
▽ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation
LOCATION: Govan Shipyard Site, Glasgow
CLIENT: Clydeport / Marine
JOB NO: 44701-002

DAMES & MOORE

START DATE: 13/05/00	**BOREHOLE NO BH152**
END DATE: 13/05/00	**Page 1 of 2**
DRILLER: Raeburn	
METHOD: Window Sampler	BOREHOLE DIAMETER(mm):
LOGGED BY: JD	SCREEN TYPE(mm): 19
CHECKED BY: DN	ELEVATION (mAOD): 5.39



SAMPLE DEPTH(m)	TYPE	SOIL VAPOUR (ppm)
		*<10
0.8-1.2	☒	*<10
		*<10
		*<10
		*<10
2.6-3.0	☒	*<10
3.5-3.8	☒	*20
		*15
4.4-5.0	☒	*<10
		*<10

DESCRIPTION	COMMENTS	
MADE GROUND - concrete.	NC	0.2
MADE GROUND - hardcore.	NC	0.35
MADE GROUND - concrete.	NC	0.55
MADE GROUND - cobbles.	NC	0.7
MADE GROUND - concrete.	NC	0.8
MADE GROUND - dark brown silty gravelly sand with some coal and ash, dry.	NC NC	1.8
Yellow brown mottled grey brown very clayey SILT, moist.	NC	3.4
Dark grey very fine sandy SILT, wet. 4.0m: with trace to some fine rounded gravel.	NC	4.1
Grey soft clayey SILT with some very fine sand.	NC	

LOCATION/NOTES

Drilled to 5.0m - hole collapsed to 4.0m. Continued drilling to 7.0m, hole collapsed to 4.3m. Installed well to 4.0m.

LEGEND

☒	Disturbed Sample
▽	Perched Groundwater
▼	Groundwater
*	Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation

LOCATION: Govan Shipyard Site, Glasgow

CLIENT: Clydeport / Marine

JOB NO: 44701-002

DAMES & MOORE

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START DATE: 13/05/00
END DATE: 13/05/00
DRILLER: Raeburn
METHOD: Window Sampler
LOGGED BY: JD
CHECKED BY: DN

BOREHOLE NO BH152

Page 2 of 2

BOREHOLE DIAMETER(mm):
SCREEN TYPE(mm): 19
ELEVATION (mAOD): 5.39

WELL CONSTRUCTION	SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS
▨				*<10			▨		
						7		Borehole terminated at 7.0mbgl.	7
						8			
						9			
						10			
						11			

LOCATION/NOTES

Drilled to 5.0m - hole collapsed to 4.0m. Continued drilling to 7.0m, hole collapsed to 4.3m. Installed well to 4.0m.

LEGEND

- ⊠ Disturbed Sample
- ▽ Perched Groundwater
- ▼ Groundwater
- * Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation
LOCATION: Govan Shipyard Site, Glasgow
CLIENT: Clydeport / Marine
JOB NO: 44701-002

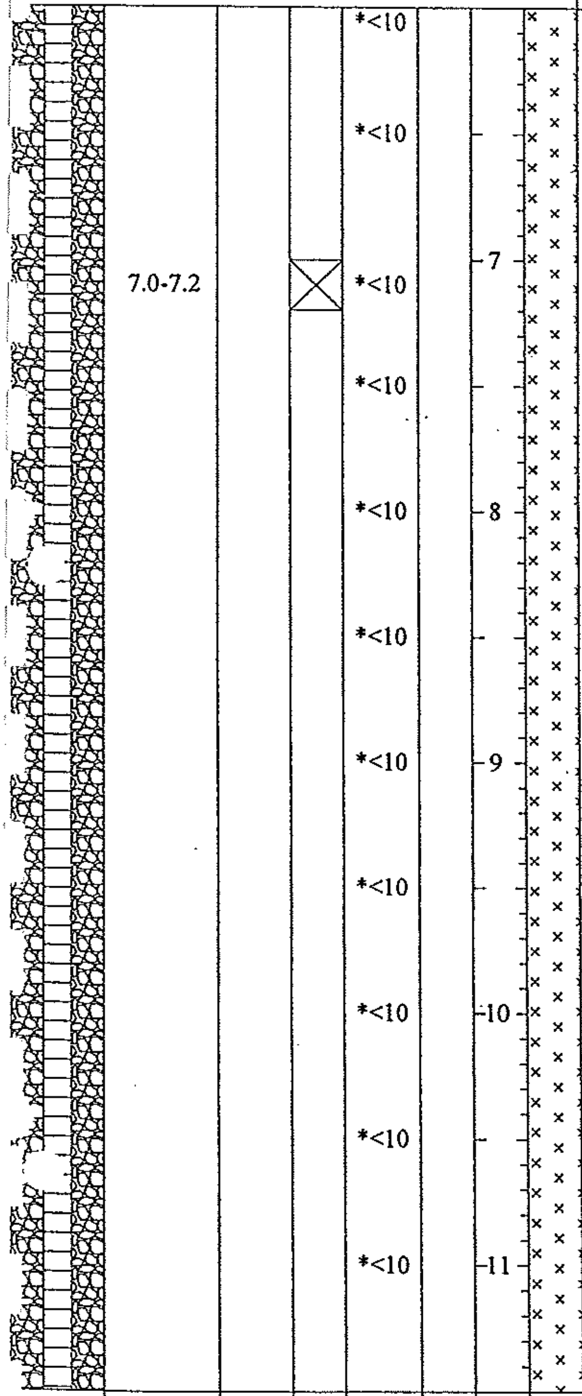
DAMES & MOORE

START DATE: 11/05/00
END DATE: 13/05/00
DRILLER: Raeburn
METHOD: Shell and Auger
LOGGED BY: JD
CHECKED BY: DN

BOREHOLE NO BH153

Page 2 of 2

BOREHOLE DIAMETER(mm): 200/150
SCREEN TYPE(mm): 19
ELEVATION (mAOD): 4.18



WELL CONSTRUCTION	SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS
				*<10					
				*<10					
	7.0-7.2		☒	*<10		7			
				*<10					
				*<10		8			
				*<10					NC
				*<10		9			
				*<10					
				*<10		10			Changed from 200mm to 150mm casing at 10mbgl.
				*<10					
				*<10		11			
						11.5		Borehole terminated at 11.5mbgl.	

LOCATION/NOTES

Gravel surface - old slipway, gently sloping to west. 200mm casing snapped at 10.0m. Inserted 150mm casing and attempted to advance borehole further. Borehole terminated at 11.5mbgl.

LEGEND

☒	Disturbed Sample
▽	Perched Groundwater
▼	Groundwater
*	Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation
LOCATION: Govan Shipyard Site, Glasgow
CLIENT: Clydeport / Marine
JOB NO: 44701-002

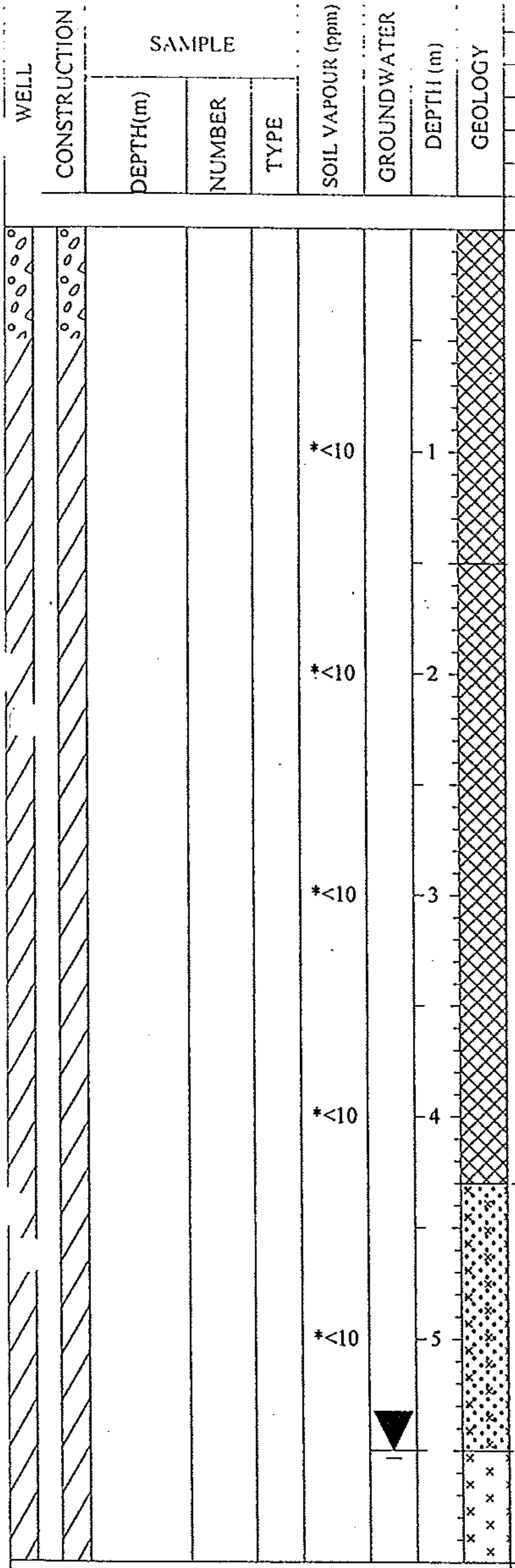
DAMES & MOORE

START DATE: 11/05/00
END DATE: 16/05/00
DRILLER: Raeburn
METHOD: Shell and Auger
LOGGED BY: JD
CHECKED BY: DN

BOREHOLE NO BH153A

Page 1 of 4

BOREHOLE DIAMETER(mm): 200/150
SCREEN TYPE(mm): 50
ELEVATION (mAOD): 4.31



DEPTH (m)	SOIL VAPOUR (ppm)	DESCRIPTION	COMMENTS	
0		MADE GROUND - dark brown medium to coarse gravelly sand with some silt, brick and blaes fragments, dry.	NC	
1	*<10	1.0m: with trace coke gravel and some concrete cobbles.		
1.5		MADE GROUND - dark grey brown medium gravelly sand with medium to coarse rounded gravel and some ash.		1.5
2	*<10			
3	*<10	3.0m: with occasional fragments of timber and glass.	NC	
4	*<10			
4.3		Dark grey brown fine sandy SILT, moist.		4.3
5	*<10		NC	
5.5	▼	Grey soft SILT, wet.		5.5

LOCATION/NOTES

Gravel surface on old slipway, gently sloping to the west.

LEGEND

⊠ Disturbed Sample
▽ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation
LOCATION: Govan Shipyard Site, Glasgow
CLIENT: Clydeport / Marine
JOB NO: 44701-002

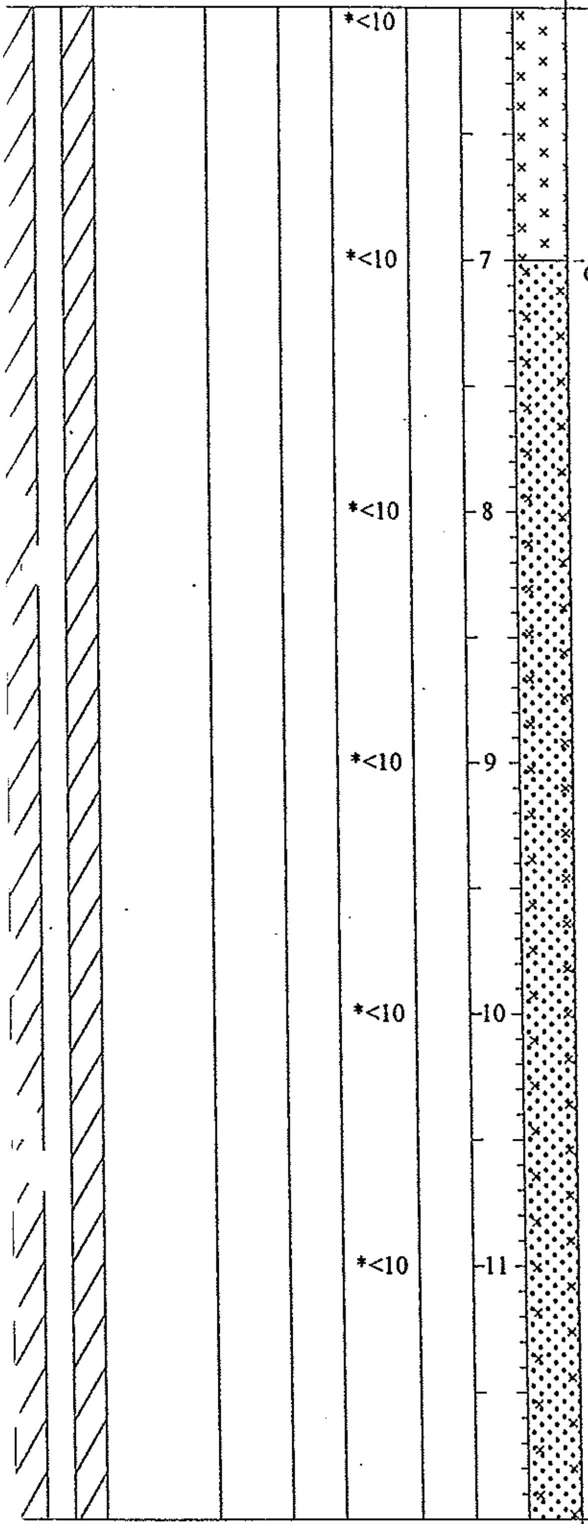
DAMES & MOORE

START DATE: 11/05/00
END DATE: 16/05/00
DRILLER: Raeburn
METHOD: Shell and Auger
LOGGED BY: JD
CHECKED BY: DN

BOREHOLE NO BH153A

Page 2 of 4

BOREHOLE DIAMETER(mm): 200/150
SCREEN TYPE(mm): 50
ELEVATION (mAOD): 4.31



WELL CONSTRUCTION	SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS
				*<10					
									NC
				*<10		7		Grey very fine silty SAND.	
				*<10		8			
				*<10		9			NC
				*<10		10			
				*<10		11			

LOCATION/NOTES

Gravel surface on old slipway, gently sloping to the west.

LEGEND

☒ Disturbed Sample
▽ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation
LOCATION: Govan Shipyard Site, Glasgow
CLIENT: Clydeport / Marine
JOB NO: 44701-002

DAMES & MOORE

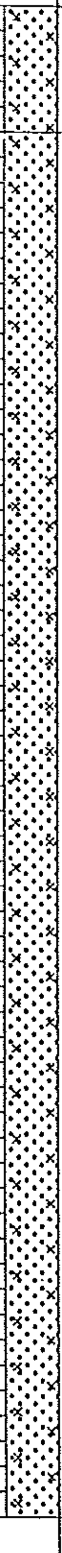
START DATE: 11/05/00
END DATE: 16/05/00
DRILLER: Raeburn
METHOD: Shell and Auger
LOGGED BY: JD
CHECKED BY: DN

BOREHOLE NO BH153A

Page 3 of 4

BOREHOLE DIAMETER(mm): 200/150
SCREEN TYPE(mm): 50
ELEVATION (mAOD): 4.31

SAMPLE			SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	DESCRIPTION	COMMENTS	
DEPTH(m)	NUMBER	TYPE						
			*<10					
						Grey very fine silty SAND with occasional clay lenses.		12.5
			*<10		13			
			*<10		14			
			*<10		15		NC	
			*<10		16		16.0m: Changed to 200mm casing	
			*<10		17			



LOCATION/NOTES

Gravel surface on old slipway, gently sloping to the west.

LEGEND

- ☒ Disturbed Sample
- ▽ Perched Groundwater
- ▼ Groundwater
- * Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation
LOCATION: Govan Shipyard Site, Glasgow
CLIENT: Clydeport / Marine
JOB NO: 44701-002

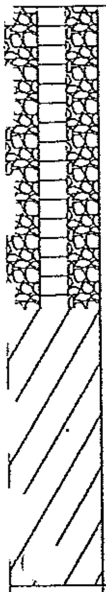
DAMES & MOORE

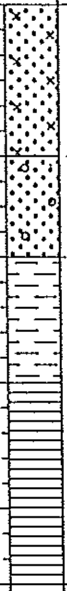
BOREHOLE NO BH153A

Page 4 of 4

START DATE: 11/05/00
END DATE: 16/05/00
DRILLER: Raeburn
METHOD: Shell and Auger
LOGGED BY: JD
CHECKED BY: DN

BOREHOLE DIAMETER(mm): 200/150
SCREEN TYPE(mm): 50
ELEVATION (mAOD): 4.31





WELL CONSTRUCTION	SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS	
				*<10						
								Yellowish brown fine to medium gravelly SAND with occasional coarse rounded sandstone gravel.	NC	18.6
				*<10		19		Grey stiff sandy CLAY	NC	19
				*<10				Dark grey highly weathered MUDSTONE	NC	19.5
						20				
								Borehole terminated at 20.3mbgl.		20.3
						21				
						22				
						23				

BOREHOLE LOG

LOCATION/NOTES

Gravel surface on old slipway, gently sloping to the west.

LEGEND

- ☒ Disturbed Sample
- ∇ Perched Groundwater
- ▼ Groundwater
- * Headspace Analysis on Soil Sample

JOB TITLE: Stage II Environmental Site Investigation
LOCATION: Govan Shipyard Site, Glasgow
CLIENT: Clydeport / Marine
JOB NO: 44701-002

DAMES & MOORE

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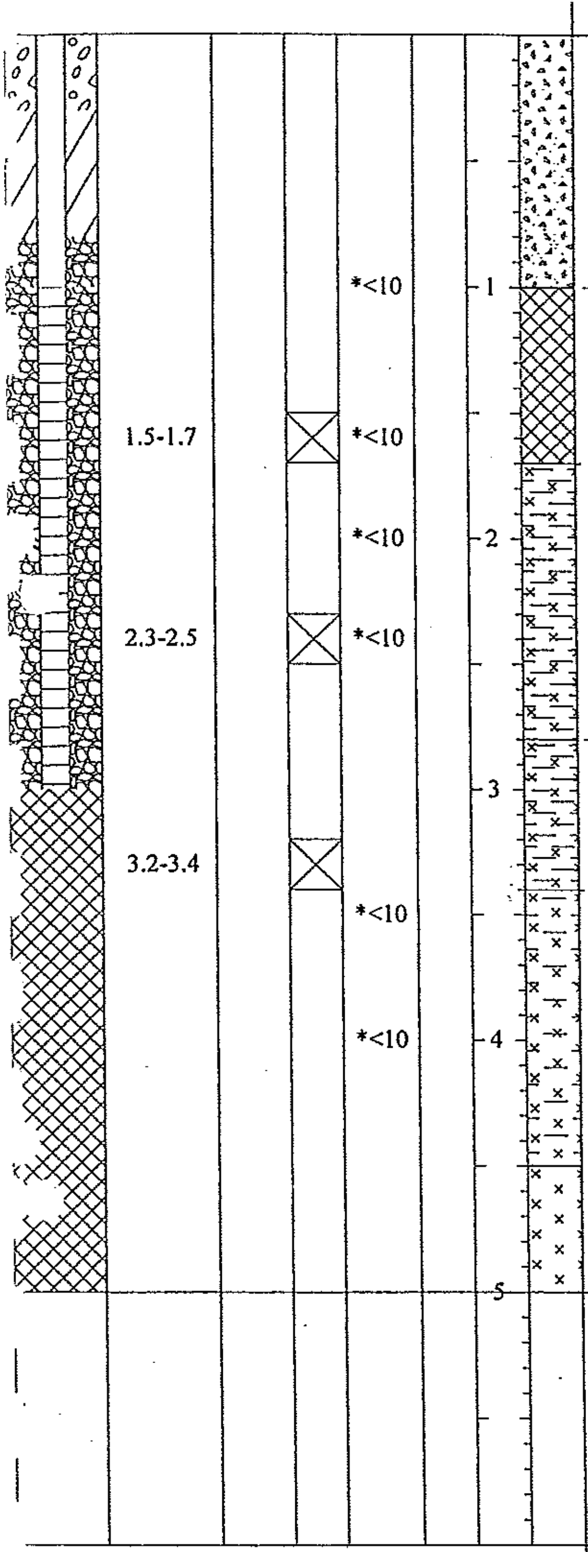
BOREHOLE NO BH154

Page 1 of 1

START DATE: 12/05/00
END DATE: 12/05/00
DRILLER: Raeburn
METHOD: Window Sampler
LOGGED BY: CM
CHECKED BY: DN

BOREHOLE DIAMETER(mm): 60/50
SCREEN TYPE(mm): 19
ELEVATION (mAOD): 5.08



SAMPLE DEPTH(m)	NUMBER	TYPE	SOIL VAPOUR (ppm)	DEPTH (m)	DESCRIPTION	COMMENTS	
					MADE GROUND - concrete and concrete rubble.	NC	1
			*<10	1	MADE GROUND - dark brown to black, slightly clayey sand and dark brown, soft to firm, sandy clay with a little fine subangular gravel and brick fragments and occasional coal fragments.	NC	
1.5-1.7		☒	*<10				1.7
					Mid to dark brown firm sandy CLAY with a little black ash and occasional coarse subrounded gravel.		
			*<10	2			
2.3-2.5		☒	*<10			NC	
					2.5m: grades to firm silty CLAY.		2.8
					Grey, soft silty CLAY. becomes damp at 3.2m.		
				3		NC	
3.2-3.4		☒			3.2m: becomes damp.		3.4
			*<10		Grey brown, soft to firm clayey SILT.		
			*<10	4		NC	4.5
					Grey, soft to firm SILT.	NC	5
				5	Borehole completed at 5.0mbgl.		

LOCATION/NOTES

Location on concrete slab of No3 Berth, north of electrical substation. Borehole collapsed at 3.0m.

LEGEND

☒ Disturbed Sample
▽ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation

LOCATION: Govan Shipyard Site, Glasgow

CLIENT: Clydeport / Marine

JOB NO: 44701-002

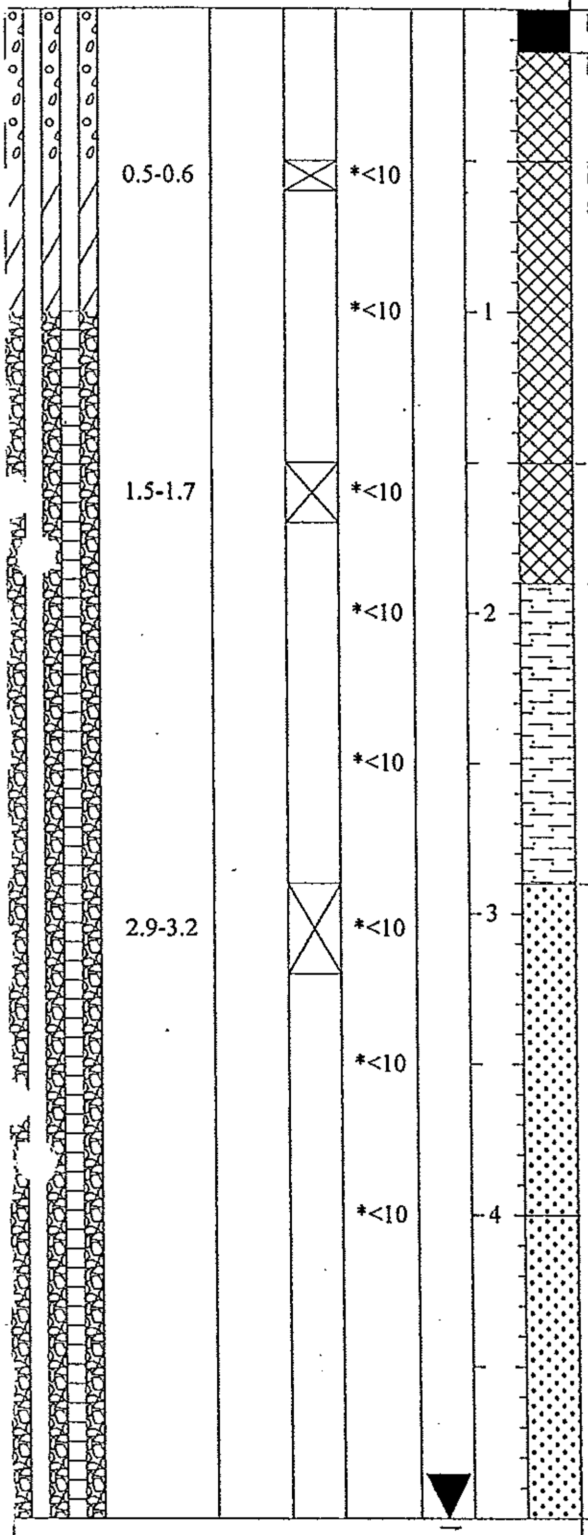
DAMES & MOORE

START DATE: 08/05/00
END DATE: 11/05/00
DRILLER: Raeburn
METHOD: Shell and Auger
LOGGED BY: CM
CHECKED BY: DN

BOREHOLE NO BH156

Page 1 of 6

BOREHOLE DIAMETER(mm): 200/150
SCREEN TYPE(mm): 50 and 19
ELEVATION (mAOD): 5.69



SAMPLE DEPTH(m)	NUMBER	TYPE	SOIL VAPOUR (ppm)
0.5-0.6		☒	*<10
			*<10
1.5-1.7		☒	*<10
			*<10
			*<10
2.9-3.2		☒	*<10
			*<10
			*<10

DESCRIPTION	COMMENTS	
MADE GROUND - tarmac.		0.14
MADE GROUND - layers of bricks.	NC	0.5
MADE GROUND - light brown fine to medium gravelly sand with much brick fragments and a little wood.	NC	1.5
MADE GROUND - medium brown soft to firm slightly sandy slightly gravelly clay with a little black ash and occasional brick fragments.	NC	1.9
Firm medium brown sandy CLAY and fine medium brown clayey SAND.	NC 2.4m: adding water	2.9
Medium brown fine to medium SAND with some fine to medium rounded to sub-angular gravel.	NC	4
Medium brown medium to coarse SAND with a little fine angular gravel.		

LOCATION/NOTES

West of main fabrication shed and south of paint/blasting shed.

LEGEND

☒ Disturbed Sample
▽ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation
LOCATION: Govan Shipyard Site, Glasgow
CLIENT: Clydeport / Marine
JOB NO: 44701-002

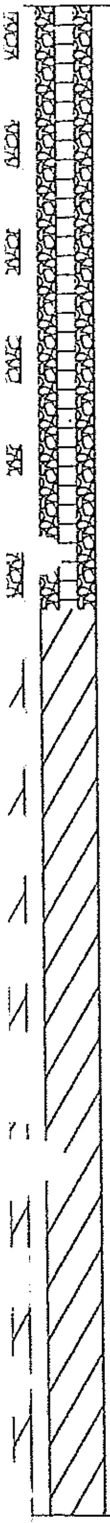
DAMES & MOORE

BOREHOLE NO BH156

Page 2 of 6

START DATE: 08/05/00
END DATE: 11/05/00
DRILLER: Raeburn
METHOD: Shell and Auger
LOGGED BY: CM
CHECKED BY: DN

BOREHOLE DIAMETER(mm): 200/150
SCREEN TYPE(mm): 50 and 19
ELEVATION (mAOD): 5.69



CONSTRUCTION	SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS	
				*<10				5.0m: as above with a little black siltstone, becomes saturated.		
				*<10		6			NC	
				*<10		7				
								Medium brown fine to medium slightly silty SAND.		7.8
				*<10		8				
				*<10		9			NC	

LOCATION/NOTES

West of main fabrication shed and south of paint/blasting shed.

LEGEND

☒ Disturbed Sample
▽ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation

LOCATION: Govan Shipyard Site, Glasgow

CLIENT: Clydeport / Marine

JOB NO: 44701-002

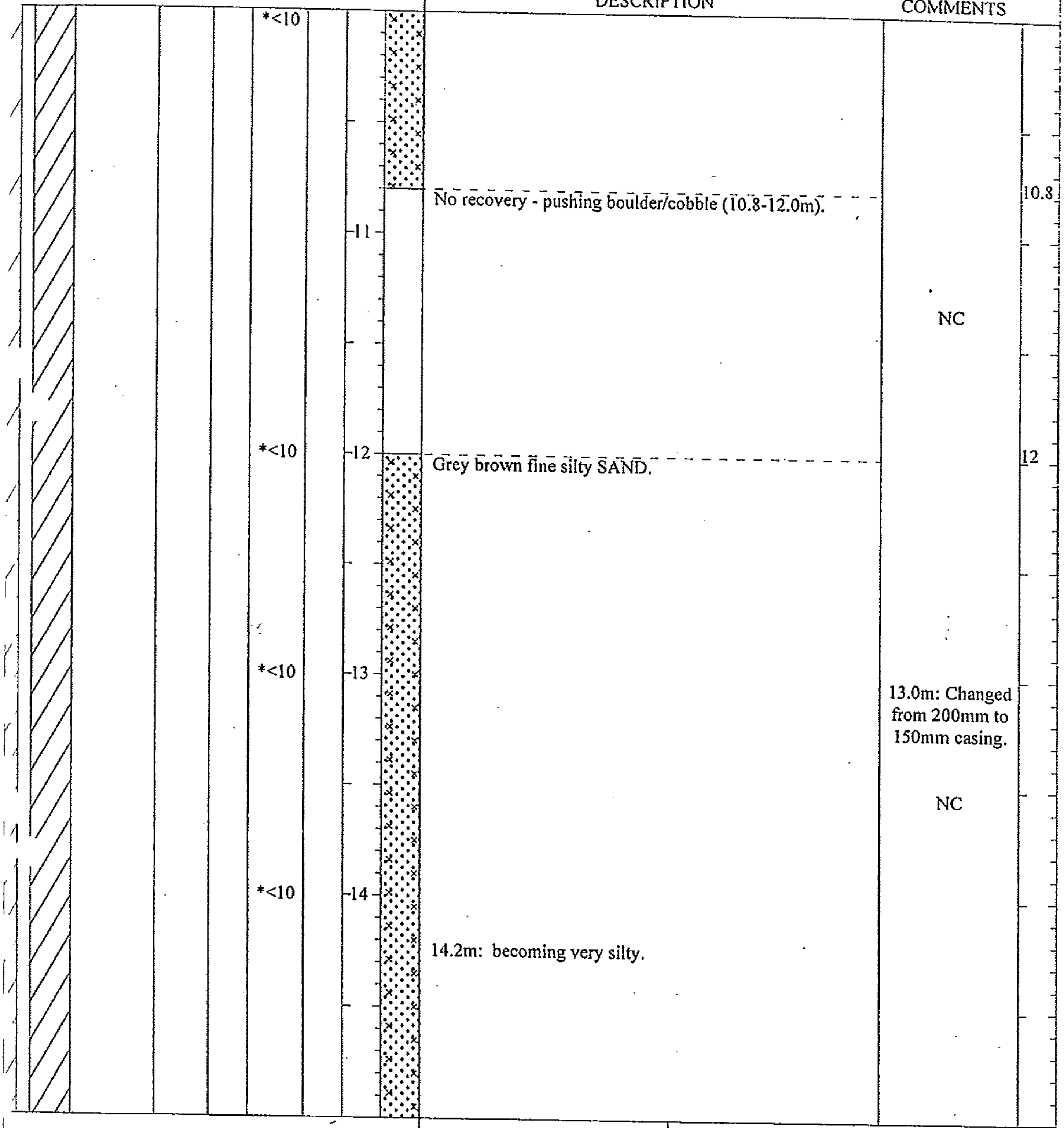
DAMES & MOORE

BOREHOLE NO BH156

Page 3 of 6

START DATE: 08/05/00
END DATE: 11/05/00
DRILLER: Raeburn
METHOD: Shell and Auger
LOGGED BY: CM
CHECKED BY: DN

BOREHOLE DIAMETER(mm): 200/150
SCREEN TYPE(mm): 50 and 19
ELEVATION (mAOD): 5.69



DEPTH (m)	SOIL VAPOUR (ppm)	DESCRIPTION	COMMENTS
	*<10		
10.8		No recovery - pushing boulder/cobble (10.8-12.0m).	NC
12	*<10	Grey brown fine silty SAND.	
13	*<10		13.0m: Changed from 200mm to 150mm casing. NC
14	*<10	14.2m: becoming very silty.	

LOCATION/NOTES

West of main fabrication shed and south of paint/blasting shed.

LEGEND

☒ Disturbed Sample
▽ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation
LOCATION: Govan Shipyard Site, Glasgow
CLIENT: Clydeport / Marine
JOB NO: 44701-002

DAMES & MOORE

BOREHOLE NO BH156

Page 4 of 6

START DATE: 08/05/00
END DATE: 11/05/00
DRILLER: Raeburn
METHOD: Shell and Auger
LOGGED BY: CM
CHECKED BY: DN
BOREHOLE DIAMETER(mm): 200/150
SCREEN TYPE(mm): 50 and 19
ELEVATION (mAOD): 5.69

CONSTRUCTION	SAMPLE			SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS
	DEPTH(m)	NUMBER	TYPE						
				*<10					
						16			
						17			
				*<10					
						18			
				*<10		19		19.0m: becoming only slightly silty.	

LOCATION/NOTES

West of main fabrication shed and south of paint/blasting shed.

LEGEND

☒ Disturbed Sample
▽ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

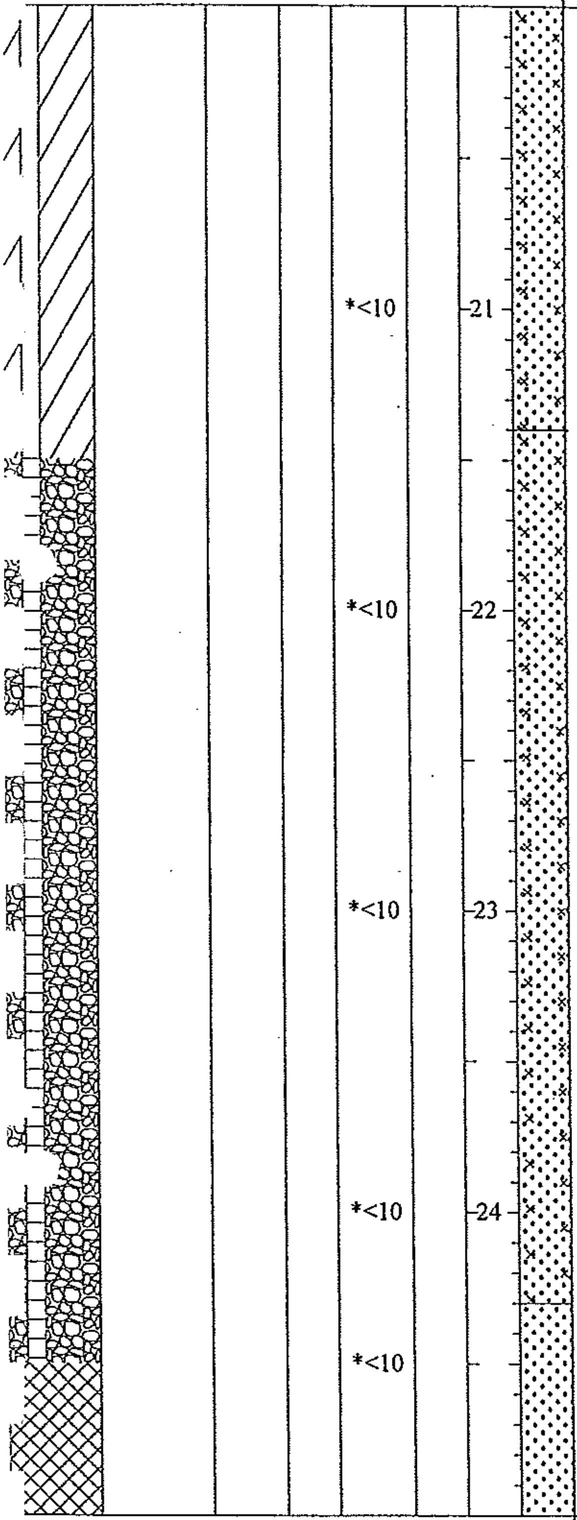
JOB TITLE: Stage II Environmental Site Investigation
LOCATION: Govan Shipyard Site, Glasgow
CLIENT: Clydeport / Marine
JOB NO: 44701-002

DAMES & MOORE

BOREHOLE NO BH156

Page 5 of 6

START DATE: 08/05/00
END DATE: 11/05/00
DRILLER: Raeburn
METHOD: Shell and Auger
LOGGED BY: CM
CHECKED BY: DN
BOREHOLE DIAMETER(mm): 200/150
SCREEN TYPE(mm): 50 and 19
ELEVATION (mAOD): 5.69



SOIL VAPOUR (ppm)	DEPTH (m)	DESCRIPTION	COMMENTS	
*<10	21			
		Grey brown fine to medium slightly silty SAND with a little medium to coarse sub-rounded to angular gravel.		21.4
*<10	22			
			NC	
*<10	23	23.0m: cobble of pale sandstone.		
*<10	24			
		Grey brown medium to coarse SAND with a little fine to medium angular and sub-angular gravel and occasional cobbles and a little soft grey brown sandy CLAY.		24.3
*<10			NC Water washing out clay from sample - drilled as very stiff clay	

LOCATION/NOTES

West of main fabrication shed and south of paint/blasting shed.

LEGEND

☒ Disturbed Sample
▽ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation

LOCATION: Govan Shipyard Site, Glasgow

CLIENT: Clydeport / Marine

JOB NO: 44701-002

DAMES & MOORE

START DATE: 08/05/00
END DATE: 11/05/00
DRILLER: Raeburn
METHOD: Shell and Auger
LOGGED BY: CM
CHECKED BY: DN

BOREHOLE NO BH156

Page 6 of 6

BOREHOLE DIAMETER(mm): 200/150
SCREEN TYPE(mm): 50 and 19
ELEVATION (mAOD): 5.69

WELL CONSTRUCTION	SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS
▨							░		25.8
						26		Borehole terminated at 25.8mbgl.	
						27			
						28			
						29			

LOCATION/NOTES

West of main fabrication shed and south of paint/blasting shed.

LEGEND

☒ Disturbed Sample
▽ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation
LOCATION: Govan Shipyard Site, Glasgow
CLIENT: Clydeport / Marine
JOB NO: 44701-002

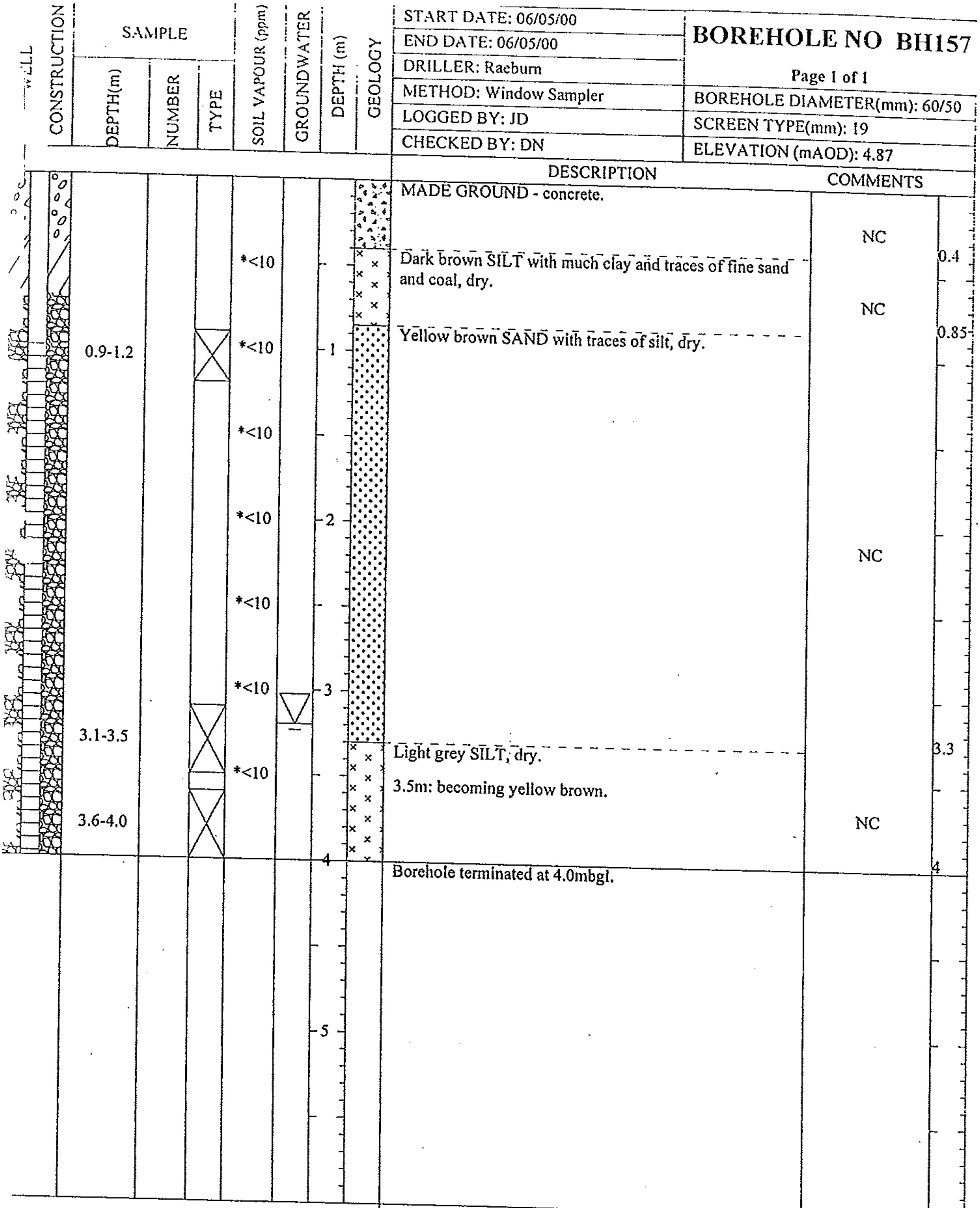
DAMES & MOORE

BOREHOLE NO BH157

Page 1 of 1

START DATE: 06/05/00
END DATE: 06/05/00
DRILLER: Raeburn
METHOD: Window Sampler
LOGGED BY: JD
CHECKED BY: DN

BOREHOLE DIAMETER(mm): 60/50
SCREEN TYPE(mm): 19
ELEVATION (mAOD): 4.87



SAMPLE DEPTH(m)	NUMBER	TYPE
0.9-1.2		☒
3.1-3.5		☒
3.6-4.0		☒

SOIL VAPOUR (ppm)
*<10
*<10
*<10
*<10
*<10
*<10
*<10

DESCRIPTION	COMMENTS	
MADE GROUND - concrete.	NC	0.4
Dark brown SILT with much clay and traces of fine sand and coal, dry.	NC	0.85
Yellow brown SAND with traces of silt, dry.	NC	3.3
Light grey SILT, dry. 3.5m: becoming yellow brown.	NC	4
Borehole terminated at 4.0mbgl.		

LOCATION/NOTES

Flat concrete hard standing. Eastern portion of site. Perched groundwater encountered at 3.2m.

LEGEND

☒ Disturbed Sample
▽ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation
LOCATION: Govan Shipyard Site, Glasgow
CLIENT: Clydeport / Marine
JOB NO: 44701-002

DAMES & MOORE

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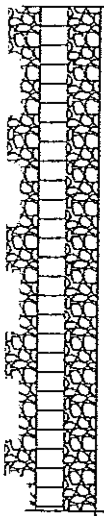
START DATE: 11/05/00
END DATE: 11/05/00
DRILLER: Raeburn
METHOD: Shell and Auger
LOGGED BY: JD
CHECKED BY: DN

BOREHOLE NO BH158A

Page 2 of 2

BOREHOLE DIAMETER(mm): 150
SCREEN TYPE(mm): 50
ELEVATION (mAOD): 4.79



WELL CONSTRUCTION	SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS	
				*<10				Yellow brown fine SAND with some rounded fine gravel, saturated.		
				*<10					NC	
				*<10		7				
				*<10				Grey brown very fine very silty SAND.		7.5
									NC	
						8		Borehole terminated at 8.0mbgl.		8
						9				
						10				
						11				

LOCATION/NOTES

Flat gravel surface north east area of site.

LEGEND

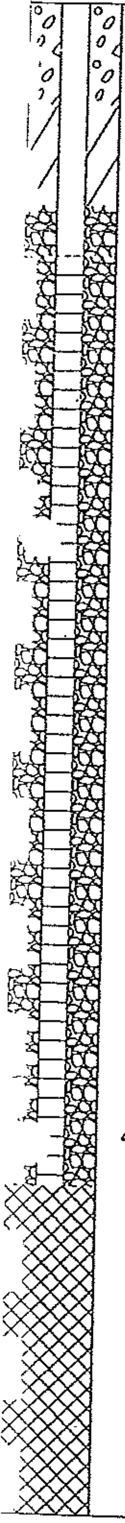
☒ **Disturbed Sample**
⊻ **Perched Groundwater**
▼ **Groundwater**
* **Headspace Analysis on Soil Sample**

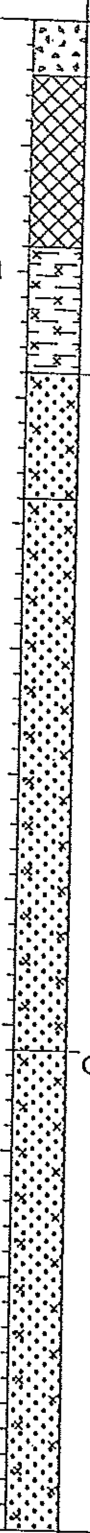
BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation
LOCATION: Govan Shipyard Site, Glasgow
CLIENT: Clydeport / Marine
JOB NO: 44701-002

DAMES & MOORE

START DATE: 13/05/00	**BOREHOLE NO BH159**
END DATE: 13/05/00	Page 1 of 2
DRILLER: Raeburn	BOREHOLE DIAMETER(mm): 60/50
METHOD: Window Sampler	SCREEN TYPE(mm): 19
LOGGED BY: JD	ELEVATION (mAOD): 5.01
CHECKED BY: DN	





SAMPLE DEPTH(m)	NUMBER	TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	DESCRIPTION	COMMENTS	
						MADE GROUND - concrete.		
						MADE GROUND - dark brown/black medium to coarse gravelly sand with gravel of coal and sandstone, dry.	NC	0.22
0.4-0.9		☒	*<10					
							NC	
			*<10		1	Brown silty CLAY with much fine sand and some coal, dry.		0.9
							NC	
1.5-2.0		☒	*<10			Yellow brown very fine silty SAND with some clay, dry.		1.4
							NC	
			*<10		2	Yellow brown fine silty SAND with some very fine rounded gravel, moist.		1.9
			*<10					
			*<10		3			
							NC	
			*<10					
			*<10		4			
4.1-4.9		☒	*<10			Grey brown very fine silty SAND, wet.		4.1
			*<10		5			
							NC	

LOCATION/NOTES

Borehole drilled to 7.0m, collapsed to 4.7m.
Installed well to 4.7mbgl.

LEGEND

- ☒ Disturbed Sample
- ▽ Perched Groundwater
- ▼ Groundwater
- * Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation

LOCATION: Govan Shipyard Site, Glasgow

CLIENT: Clydeport / Marine

JOB NO: 44701-002

DAMES & MOORE

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START DATE: 13/05/00	**BOREHOLE NO BH159**
END DATE: 13/05/00	**Page 2 of 2**
DRILLER: Raeburn	
METHOD: Window Sampler	BOREHOLE DIAMETER(mm): 60/50
LOGGED BY: JD	SCREEN TYPE(mm): 19
CHECKED BY: DN	ELEVATION (mAOD): 5.01

WELL CONSTRUCTION	SAMPLE			SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS
	DEPTH(m)	NUMBER	TYPE						
▨				*<10			▨		
						7		Borehole terminated at 7.0mbgl.	7
						8			
						9			
						10			
						11			

LOCATION/NOTES

Borehole drilled to 7.0m, collapsed to 4.7m. Installed well to 4.7mbgl.

LEGEND

- ☒ **Disturbed Sample**
- ∇ **Perched Groundwater**
- ▼ **Groundwater**
- * **Headspace Analysis on Soil Sample**

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation

LOCATION: Govan Shipyard Site, Glasgow

CLIENT: Clydeport / Marine

JOB NO: 44701-002

DAMES & MOORE

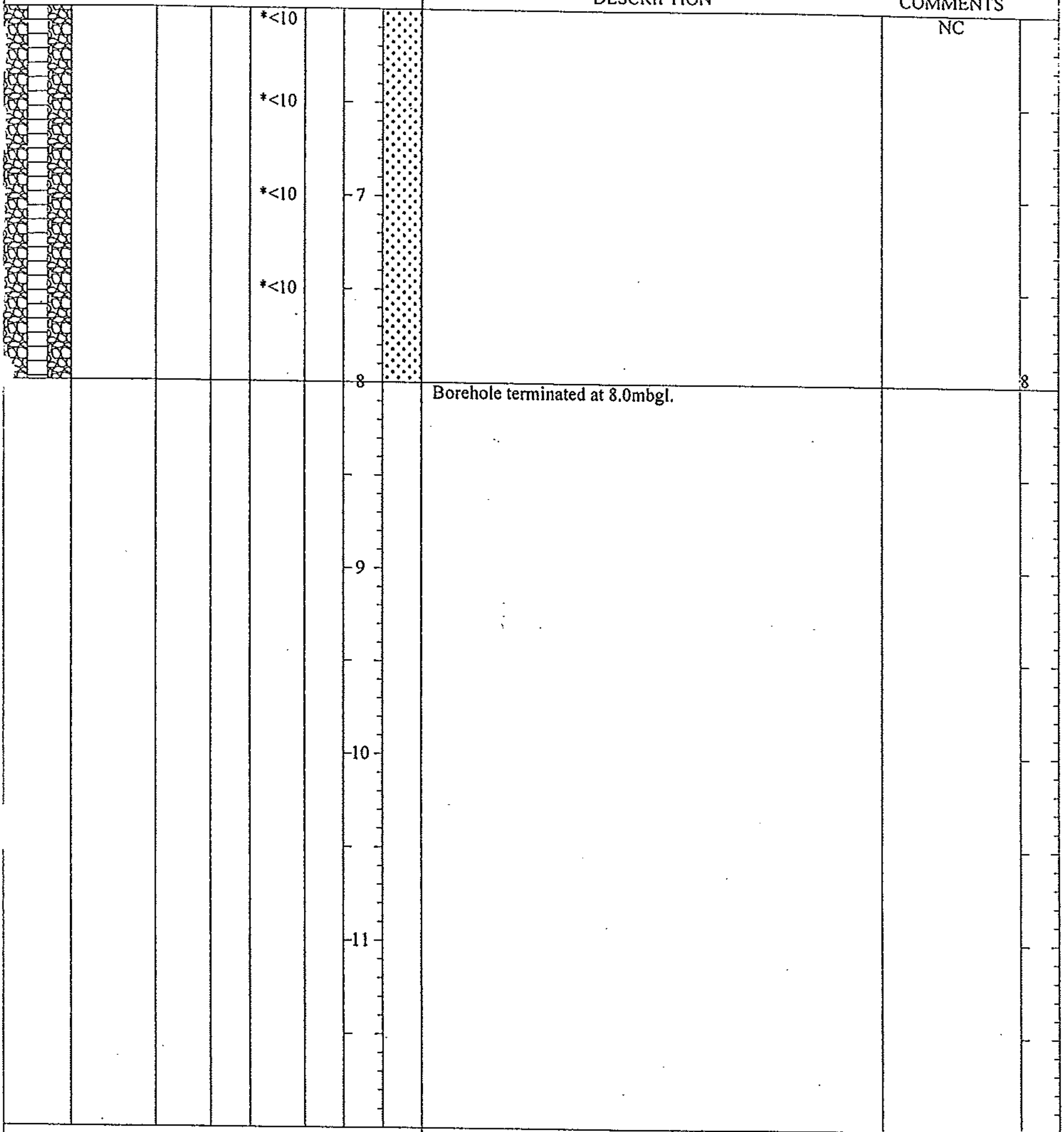
WELL CONSTRUCTION	SAMPLE			SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY
	DEPTH(m)	NUMBER	TYPE				

START DATE: 02/05/00
END DATE: 03/05/00
DRILLER: Raeburn
METHOD: Shell and Auger
LOGGED BY: JD
CHECKED BY: DN

BOREHOLE NO BH160

Page 2 of 2

BOREHOLE DIAMETER(mm): 150
SCREEN TYPE(mm): 50
ELEVATION (mAOD): 4.72



SOIL VAPOUR (ppm)	DESCRIPTION	COMMENTS
*<10		NC
*<10		
*<10		
*<10		
	Borehole terminated at 8.0mbgl.	

LOCATION/NOTES

Flat concrete hardstanding adjacent to oxygen and propane ASTs in far north east corner of site.

LEGEND

☒ Disturbed Sample
▽ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation
LOCATION: Govan Shipyard Site, Glasgow
CLIENT: Clydeport / Marine
JOB NO: 44701-002

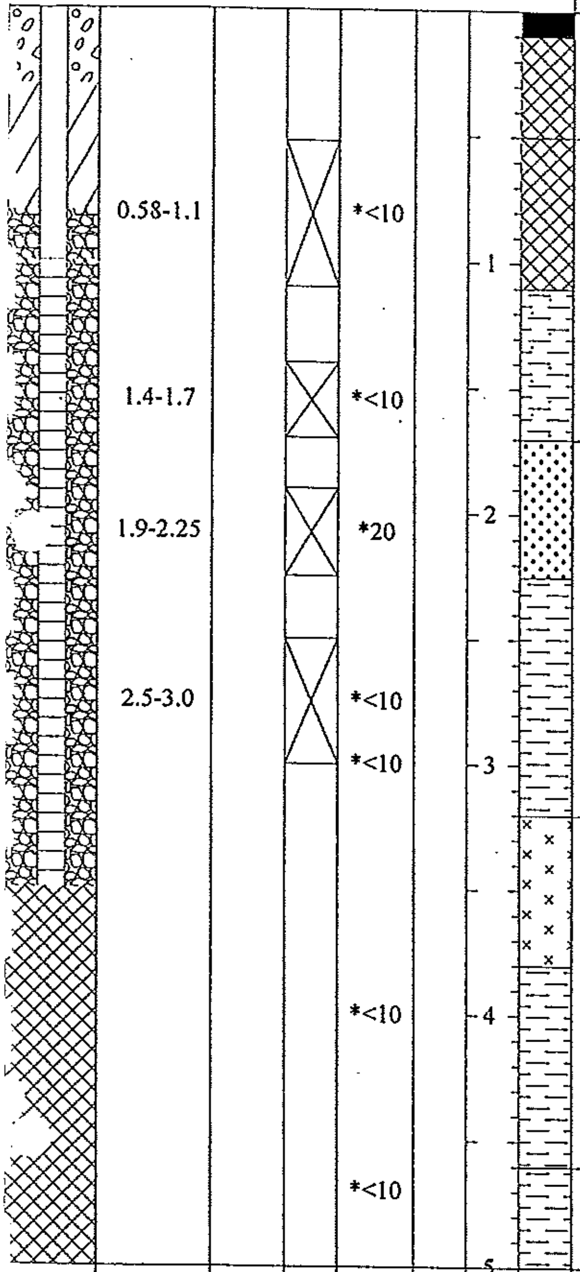
DAMES & MOORE

START DATE: 15/05/00
END DATE: 15/05/00
DRILLER: Raeburn
METHOD: Window Sampler
LOGGED BY: CM
CHECKED BY: DN

BOREHOLE NO BH161

Page 1 of 1

BOREHOLE DIAMETER(mm): 60/50
SCREEN TYPE(mm): 19
ELEVATION (mAOD): 6.77



SAMPLE DEPTH(m)	NUMBER	TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DESCRIPTION	COMMENTS	
					MADE GROUND - tarmac.		
					MADE GROUND - hardcore.	NC	0.1
						NC	
					MADE GROUND - firm to stiff, silty, very sandy clay.		0.5
0.58-1.1		☒	*<10			NC	
					Orange brown, soft, slightly sandy CLAY with occasional fine angular gravel.		1.1
1.4-1.7		☒	*<10			NC	
					White, red brown and black, medium to coarse SAND with some fine to medium angular to rounded gravel.	NC	1.7
1.9-2.25		☒	*20		2.1m: becomes damp.	NC	
					Brown, firm CLAY with occasional bands of grey, fine, silty sand.		2.25
2.5-3.0		☒	*<10				
			*<10				
					Grey, soft to firm SILT.		3.2
						NC	
					Brown, firm to stiff CLAY.		3.8
			*<10				
						NC	
			*<10		Grey, soft to firm silty CLAY.		4.6
						NC	
					Borehole completed at 5.0mbgl.		5

LOCATION/NOTES

Adjacent to car parking spaces along southern site boundary. Borehole collapsed at 3.5mbgl.

LEGEND

☒ Disturbed Sample
▽ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation
LOCATION: Govan Shipyard Site, Glasgow
CLIENT: Clydeport / Marine
JOB NO: 44701-002

DAMES & MOORE

J:\40000~1\44701\44701.002\GINT\CLYDEL~1\CLYDEPT.GPJ
26/07/2000

BOREHOLE NO BH162

Page 1 of 2

START DATE: 10/05/00	BOREHOLE DIAMETER(mm): 150
END DATE: 10/05/00	SCREEN TYPE(mm): 50
DRILLER: Raeburn	ELEVATION (mAOD): 4.87
METHOD: Shell and Auger	
LOGGED BY: CM	
CHECKED BY: DN	

SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)
0.3-0.42		☒	*<10		
0.5-0.7		☒	*<10		
			*<10		
					1
1.5-1.7		☒	*<10		
			*<10		2
2.5-2.7		☒	*<10		
			*<10		3
			*<10		
			*<10		4
			*<10		
			*<10		5
				▼	

DESCRIPTION	COMMENTS	
MADEGROUND - hardcore.	NC	0.11
MADE GROUND - red blaes.	NC	0.16
MADE GROUND - fine to coarse, subangular to angular, ashy gravel with occasional cobbles and a little red brown vesicular slag. Hydrogen Sulphide odour from slag.	LC	0.42
MADE GROUND - dark brown fine to medium sand with occasional cobbles and concrete rubble.	NC	0.9
MADE GROUND - dark grey and grey brown, slightly gravelly, clayey, fine to medium sand and soft, orange brown and mid brown sandy clay with a little fine to medium weathered gravel and occasional coal fragments. 1.5m: grades with less clay and fine, angular gravel.	NC	2
Orange brown fine to mediun SAND with a little fine to medium, subangular gravel and occasional pockets of fine grey sand.	NC	2.5
Grey brown fine to coarse SAND with much fine to medium, rounded to subangular gravel and a little black siltstone.	NC	3.3
Green, grey, brown, soft slightly sandy SILT with a little fine to medium, angular to subangular gravel. 4.0m: grades with no gravel.	NC	4.5
Grey and green brown, firm, sandy SILT. 5.0m: becomes soft and green grey. 5.5m: becomes saturated.		

LOCATION/NOTES

Located on hardcore between portakabins between large crane on side of basin and crane track for number one berth.

LEGEND

☒ Disturbed Sample
∇ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation

LOCATION: Govan Shipyard Site, Glasgow

CLIENT: Clydeport / Marine

JOB NO: 44701-002

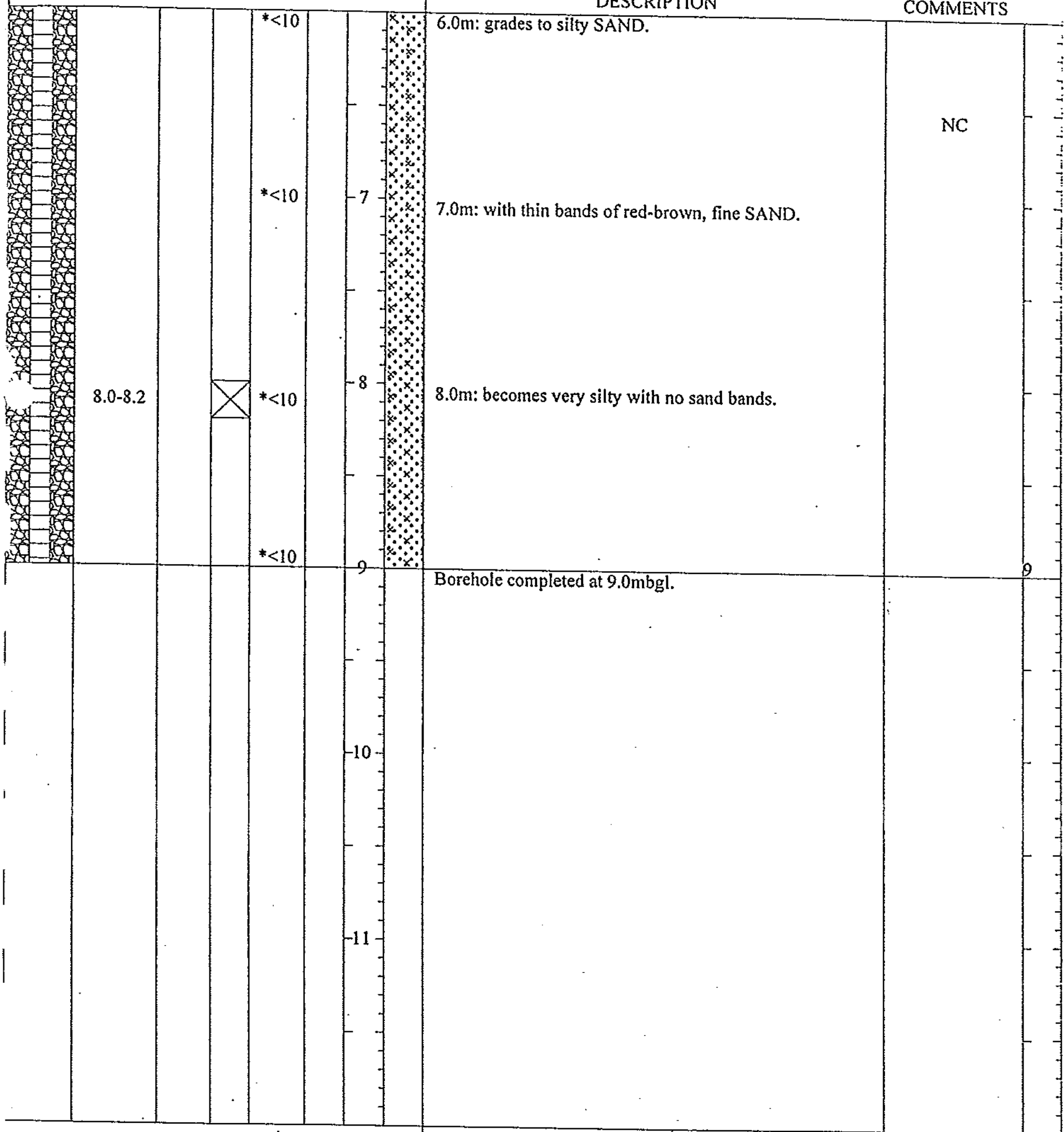
DAMES & MOORE

BOREHOLE NO BH162

Page 2 of 2

START DATE: 10/05/00
END DATE: 10/05/00
DRILLER: Raeburn
METHOD: Shell and Auger
LOGGED BY: CM
CHECKED BY: DN

BOREHOLE DIAMETER(mm): 150
SCREEN TYPE(mm): 50
ELEVATION (mAOD): 4.87



SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	DESCRIPTION	COMMENTS
			*<10			6.0m: grades to silty SAND.	NC
			*<10		7	7.0m: with thin bands of red-brown, fine SAND.	
8.0-8.2		☒	*<10		8	8.0m: becomes very silty with no sand bands.	
			*<10		9	Borehole completed at 9.0mbgl.	

LOCATION/NOTES

Located on hardcore between portakabins between large crane on side of basin and crane track for number one berth.

LEGEND

☒ Disturbed Sample
▽ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation

LOCATION: Govan Shipyard Site, Glasgow

CLIENT: Clydeport / Marine

JOB NO: 44701-002

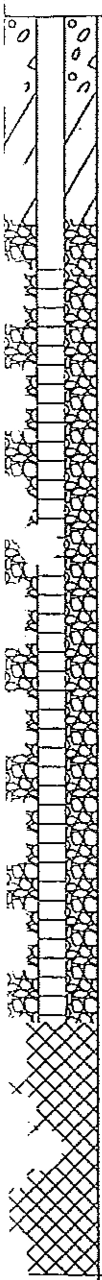
DAMES & MOORE

START DATE: 12/05/00
END DATE: 12/05/00
DRILLER: Raeburn
METHOD: Window Sampler
LOGGED BY: CM
CHECKED BY: DN

BOREHOLE NO BH163

Page 1 of 1

BOREHOLE DIAMETER(mm): 60/50
SCREEN TYPE(mm): 19
ELEVATION (mAOD): 5.37



SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	DESCRIPTION	COMMENTS	
						MADE GROUND - concrete.		0.2
0.5-0.8		⊠	*<10			MADE GROUND - dark brown fine to medium slightly clayey sand with a little red brown shale, fine to medium sub angular gravel and occasional degraded wood fragments.	NC NC	0.8
0.8-1.0		⊠	*<10		1	MADE GROUND - dark grey-green-black fine to coarse clayey sand with a little fine angular gravel and pieces of thin metal wire (0.8 - 1.0m) with an organic odour.		
1.5-1.7		⊠	*<10			1.5m: with a little coarse angular gravel, moist.	NC	1.7
2.0-2.3		⊠	*<10		2	Mid brown clayey fine SAND with occasional fine subangular gravel grading to soft to firm, orange brown clay. 2.3m: grades to grey firm slightly sandy clay.	NC	2.55
			*<10 *<10		3 4	Pale brown, grey brown and orange brown, slightly clayey fine SAND. 4.1m: grades to soft grey brown sandy clay.	NC	4.5
			*<10			Grey brown, coarse SAND with much fine, rounded to sub-angular gravel. 4.8m: grades to grey brown fine SAND.	NC NC	5
					5	Borehole terminated at 5.0mbgl.		

LOCATION/NOTES

Located in steel stocking yard at east end of site, south west of an electrical substation. Borehole collapsed at 4m.

LEGEND

⊠ Disturbed Sample
▽ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

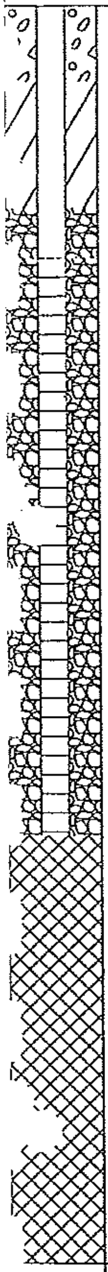
BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation
LOCATION: Govan Shipyard Site, Glasgow
CLIENT: Clydeport / Marine
JOB NO: 44701-002

DAMES & MOORE

START DATE: 15/05/00	**BOREHOLE NO BH164**
END DATE: 15/05/00	
DRILLER: Raeburn	**Page 1 of 1**
METHOD: Window Sampler	BOREHOLE DIAMETER(mm): 60/50
LOGGED BY: CM	SCREEN TYPE(mm): 19
CHECKED BY: DN	ELEVATION (mAOD): 4.8

WELL CONSTRUCTION



GEOLOGY

SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	DESCRIPTION	COMMENTS	
						MADE GROUND - concrete.	NC	
					1	MADE GROUND - dark brown fine to medium sand with a little fine to medium subangular to angular gravel.	NC	1
1.4-1.6		☒	*80					
						Grey brown, soft, slightly sandy CLAY.		1.6
			*20		2	1.9m: with a little coarse angular gravel.	NC	
						Grey brown, soft to firm, mottled sandy CLAY.	NC	2.2
2.6-3.0		☒				Grey fine, very clayey SAND.		2.6
			*60		3	3.0m: becomes less clayey with a little organic matter.		
						3.5m: becomes silty.		
3.4-4.0		☒	*80				NC	
					4	4.2m: grades to grey brown, fine to medium SAND with a little fine coal.		
			*30					
					5	Borehole completed at 5.0mbgl.		5

LOCATION/NOTES

Located on concrete to south of crane track and electrical substation.

LEGEND

- ☒ Disturbed Sample
- ▽ Perched Groundwater
- ▼ Groundwater
- * Headspace Analysis on Soil Sample

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation

LOCATION: Govan Shipyard Site, Glasgow

CLIENT: Clydeport / Marine

JOB NO: 44701-002

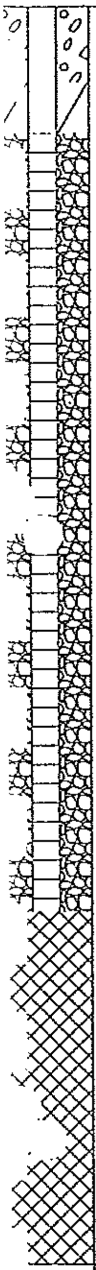
DAMES & MOORE

START DATE: 02/05/00
END DATE: 02/05/00
DRILLER: Raeburn
METHOD: Window Sampler
LOGGED BY: CM
CHECKED BY: DN

BOREHOLE NO BH165

Page 1 of 1

BOREHOLE DIAMETER(mm): 60/50
SCREEN TYPE(mm): 19
ELEVATION (mAOD): 9.03



CONSTRUCTION	SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS	
								MADE GROUND - concrete.	NC	0.15
								MADE GROUND - fine to coarse, medium to dark brown, ashy sand with a little fine angular gravel and occasional pieces of coal and slate and occasional suspected asbestos containing material (string and woven material).		
	0.5-0.7		☒	*<10						
				*<10		1		1.0m: with a piece of wood.		
									NC	
	1.5-1.7		☒	*<10						
				*<10		2				
								Fine to medium, dark brown SAND with occasional thin bands of firm grey brown clay.	NC	2.2
								Firm to stiff, grey-brown, silty CLAY.		2.4
	2.5-2.8		☒	*<10					NC	
								Fine to medium, dark brown SAND.		2.8
						3				
				*<10					NC	
						4				
								Firm to stiff, medium brown sandy CLAY.		4.1
								Fine to medium, pale brown SAND.	NC	4.3
				*<10						
									NC	
						5		Borehole terminated at 5.0mbgl.		5

LOCATION/NOTES

Down hydraulic gradient from location of former above ground fuel storage tank, (diesel). Borehole collapsed to 3.5m.

LEGEND

☒ Disturbed Sample
▽ Perched Groundwater
▼ Groundwater
* Headspace Analysis on Soil Sample

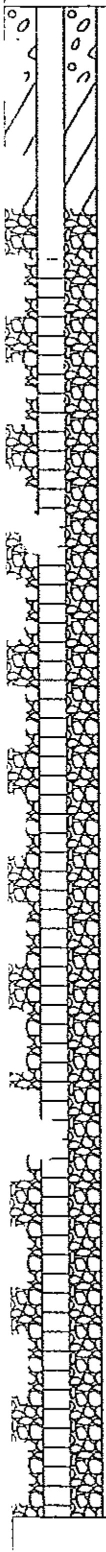
BOREHOLE LOG

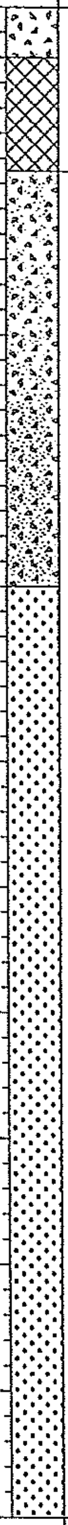
JOB TITLE: Stage II Environmental Site Investigation
LOCATION: Govan Shipyard Site, Glasgow
CLIENT: Clydeport / Marine
JOB NO: 44701-002

DAMES & MOORE

J:\40000-\44701\44701.002\GINT\CLYDEL~1\LOGS.GPJ
26/07/2000

START DATE: 13/05/00	**BOREHOLE NO BH166**
END DATE: 13/05/00	
DRILLER: Raeburn	Page 1 of 2
METHOD: Shell & Auger	BOREHOLE DIAMETER(mm): 150
LOGGED BY: CM	SCREEN TYPE(mm): 50
CHECKED BY: DN	ELEVATION (mAOD): 5.36





SAMPLE DEPTH(m)	NUMBER	TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	DESCRIPTION	COMMENTS	
						MADE GROUND - concrete.	NC	0.2
						MADE GROUND - red blaes.	NC	0.65
					1 2	MADE GROUND - concrete.	NC	2.3
2.5-2.7		☒	*<10			Orange brown, fine SAND.		
					3		3.0m: adding water.	
3.3-3.5		☒	*<10	▼		3.3m: becomes slightly silty with a little medium, angular - subangular gravel. 3.5m: becomes silty with a little fine coal and is saturated.		
					4			
			*<10		5	Very little recovery from 5.0m to 9.5m as water washing out soils.		

LOCATION/NOTES

Adjacent to panel line in steel preparation hall.
Borehole collapsed at 9.0mbgl.

LEGEND

- ☒ Disturbed Sample
- ▽ Perched Groundwater
- ▼ Groundwater
- * Headspace Analysis on Soil Sample

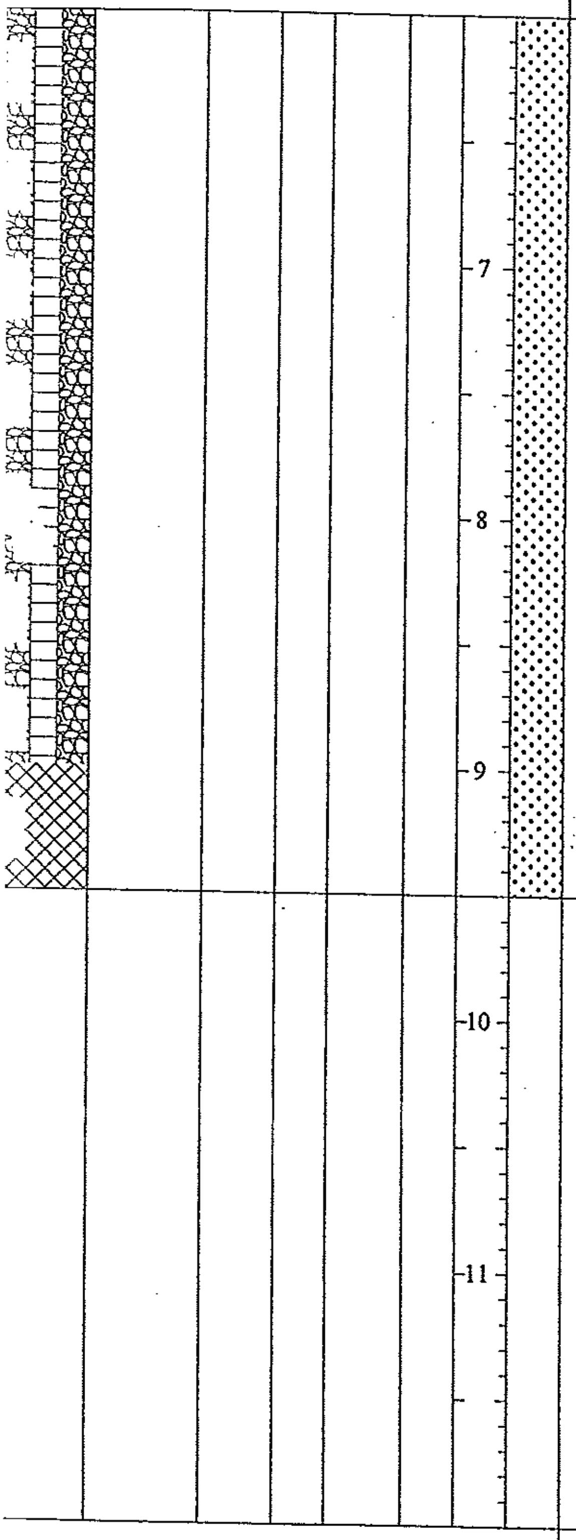
BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation
LOCATION: Govan Shipyard Site, Glasgow
CLIENT: Clydeport / Marine
JOB NO: 44701-002

DAMES & MOORE

START DATE: 13/05/00	**BOREHOLE NO BH166**
END DATE: 13/05/00	
DRILLER: Raeburn	**Page 2 of 2**
METHOD: Shell & Auger	BOREHOLE DIAMETER(mm): 150
LOGGED BY: CM	SCREEN TYPE(mm): 50
CHECKED BY: DN	ELEVATION (mAOD): 5.36

CONSTRUCTION	SAMPLE DEPTH(m)	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS	
									NC	
								Borehole terminated at 9.5mbgl.		9.5



LOCATION/NOTES

Adjacent to panel line in steel preparation hall.
Borehole collapsed at 9.0mbgl.

LEGEND

- ☒ **Disturbed Sample**
- ▽ **Perched Groundwater**
- ▼ **Groundwater**
- * **Headspace Analysis on Soil Sample**

BOREHOLE LOG

JOB TITLE: Stage II Environmental Site Investigation

LOCATION: Govan Shipyard Site, Glasgow

CLIENT: Clydeport / Marine

JOB NO: 44701-002

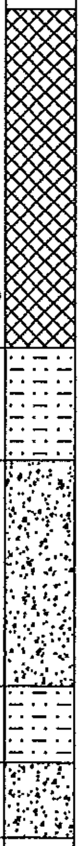
DAMES & MOORE

0002880/G_023

BAE SYSTEMS Enviromental services

Site Govan	Borehole Number BH 2		
Boring Method Cable Percussion	Diameter 200mm cased to 6.00m 150mm cased to 10.60m	Ground Level (mOD)	Client BAE S
	Location See plan (0002880/G_003)	Dates 31/10/2002	Engin Neil M
Job Number A232-00	Sheet 1/1		

Depth (m)	Sample/ Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD) (m)	Depth (m) (Thickness)		Legend	Water
0.50	D1						MADE h stone, s fragm		
1.00	D2					(2.00)			
1.50	D3								
2.00	D4					2.00	MADE stone and		
2.50	D5								
3.00	D6					(2.00)	Organ from 0m		
4.00	D7					4.00	MADE clay decor intact		1 ▼
5.00	D8					(2.50)	Orga		
				Water strike (1) at 6.00m			ile		
6.50	D9					6.50	Very fine		
8.00	D10					(4.50)	y		
9.50	D11			No sample recovery.					
11.00	D12					11.00	Com		



Logged By
NM

e No.
232-00. BH2

Remarks
Hand excavated starter pit dug to 1.20m.
Casing reduced from 200mm to 150mm at 6.0m and bentonite seal allowed an
Groundwater level measured on completion of borehole at 5.20m.
Borehole backfilled with arisings on completion.
Soil densities given as approximate only based on field observations.

Borehole BAE/BH 1

Notes

1. This drawing to be read in conjunction with drav nos. 0002880/G_003 & G_004.

CONSTRUCTION ISSUE

Do not scale this drawing

Rev	Date		
C1	17.02.03	Issued for Construction	G/

1b

Client: BAE SYSTEMS MARINE LTD.

Project: GOVAN TRANSFER QUAY

Title: SITE INVESTIGATION INFORMATION SHEET 3 OF 3

Drawing No. 0002880/G_023 C1
Scale 1:50 Date Dec.
Drawn JLD Checked GAE Approved

Babtie Group Ltd 95 Bothwell Street, Glasgow G2 7HX

Technical Appendix 8-1_Cultural Heritage

MOTT MACDONALD

BAE Govan Infill of Wet Basin and New Assembly Hall

Cultural Heritage Technical Appendix

August 2022

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BAE Govan Infill of Wet Basin and New Assembly Hall

Cultural Heritage Technical Appendix

August 2022

Mott MacDonald Limited. Registered in
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United Kingdom

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Document reference: 107212-MMD-00-XX-RP-YD-0007-P01

Information class: Standard

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Figure 5.2: A postcard from the early years of the 20th century. Sourced from The Glasgow Story and reproduced with the permission of Glasgow City Council, Libraries Information and Learning. 40

Photos

Photo 5.1: View facing north-east towards MM007, note the difference between the eastern 1871 section and the 1906 and 1916 western extension. 45

Photo 5.2: View facing south-east across the Fitting-out Basin (MM054) towards MM007 (not directly visible behind later extensions). 46

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Photo 5.6: View facing east towards the statue of John Elder. Note the setting of modern residential properties outwide the boundary of Elder Park, 53

Photo 5.7: The fitting-out basin at the Fairfield Shipyard 1898 showing the ships: Fairy, Argonaut, Hermes, Carisbrook Castle, Regele Carol I and Atmah. Sourced from The Glasgow Story and reproduced with the permission of Glasgow City Archives. 54

Photo 5.8: View facing west at the south-eastern end of the Fitting-out Basin (MM054) showing the winch (MM096) in the foreground along with several mooring posts in the background (MM095). 55

Photo 5.9: A postcard view from the River Clyde of the Fairfield Crane, claimed to be the “largest crane in the world”, around 1915. Sourced from The Glasgow Story and reproduced with the permission of Glasgow City Council, Libraries Information and Learning. 56

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Executive summary

This cultural heritage technical appendix has been produced by Mott MacDonald Ltd (MML) on behalf of BAE Systems Surface Ships Ltd (BAE Systems), to assist in understanding the heritage and archaeological constraints and opportunities associated with the proposed infill of the wet basin and construction of a new assembly hall at Govan Shipyard and Maintenance Facility (hereafter referred to as the 'proposed scheme').

The purpose of the technical appendix is to outline the methodology used, establish the legislation and policy requirements, establish the baseline for the Scheme, identify receptors (heritage assets) and understand the impact of the Scheme on these heritage assets in support of the Environmental Impact Assessment. As such the report is split into the following sections:

- Methodology;
- Legislation and Planning Policy;
- Baseline, which includes;
  - Archaeological Potential;
  - Designated Assets;
  - Non-designated Assets; and
- Gazetteer of heritage assets;
- Impact Assessment.

The document supports the Environmental Impact Assessment Report (ES, Doc ref number - 107212-MMD-00-XX-RP-YD-0016). The EIAR provides a summary of the impacts, significant and non-significant effects on key designated and non-designated heritage assets. This details the Design, Mitigation and Enhancement Measures undertaken to limit these effects. It summarises the residual effect after the design, mitigation and enhancement measures have been taken into account.

1 Abbreviations and descriptions

Table 1.1: Abbreviations and terms

Abbreviation / term	Definition
Archaeological remains	"…the buried traces of human activities or vis ble monuments, or moveable artefacts. Archaeological investigations can encompass the remains of buildings, structures, earthworks and landscapes; human, animal or plant remains, or other organic material produced by or affected by human activities, and their settings" (CIfA).
Canmore	Canmore is the online catalogue of the National Record of the Historic Environment. It holds detailed information and archive images for more than 300,000 places in Scotland.
CIfA	Chartered Institute for Archaeologists
Conservation Area	Conservation areas are areas which have special architectural or historic interest that are considered worthy of protection. To be designated as a conservation area it must me the criteria of 'special architectural or historic interest the character or appearance of which is desirable to preserve or enhance', as set out in Section 61 of the Planning Listed Buildings and Conservation Areas (Scotland) Act 1997 Act (Scottish Government 2021).
Cultural Heritage	'Cultural heritage is an expression of the ways of living developed by a community and passed on from generation to generation. It can include customs, practices, places, objects, artistic expressions and values, aesthetic, historic, scientific, social or spiritual aspects' (HEPS 2019)
Cumulative effects	The summation of effects that result from changes caused by a development in conjunction with other past, present or reasonably foreseeable actions.
Effect	The consequence of the change to the baseline environment, or impact, on the environmental receptor or particular value or sensitivity (see also: 'impact').
EIA	Environmental Impact Assessment
Effect	The consequence of the change to the baseline environment, or impact, on the environmental receptor or particular value or sensitivity (see also: 'impact').
EIA	Environmental Impact Assessment
Garden and Designed Landscape	The Inventory of Gardens and Designed Landscapes recognises sites where garden grounds and landscapes have been intentionally laid out for artistic effect which are of national importance. The inventory is maintained by Historic Environment Scotland (Scottish Government 2021).
Heritage Value	An aspect of the worth or importance attached by people to qualities of places, categorised as aesthetic, evidential, communal or historical value.
Heritage Assets	An asset (or 'historic asset' or 'heritage asset') is a physical element of the historic environment – a building, monument, site, place, area or landscape identified as having cultural significance (Scottish Government 2021; HEPS 2019).
Historic Environment Record (HER)	HERs, previously known as Sites and Monuments Records, provide access to historic information about buildings, monuments, places and sites of archaeological finds. They are held and maintained by county councils, district councils, unitary authorities, national parks and landowners.
Historic Environment Scotland (HES)	Historic Environment Scotland is the lead public body established to investigate, care for and promote Scotland's historic environment.
Impact	Used throughout this environmental statement to refer to changes to the environment that have the potential to occur as a result of the construction and/or operation of the proposed scheme (see also: 'effect').
Listed Building	A listed building is a built structure of 'special architectural or historic interest'. The term 'building' can be defined as 'anything made by people' such as houses, schools, factories, boundary walls, bridges and sculptures. They are designated by Historic Environment Scotland under the Planning (Listed Buildings and Conservation Areas) (Scotland) Act 1997 and they maintain the list (Scottish Government 2021).

Abbreviation / term	Definition
Mitigation	Measures to avoid, reduce, and possibly remedy significant adverse effects.
Scheduled Monument	Scheduled monuments are archaeological sites or monuments of national importance that are legally protected under the Ancient Monuments and Archaeological Areas Act 1979. They are designated by Historic Environment Scotland who maintains the schedule (Scottish Government 2021).
National Record of the Historic Environment (NRHE)	Hosted by Historic Environment Scotland (HES), the National Record of the Historic Environment (NRHE) is the online catalogue of Scotland's archaeology, buildings, industrial, and maritime heritage.
Protected Wrecks	These wrecks are protected under Section 1 of the Protection of Wrecks Act 1973.
Receptor	A component of the historic environment affected by an impact of the construction and/or operation of a proposed development.
Scheduled Monument	Scheduled monuments are archaeological sites or monuments of national importance that are legally protected under the Ancient Monuments and Archaeological Areas Act 1979. They are designated by Historic Environment Scotland who maintains the schedule (Scottish Government 2021).
Sensitivity	The extent to which the receptor can accept change of a particular type and scale without unacceptable adverse effects
Setting	Setting is more than the immediate surroundings of a site or building and may be related to the function or use of a place, or how it was intended to fit into the landscape of townscape, the view from it or how it is seen from areas round about, or areas that are important to the protection of the place, site or building. 'Setting' is the way the surroundings of a historic asset or place contr bute to how it is understood, appreciated and experienced (Historic Environment Scotland 2016)
Sites and Monuments Record (SMR)	SMRs were established from the 1960s onwards in response to the loss of the archaeological resource through urban and rural development. From their original remit of recording archaeological sites, they have been developed to encompass a wide range of information about the historic environment which has been reflected in the change of name from SMR to HER (Scottish Government 2014).
West of Scotland Archaeology Service (WoSAS)	The West of Scotland Archaeology Service was established in 1997 to maintain and update the Historic Environment Record (HER) - the complete record of all known archaeological sites, finds, fieldwork and research for the area covered by the service. Staff from the Service also provide professional advice to landowners, public utilities, private developers, farmers and other land managers to promote the implementation of national and international policies for the preservation of archaeological remains.

Source: Mott MacDonald 2022

2 Introduction

2.1 Project background

This cultural heritage technical appendix has been produced by Mott MacDonald Ltd (MML) on behalf of BAE Systems Surface Ships Ltd (BAE Systems), to assist in understanding the heritage and archaeological constraints and opportunities associated with the proposed infill of the wet basin and construction of a new assembly hall at Govan Shipyard and Maintenance Facility (hereafter referred to as the 'proposed scheme').

This technical appendix supplements the Cultural Heritage chapter of the Environmental Impact Assessment Report (EIAR) which has been commissioned by BAE Systems to support the request for planning consent from Glasgow City Council (GCC).

The purpose of this document is to define a cultural heritage baseline and identify the archaeological (terrestrial and marine) and built heritage resources potentially impacted by the proposed scheme. It also assesses the potential for the survival of archaeological remains within the footprint of the proposed scheme. In addition, a setting assessment of specific designated and non-designated assets that may be affected by the proposed scheme is presented.

2.2 Overview of the proposed scheme

2.2.1 Scheme location

The proposed scheme is located in Govan, an urban area west of Glasgow City Centre on the south bank of the River Clyde. The proposed scheme is based at BAE Systems Govan Shipyard, hereafter Govan Shipyard, which is centred on British National Grid Reference (NGR) NS 54615 65993.

The Shipyard is surrounded by a variety of land uses, the majority of which are industrial, business, and commercial properties, with some residential properties to the south. The River Clyde forms the northern boundary of the proposed scheme, while the A739, Govan Road, and other minor highways form the remaining boundaries. Figure 2.1 provides a more detailed plan of the shipyard and includes the red line boundary (shown as the indicative site boundary) for the proposed scheme.

The site has been used for ship building since the 19th century. The current site infrastructure consists of fabrication buildings, stores, slipways, and parking facilities, with the wet basin in the site's centre. The site is accessible via Govan Road, with the primary car parking facilities on the western area of the site.

Figure 2.1: Proposed scheme Location Plan

Source: Mott MacDonald (2022)

2.2.2 Scheme proposals

The proposed scheme comprises of the infilling of the existing wet basin, including the closing of the quay wall, together with the erection of a new ship building assembly hall (hereafter referred to as the new assembly hall) and associated accommodation and works.

2.3 Terminology

2.3.1 Basin

Throughout the description of the proposed scheme the basin has been referred to as the wet basin. However, for the purpose of this technical appendix the basin will be hereafter referred to as the Fitting-out Basin. This in line with the terminology used to describe the basin within the Glasgow Sites and Monuments Record (SMR) and National Record of the Historic Environment (NRHE).

This name relates to the use of the basin during the fitting-out stage in the construction process. This is where technicians install fittings such as furnishings, machines, the power plant, and some elements of the superstructure. The fitting-out process also involves installing painting, flooring, decorative moulding, rails, and other features on the inside and outside of the ship.

2.3.2 Cultural Heritage

'Cultural heritage' is the standard term used in EIA but is used here interchangeably with the term 'historic environment'.[1] The 'historic environment' is defined as 'the physical evidence for human activity that connects people with place, linked with the associations we can see, feel

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[1] Historic Environment Scotland and Scottish Natural Heritage (2018) *Environmental Impact Assessment Handbook*.

and understand.'[2] The 'historic environment' has also been termed, the 'cultural heritage of places'.[3]

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[2] Scottish Government 2014, Our Place in Time. Available online at: https://www.historicenvironment.scot/archives-and-research/publications/publication/?publicationId=fa088e13-8781-4fd6-9ad2-a7af00f14e30. Accessed 04/08/2022.

[3] Scottish Government 2014, Our Place in Time. Available online at: https://www.historicenvironment.scot/archives-and-research/publications/publication/?publicationId=fa088e13-8781-4fd6-9ad2-a7af00f14e30. Accessed 04/08/2022.

3 Methodology

3.1 Introduction

This section identifies the baseline information that is currently available, sets out the approach that has been taken in the assessment and identifies the likely significant effects for the historic environment.

All heritage assets in the baseline of this technical appendix have been included in a gazetteer in Section 6, with a brief description of their heritage value. Descriptions of heritage value are proportionate and relevant to any potential impact from the proposed scheme. Each heritage asset is attributed a corresponding unique reference number prefixed by an abbreviation of Mott MacDonald (MM).

3.2 Study area

This baseline identifies and describes heritage assets and their heritage value,[4] including their setting, within 1km radius of the proposed scheme red line boundary for designated heritage assets and a 500m radius for non-designated heritage assets. Heritage assets beyond the 1km study area have been included where professional judgement aided by the use of a Zone of Theoretical Visibility (ZTV),[5] shown in Volume 3, Figure 7.1, has considered inclusion necessary. Such assets typically comprise those considered of very high or high value that are particularly sensitive to change, such as Category A and some Category B listed buildings, designed gardens and landscapes, and conservation areas. This will hereafter be referred to as the study area.

The use of the 1km radius for designated heritage assets coupled with the ZTV for very high and high value assets is considered appropriate for the study area as the proposed scheme involves a structure which may cause changes to the cityscape and skyline. As such, this could result in change to the setting of designated assets at a greater distance that have designed or otherwise significant views that may be altered. The extent of the study area therefore allows for a proportional assessment of the setting of heritage assets, including key historic views to and from the proposed scheme. It should also be noted that the ZTV may overestimate views as it was designed with the potential building height in mind (46.5m), but this means that all the high value heritage assets that have the potential to be impacted by the proposed scheme have been appropriately considered within this technical appendix.

The 500m radius study area for non-designated heritage assets is considered appropriate as it is a wide enough area to include heritage assets with the potential to be impacted from physical works within and adjacent to the proposed scheme. The 500m study area is also be used to indicate the potential for the presence of unknown archaeology. Moreover, changes to noise are unlikely to result in significant effects beyond 500m except in the case of the most sensitive receptors (i.e., designated heritage assets). It is also unlikely that non-designated heritage assets of low value will be significantly affected by visual changes to their setting over 500m. However, where appropriate and based on professional judgement, non-designated heritage assets of medium or higher value outwith the 500m study area, but within the ZTV, have also been considered as part of this technical appendix as they may be more sensitive to change.

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[4] Within national planning policy and guidance, the value attributed to a heritage asset is referred to as its “significance”. To prevent confusion with EIA terminology regarding “significance of effect” this technical appendix will use the phrase “heritage value” in place of “significance” when referring to heritage assets. The definition attributed to “heritage value” remains unchanged from that attributed to “significance” in national planning policy and guidance.

[5] The zone of theoretical visibility (ZTV) is the likely (or theoretical) extent of visibility of a development.

3.3 Baseline research

The baseline conditions include known designated and non-designated heritage assets within the study area, the historic landscape character of the area and archaeological potential/ or an archaeological risk model.

The historic environment assessment considers the potential effects on the following;

- Designated assets including world heritage sites, scheduled monuments, listed buildings, conservation areas, historic marine protected areas (HMPA), protected wrecks, designed gardens and designed landscapes (GDL) or historic battlefields;
- Non-designated assets including locally listed buildings, buildings and structures of recognisable heritage value[6] and archaeological remains of national, regional and local value;
- Non-designated historic landscapes and townscapes; and
- Unknown archaeological remains.

The baseline is informed by accessing readily available historical and archaeological records. Sources consulted for this include:

- Details of the designated heritage assets outlined above, as maintained by Historic Environment Scotland (HES), datasets downloaded 8th July 2022;
- The National Record of the Historic Environment (NRHE), including maritime assets, as maintained by HES, datasets downloaded 8th July 2022;
- The Glasgow Sites and Monuments Record (SMR)[7] as maintained by the West of Scotland Archaeology Service (WoSAS), dataset received 6th July 2022;[8]
- Historic mapping available from the National Library of Scotland (NLS);
- Aerial imagery (vertical and oblique) available from online platforms including the National Collection of Aerial Photography (NCAP) as held by HES and the Cambridge University Collection of Aerial Photography (CUCAP);
- Lidar data as held by NLS;
- The British Geological Survey (BGS);
- The Historic Land-use Assessment map (HLAMap) as maintained by HES;
- Records of archaeological investigations, primarily sourced from the Archaeological Data Service (ADS) and Discovery and Excavation Scotland (DES);
- Additional online resources;
- Relevant published and unpublished documentary sources; and
- Visit to the Fairfield Heritage on 6th July 2022.

3.4 Baseline surveys

Two surveys were conducted as part of the baseline and in line with best practice and recommended guidance.[9]

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[6] Heritage value, also referred to as significance.

[7] This is more commonly known as the Historic Environment Record (HER) but SMR is the term still used by WoSAS.

[8] SMR search reference number: MM1312.

[9] Historic Environment Scotland and Scottish Natural Heritage 2018, *Environmental Impact Assessment Handbook*. Available online at: https://www.historicenvironment.scot/archives-and-research/publications/publication/?publicationId=6ed33b65-9df1-4a2f-acbb-a8e800a592c0. Accessed

The first was a comprehensive archaeological walkover survey of the proposed scheme area (hereafter scheme area) carried out on 6th July 2022. The walkover survey was used to assess the setting of heritage assets within the scheme area and inform an understanding of the potential impact of the proposed scheme. It was also used as an opportunity to identify any non-designated heritage assets not previously identified from documentary evidence that may be impacted by the proposed scheme. As part of this first walkover, the wider area was also visited to consider historic views, architectural and functional relationships, and to understand the relationship of Govan Shipyard with the surrounding heritage assets.

A second site walkover was carried out on 29th July 2022. The walkover covered publicly accessible areas in the study area and involved site visits to key heritage assets identified in the baseline, including Listed Buildings and the Govan Conservation Area in order to complete setting and character assessments and inform an understanding of the potential impact of the proposed scheme.

3.5 Consultation

The following consultation has been undertaken as part of the assessment of the baseline conditions.

3.5.1 Historic Environment Scotland

Historic Environment Scotland (HES) provides advice on land-based heritage assets such as world heritage sites, scheduled monuments and their setting, category A listed buildings and their setting, as well as assets included in both the inventory of gardens and designed landscapes and the inventory of historic battlefields. HES also cover historic marine protected areas (HMPAs) and undesignated marine cultural heritage features.

HES provided a response to Marine Scotland in relation the Screening Report for Environmental Impact Assessment (EIA) on 30th June 2022 prepared by EnviroCentre to consider whether the application for a marine licence for the infill of the wet basin would need to be accompanied by an EIA.

HES noted that while the basin itself is not listed, it is broadly contemporary with the adjacent Category A listed 1048 Govan Road, Govan Shipbuilders' Store, Former Engine Works of Fairfield Shipbuilding and Engineering Company (MM007), hereafter called the 'Former Engine Works'. Therefore, infilling the Fitting-out Basin has the potential to significantly impact on the setting of the Category A listed building. HES recommended that to fully assess this impact, the EIA should demonstrate a full appreciation of the special interest of the Category A listed Former Engine Works (MM007) and its setting, including the contribution made by the Fitting-out Basin.

This initial response from HES also highlighted the following:

'We note that the EIA Screening Report (May 2022) gives some consideration at Table 5.1 to measures for mitigating impacts on the historic environment. These include documenting the wet basin [Fitting-out Basin] *prior to construction commencing and, also, implementing suitable protocols for the recording of previously unrecorded cultural heritage assets. We recommend that an appropriately detailed description of any such mitigation measures should also be set out as part of an environmental assessment in support of the proposals. We would be happy to provide further advice on the detail of any such mitigation scheme as necessary.'*

11/07/2022, p.180; Chartered Institute for Archaeologists (CIfA) 2020a, *Standard and guidance for historic environment desk-based assessment.* Available online at https://www.archaeologists.net/sites/default/files/CIfAS%26GDBA_4.pdf. Accessed 11/07/2022.

We have interpreted this to mean the production of a Written Scheme of Investigation (as defined by the Chartered institute for Archaeologists, CIfA 2020c) for all archaeological investigation, recording, excavation and/or watching briefs in advance of, and during construction work. The work will involve consultation with Historic Environment Scotland and the West of Scotland Archaeology Service (WoSAS) on behalf of GCC, to establish and agree the scope and extent of this work, necessary monitoring by these authorities and approval of the report in advance of submission as part of the EIA and Planning Process.

3.5.2 Local Authority Conservation Officer

Glasgow City Council (GCC) were contacted on 6th July 2022. It was advised that once the EIA Scoping submission had been allocated to a case officer, then consultations could be initiated with the Conservation Officer at GCC.

At the time of the submission of the EIAR (August 2022) no formal consultation has been received, however, ongoing dialogues with GCC have outlined concerns about whether the new location of the new assembly hall will require changes to site routes and vehicle movements that could impact upon the long-term structure and useability of the Category A listed building (MM007). GCC also requested that effects on the historic environment from the infill of the wet basin should be investigated as part of the EIA process. Agreeing that, although not heavily used today, the formation of that basin and the activities that used to take place within it are a part of the history and evolution of the Fairfield Yard. Therefore, while GCC would not expect the loss of the basin to create significant cultural impacts, they highlighted that they would still like to see that investigated as part of the EIA process.

3.5.3 Local Authority Archaeological Officer

As advisers to GCC in all matters pertaining to archaeology, the West of Scotland Archaeology Service (WoSAS) were consulted upon commission of the EIA on 5th July 2022. A response was received on the 6th July 2022. WoSAS highlighted that the most obvious issue in this area would be its proximity to Govan Old Parish Church (MM001). WoSAS highlighted the potential for material relating to contemporary early medieval occupation to be present in the vicinity of the proposed scheme, but also noted that the potential may not be particularly high as a result of the high levels of ground disturbance that will have taken place on the site itself during its use as a shipyard.

WoSAS also pointed out that the non-designated heritage assets within the study area may somewhat under-represent the significance of the scheme area as an industrial ‘monument’. As such, they emphasised that the assessment would need to give weight to the effect of the proposal on the structures of the shipyard itself.

Following the decision to include the historic marine environment in this assessment, WoSAS were contacted on 28th July 2022 with a description of the proposed marine dredging works and the possible use of silt and sand from elsewhere on the Clyde to create the infill of the Fitting - out basin.

WoSAS noted that they generally do not comment on proposals below the water mark as they do not hold marine or maritime records. However, they did note that if any dredging associated with the proposed scheme was to be to a depth that is likely to have happened regularly during routine maintenance works then no issues would be anticipated regarding the historic environment. They also confirmed that the use of locally sourced silt or sand would be acceptable.

WoSAS were also contacted on 5th August 2022 in relation to the potential archaeological mitigation measures proposed as part of the scheme. From informal consultation it was agreed that as the basin (MM054) is to be infilled this would mean that the asset is largely preserved below the finish ground level a laser scan would be a suitable method of record.

It was also confirmed that it would be ideal for the mooring posts (MM095) and winches (MM096) to remain in situ; however, the WoSAS recognised that these may need to be relocated elsewhere to suit the requirements of the functioning shipyard. As such, they agreed that monitoring the removal of the mooring posts or winches may provide some opportunity to clarify how the walls of the basin were tied into the surrounding ground but also recognised that this may only provide limited information.

The technical appendix will be submitted to the Online Access to the Index of Archaeological Investigations (OASIS) website hosted by the Archaeological Data Service (ADS) for review by WoSAS on behalf of GCC.

3.6 Assessment methodology

A full assessment of the impact of the proposed scheme on all heritage receptors (including heritage assets, historic landscapes and unknown archaeology) has been undertaken based on guidance in IEMA, IHBC and CIfA "*Principles of Cultural Heritage Impact Assessment in the UK*" (PCHIA) (2021)[10] and the Design Manual for Roads and Bridges (DMRB) Guidance Notes LA104[11] and LA106.[12] Although the DMRB guidance was developed for road schemes it has been adapted so it can be used on all relevant schemes for cultural heritage assessment.

3.6.1 Impact assessment criteria

The significance of an effect is determined based on the magnitude of an impact and the sensitivity of the cultural heritage receptor affected by the impact of that magnitude. This section describes the criteria applied to characterise the magnitude of potential impacts and sensitivity of receptors. The terms used to define magnitude and sensitivity are based on the above guidance.

3.6.2 Magnitude of impact

The magnitude of impact is determined by the predicted deviation from the baseline conditions and the scale of the effect. The qualitative magnitude of each impact (in the absence of quantitative data) has been determined according to the descriptions provided within Table 3.1.

A designated heritage asset is one that has been recognised to be of heritage value(s) by giving it formal status under law or policy intended to sustain those values. These include World Heritage Sites, Scheduled Monuments, Listed Buildings, Conservation Areas, Historic Marine Protected Areas, Designated Wrecks, Gardens and Designed Landscapes or Historic Battlefields.

Non-designated heritage assets are sites, buildings, monuments, places, areas, or landscapes identified as having a degree of significance meriting consideration in planning decisions

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[10] Institute of Historic Building Conservators (IHBC), Institute of Environmental Management and Assessment (IEMA) and Chartered Institute for Archaeologists (CIfA) 2021, *Principles of Cultural Heritage Impact Assessment in the UK (PCHIA)*. Available online at: https://ihbconline.co.uk/toolbox/docs/Principles%20of%20Cultural%20Heritage%20Impact%20Assessment.pdf. Accessed 11/07/2022.

[11] Design Manual for Roads and Bridges (DMRB) 2020a, *LA 104 - Environmental assessment and* monitoring. Available online at https://standardsforhighways.co.uk/dmrb/search/0f6e0b6a-d08e-4673-8691-cab564d4a60a. Accessed 11/07/2022.

[12] Design Manual for Roads and Bridges (DMRB) 2020b, *LA 106 - Cultural heritage assessment.* Available online at https://www.standardsforhighways.co.uk/dmrb/search/8c51c51b-579b-405b-b583-9b584e996c80. Accessed 11/07/2022.

because of their heritage interest but which do not meet the criteria for designated heritage assets.

Setting is the way the surroundings of a historic asset or place contribute to how it is understood, appreciated and experienced.[13] Its extent is not fixed and may change as the heritage asset and its surroundings evolve. Elements of a setting may make a positive, negative, or neutral contribution to the value of an asset, may affect the ability to appreciate that value or may be neutral.

Table 3.1: Scale for evaluating the magnitude with respect to effects on cultural heritage receptors can be adverse or beneficial

Magnitude of effects	Criteria	Examples
Major	Adverse: Total loss or fundamental alteration to a heritage asset's value and/or setting.	Total demolition of a building or complete removal of an archaeological features. Fundamental change to all key aspects of an asset's setting.
	Beneficial: Changes which entirely restore the setting of a heritage asset or substantially better reveal its value	Total restoration of a heavily altered historic setting. Comprehensive and historically appropriate repair, restoration and/or re-use.
Moderate	Adverse: Partial loss or alteration a heritage asset's value and/or setting.	Complete removal of a key aspect of a building's architecture or heavy alterations so it cannot be understood. Partial removal of an archaeological feature. Setting changes which substantially alter how an asset is understood, but do not change the entire historic setting.
	Beneficial: restoration of key parts of the setting of an asset or better reveal its value	Restoration of key parts of a setting, changes to return key parts of a building to their historic layout or function, excellent and informed interpretation to allow better public appreciation.
Minor	Adverse: Minor loss of an element of a heritage asset and/or its setting.	Small changes in setting or small changes to the asset itself which make it harder to appreciate its value.
	Beneficial: small changes to an asset or its setting which result in better revealing of its value.	Small changes in setting or small changes to the asset itself which make it easier to appreciate its value.
Neglig ble	Adverse: Very minor loss of elements of a heritage asset's setting.	Very small changes in setting or very small changes to the asset itself which make it harder to appreciate its value.
	Beneficial: Very minor positive change within a heritage asset's setting.	Very small changes in setting or very small changes to the asset itself which make it easier to appreciate its value.
No Change	No change to the heritage asset or its setting.	

Source: Adapted from DMRB (2020), LA 104 - Section 3 Environmental assessment methodology: Table 3.4

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[13] Historic Environment Scotland 2016, Managing Change in the Historic Environment: Setting. Available online at: https://www.historicenvironment.scot/archives-and-research/publications/publication/?publicationId=80b7c0a0-584b-4625-b1fd-a60b009c2549 Accessed 11/07/2022.

3.6.3 Proportionate approach to assigning value

To ensure a proportionate approach to the assessment, selected assets in the study area have been subject to a higher level of assessment. They were selected by a process of professional judgement due to their proximity to the proposed scheme, their heritage value, and/ or the sensitivity of their character or setting to change.

The proportionate approach also looked at where assets are unlikely to be impacted due to topography, distance from scheme or type of asset. This utilised the ZTV for the proposed scheme in line with the study area outlined above. These assets were not subject to a detailed assessment.

Where assets are related due to their significant visual, design or historic relationship they may be grouped. This is referred to as group value. This selection will ascertain where heritage assets can be grouped and assessed together.

3.6.4 Sensitivity of receptors

The sensitivity (value) of receptors has been determined according to the descriptions provided within Table 3.2.

The sensitivity or value is also referred to in Historic Environment Policy for Scotland (HEPS) (2019) as cultural significance in line with the Burra Charter (International Council on Monuments and Sites, ICOMOS 2013). For the purpose of cultural heritage impact assessment the term 'value' is used to avoid confusion with significance of effect as defined in EIA guidance including the 'Environmental Impact Assessment Handbook (HES and SNH 2018).

To inform the assessment, the Scottish Archaeological Research Framework (ScARF)[14] was used to identify potential research objectives to which heritage assets identified within the study area could potentially contribute. This information was also used when assigning the sensitivity (value) of a heritage asset.

Table 3.2: Scale for evaluating the sensitivity (value) of cultural heritage receptors

Sensitivity	Cultural heritage receptor
Very High	Very high importance and rarity, international scale and very limited potential for substitution. These include World Heritage sites, assets of acknowledged international importance, assets that can contrbute significantly to acknowledged international research objectives.
High	High importance and rarity, national scale, and limited potential for substitution. Scheduled monuments, Category A Listed Buildings, Conservation Areas, Historic Marine Protected Areas, Gardens and Designed Landscapes or Historic Battlefields where the asset and its setting retain archaeological, architectural and artistic, and historic interest which contrbutes to their value. Non-designated monuments, sites or landscapes that can be shown to have specific nationally important qualities and assets that can contribute significantly to national research objectives.
Medium	Medium importance and rarity, regional scale, limited potential for substitution. Category B and C Listed Buildings, Conservation Areas, Gardens and Designed Landscapes, Historic Marine Protected Areas, Gardens and Designed Landscapes or Historic Battlefields where the asset and its setting retain less archaeological, architectural, artistic and/or historic interest which contributes to a lesser extent of their value. Non-designated sites of regional importance identified through research or survey, monuments or sites that can be shown to have important qualities in their fabric or historical association.
Low	Low importance and rarity, local scale. Non-designated assets – buildings, structures, monuments, or archaeological sites with a local importance for education or cultural appreciation, and which add to local archaeological and historic research. Very badly damaged assets that are of such poor quality that they cannot be classed as high or medium, parks and designed landscapes of local interest.

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[14] Scottish Archaeological Framework (ScARF). Available online at: https://www.scarf.scot. Accessed 04/08/2022.

Sensitivity	Cultural heritage receptor
Negligible	Very low importance and rarity, local scale. Heritage resources identified as being of little historic, archaeological, architectural and artistic interest, resources whose importance is compromised by poor preservation or survival or by contextual associations to justify inclusion into a higher grade.

Source: Adapted from DMRB (2020), LA 104 - Section 3 Environmental assessment methodology: Table 3.2.

The assessment also recognises that occasionally some heritage assets have a lower or higher than normal value / sensitivity within a local context. Additionally, this assessment process should consider the component of the heritage asset that is being affected, and the ability of the heritage asset to absorb change without compromising the understanding or appreciation of the resource.

3.6.5 Significance of effect

Within this EIAR the terms 'impact' and 'effect' are used in accordance with EIA guidance and the below described methodology.

Effects have been evaluated by combining the assessment of both the value/sensitivity (significance) of an asset, with the magnitude of the impact. This allows the prediction of the significance of the effect, as shown in Table 3.3. These effects can be beneficial or adverse; and temporary or permanent, depending on the nature of the development, the mitigation measures, and any enhancement measures proposed. Effects with an assessment of moderate and above (underlined) are significant.

Table 3.3: Scale for evaluating the significance category with respect to impacts on cultural heritage receptors – effects can be adverse or beneficial

		Magnitude of change				
Heritage Value		No change	Negligible	Minor	Moderate	Major
	Very High	Neutral	Slight	**Moderate or Large**	**Large or Very Large**	**Very Large**
	High	Neutral	Slight	**Slight or Moderate**	**Moderate or Large**	**Large or Very Large**
	Medium	Neutral	Neutral or Slight	Slight	**Moderate**	**Moderate or Large**
	Low	Neutral	Neutral or Slight	Neutral or Slight	Slight	**Slight or Moderate**
	Negligible	Neutral	Neutral	Neutral or Slight	Neutral or Slight	Slight

Source: Adapted from DMRB LA 104 - Section Environmental assessment and monitoring Revision 1: Table 3.8.1

The significance of effect is determined according to the criteria outlined below in Table 3.4. Very Large, Large and Moderate effects are considered significant, represented by the shading and bold font in Table 3.3. These have the potential to be material in the decision-making process.

Table 3.4: Significance categories and typical descriptions

Value	Asset
Very Large	Effects at this level are material in the decision-making process.
Large	Effects at this level are likely to be material in the decision-making process.
Moderate	Effects at this level can be considered to be material decision-making factors.
Slight	Effects at this level are not material in the decision-making process.
Neutral	No effects or those that are beneath levels of perception, within normal bounds of variation or within the margin of forecasting error.

Source: DMRB (2020), LA104, Table 3.7 Significance categories and typical descriptions

3.7 Impacts from the proposed scheme

Impacts to the historic environment can be both adverse (those that cause harm to heritage assets) and beneficial (those that protect or increase understanding of a heritage asset).

3.7.1 Temporary construction Impacts

Temporary construction effects to cultural heritage receptors are likely to arise from the following:

- The appearance of temporary construction compounds, access routes and work sites;
- Visual disturbance from movement of plant and construction traffic; and
- Noise disturbance from work and movement of plant and construction traffic.

3.7.2 Permanent construction impacts

Permanent construction effects to cultural heritage receptors are likely to arise from the following:

- Adverse impact on in situ archaeological remains during the infill of the Fitting-out Basin (MM054);
- Adverse impact on the heritage value of assets due to a change in their setting from the filling in of the Fitting-out Basin (MM054);
- Adverse impact on the heritage value of assets due to a change in their setting from the construction of the new assemble hall;
- Adverse physical impacts to heritage assets from the construction of the new assembly hall.

3.7.3 Permanent operation impacts

There following permanent operational impacts associated with all assets along the proposed scheme are likely to occur:

- Beneficial impacts due to changes to the setting of heritage assets as a result of decreased noise masked by the new assembly hall;
- Potential adverse/ beneficial impacts relating to the maintenance of the proposed scheme; and
- Indirect adverse/beneficial impact caused by socio-economic changes associated with the proposed scheme.

3.8 Assumptions and limitations

Assumptions

- This assessment is reliant on available data. All designated and non-designated data is up to date as of 8th July 2022.
- It has been assumed that in areas of early modern and modern development, archaeological remains from earlier periods are likely to be disturbed, incomplete, or destroyed due to later development. This will have reduced their heritage value to none, negligible or low.
- Where design or construction information is not available, a worst-case-scenario approach has been adopted in line with the precautionary principle as defined in section E of the

Environmental Impact Assessment Handbook (Historic Environment Scotland and Scottish Natural Heritage 2018).[15]

- Unless otherwise stated, it is assumed that all interfaces with designated and non-designated heritage assets are non-intrusive, and that the elements of the heritage asset that contribute to its value will not be removed or altered.
- This assessment is based on all available information at the time of the production of the Environmental Impact Assessment Report.

Limitations

- Information provided by the SMR can be limited because it depends on previous opportunities for research, fieldwork and discovery. Where nothing of historic interest is shown in a particular area, this can be down to lack of targeted research or investigation rather than the genuine absence of sub-surface archaeological deposits. As such, databases employed in this assessment have been used as a starting point for further research rather than as a definitive list. Where there is an absence of data, professional judgement has been used to reach informed decisions regarding the historic environment.
- The assessment of buried archaeological remains particularly in an urban environment is limited by the ability to investigate these remains. It may be that unknown archaeological remains exist that may be impacted by the proposed scheme.
- Documentary sources are rare before the medieval period, and many documents are inherently biased. Older primary sources often fail to accurately locate sites and place names change with time and are often duplicated in different locations, meaning interpretation can be subjective. Historic maps provide a glimpse of land-use at a specific moment. It is therefore possible that short-term structures or areas of land-use are not shown and therefore not recorded within this assessment.

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[15] Historic Environment Scotland and Scottish Natural Heritage 2018, *Environmental Impact Assessment Handbook*. Available online at: https://www.historicenvironment.scot/archives-and-research/publications/publication/?publicationId=6ed33b65-9df1-4a2f-acbb-a8e800a592c0. Accessed 11/07/2022.

4 National and Local Planning Policy

Table 4.1 sets out the legislation and planning policy against which the proposed scheme will be considered during the planning process. These policies have been used to inform the technical appendix and have also been considered in the assessments undertaken to inform the EIAR.

Table 4.1: Historic environment legislation, policy and guidance.

Title	Description	Relevance to the assessment
Legislation		
Planning (Listed Buildings and Conservation Areas) (Scotland) Act 1997[16]	The Act sets out the protection given to buildings of special architectural or historic interest through listing. It also sets out the process for designation of conservation areas, which are recognised as areas of special architectural or historic interest, the character or appearance of which it is desirable to preserve or enhance.	This proposed scheme could have potential effects on listed buildings and four conservation areas.
Ancient Monuments and Archaeological Areas Act 1979[17]	This act relates to the investigation, preservation and recording of matters of archaeological and historic interest.	The proposed scheme could have potential effects on a Scheduled Monument (MM001) and unknown archaeological remains within the scheme area.
Historic Environment Scotland Act 2014[18]	The Act sets out Historic Environment Scotland's role and legal status, including changes in processes for the designation of monuments and buildings (scheduling and listing) and for consents relating to scheduled monuments, listed buildings and conservation areas. A right of appeal against certain decisions by Historic Environment Scotland has also been introduced. The Act also amended the following policies: • Ancient Monuments and Archaeological Areas Act 1979; • Planning (Listed Buildings and Conservation Areas) (Scotland) Act 1997; • Environmental Assessment (Scotland) Act 2005; and • Marine (Scotland) Act 2010.	This sets out Historic Environment Scotland's role and legal status to protect the historic environment when undertaking such a scheme.
Policy		
Scottish Planning Policy (SPP) 2014[19]	Scottish Planning Policy (SPP) (2014) provides a framework for the protection, conservation and enhancement of the Historic Environment and its setting. The framework establishes (number 137) that the planning system should "promote the care and protection of the designated and non-designated historic environment" whilst enabling "positive change in the historic environment which is informed by a clear understanding of the importance of the heritage assets affected" (The Scottish Government 2014). Historic	This is the Scottish Planning Policy which any proposed scheme impacts on the historic environment will be evaluated against.

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[16] The UK Government 1997, Planning (Listed Buildings and Conservation Areas) (Scotland) Act 1997

[17] The UK Government 1979, Ancient Monuments and Archaeological Areas Act 1979

[18] The Scottish Government 2011, Historic Environment (Amendment) (Scotland) Act 2011

[19] The Scottish Government 2014, Scottish Planning Policy Available online at: https://www.gov.scot/publications/scottish-planning-policy/ Accessed 04/08/2022.

Title	Description	Relevance to the assessment
	Environment resources include statutory and non-statutory designations, as defined in SPP.	
Historic Environment Policy for Scotland (HEPS) (2019)[20]	The Historic Environment Policy for Scotland (HEPS) outlines six policies which define how the historic environment should be managed. These include: - HEPS 1 – Decisions affecting any part of the historic environment should be informed by an inclusive understanding of its breadth and cultural significance. - HEPS 2 – Decisions affecting the historic environment should ensure that its understanding and enjoyment as well as its benefits are secured for present and future generations. - HEPS 3 – Plans, programmes, policies and strategies, and the allocation of resources, should be approached in a way that protects and promotes the historic environment. If detrimental impact on the historic environment is unavoidable, it should be minimised. Steps should be taken to demonstrate that alternatives have been explored, and mitigation measures should be put in place. - HEPS 4 – Changes to specific assets and their context should be managed in a way that protects the historic environment. Opportunities for enhancement should be identified where appropriate. If detrimental impact on the historic environment is unavoidable, it should be minimised. Steps should be taken to demonstrate that alternatives have been explored, and mitigation measures should be put in place. - HEPS 5 – Decisions affecting the historic environment should contribute to the sustainable development of communities and places. - HEPS 6 – Decisions affecting the historic environment should be informed by an inclusive understanding of the potential consequences for people and communities. Decision-making processes should be collaborative, open, transparent and easy to understand.	This is the Historic Environment Policy for Scotland which any proposed scheme impacts on the historic environment will be evaluated against.
Planning Advice note (PAN) 2/2011: Planning and Archaeology[21]	Planning Advice Note (PAN) 2/2011 advises that, in determining planning applications, planning authorities should consider the relative importance of archaeological sites. It also notes that in determining planning applications that may impact archaeological features or their setting, planning authorities may have to balance the benefits of development against the importance of archaeological features. The desirability to preserve a monument (whether Scheduled or otherwise) is a material consideration and the objective should be able to ensure the protection and enhancement of monuments by preservation in situ, or in an appropriate setting. When preservation in situ is not possible, recording and/or excavation followed by	PAN 2/2011 relates to archaeology in the planning process, as such any potential impacts on the archaeological remains as part of the proposed scheme will be considered in relation to this advice note.

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[20] Historic Environment Scotland 2019, Historic Environment Policy (HEPS) Available online at: https://www.historicenvironment.scot/archives-and-research/publications/publication/?publicationId=1bcfa7b1-28fb-4d4b-b1e6-aa2500f942e7. Accessed 04/08/2022.

[21] Scottish Government 2011, Planning Advice note (PAN) 2/2011: Planning and Archaeology. Available online at: https://www.gov.scot/publications/pan-2-2011-planning-archaeology/. Accessed 04/08/2022.

Title	Description	Relevance to the assessment
	analysis and publication of results may be an acceptable alternative.	
Planning Advice Note (PAN) 71: On how to preserve and manage conservation areas[22]	PAN 71 complements existing national policy and provides further advice on the management of conservation areas. It identifies good practice for managing change, sets out a checklist for appraising conservation areas and provides advice on funding and implementation.	PAN 71 relates to conservation areas within Scotland, as such any potential impacts on conservation areas as part of the proposed scheme will be considered in relation to this advice note.
Glasgow City Development Plan (2017)[23]	The Glasgow City Development Plan (2017) is the main policy document used to determine planning applications within the Govan area. The relevant policy pertaining to this technical appendix is Policy CDP9: The Historic Environment. Policy CDP9 aims to ensure the appropriate protection, enhancement and management of Glasgow's heritage assets by protecting, conserving and enhancing the historic environment for the benefit of existing and future generations. This will be achieved by assessing the impact of proposed developments and supporting high quality design that respects and complements the character and appearance of the historic environment and the special architectural or historic interest of its Listed Buildings, Conservation Areas, Scheduled Monuments, archaeological remains, historic gardens and designed landscapes and their settings, or by mitigating unavoidable adverse effects on them.	Policies included in the Glasgow City Development Plan are likely to be applied as part of any consent process relating to the proposed scheme.
Govan – Partick Strategic Development Framework (SDF) (2020)[24]	The Govan – Partick Strategic Development Framework (SDF) (2020) sets out a strategic approach to urban design interventions and placemaking that establishes a shared vision for the future development of the area by the City Council, its key agency partners, and other stakeholders. The SDF aims to provide a spatial framework for this regeneration, and to broaden and deepen a shared approach. It seeks to integrate the spatial aspects of the wider approach to regeneration in this part of the City, adding value to this process wherever possible. Of particular relevance to the historic environment is part of the Spatial Design Strategy which covers the concept of 'Building A World Class Cultural Cluster', particularly focusing on '*the unique maritime heritage of the area*.'	As the Govan – Patrick Strategic Framework outlines a strategic approach to urban design interventions and placemaking, including aspects of the historic environment, it will be considered in relation to this proposed scheme.
Guidance		
Environmental Impact Assessment Handbook	This guidance offers practical guidance and information to authorities, consultation bodies and others involved in the EIA process. The handbook aims to make the EIA a more effective process, allow	The assessment methodology for the technical appendix and ES chapter has been

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[22] Scottish Government 2004, Planning Advice Note (PAN) 71: On how to preserve and manage conservation areas. Available online at: https://www.gov.scot/publications/conservation-management-planning-advice/ Accessed 04/08/2022.

[23] Glasgow City Council 2017, Glasgow City Development Plan. Available online ahttps://www.glasgow.gov.uk/index.aspx?articleid=16186. Accessed 04/08/2022.

[24] Glasgow City Council 2020, Govan – Partick Strategic Development Framework (SDF). Available online at: https://www.glasgowconsult.co.uk/UploadedFiles/Govan-Partick%20Strategic%20Development%20Framework%20-%20Draft%20Nov%202018.pdf. Accessed 04/08/2022.

Title	Description	Relevance to the assessment
(Historic Environment Scotland 2018)[25]	for better-informed decisions and, ultimately, improve environmental protection. It illustrates the treatment of cultural and natural heritage issues with principles that are often widely applicable to other environmental topics.	established in accordance with this guidance.
Managing Change in the Historic Environment: Setting (Historic Environment Scotland 2016)[26]	This guidance note sets out the principles that apply to developments affecting the setting of historic assets or places including scheduled monuments, listed buildings, Inventory historic gardens and designed landscapes, World Heritage Sites, conservation areas, historic battlefields, Historic Marine Protected Areas and undesignated sites.	The assessment methodology for the technical appendix and ES chapter has been established in accordance with this guidance.
Guide to conservation areas in Scotland (Historic Environment Scotland 2005)[27]	This interim document on the designation of Conservation Areas and Conservation Area Consent provides detailed guidance on the application of the Historic Environment Policy for Scotland (HEPS) to Conservation Areas. It sets out the principles HES recommend are followed in the Scottish planning system.	The assessment methodology for the technical appendix and ES chapter has been established in accordance with this guidance.
Standard and guidance for historic environment desk-based assessment (Chartered Institute for Archaeologists 2020a) [28]	This guidance seeks to define good practice for the execution and reporting of historic environment desk-based assessment in line with the regulations of CIfA, in particular the Code of conduct.	The assessment methodology for the technical appendix and ES chapter has been established in accordance with this guidance.
Standard and guidance for commissioning work or providing consultancy advice on archaeology and the historic environment (Chartered Institute for Archaeologists 2020b)[29]	The guidance seeks to define current good practice in the provision of archaeological advice and/or the procurement of services, in line with the regulations of CIfA, in particular the Code of conduct.	The assessment methodology for the technical appendix and ES chapter has been established in accordance with this guidance.
Code of conduct: professional ethics in archaeology (Chartered	This document outlines the code of conduct that is binding on all members and Registered Organisations to ensure that members of the Chartered Institute for Archaeologists work to high ethical and professional standards.	The assessment methodology for the technical appendix and ES chapter has been established in accordance with this guidance.

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[25] Historic Environment Scotland and Scottish Natural Heritage 2018 *Environmental Impact Assessment Handbook*. Available online at: https://www.historicenvironment.scot/archives-and-research/publications/publication/?publicationId=6ed33b65-9df1-4a2f-acbb-a8e800a592c0. Accessed 11/07/2022.

[26] Historic Environment Scotland 2016, Managing Change in the Historic Environment: Setting. Available online at: https://www.historicenvironment.scot/archives-and-research/publications/publication/?publicationId=80b7c0a0-584b-4625-b1fd-a60b009c2549 Accessed 11/07/2022.

[27] Historic Environment Scotland 2005, Guide to conservation areas in Scotland. Available online at: https://www.gov.scot/publications/guide-conservation-areas-scotland/documents/. Accessed 11/07/2022.

[28] Chartered Institute for Archaeologists (CIfA) 2020a, Standard and guidance for historic environment desk-based assessment.

[29] Chartered Institute for Archaeologists (CIfA) 2020b, *Standard and guidance for commissioning work or providing consultancy advice on archaeology and the historic environment*. *Standard and guidance for historic environment desk-based assessment.* Available online at https://www.archaeologists.net/sites/default/files/CIfAS%26GDBA_4.pdf. Accessed 11/07/2022.

Title	Description	Relevance to the assessment
Institute for Archaeologists 2021) [30]		
Principles of Cultural Heritage Impact Assessment (institute of Environmental Management and Assessment, Chartered Institute for Archaeologists and Institute of Historic Building Conservation, 2021) [31]	Guiding principles to supplement existing guidance and give a consistent framework for cultural heritage IA in a variety of settings. The application of these principles and good practice will enable practitioners to improve the standard of their assessments, regardless of their specialism within the discipline.	The assessment methodology for the technical appendix and ES chapter has been established in accordance with this guidance.
Design Manual for Roads and Bridges (DMRB): LA 104 Environmental Assessment and Monitoring[32] and LA 106 Cultural Heritage [33] (National Highways, 2020).	DMRB LA 104 sets out the requirements for assessing and reporting the effects on cultural heritage as part of the environmental assessment process of construction, operation and maintenance projects. DMRB LA 106 sets out the requirements for environmental assessment of projects, including reporting and monitoring of significant adverse environmental effects.	The assessment methodology for the technical appendix and ES chapter has been established in accordance with this guidance.

Source: Mott MacDonald (2022)

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[30] Chartered Institute for Archaeologists (CIfA) 2021, *Code of conduct: professional ethics in archaeology*. Available online at https://www.archaeologists.net/sites/default/files/Code%20of%20conduct%20revOct2021_0.pdf. Accessed 11/07/2022.

[31] Institute of Historic Building Conservators (IHBC), Institute of Environmental Management and Assessment (IEMA) and Chartered Institute for Archaeologists (CIfA) 2021, Principles of Cultural Heritage Impact Assessment in the UK (PCHIA). Available online at: https://ihbconline.co.uk/toolbox/docs/Principles%20of%20Cultural%20Heritage%20Impact%20Assessment.pdf. Accessed 11/07/2022.

[32] Design Manual for Roads and Bridges (DMRB). 2020b, Volume 11, Section 2, Part 4 LA104 Revision 1 ‘Environmental assessment and monitoring’. Available online at https://standardsforhighways.co.uk/dmrb/search/0f6e0b6a-d08e-4673-8691-cab564d4a60a. Accessed 11/07/2022.

[33] Design Manual for Roads and Bridges (DMRB). 2020a, Volume 11, Section 3, Part 2 LA106 Revision 1 ‘Cultural heritage assessment’. Available online at https://www.standardsforhighways.co.uk/dmrb/search/8c51c51b-579b-405b-b583-9b584e996c80. Accessed 11/07/2022.

5 Baseline

5.1 Overview

The historic environment baseline was established using the sources and methodology outlined in Section 3.3.

Where dates and periods are referred to in the baseline, these are based on those outlined in Table 5.1. It is accepted that these date ranges are subjective but are supplied to ease discussion based on the Scottish Archaeological Research Framework[34] (ScARF) in conjunction with professional judgement.

Table 5.1: Indicative archaeological and historical periods

Prehistoric Period Dates		Historic Period Dates	
Palaeolithic	14,000 to 11,000 BC	(Roman	AD 77 to c.211)[35]
Mesolithic	11,000 to 4,100 BC	Early Medieval	AD 401 to 1100
Neolithic	4,100 to 2,500 BC	Medieval	AD 1101 to 1500
Chalcolithic and Bronze Age	2,500 to 800 BC	Post-medieval	AD 1501 to 1800
Iron Age	800 BC to AD 400	Early Modern	AD 1801 to 1900
		Modern	AD 1901 to present

Source: Mott MacDonald after ScARF (2022)

A full gazetteer of all heritage assets within the study area is located in Section 6, with figures showing their locations included as Volume 3, Appendix 2.

5.2 Heritage Assets

5.2.1 Designated heritage assets

There are 53 designated heritage assets within the 1km study area and included from the wider landscape based on professional judgement. These consist of:

- One scheduled monument;
- One garden and designed landscape;
- Four conservation areas;
- 46 listed buildings (12 Category A listed buildings, 30 Category B listed buildings, and four Category C listed buildings).

Of these, nine listed buildings and one conservation area are considered key heritage assets at this stage based on professional judgement alongside their value, distance from, and intervisibility with the Scheme. These are listed below in Table 5.2 and discussed in more detail in Section 5.11.

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[34] ScARF 2022. Available at: https://www.scarf.scot. Accessed 12/07/2022.

[35] The period of Roman influence in Scotland runs concurrently with the Iron Age. While Roman involvement in Southern Scotland was extensive, this was primarily a military occupation which ebbed and flowed, leaving no evidence for independent domestic occupation.

Table 5.2: Designated key heritage assets within the 1km and ZTV study area

MM Number	Designation Number	Name	Description	Heritage Value	Approximate distance from the Scheme
MM001	SM10393	Govan, Carved Stones and Old Parish Church Graveyard	Scheduled Monument	High	850m
MM003	CA518	Govan	Conservation Area	High[36]	30m
MM007	LB33357	1048 Govan Road, Govan Shipbuilders' Store, Former Engine Works of Fairfield Shipbuilding and Engineering Company	Category A Listed building	High	Borders the south-east corner of the proposed scheme red line boundary.
MM008	LB33356	1030, 1048 Govan Road, Govan Shipbuilders Ltd, General Offices (Excluding 1956 Extension to w).	Category A Listed building	High	155m
MM011	LB33310	228a Langlands Road and Elder Park Street, Elder Park Library	Category A Listed Building	High	500m
MM016	LB33304	Statue of Isabella Elder, Elder Park, Glasgow	Category A Listed building	High	560m
MM028	LB33309	87, 91 Holmfauld Road, Linthouse	Category B Listed Building	Medium	80m
MM024	LB33302	Elder Park, Cottage	Category B Listed Building	Medium	170m
MM025	LB33303	Elder Park, Fragments of Linthouse Mansion	Category B Listed Building	Medium	230m
MM026	LB33305	Elder Park, Statue of John Elder	Category B Listed Building	Medium	360m

Source: HES 2022; Mott MacDonald 2022.

5.2.2 Non-designated heritage assets

There are 43 non-designated heritage assets within the 500m study area, this includes one non-designated maritime heritage asset and two assets identified during the walkover survey. Of these, there are eight assets which are considered key heritage assets within the proposed scheme area. These are listed below in Table 5.3 and discussed in more detail in Section 5.12.

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[36] The Govan conservation area is considered of high value as it comprises one scheduled monument, eight category A listed buildings, 20 category B listed buildings, and one category C listed building. This includes MM001, MM008, MM016, MM011, MM024, MM025 and MM026 listed in Table 4.2 above.

Table 5.3: Non-designated key heritage assets within the proposed scheme area

MM Number	HER Number	NRHE Number	Name	Description	Heritage Value	Approximate distance from the proposed scheme
MM054	52478	270305	Fairfield Shipyard and Engine Works, Fitting-out Basin	Non-designated	Medium	Within the proposed scheme area
MM055	52479	270304	Fairfield Shipyard and Engine Works, Plumber's Shops	Non-designated	Low	Within the proposed scheme area
MM056	13472	79701	Fairfield Shipyard and Engine Works, Plate Fabrication Shed	Non-designated	Low	Within the proposed scheme area
MM057	13473	79702	Giant Cantilever Crane / Fairfield Shipyard	Non-designated	Low	Within the proposed scheme area
MM058	13473	79702	Kvaerner Govan Shipyard, New Fabrication Shed / Fairfield Shipyard	Non-designated	Low	Within the proposed scheme area
MM085	N/A	333983	Govan Road, Fairfield Shipyard and Engine Works, Cranes	Non-designated	Low	Within the proposed scheme area
MM095	N/A	N/A	Fairfield Shipyard and Engine Works - Mooring Posts	Non-designated	Low	Within the proposed scheme area
MM096	N/A	N/A	Fairfield Shipyard and Engine Works - Shipyard Winch	Non-designated	Low	Within the proposed scheme area

Source: SMR 2022; NRHE 2022; Mott MacDonald 2022

5.3 Geology, topography and land use

The bedrock geology of the scheme and study area as mapped by the British Geological Survey (BGS)[37] comprises Limestone Coal Formation of the Clackmannan Group Type. This Sedimentary Bedrock formed approximately 328 to 329 million years ago in the Carboniferous Period and indicates a local environment previously dominated by swamps, estuaries and deltas.

The superficial deposits underlying the scheme and study area comprise Sediment and Quaternary Undifferentiated River Terrace Deposits. These deposits formed up to 3 million years ago during the Quaternary Period and indicate a local environment once dominated by shorelines and rivers. Notably, Holocene aged Alluvium is also recorded along the southern border of the scheme and to the east towards Govan Old Parish Church (MM001). Alluvium is significant in geoarchaeological terms as it has the potential to contain archaeological artefacts moved from their original location and the potential to bury sites under deep layers. The waterlogged nature of alluvium is conducive to the preservation of any such artefacts.

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[37] BGS. 2022, Geology of Britain Viewer. Available at: https://mapapps.bgs.ac.uk/geologyofbritain/home.html?&_ga=2.158821690.1646091136.1627294574-1546435123.1624539547. Accessed 12/07/2022.

As the study area is Built-Up Land, no soil type is recorded on the National Soil Map of Scotland to facilitate understanding of the nature of the topsoil and overlying superficial geology.[38]

It should also be noted that extensive dredging works have taken place across the Clyde from the mid-19th century onwards. Routine dredging activities are still undertaken to maintain navigation depths, and as such inhibit natural processes which result in the accumulation of sediment which leads to shallowing of channels, migration and or splitting of the river channel.

The proposed scheme area comprises Govan Shipyard, which includes a variety of fabrication buildings, stores, slipways, and parking facilities. The surrounding study area encompasses a range of industrial, business, and commercial properties. Elder Park and several residential properties are also located to the south and south-east of the scheme area.

5.4 BGS Borehole Records

The BGS maintains an archive of historical exploratory borehole logs throughout the United Kingdom (UK).[39] A summary of those which are considered to provide useful information on the ground profile of the scheme area is given in Table 5.4.

Table 5.4: Summary of historical borehole records recorded by BGS

Borehole Reference	Location	Ground Composition
NS56NW12557/G – Govan Shipyard	North-west edge of basin Easting: 254572 Northing: 666275	Made ground c.1.00m thick consisting of cobbles, clay, bricks, sand, stones and wood overlying a soft, dark brown, silty clay 0.90m in depth. Beneath this was a 0.60m deposit of loose dark brown fine to coarse grained gravelly sand, overlying 1.10m deposit of soft, light grey sandy silt. Below the silt was 2.20m of soft dark grey-brown sandy silt followed by 0.50m of soft dark grey silty, very firm grained sand, which sealed a medium dense dark grey-brown fine-grained sand excavated to 2.50m in depth.
NS56NW12557/H – Govan Shipyard	North-west edge of basin Easting: 254572 Northing: 666242	Made ground c.3.00m thick consisting of clay, ash, brick, stones, sand, wood and pipe remains. Below this was a 1.40m deposit of loose dark brown fine to coarse grained sand with traces at gravel, which sealed a medium dense light brown coarse-grained sand excavated to 5.10m in depth.
NS56NW7787/1 – Govan West Wharf 1	Central western edge of basin Easting: 254572 Northing: 666242	Made ground of cobbles and concrete up to 0.70m deep, overlying 3.60m of very loose ash, slag and coarse to fine sand fill material, with pieces of wood and brick. Below this was 2.60m of soft greenish brown laminated silt with thin bands of reddish-brown silty clay and partings of coarse sand and fine gravel. Beneath this was 1.60m of light brown, medium sand with some fine sand.
NS56NW7787/4 – Govan West Wharf 4	Central western edge of basin Easting: 254556 Northing: 666126	Made ground of cobble sets 0.15m thick followed by 2.85m of loose to medium dense, ash, slag and coarse to fine sand with pieces of wood. Below this was a 3.00m deposit of medium dense dark brown sandy, very clayey silt with partings of fine gravel and coarse sand, which sealed 7.00m of greyish brown, medium sand with some fine gravel, coarse sand and occasional traces of coarse sandstone gravel.
NS56NW7787/2 – Govan West Wharf 2	Western edge of basin Easting: 254575 Northing: 666090	Made ground consisting of concrete and cobble sets up to 0.45m deep followed by 4.05m of medium, dense, ash, slag, sandstone, brick and wood. Below this was a 3.70m deposit of light brown, medium sand with some find sand.

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[38] National Soil Map of Scotland 2022. Available at: http://scans.bgs.ac.uk/sobi_scans/boreholes/20090703/images/16661136.html. Accessed 12/07/2022.

[39] BGS 2022, GeoIndex Onshore Map. Available at: https://mapapps2.bgs.ac.uk/geoindex/home.html?layer=BGSBoreholes&_ga=2.5972213.738338690.1657614822-230393261.1657614822. Accessed 12/07/2022.

Borehole Reference	Location	Ground Composition
NS56NW7787/BC1 – Govan West Wharf DC1	South-west of basin (inside) Easting: 254576 Northing: 666054	Made ground comprising cobble sets 0.15m deep, ash 0.05m deep, concrete 0.30m deep and medium dense ash, slag and coarse sand fill material 5.30m deep. Beneath this was 0.2m of sand.
NS56NW7787/6 – Govan West Wharf 6	South-west edge of basin Easting: 254556 Northing: 666041	Made ground 1.20m thick comprising cobble sets and loose concrete, bricks, ash, slag and sandy clay with gravel. Below this was 1.30m of soft to firm, greenish brown, laminated silt with numerous bands of reddish brown, silty clay. Beneath this was 0.50m of soft dark brown, sandy silty clay with traces of fine gravel, followed by 1.50m of slightly mottled brown, silty fine sand. This overlay 2.20m of medium dense gravel with dark brown coarse medium sand with some gravel and 2.10m of greyish brown, slightly silty medium to fine sand with traces of fine gravel. This sealed a 1.7m deposit of greyish brown, coarse to medium sand with traces of fine gravel, and occasional coarse to medium gravel.
NS56NW7787/3 – Govan West Wharf 3	South-west edge of basin Easting: 254572 Northing: 666035	Made ground comprising of 0.20m of cobble sets, 0.35m of concrete and 5.15m of loose to medium dense, ash, slag, coarse to medium sand, brick, wood and sandy clay fill material. Below this was 2.80m of loose, greenish brown, laminated silt with bands of reddish brown, silty clay and partings of coarse to fine sand and fine gravel.

Source: BGS 2022.

The historical exploratory borehole logs summarised above highlight the industrial character of the site with the upper layers largely comprising made ground. The deposits below this of clay, sand and gravel also reflect the riverine location of the scheme area.

5.5 Historic landscape usage

5.5.1 HLAmap

Analysis of historic land-use was undertaken through HLAmap maintained by HES.[40] HLAmap provides additional information as to earlier use of the proposed development site or exploitation of the landscape. The results of this analysis can be viewed in Table 5.5.

Table 5.5: Summary of historic landscape usage as recorded by HLAmap

Period	Comments
Prehistoric	There is no Prehistoric landscape usage recorded within the study area.
Roman	There is no Roman landscape usage recorded within the study area.
Medieval	There is no Medieval landscape usage recorded within the study area.
Post-Medieval	The land to the west of the scheme, where the Clyde Tunnel is situated, was once used for mines, opencast sites or quarries that have now been abandoned.
Early Modern – Modern	The basin is recorded as an area of maritime installation while the remaining proposed scheme area and much of the study area is recorded as relating to industrial or commercial activity. The park to the south of the scheme area is recorded as an area of leisure and recreational facilities.

Source: HLAmap 2022.

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[40] HLAmap 2022. Available at: www.hlamap.org.uk . Accessed 12/07/2022.

5.6 Map regression

5.6.1 General

All relevant cartographic resources held by the NLS were consulted to identify the recorded development of the site as well as any additional features that may previously have gone unrecorded within the limits of the proposed development. A summary of consulted maps is listed in Section 8.3.

5.6.2 Pre-Ordnance Survey maps

A number of early maps that cover the proposed scheme were consulted for any indication of historical occupation within the study area. Maps which pre-date the Ordnance Survey (OS) were assessed for relevant information relating to the development within the study area. Due to the generally imprecise nature and lack of accuracy often apparent in these early maps, many of those which pre-date the first OS editions are of limited use in showing any detailed occupation of the study area and only those that are relevant are discussed below.

5.6.2.1 Timothy Pont

The earliest map of the study area was drawn by Timothy Pont between 1583 and 1614. Pont's map of Renfrewshire Teviotdale (the map is also known as Pont 33) depicts the Clyde with Glasgow to the north and 'Mekle Govan'[41] to the south-west of this (Map 5.1). These maps are 'a unique source of knowledge of Scotland's past landscapes.'[42] While specific detail may be lacking in Pont's maps and they cannot be relied upon as accurate depictions of landscape and distance, it is possible to appreciate small features such as the depiction of a church (MM001) and other buildings at Govan. Also noteworthy are the islets, such as Whiteinch to the north-west of Govan, which were visible prior to the later Clyde deepening works.

Map 5.1: Detail of Timothy Pont's *Renfrewshire* (Pont 33). Reproduced with the permission of the National Library of Scotland.

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[41] Meckle or Meikle means large or great in Scots.

[42] Stone, J. 2001, 'Timothy Pont: Three Centuries of Research, Speculation and Plagiarism' in The Nation Survey'd: Timothy Pont's Maps of Scotland', p.23

5.6.2.2 Gordon and Blaeu 17th century maps

In the 17th century Robert Gordon was commissioned to undertake work on Timothy Pont's maps during the compilation of these into the 'Atlas of Scotland', completed by the Dutch Cartographer Joan Blaeu.

Robert Gordon's 'Map of the Barony of Ranfrew' (Gordon 55) depicts the same features as Pont, including a church (MM001) and buildings at 'Mekle Govan' but does not show the study area in any further detail.

Using the work of Pont and Gordon as a template, Joan Blaeu compiled 'Praefectura Renfroana, vulgo, dicta Baronia'. Again, the study area is named as 'Mekle Govan'. The church (MM001) is shown in more detail on this map and to the north-east of this is the faint outline of several buildings drawn in pencil but not inked in.

5.6.2.3 William Roy c.1747-55

William Roy's Military Survey of Scotland was conducted from 1747-55 and is the first map of the study area which can be considered to have any real degree of accuracy. Roy's map is remarkable for its level of detail. The map was described by Roy himself as rather 'a magnificent military sketch than a very accurate map of the country',[43] but the scale and detail of the map is such that it allows the study area to be pinpointed.

The study area can be clearly established in the area named as 'Meikle Govan'. The proposed scheme area roughly lies to the west of this on the south bank of the Clyde and includes a large estate with three buildings creating an 'U' shape open to the south. The buildings are located within the centre of a large rectilinear enclosed area of land. A possible trackway aligned north-south is depicted leading up to the building.

Within the wider study area several buildings are shown concentrated around the church (MM001) and Doomster Hill, shown as a hillock on the southern bank of the Clyde, to the east of the burn. Buildings are also shown lining either side of the road aligned east-west, roughly following the modern route of Govan Road. The remainder of the study area is depicted as rectilinear fields, many of which are delineated by trees and shrubbery.

5.6.2.4 John Ainslie c.1800

The Map of the County of Renfrew was drawn by John Ainslie around 1800. The map is the first detailed depiction of the scheme area to include named features (Map 5.2). As in Roy's map, the manor house is shown to be centrally located within an estate lined by trees. The house is named as 'Fairfield' with 'Cumin Esq?' also written beside it. A house named as 'Linthouse' (MM072) is depicted to the west of the scheme area but beyond this no other features are shown on this north-west side of the study area. The remainder of the study area includes several houses to the south of the main road such as 'Greenend', 'Holmfauld Head', 'Laigh Druminine' and 'Windy Edge'. The area to the west includes the features present on earlier maps such as the Church (Kirk) (MM001), Manse, hillock and buildings aligning the road through Govan.

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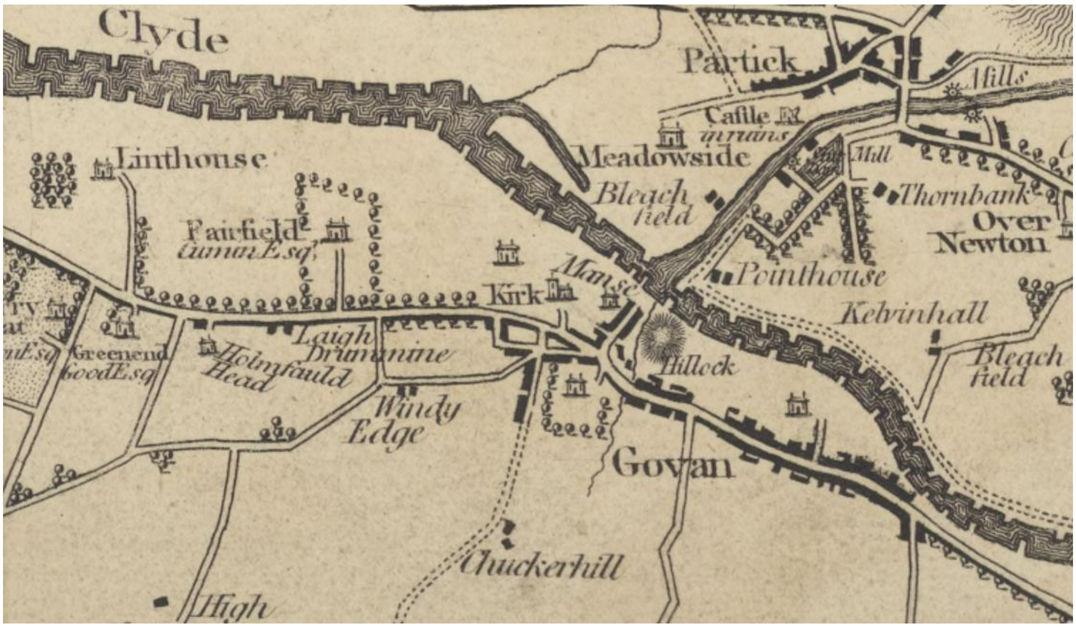
[43] Fleet et al. 2011, 'Scotland; Mapping the Nation', p.89



Map 5.2: Detail of John Ainslie's *Map of the County of Renfrew* (1800). Reproduced with the permission of the National Library of Scotland.

5.6.2.5 John Thomson and William Johnson 1822

'Lanarkshire' by John Thomson and William Johnson was produced in 1822. In the scheme area 'Fairfield' house is depicted on the south bank of the Clyde next to a single line of trees; however, the features are somewhat difficult to decipher due to the scale of the labels. To the west is a house recorded as 'Greenhead' along with 'Lintho' further west (MM072). The area to the east of the scheme area is named as 'Govandale' with features including the 'Kirk' (MM001) and 'Manse'.

5.6.3 Ordnance Survey maps

5.6.3.1 1st edition maps series

The Ordnance Survey (OS) began surveying the study area in 1857, publishing the first detailed mapping of the landscape in 1860 at a scale of 25 inches to one mile.

The map shows a landscape that is unrecognisable from the scheme area as it currently exists, with a manor house and estate depicted where the Fitting-out Basin is currently located (Map 5.3). Three separate rectilinear buildings are shown centred around an entrance court open to the south. The gardens to the east and west of the house are split into smaller rectilinear patches, while the land to the north is open and enclosed by trees. The Ordnance Survey Books of Reference, otherwise known as the Parish Area Books, refers to the land parcel as 'Fairfield House, offices, gardens &c'. The area to the north of the house is recorded as 'arable' land while the land to the south is listed as ''planation and footpath'.[44]

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[44] Ordnance Survey of Scotland 1861. Govan, Counties of Lanark & Renfrew; also Gorbals, County of Lanark. London & Southampton: Ordnance Survey. Available online at: https://digital.nls.uk/99281403. Accessed 13/07/2022.

Map 5.3: Detail of the 1860 1st edition of the OS map (Lanarkshire VI.5 (Govan) and Lanarkshire VI.9 (Govan)). Reproduced with the permission of the National Library of Scotland.

Industrial developments appear to have begun in the surrounding study area. With Govan Silk Factory (MM080) to the east and Partick Saw Mills (MM081) to the north of the Clyde. Several shipbuilding yards are already established within the wider area including 'Middleton Iron Ship Building Yard', 'Govan East, Iron Ship Building Yard', and 'Clyde Ship Building Yard'.

This map also includes the Fairfield homestead or cottage (MM025), which is located to the south-west of the scheme area.

5.6.3.2 2nd edition map series

The 2nd edition map series was surveyed at 25 inches to 1 mile between 1893 and 1894 before it was published in 1896.

The map shows the scheme area following the establishment of 'Fairfield Works (Shipbuilding & Engineering)' on the former site of Fairfield House. The site is adjacent to Govan Silk Factory (MM080) which sits on its eastern border, with the entrance from North Elder Street. The Fitting-out Basin (MM054) is shown on the western side of the site, with its form very similar to how it currently stands; however, the southern-western corner is not fully excavated, and a footbridge connects the east and west sides at the northern edge. A gasometer and a square building are depicted at the southern end of the basin but beyond this the space is empty. The remainder of the shipyard is concentrated to the east and south-east of the basin and consists of the following structures: a large rectangular building used as the shipbuilders' store and former engine works (MM007); a narrow building on the southern perimeter of the site facing onto Govan Road serving as General Offices (MM008); a large rectilinear building aligned south-east to north-west (MM058) which likely served the faintly marked out slipway; and several smaller ancillary buildings. Several mooring posts are listed across the site, particularly concentrated around the basin. The tramways for the travelling cranes (MM085), which are still visible today, are also shown running throughout the site.

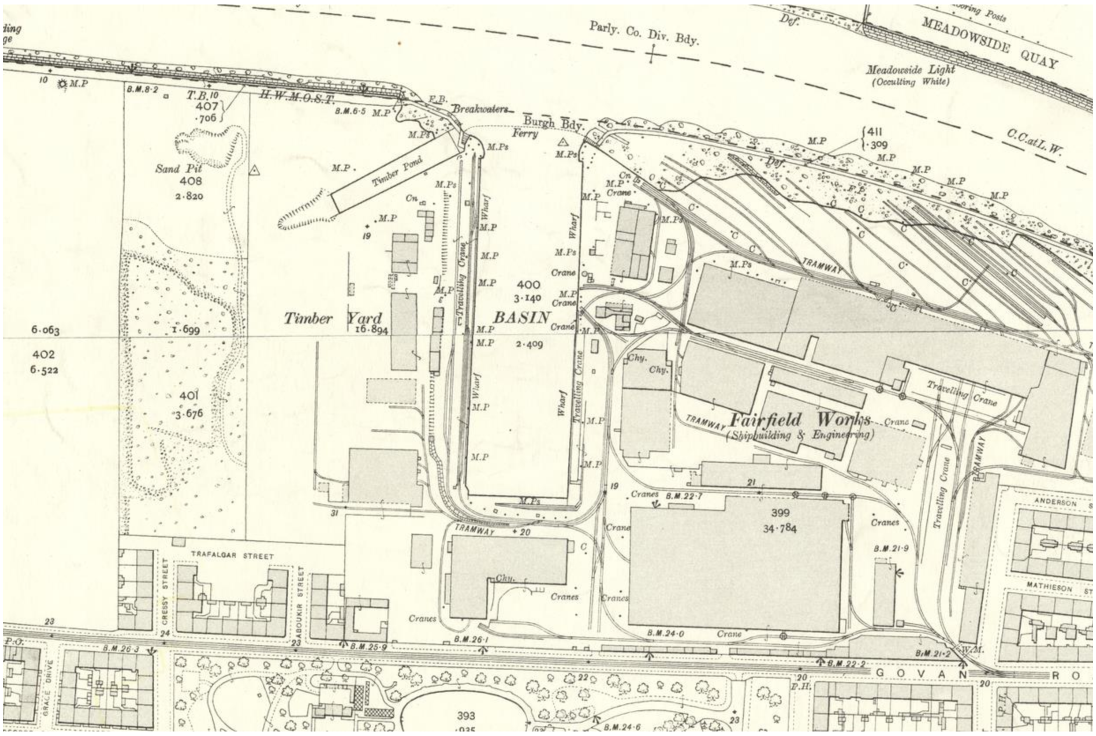
Elder Park has also been established to the south of the scheme area, incorporating the former building of Fairfield homestead into its bounds (MM025). An artificial lake as well as band stand and statue of John Elder (MM026) are also listed within the park.

The surrounding shipbuilding yards shown on the 1st edition map also appear to have grown in scale, with the creation of the 'Graving Docks'.

Map 5.4: Detail of the 1896 2nd edition of the OS map (Lanarkshire VI.5 and Lanarkshire VI.9). Reproduced with the permission of the National Library of Scotland.

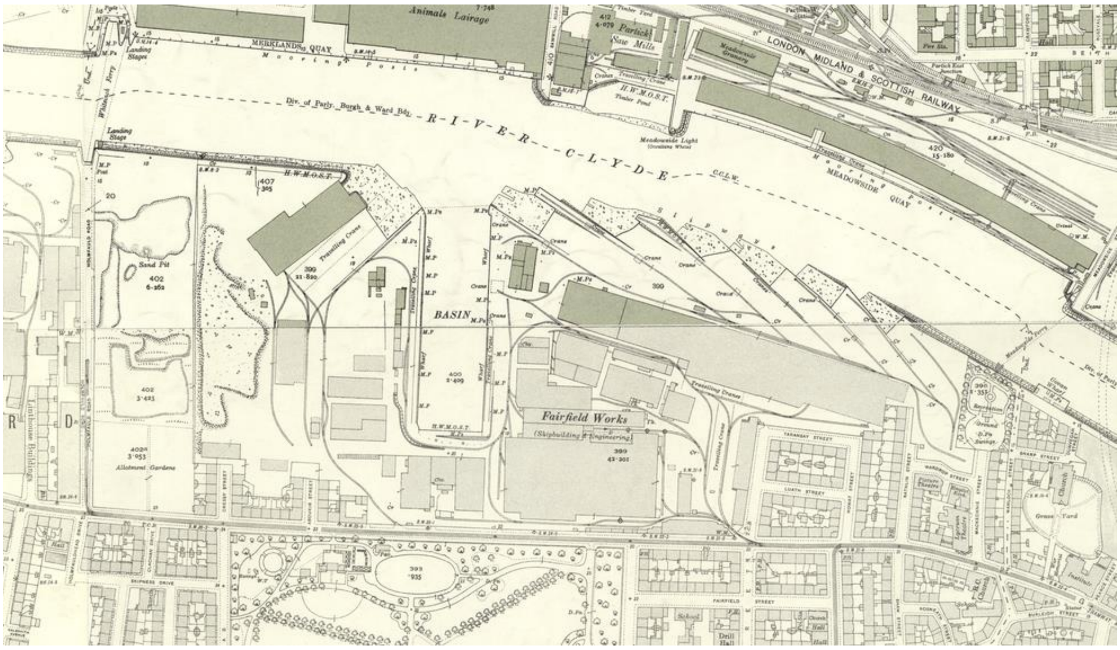
5.6.3.3 20th century map series

In the 1909 edition of the OS map, the shipyard is shown to have expanded further with the establishment of a 'Timber Yard' to the west of the basin. This includes the addition of a timber pond aligned north-east to south-west at the north-western corner of the basin opening. The basin itself is shown to have been fully excavated with all the corners and edges now clearly defined. At the southern end of the basin, a 'L' shaped building is aligned east-west, and new buildings of various sizes are depicted to the basin's west. On the east of the site, new structures are also shown amongst the larger warehouses, creating a narrow route for the travelling crane tramways (MM085). Several slipways on bank of the Clyde are also depicted though they are not clearly defined.



Map 5.5: Detail of the 1909 edition of the OS map (Lanarkshire VI.5 and Lanarkshire VI.9). Reproduced with the permission of the National Library of Scotland.

The 1935 edition of the OS map shows further developments on the site. This includes the infilling of the timber pond to locate a travelling crane alongside a larger rectangular building on the same alignment to the west of this. The giant cantilever crane (MM057) is also shown on the eastern edge of the basin. The site also appears to have expanded westwards with a refuse heap on the very western border. The buildings to the west of the basin have undergone minimal changes whereas the building to the south has been replaced by three connected buildings (MM055). Once again buildings have been added in the eastern area of the site, create a densely built-up environment which has now replaced Govan Silk Factory (MM080). The slipways are now shown as clearly defined with at least six separate areas including a crane on either side of the slipway.



Map 5.6: Detail of the 1935 edition of the OS map (Lanarkshire VI.5 and Lanarkshire VI.9). Reproduced with the permission of the National Library of Scotland.

5.6.4 Later maps

Maps from the second half of the 20th century indicate that the shipyard continued to develop during this period.

In a map published from 1950 the building and travelling crane to the north-west of the basin are no longer present; instead, this section of the site appears to be used primarily as a refuse dump. It is also during this period that the metal-clad wrap-around frame on the west and east façades may have been added to the Engine Works (MM007). Another notable change is that the three buildings at the southern end of the basin are now shown as a single structure (MM055). Many of the buildings to the east appear to have been joined together as well, though this may be a stylistic change by the cartographer.

The maps from the 1960s, 1970s, and 1980s are more standardised but less detailed than previous editions, and no new changes can be seen on any of these editions.

5.7 Remote sensing

5.7.1 Overview

Remote sensing covers analysis of lidar data and aerial imagery in order to identify previously unrecorded heritage assets. This assessment forms a pragmatic level of analysis suitable to be incorporated within a baseline but does comprise a detailed remote sensing survey.

Clear anomalies and features are identified and discussed below, but this is not considered exhaustive and professional judgement has been used as to whether to include features based on the lidar data and physical assessment during the walkover survey.

5.7.2 Lidar

Lidar data publicly available on the NLS website was accessed in order to investigate the presence and survival of previously unrecorded heritage assets. The data accessed dates from 2019-2021 at a resolution of 50cm to 1m.

As the scheme and study area is heavily built up the lidar data provided limited additional information on much of the scheme and study area. However, some anomalies were noted along the south and west edges of the basin. These features may relate to the original excavation of the basin in the late 19th century.

5.7.3 Aerial Images

The historic and modern aerial images show the proposed scheme area in a near identical layout to those shown on the maps above. The vertical image taken on 24th August 1947 shows four ships within the basin which indicates the scale on which this asset used to operate. Likewise, the Oblique aerial photograph taken facing south-east towards the shipyard on 24th March 1950 shows the Fairfield Titan crane (MM057) in operation on the eastern side of the basin.

The aerial images held by Google Earth throughout the early 21st century also show how the site has undergone minimal changes since the 20th century. The scale of the buildings surrounding the basin within the shipyard and the urban density of the surrounding study area are also notable.

5.8 Previous archaeological investigation

The only record of previous archaeological investigation within the scheme area comprises the Govan Burgh Survey conducted by GUARD in 2004 which was as synthesis of Govan's archaeological and architectural history, tracing the development of the burgh over the last 1500 years (MM090).[45]

Several investigations have also been recorded within the surrounding study area, these are summarised below in Table 5.6.

Table 5.6: Previous archaeological events recorded within the study area

MM Number	Event name	Event Type	SMR Event Reference Number	Description
MM087	Water Row site - Archaeological Investigation	Unknown	178	Archaeological investigations initiated by Glasgow City Council as part of the Water Row site.
MM088	Watching brief	Archaeological Watching Brief	1173	No information available.
MM089	Desk Based Assesment by Firat on Glasgow Harbour For Glasgow Harbor Ltd.	Desk Based Assessment	769	Erection of mixed-use development site at Meadowside Quay, (Glasgow Harbour) DBA and WB recommended.
MM090	Govan Burgh Survey	Survey	1441 (Area 611)	Context: The study is intended as an introduction to, discussion and summary of Govan's history and heritage potential. It was intended to serve as a guide to Govan's archaeological and architectural history, for the purposes of managing these resources. Results: Synthesis of Govan's archaeological and architectural history, tracing development in burgh over the last 1500 years.
MM091	Archaeological Watching Brief: Glasgow Harbour Phase 2, Castlebank Street, Glasgow	Archaeological Watching Brief	3374	Watching brief carried out during development of area because of archaeological potential of riverside location. The excavation of approximately 12100sqm was monitored during the course of the watching brief.

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[45] Dalglish, C. and Driscoll, S.T. 2004. GUARD, Scottish Burgh Survey Series: Historic Govan.

MM Number	Event name	Event Type	SMR Event Reference Number	Description
MM092	Archaeological Watching Brief: Glasgow Harbour Phase 2, Castlebank Street, Glasgow	Archaeological Watching Brief	3834	An archaeological watching brief was undertaken on the excavation of a sewer trench at the site of a proposed residential development at Glasgow Harbour. Results: The deposits encountered during the course of the works comprised an initial 1.5-2m of modern detritus, overlying 2-2.5m of fine yellow/brown sand. The next 1.5m consisted of a smooth grey clay. The watching brief also revealed the remnants of the foundations of modern buildings comprising red brick, concrete blocks and timber; most of these features are consistent with underground utilities. However, due to the nature of the stripping methods used in excavating the sewer trench, it was not possible to determine if any of the individual features were interlinked, though it is unlikely that these pre-date the industrial phase of the site.
MM093	Archaeological Watching Brief: Glasgow Harbour, Castlebank Street, Glasgow	Archaeological Watching Brief	3835	An archaeological watching brief was undertaken on the excavation of a sewer trench and basement area of approximately 11,070sqm. A selection of ceramics and kiln furniture was recovered during the course of the watching brief. This is assumed to have originated from a landfill spread. The entire development area was covered by up to 2m of made ground, comprising material dumped during a landfill project, building debris from the demolished structures and modern detritus. The made ground overlay the natural alluvial deposits. During the course of the watching brief sections of the alluvial material were excavated, but no significant archaeological remains were identified. The watching brief revealed the remnants of the foundations of modern buildings, comprising red brick and concrete blocks. However, due to the intensity of the stripping methods, it was not possible to determine if any of the individual features were interlinked. The quay wall was uncovered during the course of the watching brief, and this was subsequently photographed and planned. A more intensive programme of cleaning and recording could not be employed due to the presence of machinery and the dangers of possible flooding and collapsed sections. A selection of ceramics and kiln furniture were recovered from an upstanding section of the quay wall. Post-excavation analysis of the ceramics will be required to identify the age, source, history and subsequent importance of the material.

Source: SMR 2022; Mott MacDonald 2022

5.9 Archaeological and Historical Development

The historic baseline in the following narrative is based on indicative archaeological and historical periods and compiled using information primarily collated from the sourced outlined in Section 3.3. These historical periods are outlined in Table 5.1.

Only the periods for which there is evidence for human occupation, involvement in the study areas or in the immediate landscape are discussed below. Where assets are recorded within the study area, they are recognised by their unique identifier (MM number) as defined in the gazetteer located in Section 6. Where assets from outwith the study area are discussed for context, these are referenced by their designation (HES number), SMR (HER) number, prefixed by PIN, or NRHE number, prefixed by ID.

5.9.1 Prehistoric

Evidence for human activity in Scotland largely dates to the post-glacial period,[46] with the evidence for prehistoric activity along the Clyde around Govan predominantly coming from stray finds. This includes several stone and bronze axe heads, fragments of pots, and sometimes pieces of bone thought to be associated with cremation burials. Within the study area a stone hammer of an unknown date, but likely prehistoric, was found on the banks of the Clyde at Linthouse, to the west of the scheme area (MM084). Stone axe heads though to date to the Neolithic have also been found nearby at Shiels (PIN 8678) and the Kingston and Princes Docks (PIN 8836). A bronze axe dated to the late Bronze Age has also been found close to Govan at York Street Ferry (PIN 8732).

Evidence for the Iron Age occupation of Govan and its immediate landscape comes from two sites approximately 3km west of the scheme area. Both sites were first identified by cropmarks shown on aerial imagery before their later excavation. The first is an Iron Age settlement at Shiels (PIN 8665), comprising a single, circular enclosure ditch with several roundhouses inside with evidence of possible re-use in the Medieval period. The second site at Braehead (PIN 253) is a prehistoric multi-phased, ditched and palisaded enclosure. [47]

The lack of finds in the study area compared to the wider area around Govan does not preclude prehistoric activity but instead likely reflects the density of early modern and modern activity along the Clyde. This suggests that there are very few sites where prehistoric activity may survive along the riverbanks.

5.9.2 Roman

As with the Prehistoric period, evidence of Roman occupation within the area around Govan largely derives from stray finds, particularly coinage; for example, in 1918, on the north side of the Clyde near to Partick, a bronze coin of Vespasian minted in AD 72 or 73 was found (PIN 8584). Approximately 2.5km east of the scheme area at Yorkhill (ID 44080) traces of an earthwork were identified and excavations in 1867 revealed several Roman artefacts dated to the 2nd century AD. The site is thought to be a local fort or settlement dated to the early 2nd century AD.[48] Despite this, there is no conclusive evidence of Roman activity in the study area and the density of industrial activity from the early modern periods onwards along the Clyde suggests that there are very few sites where Roman activity may survive along the river.

5.9.3 Early Medieval

It is likely that the name Govan (*Ovania*) derives from the Brittonic word for 'little' and 'hill', which is thought to refer to the Doomster Hill (PIN 8571). The hill was a prominent feature of the Govan landscape thought to have been used as a court or law hill during the early medieval period, particularly due to the stepped form of the mound, though the dating is uncertain.[49]

Within the study area evidence for early medieval activity relates to Govan Old Parish Church (MM001), an important religious centre of the Kingdom of Strathclyde during this period. Archaeological excavations in and around Govan Old Parish Church have established the presence of a possible early church, to the east of the existing one. Two burials found below the church have produced radiocarbon dates spanning the 5th to 6th centuries AD, making them the

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[46] Bonsall, J. 1989. 'The early post-glacial settlement of Scotland'. In C. Bonsall (ed.), The Mesolithic in Europe, pp. 134-142.

[47] Ellis, C. 2000. 'Braehead, Govan, Glasgow City (Glasgow parish), later prehistoric settlement', *Discovery and Excavation Scotland*, vol. 1, p.43.

[48] Scott, J G. 1966. *South-west Scotland*. London, p.70.

[49] Driscoll, S.T. 2013. 'Govan: an early medieval royal centre on the Clyde.' In Breeze, D.J. and Clancy, T.O. and Welander, R. (Eds) The stone of destiny: artefact and icon. Society of Antiquaries of Scotland, p.80.

earliest dated Christian burials in Strathclyde. The excavations also revealed a boundary ditch that would have marked out an ancient monastic enclosure, and charcoal from this has produced a date of AD 886 to 983.[50] Govan Old Church is dedicated to St Constantine, who is traditionally associated with an early medieval saint-king, though it is unclear which Constantine this may be.[51]

The religious and political importance of Govan Old are reflected in the collection of early medieval sculpted stones (46 in total) found at the site. The stones have been dated between the 10th and 11th centuries when the Vikings raided the Clyde region. The size and quality of the stones indicate that the site may have been a royal cemetery, most likely associated with the kings of Strathclyde, who had an estate across the Clyde at Partick. The oldest are the 'hogback' tombstones, which date from around AD 925 to 1000 and are only found elsewhere in southern Scotland and northern England in areas where the Vikings settled. Many of the other stones are slabs with incised crosses and intricate decoration dating from AD 900 to 1100.

Overall, the abundance of sculpture and the presence of Doomster Hill indicate that Govan was the preeminent centre on the Clyde in the late Viking Age. The sculpture's style and the shape of the court hill both suggest a possible Norse influence in this area.

5.9.4 Medieval

From the 12th century the kingdom of Strathclyde was annexed by the Kingdom of Scotland, and consequently Govan, along with Partick, passed into the hands of Glasgow Cathedral in 1136 instead. As part of this, Patrick Castle (PIN 8595), located north of the Clyde on the west bank of the River Kelvin, is believed to have served as the country seat of the Bishops of Glasgow. Following this shift, the importance of the church at Govan declined and it is rarely mentioned in medieval documents; nevertheless, a community continued to develop within the study area during the medieval period. Medieval Govan was a small village, largely reliant on an economy of farming and craft production; however, due to its location on the Clyde it was the also the site of a ford which linked the area to Partick for seasonal cattle drovers. For example, the *Protocol Book of Mr Cuthbert Simon* (1499 – 1510) includes a note that a ship might be brought upriver as far as the ford at Govan.[52] Beyond this, little is known about medieval activity within the study area.

5.9.5 Post-medieval

The legacy of the medieval farming community remained strong in the post-medieval period, but it was also a period of change, with wider social and economic connections formed during this time. Roy’s map of 1747-55 shows how the land was enclosed and divided by hedges and according to the Statistical Account of 1792 (OSA), this enabled the agricultural lands of Govan parish to be well exploited, though the land itself provided limited success.[53] The Fairfield cottage (MM025), which is still standing in Elder Park, reflects the largely rural character of Govan during this period.

The remainder of the study area largely belonged to private estates. For example, by the mid-18th century Fairfield house had also been established within the proposed scheme area itself,

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[50] Driscoll, S.T. 2013. ‘Govan: an early medieval royal centre on the Clyde.’ In Breeze, D.J. and Clancy, T.O. and Welander, R. (Eds) The stone of destiny: artefact and icon. Society of Antiquaries of Scotland, p.79.

[51] Davies, J. R. 2010. *The Cult of Saint Constantine*. Glasgow: Friends of Govan Old.

[52] Cuthbert, S. 1513 (republished 2010). *Liber Protocollorum M. Cuthberti Simonis Notarii Publici Et Scribae Capituli Glasguensis A.D. 1499-1513*

[53] Pollock, J. 1795. ‘Govan, County of Lanark,’ in Statistical Account of Scotland (OSA) Volume XIV, p.286.

as first depicted on Roy's map (Map 4.2). According to a contemporary source Fairfield was occupied by Mr John Cumming, who died in 1794 at the age of 80.[54]

By the turn of the 19th century, Govan continued to grow because of expanding trades and crafts, which now included weaving, silk production, and cloth dyeing.

The River Clyde has long been an important part of Glasgow's history and this relationship prospered from the post-medieval onwards. According to 17th century sources, the silting up of the Clyde and the resulting shallow waters rendered the Clyde unnavigable for vessels, forcing merchants to off-load their wares at one of the ports rather than further up the river. However, by the end of the 18th century attempts were made to widen the River Clyde to allow deep cargo vessels as well as regular vehicle and passenger ferries to be introduced. This would help facilitate the subsequent development of shipbuilding as a major industry in this area.[55]

5.9.6 Early Modern

By the early part of the 19th century, Govan was rapidly losing its rural appearance and assuming the character of a town with the development of new industries and factories. This included Pollok's Silk Mill and Reid's Dye Works, which was built on the site of Doomster Hill (PIN 8571).

The 1st edition OS map shows a series of small shipyards in the vicinity of Water Row, with the Old Govan Yard and Middleton Yard laid out from the late 1830s and into the 1840s. The deepening of the Clyde continued, and new docks and ferries were provided. The Statistical Account of 1845 (NSA) records the widening of the Clyde by the Clyde trustees to the north-west of the scheme area around Whiteinch.[56] The industrial development of Govan is also recorded in the NSA with cotton and power-loom factories, iron works, and dye works all clearly established by the mid-19th century.

Dredging played an important role in the industrial development of the area as it made the Clyde navigable for larger vessels. Regular dredging of the Clyde took place annually from 1852 onwards. The work was undertaken by successive civil engineers under the direction of the Clyde Navigation Trust established in 1858 and done through the use of dredging vessels.[57] Moreover, routine dredging activities are still undertaken to maintain navigation depths, and as such inhibit natural processes which result in the accumulation of sediment which leads to shallowing of channels, migration and or splitting of the river channel. This will therefore impact on any accumulation or survival of archaeological material in the Clyde.

Glasgow's location on the River Clyde and its proximity to steel and other raw materials meant that the shipping industry boomed during the latter half of the 19th century. Thousands of people were employed in the industry, and by the early 20th century Clyde shipyards built on average one in five of the world's ships. This reputation led to the global use of the term "Clydebuilt", as a byword for quality and workmanship. In particular, Govan became a centre of shipbuilding excellence, producing some of the finest and most technically advanced ships of the era.

The Old Govan Yard was the first shipbuilding yard to open in Govan. It was founded in 1839 by MacArthur & Alexander before passing to Robert Napier in 1841. Many of the Clyde's future engineers and shipbuilders learnt their trade as Napier's apprentice, including John Elder, whose father also worked as Napier's works engineer. In 1852 John Elder left Napier's shipbuilding yard to join Randolph, Elliott & Company, founded by Charles Randolph who had also been an apprentice of Napier. The firm soon became known as Randolph, Elder &

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[54] Unknown Author, 1795. 'Settlements', *Glasgow to Greenock*; The Scots Magazine 1794, p.655

[55] Dalglish, C. and Driscoll, S.T. 2004. GUARD, Scottish Burgh Survey Series: Historic Gova, pp.58-62.

[56] Leishman, M. 1845 'County of Lanark' in Statistical Account of Scotland (NSA) Volume VI.

[57] Riddell, J. 1979 Clyde Navigation: a history of the development and deepening of the River Clyde

Company and in 1858 the company acquired the Govan Old Shipyard at Water Row before diversifying into shipbuilding. However, as the company quickly continued to grow, they decided to invest in a new yard at the former Fairfield estate in 1864. It was the first conception of a modern, large-scale and integrated shipbuilding yard and engineering works in the world.[58]

Construction on the site began in 1868; however, in 1869 both Randolph and the third partner, Richard S Cunliffe, retired from the company, which was soon followed by the untimely death of Elder in September 1869. His widow, Isabella Elder, formed a new partnership named Elder & Company in 1870 before completing the remaining works on the shipyard, engine works (MM007) and Fitting-out Basin (MM054) in the early 1870s.[59] In 1885 Isabella also purchased the area of land previously belonging to the Fairfield estate and donated it to the people of Govan as Elder Park. This was dedicated to her late husband and commemorated through a statue to him (MM026).

Following Elder's death, the company was soon sold to a new partnership consisting of Isabella's brother John Francis Ure (1820-1883), J.L.K. Jamieson (1826-1883) and Sir William Pearce. It kept the name John Elder & Company until 1886 when William Pearce converted the firm to a limited company, the Fairfield Shipbuilding & Engineering Company. It was during these years that the shipyard expanded eastwards into the former site of Govan Silk Mill (MM080). Between 1889 and 1891, the shipyard's imposing red sandstone Drawing Offices (MM008) at the south-eastern edge of the site were also constructed.[60] These features can all be seen on a drawing showing the full extent of Fairfield Shipbuilding and Engineering Works dated to around 1890.

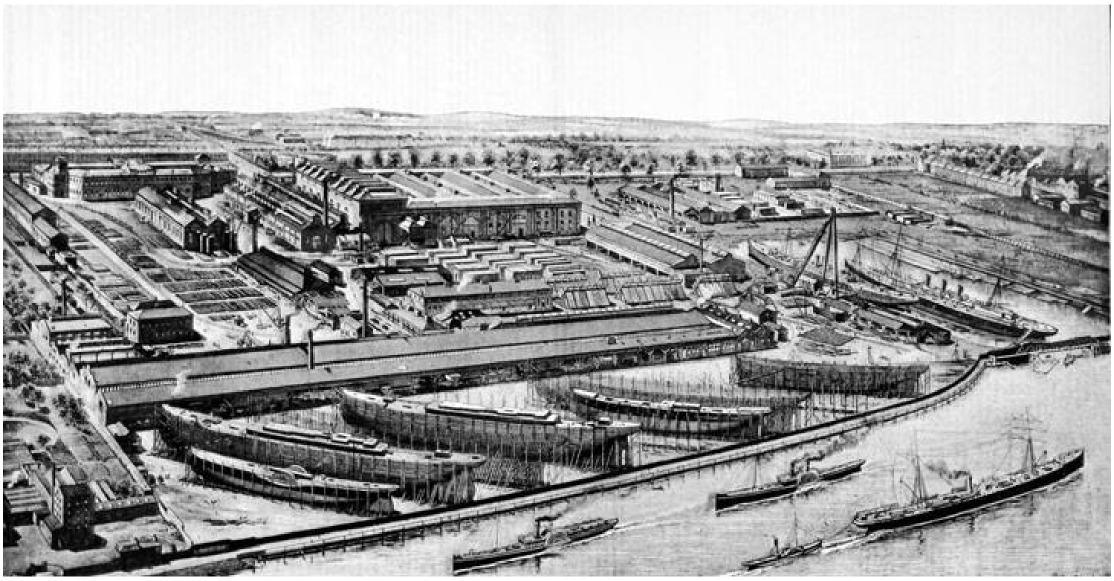

Figure 5.1: Aerial drawing showing Fairfield Shipbuilding and Engineering works in c.1890. Note the Fitting-out Basin to the right of the image, containing two vessels Sourced from The Glasgow Story and reproduced with the permission of Glasgow City Council, Libraries Information and Learning.

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[58] Hume, J. R., Kelly, T. A. D., and Paton, A. (2017). Govan Shipbuilding. United Kingdom: Friends of Govan Old, p.32.

[59] Fairfield Heritage 2021. Fairfield: A brief history of Glasgow's most famous shipyard. Fairfield Heritage: Govan Workspace Ltd, p.5.

[60] Hume, J. R., Kelly, T. A. D., and Paton, A. (2017). Govan Shipbuilding. United Kingdom: Friends of Govan Old, p.33.

In 1894 a statue of William Pearce was erected (MM033), thus symbolising the significance of labour relations and private philanthropy in Govan society in the late 19th century.

Consequently, by the end of the 19th century, Fairfield Shipyard had become one of the world's leading shipyards. It was not only one of the principal suppliers of the Royal Navy, but also repeatedly won the Blue Riband for fast transatlantic crossings in the 1880s and 1890s.

5.9.7 Modern

Fairfield continued to prosper as a shipbuilding yard in the early 20th century. Figure 5.2: shows the large number of workmen leaving by the main gate of the Fairfield Shipbuilding & Engineering Company's works at the corner of Govan Road and Elder Street. During this period new developments were made to ensure that the firm remained at the top of the industry; for example, up until the 1910s the Fitting-out Basin had previously been served by a heavy set of cranes. However, in 1911 a giant cantilever crane was installed on the east side, designed and built by Sir William Arrol & Company Limited (MM057). With a maximum lift capacity of 200 tons, it was the largest crane in the world at the time. It was employed in lifting the engines and boilers aboard ships in the fitting-out basin.[61] Arrol also built additions to the engine and boiler shop between 1906 and 1916 (MM007). The south end of the basin is lined by the 19th century pipe-shop (MM055) which also underwent renovations during the early 20th century.

Figure 5.2: A postcard from the early years of the 20th century. Sourced from The Glasgow Story and reproduced with the permission of Glasgow City Council, Libraries Information and Learning.

During the First World War, Fairfield was almost exclusively a warship-building yard but during the inter-war years Fairfield made a return to merchant shipbuilding. In 1918 the Northumberland Shipbuilding Company Limited bought control of Fairfield and made the decision to develop the West Yard. However, a short-lived boom followed by agreement among major naval powers in 1922 to curtail warship building marked the beginning of difficult times for shipbuilders. Unemployment hit Govan particularly hard, with many men migrating to find new work. In 1929 the decision was made to 'rationalise' idle yards which led to the closure and dismantling of several shipyards, including Fairfield's West Yard. Despite the economic

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[61] The crane was a Category A listed building but was demolished in 2007 during yard modernisation works.

precarity, Fairfield managed to remain open during the 1920s and 1930s. In 1936 the shipyard also became part of the Port Glasgow based Lithow group but the threat of another war and rearmament helped to revive the shipyard once again. During the Second World War the yard made battleships, aircraft carriers, cruisers and destroyers as well as two sloops, three large tank landing craft and other minor craft.[62]

Several changes occurred following the end of the Second World War. First, warship orders were halted once more, and the shipyard shifted its focus to merchant ships. After the Second World War the technique of ship construction moved from riveting to fully welded prefabrication. To accommodate this new method, and to compete against growing foreign competition, the Board began a major investment programme in 1953 to modernise and re-plan the yard. Old workshops were replaced, and new luffing cranes replaced the distinctive tower cranes that had lined the slipways since the 1920s.[63]

Despite a major modernisation programme in the 1950s, the Clyde shipyards were unable to compete with new shipbuilding superpowers such as Japan, and by the 1960s, the deterioration and economic collapse of the British shipbuilding industry had begun. Fairfield was able to survive thanks to government assistance in 1965, when it formed a new company, Fairfield (Glasgow) Limited. In 1966, following the Geddes Report, Fairfield, along with four other shipyards, became part of the Upper Clyde Shipbuilders Limited (UCS).[64] As a result, the main engine works building (MM007) ceased in use, marking the end of almost a century of use.

UCS declared bankruptcy in the early 1970s, prompting a trade union campaign to save the remaining four yards, including Fairfield. Govan Shipyard shop steward Jimmy Reid and Jimmy Airlie led the campaign, which included a "work-in". As a result, by February 1972, all four UCS yards were still in use in some capacity. Fairfield was retained and continued to operate under the new company 'Govan Shipbuilders Limited' before being nationalised on 1st July 1977 as 'British Shipbuilders'.[65]

In 1988 under the privatisation of the Thatcher government the shipyard was sold to Kvaerner, a Norwegian company who later sold the shipyard to BAE Systems in 1999.

The site is still owned and occupied by BAE Systems with the shipyard concentrating on the production of vessels for the Royal Navy. As part of modernisation works within the shipyard, the Fairfield Titan Cantilever Crane (MM057) was deconstructed in 2007.

Also no longer part of the site, the former Fairfield offices (MM008) were restored in 2013 and turned into a visitor centre and letting space by Govan Workspace.

5.10 Archaeological Potential

This section of the report identifies areas of archaeological potential, though minimal below-ground excavation will be conducted as part of the proposed scheme. Archaeological potential is a term used to identify parts of the study area where it is assessed that buried archaeology is likely to survive. Table 5.7 provides a summary of the archaeological potential of the scheme area along with the potential heritage value of the remains should they be present.

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[62] Fairfield Heritage 2021. Fairfield: A brief history of Glasgow's most famous shipyard. Fairfield Heritage: Govan Workspace Ltd, p.14.

[63] Dalglish, C. and Driscoll, S.T. 2004. GUARD, Scottish Burgh Survey Series: Historic Gova, pp.86.

[64] Fairfield Heritage 2021. Fairfield: A brief history of Glasgow's most famous shipyard. Fairfield Heritage: Govan Workspace Ltd, pp.20-23.

[65] Hume, J. R., Kelly, T. A. D., and Paton, A. (2017). Govan Shipbuilding. United Kingdom: Friends of Govan Old, p.37.

Table 5.7: Archaeological potential of the proposed scheme

Period	Heritage value	Potential
Prehistoric	In-situ prehistoric remains if present could be of medium - high value.	The only evidence for prehistoric activity within the study area derives from a stone hammer of possible prehistoric date (MM084). Evidence for prehistoric activity within the wider area of Govan appears to be restricted to the dockyard area at Shieldhall or random findspots along the Clyde. Due to the significant levels of early modern and modern activity and extensive disruption to ground surfaces this caused along the Clyde, there are likely very few areas where prehistoric activity may survive. Therefore, the potential for prehistoric remains in the scheme area is considered **negligible.**
Roman	In-situ Roman remains if present could be of medium - high value.	Despite evidence for some activity in the 2nd century AD to the north of the Clyde, no evidence of Roman activity has been found within the study area. The intense processes of urbanisation and industrialisation within Govan in the early modern and modern period have also likely had a significant impact on the survival of any Roman archaeology should it have previously existed. Consequently, the potential for Roman remains to survive within the scheme area is considered **negligible**.
Early Medieval	In-situ early medieval remains if present could be of medium - high value.	Due to the proximity of the proposed scheme to Govan Old Parish Church (MM001) there is a **negligible** potential for early medieval archaeology to be encountered within the scheme area. However, due to the use of the site as a shipyard from the late 19th century the potential for material of this type to be present may be unlikely due to the high levels of ground disturbance that will have taken place on the site.
Medieval	In-situ early medieval remains if present could be of medium - high value.	There is a **negligible** potential for medieval archaeology to be encountered within the scheme area. This is because no medieval heritage assets have been identified and the intense development of Govan in the early modern and modern period is likely to have had a significant impact on the survival of any medieval archaeology.
Post-medieval	In-situ post-medieval remains could be of low-medium value.	The intense development of Govan in the early modern and modern period following the industrialisation of the area has resulted in limited assets dated to the post-medieval period, including Fairfield cottage (MM025). As such, there is a **negligible** potential for post-medieval archaeology to be encountered within the scheme area.
Early Modern	In-situ early modern remains could be of low-medium value.	There is a **high** potential for early modern archaeological remains to survive within the Scheme area, particularly in relation to the industrial development of Govan. Fairfield shipyard was established during this period and as such significant changes were made within the Scheme area, including the excavation of the Fitting-out Basin. As such, there is a high potential for features to survive relating to the use of the site as a shipbuilding yard.
Modern	In-situ modern remains could be of low-medium value.	There is a **high** potential for modern remains within the Scheme area, as with early modern remains, mainly associated with the industrial heritage of the area. Much of the industry associated with shipbuilding carried on into the early part of the 20th century, therefore there is potential for similar archaeological remains to those identified for the early modern period to survive.
Palaeo-environmental Remains	In-situ palaeo-environmental remains if present could be of medium - high value.	A review of the historic borehole logs recorded by the BGS (see Section 4.3) indicate that there is **low** potential for paleo-environmental remains to survive within the scheme area. This is largely the result of 19th and 20th century industrial activity along

Period	Heritage value	Potential
		the Clyde which has likely removed any organic or alluvial deposits which may have been present within these areas.
Marine archaeology	In-situ marine archaeology could be of low-medium value.	A review of heritage assets associated with the marine environment indicate that there is a **low** potential for marine archaeology to survive within the scheme area. No designated historic marine protected areas were identified within the study area and there is only one non-designated heritage asset recorded approximately 510m away from the scheme area (MM094). It should also be noted that HER maintained by WoSAS, on behalf of GCC, does not include marine or maritime records and consequently there is the potential for unrecorded marine archaeology to exist within the study area. However, the routine dredging of the Clyde from the 19th century onwards would l kely have removed any remains which may have been present within these areas.
Unknown Archaeological Remains	In-situ unknown remains could be of low-medium value.	Given the intense processes of urbanisation and industrialisation within the Govan shipyard in the early modern and modern period, developments within the scheme area likely had a significant impact on the survival of any unknown archaeological remains. As such there is a **low** potential for unknown archaeological remains to survive within the Scheme area.

Source: Mott MacDonald 2022

5.11 Designated Assets

This section presents the key designated assets within the study area that have the potential to be impacted by the Scheme. A full list of all heritage assets including a short description of their value can be found in the gazetteer in Section 6. Drawings showing the location of all heritage assets can be found in Volume 3, Appendix 2.

5.11.1 Conservation Area

5.11.1.1 MM003 Govan Conservation Area

The historic centre of Govan, including Elder Park, was designated as a conservation area (MM003) in 2008 and reviewed in 2016. The conservation area covers all of Elder Park and the landscape immediately surrounding this. It excludes the scheme area north of Govan Road but incorporates the former Fairfield Shipyard Offices and their extension at 1048 Govan Road (MM008), the remainder of the area covers Govan Old and Govan Cross (MM001). The conservation area is located 30m immediately south of the scheme area.

The heritage value of the conservation area derives from its historic interest, as important centre of early Christian activity through to its prominence as an internationally renowned shipbuilding community. Govan was an independent burgh separate from the city of Glasgow until its incorporation in 1912 and this continues to play an important role in Govan's civic pride and unique identity. Govan features many listed buildings and structures, which defines the area as a distinctive place, both locally and on a City-scale. The character of the conservation area is defined by development dated to the latter half of the 19th to the first half of the 20th century at a time when the prosperity of Govan was particularly tied to the shipyards.

The setting of the conservation area includes the river front at Govan Old to the east with views across to the Riverside Museum, Govan Shipyard and the scheme area to the north, and largely residential and commercial properties to the south and west. The industrial cityscape to the north and north-west of the study area enhances the historic character of the conservation area. The setting therefore makes a positive contribution to the heritage value of the asset as it reflects the industrial character which relates to one of the prime reasons for its designation.

The scheme area sits directly north of the conservation area and visible from several viewpoints, especially within Elder Park and on Govan Road. As such, the scheme area forms an important part of the areas setting, particularly relating to the historic value of the asset.

5.11.2 Key Listed Buildings

There are a large number of listed buildings within the study area. To ensure a proportionate assessment the following listed buildings have been identified for more detailed discussion regarding their heritage value. This is because they are considered to have the highest potential to be impacted by the scheme or due to their sensitivity to change. This either due to their proximity to the scheme or their relative heritage value. A full list of all listed buildings covered by the assessment including a short description of their heritage value can be found in the gazetteer in Section 6. Drawings showing the location of all heritage assets can be found in Volume 3, Appendix 2.

5.11.2.1 MM007 1048 Govan Road, Govan Shipbuilders' Store, Former Engine Works of Fairfield Shipbuilding and Engineering Company

Located to the south-east of the scheme area, the Former Engine Works (MM007) was built for Fairfield Shipbuilding & Engineering Company in 1871 by Angus Kennedy. The 91m^2 structure has a classical brick façade with twin pilasters and blocked arches. Sir William Arrol designed and built the two western shop bays, dated 1906 and 1916, to match the demolished eastern boiler shop designed by Andrew Myles in 1889. The internal cast-iron frame is the most striking feature of this structure: the interior is made up of four machine, turning and fitting shops aligned on a 91.44m long north-south axis with a 15.24m span. The frame consists of six rows of eight cast-iron I-section stanchions, each with three pairs of bracing struts branching out to carry two cast-iron box girders at gallery levels and a larger top malleable iron girder for the travelling crane.

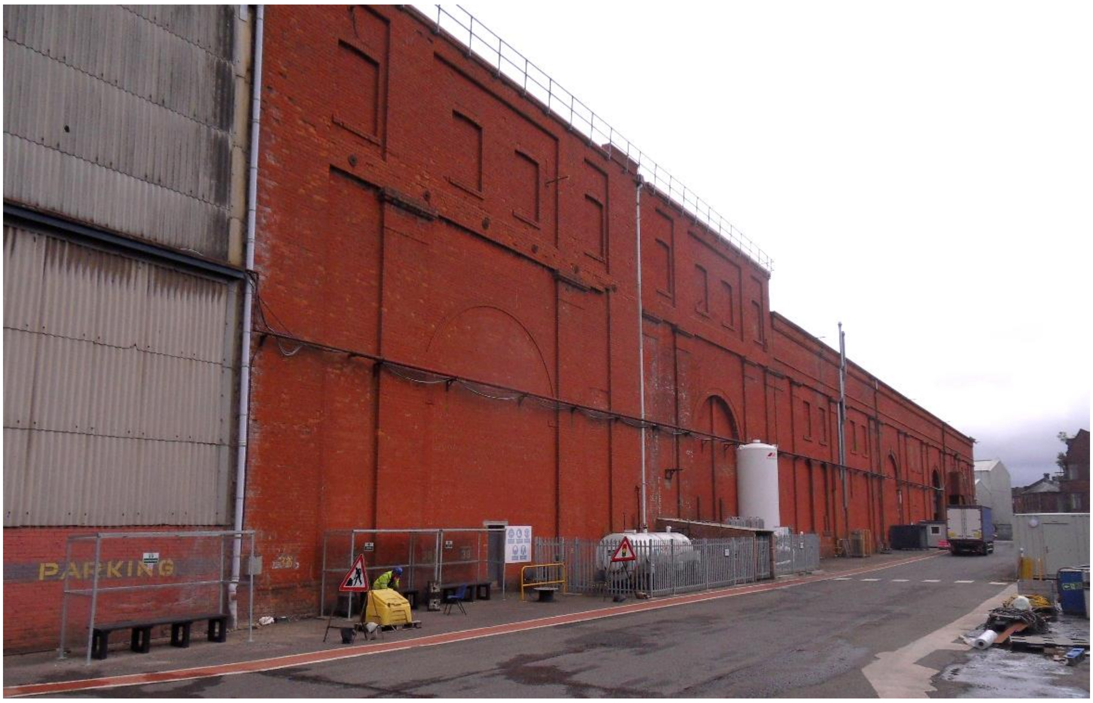

Photo 5.1: View facing north-east towards MM007, note the difference between the eastern 1871 section and the 1906 and 1916 western extension.

The building is described as the 'finest surviving engineering works in Scotland and perhaps in Britain'.[66] The national importance of the building derives from its special architectural interest as there is most likely no other building of this scale elsewhere in the world that employs an internal cast-iron frame. Moreover, cast-iron stanchions are a typical feature of Scottish engineering works, but few have survived, and those that have, such as the Linthouse and the Caledonian Ironworks, are significantly smaller in scale than this building (MM007).

The historic interest of the engine works relates to its function as part of the biggest private shipyard in the world. As the pioneers of the Compound Engine, Randolph, Elder & Company and later John Elder and Company, used the building to produce engines for pioneering ships such as the LIVADIA (1880), CAMPANIA (1892) and LUCANIA (1893). The engine works building relates to the historical development of Fairfield Shipbuilding and Engineering Company during the 19th century and early 20th century as well as the wider industrial development of Govan. Overall, this historic interest contributes to the heritage value of the asset.

The building is also valuable because it reflects the importance of industrial heritage to Govan. The Clyde was an important centre for shipbuilding and iron works in the late 19th and 20th centuries and the industrial character of the area is still retained in many of the buildings associated with the shipyard. As such, the Former Engine Works plays an important role in preserving and reflecting Govan's industrial heritage and because of this it has illustrative value as a marker of the area's identity, particularly the southern façade which has a prominent position with the Govan Road streetscape. Overall, this historic interest contributes to the value of the asset.

The immediate setting of the building includes the Govan Shipyard to the north, east, and west. This includes the General Offices (MM008) immediately to the south-east but now outwith the

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[66] Hume, J. R., Kelly, T. A. D., and Paton, A. (2017). Govan Shipbuilding. United Kingdom: Friends of Govan Old, p.24.

boundary of the shipyard. Within the shipyard the setting includes the Plate Fabrication Shed (MM056) to the north-east, Plumber's Shops to the west (MM055), Fabrication Shed (MM058) to the north, and Fitting-out Basin (MM054) to the north-west. The setting of the building within the shipyard therefore contributes to the value of the asset as it relates to the historic interest and character of the building. Many of the features within the shipyard, including the Fitting-out Basin (MM054), are also broadly contemporary and therefore likely relate to the original function of the building. However, the building is now heavily screened on the north and west by a later metal-clad, steel framed extension, which is modern and not covered by the listing. The extension takes the form of the red brick buildings with a series of pitched north light roofs. This cladding means that the original building has limited direct intervisibility to the north and west with the surrounding shipyard, including the Fitting-out Basin (MM054), which therefore lessens the ability to understand the historic interest of the asset, particularly its relationship with the basin.

Due to the cladding on the north and western façade of the building (Photo 5.2), the principal view of the building is from the south. The southern façade of the building overlooks Govan Road and beyond this Elder Park but there is a c.3m red brick wall which separates these from the shipyard. As such the primary views of the building are from Elder Park. This relationship also contributes to the value of the building as Elder Park was given to the people of Govan by Isabella Elder in 1885, in memory of her husband, the previous owner of the shipyard, John Elder. The park would have been used by many of the shipbuilders and engineers who worked at Fairfield, including within the Former Engine Works itself.

Photo 5.2: View facing south-east across the Fitting-out Basin (MM054) towards MM007 (not directly visible behind later extensions).

The wider setting of the building is urban and consists largely of industrial, commercial, and some domestic properties. Other nearby remnants of the Clyde shipbuilding industry include the Govan graving docks (LB33336), the design offices of the Linthouse Shipbuilding works (LB33309), the Stobcross crane (LB33285) and John Brown's shipyard (LB22993). These act as a reminder of the scale and importance of the shipbuilding industry along the Clyde, and of Glasgow's former reputation at the forefront of marine engineering. The wider setting of the building therefore contributes to the historic interest and value of the building as it relates to industrial character of the Clyde.

5.11.2.2 MM008 1030, 1048 Govan Road, Govan Shipbuilders Ltd, General Offices.

The General Offices of Fairfield Shipbuilding and Engineering Company (MM008) are the former headquarters of the shipbuilding firm which ran the Govan Shipyard. It is a is a two-storey over basement, multi-bay Italian Renaissance style office building constructed between 1889 and 1891 at the height of Fairfield's success. It was built to the designs of John Keppie of the renowned practice of John Honeyman and Keppie, with help from a young Charles Rennie Mackintosh.[67] Classically proportioned and built of red ashlar sandstone, there are nautical-themed carvings throughout. These include Poseidon and ships bows to the window heads, mermaids to the spandrels of the entrance door, and the statues of a shipwright and an engineer on stylised pedestals flanking the entrance door designed by James Pittendreigh Macgillivray. The west end is terminated by a three-storey tower and a five-bay block. This has round-headed window openings to the ground floor and a pediment doorcase dated '1890'. A three-storey western extension was also added in 1956, but this is excluded from the listing.

Photo 5.3: View facing south towards the entrance of the General Offices (MM008).

The building is listed for its special architectural interest as it was designed by the renowned Glasgow firm of John Honeyman and Keppie. Honeyman was a well-established and respected architect, but his practice had fallen into decline by the 1880s. In late 1888 or early 1889 Honeyman took the young John Keppie into partnership as a means of resurrecting the practice. By the 1890s, Honeyman's eyesight was failing, and he largely restricted his design work to that

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[67] Mackintosh Architecture, Fairfield Shipbuilding and Engineering Co. Ltd Offices: https://www.mackintosh-architecture.gla.ac.uk/catalogue/browse/display/?sysnum=s013 - Accessed 25/07/2022.

of churches. The commission for the Fairfield headquarters was secured by Honeyman but the Italianate design was the work of Keppie and is reflective of his Beaux Arts training. Charles Rennie Mackintosh was taken on by Keppie as a junior draughtsman in April 1889, though it is disputed whether he was actually involved at Fairfield. The building also includes ornate carvings by James Pittendreigh Macgillivray. The architectural interest of the building is therefore reflective of the prestige of the company at the time.

The headquarters building, along with the wider site, has close historical associations of national importance with the engineer, John Elder (1824-69) and the naval architect and later politician, Sir William Pearce (1833-88). The building was constructed at the height of Fairfield's success and is an important surviving feature of Fairfield Shipbuilding and Engineering Company which grew to become one of the largest and most important shipyards in the United Kingdom and was the largest on the Clyde. The building is also arguably one of the key focal points of the shipyard, serving as the public image of the Fairfield Shipbuilding and Engineering works. The building is therefore of special historic interest as it significantly adds to our knowledge and understanding of the shipbuilding industry and its importance to this area of Glasgow.

The general offices are located within Govan Conservation Area (MM003). Fronting the north side of Govan Road, the buildings occupy the south-eastern corner of the former Fairfield Shipbuilding and Engineering works, which is now operated by BAE Systems. The elevation of the buildings is impressive in its length and is an important marker of the boundary of the shipbuilding site. The placement of the building on a prominent point on Govan Road and within the conservation area therefore makes a positive contribution to the heritage value of the asset as it reflects the importance of this building as the public-front of the Fairfield Shipyard.

To the rear of the 1956 extension is the associated red brick former engine works (MM007). This relationship with the adjacent former Engine Works (MM007) is an important element of the value of the headquarters building as there is an assigned group value as both buildings relate to the use of the shipyard. Notably, the stone setts and tram lines are also retained to the rear of the main headquarters building. The setting of the building and relationship with the adjacent Engine Works (MM007), also positively contributes to the heritage value of the asset as the setting of the wider shipyard reflects the scale and importance of the former shipbuilding yard.

The wider setting of the building has been somewhat altered by the addition of modern flats to the south and the removal of an interconnected 1903 drawing office to the northeast in 2008. However, the building retains a close visual relationship and collectively represent the core elements of what was once a world-renowned shipbuilding company. It is a prominent structure within both the streetscape and the wider Govan Conservation Area, thus adding to the heritage value of the asset

5.11.2.3 87, 91 Holmfauld Road, Linthouse

This is a building of three storeys which contains a few links with the old Linthouse mansion-house. In 1920 it was decided to demolish the old mansion-house which had served as offices for forty-five years and as a canteen and Welfare centre for five. The building which had been found to be too small, was hampering work in the yard. The present administrative block, with its frontage to Homefauld Road, had been in use from July 1915. The building was built for Alexander Stephens of Linthouse in 1914. The present structure consists of a reinforced-concrete-frame with redbrick walling, the frame uprights are treated as giant pilaster strips, with a cornice above the ground floor.

The building is listed for its architectural interest as some of the solid mahogany panelled doors and a fireplace from the mansion-house are still in the same position as well as the employment of the Considere reinforced concrete system. The asset is also listed for its historic interest as the former site of the Linthouse mansion-house, the portico of the which now stands in Elder

Park. The setting of the asset comprises Holmfauld road which is the main access road into Govan Shipyard with views eastwards into what is a large open space of land used for storage. The setting to the south, west and north is largely residential, though the area retains a very industrial character. As such, the asset feels detached from the Govan Shipyard, and isolated within an area of open industrial space and modern housing which negatively contributes to the heritage value of the building.

5.11.2.4 Listed buildings within Elder Park

The listed buildings below are all within the bounds of Elder Park, also within Govan Conservation Area (MM003). The setting of the park is fairly introspective as the space is enclosed by fencing and vegetation. The external setting of the park comprises Govan Road and Govan Shipyard to the north, including the Engine Works of Fairfield Shipbuilding and Engineering Company (MM007) and the General Offices (MM008) to the east of this. The view along Govan Road from either end of Elder Park is quintessential to Govan with the shipyards to the north and Elder Park to the south lining this straight corridor leading towards Linthouse. This link is particularly important given the historic connections between the Govan Shipyard and Elder Park itself. The east, south and west perimeters of the park are marked by largely residential properties. This includes modern red brick apartments to the east but more traditional red and yellow sandstone tenements and commercial properties to the south and west. All of this is largely screened by trees which line the edge of the park.

MM016 Statue of Isabella Elder, Elder Park, Glasgow

A figurative seated bronze statue of Isabella Elder (MM016) wearing her academic gown on a large granite plinth. The statue was designed by Archibald McFarlane Shannan, of the Royal Scottish Academy and unveiled on Saturday 13 October 1906 by the Duchess of Montrose. The statue was erected by public subscription. Isabella Elder (1828-1905) was one of Scotland's greatest female philanthropists. She is renowned for her work to improve the lives of Govan's residents and for her interest in education, particularly in widening education opportunities for women. The sculpture itself is significant as an extremely rare example of an early modern Scottish historic monument commemorating a woman.

Photo 5.4: View facing south-west towards the statue of Isabella Elder (MM016) within the gardens of Elder Park.

The statue is listed for its historic interest as Isabella Elder bought the land for Elder Park in Govan. The inscription records her benefaction 'as a public park principally for the use and enjoyment of the inhabitants of the Burgh of Govan in the way of healthful recreation by music and amusements and for no other uses or purposes whatever.' Mrs Elder's wealth came from shipbuilding, an industry synonymous with 19th century Govan and Glasgow. Following the death of her husband in 1869, Elder ran what was then one of the largest shipbuilding companies in the world, John Elder & Company, for some months before her brother became its senior partner. The statue therefore reflects the philanthropy of Isabella Elder that was enabled through her connection to the shipbuilding yard to which her statue faces directly towards.

The setting of the statue is within Elder Park, specifically within the centre of circular rose garden with paths leading from north, east, south and west. This area is enclosed by a line of trees and the surrounding landscape is therefore largely screened off from the asset. The wider setting of the statue is that of Elder Park described above, which makes an important contribution to the heritage value of the asset as it reflects the relationship between Isabella Elder and the park itself. Although there is limited intervisibility between the shipyard the close proximity of yard with the statue does also contribute to the value of the asset.

MM011 228a Langlands Road and Elder Park Street, Elder Park Library

The Library, located at the south-eastern corner of the Elder Park was designed by Sir John James Burnet and completed in 1903. The portico to the Elder Park Library carries the Govan Burgh coat of arms which features shipbuilding imagery and the motto ‘nothing without labour’.[68] The library is an integral part of the park’s design and is enclosed by decorative iron railings.

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[68] Dalglish, C. and Driscoll, S.T. (2004). GUARD, Scottish Burgh Survey Series: Historic Govan. GUARD, p.115.

Photo 5.5: View facing north-west towards the entrance of the Elder Park Library (MM011)

The building is listed for its architectural interest since it was designed by Sir John James Burnet. Burnet was a Scottish architect who designed several notable structures in Glasgow and London. He was the son of architect John Burnet and later entered into collaboration with him, joining an architectural practise that would become a powerful influence in British Modern architecture in the twentieth century.

The library is also valuable for its historic interest as a public building funded by Isabella Elder. Her benefaction came with the particular stipulation that in order to allow working people to access the library it should be open on Sundays as well as weekdays. As such, along with the decorative sculpture relating the shipbuilding heritage of Govan, the library is closely connected with Fairfield Shipbuilding yard.

The setting of the library consists of Elder Park to the north and west. It is aligned on a north-east to south-west axis with primary views to the north onto the park, with the proposed scheme area in the distant background. The view towards the shipyard is largely screened by vegetation, however, and does not contribute directly to the heritage value of the asset. The eastern border of the library includes the modern red brick flats on consists of Elderpark Street, while the southern border includes the four-storey red sandstone tenement flats on Langlands Road.

MM024 Elder Park, Cottage

The Cottage (MM024), also known as Fairfield Farmhouse, is probably the oldest surviving building in Govan. Likely dated to the early 19th century the building was originally a farmhouse shown on 1st edition of the OS map. In 1885 the cottage was probably converted into a park amenity with toilets, flanking wings each with open verandah. The building presently stands in a severely neglected condition and is on the Buildings at Risk Register

The cottage is listed for its historic interest as it represents the former use of the land surrounding Fairfield shipyard and Elder Park, as well as the later conversion of the area into park by Isabella Elder. The setting of the asset is within Elder Park; however, the building is located within an area of dense vegetation and high red brick walls. As such there is no intervisibility between the building and any of the other assets within Elder Park or the scheme area. Moreover, as a precursor to the shipyard are also no historic links with the site.

MM025 Elder Park, Fragments of Linthouse Mansion

The fragments of Linthouse Mansion (MM025) date to the early 19th century. The mansion was designed in 1791 by Robert Adam and built circa 1820 on the site that would become Linthouse Engine Works and Shipyard in 1869. The remains comprise an ionic portico with paired curved flights of steps, segmental-arched tripartite doorway with fanlight and parts of the flanking wall, reflecting the mansion which was in style of David Hamilton. Following the demolition of the house in 1921 the fragments were re-sited in Elder Park. The fragments are within a small, fenced area that is heavily overgrown.

The building fragments are listed for their architectural interest as the segmental-arched tripartite opening has numerous parallels in Hamilton's work, including the Façade of the Gallery of Modern Art on Queen Street, Glasgow. The fragments of the building largely serve as ornamentation within the Park. The setting of the fragments consists of Elder Park, with the entrance facing northwards towards Govan Road and the proposed scheme area; however, due to the dense vegetation and high red brick wall there is limited inversibility with the scheme area. Moreover, as the building fragments were later moved to the park, the setting of the asset makes a neutral contribution to the heritage value of these remains.

MM026 Elder Park, Statue of John Elder

The statue is located along the main thoroughfare connecting the main entrance gates on Govan Road with Elder Park Library. The pedestrian bronze statue shows John Elder with a model of his “patent compound inverted vertical steam engine” which was patented by Elder when he was part of the firm Randolph, Elder & Company in the early 1850s. The statue was commissioned by his wife Isabella Elder and erected in 1888, it was also designed by Sir Joseph Edgar Boehm an Austrian-born British sculptor, best known for his works in London.

Photo 5.6: View facing east towards the statue of John Elder. Note the setting of modern residential properties outwide the boundary of Elder Park,

The statue is listed for its historic interest as it was the technological advances made by John Elder that played a vital role in the development of shipbuilding, and likely is one of the reasons that the Clyde reached the forefront of the world shipbuilding industry. John Elder was also model employer concerned about the welfare of his workforce and their families. He, along with his wife Isabella, were subsequently held in high esteem amongst the working-class population of Govan.

Located in Elder Park, the setting of the statue contributes to the value of the asset as it relates to legacy of John and Isabella Elder as owners of John Elder & Company. The Fairfield Headquarters building (MM008) and Engine Works (MM007) and yard are located opposite the entrance to the park and form a collective group representing an area of global importance in the shipbuilding industry. Therefore, the setting of the statue enhances the ability to understand and appreciate the value of the asset.

5.12 Non-designated Assets

5.12.1 MM054 Fairfield Shipyard and Engine Works, Fitting-out Basin

Located within the centre the proposed scheme area, the Fitting-out Basin was first excavated between 1867 and 1871 as part of the world's first integrated shipbuilding and marine engineering works. The basin was used to fit-out boilers and engines in newly launched ships. As shown in Photo 5.7, it was able to accommodate up to five ships at a time; however, due to the scale of modern ships the basin is no longer in use, and last served as a functional basin in the mid-2000s.

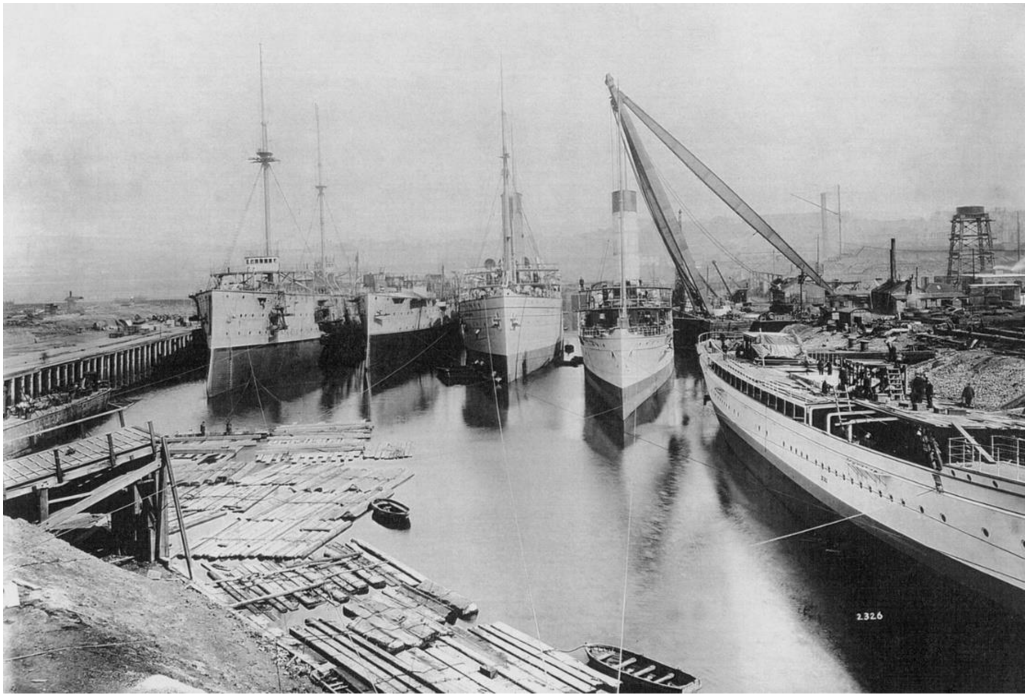

Photo 5.7: The fitting-out basin at the Fairfield Shipyard 1898 showing the ships: Fairy, Argonaut, Hermes, Carisbrook Castle, Regele Carol I and Atmah. Sourced from The Glasgow Story and reproduced with the permission of Glasgow City Archives.

The rectangular basin measures approximately 280m by 90min plan with a depth from cope to dredge level of between 9 and 14m. The basin walls are all fronted by sheet piles however the form of quay varies around the basin with some sections of quay consisting of suspended decks with voids beneath. The basin is aligned north south, on the southern bank of the Clyde. There was originally a footbridge on the northern edge, connecting the east and west sides, but this is no longer extant. The basin is first shown on the 1896 edition of the OS map, though the southern-western corner is not fully excavated but by the 1909 edition it is shown as a fully excavated rectangular basin.

The perimeter of the basin included at least 22 mooring posts, with at least eight at its southern head (MM095). The mooring posts are approximately 0.8m in diameter and c.1m in height and thought to date from at least 1909 when they are first shown in the same location on the OS map. The reinforcing metal sheets that strengthen the body of several of the posts, attests the scale of ships that were once moored to them and several photos from the First World War show that these reinforcements were already present by the early 20th century. There are also two winches (MM096), on the east and west sides of the southern edge of the basin which are also possibly contemporary with the mooring posts (Photo 5.8).

Photo 5.8: View facing west at the south-eastern end of the Fitting-out Basin (MM054) showing the winch (MM096) in the foreground along with several mooring posts in the background (MM095).

A travelling sheerleg crane ran along the western edge of the basin with a second running north-west to south-east at the eastern edge. These were replaced by a single giant cantilever crane known as the Fairfield Titan (MM057) on the eastern side. The crane was constructed in 1911 by Sir William Arrol & Company and was the biggest crane in the world at the time with an original capacity of 200 tons. Photo 5.9 shows the scale of the crane in relation to the wet basin.

Photo 5.9: A postcard view from the River Clyde of the Fairfield Crane, claimed to be the "largest crane in the world", around 1915. Sourced from The Glasgow Story and reproduced with the permission of Glasgow City Council, Libraries Information and Learning.

Located in the centre of the scheme area, the basin is almost the focal point of the shipyard. The setting of the Fitting-out Basin comprises Govan shipyard with the Engine Works (MM007) to the south-east, Plumber's Shops to the south (MM055), and Plate Fabrication Shed (MM056) and Fabrication Shed (MM058) to the east. The setting of the basin within the shipyard positively contributes to the heritage value of the asset as it reflects the original function of the asset. The remainder of the settings consists of the Clyde with views across to the north bank, which is currently a building site in the early stages for a proposed development (19/00133/DPO).

The Fairfield Shipyard and Engine Works, Fitting-out Basin is important because it reflects the evolution of the site during the second half of the 19th century as the shipyard became the first integrated works of its kind in Britain. However, the basin is not itself an innovative construction, made of standard sheet piling; instead, it is the form of the basin as opposed to the fabric of the basin walls which contributes to its heritage value.

The basin one of two surviving fitting-out basins of this scale on the Clyde. The other extant basin is located at Clydebank and was part of the Former John Brown Shipbuilding Yard. The Clydebank basin is Category A listed (LB22993) along with the Titan Cantilever Crane. As such, despite no longer in use the Fairfield Fitting-out basin plays an important role in preserving and reflecting Govan's industrial heritage and because of this it has historic interest as a marker of the area's identity as the centre of shipbuilding on the Clyde.

Overall, this historic interest contributes to the heritage value of the asset. The Fitting-out Basin is broadly contemporary with the Engine Works (MM007), where the engines would have been produced and then fitted into the ships docked in the basin. Together they represent some of the core elements of what was once a world-renowned shipbuilding and marine engineering company. They are important reminders of an industry which once defined Govan and the wider area, helping to tell the story of Glasgow's and Scotland's shipbuilding heritage. However, the historic relationship between the two assets is reduced due to the modern cladding on the north and western façade of the Engine Works (MM007). This is also reinforced by the change in use of the former Engine Works (MM007) and the fact that the basin is no longer in use. Moreover, as the basin is surrounded by modern, unsympathetic structures relating to the use of the site as a functioning shipyard, it is somewhat overlooked and dominated by the surrounding buildings. Nevertheless, the setting of the basin within the shipyard does contribute to the heritage value of the asset as it reflects its important function within the shipyard and role within the shipbuilding process.

5.12.2 MM055 Fairfield Shipyard and Engine Works, Plumber's Shops

The Plumber's Shops are located at the southern edge of the Fitting-out Basin (MM054). They are first depicted as a series of connected buildings on the 1935 edition of the OS map, though they can be seen on aerial imagery from at least 1930. The red brick buildings (the northern façade is now painted grey) comprise six different bays (Photo 5.10). The four eastern bays are uniform in design and have their own doorways and two rectangular windows either side, while the western two are larger and likely a later addition based on style and form. The overall footprint of the building measures approximately 170m by 60m. The Plumbers working in these shops would have likely worked on the ships within the Fitting-out Basin. Therefore, the heritage value of the asset derives from its relationship with other structures within the shipyard, particularly the Fitting-out Basin (MM054).

Photo 5.10: View facing south-west towards Plumber's Shops (MM055 left).

Located within the centre of the shipyard, the setting of the Plumber's Shops comprises the Fitting-out Basin to the north, the Engine Works (MM007) to the east, and a modern building and carpark to the west. The south of the building faces onto Elder Park, but this is somewhat blocked by the red brick wall which lines the perimeter of the shipyard along Govan Road. However, the distinctive shape of roofline and continuation of red brick along the edge of the shipyard in line with former Engine Works (MM007) also contributes to the value of these assets as viewed from the park. The setting of the asset in the centre of the shipyard enhances the ability to understand the asset and its relationship with the rest of the shipyard, thus making a positive contribution to its heritage value.

5.12.3 Remaining non-designated assets within Fairfield Shipyard

Fairfield Shipbuilding and Engine Works expanded to become one of the largest and most important shipyards in the United Kingdom, as well as the largest on the Clyde. Founded in the mid-19th century as a modest engine business, the company expanded into shipbuilding in 1860. In 1864, the business established a composite shipbuilding and engineering works on the Fairfield Farm site near Govan village. John Elder was in charge of creating this ground-breaking yard. The site is significant as it was the world's first concept of a modern, large-scale, combined shipbuilding yard and engineering works.[69] The yard plan has been mostly preserved with very minor changes.

The key non-designated heritage assets that fall within site include the:

- Plate Fabrication Shed (MM056);
- Site of the Titan Cantilever crane (MM057)
- New Fabrication Shed (MM058); and.
- Site of the former cranes, including their tramways (MM085)

All these features relate to the function and historic value of the site as a shipyard from the late 19th century onwards.

The setting of the shipyard to the north along the River Clyde as part of a network of historic shipyards along a stretch of riverfront from Ibrox to Govan, reflects the historic interest of shipbuilding on the Clyde. Similarly, Elder Park to the south of the shipyard adds to the asset's heritage value because it was funded with income gained from the shipbuilding company.

The view into the shipyard is also of importance to the heritage value of the site: especially the iconic stretch of red sandstone (MM008) and red brick buildings (MM007 and MM055) and red brick wall which delineates the boundary of the shipyard along Govan Road. The use of red brick is rare in Glasgow and most typically associated with industrial sites. As such, the façade reflects the industrial character of the shipyard and wider area, and therefore contributes to the value of the assets within the shipyard.

Throughout its use the shipyard became synonymous with the construction military vessels. Of particular note are the battleships HMS *Commonwealth* (1902), HMS *Renown* (1915), and HMS *Howe* (1937). The construction of these iconic ships at the Govan Shipyard therefore contribute to the value of the shipyard and the assets within the site.

Moreover, the non-designated heritage assets within the shipyard (MM056, MM057, MM058 and MM085) are assigned a group value based on their connected function within the shipyard and the role they played in the construction process.

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[69] Scottish Engineering Hall of Fame, John Elder: http://www.engineeringhalloffame.org/profile-elder.html - Accessed 25/07/2022.

6 Gazetteer

The following table describes all heritage assets identified during the production of the baseline. It provides a succinct description of the heritage asset, its heritage value and the contribution its setting makes to its heritage value. It then assigned a heritage value which is a scale of its importance in line with the assessment methodology discussed in Section 3.6.3This approach is in line with the "Principles of Cultural Heritage Impact Assessment".[70]

6.1 Gazetteer of designated heritage assets

Table 6.1: Gazetteer of designated heritage assets

MM Number	Name	Designation	HES Reference Number	Period	Description of the asset	Statement of heritage value	Value	Easting	Northing
MM001	Govan, Carved Stones and Old Parish Church Graveyard	Scheduled Monument	SM10393	Early Medieval - Post-medieval	Located 850m from the scheme area, the scheduled monument (MM001) is made up of 31 early medieval carved stones found in Govan Old Parish Church and the graveyard site south and east of the church from which the carved stones were recovered. The current Govan Old Parish Church (not scheduled but Category A listed, MM015) was built in 1884-88 on an ecclesiastical site that has seen a succession of churches since at least the medieval period. The graveyard's distinctive pear shape, approximately 110m x 95m across and defined by the modern graveyard wall, most likely reflects the shape and size of an early Christian enclosure. The large and curvilinear enclosure suggests that it was a significant lay cemetery. The medieval carved stones recovered from the site in the last 150 years, indicate it was also an important centre of lay patronage for a school of carving. At least 47 stones have been discovered at Govan, 31 of which still exist today, most of the which date from the 9th to 11th centuries AD. The surviving Govan corpus of carved stones consists of one sarcophagus, five hogback tombstones, two cross-shafts, two upright cross-slabs, and 21 recumbent cross-slabs. At least 16 more stones, which are now missing, appear to have been recumbent cross-slabs as well The setting of the graveyard and stones includes the Category A listed 'Govan Old Parish Church' (MM016) as well as the surrounding industrial and residential properties. This includes the scheme area to the west, but this is largely screened by the surrounding buildings as the cityscape is heavily built up to the west of the asset.	The value of the asset derives from its historic interest as the site of early Christian activity. The carved stones and the graveyard where they were found are of national importance on a number of levels. The site as a whole has the potential to contribute to an understanding of the development of early ecclesiastical and secular centres in Scotland at a critical period during the formation of the Scottish nation. The Govan corpus of carved stones is of national importance for the study of early medieval art and monumental sculpture, both as a group and in some cases individually. In its general character the Govan corpus is unique: no other extant collection in western Scotland testifies to an important centre of lay patronage of a lively school of carving. The Govan hogbacks also have the potential to open a window on the nature and extent of Scandinavian influence in western Scotland. The site as a whole, and the carved stones in particular, have the potential to elucidate the processes of cultural exchange between the different ethnic groups present in 9th- to 11th-century Strathclyde, and to demonstrate the influences and contacts of the Strathclyde Britons and their descendants further afield. The setting of the monument within the churchyard positively contributes to the heritage value of the asset as it reflects the use continual religious use of the site. This heritage asset is of **high** value.	High	255354	665878
MM002	Victoria Park	Garden and Designed Landscape	GDL00382	Early Modern	Victoria Park (MM002) is located to the north-west of the scheme area in central Glasgow on the north bank of the River Clyde, adjacent to the A814. The park, named in honour of Queen Victoria's Jubilee, was laid out between 1886 and 1887 on the Scotstoun Estate, on land given to the burgh of Partick by Gordon Oswald of Scotstoun. It was later extended between 1894 and 1909. The park was designed and laid out by unemployed shipbuilders from Glasgow's dockyards, connecting it to the industrial heritage of the study area. The main North Entrance Gates, made by Walter Macfarlane & Co. are of cast-iron construction. The panelled piers have inset medallions inscribed with text stating that the gates were gifted by 'The Ladies of Partick' to commemorate Queen Victoria's Jubilee. The park is enclosed by cast-iron Railings. The Fossil Grove Building is a 19th-century glass-roofed structure which has been partly modernised and extended. At the eastern end of the lake, the Clock was gifted by Gordon Oswald of Scotstoun who donated the land for the park. The War Memorial, 1922, at the opposite end of the lake comprises a granite cenotaph surmounted by a figure of Victory by F W Doyle Jones. The park is laid out on an east-west axis with a lake at the eastern end. The area is planted with mixed deciduous and coniferous trees, some of which may belong to the early phase in the park's development. Between these displays there is structural evergreen shrub planting of Rhododendrons. Bowling greens, sports pitches and other sporting facilities to the north of the Fossil Grove cover almost half of the total park area. This was the result of the expansion between 1894-1909. An amoebic-shaped lake is situated at the south-eastern end of the park. At one end of the lake, islands have been formed which are joined by two modern Chinese-style Bridges. A small pond with rockwork lies to the north of the lake.	The value of the garden and designed landscape comes from its artistic interest as the survival of the late 19th-century layout in its present form gives Victoria Park some value as a work of art. Likewise the recorded history of the development of the park gives the site some historical value. The cast-iron gates and the ancillary features also provide some architectural value. The immediate setting of the park within a largely residential townscape makes a positive contribution to the heritage value of the asset. This heritage asset is of **high** value.	High	254097	667278

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[70] Institute of Historic Building Conservators (IHBC), Institute of Environmental Management and Assessment (IEMA) and Chartered Institute for Archaeologists (CIfA) (2021), *Principles of Cultural Heritage Impact Assessment in the UK (PCHIA)*. Available online at: https://ihbconline.co.uk/toolbox/docs/Principles%20of%20Cultural%20Heritage%20Impact%20Assessment.pdf. Accessed 11/07/2022.

MM Number	Name	Designation	HES Reference Number	Period	Description of the asset	Statement of heritage value	Value	Easting	Northing
					The setting of the park is entirely urban and residential. From the surrounding streets and the A814 there are general views into the park, though these are screened by trees along the edge of the park. The scheme area is not visible from the park and does not form part of the park's setting.				
MM003	Govan	Conservation Area	CA518	Early Modern	See the description of the heritage asset and its setting in Section 5.11.1.15.11.2 2 above.	The value of the conservation area derives from the historic interest, as important centre of early Christian activity through to its prominence as an internationally renowned shipbuilding community. Govan features many listed buildings and structures, which define the area as a distinctive place, both locally and on a City-scale. The character of the conservation area is defined by development dated to the latter half of the 19th to the first half of the 20th century at a time when the prosperity of Govan was particularly tied to the shipyards. The industrial cityscape and setting of the conservation area, including the scheme area, therefore positively contributes to the heritage value of the asset. The conservation area is of **high** heritage value.	High	254890	665752
MM004	Victoria Park	Conservation Area	CA236	Early Modern	The Victoria Park Conservation Area (MM004) was designated in 1983 by GCC. The conservation area is located to the west of Partick, in Whiteinch, on the north bank of the River Clyde. The boundaries are clearly defined by Victoria Park and the Clydeside Expressway to the north, Dumbarton Road to the south, tenement properties and Haldane Street to the east, and the Primrose Court Housing Development and a landscaped area to the west. The conservation is located 1.8km north-west of the proposed scheme area on the other side of the Clyde. The Victoria Park Conservation Area is a unique area within the City of Glasgow. It was founded specifically for the workers on the Scotstoun Estate by James Gordon Oswald and largely relates to the residential properties surrounding the Park. The surrounding areas are marked by their obvious contrast to the domestic, quasi-rural character and appearance of the Victoria Park Conservation Area. The setting of the asset includes the surrounding commercial, residential and industrial properties as well as the dockyards to the south which makes a positive contribution to its heritage value.	The Victoria Park Conservation Area is significant as unique area within the City of Glasgow. The surrounding areas are marked by their obvious contrast to the domestic, quasi-rural character and appearance of the Victoria Park Conservation Area. The setting of the asset includes the surrounding commercial, residential and industrial properties as well as the dockyards to the south. The park was founded specifically for the workers on the Scotstoun Estate by James Gordon Oswald and has a unity of appearance and construction, therefore the wider industrial heritage of the Clyde area contributes to its historic interest and setting. Although there are no listed buildings in the Victoria Park Conservation Area the area does include a designated garden and designed landscape. The unique setting of Victoria Park within a largely urban and industrial landscape, including the wider industrial heritage of the Clyde area, make a positive contribution to the heritage value of the asset. The conservation area is of **medium** heritage value.	Medium	253710	667183
MM005	Glasgow West	Conservation Area	CA634	Early Modern	The Glasgow West Conservation Area (MM005) was originally designated in 1972 before it was extended in 1983 and 1990. The conservation area is located to the north-east of the scheme area and covers parts of the west end of Glasgow. It comprises the villa, terraced townhouse and tenement suburbs to the west of the City centre. The area extends from Kelvinside in the north-west, to Partickhill in the south-west to Hillhead in the south-east. It includes several listed buildings, such as the Category A listed '56 Partickhill Road 'Woodbank', Carriage House' (MM009), which reflects the wealth and investment into the area during the early modern period. The character of the conservation is also notable for its green spaces, including the River Kelvin and Glasgow Botanic Gardens. The conservation is located 1.5km north-east of the scheme area on the other side of the Clyde. The setting of the conservation area is largely introspective with axial views formed along Byres road and the surrounding residential roads. However, partial views across to the River Clyde, towards the scheme area, can be glimpsed from Partickhill.	The heritage value of the conservation area largely derives from its open green spaces and picturesque streetscapes which are largely defined by tenement flats. The setting of the conservation within the surrounding townscape therefore makes a positive contribution to the heritage value of the asset. This conservation area is of **medium** heritage value.	Medium	256562	667413
MM006	Broomhill	Conservation Area	CA669	Early Modern	The Broomhill Conservation Area (MM006) was designated in 2015 and is located on the fringes of the city's West End, to the north of the scheme area. It is situated north of the River Clyde and is bounded by Thornwood to the south and east, Hyndland and Partick to the east, Jordanhill to the north and west and Whiteinch to the south-west. The area is focused primarily on Broomhill Cross, and extends north, west and southwards to include a planned layout of villas, terraces, tenement blocks, public buildings and associated open spaces. The physical barrier of the Clyde Tunnel approaches, and Balshagray Avenue forms a strong and logical western boundary to the area. The conservation is located 775m north of the scheme area on the other side of the Clyde. Tower blocks dominate views from Broomhill Cross southwards while views northwards from the elevated position of Churchhill Drive and Beechwood Drive include Gartnavel Hospital and Kelvindale. Long views are formed along lanes and streets of tenement vistas. Dockyard cranes appear over Thornwood tenements to the south, but there are no direct views towards the Clyde and scheme area.	The value of the conservation area derives from its distinct residential character. There are thirteen listed buildings within the Broomhill study area. Of the five churches within the area, two are listed Category B and one Category C. The setting of the conservation area within a largely residential townscape makes a positive contribution to the heritage value of the asset. The conservation area is of **medium** heritage value.	Medium	254789	667348
MM007	1048 Govan Road, Govan Shipbuilders'	Category A Listed Building	LB33357	Early Modern - Modern	See the description of the heritage asset and its setting in Section 5.11.2.1 above.	The building is of national importance which derives from its special architectural interest as there is most likely no other building of this scale elsewhere in the world that employs an internal cast-iron frame.	High	254740	665961

MM Number	Name	Designation	HES Reference Number	Period	Description of the asset	Statement of heritage value	Value	Easting	Northing
	Store, Former Engine Works of Fairfield Shipbuilding and Engineering Company					Moreover, cast-iron stanchions are a typical feature of Scottish engineering works, but few have survived, and those that have, such as the Linthouse and the Caledonian Ironworks, are significantly smaller in scale than here. The historic interest of the engine works relates to its function as part of the biggest private shipyard in the world. As the pioneers of the Compound Engine, Randolph, Elder & Company and later John Elder and Company, used the building to produce engines for pioneering ships such as the LIVADIA (1880), CAMPANIA (1892) and LUCANIA (1893). The engine works building relates to the historical development of Fairfield Shipbuilding and Engineering Company during the 19th century and early 20th century as well as the wider industrial development of Govan. Overall, this historic interest contributes to the value of the asset. The building is also significant because it reflects the importance of industrial heritage to Govan. The Clyde was an important centre for shipbuilding and iron works in the late 19th and 20th centuries and the industrial character of the area is still retained in many of the buildings associated with the shipyard. As such, the Shipbuilders' Store and Former Engine Works plays an important role in preserving and reflecting Govan's industrial heritage and because of this it has illustrative value as a marker of the area's identity. The wider setting of the building is urban and consists largely of industrial, commercial, and some domestic properties. Other nearby remnants of the Clyde shipbuilding industry include the Govan graving docks (LB33336), the design offices of the Linthouse Shipbuilding works (LB33309), the Stobcross crane (LB33285) and John Brown's shipyard (LB22993). These act as a reminder of the scale and importance of the shipbuilding industry along the Clyde, and of Glasgow's former reputation at the forefront of marine engineering. The wider setting of the building, therefore, contributes to the historic interest of the building as it relates to industrial character of the Clyde. Overall, this historic interest contributes to the value of the asset. The setting of the building within the shipyard positively contributes to the heritage value of the asset as it relates to the historic interest and industrial character of the building. Many of the features within the shipyard, including the Fitting-out Basin, are also broadly contemporary with the building and therefore likely relate to the original function of the building. However, the building is now heavily screened on the north and west by a later metal-clad, steel framed extension, which is modern and not covered by the listing. The extension takes the form of the red brick buildings with a series of pitched north light roofs. This cladding means that the original building has limited direct intervisibility to the north and west with the surrounding shipyard, including the Fitting-out Basin (MM054), which therefore lessens the ability to understand the historic interest of the asset, particularly its group value with the basin. The southern façade of the building overlooks Govan Road and beyond this Elder Park. This setting and relationship with the Park also contribute to the heritage value of the building as Elder Park was given to the people of Govan by Isabella Elder in 1885, in memory of her husband, the previous owner of the shipyard, John Elder. The park would have been used by many of the shipbuilders and engineers who worked at Fairfield, including within the Shipbuilders' Store and Former Engine Works itself. This heritage asset is of **high** value.			
MM008	1030, 1048 Govan Road, Govan Shipbuilders Ltd, General Offices (excluding 1956 Extension To W).	Category A Listed Building	LB33356	Early Modern	See the description of the heritage asset and its setting in Section 5.11.2.2 above.	The building is listed for its special architectural interest as it was designed by the renowned Glasgow firm of John Honeyman and Keppie. Honeyman was a well-established and respected architect, but his practice had fallen into decline by the 1880s. In late 1888 or early 1889 Honeyman took the young John Keppie into partnership as a means of resurrecting the practice. By the 1890s, Honeyman's eyesight was failing and he largely restricted his design work to that of churches. The commission for the Fairfield headquarters was secured by Honeyman but the Italianate design was the work of Keppie and is reflective of his Beaux Arts training. Charles Rennie Mackintosh was taken on by Keppie as a junior draughtsman in April 1889 but there is no known documentary or stylistic evidence to show Mackintosh's involvement at Fairfield. The building also includes ornate carvings by James Pittendreigh Macgillivray. The architectural interest of the building is	High	254908	665873

MM Number	Name	Designation	HES Reference Number	Period	Description of the asset	Statement of heritage value	Value	Easting	Northing
						therefore reflective of the prestige of the company at the time. The headquarters building, along with the wider site, has close historical associations of national importance with the engineer, John Elder (1824-69) and the naval architect and later politician, Sir William Pearce (1833-88). The building was constructed at the height of Fairfield's success and is an important surviving feature of Fairfield Shipbuilding and Engineering Company which grew to become one of the largest and most important shipyards in the United Kingdom and was the largest on the Clyde. The building is therefore of special historic interest as it significantly adds to our knowledge and understanding of the shipbuilding industry and its importance to this area of Glasgow. The setting of the building along Govan Road positively contributes to the heritage value of the asset, serving as an important marker of the boundary of the shipbuilding site. The setting of the building and relationship with the adjacent Engine Works (MM007), also positively contributes to the heritage value of the asset as the setting of the wider shipyard reflects the scale and importance of the former shipbuilding yard. This heritage asset is of **high** value.			
MM009	56 Partickhill Road 'Woodbank', Carriage House, Arch to Service Court, Retaining Walls and Cast-Iron Gates	Category A Listed Building	LB32895	Early Modern	Circa 1841.2-storey classical house, 3 bays with additional single storey recessed E entrance bay, attached outbuildings. Polished ashlar, squared rubble rear elevations. Sash and case windows in architraves, windows to front plate glass, those to rear with 12-pane glazing, plinth. MAIN ELEVATIONS TO S: Greek Ionic central portico with cornice and blocking course, flanked by console corniced windows over centre bay. Pilastered single storey entrance to E with 2 arched windows in return. W RETURN: projecting side entrance to rear garden, corniced with sculpted lion couchant. Splayed, corniced axial stacks to E and W returns. Rear elevation: 3 bays with central, round-headed narrow stair light. INTERIOR: Corinthian columned hall screen with responds. Elaborately coffered, corniced vestibule and hall. Stone staircase with cast-iron baluster. Console corniced doors. Left upper room angle consoled marble chimneypiece. OUTBUILDINGS: attached to house by pedimented key blocked archway with sculpted eagle. Double-leaf wooden gates, panelled fret work in upper part. Plain single-storey buildings, loft with pigeonhole gable, stone coping, slate roof. Coped boundary wall. Cast-iron gates and piers The setting of the asset comprises 19th and 20th century residential properties along a wide residential road. Located at a prominent point within the landscape the building has views facing south towards the Clyde, though these are only visible when the vegetation levels are low	The building is listed because it was possibly designed by John Baird and is an unusual complete group of house outbuildings, boundary walls, railings and gates. The asset derives its value from its unique historic and architectural interest. The setting of the asset including the surrounding period properties contribute positively to the heritage value of the asset. This heritage asset is of **high** value.	High	255662	667007
MM010	1a Drumoyne Drive And Langlands Road, Elder Cottage Hospital	Category A Listed Building	LB33300	Modern	The building was designed by Sir John James Burnet in 1902 as a hospital. It includes elaboratively decorated sculpture and is listed in relation to the surrounding hospital buildings. EXTERIOR: English late renaissance. 2 storeys with attic, advanced ends (facade 2-4-2 bays). Stugged and snecked ashlar with rusticated quoins, raised margins; central columned porch with remarkable consoled arched hood, elaborately sculptured door architrave with monogrammed cartouche; sculptured panel above. Outer ground floor bipartites are set in shallow panels; small-paned windows throughout - sashes, but with top hoppers at 1st floor. Bold mutule cornice; gabled attic dormers. Bell-cast piended and slated roof breaks forward at ends; simple finials; cut-down stacks. 5-bay flank to Langlands Road; asymmetrical rear elevation. Enclosed by iron railings - serpentine, at entrance - on low ashlar coping and with corniced piers. The setting of the asset includes the single storey hospital block (LB33301) to the west, as well as Langlands Road and Elder Park to the north, and two-storey terraced houses to the south and east	The building is listed for its architectural interest as it was designed by Sir John James Burnet. Burnet was a Scottish architect who designed several notable structures in Glasgow and London. He was the son of architect John Burnet and later entered into collaboration with him, joining an architectural practise that would become a powerful influence in British Modern architecture in the twentieth century. The relationship with the Category B listed hospital block does contribute to the heritage value of the asset as together they reflect welfare facilities within Govan. The setting of the building within a largely urban setting along with the adjacent hospital block, positively contributes to the heritage value of the asset. This heritage asset is of **high** value.	High	254408	665497
MM011	228a Langlands Road and Elder Park Street, Elder Park Library	Category A Listed Building	LB33310	Modern	See the description of the heritage asset and its setting in Section 5.11.2.4 above.	The building is listed for its architectural interest since it was designed by Sir John James Burnet. Burnet was a Scottish architect who designed several notable structures in Glasgow and London. He was the son of architect John Burnet and later entered into collaboration with him, joining an architectural practise that would become a powerful influence in British Modern architecture in the twentieth century. The heritage value of the asset also derives from its historic interest as a public building funded by Isabella Elder. Her benefaction came with the particular stipulation that in order to allow working people to access the library it should be open on Sundays as well as weekdays. As such, along with the decorative sculpture relating the shipbuilding heritage of Govan, the library is closely connected with Fairfield Shipbuilding yard.	High	254777	665641

MM Number	Name	Designation	HES Reference Number	Period	Description of the asset	Statement of heritage value	Value	Easting	Northing
						The setting of the Elder Park along with the adjacent Govan shipyard positively contributes to the heritage value of the asset. This heritage asset is of **high** value.			
MM012	18 Clydebrae Street, Govan Graving Docks	Category A Listed Building	LB33336	Early Modern	An outstanding graving dock complex without parallel in Scotland. 1869-98, 3 major dry docks, associated quays, capstans and bollards, pumphouses, workshops and other ancillary buildings, retaining and boundary walls, ramped accesses and stairs. The dock walls and quay edges are of grey granite, the working surfaces whinstone setted, and retaining walls and ramp sides are of cream sandstone. Cast-iron gatepiers. DRY DOCKS: No 1 Dock (at North): by James Deas and Alex Lister, 1869-75 551' long, 72' wide at entrance, depth to sill 22'9". Stepped sides and curved end, unusually curving towards bottom. 9 sets of stairs with grooves for materials. Paved base. Modern steel caisson gate to Clyde. There is a series of associated buildings, mostly to N; pump house and sluice houses, ashlar on rusticated base with round-headed openings, with former boiler house to N and pump room to south. The pumps are sited below the building. There is a square accumulator tower with 4 oculi, heightened in brick c.1895. The sluice houses are small square buildings of similar construction. At the entrance two hydraulic capstans by the Anderston Foundry Co. No 2 Dock (Centre): by James Deas, 1883-6; 575' by 67' by 22'9". Stepped sides and vertical curved end. 4 stairs giving access through tunnels. Slides for materials. Steel caisson gate and folding bridge, opening off Clyde. Small flat-roofed brick pumphouse on S side of entrance, which is flanked by hydraulic capstans as at No 1 dock. No 3 Dock (South): by James Deas, 1894-8; by far the longest of the three, 880' by 83' by 26'6". Stepped sides and vertical curved end. 8 stairs give access through tunnels. Projecting piers in the centre with curved recesses for caisson, to subdivide dock; caisson now removed. Steel caisson gate and folding bridge opening off Prince's Dock canting basin. Associated PUMP HOUSE (at SE end of site) terra-cotta brick, with red sandstone dressings, in two sections, eastern flat-roofed with electric pumps in basement, gantry crane, tiled interior. Western part wider, pedimented gable, slated roof with ridge ventilator, housing workshop and hydraulic pumps. Dated 1895 on cast-iron commemorative plaque. On North quay, two workshops, one on either side of No 1 pump house. On West, woodworking shop (formerly harbour workshop) and offices, 2-storey 14-bay red and yellow brick with pend at west end and weighbridge (A & W Smith 1889). On east, mechanics' shop (c.1895), 1 storey 10-bay, red and white brick with iron-framed round-headed windows and wrought-iron framed roof. Doors with glazed fanlights on N. Also series of ancillary buildings ranged round the site, these of differing dates and built mostly of red or yellow brick. Small steel Scotch derrick crane at N. The setting of the assert largely relates to its prominent location on the Clyde. The wider landscape comprises industrial estates which also reflects the industrial character of the area and the relationship of the docks to this important aspect of Govan's development. On the north side of the Clyde the setting also includes the modern entertainment buildings the SEC Armadillo and OVO Hydro.	The building is listed for its historic and architectural interest within an international context as it was built for the Clyde Navigation Trust during the years when the Clyde yards led the world in the building of sophisticated merchant ships. It is considered to be of major value in terms of the history of the world shipbuilding. Docks Nos 1 and 3 were each the deepest in Britain when built and could take the largest ships afloat. The heavily industrial setting of the Graving Docks alongside its location on the Clyde positively contributes to the heritage value of the asset. This heritage asset is of **high** value.	High	256090	665463
MM013	816, 818 Govan Road, 1, 3 Water Row, Former British Linen Bank, and Flats	Category A Listed Building	LB33351	Early Modern	These tenement flats were designed by James Salmon and Son, and J G Gillespie, in 1899. They are in the typical Glasgow-style and 5-storeys with 3 by 2-bay with canted corner bay. EXTERIOR: Ground floor curved corner entrance by Derwent Wood, a boldly sculptured trireme's prow with 'B L Co' on sails between 2 winged "Winds" sitting on Corinthian capitals. Water Row elevation: 2 arched windows between columns with lively capitals by Johan Keller. Stair entrance and plain modern shop front to N; cornice. 1st floor; 3 large depressed arched windows between pilasters. Floors above have Art Nouveau detailing to window heads. N bay has shallow canted windows at 2nd to 4th floors, tripartites under steep pediment flanked by wall head stack. Deep projecting eaves over central bays. Corner bay windows canted out at 1st and 4th floors. Remarkable lead-covered crown at top with flanking wallhead stacks. Govan Road elevation: arched window between columns with lively capitals. Large altered plain window to W; cornice. W bay advanced 1st floor tripartite depressed arched and pilastered window. 2nd and 3rd floor bipartites in ogee pediment. 4th floor low round-headed keystoned window. Parapet. Middle bay, plain small and large windows 2nd to 4th floors under projecting eaves. E bay, 1st floor elaborate ogee pediment to window. All windows have original glazing except some at 4th floor and the ground floor. Bank interior modern. The setting of the building includes Govan Road to the south with several commercial properties and red-brick flats to the south of this. The views to the north and east are open towards the Clyde and the Riverside Museum on the north bank.	The building is listed for its architectural sculpture designed by Salmon, Son & Gillespie which was an architectural partnership formed by William Forrest Salmon (1843-1911), James Salmon (1873-1924) and John Gaff Gillespie (1870-1926) in Glasgow, Scotland in 1903. Although James Salmon had become a partner in the firm Salmon & Gillespie in 1898, the name of the partnership was not changed until 1903. The partnership was avowedly committed to the 'Glasgow Style' and employed the Glasgow Style craftsmen Oscar Paterson, Albert Hodge and John Crawford. The influence of the Glasgow Style, which the listed building also follows, is particularly evident in two of their projects in Glasgow - 'Hatrack', 142 St. Vincent Street (1898-1902), and 12-14 University Gardens (1900). The setting of the asset negatively contributes to the heritage value of the building as it is heavily built up, comprising several modern buildings. This heritage asset is of **high** value.	High	255428	665764

MM Number	Name	Designation	HES Reference Number	Period	Description of the asset	Statement of heritage value	Value	Easting	Northing
MM014	840, 860 Govan Road And Return Elevation to Pearce Street, Pearce Institute	Category A Listed Building	LB33352	Early Modern	The Pearce Institute is one of the most important buildings in Gova. Designed by Sir Rowand Anderson and completed in 1906. The Institute was gifted to the working men and women of Govan by Lady Pearce in memory of her late husband, Sir William Pearce, under whose guidance Fairfield Shipyards became one the biggest and most technically advanced shipyards in the world. Early 17th century Scots Renaissance style; ashlar. W elevation of MacLeod Hall: tall 6-bays with columned and richly pedimented exit inscr bed "Quit ye like men". Modern door, in keeping with the original. Octagonal projecting stair tower with bipartites and ogee roof. 4 tall transomed bipartites with rich pediments between buttresses. Slate roof and central louvred timber belfry under lead cupola with balustrade. Big curvilinear gables to N and S. The setting of the asset comprises modern buildings to the east and Govan Road to the south including a direct view towards the Sir William Pearce Statue (LB33343) which is linked to the historic value of the building as they are assigned group value. The setting to the west is open includes the Govan War Memorial immediately adjacent and Govan Old Church and church yard to the north-west, though further views west are restricted by modern residential properties.	This building is listed for its historic interest as the Pearce Institute was given to Govan by the widow of Sir William Pearce, 1835-88, owner of Fairfield shipyard and MP for Govan. It was administered by Govan Old Parish Church and the main hall is named after its minister Rev Dr John MacLeod 1875-98, but was non-sectarian. The building is considered to be of great importance to the people of Govan and of importance to social historians. The setting of the asset on Govan Road facing southwards onto the statue of Sir William Peace, makes a positively contribution to the heritage value of the asset. This heritage asset is of **high** value.	High	255362	665794
MM015	866, 868 Govan Road, Govan Old Parish Church (C of S)	Category A Listed Building	LB33353	Early Modern	An outstanding Church by the celebrated architect Rowand Anderson and now with an exceptional collection of early Christian monuments, most of which were transferred from the surrounding graveyard (see separate listing) in 1926. See 'Buildings of Scotland ' Glasgow' for a fuller account of the monuments. The 6th church on the site, whose parish covered what was to become half of Glasgow. This church is unusually ecclesiological because Rev Dr John Macleod was a pioneer of Scots-Catholicism. The orientation is N-S because its foundations are on the 1826 church moved to Golspie Street, itself on the site of a Celtic church. The design is inspired by Italian Fransiscan basilicas and the Pluscardine Priory, Elgin. The setting of the asset includes the graveyard of the church. While the views to the west and east are limited due to modern residential properties, the view northwards to the river Clyde is largely open.	This building is listed for historic and architectural interest as an outstanding Church by the celebrated architect Rowand Anderson and now with an exceptional collection of early Christian monuments, most of which were transferred from the surrounding graveyard in 1926. The present structure is the sixth church on the site, whose parish covered what was to become half of Glasgow. This church is unusually ecclesiological as Rev Dr John Macleod was a pioneer of Scots-Catholicism and the orientation is north-south because its foundations are on the 1826 church moved to Golspie Street, which itself on the site of a Celtic church. The design is also inspired by the Italian Fransiscan basilicas and the Pluscardine Priory, Elgin. The setting of the asset within the graveyard and looking onto the Clyde positively contributed to the heritage value of the asset. his heritage asset is of **high** value.	High	255349	665917
MM016	Statue of Isabella Elder, Elder Park, Glasgow	Category A Listed Building	LB33304	Modern	See the description of the heritage asset and its setting in Section 5.11.2.4 above.	The statue is listed for its historic interest as Isabella Elder bought the land for Elder Park in Govan 'as a public park principally for the use and enjoyment of the inhabitants of the Burgh of Govan in the way of healthful recreation by music and amusements and for no other uses or purposes whatever.' Mrs Elder's wealth came from shipbuilding, an industry synonymous with 19th century Govan and Glasgow. Following the death of her husband in 1869, Elder ran what was then one of the largest shipbuilding companies in the world, John Elder & Company, for some months before her brother became its senior partner. The statue therefore reflects the philanthropy of Isabella Elder that was enabled through her connection to the shipbuilding yard to which her statue faces directly towards. The setting of the statue within Elder Park combined with its proximity to the Govan shipyard positively contributes to the heritage value of the statue. This heritage asset is of **high** value.	High	254552	665587
MM017	739 South Street, North British Engine Works	Category A Listed Building	LB32280	Modern	The engine works were designed by J Galt in 1913-14. It comprises a steel framed, brick and glass building modelled on Peter Behren's A E G Turbine Factory in Berlin (1909). The tall, 13-bay main shop has a frontage onto river. The interior of the building includes a large central aisle with gallery at the east end. Steel frame pivoted at base and at gallery level at the east to allow for movement in this structure. Supporting light-weight lattic roof trusses in mansard form and glazed roof formerly with sliding roof panels, as well as fish bellied travelling cranes. The associated Titan Crane is also A listed. EXTERIOR: Steel framed, brick and glass building modelled on Peter Behren's A E G Turbine Factory in Berlin (1909). Tall, 13-bay main shop frontage onto river. Flattened mansard roof to main section with substantial flat-roofed range on E elevation. Gable-ends glazed (with entrance at ground) upper windows divided from lower by broad brick band, gable head, with lunettes, overhangs lower elevation. Large arched entrance in W end of flat-roofed section. Areas between steel frames glazed. INTERIOR: large central aisle with gallery at E. Steel frame pivoted at base and at gallery level at E to allow for movement in this structure. Supporting light-weight lattic	The former engine works is listed for its historic value as it reflects the importance of shipbuilding on the Clyde. The building itself reflects the scale of works which used to take place within this area and gave Glasgow and the Clyde its world renown reputation as shipbuilders. The building is assigned a group value alongside the Titan Crane (LB32281). The setting of the asset within an industrial site, including the Titan Crane (MM018), and on the Clyde positively contribute to the heritage value if the asset. This heritage asset is of **high** value.	High	253415	666915

MM Number	Name	Designation	HES Reference Number	Period	Description of the asset	Statement of heritage value	Value	Easting	Northing
					roof trusses in mansard form and glazed roof formerly with sliding roof panels. Fish bellied travelling cranes. Various large machine tools including a planer. Painted mustard yellow 1984. The setting of the asset Is largely industrial with the north, east and west all dominated by warehouses and storage spaces. The Clyde is located immediately south of the building.				
MM018	739 South Street, Former North British Diesel Engine Works, Quayside Titan Crane	Category A Listed Building	LB32281	Modern	Ordered 1913, completed 1920; by Sir William Arrol and Co Ltd. 150 ton giant cantilever crane built to serve the North British Diesel Engine Works through sliding roof panels in the engine erecting shop. Lattice girder tower supporting roller track on which rotates the asymmetrical truss gib with motor room and counter weight at short end. The order was cancelled in 1913 probably because of take over plans by Swan Hunter. 42 giant cantilever cranes were constructed worldwide and the Glasgow firm or Arrols were responsible for 40. 27 were located in Britain. 15 survive, in Scotland 7 remain. The former Diesel Engine Works are also A listed. The setting of the asset Is largely industrial with the north, east and west all dominated by warehouses and storage spaces and the Clyde to the south.	This crane is listed for its historic interest. The 150-ton giant cantilever crane was built to serve the North British Diesel Engine Works through sliding roof panels in the engine erecting shop. The crane is one of 42 giant cantilever cranes constructed worldwide and the Glasgow firm of Arrols were responsible for constructing 40 of these. The former engine works is also noted for its historic value as it reflects the importance of shipbuilding on the Clyde. The crane is assigned group value with the Engine Works (LB32280). The setting of the asset within an industrial site, including the Engine Works (MM017), and on the Clyde positively contribute to the heritage value if the asset. This heritage asset is of **high** value.	High	253341	666845
MM019	19,21,23,25,27,29, Squire Street And 69 Northinch Street, Former Whiteinch Jordanvale Parish Church And Hall	Category B Listed Building	LB32282	Modern	P Macgregor Chalmers, 1911. Romanesque revival; nave, aisle and chancel. Plain, slim buttresses. Bull-nosed snecked rubble with ashlar dressings. Plinth. CHURCH: Single-storey projecting vestibule with central round-arched entrance with nook shafts, plain infilled tympanum, flanking bipartite windows with colonette mullions set in arched recesses. Narrow lancet W windows arched side windows. Full-height independently roofed and gabled aisles with sanctus bellcote. Simple paired round arched windows. HALL: simply detailed, asymmetrical single storey hall and ancillary building. 2nd gabled hall to S with large, round-arched W window. INTERIOR: Droved ashlar walls. Round-arched arcade with columns, sculpted capitals. Apse with blind arcade and 3 stained glass windows. Carved timber pulpit and lectern on sculpted podium. W gallery over entrance. Timber trussed roof. The setting of the building comprises derelict land to the west and modern residential properties to the north, east and south, including a high rise flat to the south-east	The building is listed for its special architectural interest as an ecclesiastical building still in use as such. The largely industrial and semi-derelict nature of the setting around the building negatively contributes to the heritage value of the asset. This heritage asset is of **medium** value.	Medium	254011	666837
MM020	14 Victoria Park Drive South, Whiteinch Public Library	Category B Listed Building	LB32283	Modern	1923, by Office of Public Works, Glasgow. Single storey and basement, L-plan district public library. Red sandstone ashlar. Entrance at angle in boldly moulded doorpiece with fanlight above door and crowning enriched coat of arms. Continuous entablature with disc frieze. Elevations fronting reading rooms with main windows recessed and framed by giant pilastered bays, smaller architraved windows to outer bays. Small, squared lead cupola over the entrance. The setting of the asset includes, Victoria Park with views to the north comprising the A814 and park, while the remainder of the setting consists of residential properties.	The library building is listed for its architectural interest due to its decorative frieze and entablature. The setting of the building within a built-up residential area looking onto the busy A814 negatively contributes to the heritage value of the asset This heritage asset is of **medium** value.	Medium	254032	666803
MM021	3-13 (odd Nos) Crow Road and 482-492 (even Nos) Dumbarton Road	Category B Listed Building	LB32294	Early Modern	Circa 1860. 3-storey classical tenement with modern shops to ground floor at Dumbarton Road and 1st 5 return bays; 13 x 16 bays, 4th, 10th bays from E blind in Dumbarton Road, 2nd, 13th bays blind in Crow Road. Polished ashlar. Sash and case windows in architraves. Ground floor cornice. 1st floor cill band, 1st floor windows alternately pedimented or corniced. Plain 2nd floor windows, cornice. Tall parapet with wallhead stacks breaking through. Slate roof. Axial stacks. The setting of the buildings to the east on Crow Road comprises a small retail park and tenement flats while to the south on Dumbarton Road the properties are overlooked by several red sandstone tenements with commercial properties on the ground floor.	These buildings are listed for their historic interest as Formerly Downie Place. As the setting of the buildings includes a modern retail park and commercial properties, this negatively contributes to the heritage value of the asset. This heritage asset is of **medium** value.	Medium	254108	667032
MM022	30-36 (even Nos) Sandy Road, 120-124 (even Nos) Beith Street, Former Partick Fire Station	Category B Listed Building	LB32297	Modern	The Fire Station was designed by James Miller and dates to 1906. It is an the Edwardian Queen Anne revival of three storeys. The building includes an L-planned fire station and firemen's dwellings planned around rear courtyard. The material used is red brick with ashlar dressings. EXTERIOR: Red brick with ashlar dressings. Ashlar plinth. Sash and case windows, keyblocked, 12-pane glazing. ELEVATION TO SANDY ROAD: central 3-bay section set in channelled strips with ashlar, arched carriage entrance; segmentally pedimented at roof level with keyblocked oculus and relief sculpture. Segmentally pedimented entrance at No 9 Sandy Road. Stack corbelled out at 1st floor with date panel. Modillion cornice. ELEVATION TO BEITH STREET: windows 10-9 segementally pedimented, entrances at Nos 120 and 122. 9-bay E section. W section windows arranged in groups of 2. 5-bay ashlar arcaded engine house entrances, corniced frieze 'PARTICK FIRE BRIGADE STATION". Tall corniced, axial and wallhead stacks. Tall, square, corniced tower in courtyard to rear.	The Fire Station was converted into flats in 1997 and is listed for its architectural interest. The setting of the building within modern residential properties and the busy A814 negatively contributes to the heritage value of the asset. This heritage asset is of **medium** value.	Medium	255366	666612

MM Number	Name	Designation	HES Reference Number	Period	Description of the asset	Statement of heritage value	Value	Easting	Northing
					The setting of the building comprises Beith Street to the south with views towards the A814 and the green space to the north of this. The setting to the east on Sandy Street includes modern red-brick residential properties.				
MM023	2a Drumoyne Drive and Langlands Road, Elder Cottage Hospital (West Block)	Category B Listed Building	LB33301	Modern	The single storey hospital block was designed by Sir John James Burnet, circa 1902. building is listed in relation to the adjacent hospital building. Harled, with half-timber gables; barge boards. Doorway set at right on 5-bay elevation to Drumoyne Drive - tall architrave, gabled hood shares main eaves level; small-paned bipartites with top hoppers; attic window faces Langlands Road; projecting eaves; slated roof. The setting of the building includes the early 20th century hospital building, a large two-storey sandstone property to the east (LB33300), as well as Langlands Road and Elder Park to the north, and two-storey terraced houses to the south and west.	The building is listed for its historic interest as the site was formerly used as a hospital. The setting of the asset, especially its proximately to the Category A listed hospital block (MM010) positively contributes to the heritage value of the asset as together they reflect welfare facilities within Govan. This heritage asset is of **medium** value.	Medium	255362	666627
MM024	Elder Park, Cottage	Category B Listed Building	LB33302	Early Modern	See the description of the heritage asset and its setting in Section 5.11.2.4 above.	The cottage is listed for its historic interest as it represents the former use of the land surrounding Fairfield shipyard and Elder Park, as well as the later conversion of the area into park by Isabella Elder. The setting of the fragments within Elder Park, the former ground of Fairfield House and the cottage therefore positively contributes to the heritage This heritage asset is of **medium** value.	Medium	255360	666613
MM025	Elder Park, Fragments of Linthouse Mansion	Category B Listed Building	LB33303	Early Modern	See the description of the heritage asset and its setting in Section 5.11.2.4 above.	The building fragments are listed for their architectural interest as the segmental-arched tripartite opening has numerous parallels in Hamilton's work, including the Façade of the Gallery of Modern Art on Queen Street, Glasgow. The setting of the fragments within Elder Park and the wider industrial setting of Govan positively contributes to the heritage value of the asset This heritage asset is of **medium** value.	Medium	255221	666432
MM026	Elder Park, Statue of John Elder	Category B Listed Building	LB33305	Early Modern	See the description of the heritage asset and its setting in Section 5.11.2.4 above.	The statue is listed for its historic interest as it was the technological advances made by John Elder that played a vital role in the development of shipbuilding, and likely is one of the reasons that the Clyde reached the forefront of the world shipbuilding industry. John Elder was also model employer concerned about the welfare of his workforce and their families. He, along with his wife, were subsequently held in high esteem amongst the working-class population of Govan. Located in Elder Park, the setting of the statue positively contributes to the value of the statue as it relates to legacy of John and Isabella Elder. This heritage asset is of **medium** value.	Medium	255232	666456
MM027	1345 Govan Road, Southern General Hospital, (Former Govan Poorhouse Hospital Block)	Category B Listed Building	LB33307	Early Modern	The building was designed in 1867 by James Thomson and built in 1872. James Thomson (1835-1905) was a Glasgow based architect with one of the largest practices in Scotland. EXTERIOR: 2-storey, 23-bay symmetrical former poorhouse hospital block with iron-crested French-roofed pavilions and small square tower over shallow advanced 7-bay centrepiece (now part of Southern General Hospital, 2012). Snecked, stugged and squared ashlar with polished dressings, unmargined windows, horizontal bands between floors, small-paned sashes; centrepiece has alternate ground floor windows bipartite, segmental-arched at 1st floor, round-headed lights in pavilions; pilastered tripartite doorway, central, painted, now with modern doors; corniced stacks, slate roofs (finialed and leaded axial platform at S end of main roof). Rear elevation similarly treated, large rear wing also with iron-crested French roofs. The setting of the asset comprises the wider site of Southern General Hospital with modern buildings dominating the view from the building.	This building is listed for its architectural interest and forms part of the Southern General Hospital, one of the finest surviving examples of the large-scale poorhouses built in the latter part of the 19th century. This building was originally the hospital for the Govan Combination Poorhouse and is distinctively decorated with a French-pavilioned roof tower and end bays. This decoration echoes that used in the main former poorhouse building in the complex, now the administration block to the current hospital (see separate listing). The building is also listed for its historic interest as the Southern General Hospital was originally the Govan Combination Poorhouse and was built to replace previous poorhouse premises nearby. Although some parishes in Scotland had poorhouses before 1845, it was after the Poor Law (Scotland) Act of that year that most were built. This Act set up a Central Supervision Board to administer poor relief throughout the country, in an attempt to standardise the care provided. The great majority of the larger poorhouses have been demolished in the 20th century. This building is therefore one of the few large-scale poorhouses to survive. The setting of the asset within the wider setting of Southern General Hospital positively contributes to the heritage value of the asset. This heritage asset is of **medium** value.	Medium	254376	665497
MM028	87,91 Holmfauld Road, Linthouse Buildings	Category B Listed Building	LB33309	Modern	This is a building of three storeys which contains a few links with the old Linthouse mansion-house. In 1920 it was decided to demolish the old mansion-house which had served as offices for forty-five years and as a canteen and Welfare centre for five. The building which had been found to be too small, was hampering work in the yard. The present administrative block, with its frontage to Homefauld Road, had been in use from July 1915. The building was built for Alexander Stephens of Linthouse in	The building is listed for its architectural interest as some of the solid mahogany panelled doors and a fireplace from the mansion-house are still in the same position as well as the employment of the Considere reinforced concrete system. The asset is also listed for its historic interest as the former site of the Linthouse mansion-house, the portico of the which now stands in Elder Park.	Medium	254475	665839

MM Number	Name	Designation	HES Reference Number	Period	Description of the asset	Statement of heritage value	Value	Easting	Northing
					1914. The present structure consists of a reinforced-concrete-frame with redbrick walling, the frame uprights are treated as giant pilaster strips, with a cornice above the ground floor. The building is located on a quiet road leading to an industrial estate, it is surrounded by a combination of residential and industrial properties along with an open area of land to the east.	The industrial setting of the building positively contributes to the heritage value of the asset as it reflects the later use of the Linthouse site as shipyard. This heritage asset is of **medium** value.			
MM029	200 Shieldhall Road, Drumoyne Primary School, Janitor's Lodge Gatepiers and Boundary Walls	Category B Listed Building	LB33312	Modern	This building was built by the Master of Works Department of Education Authority of Glasgow, between 1929-31. It is a large symmetrical school, based around a U-shaped plan about a playground, with wide central range with centrepiece. The Harled janitor's lodge at the south-east is presumably part of original composition, but it is plainer in design. The building is set back from Shieldhall Road to the south within large open grounds. It is surrounded by residential properties on the east and west and Elder Park recreational grounds to the north.	This building is listed for its architectural interest a prime example of early 20th century architecture. The urban and residential character of the building's setting positively contribute to the heritage value of the asset as they reflect the functional and social use of building. This heritage asset is of **medium** value.	Medium	254472	665805
MM030	9 Skipness Drive, Linthouse/St Kenneth's Church including Original Church Hall and Church Officer's House	Category B Listed Building	LB33313	Early Modern - Modern	Designed by James Miller between 1899-1900. The building was an Arts and Crafts church, with a halls and church officer's house flanking the eastern side. It was then altered in 1933 by Keppie and Henderson to provide new organ chamber. The hall to the west was added 1953 by John S Boyd, the Scottish architect. It is built of stugged red ashlar with polished dressings, with a slate roof. EXTERIOR: Stugged red ashlar with polished dressings. Slate roofs. Church: gabled main elevation to road flanked by battered square entrance towers fronting aisles, and each with off-centre doorway and topped by finialed and leaded ogee-domed open cupola; main (3-bay) gable with key-stoned main doorway central (2-leaf timber doors with iron hinges) set in columned and arched doorpiece, gallery windows set in giant scale Venetian window derived feature full width of gable and reaching into gable-head; skews; finialed decorative axial ventilator. Original hall: has mullioned small-paned windows to E flank (Hutton Drive), gable to Skipness Drive with kneeler skewputts, finialed axial ventilator; linked to church by archway facing Skipness Drive. Church officer's house: at S end of hall, fronting Hutton Drive; twin-gabled 2-storey elevation with door left, mullioned domestic-scale 1st floor windows, skews with kneeler skewputts, corniced square stack over front angle at right. Set behind decorative wrought-iron railings. The setting of the building comprises red sandstone four-storey tenements to the north, east and west. The view to the south is open and includes the gardens of the tenement properties adjacent to the building.	The building is listed for its architectural interest. The value of the building derives from its use as an Ecclesiastical building in use from the late 19th century. The memorial stone was laid 24 June 1899 and the church itself opened 5 April 1900. The setting of the church within a residential area surrounded by 19th and 20th century tenements positively contributes to the heritage value of the asset as they are possibly contemporary. This heritage asset is of **medium** value.	Medium	254776	665727
MM031	65-69 (odd Nos) Golspie Street, Former Hill's Trust School	Category B Listed Building	LB33339	Early Modern	School designed by James Thomson of Baird and Thomson in 1874. It is a severe Italianate, two-storey school. The building follows a L-plan and includes a three-storey bell-tower and janitor's house. It is built of ashlar with a rubble rear. EXTERIOR: Golspie Street elevation: 2-storey, 9-bay. Central arched entrance between Doric columns, entablature, corbelled balustraded balcony in front of 1st floor tripartite window. Square tower above has blank rubble panel (formerly with inscription?) and belfry, louvres now blocked. Wooden eaves, slate roof and weather vane. 4 bays to either side with 8-pane sash and case windows. N wing: 2-storey, 6-bay, 3rd bay ground floor has tripartite pilastered door and dentil cornice. Janitor's House: 2-storey, 1-by 3-bay, central pedimented door, bipartite windows and bipartite dormers with skewputts. Slate roof. The setting of the building includes modern flats on Goslpie to the north and north-west, and then red-brick apartments to the west and south.	The building is listed for its historic interest, with the heritage value of this asset deriving from its association with the use of the site as a school from the 18th century onwards. It is recorded that Abraham Hill, a Govanite turned Wolverhampton merchant, endowed the trust in 1757 with $200 to buy land the rent from which paid a teacher to teach free 10 boys and girls from the poorest families of Meikle Govan. By 1869 increasing land values made possible a new and larger school, later acquired by Govan School Board. The setting of the building within the urban townscape surrounded by modern properties negatively contributes to the heritage value of the asset. This heritage asset is of **medium** value.	Medium	253815	665802
MM032	705, 707 Govan Road, Return Elevations To Broomloan Road, Former Savings Bank, Govan Branch	Category B Listed Building	LB33342	Modern	Designed by Eric A Sutherland in 1906-7. It is a four-storey, four by four-bay ashlar building with identical elevations to Govan Road and Broomloan Road and prominent corner bay. Highly decorative with polished granite Doric columns flanking the entrance. EXTERIOR: Ground floor, polished granite, corner entrance with Doric columns. Rusticated arcade contains 4 arched windows to E and 3 arched windows and a stairdoor to N. 1st floor channelled ashlar with projecting corner oriel flanked by large, sculptured panels of the Royal Coat of Arms. Giant paired Corinthian columns rise through 2nd and 3rd floors between the corner oriel and the advanced end bays, which have 2nd floor balconies and 3rd floor open segmental pediments. Small windows between columns have cornices and open segmental pediments at 2nd floor architraves at 3rd floor. All windows frames are modern. Entablature and unusual corner turret wash-house. Flat roof serves as a "back court". Interior modernised. Located on Govan Road the setting of the building includes a modern residential estate to the north, though this is heavily screened by a line of trees. The remainder of the setting comprises six-storey modern red-brick apartments on the east and west sides.	The building is listed for its architectural interest as it was designed by Eric Alexander Sutherland Born at Whiteburn, West Lothian on 11 June 1870, Sutherland was educated at Glasgow Academy. He was articled to Campbell Douglas & Sellars in 1887 and remained with Campbell Douglas & Morrison after Sellars's death in 1888. During those years he attended classes at Glasgow School of Art. He was admitted LRIBA in the mass intake of 20 July 1911, proposed by John Bennie Wilson and the Glasgow Institute of Architects, of which he had recently been made a member; and was advanced to FRIBA on 23 October 1933. The setting of the asset within the urban townscape does not contribute to the heritage value of the building. This heritage asset is of **medium** value.	Medium	254171	666091

MM Number	Name	Designation	HES Reference Number	Period	Description of the asset	Statement of heritage value	Value	Easting	Northing
MM033	Near 801 Govan Road, Junction With Burleigh Street, Sir William Pearce, Statue	Category B Listed Building	LB33343	Early Modern	Designed by Onslow Ford in 1894. The statue depicts a bronze figure of John Pearce holding a plan. It is situated on a square granite plinth with consoled base and dentil cornice. The setting of the asset on Govan Road opposite the Pearce Institute (LB33352) contributes to the historic value of the statue as both assets reflect the important role of Pearce within the Govan community both as shipyard owner and later a local member of government.	The statue is listed for its historic interest and assigned group value with 801-5, 840 and 868 Govan Road Sir William Pearce born 1835 at Brompton, Kent, became general manager of Napier's Yard, Govan in 1863 and was the partner in John Elder and Co from 1869 before becoming sole proprietor of Fairfield shipyard in 1878. Pearce was Govan's first MP in 1885, a baronet in 1887 and died in 1888. The setting of the statue on Govan Road, with the Pearce Institute to the south positively contributes to the heritage value of the asset due to their associative value. This heritage asset is of **medium** value.	Medium	254133	664997
MM034	801, 805 Govan Road, 2, 4 Burleigh Street, Cardell Halls and Public House	Category B Listed Building	LB33344	Early Modern	The building is dated to 1894. It is a Scots Baronial with traditional detailing gusset building. Comrpising two-storeys and attic, it is built of red coursed rubble. The façade includes a Jacobean stack, scalloped skewputts, arrow cross-slit. It includes a depressed arched and columned door with elaborate cushion capital and carved dog while a sculptured cat clings to the cornice. The setting of the asset comprises Govan Road with views to the south including the Pearce Institute (LB33352), and Sir William Pearce Statue to the east (LB33343). These assets reflect the wider character of Govan and is roughly contemporary with these two buildings which it is assigned a group value with.	This building is listed for its architectural interest and historic value as a Public House formerly the Govan Conservative Association Halls. The carving is similar to that on 816-8 Govan Road (LB33351) by Derwent Wood and Johan Keller. The setting of the building within the central townscape of Govan, especially southwards onto Govan Road contribute to the heritage value of the asset. This heritage asset is of **medium** value.	Medium	254159	664943
MM035	831 Govan Road, St Anthony's RC Church	Category B Listed Building	LB33345	Early Modern	Designed by John Honeyman in 1877-8 and opened in 1879. It is a Byzantine style church, built from coursed rubble with red ashlar polychrome bands. Features include a Romanesque arcade to gallery, columns with cushion capitals, a usped rose window flanked by blind arches and 2 quatrefoils in gable end. The chancel has semi-circular domed apse, lined with coloured marble panels to dado, and stencil decoration above. Round headed lancets with good stained glass, but with simpler stained glass side windows.	The building is listed for its architectural and historic interest, particularly as an Ecclesiastical Building in still in use as such. The setting of the asset comprises Govan Road with views across to the Former Lyceum theatre (LB33355) on the north side of the road as well as modern red-brick apartments. The remainder of the setting to the south, west and east consists of residential and commercial properties. These aspects of the buildings' setting do not contribute to the heritage value of the asset. This heritage asset is of **medium** value.	Medium	254251	665798
MM036	881, 883, 885, 887 Govan Road, 2, 4 Shaw St	Category B Listed Building	LB33346	Modern	Frank, Burnet and Boston, 1900. Glasgow-style tenement with public house, 4-storey and attic, red ashlar with projecting corner bay. Ground floor public house and shop front, altered. Govan Road elevation, canted oriel rises through 1st, 2nd and 3rd floors, corbelled balcony over 3rd and wide arched window in dormer with stone finial. Main 1st floor windows have roll-moulded arrises, 2nd and 3rd floor depressed ogee, lipped lintels. Tall wallhead stack with adjoining segmental arched dormer breaking eaves. Bipartite pedimented dormer with carved tympana adjoins stack at left, corbelled out from 3rd floor. Corner bay, corbelled out from 1st floor, has plain windows, corbelled balcony at 4th floor and hexagonal slated roof with iron finial. Elevation to Shaw St similar with S bay oriel through 1st, 2nd and 3rd floors, simple balcony and small dormer, 2 semi-curvilinear pedimented dormers adjoining 2 wallhead stacks. Slate roofs, All windows are modern pivot but in keeping with the original glazing pattern. The setting of the buildings includes yellow sandstone tenements to the west while the remainder of the buildings are red sandstone tenements.	The building is listed for its architectural interest as it was designed by the architect firm Burnet, Boston & Carruthers in 1900. Frank Burnet (1846-1923) was born in Melrose, Roxburghshire and studied architecture at Glasgow School of Art. He set up on his own as an architect and property valuator in 1879, at 65 West Regent Street, and in 1890 he was joined by William James Boston (1861-1937), as Burnet & Boston. They later assumed their former apprentice, James Carruthers (b. 1872), as a third partner in 1901, and trained the future tenement architect, John Nisbet. The firm produced 540 tenements from 1883-1906. Burnet & Boston's other work includes warehouses, banks, factories, schools, churches and commercial buildings, with sculpture produced by WK Brown, J M Sherriff and others. The setting of the asset amongst the contemporary yellow sandstone tenement buildings positively contributes to the heritage value of the building as it contributes to the character of the area and reflects the historic value of tenement flats to Glasgow. This heritage asset is of **medium** value.	Medium	254237	665798
MM037	638-646 (even Nos) Govan Road, 3 Napier Street, Napier House	Category B Listed Building	LB33348	Early Modern - Modern	W J Anderson, 1898-9. Modern Movement manner 4 and 5- storey, concrete model lodging house with ground floor shops arranged in 4 sections. Front clad in red ashlar, ground floor shop with polished granite facade. Elevation to Govan Road: 1st floor: small transomed windows, 2 oriels rise through 2nd and 3rd floors from corbelled balcony, separated by large cross window and smaller recessed windows. Gabled attic dormers and corner finials. Lower 3-bay section to E has 2 corbelled oriels square at 1st, canted above, rising through 1st, 2nd and 3rd floors. 1st floor mullioned windows with curvilinear heads. Panel between incribed "WO". Corbelled cornice at 3rd floor cill-level. Wallhead stack. This section heightened in 1905 by George Simpson for a telephone exchange. Napier St elevation: 1st floor cross windows, 2nd floor basket arched cross windows, 3rd floor small deeply recessed windows, 4th gabled attic dormers. Small 16th century style Scots windows and panel over stair door. Corbelled chimney breast. 4-bay section to S, concrete facade on 3 lower floors. Large windows at ground floor. Deeply recessed windows with thick transoms and mullions at 1st and 2nd floors. 4th floor, ashlar (now painted), 4 pedimented windows, 2 segmental, inscribed WO/AD/1898. Block at rear 3 by 5-bay, concrete facade. Ground and 1st floor separated by plain pilasters, ground floor large windows, 1 bow, and door. 1st and 2nd floors bipartite to W and tripartite to N, small, recessed windows at 4th floor. Parapet. End bay projects at an angle with small windows.	The building is listed for its architectural interest as an early concrete floored and walled building without reinforcement. It was commissioned by William James Anderson an architect from Dundee. Of note is Anderson's appointment as Director of the Architectural Department at Glasgow School of Art in 1894 at the early age of thirty. Anderson's principal client was The Fireproof Building Company, the principal of which was a Mr Orr, a pioneer of pre-Hennebique reinforced concrete construction based on the use of steel beams, old rails and barbed wire. Orr was his own structural engineer and Anderson's superintendence correspondingly limited. In 1898 there was a partial collapse of the floors of listed building (Napier House in Govan Road) which killed five of the men working on it. At the inquest the jury found that insufficient steel beams had been specified for the floors, but Hislop and Anderson's friend Alexander Wright's recollection was that the collapse resulted from a combination of a bad mix in the concrete and too early removal of the shuttering. Anderson suffered a nervous breakdown and had to become a patient at Gartnavel where he committed suicide with a razor on the evening of 25 March 1900. The building therefore derives its heritage value from its connection to this event and its architectural history.	Medium	255096	665626

MM Number	Name	Designation	HES Reference Number	Period	Description of the asset	Statement of heritage value	Value	Easting	Northing
					Although the area immediately surrounding the building is open with views south towards Govan Road, the wider setting of the building includes modern residential properties on all sides.	The modern and heavily developed setting of the building does not contribute to the heritage value of the asset. This heritage asset is of **medium** value.			
MM038	784-796 (even Nos) Govan Road, New Govan, formerly St Mary's, Church Hall and Shops Below	Category B Listed Building	LB33349	Early Modern	Designed by Robert Baldie in 1873. The building is a two-storey snecked rubble gothic block containing shops under church hall and church officer's house. The ground floor to Govan Road is concealed behind modern cladding, but the gothic door survives at Greenwell Street. House at W end, 1st floor and attic of gusset. 1st floor sash windows under false pointed arches with trefoils. Cornice broken by 3 segmental arched dormer windows with fleur de lis finials. Oculus in dormer at head of gusset. 1 ridge and 2 wallhead stacks; slate roof. Hall has 3 pairs of 3 lancets facing Govan Road linked by a continuous hoodmould. E elevation blank rubble. Plain interior. Behind hall: 2-storey rubble and brick extension, and a square stone tower, with eaves cornice, large wooden belfry. This replaced the original 150-foot spire. The setting of the asset includes Govan Subway Station to the south and several commercial properties to the east and west, including Govan Cross Shopping centre.	The building is listed for its historic interest as St Mary's Church Hall on the first floor served as an ecclesiastical building but was also the original home of Fairfield school. This school was designed by John Honeyman and built in 1873 as St Mary's Hall Public School. Although it was managed by the Govan Parish School Board it was paid for using funds from Abraham Hill's Trust. In 1878 it was renamed Fairfield Public School before becoming Fairfield Primary School in 1949. The heritage value of the building also derives from its architectural interest as some of the carved details on the building were by Charles Benham Grassby (1834-1910). The central location of the building within a largely urban along Govan Road does positively contribute to the heritage value of the asset as it reflects the original purpose of the building to serve the Govan community. This heritage asset is of **medium** value.	Medium	255603	665581
MM039	Govan Road, Govan Cross Drinking Fountain	Category B Listed Building	LB33350	Early Modern	Designed and produced by Cruikshanks and Co, Denny Iron Works in 1884. The cast-iron drinking fountain shows a a small boy on a rock in an upturned dish, which is enclosed by a hexagonal arcade. It includes six cast-iron columns with bell capitals and inward-facing mythological beasts carry drop-traceried cusped arches topped by brattishing and plaques with the Arms of Govan; Masonic and Oddfellow symbols and a dedication to John Aitkin, The decorative roof is also of an elaborate fish-scale pattern. The setting of the asset includes the Clyde and Riverside Museum to the north, Former British Linen Bank, and Flats (LB33351) to the west, and Govan & Linthouse Parish Church (LB33358) to the east. Within an open area of the streetscape.	The heritage value of the fountain is associated with the age of the drinking fountain, which was produced by Cruikshanks and Co, Denny Iron Works in Stirling. The fountain itself was dedicated to John Aitkin who was the first Medical Officer of Health for the Burgh of Govan. The setting of the fountain within a central point of Govan positively contributes to the heritage value of the asset. This heritage asset is of **medium** value.	Medium	255349	665767
MM040	908 Govan Road And Return Elevation to Mckechnie Street, County Bingo Social Club, Former Lyceum Cinema	Category B Listed Building	LB33355	Modern	Designed by C J McNair and Elder between 1937-8. It is a streamlined International Modern suburban super-cinema, later converted to bingo hall and cinema in 1974, and closed 2006. The building is strikingly positioned to fully exploit corner site with coloured brick faience and glass façade fronting circular foyer with void behindWide curved corner entrance with 5 broad doors and decorative tile banding under full-width cantilevered canopy giving way to 5 tall, back-lit, Cristol glass-block windows divided by sky-blue terracotta-tiled, reinforced concrete mullions (now, 2008, covered with banner) and surmounted by further canopy. Auditorium, aligned E-W some distance from entrance façade. FURTHER DESCRIPTION: short S elevation to Govan Road tiled below canopy, brick above, with large film hoarding panel and vertical "Lyceum" sign (altered to read County Bingo). Long E elevation to McKechnie Street tiled with simple Art Deco doors at ground floor, large hoarding panel in blank brick wall above. High concrete block (set back at E) with 4 pilaster strips houses projection room. INTERIOR: (partly seen 2008). Many original features including light fittings survive. Glazed entrance doors lead to circular foyer (partitioned 1974) with geometric patterned terrazzo floor. Steps lead from foyer to large, streamlined auditorium. Stalls now refitted for bingo. Ornate scrollwork to grilles flanking screen. Information from previous list description: other half of foyer with circular frieze depicting Walt Disney characters; balcony with original seating, simple decoration. Projection room has projector base, 1938 lighting board (F H Pride, Illuminations and Electrical Engineers) with brass handles and dials built into wall and Hewittic Rectifier in Battery Room. The setting of the asset facing south and south-east onto Govan Road is the primary view from the building and contributes to the heritage significance of the asset as it reflects the building's prominent location within the Govan streetscape.	The building is listed for its architectural and historic value. It was designed by renowned cinema architects, CJ McNair and Elder. The Lyceum opened in December 1938 and was built to seat 2,600. It is the best preserved example of McNair and Elder's cinema work. The heritage value of the building derives from the fact that the Lyceum is an important and rare example of a streamlined International Modern super-cinema. It forms an important part of the streetscape in Govan and it is a good example of cinema architecture in a city which was closely associated with the type, but where examples with this level of intactness are increasingly rare. The interior contains many surviving features of interest and continues the streamlined design of the exterior. The architects, Charles John McNair and Robert Elder, had entered into partnership with Glasgow entrepreneur and cinema exhibitor George Urie Scott early in the 1930s. Together they formed the Cinema Construction Company, soon becoming one of the most prolific cinema design companies in Scotland, producing designs for independent cinemas as well as the ABC chain. Stylistic changes within the McNair and Elder partnership lead to the conclusion, based also on anecdotal evidence from Robert Forsyth a junior draughtsman with the practice at the time, that Elder was responsible for most of the designs, especially the interiors. The setting of the asset along Govan Road reflects the building's prominent location within the Govan streetscape which positively contributes to the heritage value of the asset. This heritage asset is of **medium** value.	Medium	255335	665769
MM041	2 Water Row, Govan Cross, New Govan Church of Scotland, Former St Mary's Church.	Category B Listed Building	LB33358	Early Modern	Designed by Robert Baldiein 1873. The Gothic church includes a three-gable facade, made of snecked rubble. The wide central gable contains three pointed arched doorways with chevron panelled doors and geometrical tracery in tympana. There is a Celtic cross finial to the south gable, but this is missing from north gable. The building has a slate roof and small square-section louvred bell tower with steep pyramidal roof and iron finial. Slate roof and small square-section louvred bell tower with steep pyramidal roof and iron finial. Side elevations rubble with 5 tall geometric traceried windows, simple stained glass and oculus. Rubble rear contains small rose window. Interior: horseshoe gallery on bell-capital cast-iron columns. Ceiling at rear of gallery carried by 4 stiff leafed-capital iron columns. Prominent organ behind wooden pulpit. Flat ceiling divided into panels by timber beams springing from corbels with dogtooth moulding.	The building is listed for its architectural and historic interest as an ecclesiastical building still in use as such. The church contains the congregations of and some plaques and windows from St.Columba's, Fairfield, St. Kiarans/Dean Park, and Trinity, Summerton Road Churches. The heritage value of the church therefore derives from the religious use of the space by several groups within Govan. The setting of the asset within the busy townscape of Govan contributes to the heritage value of the asset as it reflects the central role of the church within the local community. This heritage asset is of **medium** value.	Medium	255250	665783

MM Number	Name	Designation	HES Reference Number	Period	Description of the asset	Statement of heritage value	Value	Easting	Northing
					The setting of the building includes Govan Road to the south with Govan Subway station to the south-east. The views to the north and east are open towards the Clyde and the Riverside Museum on the north bank. The setting to the north-west includes Govan Cross Drinking Fountain and Former British Linen Bank, and Flats (LB33351).				
MM042	18,20 Orkney Street Govan Police Building, Former Govan Municipal Buildings	Category B Listed Building	LB33361	Early Modern	Designed between 1866-7 byJohn Burnet. The building is a two-storey, 11-bay painted channelled ashlar. The four bays to south are a later addition: The entrance hall has two marble Corinthian columns dentil cornice and cast-iron scrolled stair banister. Also small cast-iron spiral staircase. The building also includes a 1898, -threestorey brick with red sandstone margins prison block to the rear. This prison blocks contains 40 cells on either side of central top-lit hall. The setting of the building comprises modern residential properties.	The building is listed for its historic and architectural interest as a fine example of public architecture. The building was largely restored following a fire which destroyed a considerable part of the building in 1882. Notable features include that the courtroom is partitioned and has a false ceiling. The setting of the asset is largely modern residential properties and therefore makes a negative contribution to the heritage value of the asset. This heritage asset is of **medium** value.	Medium	255129	665828
MM043	5,7,9 Water Row Former YMCA	Category B Listed Building	LB33362	Early Modern	Designed by William Tennant in 1897. The building comprises four-storeys and an attic, it is built of red ashlar. There is a string course over each storey. The façade onto Govan Rpad includes a parapet with two pedimented dormer windows, ball finials, and a central Venetian dormer window with segmental pediment. The setting of the building includes Govan Road to the south with several commercial properties and red-brick flats to the south of this. The views to the north and east are open towards the Clyde and the Riverside Museum on the north bank.	The building is listed for its architectural and historic interest as the Young Men's Christian Institute (sic D of G) had the ground floor shops while the 1st floor consisted of reading rooms. It is located to the north of Former British Linen Bank, and Flats (LB33351). The setting of the asset, especially to the north, negatively contributes to the heritage value of the asset as it is heavily built up comprising several modern buildings. This heritage asset is of **medium** value.	Medium	255788	665525
MM044	Dumbarton Road, Whiteinch, St Paul's Roman Catholic Church including Boundary Walls, Gatepiers, Gates and Railings	Category B Listed Building	LB48412	Modern	Reginald Fairlie & Partners, 1957-60; dalle de verre stained glass by Gabriel Loire of Chartres. Basilican-type church with plain rectilinear detail to 5-bay flat-roofed narthex and 6-bay, pitch-roofed nave with low side-aisles. Red sandstone ashlar and red brick. Base course. Stepped, segmentally-arched, voussoired openings. Raked cills and stone and concrete mullions. NE (PRINCIPAL) ELEVATION: symmetrical. Tall slightly advanced 3-stage tower to centre bay with steps up to square-headed, part-glazed 2-leaf panelled timber door below statue of St Paul on corbelled base giving way to tall tripartite window, all in tall stepped segmental panel; 3rd stage with small tripartite opening and pedimented gablehead with tall corbelled cross and flat roof behind; each return with wide-centre tripartite (all 3rd stage openings timber-louvered). Lower flanking bays each with segmentally-arched stepped doorway over square-headed door as above, and small tripartite window over. Further set-back brick outer bays, that to left with 2 small narrow lights at ground and taller single light above, that to right with window at ground. SW ELEVATION: broad gabled elevation with full-height, 9-light, bowed sanctuary window (see stained glass) and low flanking aisles. NW ELEVATION: projecting gabled side chapel with tall tripartite window in penultimate bay to right, broad horizontally-aligned 5-light clerestorey window to outer right and tall tripartite clerestorey windows to left. Link to presbytery at outer left and single storey, flat-roofed extension in re-entrant angle to right. SE ELEVATION: variety of elements largely detailed as NW elevation but including additional flat-roofed bay (Chapel of St John Ogilvie) to right. Mostly abstract stained glass (figurative glass see below). Modern sheet metal roofing material. Deep ashlar-coped skews. Cast-iron downpipes with decorative rainwater hoppers. INTERIOR: dark and rectilinear with dramatic colour from stained glass. Nave with shallow-vaulted ceiling, squat brick piers dividing bays, bow-fronted galleries to NE and SE side chapels, timber pews, low side aisles and carved 'Stations of The Cross' below clerestorey windows. Panelled organ housing on polygonal columns to NW side chapel. STAINED GLASS: by Gabriel Loire. 9-light sanctuary window panels depicting life of St Paul. 3-light window with Virgin and Child to NW. Abstract designs to nave and clerestorey. Baptistry to NW with cupola depicting Dove of Peace (also in dalle de verre style, see Notes). BOUNDARY WALLS, GATEPIERS, GATES AND RAILINGS: low saddleback-coped brick boundary walls with inset railings and dry-dash boundary walls. Square-section, flat-coped brick gatepiers and decorative ironwork gates. The setting of the asset includes another church immediately north, yellow sandstone tenements to the west and modern flats to the south and east	The building is listed for its architectural interest as Gabriel Loire's stained glass within the building is the principal reason for the listing. The stained glass is produced in the 'dalle de verre' (or 'paving stone' glass) style, with thick glass pieces set into concrete 'tracery'. His other commissions for glass include work at the Roman Catholic Archiepiscopal Chapel at Greenhill Gardens, Edinburgh, and in Glasgow, Our Lady of Perpetual Succour, Broomhill, and St Augustine's, Milton. The adjoining presbytery was converted from Jordanvale House in 1904. The setting of the asset within an residential area comprising tenement flats and another church positively contributes to the heritage value of the asset. This heritage asset is of **medium** value.	Medium	255459	665700
MM045	36-40 Golspie Street & 16 Garnmouth Street, Salvation Army Citadel	Category B Listed Building	LB49789	Modern	Designed by John Hamilton and dated 1903, the Junior Hall was sympathetically enlarged 1906. It is a single-storey building and gallery, with 7-bay rectangular-plan. It includes free Renaissance details recording it as the Salvation Army Citadel. The principal elevation is to the east and includes a 3-bay gable containing Large Hall with central slightly advanced principal entrance with open pediment containing Salvation Army Crest with 'BLOOD AND FIRE' motto. Above this is the lettering 'THE SALVATION ARMY.1903.' surmounted by pair of 4-light mullioned and transomed windows.	The building is listed for its historic and architectural interest, and it remains in use as an ecclesiastical building. It is one of the more impressive of Hamilton's Salvation Army commissions in Glasgow. In particular, this building is indicative of the missions established by the Salvation Army in socially excluded urban areas. The heritage value of the building derives from its contribution to Glasgow's social history. The building was funded by a bequest by James Orr of Glasgow.	Medium	255478	665711

MM Number	Name	Designation	HES Reference Number	Period	Description of the asset	Statement of heritage value	Value	Easting	Northing
					Once part of a dense area of tenements and directly adjacent to a United Free Church and Hall, the area around the Citadel has changed dramatically within the last 50 years. The setting of the building now comprises modern residential properties.	The modern residential character of the building's setting negatively contributes to the heritage value of the asset. This heritage asset is of **medium** value.			
MM046	35 Inchlee Street, 15, 16 Victoria Park Drive South Former Whiteinch Burgh Hall, Former Police Station And Former Fire Station including Boundary Wall, Gatepiers and Railings	Category B Listed Building	LB50283	Early Modern	1894; later additions. Set of Scottish Renaissance public buildings, including burgh hall, police and fire stations on large site bounded by Victoria Park Drive S, Inchlee Street and Medwyn Street. 4-bay, 2-storey with upper breaking eaves, L-plan, Scottish Renaissance burgh hall linked to single storey former police station to S and 3-storey former fire station and accommodation block linked to police station to SE corner of site. Circa 1905 extension to hall in similar style to original to SW. Squared and snecked, bull-faced red sandstone rubble with ashlar dressings. HALL: slightly splayed gable ended entrance elevation to E. Central round-arched doorway with prominent key stone and carved roundels; corniced and balustraded balcony above. Large quadripartite transomed and mullioned window with triangular pediment and inset escutcheon, all set within large recessed, round arch gable apex. Advanced corniced square-plan towers (reduced in height) with prominent single fluted and scrolled corbal to upper section flanking central bay; pedimented doorway to left; advanced single storey piended section to far left with blocking course and bipartite window. N (Victoria Park Drive South) elevation: 4 bays. Curved pedimented doorway to far left; canted bay with single window to right; advanced entrance with door to far right; narrow battered buttresses extending to low eaves course set between each bay. Tall triangular and curvilinear pedimented breaking eaves dormers; transomed and mullioned bipartite windows with moulded cills. Similar breaking eaves dormers to S elevation. Predominantly plate glass in timber sash and case windows. Swept pitched roof; grey Scots slates in diminishing courses; base of (removed) cast-iron roof lantern at centre ridge; coped, ashlar chimneystack to W gable. Cast-iron rainwater goods. INTERIOR: coffered ceiling; good polychrome plaster work; raised stage with chamfered, plaster arch surround. CIRCA 1905 EXTENSION TO HALL: small 2-storey rectangular-plan pitched roof hall linked to 1894 hall to SW. S (entrance) elevation: 3-bay gable end, further round arched entrance bay recessed to left. Bipartite windows flanking narrow central window. Dentilled string course with returns; 1st floor pedimented tripartite window; masonic crest. Arrow point gable apex; corniced ashlar skews and skewputts. Raised lugged margins. Pitched roof; grey slates; 2 louvred ridge lanterns and coped stack to N gable. POLICE AND FIRE STATIONS (1894): single and 3-storey, U-plan police station incorporating block of living quarters to S (restored with upper storeys converted to sheltered accommodation - 2000). Police station entrance to S re-entrant angle; canted porch. Boiler house with pitched, slate roof to N of small courtyard. S Block: 4 bay; string course with down pipe mouldings; band course to upper storey; raised chimney flue detail at wallhead gables to S and E; blind gable to W. Plate glass timber sash and case windows; flush ashlar dressings. Former fire station entrance with raised lintel surround to S central bays (door blocked to sash and case window, mid-20th century). Pitched roof; replacement slates; coped ashlar stacks. Cast iron rainwater goods. BOUNDARY WALL, GATEPIERS AND RAILINGS: low coped boundary wall to N and E; original cast-iron railings and gates. Squared, coped stone piers with square bell caps and ball-finials to gates (N and E). Stepped and coped wall with entrance to police station courtyard to E. Square, coped gate piers with ball-finials to SW corner; cast iron double gate with scroll motifs. Occupying a prominent position on the Southern edge of Victoria Park (opened 1886), building and its setting is now cut off from the park by the A814 expressway. The Whiteinch Conservation Area (rows of villas surrounding bowling green built in the 1880s for workers from the Scotstoun estate) lies one block to the West.	The building is listed for its historic and architectural interest. The Lesser Burgh Hall itself makes distinctive use of Scottish Renaissance details. Despite the loss of its flanking entrance towers and ornate roof lantern, the character of the building remains substantially unimpaired. The complex of buildings as a whole is of historic value in terms of the social and municipal development of Whiteinch. The hall was utilised by St Johns Lodge, Whiteinch between 1895 until its closure in 1964, with the c.1905 extension purpose built for masonic usage. Also of note are the police station's cells which retain their original stone beds. The small fire station, which would have utilised a handbarrow with hose and ladder, is indicated on the OS map of 1892-7. It is not shown on the map of 1908-11 and may have become redundant by that time. The setting of the asset including Victoria Park and the residential area of Whiteinch positively contributes to the heritage value of the asset.This heritage asset is of **medium** value.	Medium	255458	665736
MM047	57 Laurel Street, Crathie Court including Terrace Wall	Category B Listed Building	LB51966	Modern	Ronald Bradbury, designed 1946, completed 1952. 6- and 8-storey, Modernist, flat-roofed, U-plan high-rise block of balcony-access (single occupancy) flats set on sloping site within own grounds. Reinforced concrete frame, later rendering to original pre-cast concrete facing slabs. Continuous, horizontal, open-air cantilevered access balconies to N, E and W with contrasting trim. 3 staircase towers rising above roofline with full-height, long vertical windows and small round nautical windows. Rectangular window openings; replacement timber doors. Rendered terrace wall to ground to S, E and W with later decorative metal screen. Random rubble terrace wall and steps to S. N (ENTRANCE) ELEVATION: off-centre, slightly curved flat-roofed advanced random-rubble porch with, nautical window, timber and glass entrance door with sidelights. Staircase tower behind, with full-length window; raised margins. Recessed, 6-storey wing to right with corner staircase tower. 8-storey wing to left, with corner staircase tower. S ELEVATION: asymmetrical with projecting outer wings. Off-centre stairs lead to slender flat-roofed porch with tall, 8-storey stair tower above with full-length window to right. Balcony to top storey at right. Later flat-roofed extension to far left. Predominantly, replacement plastic windows. Flat and piended roofs. INTERIOR:	The building is listed for its architectural interest as Crathie Court was the first high-rise public housing to be built in Glasgow and its geometric, Modernist form has a significant streetscape presence. The tall vertical stair towers contrast with the long horizontal balconies to create a strong, distinctive design, following precedents in Continental Modernism, but with direct precedents in London County Council high-rise developments. The mix of different height levels within the block create architectural interest and the recent rendering of the original pre-cast concrete facing has not detracted from the strong geometric lines and form of the structure. The tall, staircase tower in the middle of the building provides the link between the 8-storey and the 6-storey wings. Crathie Court was originally designed to provide housing for single women, and the 88 flats continue to house single people (2012). The variation in the heights of the wings was determined by the position of the surrounding buildings and the light that could be gained from various angles. The houses were designed to be heated from a central	Medium	255212	665882

MM Number	Name	Designation	HES Reference Number	Period	Description of the asset	Statement of heritage value	Value	Easting	Northing
					(partially seen, 2012). Original number (88) of single-person flats remain; one 2-bedroom flat (originally caretaker's accommodation). Common room. 3 lift-shafts, stone tiled staircases; some timber painted number boards. Individual flat layouts thought to be as original, including bed alcove. TERRACE WALL TO S: full width coped random rubble terrace wall. The setting of the asset largely comprises residential properties, including several red sandstone tenements and their respective gardens.	boiler, as this was thought to be more efficient that individual coal fires and each flat had a living room, kitchen, bathroom, and a bed alcove. The three tall staircases also had a self-operated lift which lead to the open access balconies. The heritage value of the asset also derives from its historic interest. Dr Ronald Bradbury was the Director of Housing in Glasgow from 1943-1948. Bradbury outlined the design of Crathie Court in 1946 to provide the city with a prototype high-rise model to move forward with its urgent slum clearance programme. Crathie Court is therefore recognised as a landmark development in Scotland's post-war housing programme. The setting of the asset within a residential area dominated by red sandstone tenements therefore positively contributes to the heritage value of the asset as it reflects a period of innovative design and important development in social housing in Scotland. This heritage asset is of **medium** value.			
MM048	Former Greenfield Primary School, Including Janitor's Accommodation, Laundary and Swimming Pool Block, Boundary Walls and Gatepiers, 29 Nimmo Drive, Govan, Glasgow	Category B Listed Building	LB52416	Modern	Dated 1901, Greenfield Primary School was designed by Steele and Balfour in 1899-1900 and constructed in 1901-1902 for the Govan Parish School Board. The date panel and inscriptions Greenfield Public School', 'GOVAN PARISH' and 'SCHOOL BOARD' are found on the principal elevation. The red sandstone building is 3 storeys and basement, with a symmetrical 7-bays to the principal elevation facing Nimmo Drive. The central, 3-bay section is flanked by slightly advanced 2-bay piended pavilions. The basement has arched openings and is semi-sunken and rusticated. The principal elevation has ashlar band courses, pilasters and quoins, with rusticated details. There are base and cill courses, and dentilled eaves. There is clay ridge tiling and finials to the roof. The side and rear elevations are of squared and snecked stone with ashlar window surrounds and quoins to angles. The windows are predominantly 2 over 2 pane with a horizontally set pane to the lower section. There are pedimented, flat roofed entrance blocks for boys (to east) and infants and girls (to west). There is a 3-bay, 2 storey, piended roof, janitor's accommodation adjoining to the southeast. There are segmental pedimented windows breaking the eaves. There is a tall and square two stage boiler chimney stack to the south which is octagonal and corniced at the second stage. Connected at the ground floor to the south of the school is an L-plan section including the former laundry (later used as a gymnasium), and a long, single storey rectangular-plan swimming pool block, with a bulls-eye window to the gable ends, constructed of squared and coursed sandstone with ashlar quoins. The interior was partially seen in 2016. There is a large double height central hall with a hammerbeam roof with timber trusses resting on stone corbels and with a large skylight opening above, galleried at the first and second floors, with an atrium above. The walls are tiled, with a green border, up to dado height in the public circulation and corridor areas, and predominantly timber lined in the classrooms. Decorative scrolled stone consoles support each floor level of the central hall. The pool block interior has a rectangular pool with white tiles and white painted brick walls. There are changing cubicles to the north wall under a blind arcade and shower facilities to the east. There are simple detailed iron roof supports on stone corbels and a timber lined ceiling. There are low coped stone boundary walls with plain cast iron railings, and with square ashlar square gatepiers at regular intervals surmounted with large ball finials forming the boundary to the east, north and west. The building has a prominent street presence within its immediate location. The building is centred on a large grid-street pattern which provides a feeling of spaciousness. The views northwards across the street into the allotments of several tenement flats alongside the semi-detached terraces to the east of the building reinforce the residential character of the area.	The building is listed for its architectural interest. Greenfield Primary School is a good example of a large city board school. The interior of the building retains a significant amount of historic fabric. Its plan conforms to the typical 'central hall' model of school building at the time and remains substantially intact. Of further heritage value is the completeness of the site which also retains its janitor's house, and less commonly compared to the majority of Glasgow's board school, a swimming pool. The school and its ancillary buildings remain largely as built, and this adds to its interest in listing terms. The residential character of the setting of the building positively contributes to the heritage value of the asset. This heritage asset is of **medium** value.	Medium	255492	665724
MM049	1345 Govan Road, Southern General Hospital, Administration Block (Former Govan Poorhouse)	Category B Listed Building	LB33306	Early Modern	James Thomson, 1867-72. Long, symmetrical, 35-bay, 3-storey, roughly T-plan, former poorhouse with distinctive French pavilion-roofed bays and central clock tower (now part of Southern General Hospital, 2012). Coursed, snecked and stugged sandstone with ashlar dressings. Band courses, cill course, dentilled cornice. Raised cills. Variety of later, 20th century, extensions and infill buildings. PRINCIPAL ELEVATION TO E: central, well-advanced, single-storey parapetted entrance bay with Doric portico and canted 3-light windows to corners. Distinctive square-plan 6-stage central clock tower immediately to rear of elevation with louvred bipartite windows to 4th stage and curved gables above with clocks to all faces. Pyramidal-roofed top stage with iron pinnacle. Advanced pavilion bays regularly spaced to elevation, each with iron crested French roofs. Predominantly plate-glass and 4-over 4-pane timber sash and case windows. Grey slates, corniced stacks. The setting of the asset comprises the wider site of Southern General Hospital with modern buildings dominating the view from the building.	This building is listed for its historic and architectural interest as it forms part of the Southern General Hospital, one of the finest surviving examples of the large-scale poorhouses built in the latter part of the 19th century. This building was the central poorhouse and is a prominent and extensive building with a distinctive and elaborate French clock tower and French pavilion roofs. These decorative details add significantly to the building's heritage value, particularly as it was built as a functional building. It was designed with the east elevation forming the entrance elevation to the poorhouse complex. James Thomson (1835-1905) was a Glasgow based architect with one of the largest practices in Scotland. Once situated in every major town and city in Scotland, these large-scale poorhouses have gradually been demolished. This building is therefore one of the few large-scale poorhouses to survive which adds to its heritage value.	Medium	255604	665504

MM Number	Name	Designation	HES Reference Number	Period	Description of the asset	Statement of heritage value	Value	Easting	Northing
						The setting of the building within the wider hospital positively contributes to the historic value of the asset. This heritage asset is of **medium** value.			
MM050	2 Broomhill Avenue and 1-3 (Odd Nos) Broomhill Terrace	Category C Listed Building	LB32288	Early Modern	Circa 1860, in the style of Charles Wilson. Corner tenement block, 3-storey and attic, 8 x 6 bays. Yellow sandstone ashlar, channelled ground floor. Continuous band course over ground floor, cill course to 1st and 2nd floor, eaves band and dentil cornice. 3 entrances at ground. Corner block with full-height canted windows to Broomhill Terrace, bold 6-light. full-height semi- circular plan window to Broomhill Avenue; tall pavilion roof with segmentally pedimented tripartite dormers. Outer bays with full-height canted windows and facetted roof. Concrete tile roof (replacing slate); set-back piended dormers; corniced ridge stacks. The setting of the building comprises tenement blocks to the east and west, the A814 to the south, while the north is dominated by modern high-rise flats.	The building is listed for its architectural interest as it is built in the style of Charles Wilson, a Glasgow based architect. Continental neoclassicism increasingly influenced his work during the 1840s and 1850s, although he also produced work in the Scots Baronial style. The heritage value of the asset is also derived from its group value with LB32289 (MM051). . The setting of the building among the other tenement flats (MM051) positively contributes to the historic value of the asset. This heritage asset is of **medium** value.	Medium	254676	666835
MM051	23-41 (Odd Nos) Broomhill Drive and 1-15 (Odd Nos) Broomhill Avenue, with Gatepiers and Low Boundary Wall	Category C Listed Building	LB32289	Early Modern	Circa 1860. Style of Charles Wilson. 3-storey and attic tenement. Polished ashlar, channelled at ground floor. Sash and case windows throughout. 1st floor windows in flat bays with shell heads and sculpted consoles supporting continuous cornice. ELEVATION TO BROOMHILL DRIVE: 40 bays stepped in slope. 1st, 8th, 13th, 18th, 23rd, 28th, 33rd, 40th bay from N canted with battered plinths. Pseudo pilastraded ground floor windows; ground floor cornice band, 1st floor cill band; continuous main dentil cornice. Mansard roofs in outer bays with tripartite, segmentally pedimented dormers. Low tripartite dormers over Nos 23-27 and No 41 with swept roofs. ELEVATION TO BROOMHILL AVENUE: as Broomhill Drive elevation in 26 bays with turret at N only. 8th, 12th, 17th, 21st, 26th bays canted. Full-height bowed bay with segmentally pedimented dormer over in 1st bay from N. Coped boundary walls. Battered obelisk gatepiers. The setting of the building comprises tenement blocks to the east and west, the A814 to the south, while the north is dominated by modern high-rise flats.	The building is listed for its architectural interest as it is built in the style of Charles Wilson, a Glasgow based architect. Continental neoclassicism increasingly influenced his work during the 1840s and 1850s, although he also produced work in the Scots Baronial style. The heritage value of the asset is also derived from its group value with LB32288 (MM050). The setting of the building among the other tenement flats (MM050) positively contributes to the historic value of the asset. This heritage asset is of **medium** value. This heritage asset is of **medium** value.	Medium	254730	666789
MM052	62, 64 Langlands Road and Return Elevation to Roseneath Street, St Anthony's RC Presbytery	Category C Listed Building	LB33359	Early Modern	1892, with 1909 addition by Fred V. Burke. Asymmetrical 2-storey coursed rubble L-plan presbytery. Gable end to S over depressed arched door and traceried stained glass window. 2-storey canted window to W and bipartites iN recessed bay to E. Quatrefoil and cross finial to apex of gable. 1909 addition at E with 2 depressed arch doors and 1st floor tripartite. Gambrel roof. Side and rear harled. Roseneath Street elevation large transomed and mullioned stair window, 2 bipartites and later oriel. Modern dormer. Rubble rear. Slate roof with 4 stacks. Iron railings, low retaining wall and stone gatepiers The setting of the building includes Govan Cross Shopping centre to the east and its car park to the south. The views to the west and north include several four-storey red sandstone tenement properties.	The building is listed for its architectural interest as an 1892 building with 1909 additions by Fred Vincent Burke, a well-known Scottish architect. The setting of the building along Govan Road does not contribute to the heritage value of the asset. This heritage asset is of **medium** value.	Medium	255222	665735
MM053	27 Broomhill Avenue, Former Balshagray Public School Including Swimming Pool and Janitor's House, Gates, Gatepiers and Railings	Category C Listed Building	LB51044	Modern	Donald Bruce and Edward A B Hay, 1904. Imposing, 3-storey, 12-bay, rectangular-plan, former Board School with symmetrical principal elevation in expressive Roman-Renaissance style with pedimented outer bays. Squared and snecked red sandstone; polished ashlar margins. Base course; cill courses (excluding rear). Channelled corner pilasters; bracketed eaves. To W, long, rectangular-plan swimming pool block with 2-storey former janitor's house adjoined to right. FURTHER DESCRIPTION: PRINCIPAL (N) ELEVATION: channelled rustication to ground floor; deep moulded cornicing between each floor; blocking course. Pedimented outer-bays with wide double-height Corinthian pilasters and engaged columns to windows: square-cut Tuscan to ground, round Ionic to 1st floor and round Tuscan to 2nd floor. Above, moulded round-arched windows with keystones. Slightly recessed central 6-bay section with inscription 'BALSHAGRAY PUBLIC SCHOOL' with '1904' date panels to left and right; further inscription between 1st and 2nd floor 'GOVAN PARISH SCHOOL BOARD'. Raised cills to rear elevation; tall square-plan chimney rising from ground with corniced string courses, breaking eaves at centre right. Advanced central sections to E and W elevations with regularly arranged bi-partite fenestration separated by moulded panels between floors. 'BOYS' entrance to SW angle and 'INFANTS' entrance to rear far left, both with segmental-arch moulding. Additional deep single storey projection to E elevation with blocking course and ball finials. Later, single storey addition to SE angle cutting through former 'GIRLS' entrance. Predominantly 6-pane timber sash and case windows to side and rear elevations. Later replacements to principal elevation. Piended grey slate roofs; crested terracotta ridges. Cast iron rainwater goods. INTERIOR: double-height central hall, galleried at 1st and 2nd floors. Decorative hammerbeam type roof with baluster detail and glazed rooflights. Segmental-arched architraves to doorways. Stairwells to E and W with scrolled iron railings, timber handrails. Tiled dado throughout with green border. SWIMMING POOL AND JANITOR'S HOUSE: Pool with 6-bay entrance elevation to Broomhill Avenue with shaped apex; moulded eaves course and continuous glazed	The building is listed for its architectural interest as the former Balshagray School is a good example of a Glasgow board school. The interior of the building conforms to the 'central hall' model although on a scale significantly larger than the norm. Its plan remains substantially intact and the surviving Swimming Pool with its adjoining Janitor's House is notable. One of two schools designed for the Govan School Board by the respected practice of Bruce and Hay, it forms a significant part of the streetscape. Its exceptional detailing sets it apart, particularly the imposing classical principal elevation designed to persuade the local populace of the school's reliability and respectability. Glasgow has a rich heritage of quality board schools which add much to the architectural character of the city. The 'central hall' model of school building, widespread in Britain between 1873 and 1920, was favoured for providing a light, airy and safe internal space where the school could assemble for lessons, gymnastics and the encouragement of 'school spirit'. At Balshagray, the glazed roof over the huge central hall allows natural light to penetrate the building and the large classroom windows and dividing screens perform the same purpose. To create effective ventilation, the basement of Balshagray contained a fresh air chamber with ducts to pump new air around the building. The stairwells to either end of the hall maintained the segregation of boys and girls as far as possible outwith the classroom. The former Balshagray School was built for Govan Parish School Board by renowned Glasgow architects Donald Bruce and E A B Hay who also built the Church Street Public School for the Board in 1903-04 and made alterations to Bellahouston Academy between 1893 and 1901 (see separate listings). Bruce and Hay also designed some of Glasgow's finest commercial buildings including the former Scottish Co-operative Wholesale Society headquarters on	Medium	254675	666745

MM Number	Name	Designation	HES Reference Number	Period	Description of the asset	Statement of heritage value	Value	Easting	Northing
					timber raised rooflight. 2-bay, 2-storey former Janitor's House to right. Pitched grey slate roof. POOL INTERIOR: rectangular pool with white tiles; white glazed brick walls to gallery height; changing cubicles to S wall. Stone stairs at either end leading to timber-floored deck and viewing gallery. Decorative scrolled wrought iron railings. Cast iron roof supports with pierced quatrefoil detail. GATEPIERS AND BOUNDARY WALLS: forming boundary to S, E and W. Predominantly low, sandstone wall with ashlar coping and scrolled iron railings (repeating pattern inside school). Polished ashlar square-section gate piers with ball finials (one finial missing at Broomhill Drive). The setting of the asset includes the A814 to the south with views towards the Clyde. The remainder of the building's setting comprises modern residential properties.	Morrison Street (see separate listing). The swimming pool at Balshagray is a good example of functionalist design with hygienic white glazed surfaces and natural light provided by the glazed roof. The setting of the asset among modern residential properties and the A814 negatively contributes to the heritage value of the building. This heritage asset is of **medium** value.			

Source: Mott MacDonald 2022

6.2 Gazetteer of Non-Designated Assets and Archaeological Events

Table 6.2: Gazetteer of non-designated heritage assets and archaeological events

MM Number	Site Name	Type	SMR Reference Number	NRHE Reference Number	Period	Description of the asset	Statement of heritage value	Historic Value	Easting	Northing
MM054	Fairfield Shipyard and Engine Works, Fitting-out Basin / Bae Systems; Upper Clyde Shipbuilding Yard; Kvaerner Govan Shipyard	Fitting-out Basin	52478	270305	Early Modern	See the description of the heritage asset and its setting in Section 5.12.1above.	The Fairfield Shipyard and Engine Works, Fitting-out Basin is significant because it reflects the evolution of the site during the second half of the 19th century as the shipyard became the first integrated works of its kind in Britain. The basin is at least one of two surviving fitting-out basins on the Clyde. The other extant basin is located at Clydebank and was part of the Former John Brown Shipbuilding Yard. This basin is Category A listed (LB22993) along with the Titan Cantilever Crane. As such, despite no longer in use the Fairfield Fitting-out basin plays an important role in preserving and reflecting Govan's industrial heritage and because of this it has illustrative value as a marker of the area's identity as the centre of shipbuilding on the Clyde. Overall, this historic interest contributes to the value of the asset. The Fitting-out Basin is broadly contemporary with the Engine Works, where the engines would have been produced and then fitted into the ships docked in the basin. Together they represent the core elements of what was once a world-renowned shipbuilding and marine engineering company and share an associated value. They are important reminders of an industry which once defined the area, helping to tell the story of Glasgow's and Scotland's shipbuilding heritage. However, the historic relationship between the two assets is reduced due to the modern cladding on the north and western façade of the Engine Works (MM007). Moreover, as the basin is no longer in use and surrounded by modern structures relating to the use of the site as a functioning shipyard, it is somewhat overlooked and dominated by the surrounding buildings. Nevertheless, the setting of the basin within the shipyard does positively contribute to the heritage value of the asset. This asset is of **medium** heritage value.	Medium	254617	666100
MM055	Fairfield Shipyard and Engine Works, Plumber's Shops / Bae Systems; Upper Clyde Shipbuilding Yard; Kvaerner Govan Shipyard	Plumber's Shops	52479	270304	Early Modern	See the description of the heritage asset and its setting in Section 5.12.2 above.	The heritage value of the asset derives from its group value with other prominent buildings within former site of Fairfield Shipyard and Engine Works. Located within the centre of the shipyard, the setting of the Plumber's Shop comprises the Fitting-out Basin to the north, the Engine Works (MM007) to the east, and a modern building and carpark to the west. The south of the building faces onto Elder Park, but this is largely blocked by the red-brick wall which lines the perimeter of the shipyard along Govan Road. The setting of the asset in the centre of the shipyard enhances the ability to understand the asset and its relationship with the rest of the shipyard, and therefore positively contributes to the heritage value of the asset. This asset is of **low** heritage value.	Low	254588	665945
MM056	Fairfield Shipyard and Engine Works, Plate Fabrication Shed / Bae Systems; Upper Clyde Shipbuilding Yard;	Plate Fabrication shed	52481	270302	Modern	See a brief description of the heritage asset and its setting within the shipyard in Section 5.12.3 above. The plate fabrication shed is located at the east end of the shipyard. It is aligned roughly north-east to south-west and measures 75m by 175m. The date of the shed is currently unknown.	The heritage value of the asset derives from its group value with other prominent buildings within former site of Fairfield Shipyard and Engine Works. Located to the east of the Fitting-out Basin the setting includes the Engine Works (MM007) to the north and several ancillary structures around this. The shed also looks out onto the Clyde from the north. The setting of the asset in the centre of the shipyard enhances the ability to understand the asset and its relationship with the rest of the shipyard,	Low	254931	665986

MM Number	Site Name	Type	SMR Reference Number	NRHE Reference Number	Period	Description of the asset	Statement of heritage value	Historic Value	Easting	Northing
	Kvaerner Govan Shipyard						and therefore positively contributes to the heritage value of the asset. This asset is of **low** heritage value.			
MM057	Giant Cantilever Crane / Fairfield Shipyard	Crane	13472	79701	Modern	See a brief description of the heritage asset and its setting within the shipyard in Section 5.12.3 above. The Fairfield crane was built by Sir William Arrol and Co. (in collaboration with Stother and Pitt) in 1911 (200 tonnes, upgraded to 250 tonnes c.1941). The crane was given A-listed status in April 1989. The crane was dismantled in 2007 as part of site occupiers BAE Systems' plans to modernise the shipyard. There are four cranes of this kind surviving on the River Clyde; the Finnieston/Stobcross crane, Glasgow (Cowans Sheldon and Co. of Carlisle, Cleveland Bridge and Engineering Co., 1931, 175 tonnes); the former John Brown Shipyard, Clydebank, West Dunbartonshire (Sir William Arrol and Co., 1907, 150 tonnes); the James Watt Dock crane, Greenock, Inverclyde (Sir William Arrol and Co., 1917, 150 tonnes); the former Barclay Curle/North British Diesel Engine Works crane, Glasgow (Sir William Arrol and Co., 1920, 150 tonnes).	The heritage value of the asset derives from its group value with other prominent buildings within former site of Fairfield Shipyard and Engine Works. However, as the asset is no longer extant following its dismantlement in 2007 this asset is of **negligible** heritage value.	Negligible	254680	666160
MM058	Kvaerner Govan Shipyard, New Fabrication Shed / Fairfield Shipyard	Fabrication Shed	13473	79702	Early Modern	See a brief description of the heritage asset and its setting within the shipyard in Section 5.12.3 above. The 19th century fabrication shed is located within the centre of the shipyard to the east of the Fitting-out Basin. It is aligned roughly east-west measuring 155m by 75m.	The heritage value of the asset derives from its group value with other prominent buildings within former site of Fairfield Shipyard and Engine Works. Located to the east of the Fitting-out Basin the setting includes the Engine Works (MM007) to the north and several ancillary structures around this. The shed also looks out onto the Clyde from the north. The setting of the asset in the centre of the shipyard enhances the ability to understand the asset and its relationship with the rest of the shipyard, and therefore positively contributes to the heritage value of the asset.. This asset is of **low** heritage value.	Low	254750	666150
MM059	Meadowside Quay, Meadowside Granaries	Quays; Granaries	11735	244791	Modern	Located on the north bank of the Clyde the quay and granaries once served the important crossing point on the Clyde. The granaries are now demolished.	As the heritage asset is no longer extant, the asset is of **negligible** heritage value.	Low	254800	666400
MM060	Broomielaw, Clyde Foot Tunnel / Finnieston Entrance	Tunnel	46894	167373	Modern	The Clyde Tunnel is a crossing beneath the River Clyde in Glasgow, Scotland for road traffic, cyclists and pedestrians. Two parallel tunnel tubes connect the districts of Whiteinch to the north and Govan to the south in the west of the city. Both sides of the Clyde tunnel are open to pedestrians in both directions. The eastern tunnel is open to cyclists going southbound, and the western tunnel to cyclists going northbound. The setting of the asset includes the Clyde and wider townscape of Govan.	The heritage value of the asset derives from the importance of the Clyde tunnel connecting the districts of Whiteinch to the north and Govan to the south in the west of the city. The setting of the asset along the Clyde positively contributes to the heritage value of the asset. This asset is of **low** heritage value.	Low	254200	666350
MM061	Partick, Meadowside Quay / Clyde Aa Defences; Castlebank Street	Barrage Balloon Site	48096	203598	Modern	A barrage balloon mooring site has been identified from World War II RAF vertical air photographs (NLA 44, 5.24-5.25, flown 27 August 1942) in an area between the railway immediately N of Castlebank Street and Meadowside Quay. The asset and its wider setting has subsequently been redeveloped and new warehouses have been built on the site.	The heritage value of the asset derives from the historic interest of barrage balloon mooring site as a feature from the Second World War. The setting of the asset does not contribute to the heritage value of the site. This asset is of **low** heritage value.	Low	254860	666460
MM062	South Street, Merklands Animals Lairage / Merklands Quay	Warehouse and Storage;	50782	241068	Modern	The Merklands Animals Lairage was situated on the north bank of the River Clyde in the Whiteinch area of Glasgow. It opened in 1907 at a cost to Glasgow Corporation of £86,000 (Riddell 1979: 240-1) to receive stock imported from Ireland and Canada, and it could cope with 2000 cattle and 3000 sheep at any one time. The lairage, at which animals were also slaughtered, is depicted on the 2nd edition of the OS 25-inch map and annotated 'Merklands Foreign Animals Wharf' (Lanarkshire 1913, Sheet 006.05). The Clyde Shipping Co. Ltd. also made use of the facilities, which were closed in 1974 and subsequently demolished. The setting of the asset includes the Clyde and several modern residential properties.	The heritage value of the asset relates to the use of site as an Animals Lairage as it reflects the use of the Clyde as an important means of access for transporting livestock along into the city, The later use of the facilities by the Clyde Shipping Co. Ltd. also reflects the industrial heritage of the area. The setting of the asset on the Clyde positively contributes to the heritage value of the site as it reflects the role of the river in transportation of livestock to the asset. The asset is of **low** heritage value.	Low	254490	666520
MM063	Castlebank St, Meadowside Granary / Meadowside Quay / Whiteinch	Granary	8563	68403	Modern	Meadowside Granary, Castlebank St. The first part of this very large granary was built 1911-13 for the Clyde Navigation Trust, William Alston engineer (£130,000). The capacity of the first part is 31,000 tons, and it is 13 storeys high, 6 by 13 bays. The adjacent quay was built under an Act of 1907. J R Hume 1974. Along Castlebank Steet, there loom the Maedowside Granaries,, Partick's most dramatic structure by far, but which, sadly, closed in 1988. The first granary (of 13 bays and 13 storeys) was built in brick for the Clyde Navigation Trust in 1911-13 by the engineer William Alston. Extended E and W in 1936-7, creating a colossal 34-bay, 13-torey building. In 1960 and 1967 two more granaries were built to the W for what was then the Clyde Port Authority. E Williamson, A Riches and M Higgs 1990. This bulding has been demolished.	As the heritage asset is no longer extant, the asset is of **negligible** heritage value.	Negligible	255020	666410

MM Number	Site Name	Type	SMR Reference Number	NRHE Reference Number	Period	Description of the asset	Statement of heritage value	Historic Value	Easting	Northing
MM064	Linthouse Engine Works, Shipyard / Alexander Stephens and Sons / Holmfauld Road / Linthouse Shipbuilding Yard	Engineering Works; Shipyard	8687	44195	Early Modern - Modern	Founded 1869 by Alexander Stephen & Sons, and subsequently greatly extended. An engine works was added in 1872 and substantial additions made in 1905, 1908 and 1914. The three-storey 3-by-7 bay red brick office block was built in 1914 (?14,438). A large complex of mainly single storey red-brick, corrugated-iron and corrugated-asbestos-clad steel buildings. J R Hume 1974. (Location cited as NS 540 660 and name as Linthouse Shipbuilding Yard). Founded 1869 by Alexander Stephen & Sons. The most interesting part of this large complex is the original cast-iron-framed engine works of 1872. J R Hume 1976. The engine works building has been moved to the Scottish Maritime Museum, Irvine. The setting of the asset is a modern industrial estate.	The heritage value of the asset derives from the use of the site as the former Linthouse Engine Works and Shipyard. Located on the south bank of the Clyde, the setting of the asset on the bank of the Clyde enhances the ability to understand the asset and its relationship with the rest of the Govan and its industrial heritage; however, most of the industrial facilities and features are no longer extant or have been removed to the Scottish Maritime Museum. The modern setting of the asset does not contribute to the heritage value of the asset. This asset is of **low** heritage value.	Low	254000	666100
MM065	Linthouse	Stone Hammer	8719	44228	Unknown - Prehistoric?	A stone hammer found at Linthouse (name: NS 543 661) on the banks of the Clyde was exhibited in 1901. Its present whereabouts is unknown.	As a findspot the asset is of **negligible** heritage value.	Negligible	254350	666150
MM066	Partick, Chapel	Chapel	N/A	44088	Unknown	There was a chapel at Partick, but this location is unknown and is no longer extant.	As the heritage asset is no longer extant, the asset is of **negligible** heritage value.	Low	255000	666000
MM067	Partick, Coin Hoard	Coin Hoard	N/A	44104	Early Modern	In July 1766, a number of old coins were found at Partake, near Glasgow (Partick: NS 55 66). They weighed more than 30 ounces and consisted of German crowns, Spanish dollars, pieces of Elizabeth, James I, Charles I, and a few Scotch of the last king.	As a findspot the asset is of **negligible** heritage value.	Negligible	255000	666000
MM068	Castlebank Street, Tenement	Tenement	N/A	164307	Unknown	No information available.	The asset is of **negligible** heritage value.	Negligible	254950	666470
MM069	8-10 Cressy Street	Unassigned	N/A	167885	Unknown	No information available.	The asset is of **negligible** heritage value.	Negligible	255000	666000
MM070	Holmfaud House	House	N/A	168605	Post Medieval	The Rowan family was established in Govan before the Reformation and owned the estate of Holmfauldhead from at least the seventeenth century (fig 4.21; Brotchie 1905, 44–6; Dalrymple Duncan 1899, 108–10). Stephen Rowan expanded the estate in the 1750s and was still in possession in 1795, by which date Richardson's map shows that a mansion had been built.	The asset is of **negligible** heritage value.	Negligible	254180	665840
MM071	Glasgow, Linthouses	Engineering works; House; Shipyard	N/A	167782	Early Modern	The David Hamilton-style Mansion was built in 1791 on the 8-hectare (20-acre) Spreul estate of Linthouse. It became the residence of Michael Rowand, cashier of the Ship Bank. Alexander Stephen moved his shipyard across the river, then to Linthouse in 1869. The firm was actually founded at Burghead in 1750. The yard was later merged into Upper Clyde Shipbuilders (UCS),but closed in 1970 and the site is now occupied by an industrial estate. Stephen used the mansion for his offices until 1921, when the house was demolished and the porch re-erected in Elder Park. The estate was developed for housing after the shipyard was opened. The setting of the asset now comprises a modern industrial estate.	The heritage value of the asset derives from the use of the site as the former Linthouse Engine Works and Shipyard. The heritage value also derives from the relationship with the Category B listed 'fragments of Linthouse Mansion' in Elder Park. The setting of the asset within an industrial site positively contributes to the heritage value of the former shipyard. This asset is of **low** heritage value.	Low	253990	666270
MM072	Glasgow, 91 Holmfauld Road, Training Centre	Office; Training Centre	N/A	168620	Unknown	No information available.	The asset is of **negligible** heritage value.	Negligible	254171	666091
MM073	Glasgow, 9 Skipness Drive, Linthouse Church	Church	N/A	169674	Unknown	No information available.	The asset is of **negligible** heritage value.	Negligible	254251	665798
MM074	Glasgow, Sawmill Road, Railway Bridge	Railway Bridge	N/A	209597	Unknown	No information available.	The asset is of **negligible** heritage value.	Negligible	254770	666560
MM075	Ferry Terminal (20th Century)	Ferry Terminal	N/A	241032	Modern	Whiteinch Ferry. A high-level vehicular ferry was introduced here in 1900 and withdrawn in 1963. The southern terminal has been obliterated, but the northern has been decked over. The setting of the asset includes to the Clyde to the south.	The heritage value of the asset derives from its connection to the transportation system in Whiteinch, The setting of the asset on the north bank of the Clyde positively contributes to the heritage value of the asset. The asset is of **negligible** heritage value.	Negligible	254242	666476
MM076	Glasgow, 9 Skipness Drive, Hall and Church Officer's House	Church Hall	N/A	259806	Unknown	No information available.	The asset is of **negligible** heritage value.	Negligible	254237	665798
MM077	Glasgow, Lower Harbour, Clyde Tunnel, South Portal	Road Tunnel	N/A	278024	Modern	No information available.	The heritage value of the asset derives from the importance of the Clyde tunnel connecting the districts of Whiteinch to the north and Govan to the south in the west of the city. This asset is of **low** heritage value.	Low	254199	666005
MM078	Linthouse Shipyard	Industrial, Maritime	N/A	315253	Early Modern	Having leased a yard at Kelvinhaugh (NS56 NE5101) since 1851, the shipbuilding company of Alexander Stephen and Sons purchased the Linthouse estate in 1869	The heritage value of the asset derives from the use of the site as the former Linthouse Engine Works and Shipyard. Located on the south	Low	254056	666319

MM Number	Site Name	Type	SMR Reference Number	NRHE Reference Number	Period	Description of the asset	Statement of heritage value	Historic Value	Easting	Northing
						for £32,000. The firm laid out a shipyard on these 32 acres of ground, situated on the south bank of the Clyde opposite Whiteinch. The mansion of Linthouse estate was turned in to the company's offices and the buildings of the shipyard built to the south of this. In the 1890s the firm employed 2000 workers and in anticipation of expanding further houses known as the 'Linthouse Buildings' were erected in the SE corner of the estate to accommodate 120 families. These are depicted on the 2nd edition of the OS 25-inch map (Lanarkshire 1895, Sheet 005.08), which also shows that the yard was roughly rectangular on plan, with the Linthouse burn marking its western extent. The Linthouse landing stage was situated on the river bank at the NE corner of the yard and an Aerofilms photograph of 1931 (SC1257233) has recorded the irregularly- shaped 250m indent in the river bank that provided space for the construction of vessels,. Access to the SE of the yard was via Renfrew Road. In 1968, the company was incorporated into Upper Clyde Shipbuilders and was closed in 1971. The shipyard has since been demolished and a large office and car park now occupy the site.	bank of the Clyde, the setting of the asset on the bank of the Clyde enhances the ability to understand the asset and its relationship with the rest of the Govan and its industrial heritage, therefore the setting positively contributes to the heritage value of the asset This asset is of **low** heritage value.			
MM079	Govan, Howat Street	Courtyard;; Tenement	N/A	315773	Unknown	No information available.	The asset is of **negligible** heritage value.	Negligible	255094	665911
MM080	Govan Silk Factory	Silk Factory	N/A	317917	Early Modern	Nothing is now visible of the Govan Silk Factory, which stood at the N end of the formal garden of an earlier mansion house (NS 5505 6590) on the S side of the River Clyde. As depicted on the 1st edition of the OS 6-inch map (Lanarkshire 1858, Sheet V), the factory comprised one large Z-shaped range and three smaller structures, two of them perched on the actual river bank. The site of the factory is now occupied by a later shipyard. The site of the mansion house now lies under houses on Luath Street	The heritage value of the asset derives from the industrial use of the site, but the site has since been re-developed. The asset is therefore of **negligible** heritage value.	Negligible	255086	666103
MM081	Robinson Dunn and Co Sawmills	Saw Mill	N/A	318152	Early Modern	No information available.	The heritage value of the asset derives from the industrial use of the site. The asset is of **low** heritage value.	Low	254799	666456
MM082	925 Govan Road, Assist, House Improvement Advisory Centre	Office (Period Unassigned)	N/A	317863	Modern	No information available.	The asset is of **negligible** heritage value.	Negligible	255032	665832
MM083	Govan, Elder Park	Barrage Balloon Site (Second World War)	N/A	354787	Modern	Nothing is now visible in an area occupied by grassland within the park of a World War Two Barrage Balloon anchoring site, which is visible on an RAF photograph (CAM015, X00899) taken on 21 October 1941. This site was one of an extensive network that protected the population and industry of central Glasgow and the Clyde from low flying enemy bombers. Visited by HES, Survey and Recording (ATW, AKK) 29 March 2017. The asset and its wider setting has subsequently been redeveloped and new warehouses have been built on the site.	The heritage value of the asset derives from the historic interest of barrage balloon mooring site as a feature from the Second World War. The setting of the site does not contribute to the heritage value of the asset. This asset is of **low** heritage value.	Low	254708	665738
MM084	Jetty, River Clyde, Partick Saw Mills	Jetty	N/A	351189	Early Modern	Nothing is now visible of a short jetty which extended from the N bank of the River Clyde and is depicted on the 1st edition of the OS 6-inch map (Lanarkshire 1858, Sheet V). It was situated at the S end of a road or track that linked Dumbarton Road with the river and ran between Merklands - a small farmstead on the W, and the Partick Saw Mills on the E.	As the heritage asset is no longer extant, the asset is of **negligible** heritage value.	Negligible	254745	666372
MM085	Govan Road, Fairfield Ship Yard and Engine Works, Cranes	Crane	N/A	333983	Early Modern	See a brief description of the heritage asset and its setting within the shipyard in Section 5.12.3 above. The cranes tramways are still visible around the shipyard, connecting several of the buildings and centred on the fitting-out basin. The cranes would have served the fitting-out basin directly before their replacement with the Titan Crane in 1911.	The heritage value of the asset derives from its group value with buildings within former site of Fairfield Shipyard and Engine Works. Located around the Fitting-out Basin and thought the site the setting of the crane tramways includes the Engine Works (MM007) to the north and several ancillary structures around this. The setting of the former crane tramways in the centre of the shipyard enhances the ability to understand the asset and its relationship with the rest of the shipyard, , and therefore positively contributes to the heritage value of the asset. This asset is of **low** heritage value.	Low	254600	666100
MM086	Mile Post, River Clyde, Govan	Milepost	N/A	350975	Early Modern	No information available.	The asset is of **negligible** heritage value.	Negligible	254914	666215
MM094	Maritime Obstruction	Obstruc-tion – Maritime asset	N/A	324016	N/A	Depth unknown. Water Depth : 4. Name : Obstruction. Original Detection Year : 2004. Surveying Details : **HH274/490/07 1.7.04 OBSTN (NO DEPTH SPECIFIED) IN 5552.122N, 0420 290W [WGD]. (CLYDEPORT OPERATIONS LTD). - NM 3070/04.	As an unknown maritime obstruction, the asset is of **negligible** heritage value.	Negligible	253789	666420
MM095	Fairfield Shipyard and Engine Works - Mooring Posts	Mooring Posts	N/A	N/A	Early Modern	See a brief description of the heritage asset and its setting within the shipyard in Section 5.12.3 above. Mooring Posts located along the Fitting-out Basin, approximately 0.8m in diameter and c.1m in height. Wear can be seen on at least three, with reinforced metal sheets added to strengthen the posts. Locations are as follows (NGR):	The heritage value of the mooring posts derives from their group value with other prominent buildings within former site of Fairfield Shipyard and Engine Works, particularly the fitting-out Basin which they are associated with.	Low	254614	665988

MM Number	Site Name	Type	SMR Reference Number	NRHE Reference Number	Period	Description of the asset	Statement of heritage value	Historic Value	Easting	Northing
						North-west end: NS 54579 66285; NS 54582 66283; NS 54584 66281. South end: NS 54571 65995; NS 54606 65990; NS 54596 65990; NS 54616 65987; NS 54639 65989; NS 54644 65985; NS 54655 65983; NS 54661 65979.	The setting of the asset in the centre of the shipyard next to the Fitting-out Basin (MM054) positively contributes to the heritage value of the mooring posts as it enhances the ability to understand the asset and their relationship with the rest of the shipyard. This asset is of **low** heritage value.			
MM096	Fairfield Shipyard and Engine Works - Shipyard Winch	Winch	N/A	N/A	Early Modern	See a brief description of the heritage asset and its setting within the shipyard in Section 5.12.3 above. Two large winches now painted red. Measuring approximately 2m across by 1.5m and 1.2m in height. Locations (NGR): NS 54578 65993 on west side and NS 54654 65982 on east side. Used to pull in the ships into the basin.	The heritage value of the winches derives from their group value with other prominent buildings within former site of Fairfield Shipyard and Engine Works, particularly the fitting-out Basin which they are associated with. The setting of the asset in the centre of the shipyard next to the Fitting-out Basin (MM054) positively contributes to the heritage value of the winches as it enhances the ability to understand the asset and their relationship with the rest of the shipyard. This asset is of **low** heritage value.	Low	254654	665982

Source: Mott MacDonald 2022

7 Impact Assessment

7.1 Assessment of temporary effects from the construction of the proposed scheme

Table 7.1: Assessment of temporary effects from construction impacts on designated heritage assets

MM Number	Name	Designation	Description of impact	Value/ sensitivity	Magnitude of impact	Significance of effect
MM001	Govan, Carved Stones and Old Parish Church Graveyard	Scheduled Monument	There will be no physical impacts on the scheduled monument from the construction of the proposed scheme. The setting of the scheduled monument includes the traffic and soundscape of a busy urban area, as well as being adjacent to industrial areas. As such, any increase in noise associated with the proposed scheme will not alter the setting. There will be no change to the heritage value of the asset.	High	No change	Neutral
MM002	Victoria Park	Garden and Designed Landscape	The park is considered far enough from the proposed scheme for the construction works to have a no change on the park or its setting.	High	No change	Neutral
MM003	Govan	Conservation Area	The introduction of construction work and associated noise into the setting of Govan conservation area will be consistent with the industrial nature of the shipyard and surrounding area. This will result in no change to the heritage value of the conservation area.	High	No change	Neutral
MM004	Victoria Park	Conservation Area	The conservation area is considered far enough from the Scheme for the construction works to have a no change on the conservation area or its setting.	Medium	No change	Neutral
MM005	Glasgow West	Conservation Area	The conservation area is considered far enough from the proposed scheme for the construction works to have a no change on the conservation area or its setting.	Medium	No change	Neutral
MM006	Broomhill	Conservation Area	The conservation area is considered far enough from the proposed scheme for the construction works to have a no change on the conservation area or its setting.	Medium	No change	Neutral
MM007	1048 Govan Road, Govan Shipbuilders' Store, Former Engine Works of Fairfield Shipbuilding and Engineering Company	Category A Listed Building	The introduction of construction traffic, plant and noise will alter the setting of the heritage asset. However, this setting is one of an active industrial shipyard and the presence of construction machinery, noise and activity is consistent with the noise of the shipyard. The change in the setting, therefore, will not alter how the asset is appreciated. Moreover, Section 5 Construction Traffic Management of the CEMP also highlights that traffic and transport routes within the site will be concentrated to the west and therefore there will be no interaction with the building. As such, there will be no impact to the heritage value of the asset.	High	No change	Neutral
MM008	1030, 1048 Govan Road, Govan Shipbuilders Ltd, General Offices (excluding 1956 Extension To W).	Category A Listed Building	The introduction of construction traffic, plant and noise will alter the setting of the heritage asset. However, this setting is one of an active industrial shipyard and the presence of construction machinery, noise and activity is consistent with the noise of the shipyard. The change in the setting, therefore, will not alter how the asset is appreciated. There will be no impact to the heritage value of the asset.	High	No change	Neutral
MM009	56 Partickhill Road 'Woodbank', Carriage House, Arch to Service Court, Retaining Walls and Cast-Iron Gates	Category A Listed Building	The building is considered far enough from the proposed scheme for the construction works to have a no change on the building or its setting.	High	No change	Neutral
MM010	1a Drumoyne Drive and Langlands Road, Elder Cottage Hospital	Category A Listed Building	The building is considered far enough from the proposed scheme for the construction works to have a no change on the building or its setting.	High	No change	Neutral
MM011	228a Langlands Road and Elder Park Street, Elder Park Library	Category A Listed Building	The introduction of construction traffic, plant and noise will alter the setting of the library. However, this setting has always included noise from the adjacent shipyard. Consequently, the introduction of noise from construction work will not alter the setting of the asset. Therefore, there will be no impact to the heritage value of the asset.	High	No change	Neutral
MM012	18 Clydebrae Street, Govan Graving Docks	Category A Listed Building	The building is considered far enough from the proposed scheme for the construction works to have a no change on the building or its setting.	High	No change	Neutral
MM013	816, 818 Govan Road, 1, 3 Water Row, Former British Linen Bank, and Flats	Category A Listed Building	The introduction of construction traffic, plant and noise will alter the setting of the heritage asset. However, this setting has always included the traffic and soundscape of a busy urban area, As such, any increase in noise associated with the proposed scheme will not alter the setting. There will be no change to the heritage value of the asset.	High	No change	Neutral
MM014	840, 860 Govan Road And Return Elevation to Pearce Street, Pearce Institute	Category A Listed Building	The introduction of construction traffic, plant and noise will alter the setting of the heritage asset. However, this setting has always included the traffic and soundscape of a busy urban area, As such, any increase in noise associated with the proposed scheme will not alter the setting. There will be no change to the heritage value of the asset	High	No change	Neutral
MM015	866, 868 Govan Road, Govan Old Parish Church (C of S)	Category A Listed Building	The introduction of construction traffic, plant and noise will alter the setting of the heritage asset. However, this setting has always included the traffic and soundscape of a busy urban area, As such, any increase in noise associated with the proposed scheme will not alter the setting. There will be no change to the heritage value of the asset.	High	No change	Neutral
MM016	Statue of Isabella Elder, Elder Park, Glasgow	Category A Listed Building	The introduction of construction traffic, plant and noise will alter the setting of the heritage asset. However, this setting has always included the traffic and soundscape of a busy urban area, As such, any increase in noise associated with the proposed scheme will not alter the setting. There will be no change to the heritage value of the asset.	High	No change	Neutral
MM017	739 South Street, North British Engine Works	Category A Listed Building	The introduction of construction traffic, plant and noise will alter the setting of the heritage asset. However, as this setting is heavily industrial, any increase in noise associated with the proposed scheme will not alter the setting. There will be no change to the heritage value of the asset	High	No change	Neutral
MM018	739 South Street, Former North British Diesel Engine Engine Works, Quayside Titan Crane	Category A Listed Building	The introduction of construction traffic, plant and noise will alter the setting of the heritage asset. However, as this setting is heavily industrial, any increase in noise associated with the proposed scheme will not alter the setting. There will be no change to the heritage value of the asset.	High	No change	Neutral

MM Number	Name	Designation	Description of impact	Value/ sensitivity	Magnitude of impact	Significance of effect
MM019	19,21,23,25,27,29, Squire Street And 69 Northinch Street, Former Whiteinch Jordanvale Parish Church And Hall	Category B Listed Building	The building is considered far enough from the proposed scheme for the construction works to have a no change on the building or its setting.	Medium	No change	Neutral
MM020	14 Victoria Park Drive South, Whiteinch Public Library	Category B Listed Building	The building is considered far enough from the proposed scheme for the construction works to have a no change on the building or its setting.	Medium	No change	Neutral
MM021	3-13 (odd Nos) Crow Road and 482-492 (even Nos) Dumbarton Road	Category B Listed Building	The building is considered far enough from the proposed scheme for the construction works to have a no change on the building or its setting.	Medium	No change	Neutral
MM022	30-36 (even Nos) Sandy Road, 120-124 (even Nos) Beith Street, Former Partick Fire Station	Category B Listed Building	The building is considered far enough from the proposed scheme for the construction works to have a no change on the building or its setting.	Medium	No change	Neutral
MM023	2a Drumoyne Drive and Langlands Road, Elder Cottage Hospital (West Block)	Category B Listed Building	The building is considered far enough from the proposed scheme for the construction works to have a no change on the building or its setting.	Medium	No change	Neutral
MM024	Elder Park, Cottage	Category B Listed Building	The introduction of construction traffic, plant and noise will alter the setting of the heritage asset. However, this setting has always included noise from the adjacent shipyard. Consequently, the introduction of noise from construction work will not alter the setting of the asset. Therefore, there will be no impact to the heritage value of the asset.	Medium	No change	Neutral
MM025	Elder Park, Fragments of Linthouse Mansion	Category B Listed Building	The introduction of construction traffic, plant and noise will alter the setting of the heritage asset. However, this setting has always included noise from the adjacent shipyard. Consequently, the introduction of noise from construction work will not alter the setting of the asset. Therefore, there will be no impact to the heritage value of the asset.	Medium	No change	Neutral
MM026	Elder Park, Statue of John Elder	Category B Listed Building	The introduction of construction traffic, plant and noise will alter the setting of the heritage asset. However, this setting has always included noise from the adjacent shipyard. Consequently, the introduction of noise from construction work will not alter the setting of the asset. Therefore, there will be no impact to the heritage value of the asset.	Medium	No change	Neutral
MM027	1345 Govan Road, Southern General Hospital, (Former Govan Poorhouse Hospital Block)	Category B Listed Building	The building is considered far enough from the proposed scheme for the construction works to have a no change on the building or its setting.	Medium	No change	Neutral
MM028	87,91 Holmfauld Road, Linthouse Buildings	Category B Listed Building	The introduction of construction traffic, plant and noise will alter the setting of the heritage asset. However, this setting has always included noise from the adjacent shipyard. Consequently, the introduction of noise from construction work will not alter the setting of the asset. Therefore, there will be no impact to the heritage value of the asset.	Medium	No change	Neutral
MM029	200 Shieldhall Road, Drumoyne Primary School, Janitor's Lodge Gatepiers and Boundary Walls	Category B Listed Building	The building is considered far enough from the proposed scheme for the construction works to have a no change on the building or its setting.	Medium	No change	Neutral
MM030	9 Skipness Drive, Linthouse/St Kenneth's Church including Original Church Hall and Church Officer's House	Category B Listed Building	The introduction of construction traffic, plant and noise will alter the setting of the heritage asset. However, this setting has always included the traffic and soundscape of a busy urban area, As such, any increase in noise associated with the proposed scheme will not alter the setting. There will be no change to the heritage value of the asset.	Medium	No change	Neutral
MM031	65-69 (odd Nos) Golspie Street, Former Hill's Trust School	Category B Listed Building	The introduction of construction traffic, plant and noise will alter the setting of the heritage asset. However, this setting has always included the traffic and soundscape of a busy urban area, As such, any increase in noise associated with the proposed scheme will not alter the setting. There will be no change to the heritage value of the asset.	Medium	No change	Neutral
MM032	705, 707 Govan Road, Return Elevations To Broomloan Road, Former Savings Bank, Govan Branch	Category B Listed Building	The introduction of construction traffic, plant and noise will alter the setting of the heritage asset. However, this setting has always included the traffic and soundscape of a busy urban area, As such, any increase in noise associated with the proposed scheme will not alter the setting. There will be no change to the heritage value of the asset.	Medium	No change	Neutral
MM033	Near 801 Govan Road, Junction With Burleigh Street, Sir William Pearce, Statue	Category B Listed Building	The introduction of construction traffic, plant and noise will alter the setting of the heritage asset. However, this setting has always included the traffic and soundscape of a busy urban area, As such, any increase in noise associated with the proposed scheme will not alter the setting. There will be no change to the heritage value of the asset.	Medium	No change	Neutral
MM034	801, 805 Govan Road, 2, 4 Burleigh Street, Cardell Halls and Public House	Category B Listed Building	The introduction of construction traffic, plant and noise will alter the setting of the heritage asset. However, this setting has always included the traffic and soundscape of a busy urban area, As such, any increase in noise associated with the proposed scheme will not alter the setting. There will be no change to the heritage value of the asset.	Medium	No change	Neutral
MM035	831 Govan Road, St Anthony's RC Church	Category B Listed Building	The introduction of construction traffic, plant and noise will alter the setting of the heritage asset. However, this setting has always included the traffic and soundscape of a busy urban area, As such, any increase in noise associated with the proposed scheme will not alter the setting. There will be no change to the heritage value of the asset.	Medium	No change	Neutral
MM036	881, 883, 885, 887 Govan Road, 2, 4 Shaw St	Category B Listed Building	The introduction of construction traffic, plant and noise will alter the setting of the heritage asset. However, this setting has always included the traffic and soundscape of a busy urban area, As such, any increase in noise associated with the proposed scheme will not alter the setting. There will be no change to the heritage value of the asset.	Medium	No change	Neutral
MM037	638-646 (even Nos) Govan Road, 3 Napier Street, Napier House	Category B Listed Building	The introduction of construction traffic, plant and noise will alter the setting of the heritage asset. However, this setting has always included the traffic and soundscape of a busy urban area, As such, any increase in noise associated with the proposed scheme will not alter the setting. There will be no change to the heritage value of the asset.	Medium	No change	Neutral
MM038	784-796 (even Nos) Govan Road, New Govan, formerly St Mary's, Church Hall and Shops Below	Category B Listed Building	The introduction of construction traffic, plant and noise will alter the setting of the heritage asset. However, this setting has always included the traffic and soundscape of a busy urban area, As such, any increase in noise associated with the proposed scheme will not alter the setting. There will be no change to the heritage value of the asset.	Medium	No change	Neutral
MM039	Govan Road, Govan Cross Drinking Fountain	Category B Listed Building	The introduction of construction traffic, plant and noise will alter the setting of the heritage asset. However, this setting has always included the traffic and soundscape of a busy urban area, As such, any increase in noise associated with the proposed scheme will not alter the setting. There will be no change to the heritage value of the asset.	Medium	No change	Neutral

MM Number	Name	Designation	Description of impact	Value/ sensitivity	Magnitude of impact	Significance of effect
MM040	908 Govan Road And Return Elevation to Mckechnie Street, County Bingo Social Club, Former Lyceum Cinema	Category B Listed Building	The introduction of construction traffic, plant and noise will alter the setting of the heritage asset. However, this setting has always included the traffic and soundscape of a busy urban area, As such, any increase in noise associated with the proposed scheme will not alter the setting. There will be no change to the heritage value of the asset.	Medium	No change	Neutral
MM041	2 Water Row, Govan Cross, New Govan Church of Scotland, Former St Mary's Church.	Category B Listed Building	The introduction of construction traffic, plant and noise will alter the setting of the heritage asset. However, this setting has always included the traffic and soundscape of a busy urban area, As such, any increase in noise associated with the proposed scheme will not alter the setting. There will be no change to the heritage value of the asset.	Medium	No change	Neutral
MM042	18,20 Orkney Street Govan Police Building, Former Govan Municipal Buildings	Category B Listed Building	The introduction of construction traffic, plant and noise will alter the setting of the heritage asset. However, this setting has always included the traffic and soundscape of a busy urban area, As such, any increase in noise associated with the proposed scheme will not alter the setting. There will be no change to the heritage value of the asset.	Medium	No change	Neutral
MM043	5,7,9 Water Row Former YMCA	Category B Listed Building	The introduction of construction traffic, plant and noise will alter the setting of the heritage asset. However, this setting has always included the traffic and soundscape of a busy urban area, As such, any increase in noise associated with the proposed scheme will not alter the setting. There will be no change to the heritage value of the asset.	Medium	No change	Neutral
MM044	Dumbarton Road, Whiteinch, St Paul's Roman Catholic Church including Boundary Walls, Gatepiers, Gates and Railings	Category B Listed Building	The building is considered far enough from the proposed scheme for the construction works to have a no change on the building or its setting.	Medium	No change	Neutral
MM045	36-40 Golspie Street & 16 Garmouth Street, Salvation Army Citadel	Category B Listed Building	The introduction of construction traffic, plant and noise will alter the setting of the heritage asset. However, this setting has always included the traffic and soundscape of a busy urban area, As such, any increase in noise associated with the proposed scheme will not alter the setting. There will be no change to the heritage value of the asset.	Medium	No change	Neutral
MM046	35 Inchlee Street, 15, 16 Victoria Park Drive South Former Whiteinch Burgh Hall, Former Police Station And Former Fire Station including Boundary Wall, Gatepiers and Railings	Category B Listed Building	The building is considered far enough from the proposed scheme for the construction works to have a no change on the building or its setting.	Medium	No change	Neutral
MM047	57 Laurel Street, Crathie Court including Terrace Wall	Category B Listed Building	The building is considered far enough from the proposed scheme for the construction works to have a no change on the building or its setting.	Medium	No change	Neutral
MM048	Former Greenfield Primary School, Including Janitor's Accommodation, Laundary and Swimming Pool Block, Boundary Walls and Gatepiers, 29 Nimmo Drive, Govan, Glasgow	Category B Listed Building	The building is considered far enough from the proposed scheme for the construction works to have a no change on the building or its setting.	Medium	No change	Neutral
MM049	1345 Govan Road, Southern General Hospital, Administration Block (Former Govan Poorhouse)	Category B Listed Building	The building is considered far enough from the proposed scheme for the construction works to have a no change on the building or its setting.	Medium	No change	Neutral
MM050	2 Broomhill Avenue and 1-3 (Odd Nos) Broomhill Terrace	Category C Listed Building	The building is considered far enough from the proposed scheme for the construction works to have a no change on the building or its setting.	Medium	No change	Neutral
MM051	23-41 (Odd Nos) Broomhill Drive and 1-15 (Odd Nos) Broomhill Avenue, with Gatepiers and Low Boundary Wall	Category C Listed Building	The building is considered far enough from the proposed scheme for the construction works to have a no change on the building or its setting.	Medium	No change	Neutral
MM052	62, 64 Langlands Road and Return Elevation to Roseneath Street, St Anthony's RC Presbytery	Category C Listed Building	The introduction of construction traffic, plant and noise will alter the setting of the heritage asset. However, this setting has always included the traffic and soundscape of a busy urban area, As such, any increase in noise associated with the proposed scheme will not alter the setting. There will be no change to the heritage value of the asset.	Medium	No change	Neutral
MM053	27 Broomhill Avenue, Former Balshagray Public School Including Swimming Pool and Janitor's House, Gates, Gatepiers and Railings	Category C Listed Building	The building is considered far enough from the proposed scheme for the construction works to have a no change on the building or its setting.	Medium	No change	Neutral

Source: Mott MacDonald 2022

Table 7.2: Assessment of temporary effects from construction impacts on non-designated heritage assets

MM Number	Site Name	Type	Description of impact	Value/ sensitivity	Magnitude of impact	Significance of effect
MM054	Fairfield Shipyard and Engine Works, Fitting-out Basin / Bae Systems; Upper Clyde Shipbuilding Yard; Kvaerner Govan Shipyard	Non-designated	The introduction of construction traffic, plant and noise will alter the setting of the heritage asset. However, this setting is one of an active industrial shipyard and the presence of construction machinery, noise and activity is consistent with the noise of the shipyard. The change in the setting, therefore, will not alter how the asset is appreciated as it will still be interpreted as a basin during temporary construction works. There will be no impact to the heritage value of the asset.	Medium	No change	Neutral
MM055	Fairfield Shipyard and Engine Works, Plumber's Shops / Bae Systems; Upper Clyde Shipbuilding Yard; Kvaerner Govan Shipyard	Non-designated	The introduction of construction traffic, plant and noise will alter the setting of the heritage asset. However, this setting is one of an active industrial shipyard and the presence of construction machinery, noise and activity is consistent with the noise and function of the shipyard. The change in the setting, therefore, will not alter how the asset is appreciated. There will be no impact to the heritage value of the asset.	Low	No change	Neutral
MM056	Fairfield Shipyard and Engine Works, Plate Fabrication Shed / Bae Systems; Upper Clyde Shipbuilding Yard; Kvaerner Govan Shipyard	Non-designated	The introduction of construction traffic, plant and noise will alter the setting of the heritage asset. However, this setting is one of an active industrial shipyard and the presence of construction machinery, noise and activity is consistent with the noise and function of the shipyard. The change in the setting, therefore, will not alter how the asset is appreciated. There will be no impact to the heritage value of the asset.	Low	No change	Neutral

MM Number	Site Name	Type	Description of impact	Value/ sensitivity	Magnitude of impact	Significance of effect
MM057	Giant Cantilever Crane / Fairfield Shipyard	Non-designated	The introduction of construction traffic, plant and noise will alter the setting of the heritage asset. However, this setting is one of an active industrial shipyard and the presence of construction machinery, noise and activity is consistent with the noise and function of the shipyard. The change in the setting, therefore, will not alter how the asset is appreciated. There will be no impact to the heritage value of the asset.	Negligible	No change	Neutral
MM058	Kvaemer Govan Shipyard, New Fabrication Shed / Fairfield Shipyard	Non-designated	The introduction of construction traffic, plant and noise will alter the setting of the heritage asset. However, this setting is one of an active industrial shipyard and the presence of construction machinery, noise and activity is consistent with the noise and function of the shipyard. The change in the setting, therefore, will not alter how the asset is appreciated. There will be no impact to the heritage value of the asset.	Low	No change	Neutral
MM059	Meadowside Quay, Meadowside Granaries	Non-designated	The asset marks the former site of a quay that is no longer extant and therefore it is considered that the construction of the proposed scheme will have a no change on the asset or its setting.	Low	No change	Neutral
MM060	Broomielaw, Clyde Foot Tunnel / Finnieston Entrance	Non-designated	The asset is considered far enough from the proposed scheme for the construction works to have a no change on the asset or its setting.	Low	No change	Neutral
MM061	Partick, Meadowside Quay / Clyde Aa Defences; Castlebank Street	Non-designated	The introduction of construction traffic, plant and noise will alter the setting of the heritage asset. However, this setting has always included the traffic and soundscape of a busy industrial area, As such, any increase in noise associated with the proposed scheme will not alter the setting. There will be no change to the heritage value of the asset	Low	No change	Neutral
MM062	South Street, Merklands Animals Lairage / Merklands Quay	Non-designated	The introduction of construction traffic, plant and noise will alter the setting of the heritage asset. However, this setting has always included the traffic and soundscape of a busy industrial area, As such, any increase in noise associated with the proposed scheme will not alter the setting. There will be no change to the heritage value of the asset	Low	No change	Neutral
MM063	Castlebank St, Meadowside Granary / Meadowside Quay / Whiteinch	Non-designated	The introduction of construction traffic, plant and noise will alter the setting of the heritage asset. However, this setting has always included the traffic and soundscape of a busy industrial area, As such, any increase in noise associated with the proposed scheme will not alter the setting. There will be no change to the heritage value of the asset	Negligible	No change	Neutral
MM064	Linthouse Engine Works, Shipyard / Alexander Stephens and Sons / Holmfauld Road / Linthouse Shipbuilding Yard	Non-designated	The introduction of construction traffic, plant and noise will alter the setting of the heritage asset. However, this setting has always included the traffic and soundscape of a busy industrial area, As such, any increase in noise associated with the proposed scheme will not alter the setting. There will be no change to the heritage value of the asset.	Low	No change	Neutral
MM065	Linthouse	Non-designated	The asset marks a find-spot and therefore it is considered that the construction works will have a no change on the asset.	Negligible	No change	Neutral
MM066	Partick, Chapel	Non-designated	The asset marks the possible location of a former church and therefore it is considered that the construction works will have a no change on the asset.	Low	No change	Neutral
MM067	Partick, Coin Hoard	Non-designated	The asset marks a find-spot and therefore it is considered that the construction works will have a no change on the asset.	Negligible	No change	Neutral
MM068	Castlebank Street, Tenement	Non-designated	The asset is considered far enough from the proposed scheme for the construction works to have a no change on the asset or its setting.	Negligible	No change	Neutral
MM069	8-10 Cressy Street	Non-designated	The introduction of construction traffic, plant and noise will alter the setting of the heritage asset. However, this setting has always included the traffic and soundscape of a busy industrial area, As such, any increase in noise associated with the proposed scheme will not alter the setting. There will be no change to the heritage value of the asset	Negligible	No change	Neutral
MM070	Holmfaud House	Non-designated	The introduction of construction traffic, plant and noise will alter the setting of the heritage asset. However, this setting has always included the traffic and soundscape of a busy industrial area, As such, any increase in noise associated with the proposed scheme will not alter the setting. There will be no change to the heritage value of the asset	Negligible	No change	Neutral
MM071	Glasgow, Linthouses	Non-designated	The introduction of construction traffic, plant and noise will alter the setting of the heritage asset. However, this setting has always included the traffic and soundscape of a busy industrial area, As such, any increase in noise associated with the proposed scheme will not alter the setting. There will be no change to the heritage value of the asset	Low	No change	Neutral
MM072	Glasgow, 91 Holmfauld Road, Training Centre	Non-designated	The introduction of construction traffic, plant and noise will alter the setting of the heritage asset. However, this setting has always included the traffic and soundscape of a busy industrial area, As such, any increase in noise associated with the proposed scheme will not alter the setting. There will be no change to the heritage value of the asset	Negligible	No change	Neutral
MM073	Glasgow, 9 Skipness Drive, Linthouse Church	Non-designated	The introduction of construction traffic, plant and noise will alter the setting of the heritage asset. However, this setting has always included the traffic and soundscape of a busy industrial area, As such, any increase in noise associated with the proposed scheme will not alter the setting. There will be no change to the heritage value of the asset	Negligible	No change	Neutral
MM074	Glasgow, Sawmill Road, Railway Bridge	Non-designated	The introduction of construction traffic, plant and noise will alter the setting of the heritage asset. However, this setting has always included the traffic and soundscape of a busy industrial area, As such, any increase in noise associated with the proposed scheme will not alter the setting. There will be no change to the heritage value of the asset	Negligible	No change	Neutral
MM075	Ferry Terminal (20th Century)	Non-designated	The introduction of construction traffic, plant and noise will alter the setting of the heritage asset. However, this setting has always included the traffic and soundscape of a busy industrial area, As such, any increase in noise associated with the proposed scheme will not alter the setting. There will be no change to the heritage value of the asset	Negligible	No change	Neutral
MM076	Glasgow, 9 Skipness Drive, Hall and Church Officer's House	Non-designated	The introduction of construction traffic, plant and noise will alter the setting of the heritage asset. However, this setting has always included the traffic and soundscape of a busy industrial area, As such, any increase in noise associated with the proposed scheme will not alter the setting. There will be no change to the heritage value of the asset	Negligible	No change	Neutral
MM077	Glasgow, Lower Harbour, Clyde Tunnel, South Portal	Non-designated	The introduction of construction traffic, plant and noise will alter the setting of the heritage asset. However, this setting has always included the traffic and soundscape of a busy industrial area, As such, any increase in noise associated with the proposed scheme will not alter the setting. There will be no change to the heritage value of the asset	Low	No change	Neutral
MM078	Linthouse Shipyard	Non-designated	The introduction of construction traffic, plant and noise will alter the setting of the heritage asset. However, this setting has always included the traffic and soundscape of a busy industrial area, As such, any increase in noise associated with the proposed scheme will not alter the setting. There will be no change to the heritage value of the asset	Low	No change	Neutral

MM Number	Site Name	Type	Description of impact	Value/ sensitivity	Magnitude of impact	Significance of effect
MM079	Govan, Howat Street	Non-designated	The introduction of construction traffic, plant and noise will alter the setting of the heritage asset. However, this setting has always included the traffic and soundscape of a busy industrial area, As such, any increase in noise associated with the proposed scheme will not alter the setting. There will be no change to the heritage value of the asset	Negligible	No change	Neutral
MM080	Govan Silk Factory	Non-designated	The introduction of construction traffic, plant and noise will alter the setting of the heritage asset. However, this setting has always included the traffic and soundscape of a busy industrial area, As such, any increase in noise associated with the proposed scheme will not alter the setting. There will be no change to the heritage value of the asset	Negligible	No change	Neutral
MM081	Robinson Dunn and Co Sawmills	Non-designated	The introduction of construction traffic, plant and noise will alter the setting of the heritage asset. However, this setting has always included the traffic and soundscape of a busy industrial area, As such, any increase in noise associated with the proposed scheme will not alter the setting. There will be no change to the heritage value of the asset	Low	No change	Neutral
MM082	925 Govan Road, Assist, House Improvement Advisory Centre	Non-designated	The introduction of construction traffic, plant and noise will alter the setting of the heritage asset. However, this setting has always included the traffic and soundscape of a busy industrial area, As such, any increase in noise associated with the proposed scheme will not alter the setting. There will be no change to the heritage value of the asset	Negligible	No change	Neutral
MM083	Govan, Elder Park	Non-designated	The introduction of construction traffic, plant and noise will alter the setting of the heritage asset. However, this setting has always included the traffic and soundscape of a busy industrial area, As such, any increase in noise associated with the proposed scheme will not alter the setting. There will be no change to the heritage value of the asset	Low	No change	Neutral
MM084	Jetty, River Clyde, Partick Saw Mills	Non-designated	The introduction of construction traffic, plant and noise will alter the setting of the heritage asset. However, this setting has always included the traffic and soundscape of a busy industrial area, As such, any increase in noise associated with the proposed scheme will not alter the setting. There will be no change to the heritage value of the asset	Negligible	No change	Neutral
MM085	Govan Road, Fairfield Ship Yard and Engine Works, Cranes	Non-designated	The introduction of construction traffic, plant and noise will alter the setting of the heritage asset. However, this setting has always included the traffic and soundscape of a busy industrial area, As such, any increase in noise associated with the proposed scheme will not alter the setting. There will be no change to the heritage value of the asset	Low	No change	Neutral
MM086	Mile Post, River Clyde, Govan	Non-designated	The introduction of construction traffic, plant and noise will alter the setting of the heritage asset. However, this setting has always included the traffic and soundscape of a busy industrial area, As such, any increase in noise associated with the proposed scheme will not alter the setting. There will be no change to the heritage value of the asset	Negligible	No change	Neutral
MM094	Maritime Obstruction	Non-designated	The asset is recorded as a maritime obstruction at an unknown depth, as such it is considered that the construction works will have a no change on the asset.	Negligible	No change	Neutral
MM095	Fairfield Shipyard and Engine Works - Mooring Posts	Non-designated	The introduction of construction traffic, plant and noise will alter the setting of the heritage asset. However, this setting is one of an active industrial shipyard and the presence of construction machinery, noise and activity is consistent with the noise and function of the shipyard. The change in the setting, therefore, will not alter how the asset is appreciated. There will be no impact to the heritage value of the asset.	Low	No change	Neutral
MM096	Fairfield Shipyard and Engine Works - Shipyard Winch	Non-designated	The introduction of construction traffic, plant and noise will alter the setting of the heritage asset. However, this setting is one of an active industrial shipyard and the presence of construction machinery, noise and activity is consistent with the noise and function of the shipyard. The change in the setting, therefore, will not alter how the asset is appreciated. There will be no impact to the heritage value of the asset.	Low	No change	Neutral
N/A	Unknown archaeological remains	Non-designated	There are no anticipated temporary construction impacts on unknown archaeological remains.	Low	No change	Neutral

Source: Mott MacDonald 2022

7.2 Assessment of permanent effect from the construction of the proposed scheme

Table 7.3: Assessment of permanent effects from construction impacts on designated heritage assets

MM Number	Name	Designation	Description of impact	Value/ sensitivity	Magnitude of impact	Significance of effect
MM001	Govan, Carved Stones and Old Parish Church Graveyard	Scheduled Monument	There will be no permanent physical impacts on the scheduled monument from the construction of the proposed scheme. While the construction of the new assembly hall will alter the setting of the scheduled monument, the setting will retain it industrial character As such, there will be no change to the heritage value of the asset.	High	No change	Neutral
MM002	Victoria Park	Garden and Designed Landscape	The construction of the new assembly hall will be visible in views towards the Govan shipyard and therefore will alter the skyline and the setting of the park. However, as the setting of the park is largely urban and industrial comprising several high-rise structures to the south towards the Clyde, the character of the setting of the park will continue to be industrial. As such, there will be no change to the heritage value of the asset.	High	No change	Neutral
MM003	Govan	Conservation Area	The construction of the new assembly hall will alter the setting of the conservation area, especially views facing north from Elder Park. However, this will not impact the ability to understand the heritage value of the conservation area; instead, it will reinforce the industrial character of the area which is one of the primary reasons for its designation. As such, there will be no change to the heritage value of the asset.	High	No change	Neutral
MM004	Victoria Park	Conservation Area	The construction of the new assembly hall will be visible in views towards the Govan shipyard and therefore will alter the skyline and the setting of the conservation area. However, as the setting of the conservation area is largely urban and industrial, the character of the setting of the park will continue to be industrial. As such, there will be no change to the heritage value of the asset.	Medium	No change	Neutral
MM005	Glasgow West	Conservation Area	The construction of the new assembly hall will be visible from Patrickhill but these views already include the skyline of the Clyde which is urban and industrial in nature. As such, while the construction of the proposed scheme will alter part of the setting of the conservation area, the character of the setting will not be changed. Therefore, there will be no change to the heritage value of the asset.	Medium	No change	Neutral
MM006	Broomhill	Conservation Area	The construction of the new assembly hall may be visible from sections of the conservation area but these views towards the skyline of the Clyde are largely urban and industrial in nature. As such, while the construction of the proposed scheme will alter part of the setting of the conservation area, the character of the setting will not be changed. Therefore, there will be no change to the heritage value of the asset.	Medium	No change	Neutral

MM Number	Name	Designation	Description of impact	Value/ sensitivity	Magnitude of impact	Significance of effect
MM007	1048 Govan Road, Govan Shipbuilders' Store, Former Engine Works of Fairfield Shipbuilding and Engineering Company	Category A Listed Building	There will be no physical impact on the building. Therefore, the historic and architectural interest associated with the cast-iron framework of the building, which makes a strong positive contribution to its heritage value, will be retained. From the infilling of the Fitting-out Basin and construction of the new assembly hall there will be a change to the setting of the Former Engine Works (MM007). However, this change will only partially impact its heritage value as the relationship between the building and Fitting-out Basin (MM054) has been diminished by later development, including the modern metal cladding extension on the north and west sides. As such, this reduces the ability to understand the relationship between the Former Engine Works (MM007) and the Fitting-out Basin (MM054), and therefore how the setting of the building contributes to its heritage value. However, as the character of the area continues to be industrial, the setting of the building will continue to partially contribute to the heritage value of the Former Engine Works. The Former Engine Works (MM007) also has an associative value with the Fitting-out Basin (MM054) as it forms part of its historic context. The association of the Former Engine Works (MM007) with the wet basin helps to explain the functionality of the Govan shipyard, which contributes to the heritage value of the building. This relationship will be retained as the Fitting-out basin (MM054) will still survive beneath the new building. Moreover, potential enhancement measures may include ensuring that the former edge of the Fitting-out Basin is delineated will help to preserve this relationship. However, once infilled, this relationship will not be easily interpretable, and the permanent impacts will result in a reduction in the ability to understand the relationship between the Former Engine Works (MM007) and basin within the shipyard. Therefore, this will contribute to an impact on the heritage value of the Former Engine Works (MM007). The construction of the proposed scheme will have a minor adverse impact on the heritage value of the asset.	High	Minor adverse	Slight adverse
MM008	1030, 1048 Govan Road, Govan Shipbuilders Ltd, General Offices (excluding 1956 Extension To W).	Category A Listed Building	The construction of the new assembly hall will alter the setting of the heritage asset to the north-west. However, due to limited intervisibility with the shipyard itself and the retention of the industrial character of the setting, this will not impact the ability to understand the heritage value of the building. As such, there will be no change to the heritage value of the asset.	High	No change	Neutral
MM009	56 Partickhill Road 'Woodbank', Carriage House, Arch to Service Court, Retaining Walls and Cast-Iron Gates	Category A Listed Building	The building is considered far enough from the proposed scheme for the presence of the new assembly hall to have no permanent change to the setting of the building and will not impact its heritage value.	High	No change	Neutral
MM010	1a Drumoyne Drive and Langlands Road, Elder Cottage Hospital	Category A Listed Building	The building is considered far enough from the proposed scheme for the presence of the new assembly hall to have no permanent change to the setting of the building and will not impact its heritage value.	High	No change	Neutral
MM011	228a Langlands Road and Elder Park Street, Elder Park Library	Category A Listed Building	The construction of the new assembly hall will change the setting of the library, especially views north of Elder Park. However, as the asset is heavily screened by vegetation surrounding the park, as well as having a wider connection with the shipyard itself, these changes to the setting do not impact the ability to understand the heritage value of the library. Therefore, there will be no change to the heritage value of the asset.	High	No change	Neutral
MM012	18 Clydebrae Street, Govan Graving Docks	Category A Listed Building	The building is considered far enough from the proposed scheme for the presence of the new assembly hall to have no permanent change to the setting of the building and will not impact its heritage value.	High	No change	Neutral
MM013	816, 818 Govan Road, 1, 3 Water Row, Former British Linen Bank, and Flats	Category A Listed Building	The building is considered far enough from the proposed scheme for the presence of the new assembly hall to have no permanent change to the setting of the building and will not impact its heritage value.	High	No change	Neutral
MM014	840, 860 Govan Road And Return Elevation to Pearce Street, Pearce Institute	Category A Listed Building	The building is considered far enough from the proposed scheme for the presence of the new assembly hall to have no permanent change to the setting of the building and will not impact its heritage value.	High	No change	Neutral
MM015	866, 868 Govan Road, Govan Old Parish Church (C of S)	Category A Listed Building	The building is considered far enough from the proposed scheme for the presence of the new assembly hall to have no permanent change to the setting of the building and will not impact its heritage value.	High	No change	Neutral
MM016	Statue of Isabella Elder, Elder Park, Glasgow	Category A Listed Building	The construction of the new assembly hall will change the setting of the asset, especially views north of Elder Park. . However, as the statue is heavily screened by vegetation surrounding the rose garden and Elder Park, as well as having a wider connection with the shipyard itself, these changes do not impact the ability to understand the heritage value of the statue. Therefore, there will be no change to the heritage value of the asset.	High	No change	Neutral
MM017	739 South Street, North British Engine Works	Category A Listed Building	The construction of the new assembly hall will change the setting of the asset, especially views towards the south bank of the Clyde and its skyline. However, as the setting of the asset is industrial and the proposed scheme will ensure that shipbuilding activity remains an important aspect of the engine work's wider setting, as well as reinforcing the identity and character of the Clyde, this will not change the ability to understand the heritage value of the asset. Therefore, there will be no change to the heritage value of the asset.	High	No change	Neutral
MM018	739 South Street, Former North British Diesel Engine Engine Works, Quayside Titan Crane	Category A Listed Building	The construction of the new assembly hall will change the setting of the asset, especially views towards the south bank of the Clyde and its skyline. However, as the setting of the asset is industrial and the proposed scheme will ensure that shipbuilding activity remains an important aspect of the crane's wider setting, as well as reinforcing the identity and character of the Clyde, this will not change the ability to understand the heritage value of the asset. Therefore, there will be no change to the heritage value of the asset.	High	No change	Neutral
MM019	19,21,23,25,27,29, Squire Street And 69 Northinch Street, Former Whiteinch Jordanvale Parish Church And Hall	Category B Listed Building	The building is considered far enough from the proposed scheme for the presence of the new assembly hall to have no permanent change to the setting of the building and will not impact its heritage value.	Medium	No change	Neutral
MM020	14 Victoria Park Drive South, Whiteinch Public Library	Category B Listed Building	The building is considered far enough from the proposed scheme for the presence of the new assembly hall to have no permanent change to the setting of the building and will not impact its heritage value.	Medium	No change	Neutral
MM021	3-13 (odd Nos) Crow Road and 482-492 (even Nos) Dumbarton Road	Category B Listed Building	The building is considered far enough from the proposed scheme for the presence of the new assembly hall to have no permanent change to the setting of the building and will not impact its heritage value.	Medium	No change	Neutral
MM022	30-36 (even Nos) Sandy Road, 120-124 (even Nos) Beith Street, Former Partick Fire Station	Category B Listed Building	The building is considered far enough from the proposed scheme for the presence of the new assembly hall to have no permanent change to the setting of the building and will not impact its heritage value.	Medium	No change	Neutral
MM023	2a Drumoyne Drive and Langlands Road, Elder Cottage Hospital (West Block)	Category B Listed Building	The building is considered far enough from the proposed scheme for the presence of the new assembly hall to have no permanent change to the setting of the building and will not impact its heritage value.	Medium	No change	Neutral
MM024	Elder Park, Cottage	Category B Listed Building	The construction of the new assembly hall will change the setting of the heritage asset, especially views north of Elder Park. However, as the asset is heavily screened by vegetation surrounding the park, as well as having a wider connection with the shipyard itself, these changes to	Medium	No change	Neutral

MM Number	Name	Designation	Description of impact	Value/ sensitivity	Magnitude of impact	Significance of effect
			the setting do not impact the ability to understand the heritage value of the building. Therefore, there will be no change to the heritage value of the asset.			
MM025	Elder Park, Fragments of Linthouse Mansion	Category B Listed Building	The construction of the new assembly hall will change the setting of the asset, especially views north of Elder Park. However, as the asset is heavily screened by vegetation surrounding the park, as well as having a wider connection with the shipyard itself, these changes to the setting do not impact the ability to understand the heritage value of the asset. Therefore, there will be no change to the heritage value of the asset.	Medium	No change	Neutral
MM026	Elder Park, Statue of John Elder	Category B Listed Building	The construction of the new assembly hall will change the setting of the statue, especially views north of Elder Park. However, as the statue is heavily screened by vegetation surrounding the park, as well as having a wider connection with the shipyard itself, these changes to the setting do not impact the ability to understand the heritage value of the statue. Therefore, there will be no change to the heritage value of the asset.	Medium	No change	Neutral
MM027	1345 Govan Road, Southern General Hospital, (Former Govan Poorhouse Hospital Block)	Category B Listed Building	The building is considered far enough from the proposed scheme for the presence of the new assembly hall to have no permanent change to the setting of the building and will not impact its heritage value.	Medium	No change	Neutral
MM028	87,91 Holmfauld Road, Linthouse Buildings	Category B Listed Building	The construction of the new assembly hall will change the setting of the asset, especially views east towards the Govan Shipyard. However, as the setting of the asset is industrial and the character of this will not be changed, there will be no impact on the heritage value of the asset. Therefore, there will be no change to the heritage value of the asset.	Medium	No change	Neutral
MM029	200 Shieldhall Road, Drumoyne Primary School, Janitor's Lodge Gatepiers and Boundary Walls	Category B Listed Building	The building is considered far enough from the proposed scheme for the presence of the new assembly hall to have no permanent change to the setting of the building and will not impact its heritage value.	Medium	No change	Neutral
MM030	9 Skipness Drive, Linthouse/St Kenneth's Church including Original Church Hall and Church Officer's House	Category B Listed Building	The building is considered far enough from the proposed scheme for the presence of the new assembly hall to have no permanent change to the setting of the building and will not impact its heritage value.	Medium	No change	Neutral
MM031	65-69 (odd Nos) Golspie Street, Former Hill's Trust School	Category B Listed Building	While the ZTV has highlighted potential intervisibility between the new assembly hall and this asset, the construction of the new assembly hall will not alter the character of the building's setting which is largely urban and industrial. As such, these changes to the setting do not impact the ability to understand the heritage value of the building. Therefore, there will be no change to the heritage value of the asset.	Medium	No change	Neutral
MM032	705, 707 Govan Road, Return Elevations To Broomloan Road, Former Savings Bank, Govan Branch	Category B Listed Building	While the ZTV has highlighted potential intervisibility between the new assembly hall and this asset, the construction of the new assembly hall will not alter the character of the building's setting which is largely urban and industrial. As such, these changes to the setting do not impact the ability to understand the heritage value of the building. Therefore, there will be no change to the heritage value of the asset.	Medium	No change	Neutral
MM033	Near 801 Govan Road, Junction With Burleigh Street, Sir William Pearce, Statue	Category B Listed Building	While the ZTV has highlighted potential intervisibility between the new assembly hall and this asset, the construction of the new assembly hall will not alter the character of the building's setting which is largely urban and industrial. As such, these changes to the setting do not impact the ability to understand the heritage value of the building. Therefore, there will be no change to the heritage value of the asset.	Medium	No change	Neutral
MM034	801, 805 Govan Road, 2, 4 Burleigh Street, Cardell Halls and Public House	Category B Listed Building	While the ZTV has highlighted potential intervisibility between the new assembly hall and this asset, the construction of the new assembly hall will not alter the character of the building's setting which is largely urban and industrial. As such, these changes to the setting do not impact the ability to understand the heritage value of the building. Therefore, there will be no change to the heritage value of the asset.	Medium	No change	Neutral
MM035	831 Govan Road, St Anthony's RC Church	Category B Listed Building	While the ZTV has highlighted potential intervisibility between the new assembly hall and this asset, the construction of the new assembly hall will not alter the character of the building's setting which is largely urban and industrial. As such, these changes to the setting do not impact the ability to understand the heritage value of the building. Therefore, there will be no change to the heritage value of the asset.	Medium	No change	Neutral
MM036	881, 883, 885, 887 Govan Road, 2, 4 Shaw St	Category B Listed Building	While the ZTV has highlighted potential intervisibility between the new assembly hall and this asset, the construction of the new assembly hall will not alter the character of the building's setting which is largely urban and industrial. As such, these changes to the setting do not impact the ability to understand the heritage value of the building. Therefore, there will be no change to the heritage value of the asset.	Medium	No change	Neutral
MM037	638-646 (even Nos) Govan Road, 3 Napier Street, Napier House	Category B Listed Building	While the ZTV has highlighted potential intervisibility between the new assembly hall and this asset, the construction of the new assembly hall will not alter the character of the building's setting which is largely urban and industrial. As such, these changes to the setting do not impact the ability to understand the heritage value of the building. Therefore, there will be no change to the heritage value of the asset.	Medium	No change	Neutral
MM038	784-796 (even Nos) Govan Road, New Govan, formerly St Mary's, Church Hall and Shops Below	Category B Listed Building	While the ZTV has highlighted potential intervisibility between the new assembly hall and this asset, the construction of the new assembly hall will not alter the character of the building's setting which is largely urban and industrial. As such, these changes to the setting do not impact the ability to understand the heritage value of the building. Therefore, there will be no change to the heritage value of the asset.	Medium	No change	Neutral
MM039	Govan Road, Govan Cross Drinking Fountain	Category B Listed Building	While the ZTV has highlighted potential intervisibility between the new assembly hall and this asset, the construction of the new assembly hall will not alter the character of the building's setting which is largely urban and industrial. As such, these changes to the setting do not impact the ability to understand the heritage value of the building. Therefore, there will be no change to the heritage value of the asset.	Medium	No change	Neutral
MM040	908 Govan Road And Return Elevation to Mckechnie Street, County Bingo Social Club, Former Lyceum Cinema	Category B Listed Building	While the ZTV has highlighted potential intervisibility between the new assembly hall and this asset, the construction of the new assembly hall will not alter the character of the building's setting which is largely urban and industrial. As such, these changes to the setting do not impact the ability to understand the heritage value of the building. Therefore, there will be no change to the heritage value of the asset.	Medium	No change	Neutral
MM041	2 Water Row, Govan Cross, New Govan Church of Scotland, Former St Mary's Church.	Category B Listed Building	While the ZTV has highlighted potential intervisibility between the new assembly hall and this asset, the construction of the new assembly hall will not alter the character of the building's setting which is largely urban and industrial. As such, these changes to the setting do not impact the ability to understand the heritage value of the building. Therefore, there will be no change to the heritage value of the asset.	Medium	No change	Neutral
MM042	18,20 Orkney Street Govan Police Building, Former Govan Municipal Buildings	Category B Listed Building	While the ZTV has highlighted potential intervisibility between the new assembly hall and this asset, the construction of the new assembly hall will not alter the character of the building's setting which is largely urban and industrial. As such, these changes to the setting do not impact the ability to understand the heritage value of the building. Therefore, there will be no change to the heritage value of the asset.	Medium	No change	Neutral
MM043	5,7,9 Water Row Former YMCA	Category B Listed Building	While the ZTV has highlighted potential intervisibility between the new assembly hall and this asset, the construction of the new assembly hall will not alter the character of the building's setting which is largely urban and industrial. As such, these changes to the setting do not impact the ability to understand the heritage value of the building. Therefore, there will be no change to the heritage value of the asset.	Medium	No change	Neutral

MM Number	Name	Designation	Description of impact	Value/ sensitivity	Magnitude of impact	Significance of effect
MM044	Dumbarton Road, Whiteinch, St Paul's Roman Catholic Church including Boundary Walls, Gatepiers, Gates and Railings	Category B Listed Building	The building is considered far enough from the proposed scheme for the presence of the new assembly hall to have no permanent change to the setting of the building and will not impact its heritage value.	Medium	No change	Neutral
MM045	36-40 Golspie Street & 16 Garmouth Street, Salvation Army Citadel	Category B Listed Building	While the ZTV has highlighted potential intervisibility between the new assembly hall and this asset, the construction of the new assembly hall will not alter the character of the building's setting and the principal views are to the east where the entrance is located. As such, these changes to the setting do not impact the ability to understand the heritage value of the building. Therefore, there will be no change to the heritage value of the asset.	Medium	No change	Neutral
MM046	35 Inchlee Street, 15, 16 Victoria Park Drive South Former Whiteinch Burgh Hall, Former Police Station And Former Fire Station including Boundary Wall, Gatepiers and Railings	Category B Listed Building	The building is considered far enough from the proposed scheme for the presence of the new assembly hall to have no permanent change to the setting of the building and will not impact its heritage value.	Medium	No change	Neutral
MM047	57 Laurel Street, Crathie Court including Terrace Wall	Category B Listed Building	The building is considered far enough from the proposed scheme for the presence of the new assembly hall to have no permanent change to the setting of the building and will not impact its heritage value.	Medium	No change	Neutral
MM048	Former Greenfield Primary School, Including Janitor's Accommodation, Laundary and Swimming Pool Block, Boundary Walls and Gatepiers, 29 Nimmo Drive, Govan, Glasgow	Category B Listed Building	The building is considered far enough from the proposed scheme for the presence of the new assembly hall to have no permanent change to the setting of the building and will not impact its heritage value.	Medium	No change	Neutral
MM049	1345 Govan Road, Southern General Hospital, Administration Block (Former Govan Poorhouse)	Category B Listed Building	The building is considered far enough from the proposed scheme for the presence of the new assembly hall to have no permanent change to the setting of the building and will not impact its heritage value.	Medium	No change	Neutral
MM050	2 Broomhill Avenue and 1-3 (Odd Nos) Broomhill Terrace	Category C Listed Building	The building is considered far enough from the proposed scheme for the presence of the new assembly hall to have no permanent change to the setting of the building and will not impact its heritage value.	Medium	No change	Neutral
MM051	23-41 (Odd Nos) Broomhill Drive and 1-15 (Odd Nos) Broomhill Avenue, with Gatepiers and Low Boundary Wall	Category C Listed Building	The building is considered far enough from the proposed scheme for the presence of the new assembly hall to have no permanent change to the setting of the building and will not impact its heritage value.	Medium	No change	Neutral
MM052	62, 64 Langlands Road and Return Elevation to Roseneath Street, St Anthony's RC Presbytery	Category C Listed Building	The building is considered far enough from the proposed scheme for the presence of the new assembly hall to have no permanent change to the setting of the building and will not impact its heritage value.	Medium	No change	Neutral
MM053	27 Broomhill Avenue, Former Balshagray Public School Including Swimming Pool and Janitor's House, Gates, Gatepiers and Railings	Category C Listed Building	The building is considered far enough from the proposed scheme for the presence of the new assembly hall to have no permanent change to the setting of the building and will not impact its heritage value.	Medium	No change	Neutral

Source: Mott MacDonald 2022

Table 7.4: Assessment of permanent effects from construction impacts on non-designated heritage assets

MM Number	Site Name	Type	Description of impact	Value/ sensitivity	Magnitude of impact	Significance of effect
MM054	Fairfield Shipyard and Engine Works, Fitting-out Basin / Bae Systems; Upper Clyde Shipbuilding Yard; Kvaerner Govan Shipyard	Non-designated	The construction of the proposed scheme will alter the fabric of the Fitting-out basin (MM054) walls as the south wall will no longer be functional, the east wall will be burnt down, the cope broken out and the tie rods removed. The base of the basin will also be directly impacted by piling. The basin will then be infilled with an inert material. This will impact the heritage value of the asset as it will not be understood as a working basin; however, elements of the basin will be retained in situ and preserved as an archaeological asset. The presence of the new assembly hall, over the former basin, will mean that the basin cannot be readily interpreted as such, and its original function, and the contribution this makes to its heritage value will be lost. It should be noted that the design preserves the form of the north entrance from the River Clyde so its former presence can still be discerned on the waterfront. The associated mooring posts and winches which surround the basin will be removed. The loss of these associated assets will also impact the heritage value of the basin. However, it is anticipated that this impact will be partially mitigated as some of these assets may be placed around the edge of the basin after the completion of construction. Therefore, there will be a moderate adverse change to the heritage value of the asset.	Medium	Major adverse	Moderate adverse
MM055	Fairfield Shipyard and Engine Works, Plumber's Shops / Bae Systems; Upper Clyde Shipbuilding Yard; Kvaerner Govan Shipyard	Non-designated	The infilling of the basin and construction of the new assembly hall will alter the setting of the heritage asset to the north. However, as the industrial character of the setting will be retained through the functioning shipyard this will not impact the heritage value of the asset. The infilling of the basin itself will remove the relationship between the Fitting-out Basin and the Plumber's Shops which are directly to the south of it. However, it is anticipated that this impact will be partially mitigated as design measures will be taken to ensure that the former edge of the basin is delineated and its relationship with the wider shipyard is reflected. This may be done through re-instating the mooring posts (MM095) or winches (MM096) or the use of different coloured paving. The northern entrance of the basin will also still be retained, As such, there will be no change to the heritage value of the asset.	Low	No change	Neutral
MM056	Fairfield Shipyard and Engine Works, Plate Fabrication Shed / Bae Systems; Upper Clyde Shipbuilding Yard; Kvaerner Govan Shipyard	Non-designated	The infilling of the basin and construction of the new assembly hall will alter the setting of the heritage asset to the west. However, as the industrial character of the setting will be retained through the functioning shipyard this will not impact the heritage value of the asset. The infilling of the basin itself will remove the relationship between the Fitting-out Basin and the Plate Fabrication Shed which to the east of it. However, it is anticipated that this impact will be partially mitigated as design measures will be taken to ensure that the former edge of the basin is delineated and its relationship with the wider shipyard is reflected. This may be done through re-instating the mooring posts (MM095) or winches (MM096) or the use of different coloured paving. The northern entrance of the basin will also still be retained,	Low	No change	Neutral

MM Number	Site Name	Type	Description of impact	Value/ sensitivity	Magnitude of impact	Significance of effect
			As such, there will be no change to the heritage value of the asset.			
MM057	Giant Cantilever Crane / Fairfield Shipyard	Non-designated	The construction of the proposed scheme will have no change on the crane as it no longer exists, as such it will not impact the setting of the asset and therefore the ability to understand the heritage value of the asset.	Negligible	No change	Neutral
MM058	Kvaerner Govan Shipyard, New Fabrication Shed / Fairfield Shipyard	Non-designated	The infilling of the basin and construction of the new assembly hall will alter the setting of the heritage asset to the west. However, as the industrial character of the setting will be retained through the functioning shipyard this will not impact the heritage value of the asset. The infilling of the basin itself will remove the relationship between the Fitting-out Basin and the Plate Fabrication Shed which to the east of it. However, it is anticipated that this impact will be partially mitigated as design measures will be taken to ensure that the former edge of the basin is delineated and its relationship with the wider shipyard is reflected. This may be done through re-instating the mooring posts (MM095) or winches (MM096) or the use of different coloured paving. The northern entrance of the basin will also still be retained, As such, there will be no change to the heritage value of the asset.	Low	No change	Neutral
MM059	Meadowside Quay, Meadowside Granaries	Non-designated	The asset marks the former site of a quay that is no longer extant and therefore it is considered that the construction of the proposed scheme will have no permanent change to the setting of the building and will not impact its heritage value.	Low	No change	Neutral
MM060	Broomielaw, Clyde Foot Tunnel / Finnieston Entrance	Non-designated	There is no intervisibility between the Clyde Foot Tunnel and the proposed scheme area therefore it is considered that the construction of the proposed scheme will have no permanent change to the setting of the building and will not impact its heritage value.	Low	No change	Neutral
MM061	Partick, Meadowside Quay / Clyde Aa Defences; Castlebank Street	Non-designated	The asset marks the former site of Second World War balloon barrage that is no longer extant and has subsequently been built over. Therefore, it is considered that the construction of the proposed scheme will have no permanent change to the setting of the building and will not impact its heritage value.	Low	No change	Neutral
MM062	South Street, Merklands Animals Lairage / Merklands Quay	Non-designated	The asset marks the site of a warehouse that is no longer extant and is currently being built on. Therefore, it is considered that the construction of the proposed scheme will have no permanent change to the setting of the building and will not impact its heritage value.	Low	No change	Neutral
MM063	Castlebank St, Meadowside Granary / Meadowside Quay / Whiteinch	Non-designated	The asset marks the former site of a granary that is no longer extant and therefore it is considered that the construction of the proposed scheme will have no permanent change to the setting of the building and will not impact its heritage value.	Negligible	No change	Neutral
MM064	Linthouse Engine Works, Shipyard / Alexander Stephens and Sons / Holmfaud Road / Linthouse Shipbuilding Yard	Non-designated	The asset marks the former site of the Linthouse Engine Works; however, no aspects of the building or wider shipyard are visible as the site is currently occupied by Thales UK. Therefore, it is considered that the construction of the proposed scheme will have no permanent change to the setting of the building and will not impact its heritage value.	Low	No change	Neutral
MM065	Linthouse	Non-designated	The asset marks a find-spot and therefore it is considered that the construction of the proposed scheme will have no permanent change to the setting of the building and will not impact its heritage value.	Negligible	No change	Neutral
MM066	Partick, Chapel	Non-designated	The asset marks the former site of chapel that is no longer extant and therefore it is considered that the construction of the proposed scheme will have no permanent change to the setting of the building and will not impact its heritage value.	Low	No change	Neutral
MM067	Partick, Coin Hoard	Non-designated	The asset marks a find-spot and therefore it is considered that the construction of the proposed scheme will have no permanent change to the setting of the building and will not impact its heritage value.	Negligible	No change	Neutral
MM068	Castlebank Street, Tenement	Non-designated	While the ZTV has highlighted potential intervisibility between the new assembly hall and this asset, the construction of the new assembly hall will not alter the character of the building's setting which is largely urban and industrial. As such, these changes to the setting do not impact the ability to understand the heritage value of the building. Therefore, there will be no change to the heritage value of the asset.	Negligible	No change	Neutral
MM069	8-10 Cressy Street	Non-designated	While the ZTV has highlighted potential intervisibility between the new assembly hall and this asset, the construction of the new assembly hall will not alter the character of the building's setting which is largely urban and industrial. As such, these changes to the setting do not impact the ability to understand the heritage value of the building. Therefore, there will be no change to the heritage value of the asset.	Negligible	No change	Neutral
MM070	Holmfaud House	Non-designated	While the ZTV has highlighted potential intervisibility between the new assembly hall and this asset, the construction of the new assembly hall will not alter the character of the building's setting which is largely urban and industrial. As such, these changes to the setting do not impact the ability to understand the heritage value of the building. Therefore, there will be no change to the heritage value of the asset.	Negligible	No change	Neutral
MM071	Glasgow, Linthouses	Non-designated	While the ZTV has highlighted potential intervisibility between the new assembly hall and this asset, the construction of the new assembly hall will not alter the character of the building's setting which is largely urban and industrial. As such, these changes to the setting do not impact the ability to understand the heritage value of the building. Therefore, there will be no change to the heritage value of the asset.	Low	No change	Neutral
MM072	Glasgow, 91 Holmfauld Road, Training Centre	Non-designated	While the ZTV has highlighted potential intervisibility between the new assembly hall and this asset, the construction of the new assembly hall will not alter the character of the building's setting which is largely urban and industrial. As such, these changes to the setting do not impact the ability to understand the heritage value of the building. Therefore, there will be no change to the heritage value of the asset.	Negligible	No change	Neutral
MM073	Glasgow, 9 Skipness Drive, Linthouse Church	Non-designated	While the ZTV has highlighted potential intervisibility between the new assembly hall and this asset, the construction of the new assembly hall will not alter the character of the building's setting which is largely urban and industrial. As such, these changes to the setting do not impact the ability to understand the heritage value of the building. Therefore, there will be no change to the heritage value of the asset.	Negligible	No change	Neutral
MM074	Glasgow, Sawmill Road, Railway Bridge	Non-designated	While the ZTV has highlighted potential intervisibility between the new assembly hall and this asset, the construction of the new assembly hall will not alter the character of the building's setting which is largely urban and industrial. As such, these changes to the setting do not impact the ability to understand the heritage value of the building. Therefore, there will be no change to the heritage value of the asset.	Negligible	No change	Neutral
MM075	Ferry Terminal (20th Century)	Non-designated	The asset marks the site of a former ferry terminal that is no longer in use and is currently being built on. Therefore, it is considered that the construction of the proposed scheme will have no permanent change to the setting of the building and will not impact its heritage value.	Negligible	No change	Neutral
MM076	Glasgow, 9 Skipness Drive, Hall and Church Officer's House	Non-designated	While the ZTV has highlighted potential intervisibility between the new assembly hall and this asset, the construction of the new assembly hall will not alter the character of the building's setting which is largely urban and industrial. As such, these changes to the setting do not impact the ability to understand the heritage value of the building. Therefore, there will be no change to the heritage value of the asset.	Negligible	No change	Neutral
MM077	Glasgow, Lower Harbour, Clyde Tunnel, South Portal	Non-designated	There is no intervisibility between the Clyde Tunnel and the proposed scheme area, therefore it is considered that the construction of the proposed scheme will have no permanent change to the setting of the building and will not impact its heritage value.	Low	No change	Neutral

MM Number	Site Name	Type	Description of impact	Value/ sensitivity	Magnitude of impact	Significance of effect
MM078	Linthouse Shipyard	Non-designated	The asset marks the former site of the Linthouse shipyard; however, no aspects of the shipyard are visible as the site is currently occupied by Thales UK. Therefore, it is considered that the construction of the proposed scheme will have no permanent change to the setting of the building and will not impact its heritage value.	Low	No change	Neutral
MM079	Govan, Howat Street	Non-designated	While the ZTV has highlighted potential intervisibility between the new assembly hall and this asset, the construction of the new assembly hall will not alter the character of the building's setting which is largely urban and industrial. As such, these changes to the setting do not impact the ability to understand the heritage value of the building. Therefore, there will be no change to the heritage value of the asset.	Negligible	No change	Neutral
MM080	Govan Silk Factory	Non-designated	The asset marks the former site of Govan Silk Factory that is no longer extant and is currently being built on. Therefore, it is considered that the construction of the proposed scheme will have no permanent change to the setting of the building and will not impact its heritage value.	Negligible	No change	Neutral
MM081	Robinson Dunn and Co Sawmills	Non-designated	The asset marks the former site of Robinson Dunn and Co Sawmills that is no longer extant. Therefore, it is considered that the construction of the proposed scheme will have no permanent change to the setting of the building and will not impact its heritage value.	Low	No change	Neutral
MM082	925 Govan Road, Assist, House Improvement Advisory Centre	Non-designated	While the ZTV has highlighted potential intervisibility between the new assembly hall and this asset, the construction of the new assembly hall will not alter the character of the building's setting which is largely urban and industrial. As such, these changes to the setting do not impact the ability to understand the heritage value of the building. Therefore, there will be no change to the heritage value of the asset.	Negligible	No change	Neutral
MM083	Govan, Elder Park	Non-designated	The asset marks the former site of Second World War balloon barrage that is no longer extant. Therefore, it is considered that the construction of the proposed scheme will have no permanent change to the setting of the building and will not impact its heritage value.	Low	No change	Neutral
MM084	Jetty, River Clyde, Partick Saw Mills	Non-designated	The asset marks the former site of a jetty that is no longer extant. Therefore, it is considered that the construction of the proposed scheme will have no permanent change to the setting of the building and will not impact its heritage value.	Negligible	No change	Neutral
MM085	Govan Road, Fairfield Ship Yard and Engine Works, Cranes	Non-designated	The infilling of the basin and construction of the new assembly hall will alter the setting of the heritage asset. However, as the industrial character of the setting will be retained through the functioning shipyard this will not impact the heritage value of the asset. The infilling of the basin itself will remove the relationship between the Fitting-out Basin and the crane tramways which served the basin. However, it is anticipated that this impact will be partially mitigated as design measures will be taken to ensure that the former edge of the basin is delineated and its relationship with the wider shipyard is reflected. This may be done through re-instating the mooring posts (MM095) or winches (MM096) or the use of different coloured paving. The northern entrance of the basin will also still be retained, As such, there will be no change to the heritage value of the asset.	Low	No change	Neutral
MM086	Mile Post, River Clyde, Govan	Non-designated	The asset marks the site of a mile post that is within an entirely industrial setting, which will be retained through the construction of the proposed scheme. Therefore, it is considered that the construction of the proposed scheme will have no permanent change to the setting of the building and will not impact its heritage value.	Negligible	No change	Neutral
MM094	Maritime Obstruction	Non-designated	The asset is recorded as a maritime obstruction at an unknown depth; therefore it is considered that the construction of the proposed scheme will have no permanent change to the setting of the building and will not impact its heritage value.	Negligible	No change	Neutral
MM095	Fairfield Shipyard and Engine Works - Mooring Posts	Non-designated	The removal of the mooring posts during the construction of the proposed scheme will result in a major adverse impact on the heritage asset. This is because this will involve removing the asset from around the basin and within the shipyard. This impact will not be mitigated during design measures; however, some of the posts may be reinstated around the former edge of the basin or elsewhere within the shipyard to retain their relationship with the site. Moreover, the infilling of the basin and construction of the new assembly hall will alter the setting of the heritage asset, but the industrial character of the setting will be retained through the functioning shipyard. Therefore, this will not impact the heritage value of the asset. The infilling of the basin itself will also remove the relationship between the Fitting-out Basin and the mooring posts which served the basin. As such, there will be moderate adverse impact to the heritage value of the asset following mitigation.	Low	Major adverse	Moderate adverse
MM096	Fairfield Shipyard and Engine Works - Shipyard Winch	Non-designated	The removal of the winches during the construction of the proposed scheme will result in a major adverse impact on the heritage asset. This is because this will involve removing the asset from around the basin and within the shipyard. This impact will not be mitigated during design measures; however, one of winches may be reinstated around the former edge of the basin or elsewhere within the shipyard to retain tits relationship with the site. Moreover, the infilling of the basin and construction of the new assembly hall will alter the setting of the heritage asset, but the industrial character of the setting will be retained through the functioning shipyard. Therefore, this will not impact the heritage value of the asset. The infilling of the basin itself will also remove the relationship between the Fitting-out Basin and the winches which served the basin. As such, there will be moderate adverse impact to the heritage value of the asset following mitigation.	Low	Major adverse	Moderate adverse
N/A	Unknown archaeological remains	Non-designated	As the construction works do not involve excavation but only infill, and provided that appropriate archaeological mitigation is followed then there are no anticipated impacts on unknown archaeological remains from the proposed scheme.	Low	No change	Neutral

Source: Mott MacDonald 2022

7.3 Assessment of effects from operation of the proposed scheme

Table 7.5: Assessment of effects from operation impacts on designated heritage assets

MM Number	Name	Designation	Description of impact	Value/ sensitivity	Magnitude of impact	Significance of effect
MM001	Govan, Carved Stones and Old Parish Church Graveyard	Scheduled Monument	The Scheduled Monument is considered far enough from the proposed scheme for the operation of the new assembly hall to have no change to the setting of the heritage asset. There will be no impact to its heritage value.	High	No change	Neutral

MM Number	Name	Designation	Description of impact	Value/ sensitivity	Magnitude of impact	Significance of effect
MM002	Victoria Park	Garden and Designed Landscape	The garden and designed landscape is considered far enough from the proposed scheme for the operation of the Scheme to have no change to the setting of the heritage asset. There will be no impact to its heritage value.	High	No change	Neutral
MM003	Govan	Conservation Area	The operation of the new assembly hall will have no change on the conservation area as the functioning shipyard already contributes to the partial industrial character of Govan Conservation Area. Therefore, any reduction in noise from the manufacturing process shielded by the new assembly hall will have no change to the setting of this asset. There will be no impact to its heritage value.	High	No change	Neutral
MM004	Victoria Park	Conservation Area	The conservation area is considered far enough from the proposed scheme for the operation of the new assembly hall to have no change to the setting of the heritage asset. There will be no impact to its heritage value.	High	No change	Neutral
MM005	Glasgow West	Conservation Area	The conservation area is considered far enough from the proposed scheme for the operation of the new assembly hall to have no change to the setting of the heritage asset. There will be no impact to its heritage value.	High	No change	Neutral
MM006	Broomhill	Conservation Area	The conservation area is considered far enough from the proposed scheme for the operation of the new assembly hall to have no change to the setting of the heritage asset. There will be no impact to its heritage value.	High	No change	Neutral
MM007	1048 Govan Road, Govan Shipbuilders' Store, Former Engine Works of Fairfield Shipbuilding and Engineering Company	Category A Listed Building	The operation of the new assembly hall will have no change to the setting of the building. The functioning shipyard already forms an important part of the industrial setting which contributes to the heritage value of the building. Therefore, any reduction in noise from the manufacturing process shielded by the new assembly hall will have no impact on the setting of this asset. There will also be no changes to site routes and vehicle movements within the site during operation of the proposed scheme therefore this will have no long-term change on the structure or its useability.	High	No change	Neutral
MM008	1030, 1048 Govan Road, Govan Shipbuilders Ltd, General Offices (excluding 1956 Extension To W).	Category A Listed Building	The operation of the new assembly hall will have no change to the setting of the building. The functioning shipyard already forms an important part of the industrial setting which contributes to the heritage value of the building. Therefore, any reduction in noise from the manufacturing process shielded by the new assembly hall will have no impact on the setting of this asset.	High	No change	Neutral
MM009	56 Partickhill Road 'Woodbank', Carriage House, Arch to Service Court, Retaining Walls and Cast-Iron Gates	Category A Listed Building	The building is considered far enough from the proposed scheme for the operation of the new assembly hall to have no change to the setting of the heritage asset. There will be no impact to its heritage value.	High	No change	Neutral
MM010	1a Drumoyne Drive and Langlands Road, Elder Cottage Hospital	Category A Listed Building	The building is considered far enough from the proposed scheme for the operation of the new assembly hall to have no change to the setting of the heritage asset. There will be no impact to its heritage value.	High	No change	Neutral
MM011	228a Langlands Road and Elder Park Street, Elder Park Library	Category A Listed Building	The operation of the new assembly hall will have a beneficial minor impact on the heritage value of the library. This is because the construction of the new assembly hall will reduce the noise from the shipyard. Although this noise forms part of the setting of the library, it detracts from its heritage value as a place of quiet learning. The reduction in noise will improve the setting and how the asset can be appreciated.	High	Minor beneficial	Slight beneficial
MM012	18 Clydebrae Street, Govan Graving Docks	Category A Listed Building	The building is considered far enough from the proposed scheme for the operation of the new assembly hall to have no change to the setting of the heritage asset. There will be no impact to its heritage value.	High	No change	Neutral
MM013	816, 818 Govan Road, 1, 3 Water Row, Former British Linen Bank, and Flats	Category A Listed Building	The building is considered far enough from the proposed scheme for the operation of the new assembly hall to have no change to the setting of the heritage asset. There will be no impact to its heritage value.	High	No change	Neutral
MM014	840, 860 Govan Road And Return Elevation to Pearce Street, Pearce Institute	Category A Listed Building	The building is considered far enough from the proposed scheme for the operation of the new assembly hall to have no change to the setting of the heritage asset. There will be no impact to its heritage value.	High	No change	Neutral
MM015	866, 868 Govan Road, Govan Old Parish Church (C of S)	Category A Listed Building	The building is considered far enough from the proposed scheme for the operation of the new assembly hall to have no change to the setting of the heritage asset. There will be no impact to its heritage value.	High	No change	Neutral
MM016	Statue of Isabella Elder, Elder Park, Glasgow	Category A Listed Building	The building is considered far enough from the proposed scheme for the operation of the new assembly hall to have no change to the setting of the heritage asset. There will be no impact to its heritage value.	High	No change	Neutral
MM017	739 South Street, North British Engine Works	Category A Listed Building	The building is considered far enough from the proposed scheme for the operation of the new assembly hall to have no change to the setting of the heritage asset. There will be no impact to its heritage value.	High	No change	Neutral
MM018	739 South Street, Former North British Diesel Engine Engine Works, Quayside Titan Crane	Category A Listed Building	The building is considered far enough from the proposed scheme for the operation of the new assembly hall to have no change to the setting of the heritage asset. There will be no impact to its heritage value.	High	No change	Neutral
MM019	19,21,23,25,27,29, Squire Street And 69 Northinch Street, Former Whiteinch Jordanvale Parish Church And Hall	Category B Listed Building	The building is considered far enough from the proposed scheme for the operation of the new assembly hall to have no change to the setting of the heritage asset. There will be no impact to its heritage value.	Medium	No change	Neutral
MM020	14 Victoria Park Drive South, Whiteinch Public Library	Category B Listed Building	The building is considered far enough from the proposed scheme for the operation of the new assembly hall to have no change to the setting of the heritage asset. There will be no impact to its heritage value.	Medium	No change	Neutral
MM021	3-13 (odd Nos) Crow Road and 482-492 (even Nos) Dumbarton Road	Category B Listed Building	The building is considered far enough from the proposed scheme for the operation of the new assembly hall to have no change to the setting of the heritage asset. There will be no impact to its heritage value.	Medium	No change	Neutral
MM022	30-36 (even Nos) Sandy Road, 120-124 (even Nos) Beith Street, Former Partick Fire Station	Category B Listed Building	The building is considered far enough from the proposed scheme for the operation of the new assembly hall to have no change to the setting of the heritage asset. There will be no impact to its heritage value.	Medium	No change	Neutral
MM023	2a Drumoyne Drive and Langlands Road, Elder Cottage Hospital (West Block)	Category B Listed Building	The building is considered far enough from the proposed scheme for the operation of the new assembly hall to have no change to the setting of the heritage asset. There will be no impact to its heritage value.	Medium	No change	Neutral
MM024	Elder Park, Cottage	Category B Listed Building	The operation of the new assembly hall will have no change on the heritage asset or its setting.	Medium	No change	Neutral

MM Number	Name	Designation	Description of impact	Value/ sensitivity	Magnitude of impact	Significance of effect
MM025	Elder Park, Fragments of Linthouse Mansion	Category B Listed Building	The operation of the new assembly hall will have no change on the heritage asset or its setting.	Medium	No change	Neutral
MM026	Elder Park, Statue of John Elder	Category B Listed Building	The operation of the new assembly hall will have no change on the heritage asset or its setting.	Medium	No change	Neutral
MM027	1345 Govan Road, Southern General Hospital, (Former Govan Poorhouse Hospital Block)	Category B Listed Building	The building is considered far enough from the proposed scheme for the operation of the new assembly hall to have no change to the setting of the heritage asset. There will be no impact to its heritage value.	Medium	No change	Neutral
MM028	87,91 Holmfauld Road, Linthouse Buildings	Category B Listed Building	The operation of the new assembly hall will have no change on the heritage asset or its setting.	Medium	No change	Neutral
MM029	200 Shieldhall Road, Drumoyne Primary School, Janitor's Lodge Gatepiers and Boundary Walls	Category B Listed Building	The building is considered far enough from the proposed scheme for the operation of the new assembly hall to have no change to the setting of the heritage asset. There will be no impact to its heritage value.	Medium	No change	Neutral
MM030	9 Skipness Drive, Linthouse/St Kenneth's Church including Original Church Hall and Church Officer's House	Category B Listed Building	The building is considered far enough from the proposed scheme for the operation of the new assembly hall to have no change to the setting of the heritage asset. There will be no impact to its heritage value.	Medium	No change	Neutral
MM031	65-69 (odd Nos) Golspie Street, Former Hill's Trust School	Category B Listed Building	The building is considered far enough from the proposed scheme for the operation of the new assembly hall to have no change to the setting of the heritage asset. There will be no impact to its heritage value.	Medium	No change	Neutral
MM032	705, 707 Govan Road, Return Elevations To Broomloan Road, Former Savings Bank, Govan Branch	Category B Listed Building	The building is considered far enough from the proposed scheme for the operation of the new assembly hall to have no change to the setting of the heritage asset. There will be no impact to its heritage value.	Medium	No change	Neutral
MM033	Near 801 Govan Road, Junction With Burleigh Street, Sir William Pearce, Statue	Category B Listed Building	The building is considered far enough from the proposed scheme for the operation of the new assembly hall to have no change to the setting of the heritage asset. There will be no impact to its heritage value.	Medium	No change	Neutral
MM034	801, 805 Govan Road, 2, 4 Burleigh Street, Cardell Halls and Public House	Category B Listed Building	The building is considered far enough from the proposed scheme for the operation of the new assembly hall to have no change to the setting of the heritage asset. There will be no impact to its heritage value.	Medium	No change	Neutral
MM035	831 Govan Road, St Anthony's RC Church	Category B Listed Building	The building is considered far enough from the proposed scheme for the operation of the new assembly hall to have no change to the setting of the heritage asset. There will be no impact to its heritage value.	Medium	No change	Neutral
MM036	881, 883, 885, 887 Govan Road, 2, 4 Shaw St	Category B Listed Building	The building is considered far enough from the proposed scheme for the operation of the new assembly hall to have no change to the setting of the heritage asset. There will be no impact to its heritage value.	Medium	No change	Neutral
MM037	638-646 (even Nos) Govan Road, 3 Napier Street, Napier House	Category B Listed Building	The building is considered far enough from the proposed scheme for the operation of the new assembly hall to have no change to the setting of the heritage asset. There will be no impact to its heritage value.	Medium	No change	Neutral
MM038	784-796 (even Nos) Govan Road, New Govan, formerly St Mary's, Church Hall and Shops Below	Category B Listed Building	The building is considered far enough from the proposed scheme for the operation of the new assembly hall to have no change to the setting of the heritage asset. There will be no impact to its heritage value.	Medium	No change	Neutral
MM039	Govan Road, Govan Cross Drinking Fountain	Category B Listed Building	The building is considered far enough from the proposed scheme for the operation of the new assembly hall to have no change to the setting of the heritage asset. There will be no impact to its heritage value.	Medium	No change	Neutral
MM040	908 Govan Road And Return Elevation to Mckechnie Street, County Bingo Social Club, Former Lyceum Cinema	Category B Listed Building	The building is considered far enough from the proposed scheme for the operation of the new assembly hall to have no change to the setting of the heritage asset. There will be no impact to its heritage value.	Medium	No change	Neutral
MM041	2 Water Row, Govan Cross, New Govan Church of Scotland, Former St Mary's Church.	Category B Listed Building	The building is considered far enough from the proposed scheme for the operation of the new assembly hall to have no change to the setting of the heritage asset. There will be no impact to its heritage value.	Medium	No change	Neutral
MM042	18,20 Orkney Street Govan Police Building, Former Govan Municipal Buildings	Category B Listed Building	The building is considered far enough from the proposed scheme for the operation of the new assembly hall to have no change to the setting of the heritage asset. There will be no impact to its heritage value.	Medium	No change	Neutral
MM043	5,7,9 Water Row Former YMCA	Category B Listed Building	The building is considered far enough from the proposed scheme for the operation of the new assembly hall to have no change to the setting of the heritage asset. There will be no impact to its heritage value.	Medium	No change	Neutral
MM044	Dumbarton Road, Whiteinch, St Paul's Roman Catholic Church including Boundary Walls, Gatepiers, Gates and Railings	Category B Listed Building	The building is considered far enough from the proposed scheme for the operation of the new assembly hall to have no change to the setting of the heritage asset. There will be no impact to its heritage value.	Medium	No change	Neutral
MM045	36-40 Golspie Street & 16 Garmouth Street, Salvation Army Citadel	Category B Listed Building	The building is considered far enough from the proposed scheme for the operation of the new assembly hall to have no change to the setting of the heritage asset. There will be no impact to its heritage value.	Medium	No change	Neutral
MM046	35 Inchlee Street, 15, 16 Victoria Park Drive South Former Whiteinch Burgh Hall, Former Police Station And Former Fire Station including Boundary Wall, Gatepiers and Railings	Category B Listed Building	The building is considered far enough from the proposed scheme for the operation of the new assembly hall to have no change to the setting of the heritage asset. There will be no impact to its heritage value.	Medium	No change	Neutral
MM047	57 Laurel Street, Crathie Court including Terrace Wall	Category B Listed Building	The building is considered far enough from the proposed scheme for the operation of the new assembly hall to have no change to the setting of the heritage asset. There will be no impact to its heritage value.	Medium	No change	Neutral
MM048	Former Greenfield Primary School, Including Janitor's Accommodation, Laundary and	Category B Listed Building	The building is considered far enough from the proposed scheme for the operation of the new assembly hall to have no change to the setting of the heritage asset. There will be no impact to its heritage value.	Medium	No change	Neutral

MM Number	Name	Designation	Description of impact	Value/ sensitivity	Magnitude of impact	Significance of effect
	Swimming Pool Block, Boundary Walls and Gatepiers, 29 Nimmo Drive, Govan, Glasgow					
MM049	1345 Govan Road, Southern General Hospital, Administration Block (Former Govan Poorhouse)	Category B Listed Building	The building is considered far enough from the proposed scheme for the operation of the new assembly hall to have no change to the setting of the heritage asset. There will be no impact to its heritage value.	Medium	No change	Neutral
MM050	2 Broomhill Avenue and 1-3 (Odd Nos) Broomhill Terrace	Category C Listed Building	The building is considered far enough from the proposed scheme for the operation of the new assembly hall to have no change to the setting of the heritage asset. There will be no impact to its heritage value.	Medium	No change	Neutral
MM051	23-41 (Odd Nos) Broomhill Drive and 1-15 (Odd Nos) Broomhill Avenue, with Gatepiers and Low Boundary Wall	Category C Listed Building	The building is considered far enough from the proposed scheme for the operation of the new assembly hall to have no change to the setting of the heritage asset. There will be no impact to its heritage value.	Medium	No change	Neutral
MM052	62, 64 Langlands Road and Return Elevation to Roseneath Street, St Anthony's RC Presbytery	Category C Listed Building	The building is considered far enough from the proposed scheme for the operation of the new assembly hall to have no change to the setting of the heritage asset. There will be no impact to its heritage value.	Medium	No change	Neutral
MM053	27 Broomhill Avenue, Former Balshagray Public School Including Swimming Pool and Janitor's House, Gates, Gatepiers and Railings	Category C Listed Building	The building is considered far enough from the proposed scheme for the operation of the new assembly hall to have no change to the setting of the heritage asset. There will be no impact to its heritage value.	Medium	No change	Neutral

Source: Mott MacDonald 2022

Table 7.6: Assessment of effects from operation impacts on non-designated heritage assets

MM Number	Site Name	Type	Description of impact	Value/ sensitivity	Magnitude of impact	Significance of effect
MM054	Fairfield Shipyard and Engine Works, Fitting-out Basin / Bae Systems; Upper Clyde Shipbuilding Yard; Kvaerner Govan Shipyard	Non-designated	The operation of the Scheme will have no operational effect on the Fitting-out basin as the asset already has a permanent construction effect. The construction of the scheme therefore is preventing the use of the basin.	Medium	No change	Neutral
MM055	Fairfield Shipyard and Engine Works, Plumber's Shops / Bae Systems; Upper Clyde Shipbuilding Yard; Kvaerner Govan Shipyard	Non-designated	The operation of the new assembly hall will have no change on the building as the functioning shipyard already contributes to the industrial heritage value of the building. Therefore, any reduction in noise from the manufacturing process shielded by the new assembly hall will have no impact on the setting of this asset.	Low	No change	Neutral
MM056	Fairfield Shipyard and Engine Works, Plate Fabrication Shed / Bae Systems; Upper Clyde Shipbuilding Yard; Kvaerner Govan Shipyard	Non-designated	The operation of the new assembly hall will have no change on the building as the functioning shipyard already contributes to the industrial heritage value of the building. Therefore, any reduction in noise from the manufacturing process shielded by the new assembly hall will have no impact on the setting of this asset.	Low	No change	Neutral
MM057	Giant Cantilever Crane / Fairfield Shipyard	Non-designated	There is not expected to be any impacts to the asset during operation of the proposed scheme.	Negligible	No change	Neutral
MM058	Kvaerner Govan Shipyard, New Fabrication Shed / Fairfield Shipyard	Non-designated	The operation of the new assembly hall will have no change on the building as the functioning shipyard already contributes to the industrial heritage value of the building. Therefore, any reduction in noise from the manufacturing process shielded by the new assembly hall will have no impact on the setting of this asset.	Low	No change	Neutral
MM059	Meadowside Quay, Meadowside Granaries	Non-designated	There is not expected to be any impacts to the asset during operation of the proposed scheme.	Low	No change	Neutral
MM060	Broomielaw, Clyde Foot Tunnel / Finnieston Entrance	Non-designated	There is not expected to be any impacts to the asset during operation of the proposed scheme.	Low	No change	Neutral
MM061	Partick, Meadowside Quay / Clyde Aa Defences; Castlebank Street	Non-designated	There is not expected to be any impacts to the asset during operation of the proposed scheme.	Low	No change	Neutral
MM062	South Street, Merklands Animals Lairage / Merklands Quay	Non-designated	There is not expected to be any impacts to the asset during operation of the proposed scheme.	Low	No change	Neutral
MM063	Castlebank St, Meadowside Granary / Meadowside Quay / Whiteinch	Non-designated	There is not expected to be any impacts to the asset during operation of the proposed scheme.	Negligible	No change	Neutral
MM064	Linthouse Engine Works, Shipyard / Alexander Stephens and Sons / Holmfauld Road / Linthouse Shipbuilding Yard	Non-designated	There is not expected to be any impacts to the asset during operation of the proposed scheme.	Low	No change	Neutral
MM065	Linthouse	Non-designated	There is not expected to be any impacts to the asset during operation of the proposed scheme.	Negligible	No change	Neutral
MM066	Partick, Chapel	Non-designated	There is not expected to be any impacts to the asset during operation of the proposed scheme.	Low	No change	Neutral
MM067	Partick, Coin Hoard	Non-designated	There is not expected to be any impacts to the asset during operation of the proposed scheme.	Negligible	No change	Neutral
MM068	Castlebank Street, Tenement	Non-designated	There is not expected to be any impacts to the asset during operation of the proposed scheme.	Negligible	No change	Neutral
MM069	8-10 Cressy Street	Non-designated	There is not expected to be any impacts to the asset during operation of the proposed scheme.	Negligible	No change	Neutral
MM070	Holmfaud House	Non-designated	There is not expected to be any impacts to the asset during operation of the proposed scheme.	Negligible	No change	Neutral

MM Number	Site Name	Type	Description of impact	Value/ sensitivity	Magnitude of impact	Significance of effect
MM071	Glasgow, Linthouses	Non-designated	There is not expected to be any impacts to the asset during operation of the proposed scheme.	Low	No change	Neutral
MM072	Glasgow, 91 Holmfauld Road, Training Centre	Non-designated	There is not expected to be any impacts to the asset during operation of the proposed scheme.	Negligible	No change	Neutral
MM073	Glasgow, 9 Skipness Drive, Linthouse Church	Non-designated	There is not expected to be any impacts to the asset during operation of the proposed scheme.	Negligible	No change	Neutral
MM074	Glasgow, Sawmill Road, Railway Bridge	Non-designated	There is not expected to be any impacts to the asset during operation of the proposed scheme.	Negligible	No change	Neutral
MM075	Ferry Terminal (20th Century)	Non-designated	There is not expected to be any impacts to the asset during operation of the proposed scheme.	Negligible	No change	Neutral
MM076	Glasgow, 9 Skipness Drive, Hall and Church Officer's House	Non-designated	There is not expected to be any impacts to the asset during operation of the proposed scheme.	Negligible	No change	Neutral
MM077	Glasgow, Lower Harbour, Clyde Tunnel, South Portal	Non-designated	There is not expected to be any impacts to the asset during operation of the proposed scheme.	Low	No change	Neutral
MM078	Linthouse Shipyard	Non-designated	There is not expected to be any impacts to the asset during operation of the proposed scheme.	Low	No change	Neutral
MM079	Govan, Howat Street	Non-designated	There is not expected to be any impacts to the asset during operation of the proposed scheme.	Negligible	No change	Neutral
MM080	Govan Silk Factory	Non-designated	There is not expected to be any impacts to the asset during operation of the proposed scheme.	Negligible	No change	Neutral
MM081	Robinson Dunn and Co Sawmills	Non-designated	There is not expected to be any impacts to the asset during operation of the proposed scheme.	Low	No change	Neutral
MM082	925 Govan Road, Assist, House Improvement Advisory Centre	Non-designated	There is not expected to be any impacts to the asset during operation of the proposed scheme.	Negligible	No change	Neutral
MM083	Govan, Elder Park	Non-designated	There is not expected to be any impacts to the asset during operation of the proposed scheme.	Low	No change	Neutral
MM084	Jetty, River Clyde, Partick Saw Mills	Non-designated	There is not expected to be any impacts to the asset during operation of the proposed scheme.	Negligible	No change	Neutral
MM085	Govan Road, Fairfield Ship Yard and Engine Works, Cranes	Non-designated	There is not expected to be any impacts to the asset during operation of the proposed scheme.	Low	No change	Neutral
MM086	Mile Post, River Clyde, Govan	Non-designated	There is not expected to be any impacts to the asset during operation of the proposed scheme.	Negligible	No change	Neutral
MM094	Maritime Obstruction	Non-designated	There is not expected to be any impacts to the asset during operation of the proposed scheme.	Negligible	No change	Neutral
MM095	Fairfield Shipyard and Engine Works - Mooring Posts	Non-designated	The operation of the new assembly hall may have a beneficial moderate impact on the assets if they are repurposed as part of the Scheme. The Scheme may also have wider socio-economic changes on the shipyard which will have an overall moderate beneficial impact.	Low	No change	Neutral
MM096	Fairfield Shipyard and Engine Works - Shipyard Winch	Non-designated	The operation of the new assembly hall may have a beneficial moderate impact on the assets if they are repurposed as part of the Scheme. The Scheme may also have wider socio-economic changes on the shipyard which will have an overall moderate beneficial impact.	Low	No change	Neutral
N/A	Unknown archaeological remains	Non-designated	As any unknown archaeological remains within the Fitting-out Basin will be kept in situ, and provided that appropriate archaeological mitigation is followed then there are no anticipated impacts on unknown archaeological remains from the operation of the proposed scheme.	Low	No change	Neutral

Source: Mott MacDonald 2022

8 Bibliography

8.1 Aerial images

Table 8.1: Aerial images consulted

Frame Numbers	Sortie	Date	Platforms
5455	CPE/Scot/UK/0277	24 August 1947	NCAP
SFFO_0049	58/A/0436	24 March 1950	NCAP
PFFO_0049	58/A/0436	24 March 1950	NCAP
SFFO_0052	58/A/0436	24 March 1950	NCAP
F21_0042	58/8441	29 November 1967	NCAP
F42_0076	58/8893	17 July 1968	NCAP
F42_0077	58/8893	17 July 1968	NCAP
0983	FSL/7825	26 August 1978	NCAP
0984	FSL/7825	26 August 1978	NCAP
0789	CLY/8502	23 March 1985	NCAP
0806	CLY/8502	23 March 1985	NCAP
0807	CLY/8502	23 March 1985	NCAP
0808	CLY/8502	23 March 1985	NCAP
0809	CLY/8502	23 March 1985	NCAP
0810	CLY/8502	23 March 1985	NCAP
-	-	12/2002	Google Earth
-	-	01/2005	Google Earth
-	-base	05/2006	Google Earth
-	-	03/2009	Google Earth
-	-	05/2012	Google Earth
-	-	05/2015	Google Earth
-	-	03/2019	Google Earth
-	-	-	www.google.com/maps
-	-	-	www.bing.com/maps

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8.3.1 Pre-Ordnance Survey

Table 8.2: Pre-Ordnance Survey maps consulted

Date	Surveyed	Who	Title
1583 - 1614	-	Timothy Pont	Renfrewshire (Pont 33)
1636-52	-	Robert Gordon	Barony of Ranfrew. Barony of Renfrew. (Gordon 55)
1654	-	Joan Blaeu	Praefectura Renfroana, vulgo, dicta Baronia. (The Baronie of Renfrow)
1685	-	John Adair	A mape of the west of Scotland containing Clydsdail, Nithsdail, Ranfrew, Shyre of Ayre, & Galloway
1745	Pre-1732	Herman Moll	The Shire of Clydesdale or Lanerk
1747-55	-	William Roy	Military Survey of Scotland
1760	-	John Watt	The Shire of Clydesdale or Lanerk
1775	-	George Taylor Andrew Skinner	The road from Edinr, to Glasgow & Greenock & to Dunbarton & Inveraray.
1800	-	John Ainslie	Map of the County of Renfrew
1814	-	Robert Stevenson	Forth & Clyde Canal - Sketch of country between Edin, & Glasgow showing canal
1822	-	John Thomson William Johnson	Northern Part of Lanarkshire. Southern Part.

Source: www.nls.uk

8.3.2 Ordnance Survey

Table 8.3: Ordnance Survey maps consulted

Date	Surveyed	Scale	Title
1860	1857 to 1858	25 inches to 1 mile	Lanarkshire VI.5 (Govan)

Date	Surveyed	Scale	Title
1860	1857 to 1858	25 inches to 1 mile	Lanarkshire VI.9 (Govan)
1896	1893 to 1894	25 inches to 1 mile	Lanarkshire VI.5
1896	1893 to 1894	25 inches to 1 mile	Lanarkshire VI.9
1913	1909	25 inches to 1 mile	Lanarkshire VI.5
1913	1909	25 inches to 1 mile	Lanarkshire VI.9
1935	1933	25 inches to 1 mile	Lanarkshire VI.5
1935	1933	25 inches to 1 mile	Lanarkshire VI.9
1950	1948	6 inches to 1 mile	NS5465NE - A
1951	1951	6 inches to 1 mile	NS5466SE - B
1967	1949 to 1965	1:2,500	NS5466-NS5566 - BB
1973	1952 to 1972	1:10,000	NS56NW - A
1989	1966 to 1987	1:10,000	NS56NW - B

Source: www.nls.uk

Technical Appendix 9-1_Preliminary Ecological Assessment

Govan Facilities Investment
Preliminary Ecological Appraisal

August 2022

Govan Facilities Investment
Preliminary Ecological Appraisal

Client: Arch Henderson

Document number: 10086
Project number: 175756
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Author: Alexandria Shaw
Reviewer: Gemma Nixon/ Graeme Duff

Date of issue: 5 August 2022
Filename: K:\175756 Govan Facilities Investment\Outputs\Issued

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This report has been prepared by EnviroCentre Limited with all reasonable skill and care, within the terms of the Contract with Arch Henderson ("the Client"). EnviroCentre Limited accepts no responsibility of whatever nature to third parties to whom this report may be made known.

EnviroCentre Limited is registered in Scotland under no. SC161777.

VAT no. GB 348 6770 57.

EXECUTIVE SUMMARY

EnviroCentre Ltd has been appointed by Arch Henderson on behalf of BAE Systems Ltd to conduct a Preliminary Ecological Appraisal (PEA) in relation to the proposals to infill the wet basin at Govan Shipyard and Maintenance Facility (Govan shipyard).

The site is situated in an urban area to the southwest of Glasgow City Centre and forms a portion of the wider BAE Complex. The habitats that dominate the site comprise built up areas and waterfront including a combination of inclined slipways, masonry walls, sheet piled wharf structures and an extent of informal riverbank. Ephemeral/short perennial vegetation, tall ruderals and scattered scrub are also present in the north-west of the site boundary.

The wet basin that dominates the site is part of a non-statutory designation, River Clyde Site of Importance for Nature Conservation (SINC). No further statutory designated ecological sites are located within the site boundary, though five statutory designated sites up to 10km from the site, four further non-statutory designated sites within 2km of the site, and one ancient woodland within 2km of the site have been recorded.

Faunal species recorded onsite at the time of the survey included likely nesting swallows and commuting and foraging black headed gull, herring gull, blackbird, and wood pigeon. Two buildings of low bat roosting suitability were also noted adjacent to the site boundary. Suitable habitat for badger, otter, reptiles, aquatic/semi-aquatic mammals, and fish are present/likely present onsite and/or within bounding habitats and therefore have potential to utilise the site or be impacted by development.

At present no protected species licencing requirements have been identified. However, further survey work/actions have been recommended:

- Engagement with Glasgow City Council regarding scope of survey work and SINC designation;
- Consultation with Marine Scotland, SEPA and the local fisheries trusts (i.e. Clyde Rivers Foundation) regarding local fish presence; *and*
- Bat Activity Survey of buildings with low bat roost potential where disturbance is likely to occur.

Pre-commencement checks for nesting birds, badger, and otter have also been recommended.

Although further surveys are still required to formally establish mitigation, mitigation recommendations have been provided:

- Implementation of a site-specific Construction Environmental Management Plan
- Implementation of a site-specific Wastewater Management Plan
- Implementation of an Invasive species Management Plan
- Implementation of a Marine Mammal Protection Plan
- Compliance with SEPA Guidelines for Pollution Prevention
- General mitigation including installation of protective Heras fencing, sensitive timings of work, sensitive working methods, sensitive storage of building materials, and covering of any open trenches overnight
- Installation of swallow nesting cups
- Implementation of a sensitive lighting strategy

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1 INTRODUCTION

1.1 Terms of Reference

EnviroCentre Ltd has been appointed by Arch Henderson on behalf of BAE Systems Ltd to conduct a Preliminary Ecological Appraisal (PEA) in relation to the proposals to infill the wet basin at Govan Shipyard and Maintenance Facility (Govan Shipyard).

The ‘site’ is defined as the area demarcated by the red line boundary as shown on the proposed Site Location Plan in Appendix A. The ‘wider BAE Complex’ is demarcated by the red line boundary as shown on the Govan Site Plan in Appendix B.

The results and recommendations in this document relate to the site boundary as provided by the client at the time of the survey.

1.2 Scope of Report

The aim of the survey was to provide a baseline ecological evaluation of the site to inform proposed development plans. The objectives were as follows:

- Conduct a desk study to gather pre-existing biological data relating to the site including any statutory or non-statutory designated sites and any notable flora or fauna which may be impacted by proposed development;
- Identify and map the broad habitats present on site;
- Search for field evidence of protected or notable floral & faunal species which may frequent/be present within the survey area;
- Identify suitable habitat for protected or notable species in the survey area;
- Identify potential impacts to protected/notable species, habitats and designated sites as a result of proposed development;
- Make recommendations for any further survey and/or species licensing requirements;
- Identify any measures to avoid, minimise and compensate for the predicted negative ecological effects associated with the proposed development; *and*
- Identify the opportunities to deliver biodiversity gain.

The scope of this appraisal has been determined with due consideration for best-practice guidance provided by the Chartered Institute of Ecology and Environmental Management (CIEEM)[1].

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[1] CIEEM (2017) *Guidelines for Preliminary Ecological Appraisal*. 2nd edition. available at: https://cieem.net/wp-content/uploads/2019/02/Guidelines-for-Preliminary-Ecological-Appraisal-Jan2018-1.pdf

1.3 Site Background

Previous ecological surveys of the site and the wider BAE Complex have been carried out between 2014 and 2022. A summary of previous survey work is provided below. Building numbers are those illustrated on the Govan Site Plan in Appendix B.

1.3.1 Ecological Impact Assessment and Environmental Statement, EnviroCentre Limited, June 2014

EnviroCentre Limited was commissioned to undertake an Ecological Impact Assessment (EcIA)[2] and produce an Ecology Chapter for an Environmental Statement[3] to support upgrades to the BAE Systems shipbuilding maintenance facilities.

The scope of the EcIA involved assessment of the site and wider BAE Complex including survey of all buildings for their potential to support bat roosts, a survey for otter along the north and south banks of the River Clyde in proximity to the Site, a survey for badger, and a survey for invasive non-native species (INNS). An assessment of construction and operational impacts to the watercourse and how they could impact bats, birds, otters, cetaceans, pinnipeds, and fish was also carried out.

The EcIA concluded that the proposed works had the potential to result in impacts to fish, cetaceans, pinnipeds and the River Clyde Site of Importance for Nature Conservation (SINC).

1.3.2 Bat Activity Report, EnviroCentre Limited, August 2014

Subsequent to the EcIA, EnviroCentre Limited were commissioned to undertake a Preliminary Roost Assessment (PRA) and bat roost survey for a small brick extension located at the east end of the Steelwork Fabrications Building (Building 2, c. 450m east of the current site boundary)[4]. The building was assessed as offering low potential for roosting bats including low suitability for winter (hibernation) roosting. A single dawn re-entry survey was undertaken in August 2014. No bats were recorded during this survey.

1.3.3 Preliminary Roost Assessment and Bat Activity Survey, EnviroCentre Limited, July 2021

To support potential demolition of the ward complex warehouse building and subsequent extension of the Ship Block Outfit Hall (building 11, c.90m south-east of the site), EnviroCentre Limited were commissioned to undertake a PRA and bat roost survey[5].

The southern aspect of warehouse consists of a red brick wall was assessed as offering moderate potential for roosting bats. A dusk emergence survey undertaken in May 2021 and a dawn re-entry survey undertaken in July 2021 was therefore carried out. No bats were recorded during either of these surveys.

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[2] EnviroCentre Limited. (2014). *Ecological Impact Assessment (ECRPT 6115)*. EnviroCentre Limited, Glasgow

[3] EnviroCentre Limited. (2014). *Environmental Statement*. EnviroCentre Limited, Glasgow

[4] EnviroCentre Limited. (2014). *Bat Activity survey Report (ECRPT 6225)*. EnviroCentre Limited, Glasgow

[5] EnviroCentre Limited. (2021). *Preliminary Roost Assessment and Bat Activity Survey Report (ECRPT 9633)*. EnviroCentre Limited, Glasgow

1.3.4 Preliminary Ecological Appraisal Report, Mott MacDonald March 2022

Mott MacDonald were commissioned to undertake a PEA[6] of three development options, across the site and wider BAE Complex, to facilitate future shipbuilding. The three options for consideration were as follows:

- Option 1 (1A or 1B) locates the new facility along the riverside to the north of the site.
- Option 2 reclaims land to build over the current wet basin.
- Option 3 was proposed to the west of the site but is no longer considered viable.

Option 2 was considered to be the most viable.

With specific Regards to Option 2 Mott MacDonald had recommended the further surveys are carried out in relation to otter, badger, bats, birds, and INNS.

1.4 Site Description

The site is situated in an urban area to the southwest of Glasgow City Centre, centred at grid reference NS 54604 66150. The site is approximately (*c*.) 10 hectares (ha) in size, and ranges from c. 2 metres (m) to 12m above sea level.

The surrounding area comprises a mixture of uses including industrial, business, commercial, and residential, along with the Queen Elizabeth University Hospital complex, transport links, and public open space. A parcel of broadleaved woodland is also present off-site to the northwest.

The site forms a portion of the wider BAE Complex and, as such, is immediately bounded to the east, south and west by commercial infrastructure. The site is located on the southern bank of the River Clyde.

Govan Shipyard has been used for ship building since the middle of the 19th century, though the wet basin on site is currently not in use. The habitats that dominate the site comprise built up areas and River Clyde waterfront including a combination of inclined slipways, masonry walls, sheet piled wharf structures and an extent of informal riverbank. Ephemeral/short perennial vegetation, tall ruderals and scattered scrub are also present in the north-west of the site boundary

1.5 Development Description

BAE Systems are currently considering their options for developing the Govan shipyard to support the long-term future of ship building at the site. The aim was to create a modern, undercover building that enables construction within an enclosed controlled environment to support future ship building at the shipyard.

The current proposals are to infill the existing wet basin located at Grid Reference NS 254624 666109 up to existing quay level to create a working platform. The area of the construction works is 4.57ha which includes the wet basin and contractor compound (Refer to Drawing No 225010-BAE-AHN-ZZXX-DR-C-0001, Appendix C). It is anticipated circa 195,000 m^3 of material will be required to infill the wet basin and that it will be brought to site primarily by barge (~95%) but also by road (~5%).

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[6] Mott MacDonald (2022). *BAE Govan – New Assembly Hall: Preliminary Ecological Appraisal Report*. Mott MacDonald, Glasgow

It is envisaged that construction works will involve the activities listed below.

1. Enabling works including:
    a. Area to west of the site to be cleared of all debris to set up the contractor compound;
    b. Separate contractor access to be created from entrance roadway to allow construction traffic to be segregated from operational shipyard traffic;
2. Deployment of a silt curtain, bubble screen or similar barrier across the wet basin entrance (including a demountable section to allow passage of the barge);
3. Initial infill by long reach excavator from a barge which will place a 2m layer of fill to cover existing sediment on the basin bed;
4. Continued infill using a combination of barge and excavators or self-discharging vessels. The infill material will extend beyond the line of the proposed quay wall;
5. Installation of a carrier drain around the existing basin quay wall to collect discharge from existing outfalls and direct to new outfalls protruding through the coffer dam;
6. Hydraulic compaction of infill material below mean sea level and dynamic compaction using rollers above mean sea level;
7. Land based piling through the infill material to create the outer quay wall. The work entails:
    a. Tubular piles being driven/vibrated into deep strata. These piles may need anchored by using a concrete pile toe bored into the rock through the tubular pile section;
    b. Sheet piles installed between the steel tubular piles. Sheet piles expected to be driven to shallower depths than the tubular piles;
    c. Reinforced concrete capping beam is installed to complete the quay wall.
8. Existing quayside at tie locations will be broken out and new tie ins installed between existing quay and the new cofferdam;
9. Basin infill taken up to design level by barged material placed over the new cofferdam and pushed into place by dozers; *and*
10. Fill in front of cofferdam wall removed and berth pocket dredged to current maintenance dredge level.

1.6 Report Usage

The information and recommendations contained within this report have been prepared in the specific context stated above and should not be utilised in any other context without prior written permission from EnviroCentre Limited.

If this report is to be submitted for regulatory approval more than 12 months following the report date, it is recommended that it is referred to EnviroCentre Limited for review to ensure that any relevant changes in data, best practice guidance or legislation in the intervening period are integrated into an updated version of the report.

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2 LEGISLATION AND PLANNING POLICY

2.1 Legislation

Legislation relating to wildlife and biodiversity of particular relevance to this Ecological Assessment Report includes:

- The Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019[7]
- Wildlife and Countryside Act 1981[8] (as amended)
- Natural Environment and Rural Communities (NERC) Act 2006[9]
- Protection of Badgers Act 1992[10]
- The Water Framework Directive (2000/60/EC)[11]
- The Nature Conservation (Scotland) Act 2004[12]
- The Wildlife and Natural Environment (Scotland) Act 2011[13]

A summary of protected species legislation is provided in Appendix D.

2.2 Planning Policy and Supplementary Guidance

The following planning policies and supplementary guidance of relevance to this assessment are:

- National Planning Framework 3 (currently under review[14])
- The Scottish Biodiversity Strategy (2004)[15]
- Scottish Planning Policy (2014)[16]
- Glasgow City Development Plan (Adopted March 2017)[17]
- Glasgow's Local Biodiversity Action Plan (LBAP)[18]
- Glasgow's Local Biodiversity Action Plan Implementation Plan[19]

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[7] Great Britain. *The Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019* No.579 [online]. Available from: https://www.legislation.gov.uk/uksi/2019/579/contents/made

[8] Great Britain. *Wildlife and Countryside Act 1981* [online]. Available from: http://www.legislation.gov.uk/ukpga/1981/69/contents

[9] Great Britain. *Natural Environment and Rural Communities Act 2006* [online]. Available from: http://www.legislation.gov.uk/ukpga/2006/16/contents

[10] Great Britain. *Protection of Badgers Act 1992* [online]. Available from: https://www.legislation.gov.uk/ukpga/1992/51/contents

[11] European Committee. *The EU Water Framework Directive 2000* [online]. Available from: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32000L0060&from=EN

[12] Scottish Government. *The Nature Conservation (Scotland) Act 2004* [online]. Available from: https://www.legislation.gov.uk/asp/2004/6/contents

[13] Scottish Government. *The Wildlife and Natural Environment (Scotland) Act 2011* [online]. Available from: https://www.legislation.gov.uk/asp/2011/6/contents

[14] Scotland. *National Planning Framework 3 2014* [online]. Available from: https://www.gov.scot/publications/national-planning-framework-3/pages/2/ , draft of planned update available from: https://www.gov.scot/publications/scotland-2045-fourth-national-planning-framework-draft/

[15] Scotland. *Scottish Biodiversity Strategy 2004 (as amended)* [online]. Available from: https://tinyurl.com/7uphk7ch

[16] Scotland. *Scottish Planning Policy 2014* [online]. Available from: https://tinyurl.com/3p6ewzdr

[17] Glasgow City Council. (2021). Glasgow City Development Plan. [online] Available at: https://www.glasgow.gov.uk/CHttpHandler.ashx?id=35882&p=0 (Accessed on 23.09.2021)

[18] Glasgow City Council. (2021). Glasgow's Local Biodiversity Action Plan [online] Available at: https://www.glasgow.gov.uk/CHttpHandler.ashx?id=31719&p=0 (Accessed 23.09.2021)

[19] Glasgow City Council. (2021). Glasgow's Local Biodiversity Action Plan Implementation Plan [online] Available at: https://www.glasgow.gov.uk/CHttpHandler.ashx?id=40409&p=0 (Accessed 23.09.2021)

3 METHODS

3.1 Desk Study

A desk study for the presence of statutory and non-statutory designated sites and protected/notable species records was undertaken in May 2022. The following sources were checked:

- All previous ecology reports produced by EnviroCentre Limited[2,3,4,5] and Mott MacDonald[6];
- National Biodiversity Network (NBN) Atlas[20] for notable or protected species records within 2km of the site – only records which are licenced for commercial use are reported;
- The Glasgow City Council City Development Plan: IPG6 Green Belt and Green Network Interactive Map[21] for Local Nature Conservation Sites (LNCS) within 2km of the site.
- NatureScot Sitelink[22] for information on:
    - Special Protection Areas (SPA), Special Areas of Conservation (SAC) and Ramsar sites within 10km of the Site (including possible/proposed sites); and
    - Sites of Special Scientific Interest (SSSI), National Nature Reserves (NNR), and Local Nature Reserves (LNR) within 5km of the Site;
- Scotland's Environment Web[23] website for ancient/native woodland within 1km from the site;
- The Scottish Biodiversity List (SBL) for Priority Habitats and Species[24];
- Glasgow's Local Biodiversity Action Plan (LBAP)[18] and Glasgow's Local Biodiversity Action Plan Implementation Plan[19] for notable habitats and species in Glasgow; *and*
- Aerial imagery from Google Maps[25], and Grid reference finder from Ordnance Survey[26] to identify notable features such as ponds within 500m of the site.

3.2 Field Survey

All field work, including habitat survey and assessment for protected species, was undertaken by Alexandria Shaw, Senior Ecologist for EnviroCentre Limited and associate member of the Chartered Institute of Ecology and Environmental Management (CIEEM), on the 01st May 2022. Weather conditions during the survey were dry and sunny, with a high temperature of 14°C.

The surveys were designed using known background data and the guidelines endorsed by NatureScot and CIEEM and focussed on plants and habitats on site and those species most likely to be found associated with the habitats which make up the landscape in and around the site. Invasive Non-Native Species (INNS) were also considered.

Species including water vole, pine marten, red squirrel, and brown hare, and Ground Water Dependent Terrestrial Ecosystems (GWDTE) have been scoped out of assessment due to lack of

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[20] NBN Atlas – UK's largest collection of biodiversity records, Available at: NBN Atlas - UK's largest collection of biodiversity information (NBN Atlas occurrence download at NBN Atlas accessed on Tue Aug 31 14:20:48 UTC 2021).

[21] Glasgow City Council. (No Date). *City Development Plan: IPG6 Green Belt and Green Network Interactive Map*. [Online] Available from: https://glasgowgis.maps.arcgis.com/apps/webappviewer/index.html?id=53f7e7c8e21448e7ac5d958ce1f2baaa (Accessed on 03/06/2022)

[22] NatureScot Sitelink, Available at: https://sitelink.nature.scot/home (Accessed April 2022)

[23] Scotland's environment web, Available at: https://www.environment.gov.scot/ (Accessed April 2022)

[24] Joint Nature Conservation Committee (JNCC). *UK Biodiversity Action Plan (UKBAP) Priority Habitats & Species*. Available at: https://hub.jncc.gov.uk/assets/98fb6dab-13ae-470d-884b-7816afce42d4 Accessed April 2022)

[25] Google Maps, Available at: https://www.google.co.uk/maps/ (Accessed April 2022)

[26] Grid Reference Finder from Ordnance Survey, Available at: https://www.gridreferencefinder.com/os.php (Accessed April 2022)

suitable habitat on site as identified within previous ecological reports[2,3,4,5,6], confirmed during the update field survey work in May 2022.

Table 3-1 provides an overview of the area surveyed for specific habitats, species, and species groups. Detailed methods regarding habitat and species surveys are provided in relevant sections below.

Table 3-1: Survey Areas

Important Ecological Features	Survey/Assessment Area (where accessible)
Phase 1 Habitat Survey	Site
Invasive Non-Native Species	Site plus 10m buffer
Badger (*Meles meles*)	Site plus 30m buffer
Bats	Site plus 50m buffer
Otter (*Lutra lutra*)	Site plus 30m buffer
West European hedgehog (*Erinaceus europaeus*)	Site plus 10m buffer
Birds	Site plus 50m buffer
Amphibians	Site plus 500m buffer where ponds are present
Reptiles	Site plus 10m buffer where accessible
Cetaceans and Pinnipeds	Site plus aquatic habitats at least 250m up and downstream
Fish	Site plus aquatic habitats at least 250m up and downstream

3.2.1 Phase 1 Habitat Survey

A Phase 1 Habitat Survey is a method that rapidly records vegetation and wildlife habitat over large areas. The survey involved classifying habitats and determining dominant plant species for each habitat type. The information is used to identify ecologically sensitive features, inform additional species surveys and, ultimately, recommend mitigation and enhancement measures in connection with a proposed development.

The Phase 1 Habitat Survey was undertaken according to the standard Joint Nature Conservation Committee method[27] and was used to determine the potential presence of any Annex I, UK Biodiversity Action Plan (BAP), Scottish Biodiversity List (SBL), and/or priority habitats.

3.2.2 Invasive Non-Native Species

The habitat survey included a check for the presence of any invasive non-native species (INNS) including but not limited to the following:

- Japanese knotweed (*Reynoutria japonica*);
- Giant hogweed (*Heracleum mantegazzianum*); and
- Himalayan balsam (*Impatiens glandulifera*)

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[27] JNCC (2010) *Handbook for Phase 1 Habitat Survey A Technique for Environmental Audit.*

3.2.3 Badger

A badger survey was undertaken in suitable and accessible habitat, with reference to the methodology described by Scottish Badgers[28] and NatureScot[29,30], which aimed to identify the following field evidence:

- Direct sightings;
- Setts (any structure or place, which displays signs indicating current use by badger/located within an active badger territory, as defined by NatureScot guidance[31]);
- Day beds (above ground area where badgers sleep, characterised by flattened vegetation or bundles of grass);
- Dung pits (single faeces deposit placed in a small excavation);
- Latrines (collection of faecal deposits often used by clans to mark home range boundaries);
- Foraging signs such as diggings or snuffle holes (badgers use their snout to turn over vegetation or soft soil to forage for bulbs and invertebrates);
- Paths (network of paths generally linking setts to foraging habitat);
- Breach points (gaps in fences or crossing points over roads);
- Scratching posts (marks on tree trunks/fallen trees where badgers have left claw marks);
- Guard hair; and
- Footprints.

Badger foraging habitat was classified on a primary and secondary basis as per best practice guidance[32]. An assessment of the distribution of primary and secondary habitat (defined below) within the survey area was undertaken:

- Primary foraging habitat: short grazed or mown grassland, improved or unimproved, golf course habitat and broadleaved woodland (> 80% broadleaves); and
- Secondary foraging habitat: arable, rough grassland (not grazed by domestic stock or mown), scrub and mixed woodland.

3.2.4 Bats

An initial assessment of foraging, commuting, and roosting opportunities present on site was undertaken in accordance with the criteria set out by the Bat Conservation Trust (BCT)[33].

The suitability of the commuting and foraging habitats on site were classified as outlined within Table 3-2.

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[28] Scottish Badgers. (2018). *Surveying for Badgers – Good Practice Guidelines. Version 1: 2018*. [online] Available from: https://www.scottishbadgers.org.uk/wp-content/uploads/2020/12/Surveying-for-Badgers-Good-Practice-Guidelines_V1-2020-2455979.pdf

[29] NatureScot. (No Date) *Licensing Guidance*. [online] Available from: https://www.nature.scot/sites/default/files/2018-10/Guidance%20-%20Licensing%20-%20Badgers%20-%20What%20is%20a%20Badger%20sett_.pdf

[30] NatureScot. (2020). *Protected Species Advice for Developers – Badger*. [online] Available from: https://www.nature.scot/species-planning-advice-badger

[31] NatureScot definition of current use: "*There is no case law to clarify what signs of current use means. For the purpose of this guidance, and in the absence of such case law, we consider that the presence of field signs such as bedding, fresh spoil heaps, signs of recent digging, hair, latrines, or footprints in or around the potential sett or evidence of badgers entering or exiting the structure or place in question would indicate current use of the structure / place by a badger.*"

[32] The Highland Council. Best Practice Guidance – Model badger Protection Plan (BPP)– Badger foraging habitats (2006). Available from: https://www.highland.gov.uk/downloads/file/2635/badger_best_practice_guidance_badger_protection_plans_september_2006

[33] Collins, J. (2016). *Bat Surveys for Professional Ecologists: Good Practice Guidelines*. (London The Bat Conservation Trust, Ed.) (3rd ed.).

Table 3-2: Categorising the Suitability of Commuting and Foraging Habitats

Suitability	Commuting and Foraging Habitats
High	Continuous high-quality habitat likely to be used regularly by commuting bats such as river valleys, streams, hedgerows, lines of trees and woodland edge. Continuous high-quality likely to be used regularly by foraging bats such as broadleaved woodland, tree-lined watercourses, and grazed parkland. Site is close to and connected to known roosts.
Moderate	Continuous habitat connected to the wider landscape that could be used by bats for commuting such as lines of trees and scrub or linked back gardens. Habitat that is connected to the wider landscape that could be used by bats for foraging such as trees, scrub, grassland, or water.
Low	Isolated habitat that could be used by small numbers of commuting bats such as a fragmented hedgerow or un-vegetated stream. Suitable but isolated habitat that could be used by small numbers of foraging bats such as a lone tree or a patch of scrub.
Negligible	Habitat features on site unlikely to be used by foraging or commuting bats.

The Preliminary Roost Assessment (PRA) aimed to categorise features in terms of their potential to host roosting bats, based on the methods detailed within the Bat Conservation Trust (BCT) survey guidelines[33].

The inspections were carried out to identify Potential Roost Features (PRFs) such as those presented in Table 3-3, and any evidence of bat presence, such as scratches / smooth surfaces/ droppings / urine staining / moth wings / audible squeaks / flies.

Table 3-3: PRFs in Trees and Structures Frequently Used by Bats for Roosting

PRFs in trees frequently used as bat roosts	Access points in structures frequently used as bat roosts	Frequently used roosting locations in structures
Hollows and cavities from woodpecker, rot and knot holes	Gaps in windowsills and windowpanes	Top of chimney breasts, gable ends and dividing walls
Hazard beams and other vertical or horizontal cracks and splits in stems or branches	Underneath peeling paintwork or lifted rendering	All beams and roof beams (ridge, hip etc.)
Partially detached plated bark	Behind hanging tiles, weatherboarding, eaves, soffit boxes, fascias and lead flashing	Junction of timber joints, mortise and tenon joints
Cankers, included bark and compression forks with potential cavities	Under tiles and slates	Behind purlins
Partially detached ivy with stem diameters in excess of 50mm	Gaps in brickwork and stonework	Between tiles/slates and the roof lining
Bat or bird boxes	Gaps in rendering behind gutters	Under flat roof materials

Where applicable, according to their suitability to host roosting bats, built structures and trees were subsequently categorised in line with Table 3-4.

Table 3-4: Categorising PRFs in Trees and Built Structures

Suitability	Roosting Features
High	A structure or tree with one or more potential roost sites that are obviously suitable for use by larger numbers of bats on a more regular basis and potentially for longer periods of time due to their size, shelter, protection, conditions and surrounding habitat.
Moderate	A structure or tree with one or more potential roost sites that could be used by bats due their size, shelter, protection, conditions and/or surrounding habitat but unlikely to support a roost of high conservation status.
Low	A structure with one or more potential roost sites that could be used by individual bats opportunistically. However, these potential roost sites do not provide enough space, shelter, protection, appropriate conditions and/or suitable surrounding habitat to be used on a regular basis; or A tree of sufficient size and age to contain potential roost features but with none seen from the ground; or features seen with only very limited roosting potential.
Negligible	A structure or a tree with negligible features likely to be used by roosting bats.

3.2.5 Otter

The otter survey followed best practice guidelines[34], and aimed to identify suitable otter habitat and field signs, including:

- Direct sightings;
- Spraints - Otter faeces/droppings used as territorial signposts. Often located in prominent positions and can be placed on deliberate piles of soil or sand. Three categories are used for describing otter spraint: Dried fragmented (Df); Dried intact (Di); and Not fully dry (Nd);
- Footprints;
- Feeding remains;
- Paths/slides - Distinctive path from and into the watercourse;
- Holts - Underground shelter which are generally found:
  - Within trees roots at the edge of the bank of a river;
  - Within hollowed out trees;
  - In naturally formed holes in the river banks that can be easily extended;
  - Or preferably in ready-made holes created by other large mammals such as badger setts, rabbit burrows or outlet pipes; and
- Couches/lay-ups - Places for lying up above ground are usually located near a watercourse, between rocks or boulders, under dense vegetation.

In order to assess their importance, where identified, the status of otter resting sites was assigned from Low to High according to Table 3-5, overleaf.

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[34] Chanin, P. (2003). Ecology of the European Otter. Conserving Natura 2000 Rivers Ecology (No. 10). Peterborough: EN, CCW, EA, SEPA, SNH & SNIFFER.

Table 3-5: Status of Otter Resting Sites[35]

Status	Definition
High	Feature has a high level of otter activity, including an abundance of sprainting of all age classes, large spraint mounds, well used grooming hollows, paths and slides. Affords a high degree of cover and is linked to key features such as fresh water and abundance of prey. May be suitable as a breeding area (spraints may be absent from natal holts). The site is usually available at all times of year and at high and low tide/flow. The loss/ disturbance of such as feature will often be considered significant in terms of the individual or population.
Moderate	Feature containing sprainting with a range of age classes, but not in significant quantities. Availability may be limited by season, tides or flow. Unlikely to be suitable as a breeding/natal site but will be a key resting site and may be linked to other important features within the territory. The impact arising from a loss or disturbance of such a feature will be determined by the availability of more suitable or well used sites within the otter's territory.
Low	Feature with limited evidence of otter activity – low number of spraints, not all age classes present. Insufficient seclusion to be a breeding site/key resting site, unlikely to have links to the key otter requirements. Most likely to provide a temporary 'stop off' for otters when moving through their territory. Loss/disturbance of such a feature is unlikely to be significant in terms of the individual or population.

3.2.6 West European Hedgehog

The suitability of the habitats for hedgehog on site was assessed according to guidance[36]. Suitable habitats include:

- Grazed pastureland separated into small fields by hedgerows;
- Deciduous woodland copses (oak, beech);
- Overgrown verges or margins; and
- Suburban gardens, woodpiles or parklands.

3.2.7 Birds

Habitats within the survey area were assessed for their suitability to support breeding and over wintering birds.

Observations of birds were also noted during the survey. Observations of the following were recorded:

- Birds present – nesting or foraging on-site, or flying over site;
- Birds present – corpses;
- Pellets/droppings;
- Nests – within trees or in ground vegetation;
- Eggs – intact/broken or within nest/below nest; and
- Feathers – adult or natal down.

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[35] Bassett, S., & Wynn, J. (2010). Otters in Scotland: How Vulnerable Are They to Disturbance? CIEEM In Practice, (70), 19–22.

[36] Cresswell, W.J., Birks, J.D.S., Dean, M., Pacheco, M., Trewhella, W.J., Wells, D. and Wray, S. (2012). *UK BAP Mammals: Interim Guidance for Survey Methodologies, Impact Assessment and Mitigation.* The Mammal Society, Southampton

3.2.8 Amphibians

An assessment of the suitability of habitats on site for amphibians was undertaken in accordance with the criteria set out by the Joint Nature Conservation Committee (JNCC)[37]. This assessment reviews habitat requirements necessary for amphibian populations, including:

- Breeding habitat – ponds or standing water that provide food and shelter;
- Terrestrial habitat – close to breeding ponds;
- Connectivity to additional suitable aquatic and terrestrial habitat;
- Foraging resources i.e., invertebrates; and
- Hibernation sites – normally below ground systems that protect against weather and predators.

3.2.8.1 Great Crested Newt

With specific regards to great crested newt, where standing water was situated within a 500m radius and connected to the site by suitable terrestrial habitats, a Habitat Suitability Index (HSI) assessment, using best practice guidelines[38] should be carried out. A desk study identified no ponds within 500m of the site. The only water feature present with connectivity to the site is the River Clyde and on-site water basin. As great crested newt typically favour ponds / standing water with vegetation for egg laying, the River Clyde and water basin are not considered suitable to support great crested newt. As such an HSI assessment was not carried out.

3.2.9 Reptiles

An assessment of the suitability of habitats for reptiles was undertaken in accordance with the criteria set out by Amphibian and Reptile Conservation[39]. This assessment takes into account habitat type, basking and foraging opportunities, and linkages to other areas of potential reptile habitat. The quality of the reptile habitat was assigned from Low to High according to Table 3-6.

Table 3-6: Quality of Reptile Habitat

Status	Definition
High	Suitable vegetation cover offering foraging opportunities, basking sites and a variety of refugia. Good linkages with other areas of reptile habitat. For example semi-improved grassland with areas of dense continuous scrub.
Moderate	Some suitable vegetation cover offering foraging opportunities, basking sites and refugia. Limited linkages to other areas of suitable reptile habitat. For example dense continuous scrub surrounded by short improved grassland.
Low	Unsuitable vegetation cover with no linkages to other areas of suitable reptile habitat. For example dense mature conifer plantation, closely mown amenity grassland.

In addition, direct sightings of reptiles, and features that offer suitable hibernation refugia (e.g. dry stone walls, vegetated stone piles containing cavities etc.) were recorded where identified.

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[37] JNCC (2004). *Common Standards Monitoring Guidance for Reptiles and Amphibians*. [Online] Available at: https://data.jncc.gov.uk/data/43e8e8ed-5f05-4613-a277-f116b34829f4/CSM-ReptilesAmphibians-2004.pdf

[38] Oldham R.S., Keeble J., Swan M.J.S. & Jeffcote M., 2000. *Evaluating the suitability of habitat for the Great Crested Newt (Triturus cristatus)*. Herpetological Journal 10(4), 143-155.

[39] Edgar, P., Foster, J. and Baker, J. (2010). *Reptile Habitat Management Handbook*. Amphibian and Reptile Conservation, Bournemouth

3.2.10 Cetaceans and Pinnipeds Aquatic/Semi Aquatic Mammals

In addition to the desk-based assessment, a general habitat suitability survey was made of the River Clyde and its suitability to host cetaceans and pinnipeds.

3.2.11 Fish

In addition to the desk-based assessment, a general habitat suitability survey was made of the River Clyde and its suitability to host fish species (specifically salmonids) and other relevant species including lamprey and eel[40]. Any obstacles to migration were also identified during the survey.

3.3 Survey Constraints

3.3.1 Desk Study

Desk studies are limited by the reliability of third-party information and the geographical availability of biological and/or ecological records and data. This emphasises the need to collate up-to-date, site-specific data based on field surveys by experienced surveyors. The absence of a species from biological records cannot be taken to represent actual absence. Species distribution patterns should be interpreted with caution as they may reflect survey/reporting effort rather than actual distribution.

3.3.2 Field Survey

Due to electrified security fencing bounding the wider BAE Complex and inability to access the River Clyde waterfront, access was limited to the site and wider BAE Complex only. Where the survey area for protected species and/or notable habitats extended further than the site boundary efforts were made to assess bounding habitats where possible.

3.4 Evaluation of Ecological Features

European, national and local governments and specialist organisations have together identified a large number of sites, habitats and species that provide the key focus for biodiversity conservation in the UK and Ireland, supported by policy and legislation. These provide an objective starting point for identifying the important ecological features that need to be considered. A geographical level of importance, as described in Appendix E, has been assigned to the designated sites, habitats and species identified on the site and in the survey area. Where a feature is important at more than one level in the table, its overriding importance is that of the highest level. Usually only the highest level of legal protection is listed.

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[40] https://www.sepa.org.uk/media/131098/hydropower_annexb.pdf

4 BASELINE ECOLOGICAL RESULTS AND ASSESSMENT

4.1 Desk Study

4.1.1 Statutory Designated Sites

No statutory designated sites are present within or adjacent to the site boundary.

Three internationally designated sites, one nationally designated site, and one locally designated site were identified as a result of the desk study (as identified within Table 4-1).

Fossil Grove SSSI is also noted 1.2km northeast of the site, though as it is designated for geology it has been ruled out of ecological assessment.

All statutory designated sites identified within the desk study are described in Table 4-1.

Table 4-1: Statutory Designated Sites

Site Name	Designation	Distance & Orientation at Closest Point	Reason for Designation	Level of Importance
Internationally Designated Sites within 10km of the site boundary				
Black Cart	SPA	6.2km west	Non-breeding whooper swan (*Cygnus cygnus*)	International
Inner Clyde	Ramsar	6.4km northwest	Non-breeding redshank (*Tringa totanus*)	International
Inner Clyde	SPA	6.4km northwest	Non-breeding redshank (*Tringa totanus*)	International
Nationally designated sites within 5km of the site boundary				
Possil Marsh	SSSI	5.0km north	Mesotrophic loch	National
Locally designated sites within 5km of the site boundary				
Dawsholm	LNR	3.0km north	Plantation woodland and the associated populations of birds	Local

*SAC (Special Area of Conservation; SSSI (Site of special Scientific Interest); NNR (National Nature Reserve).

Black Cart SPA and Inner Clyde Ramsar and SPA are connected to the site ecologically via the River Clyde. Habitats on-site are highly disturbed and support little vegetation. As such, the site provides limited opportunities for whooper swan and redshank. There is a low risk of the development options resulting in direct impacts upon the habitats or qualifying species of the designated sites. However, the potential for impacts during construction as a result of pollution events cannot be ruled out.

Possil Marsh SSSI lies adjacent to the Forth and Clyde Canal. Although the Forth and Clyde Canal is connected to the River Clyde, connectivity is fragmented by urban development including canal lock gates.

There is no ecological connectivity between the site and Dawsholm LNR.

4.1.2 Non-Statutory Designated Sites

In Glasgow, non-statutory designated sites are termed city-wide or local Sites of Importance for Nature Conservation (SINCs).

The on-site wet basin is covered under the River Clyde city-wide SINC, an important green network for fauna. Infill operations will result in the loss of approximately 1.8ha of open water habitat and a subsequent impact in the River Clyde SINC.

Four further non-statutory designated sites, are present within a 2km radius of the site boundary, as detailed in Table 4-2. The four further non-statutory designated sites are not considered ecologically connected to the site due to the urban setting.

Table 4-2: Non-Statutory Designated Sites

Site Name	Designation	Distance & Orientation	Level of Importance
The River Clyde	City-wide SINC	On-site	County
River Kelvin	City-wide SINC	0.95km east	County
Disused Railway (King George V Docks)	Local SINC	1.9km west	County
Bingham's Pond	Local SINC	1.9km north	County
Festival Park	Local SINC	2.0 km east	County

4.1.3 Ancient Woodland

No ancient woodland is located within or directly bordering the site boundary. The closest ancient woodland is an unnamed ancient woodland of semi-natural origin located 1.9km northeast of the site and is considered to be ecologically fragmented from the site.

4.2 Habitats

The Phase 1 Habitat Survey Plan can be found in Appendix F. Seven Phase 1 habitat types and boundary features are present within or directly adjacent to the site including:

- A2.2 Scattered Scrub
- C3.1 Tall Ruderals
- G2 Running Water
- J1.3 Ephemeral / Short Perennial
- J3.6 Buildings
- Hardstanding
- Fence

4.2.1 Scattered Scrub (A2.2)

Scattered scrub is present in the northwest of the site and is comprised of individual birch (*Betula* sp.), willow (*Salix* sp.), sycamore (*Acer pseudoplatanus*), and gorse (*Ulex* europaeus) saplings.

The scattered scrub is a common and widespread habitat within the locale, considered to have Site Level ecological importance.

4.2.2 Tall Ruderals (C3.1)

Tall ruderal vegetation is dominant along the riverbank in the north/north-western extent of the site. Tall ruderal vegetation is dominated by horsetail (*Equisetum arvense*) and rosebay willowherb (*Chamerion angustifolium*). Other species frequently present include ribwort plantain (*Plantago lanceolata*), broad-leaved dock (*Rumex obtusifolius*), fern (*Polystichum* sp.), Yorkshire fog (*Holcus lanatus*), creeping bent (*Agrostis stolonifera*), meadow buttercup (*Ranunculus acris*), and common hogweed (*Heracleum sphondylium*), and rare occurrences of bramble (*Rubus fruticosus* agg).

The tall ruderal vegetation is a common and widespread habitat, both locally to the site and within the wider landscape. As a result, the on-site tall ruderal vegetation is considered to be important at the Site Level, within invasive horsetail of Negligible value to the site.

4.2.3 Running Water (G2)

The wet basin, connected to the River Clyde, is the dominant habitat on site. The banks of the basin and River Clyde are heavily modified through straightening and deepening, with the banks supported by sheet piled wharf structures and masonry banks. No aquatic vegetation was recorded within the wet basin.

Rivers and streams are SBL and LBAP priority habitats. Specifically, the on-site wet basin is covered under the River Clyde city-wide SINC, an important green network for fauna within the Glasgow LBAP. The wet basin onsite is therefore considered to be of up to County Importance due to its location within a SINC. However, it is noted that the aquatic and terrestrial habitats on site are highly disturbed and unlikely to support a range of faunal species.

4.2.4 Ephemeral / Short Perennial (J1.3)

Where areas of the site in the northwest are periodically disturbed or used for storage ephemeral/short perennial vegetation has become established. Ephemeral/short perennial vegetation was patchy and lacked a dominant species. Species within the ephemeral habitats consist of forget-me-not (*Myosotis* sp.), black medick (*Medicago lupulina*), common vetch (*Vicia sativa*), colt’s-foot (*Tussilago farfara*), common mouse-ear (*Cerastium fontanum*), oxeye daisy (*Leucanthemum* vulgare), pineapple weed (*Matricaria discoidea*), and common cat’s-ear (*Hypochaeris radicata*).

The ephemeral/short perennial vegetation is a common and widespread habitat. As a result, the on-site tall ruderal vegetation is considered to be important at the Site Level.

4.2.5 Buildings (J3.6)

The wider BAE Complex is dominated by built structures which range in construction type. Within the site boundary three buildings are noted including an office (Building 40), distribution building (Building 46), and visitor centre (Building 52). Building descriptions are provided in Table 4-3 and building locations are illustrated on the Habitats Plan in Appendix F and Govan Site Plan in Appendix B.

Table 4-3: On Site Building Descriptions

Building	Construction Description
Office (Building 40)	A modern modular two/tree storey build with brick base up to 1m an sheet metal rendering. Decorative wooden cladding up to 2 m wide is also present on the north and west building aspect
Distribution building (Building 46).	A single storey red brick and corrugated steel storage building
Visitor Centre (Building 52)	A modern modular build

Other buildings present within the wider BAE Complex include a range of red brick build, rendered office blacks, and sheet metal warehouses.

The building is of Negligible Importance, though shall be discussed further in its relation to support protected species.

4.2.6 Hardstanding

Roads and pavements are present within the site. The hardstanding is not considered to provide resources for wildlife and are considered to be of Negligible value.

4.2.7 Fence

Security fencing comprised of electric fencing and palisade style fencing, approximately 2.5m tall, is present along the northwestern boundary of the site, extending throughout the wider BAE Complex.

The fence present is not considered to provide resources for wildlife and are considered to be of negligible value.

4.3 Invasive Non-Native Species

The River Clyde catchment is known to host several invasive species:

- Japanese knotweed;
- Himalayan balsam;
- Giant hogweed;
- Skunk cabbage; and
- American signal crayfish

In previous ecological reports giant hogweed was recorded within the wider BAE Complex[2,6]. The closest stands identified within the previous ecological reports were adjacent to the northwest of the site boundary. During the field survey completed in May 2022, giant hogweed was continued to be identified adjacent to the northwest boundary, though no stands were identified within the site boundary at the time of the survey.

Horsetail was identified as the dominant species within the tall ruderal habitat in the northwest of the site. Although horsetail is not controlled by legislation it is a highly invasive perennial weed that spreads quickly and vigorously, reproducing through spores and root fragments.

Locations of the INNS identified during the site visit in May 2022 can be found on the INNS Plan in Appendix G.

No other invasive species known along the catchment of the River Clyde were recorded on site.

Due to their invasive nature, the INNS identified are considered to be of Negative value to the site.

4.4 Faunal and Species Groups

4.4.1 Disclaimer

Faunal species are transient and can move between favoured habitats regularly throughout and between years. This survey provides a snapshot of field signs present in the survey area in May 2022.

4.4.2 Badger

Historic badger records are present within 2km of the site as identified within review of previous ecological reports. An updated desk study identified badger as recently active within 2km of the site, though no further details can be provided due to the confidential nature of the records. No diagnostic evidence of badger was identified during the site visits conducted between 2014 and 2022.

Woodland habitats off-site to the west may offer primary and secondary foraging habitat for badger in the locale. Due to the dominant hardstanding and built structures on site, badger foraging resources are limited to tall ruderal and ephemeral/short perennial vegetation in the northwest. Although tall ruderal and ephemeral/short perennial vegetation can offer primary foraging habitat, disturbance from onsite works which are understood to occur 24 hours and barriers to dispersal due to electrified security fencing may reduce the likelihood of badger on site.

Badgers are protected under the Protection of Badgers Act 1992 and therefore are of National (UK) Importance.

4.4.3 Bats

Within the desk study the following bat species were recorded within 2km of the site: Daubenton’s bat (*Myotis daubentonii*), Nathusius pipistrelle (*Pipistrellus nathusii*), common pipistrelle (*Pipistrellus pipistrellus*), soprano pipistrelle (*Pipstrellus pygmaeus*), and brown long-eared bat (*Plecotus auritus*).

Bat activity surveys carried out in 2014 and 2021 in relation to the wider BAE Complex site boundary did not identify any bats roosting, foraging or commuting.

4.4.3.1 Roosting

Buildings

In addition to the buildings identified in Table 4.3, buildings adjacent to the site boundary were also assessed for their suitability to support bats. Buildings on site, or off-site with potential to support bats and be disturbed by works, are described in Table 4-4, overleaf.

Table 4-4: Bat Roosting Potential, May 2022

Building	Potential Roosting features	Bat Roost Potential
Old ambulance room (Building 19)	Gaps behind the metal fascia and gaps within the brickwork	Low
Amenity and toilet block (Building 20)	Missing mortar potentially providing access to a cavity wall if present	Low
Office (Building 40)	None	Negligible
Distribution building (Building 46).	None	Negligible
Unnumbered storage unit	None	Negligible

On site buildings were assessed as having **negligible potential** in reference to Table 3-6 for roosting bats: '*A structure with negligible features likely to be used by roosting bats*.'.

Two buildings off site with **low bat roost potential** in reference to Table 3-6 '*A structure with one or more potential roost sites that could be used by individual bats opportunistically. However, these potential roost sites do not provide enough space, shelter, protection, appropriate conditions and/or suitable surrounding habitat to be used on a regular basis*' were also recorded.

Trees

No trees are present within the boundary of the site. However, a woodland comprising number of semi-mature and mature trees is present off site to the northwest. The trees identified were not noted to have any bat roosting features when inspected from the ground level. Though due to the size of the trees there is potential for features to be present within the canopy, not identifiable from the ground.

The trees adjacent to the site are therefore considered to offer **low bat roost potential**, in reference to Table 3.6 for roosting bats: '*A tree of sufficient size and age to contain potential roost features but with none seen from the ground'.*

4.4.3.2 Commuting and Foraging

The habitats on site are dominated by artificially lit built structures and hard standing, offering limited opportunities for foraging and commuting bats.

Elder Park an amenity parkland with semi-mature to mature broadleaved trees and large pond, is located c.100m south of the site. The River Clyde, to the north of the site, also links to greenspace, parkland, woodland, rough grassland, and running water. However, fragmentation, due to artificial lighting, roads, buildings and unvegetated sections of land is recorded. The habitat on and near to the site is assessed to be of up to **moderate suitability for commuting and foraging bats**, in reference to Table 3.6: '*Continuous habitat connected to the wider landscape that could be used by bats for commuting such as lines of trees and scrub or linked back gardens. Habitat that is connected to the wider landscape that could be used by bats for foraging such as trees, scrub, grassland or water*'.

Bats are European Protected Species (EPS) and therefore of International Importance.

4.4.4 Otter

The desk study has identified otter within a 2km radius of the site, with instances of otter recorded within the same grid square as the site (NS 54 66) in 2019. No resting sites or any other evidence of otter activity were found during previous surveys, including a detailed in-channel survey of otter in 2014 survey.

The north and south banks of the River Clyde adjacent to the site were dominated by vertical man-made quay walls consisting of metal sheet piling, stone blocks and concrete. These areas have no potential to support otter resting sites as there are no holes or crevices in which they could shelter. A section of the south bank, west of the site was identified as having sub-optimal habitat for resting otters in 2014. The banks were more gently sloping and cover was provided by willow and birch trees, although closer inspection identified the bank to be heavily littered by old building materials and fly-tipping, reducing the banks suitability for holt creation.

The wet basin may be used by transient otter. However, potential for resident otter within the site are unsuitable consisting largely of a built-up environment. Tall ruderal vegetation has the potential to offer couch opportunities to otter. Although suitability is likely reduced due to electrified security fencing and steep metallic water banks limiting on site access and high levels of disturbance associated with the 24 hour operation of the site.

Otter is an EPS and therefore of International Importance.

4.4.5 West European Hedgehog

Records of west European hedgehog have been identified within 2km of the site as a result of the desk study, though no diagnostic evidence of hedgehog was identified during the site survey.

Although there is potential for west European hedgehog within the wider landscape, suitable habitats within the site are limited to tall ruderal vegetation. Tall ruderal vegetation has the potential to offer foraging opportunities, however the suitability is likely reduced due to electrified security fencing enclosing the entire site and high levels of disturbance associated with the 24 hour operation of the site.

West European hedgehogs are a Scottish Biodiversity List (SBL) species and therefore of National Importance.

4.4.6 Birds

Numerous bird records (>14,000) have been identified as a result of the desk study. Of note the following species have been recorded on or near site within desk-based research; cormorant (*Phalacrocorax carbo*), goldeneye (*Bucephala clangula*), Reed bunting (*Emberiza schoeniclus*), Skylark (*Alauda arvensis*), Common swift (*Apus apus*), Redshank, Mallard (*Anas platyrhynchos*), Common sandpiper (Actitis hypoleucos), Grey wagtail (Motacilla cinerea), Black-headed gull (*Chroicocephalus ridibundus*), Common gull (Larus canus), Redshank, Lesser black-backed gull (*Larus fuscus*), and Feral pigeon (*Columba livia*).

There is no suitable habitat on the site for reed bunting (SBL species), skylark, common swift (LBAP species) or redshank (designated feature of the Inner Clyde Ramsar and SPA). Similarly, there is limited suitable habitat on site for the UK BAP species common linnet, Eurasian curlew, house sparrow, common starling or song thrush.

Man-made structures within the site and tall ruderal vegetation may provide nesting habitat for a range of bird species including Herring gull. Review of previous reports has identified a large bird nest, likely created by Corvid species on the northern elevation of an off-site building at approximate NGR: NS 55042 66056.

During the site visit in May 2022, up to 15 swallows (*Hirundo rustica*) were seen emerging from the reinforced wet basin banks. It is assumed that there are gaps present between the steel sheet piling and concrete, though this could not be confirmed. Although no nesting behaviour, such as movement of food or nest making material, was observed it is considered that active nests may be present.

Other bird species noted in May 2022 include:

- Black headed gull
- Blackbird (*Turdus merula*)
- Wood pigeon (*Columba palumbus*)
- Herring gull

Whooper swan was also noted within the River Clyde, but did not utilise the site throughout the duration of the survey.

Birds listed in the Red Birds of Conservation Concern (BoCC) list are of National (UK) importance. Birds on the Amber BoCC list are of regional importance and birds on the Green BoCC list are of local importance

4.4.7 Amphibians

A number of historic amphibian records were identified within the desk study. A single recent record of common toad (*Bufo bufo)* was also provided from grid square NS 55 67, approximately 1km northeast of the site boundary in 2013. No amphibians were identified during the site survey.

Although there is potential for amphibians within the wider landscape, the habitats within the site are sub-optimal consisting largely of a built-up environment. Tall ruderal vegetation has the potential to offer foraging and commuting opportunities, however the suitability is likely reduced due to high levels of disturbance including artificial lighting associated with the 24 hour operation of the site.

Although amphibians are common within wetland environments, the on-site wet basin and adjacent section of the River Clyde provide sub-optimal resources for amphibian species. This is due to a lack of vegetation for foraging and sheltering from predation by birds and fish.

Common toads are on the Scottish Biodiversity List and are of regional importance.

4.4.8 Reptiles

Historic records of grass snake (*Natrix Helvetica*), common lizard (*Zootoca vivipara*), and slow worm (*Anguis fragilis*) have all been identified within a 2km search of the site boundary.

The tall ruderal vegetation and stored materials located adjacent to off-site woodland provide foraging, basking, and sheltering opportunities.

No reptiles were identified whilst on site, though the habitats are assessed as being of moderate suitability for reptiles in reference to Table 3-9*'Some suitable vegetation cover offering foraging opportunities, basking sites and refugia. Limited linkages to other areas of suitable reptile habitat. For example dense continuous scrub surrounded by short improved grassland.'*

Reptiles are on the Scottish Biodiversity Action List and are protected under the WCA and are therefore of National (UK) importance.

4.4.9 Cetaceans and Pinnipeds

The site lies approximately 50km upstream of the Firth of Clyde, a marine environment known to support cetaceans and pinnipeds. Though cetaceans and pinnipeds are recorded to navigate the River Clyde with historic records of common dolphin (*Delphinus delphis*), white-beaked dolphin

(*Lagenorhynchus albirostris*), and harbour seal (*Phoca vitulinav*) and a recent record of grey seal (*Halichoerus grypus*) all identified within the desk study within 2km of the site.

Information received from the Scottish Oceans Institute at the University of St. Andrews to inform the Ecological Impact assessment in 2014 suggests that common/harbour porpoise, grey seal, and common/harbour seal occurs only occasionally in the river (Claire Lacey, pers. comm. 25/02/14).

As there is no physical barrier between the wet basin on site and the River Clyde, there is potential for aquatic and semi-aquatic mammals to utilise the site for foraging and commuting purposes.

All cetaceans found in Scottish territorial waters on the on the Scottish Biodiversity List, and all are protected under the Conservation (Natural Habitats, &c.) Regulations 1994 (as amended in Scotland) against damage destruction to breeding or rest sites, harm and disturbance to individuals.

Whilst in Scottish waters, seals are protected under the Marine (Scotland) Act 2010 from intentional or reckless killing / injury, they are also protected from disturbance at significant haul-out sites under the Protection of Seal (Designation of Haul-out Sites) (Scotland) Order 2014. Common seal are also on the Scottish Biodiversity List.

Aquatic and semi-aquatic mammals are considered be of up to International importance. However, the value of the site to support cetaceans and pinnipeds is local.

4.4.10 Fish

The nearest Special Area of Conservation (SAC) designated for fish species (Atlantic salmon, brook lamprey and river lamprey) is the River Endrick, which discharges via the River Leven approximately 20km downstream within the Clyde estuary.

Desk study has identified European eel *(Anguilla Anguilla)*, Atlantic salmon *(Salmo salar)*, grayling *(Thymallus thymallus)*, brown trout *(Salmo trutta)*, brook lamprey (*Lampetra planeri*), sea lamprey (*Petromyzon marinus*), river lamprey (*Lampetra fluviatilis),* Smelt *(Osmerus eperlanus*), common minnow (*Phoxinus phoxinus),* stone loach (*Barbatula barbatula*), and three-spined stickleback (*Gasterosteus Aculaeatus*) within the River Clyde. In addition, the Marine Scotland National Marine Plan Interactive Map highlights the River Clyde as a salmonid river[41].

Atlantic salmon, brown (sea) trout, European eel, river lamprey and sea lamprey will all be present in the area with different life stages and species are likely to be present at different times of year and possibly at different states of the tide, etc.

The wet basin provides opportunities for migrating spawning fish, though due to the heavy modification of the river spawning habitat is likely to be limited.

Atlantic salmon, smelt, sea trout, brown trout, Arctic charr, brook lamprey, river lamprey, sea lamprey and eel are all listed as priority species on the SBL. Atlantic salmon and brook lamprey and both also listed on Annex II of the Habitats Directive. Therefore, all species aforementioned are of National (Scotland) importance.

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[41] Marine Scotland (No Date). *National Marine Plan Interactive*. [online] Available from: atkinsgeospatial.com (accessed 3 May 2022)

4.4.11 Other wildlife

During review of the PEA, produced by Mott MocDonald in March 2022, a single recent observation for an individual beaver (*Castor fiber*) has anecdotally been reported swimming within the wet basin. Glasgow is not typically known for supporting a population of beaver and no habitats suitable for supporting beaver are present on site due to the manmade steel embankments. Although beaver are not typically considered present, precautionary working methods put in place for other protected species will safeguard beaver.

Beaver are a SBL species of National (Scotland) importance.

4.5 Summary of Ecological Features

In accordance with CIEEM guidelines, important ecological features with the potential to be affected by the proposed development are listed in Table 4-3. The features listed in Table 4-3 will require mitigation and or further survey as detailed in Section 5.0.

Table 4-5: Important Ecological Features Brought Forward for Impact Assessment

Statutory sites	Black Cart SPA Inner Clyde Ramsar Inner Clyde SPA
Non-Statutory sites	River Clyde SINC
Habitats	Running water - wet basin
Invasive Species	Giant hogweed Horsetail
Species and species groups	Badger Bats Otter Birds Reptiles Aquatic/semi-aquatic mammals Fish

Ecological features that have been scoped out of the further assessment, owning to the conclusion that no significant effects are predicted, are listed in Table 4.4:

Table 4-6: Ecological Features Scoped out of Further Assessment

Statutory sites	Possil Marsh SSSI Dawsholm LNR
Non-Statutory sites	River Kelvin Disused Railway (King George V Docks) Bingham's Pond Festival Park
Ancient woodland	Unnamed Ancient Woodland
Habitats	Scattered scrub Tall ruderals Ephemeral/short perennial Buildings Hardstanding Fence
Species and species groups	West European hedgehog Amphibians Beaver

5 POTENTIAL IMPACTS AND RECOMMENDATIONS FOR MITIGATION

Current proposals are being considered to infill the existing wet basin on site to create a working platform and allow the expansion of the assembly line within a controlled environment.

The following potential sources of impacts have been identified that may have ecological effects:

- Infilling of 1.8ha of water basin to provide hardstanding extension including deployment of a silt curtain and infill using long reach excavator, barge excavator and/or self-discharging vessels;
- Breakout of existing hardstanding and ground infrastructure;
- Movement of topsoil;
- Clearance of current building material stockpiles;
- Creation of new hardstanding areas/access roads;
- Land based piling through the infill material to create the outer quay wall; and
- Installation of new drainage.

The following sub-sections detail potential impacts of development on important ecological features on site and appropriate mitigation measures to avoid/reduce negative impacts.

5.1 Nature Conservation Designations

5.1.1 Statutory Designated Sites

Black Cart SPA and Inner Clyde Ramsar and SPA, primarily of importance for breeding bird assemblages, lies approximately 6.2km - 6.4km downstream of the site.

NatureScot has stated they have no comment regarding development as the proposal does not impact on any statutory designated sites[42]. Precautionary mitigation to avoid accidental pollution events should however ensure in-river works are appropriately planned and include measures to prevent the release of silt or contaminants (i.e. concrete, fuel etc.) into the River Clyde which is hydrologically connected to Black Cart SPA and Inner Clyde Ramsar and SPA. In order to prevent an accidental pollution event, the following mitigation should be implemented:

- Compliance with SEPA Guidelines for Pollution Prevention (GPPs)[43]
- Compliance with a suitable site-specific construction environmental management plan (CEMP)
- Building materials/plant machinery when parked to be sited on an impermeable area
- Compliance with a suitable and site-specific wastewater management plan (WMP), or similar, identifying how wastewater shall be managed to avoid pollution of the River Clyde.

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[42] *Comms between NatureScot and Arch Henderson dated 8th June 2022*

[43] SEPA (n.d.) *Guidance Documents* [online]. Available from: https://www.sepa.org.uk/regulations/water/guidance/

5.1.2 Non-Statutory Designated Site

Proposed development will require levelling of the wet basin, which will lead to a direct loss of c. 1.8ha of the River Clyde SINC. It is therefore recommended that consultation is undertaken with Glasgow City Council to discuss direct impacts/loss of a small area of the River Clyde SINC.

Mitigation measures identified in relation to internationally designated sites will however provide mitigation to prevent accidental pollution events of the wider River Clyde SINC.

5.2 Habitats

Although highly disturbed, proposed development will result in a loss of c. 1.8ha of wet basin, a habitat considered to be up to County Importance due to its association with the River Clyde SINC. This loss shall require consultation with Glasgow City Council to discuss direct impacts / loss of a small area of the River Clyde SINC.

5.3 Invasive Species

Construction activities, to facilitate development, have potential to spread known infestations of giant hogweed and horsetail, through spoil movement and movement of plant fragments.

In addition, where invasive species are left to naturally spread, invasive species have potential to reduce diversity across the site.

A toolbox talk is to be given prior to construction (including vegetation clearance) to all contractors regarding the location and identification of invasive species and best practice for preventing spread, including checking clothes, tools and machinery are clear of invasive species contamination. The toolbox talk will be undertaken by an ecologist (or the Site Manager).

In order to manage INNS on-site a management plan must be implemented and detail suitable methods for control. A number of measures can be employed to control giant hogweed and horsetail, these include:

- Mechanical control, whereby the stems of the plant are cut by hand. Extreme caution is required due to the serious injurious nature of the sap of giant hogweed. Stems should be cut below ground with a spade and should be done early in the season to prevent flowering and seed production. Because giant hogweed is a herbaceous perennial, cutting often requires to be repeated, often for several years, to eradicate the plant.
- Chemical control, whereby the plants are sprayed with a chemical herbicide such as Glyphosate. Spraying should commence in spring, as soon as the plants are around 1m high. More than one application is often required. This method is deemed the most effective, however consultation with SEPA will be required due to the proximity of the River Clyde and the risk of these chemicals entering the watercourse.

Any soils within the site should be considered to be contaminated with INNS. In the event that the INNS or associated soils are required to be removed, arisings should be carefully separated, taken off site and disposed of appropriately (i.e. at a licenced facility).

Appropriate biosecurity measures should be implemented on site to prevent the spread of these species, this should include appropriate equipment, machine, wheel and foot washing stations.

It is important to consider infestations of INNS in the wider environment. If INNS and invasive species are growing profusely on adjacent land, then recolonisation of recently cleared sites is likely. Discussion with neighbouring land-owners may help encourage them to remove and/or manage invasive plants.

5.4 Fauna

The following general mitigation measures should be followed in relation to all fauna:

- Care must be taken during clearance/groundworks/water removal to ensure wildlife is not harmed. In the event any protected species are found when the ecologist is not in attendance, works must stop, the animal must not be handled and EnviroCentre Limited contacted immediately;
- Any works causing high levels of noise or vibration should be limited to daylight hours to reduce disturbance to nocturnal or crepuscular species in the locale such as bats or otter;
- Any excavations must be covered at night wherever practical. Where excavations are left open, a means of escape must be provided in the form of a ramp to allow trapped fauna to escape;
- Excavations must be managed to avoid the formation of temporary waterbodies; and
- All temporarily exposed pipes must be capped overnight to prevent animals gaining access and later becoming trapped.

Specific mitigation recommended in relation to notable species on/in proximity to the site has been detailed in subsequent sub-sections.

5.4.1 Badger

Although badger are not likely to utilise habitats on-site, there is potential for badger setts to become established off-site within a distance that may be disturbed by future development works. As badger can create new setts and commuting corridors at any time of year, it is recommended that an update site walkover is carried out within three months of construction commencing.

5.4.2 Bats

Two buildings with low bat roost potential have potential to be disturbed by development.

The Bat Conservation Trust's Survey Guidelines[33] state that buildings with low bat roosting potential to be demolished or disturbed typically require a single bat activity survey visits between May and September. The activity survey should be undertaken in optimum weather conditions, so to maximise the likelihood of recording bats, with dusk air temperatures exceeding 10^0C and no rain or strong wind.

If no roosts are found during the activity surveys, no further ecological input would be required. However, where bats are recorded roosting in an area that may be disturbed by works, **a European Protected Species (EPS) licence for bats is likely to be required** from NatureScot to undertake proposed works that would otherwise be unlawful.

In order to maintain any potential roosting, commuting and/or foraging resources the development design must not increase its current artificial lighting levels. Any temporary construction lighting or new permanent operational lighting should be 'bat friendly' i.e., should not illuminate bat commuting, foraging and roosting habitats including off-site woodland.

5.4.3 Otter

Construction activities have potential to temporarily disturb otter through noise, vibrations, water pollution, and use of artificial lighting.

It is recommended that where works do not commence within three months of an ecological survey visit, a pre-commencement otter holt check is carried out. In the event that an otter holt is found, works should cease so that further surveys can establish use and determine if they may need to be closed under a NatureScot licence.

During construction, the general mitigation measures and CEMP must be followed.

5.4.4 Birds

During the site survey swallows were recorded emerging from between the sheet piled wharf structures and masonry banks. To mitigate for the loss of habitat utilised by swallows, a minimum of 10 swallow boxes should be installed across the site, in close proximity to open water.

Given the protection afforded to all nesting birds, any removal of vegetation or features supporting nesting birds should be undertaken during September to February (inclusive) outside of the main bird breeding season. If any active bird's nests are found, works must stop in the area and an appropriate buffer zone (as determined by the ecologist, usually approximately 5m) must be established around the nest. The buffer must remain intact and the nest undisturbed until it has been confirmed that the young have fledged, and the nest is no longer in use.

5.4.5 Reptiles

No further reptile surveys are required to inform proposed development. However, it is recommended that sensitive vegetation clearance methods are adopted.

The tall ruderal and ephemeral/short perennial vegetation should be cleared using a two staged clearance method. The initial cut should be carried out to a height no lower than 150mm with all arisings removed from site. The second phase, where vegetation may be cut to ground level, should be undertaken within 48 hours of stage one clearance in a directional manner, moving out towards off-site woodland, with arisings removed from the site. Soil strip can progress after the second phase of vegetation clearance, again working towards retained habitat areas.

Any rubble/log/brash piles or stockpiles of materials currently on site that require removal must be dismantled under an ecological watching brief. This should take place between April and October, outside the reptile hibernation season.

Any reptiles or reptiles found during clearance will be moved to suitable off-site habitat.

5.4.6 Cetaceans and Pinnipeds

A number of aquatic and semi-aquatic mammals have been recorded within the River Clyde. Although many of these records are historic, these animals are sensitive to underwater noise, which can cause lethal or sub-lethal effects where mitigation is not implemented[44].

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[44] In: Subsea Noise Impact Modelling report to Aberdeen Harbour Board by SubAcoustech (2009).

In line with assessment carried out in 2014, in specific relation to common/harbour porpoise due to their high sensitivity to noise, the Deliberate Disturbance of Marine European Protected Species[45] and the Statutory Nature Conservation Agency Protocol for Minimising the Risk of Injury to Marine Mammals from Piling Noise[46] was consulted and an extract from the former is reproduced below.

'*Current data suggests that the population of common/harbour porpoise in UK waters is favourable. Most common/harbour porpoise schools are small, consisting of less than eight individuals, however, they do, at times, form large, loose aggregations of 50 to several hundred animals, mostly for feeding or migration. In the North Sea and adjacent waters, mean school size estimates were between 1.13 and 1.65 animals. An activity that would disturb a 'significant group' of animals of this species would have to be one that lasted for a considerably long period of time. Broadly, 'significant group' should be interpreted as the fraction of the population that, if exposed to disturbance in a way that that would adversely affect those animals, would result in detrimental effects at the population level (although not necessarily affecting the species Favourable Conservation Status (FCS) status in UK waters, otherwise the activity should not go ahead in any circumstance).*'

A Marine Mammal Protection Plan should be produced and implemented including the following recommendations:

- The Statutory Nature Conservation Agency Protocol for Minimising the Risk of Injury to Marine Mammals from Piling Noise[47] should be followed. This includes recommendations for a 'soft start' to be employed for any impact piling, or vibro-piling in open water, which allows animals to move away and then habituate to the noise at a distance or pass by the works; *and*
- In the event in-river piling is required, it is recommended that a Marine Mammal Observer is employed to ensure that no marine mammals are present within the area prior to the commencement of works. Observers would not allow piling to start until marine mammals had moved out of the area.

5.4.7 Fish

The construction phases of the development will result in the loss of open water habitats as well as has potential to result in a temporary increase in suspended sediment and pollution events which may kill or alter the behaviour of fish species known to be or have historically been recorded present in the River Clyde. In addition, underwater noise can cause lethal or sub-lethal effects and fish behaviour can be affected, especially during migration periods.

The following recommendations are provided to minimise impacts to fish species:

- A tool-box talk should be provided to workers, prior to construction, to ensure any works impacting the River Clyde/water basin are undertaken with due consideration to fish species.
- Where possible, the timing of construction activities, especially piling and any works in open water, would take place in daylight hours and avoid sensitive periods for fish species especially if water quality was poor. Sensitive periods for migratory fish are:
  - Atlantic salmon: August-September/October and May-June
  - European eel: May; and

---

[45] Joint Nature Conservation Committee (JNCC) (March 2008). *The Deliberate Disturbance of Marine European Protected Species: Guidance for English and Welsh Territorial Waters and the UK Offshore Marine Area*. Available at: http://jncc.defra.gov.uk/PDF/consultation_epsGuidanceDisturbance_all.pdf

[46] (August 2010). Statutory Nature Conservation Agency Protocol for Minimising the Risk of Injury to Marine Mammals from Piling Noise. Available from: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/50006/jncc-pprotocol.pdf

[47] JNCC. (August 2020). *Statutory nature conservation agency protocol for minimising the risk of injury to marine mammals from piling noise.* [Online] Available from: jncc.gov.uk (Accessed May 2022)

  - sea trout: March- May/June,
- Works should also avoid the upstream migration period for adult salmonid (generally May to November) and the downstream passage of smolts (generally April to June).
- Where possible, it is recommended that consultation is completed with Marine Scotland, SEPA and the local fisheries trusts (i.e. Clyde Rivers Foundation) for this stretch of the River Clyde, who may offer more accurate information regarding the potential presence and migration patterns of salmonids.
- A physical silt barrier, bubble curtain or isolation barrier will be placed between the infill area and the River Clyde during infill and prior to establishment of the coffer dam;
- A fish rescue and translocation exercise will be undertaken within the wet basin following installation of the barrier;
- In the event in-channel dry working areas are required, these should be kept as small as practically possible to retain as much of the channel dimensions as possible to maintain free passage for fish.
- Consideration should be given to slow-start procedures during in-stream works to allow any fish present to disperse naturally from the working areas.
- All works should be covered by a suitable CEMP to limit any potential pollution events.

5.5 Summary of Further Survey and Licence Requirements

As a result of the PEA further survey work/consultation is required to inform proposed development. In line with the current indicative development framework, recommended further survey work/consultation is summarised in Table 5-1.

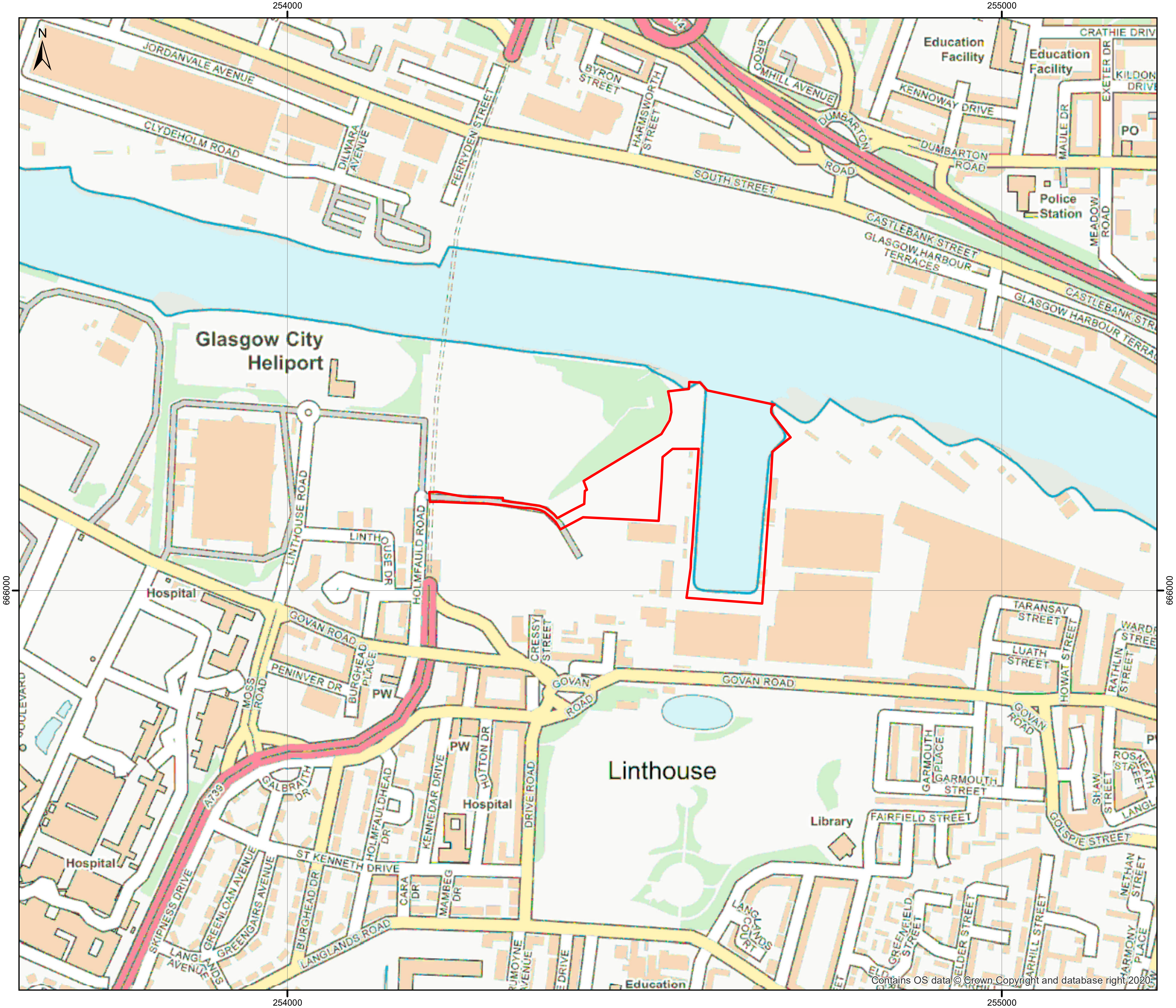
Table 5-1. Recommendations for Further Inspection/Survey

Inspection/Survey	Timescales
Engagement with Glasgow City Council regarding scope of survey work and SINC designation	As soon as possible
Bat Activity Survey of buildings to be demolished with low bat roost potential	May – August
Badger update site walkover to confirm no set creation	Prior to construction (including vegetation clearance)
Nesting Bird Check	Prior to development
Nesting Bird Survey	Prior to construction (including vegetation clearance)
Otter pre-commencement check	Prior to construction (including vegetation clearance)
Consultation with Marine Scotland, SEPA and the local fisheries trusts (i.e. Clyde Rivers Foundation) regarding local fish presence	As soon as possible

At present there is no requirement for protected species licencing, however, this may change as a result of the recommended further surveys/development of the masterplan.

APPENDICES

A SITE LOCATION PLAN



Legend

🟥 Site Boundary

Do not scale this map

Client
Arch Henderson

Project
Govan Facilities Investment

Title
Site Location Plan

Status
Final

Drawing No.	Revision	Date
175756-GIS001	-	18 May 2022
Drawn	**Checked**	**Approved**
AH	GD	GD

Scale
1:5,000 @A3

0 25 50 100 150 Metres

Rev	Date	Amendment	Initials

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B GOVAN SITE PLAN

Ref. No.	Building Name	Ref. No.	Building Name	Ref. No.	Building Name	Ref. No.	Building Name
9601	RUBB Cells	9605	Fabrication Shed Office	H	Compressor House	9620	Old Ambulance Room
01	Bay 1	9606	Meter House	9613	South Basin Complex	9638	Wet Basin Office / Wellness Centre
02	Bay 2	9609	Govan Road Gatehouse	A	South Basin Office	9639	Charles Randolph Office
03	Bay 3	A	Govan Road Security Cabin	B	Canteen	9640	Robert Napier Office
9602	Fabrication Shed	9610	Ship Block Outfitting Hall (SBOH)	C	Central Services Store	9642	Berth Office & Amenity
A	Fab Area 1	01	SBOH Bay 1	D	Paint Cell	9643	Berth Workshop
B	Fab Area 2	02	SBOH Bay 2	E	Weld Training Centre	9644	"A" Track Store (west)
C	Fab Area 3	03	SBOH Bay 3	F	Prep Bay 5	9645	Maintenance Welding Repair Centre
D	Fab Area 4	9611	Ward Complex	G	Sub Station	9646	Govan Distribution Centre
9603	Preparation Shop	A	Pipe Store	9614	Site Services Department	9649	Linthouse Gatehouse (Cabins)
A	Prep Bay 1	B	Steel Outfit Shop	9615	Substation (Scottish Power)	9650	Transport (Cabins)
B	Prep Bay 2	C	Sawmill	9618	Supplier Park	9651	Clyde Suite
C	Prep Bay 3	E	Module Hall	A	Tackle Store	9652	Visitor Centre
D	Prep Bay 4	F	Goods Inwards	B	Covid Test Centre		
9604	Steel Stockyard	G	Hay Shed	C	West Store		
A	Paint Treatment Line			9619	Amenity & Toilet Block		

REV	DATE	REVISION	BY

PROJECT
SITE PLAN
GOVAN SITE PLAN

DATE
30/11/2021

DRAWN BY
CD

APPROVED

TITLE
YARD LAYOUT
GENERAL ARRANGEMENT

SHEET No
1/1

SCALE
SCALE

DWG CODE
201006-01

REV

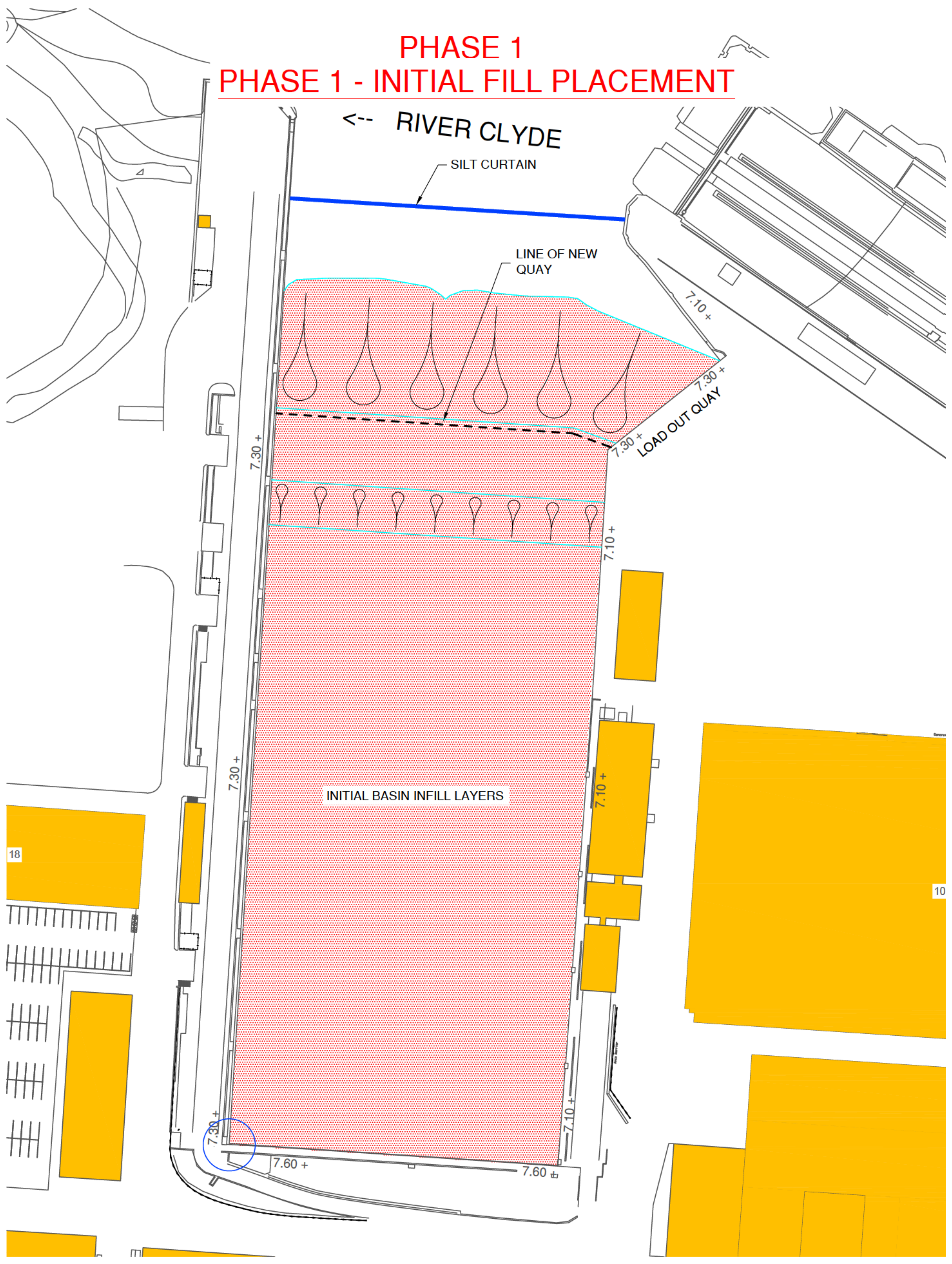
SIZE
A1

CLASSIFICATION
PROPRIETARY

BAE Systems
South Street, Scotstoun, Glasgow, G14 OXN
Tel: 0141-959-1207 Fax: 0141-958-0642

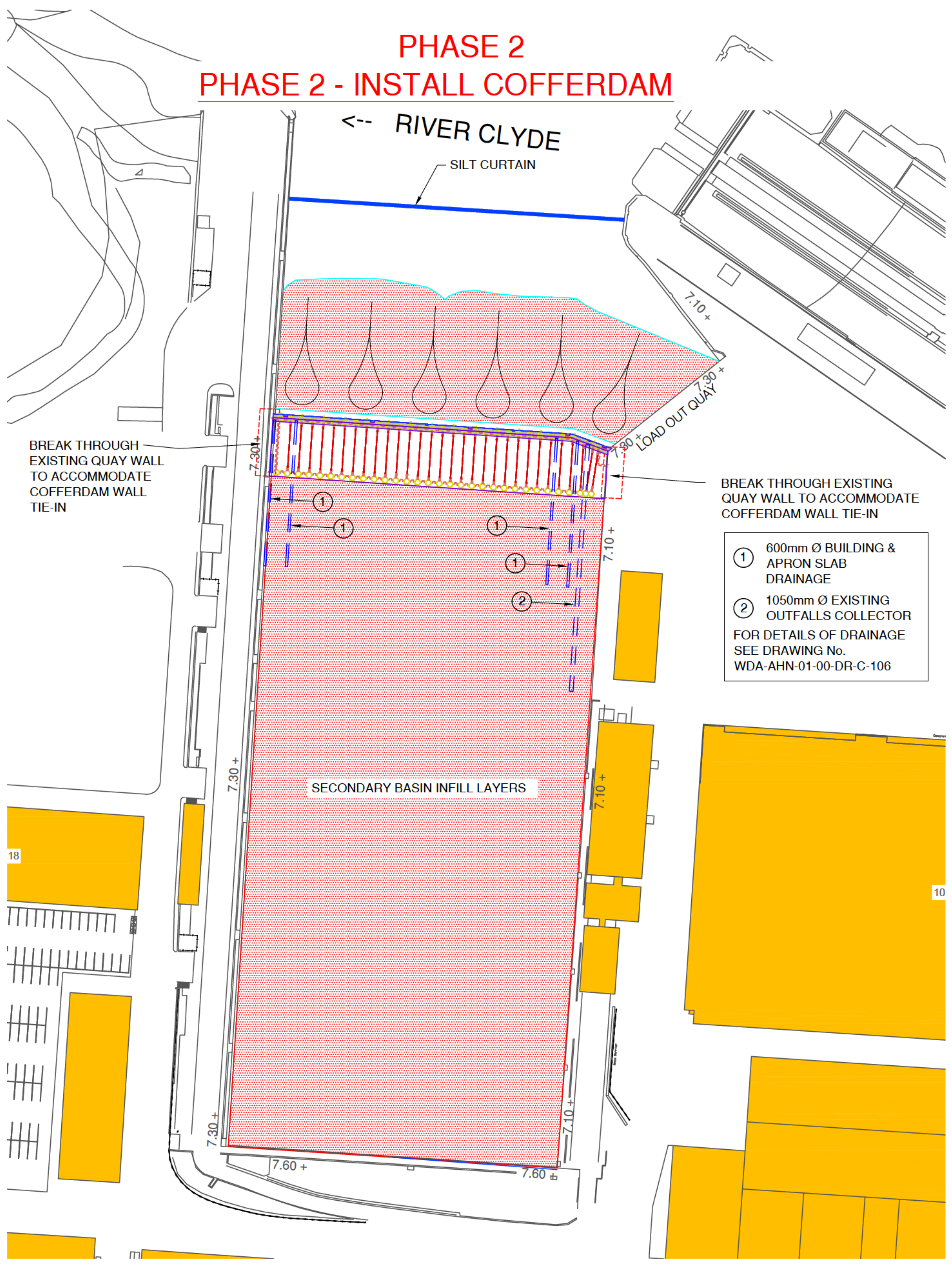
C ILLUSTRATIVE LAYOUT

PHASE 1
PHASE 1 - INITIAL FILL PLACEMENT



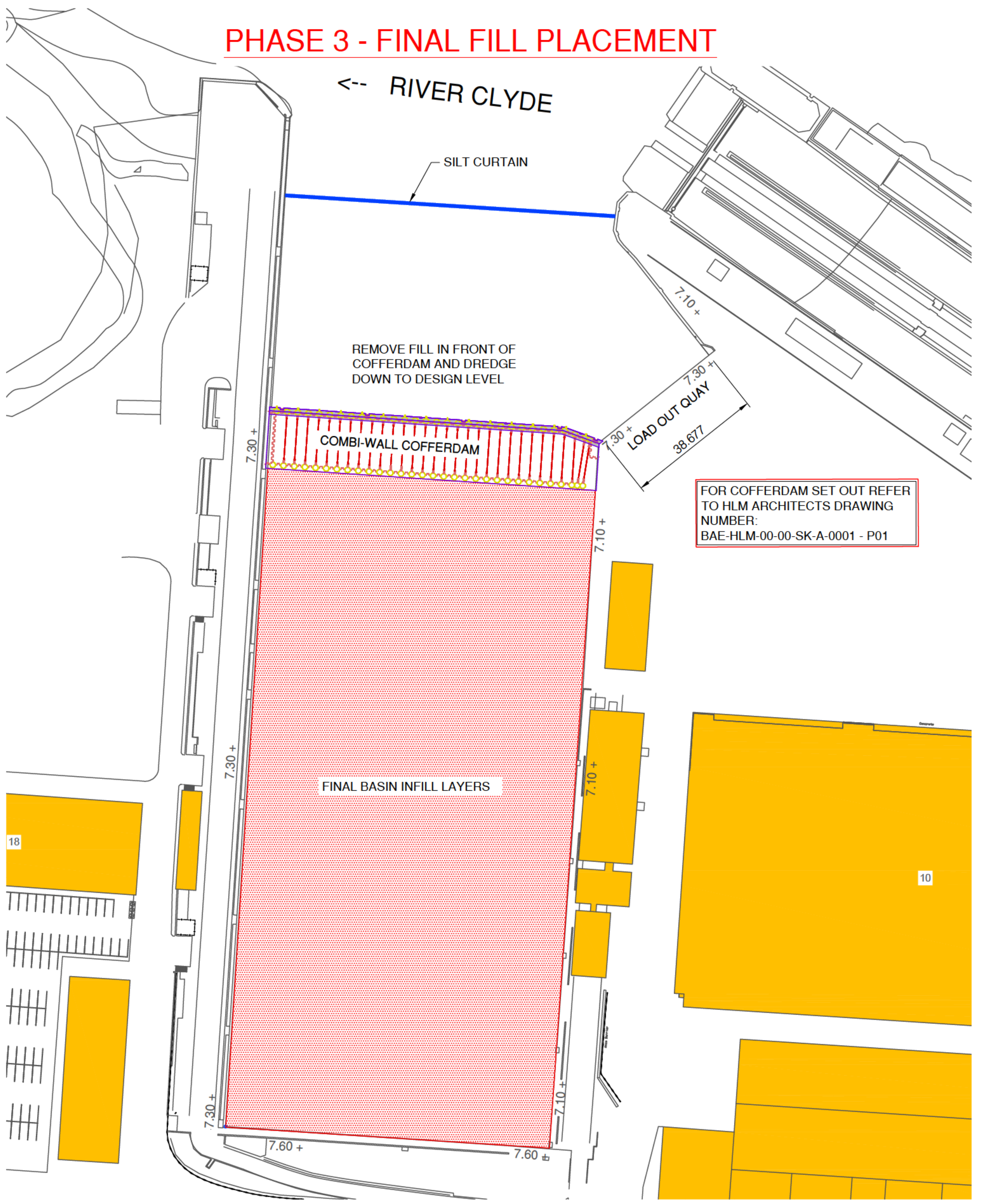
1. INSTALL SILT CURTAIN AND / OR BUBBLE CURTAIN AT ENTRANCE TO GOVAN BASIN.
2. BERM OF MATERIAL PLACED AT FRONT OF BASIN TO HELP CONTAIN ANY SUSPENDED SEDIMENT. HEIGHT TO BE DETERMINED BASED ON FINAL METHODOLOGY.
3. UP TO 2m INFILL PLACEMENT TO COVER EXISTING BASIN SEDIMENT.
4. CONTINUE TO FILL USING BARGE AND EXCAVATOR OR SPLIT HOPPER BARGE, OR HYDRAULIC DISCHARGE FROM PIPELINE.
5. PLACE MATERIAL, PLACEMENT BY BARGE AND EXCAVATOR AND PUSHING MATERIAL ACROSS BASIN USING DOZER IF NECESSARY.

PHASE 2
PHASE 2 - INSTALL COFFERDAM



1. INFILL TO PRE DETERMINED LEVEL AND INFILL WEDGE VOID BEHIND EXISTING SHEET PILE WALL CONCURRENTLY. THIS MAY REQUIRE LOCAL DEMOLITION OF THE EXISTING COPE BEAM AND CUTTING DOWN OR EXTRACTION OF SHEET PILES.
2. INSTALL COFFERDAM

PHASE 3 - FINAL FILL PLACEMENT



1. REMOVE STONE BUND FROM FRONT OF COFFERDAM.
2. INFILL TO +6.5m.

REV	DATE	REVISION DESCRIPTION	DRN	VER
P05	25.08.22	REVISED AS PER CLIENT COMMENTS.	GB	TR
P04	24.08.22	COFFERDAM LOCATION REVISED. CONSTRCTION SEQUENCE REVISED. MARINE LICENCE APPLICATION.	GB	TR
P03	26.05.22	CONSENT ISSUE	CAB	TR
P02	26.05.22	ISSUED FOR DESIGN BRIEF	CAB	TR
P01	19.05.22	ISSUED FOR COMMENT	CAB	TR

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CONSENT

GENERAL NOTES

THIS DRAWING TO BE READ IN CONJUNCTION WITH ALL DRAWINGS IN THE 225010 SERIES.

FOR SECTION THROUGH WORKS, REFER TO DRAWING NUMBER BAE-AHN-XX-XX-DR-C-0005

PROJECT :
BAE Surface Ships Limited - Govan
Wet Basin Infill

TITLE :
Draft Phasing Plans

DRAWN :	DATE :	VERIFIED :	APPROVED :
CAB	11.05.22	TR	GB

SCALE : (A1) AS SHOWN
DRAWING STATUS : LICENCE

DO NOT SCALE

DRAWING No : 225010-BAE-AHN-ZZ-XX-DR-C-0004
REV : P05

D PROTECTED SPECIES LEGISLATION

European Protected Species (Bats, Otter, Atlantic Salmon in fresh water, Brook Lamprey, and Cetaceans)

A European Protected Species (EPS) is a species listed in the EC Directive (92/43) The Conservation of Natural Habitats and of Wild Flora and Fauna (the “Habitats Directive”), which is transposed into UK law through the Conservation (Natural Habitats &c.) Regulations 1994 (the “Habitat Regulations”) as amended by The Conservation (Natural Habitats, &c.) Amendment (Scotland) Regulations 2019. Under this legislation an EPS (*e.g.* all bat species) are protected from:

(a) Deliberate or reckless capture, injuring or killing;

(b) deliberate or reckless

  (i) harassment of an animal or group of animals;

  (ii) disturbance of such an animal while it is occupying a structure or place which it uses for shelter or protection;

  (iii) disturbance of such an animal while it is rearing or otherwise caring for its young;

  (iv) obstructing access to a breeding site or resting place of such an animal, or otherwise denying the animal use of the breeding site or resting place;

  (v) disturbance of such an animal in a manner that is, or in circumstances which are, likely to significantly affect the local distribution or abundance of the species to which it belongs; or

  (vi) disturbing such an animal in a manner that is, or in circumstances which are, likely to impair its ability to survive, breed or reproduce, or rear or otherwise care for its young;

(c) deliberate or reckless taking or destroying the eggs of such an animal; or,

(d) damaging or destroying a breeding site or resting place of such an animal.

(e) any person:

  (i) possessing or controlling;

  (ii) transporting;

  (iii) selling or exchanging; or

  (iv) offering for sale or exchange

of any live or dead animal or part of an animal or anything derived from such an animal which has been taken from the wild and which is of a species or subspecies listed in Annex IV(a) to the Habitats Directive – unless the animal from which the part or the thing in question is derived, was lawfully taken from the wild (i.e. taken from the wild in the European Union without contravention of appropriate domestic legislation and before the implementation date of the Habitats Directive (in that Country e.g. 1994 in UK) or if it was taken from elsewhere).

European Protected Species Licensing

For a licence to be issued these three tests must be satisfied:

- That the development is 'in the interests of public health and public safety, or for other imperative reasons of overriding public interest, including those of a social or economic nature and beneficial consequences of primary importance for the environment';
- That there is 'no satisfactory alternative'; and
- That the derogation (i.e. any permission/licence granted) is 'not detrimental to the maintenance of the populations of the species concerned at a favourable conservation status in their natural range'.

To obtain a licence a Method Statement is required that identifies the activities to be undertaken, the location of all resting sites (*e.g.* bat roosts), the potential effects and details of the proposed mitigation.

Badger

Under the Protection of Badgers Act (1992), as amended by the Nature Conservation (Scotland) Act 2004, it is an offence to:

- Kill, injure or take a badger;
- Have in possession a dead badger or any part of a badger;
- Cruelly ill-treat a badger; and
- Damage, destroy, interfere or obstruct a badger sett or disturb a badger whilst it is occupying a sett.

Where an offence is committed the individual (as well as the body corporate, Scottish partnership or, as the case may be, unincorporated association) is guilty of the offence and is liable to be proceeded against and punished accordingly.

In some cases licenses may be issued by NatureScot to enable certain otherwise illegal activities to take place. With respect to development-related activities, licenses can be issued where there is likely to be damage or disturbance to a badger sett, for social, economic or environmental reasons. Licenses may only be issued for this purpose provided that:

- The activity authorised by the licence will contribute to significant social, economic or environmental benefit; and
- There is no other satisfactory solution.

General Breeding Birds

All wild bird species in the UK are protected from killing, injury and taking under the Wildlife and Countryside Act 1981, as amended. It an offence to take, damage or destroy a nest while in use or being built, and to take or destroy the eggs of any nesting bird.

Birds listed on Schedule 1 of the Act are provided additional protection. It is an offence, with certain exceptions, to:

- Intentionally kill, injure, or take (handle) any wild Schedule 1 bird;
- Intentionally take, damage or destroy any nest whilst in use or being “built” by a Schedule 1 bird;
- Intentionally take or destroy a wild Schedule 1 bird egg;
- Have in one’s possession or control a wild Schedule 1 bird (dead or alive), or egg, (unless one can show that it was obtained legally);
- Intentionally or recklessly disturb any wild Schedule 1 bird whilst “building” a nest or whilst in, on, or near a nest containing eggs or young; and
- Intentionally or recklessly disturb any dependent young of a Schedule 1 bird.

Licences can be granted by NatureScot to permit otherwise illegal acts; however licences cannot be issued for the removal of Schedule 1 birds to facilitate development.

Note: The above information constitutes a summary only. Please refer to original legislation for full information.

Reptiles

Common reptiles (slow worm, common lizard, adder and grass snake) are protected under Schedule 5 of the Wildlife and Countryside Act 1981 (as amended). Subject to certain exceptions, it is an offence to intentionally or recklessly:

- kill, injure or take (capture) an individual;
- damage, destroy or obstruct access to any structure or place which they use for shelter or protection;
- disturb an individual while it is occupying a structure or place which it uses for that purpose; or to
- possess or control, sell, offer for sale or possess or transport for the purpose of sale any live or dead animal or any derivative of such an animal.

Knowingly causing or permitting any of the above acts to be carried out is also an offence.

Pinnipeds

Whilst in Scottish waters, seals are protected under the Marine (Scotland) Act 2010 from intentional or reckless killing / injury, they are also protected from disturbance at significant haul-out sites under the Protection of Seal (Designation of Haul-out Sites) (Scotland) Order 2014.

It is also an offence to intentionally or recklessly harass seals at significant haul-out sites under the Protection of Seals (Designation of Haul-out Sites) (Scotland) Order 2014.

Invasive Non-Native Species (Plants)

Under the Wildlife and Countryside Act 1981 (as amended) it is an offence to plant, or otherwise cause to grow, any plant in the wild at a location outside its native range.

‘Native range’ is defined in the 1981 Act as, “the locality to which the animal or plant of that type is indigenous, and does not refer to any locality to which that type of animal or plant has been imported (whether intentionally or otherwise) by any person.”

The Scottish Governments Non-natives Code of Practice[48] defines ‘in the wild’. Just about everywhere is wild except for:

- arable and horticultural land;
- improved pasture;
- settlements; and
- private and public gardens.

In exceptional circumstances it may be possible to obtain a licence from NatureScot to permit the above offence.

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[48] https://www.gov.scot/publications/non-native-species-code-practice/

E GEOGRAPHICAL LEVEL OF IMPORTANCE OF ECOLOGICAL FEATURES

Appendix E Table 1. Geographical level of importance of ecological features

Level of Importance	Sites	Habitats	Species
International	Designated, candidate or proposed Special Areas of Conservation, Special Protection Areas and Ramsar sites; UNESCO (Ecological) World Heritage Sites; UNESCO Biosphere Reserves; Biogenetic Reserves.	A viable area of habitat included in Annex I of the EC Habitats Directive; a habitat area that is critical for a part of the life cycle of an internationally important species.	A European Protected Species; an IUCN Red Data Book species that is globally Vulnerable, Endangered or Critically Endangered; a Category A internationally important bryophyte assemblage[49].
National (UK)	Sites of Special Scientific Interest/Areas of Special Scientific Interest; National Nature Reserves; Nature Conservation Review Sites; Marine Conservation Zones (UK offshore).	An area of habitat fulfilling the criteria for designation as an SSSI/ASSI or MCZ; a habitat area that is critical for a part of the life cycle of a nationally important species.	An IUCN Red Data Book species that is Vulnerable, Endangered or Critically Endangered in the UK; a species that is Rare in the UK (<15 10km grid squares); a Schedule 5 (animal) or Schedule 8 (plant) species included in the Wildlife and Countryside Act 1981; any species protected under national (UK) legislation where there is the potential for a breach of the legislation; a Category A nationally important bryophyte assemblage[50]; a species that is Vulnerable, Endangered or Critically Endangered in The Vascular Plant Red Data List for Great Britain[51].
National (Scotland)	National Parks (England, Scotland, Wales); Marine Protected Areas (Scotland offshore); Marine Consultation Areas (Scotland).	Habitats of principal importance for biodiversity in the relevant countries[52], including; Scottish Biodiversity List (SBL) Priority Habitats and Priority Marine Features (PMFs)[53] (Scotland).	Species of principal importance for biodiversity in the relevant countries[54], including;SBL Priority Species and PMFs (Scotland);

---

[49] Averis, A.B.G, Genney, D.R, Hodgetts, N.G, Rothero, G.P. & Bainbridge, I.P. 2012. Bryological assessment for hydroelectric schemes in the west highlands – 2nd edition. Scottish Natural Heritage Commissioned Report No. 449b

[50] Averis, A.B.G, Genney, D.R, Hodgetts, N.G, Rothero, G.P. & Bainbridge, I.P. 2012. Bryological assessment for hydroelectric schemes in the west highlands – 2nd edition. Scottish Natural Heritage Commissioned Report No. 449b

[51] Cheffings, C.M. & Farrell, L. (eds), Dines, T.D., Jones, R.A., Leach, S.J., McKean, D.R., Pearman, D.A., Preston, C.D., Rumsey, F.J., Taylor, I. (2005) *The Vascular Plant Red Data List for Great Britain. Species Status No. 7.* JNCC, Peterborough. Available at: https://hub.jncc.gov.uk/assets/cc1e96f8-b105-4dd0-bd87-4a4f60449907 (Accessed August 2021)

[52] These are all the habitats that were identified as requiring action in the UK Biodiversity Action Plan and continue to be regarded as conservation priorities in the subsequent UK Post-2010 Biodiversity Framework, including any additions.

[53] In July 2014, Scottish Ministers adopted a list of 81 priority marine features (PMFs) – many of which are features characteristic of the Scottish marine environment. Most are on other conservation status lists so may be valued higher than this.

[54] These are all the species that were identified as requiring action in the UKBAP and continue to be regarded as conservation priorities in the subsequent UK Post-2010 Biodiversity Framework, including any additions.

Level of Importance	Sites	Habitats	Species
Regional	Regional Parks (Scotland).	Regional Local Biodiversity Action Plan habitats noted as requiring protection.	A species that is Nationally Scarce in the UK (present in 16-100 10km grid squares); a species that is included in the Regional LBAP; an assemblage of regionally scarce species.
County / Metropolitan	Local Nature Reserves; Woodland Trust Sites; Royal Society for the Protection of Birds Sites; Local Wildlife Sites (Scotland).	County LBAP habitats noted as requiring protection; semi-natural, ancient woodland >0.25ha in extent.	A species that is included in the County LBAP; an assemblage of species that are scarce at the county level.
Local		Semi-natural, ancient woodland <0.25ha in extent; semi-natural habitats that are unique or important in the local area.	Species as defined by Local Authority lists (if available).
Site		Common and widespread habitats not covered above.	Common and widespread species not covered above.
Negative			An Invasive Non-Native Species (INNS) as defined by the GB Non-Native Species Secretariat (NNSS) and supported by the GB Invasive Non-native Species Strategy (2015); legally controlled species under Schedule 9 of the Wildlife and Countryside Act 1981 (as amended by the relevant country legislation).
Negligible		None present of value	None present of value

F PHASE 1 HABITAT PLAN

Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Legend

- ▭ Site Boundary

JNCC Code

- ✕ A2.2 Scattered Scrub
- ▨ C3.1 Tall Ruderal
- 🟦 G2 Running Water
- ✕ J1.3 Ephemeral/short perennial
- ■ J3.6 Building
- ■ Hardstanding

Do not scale this map

Client
Arch Henderson

Project
Govan Facilities Investment

Title
Phase 1 Habitat Survey

Status
Final

Drawing No.	**Revision**	**Date**
175756-GIS003	-	07 June 2022
Drawn	**Checked**	**Approved**
JAS	AS	AS

Scale
1:2,000 @A3

0 10 20 40 60 Metres

Rev	Date	Amendment	Initials

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G INVASIVE NON-NATIVE SPECIES PLAN

Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Legend

- ▭ Site Boundary
- ▨ Giant Hogweed
- ▦ Horsetail

Do not scale this map

Client
Arch Henderson

Project
Govan Facilities Investment

Title
Invasive Non-Native Species Plan

Status
Final

Drawing No.	Revision	Date
175756-GIS004	-	07 June 2022
Drawn	**Checked**	**Approved**
JAS	AS	AS

Scale
1:2,000 @A3
0 10 20 40 60 Metres

Rev	Date	Amendment	Initials

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Technical Appendix 9-2_European Protected Species (EPS) and Fish Risk Assessment

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Govan Wet Basin Infill
Water Framework Directive Assessment

July 2022

Govan Wet Basin Infill
Water Framework Directive Assessment

Client:	Arch Henderson
Document number:	10197
Project number:	175756
Status:	Final
Author:	Graeme Duff
Reviewer:	Campbell Stewart
Date of issue:	27 July 2022
Filename:	WFD Assessment

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This report has been prepared by EnviroCentre Limited with all reasonable skill and care, within the terms of the Contract with Arch Henderson ("the Client"). The report is confidential to the Client, and EnviroCentre Limited accepts no responsibility of whatever nature to third parties to whom this report may be made known.

EnviroCentre Limited is registered in Scotland under no. SC161777.

VAT no. GB 348 6770 57.

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1 INTRODUCTION

1.1 Terms of Reference

EnviroCentre Ltd has been appointed by Arch Henderson on behalf of BAE Systems Ltd to produce a Water Framework Directive(WFD) Assessment in relation to the proposals to infill the wet basin at Govan Shipyard and Maintenance Facility (Govan shipyard) (Refer to Drawing No 175756-GIS001 provided in Appendix A).

The following report details the assessment and its findings.

1.2 Report Usage

The information and recommendations contained within this report have been prepared in the specific context stated above and should not be utilised in any other context without prior written permission from EnviroCentre.

If this report is to be submitted for regulatory approval more than 12 months following the report date, it is recommended that it is referred to EnviroCentre for review to ensure that any relevant changes in data, best practice, guidance or legislation in the intervening period are integrated into an updated version of the report.

EnviroCentre accepts no liability for use of the report for purposes other than those for which it was originally provided, or where EnviroCentre has confirmed it is appropriate for the new context.

2 WATER FRAMEWORK DIRECTIVE

The Water Framework Directive (WFD) arose from the European Community (EC)'s Water Framework Directive (WFD) becoming law in Scotland as the Water Environment and Water Services (Scotland) Act 2003 (WEWS Act) and further implemented through Water Environment (Controlled Activities) (Scotland) Regulations 2011 – more commonly known as the Controlled Activity Regulations (CAR) – and their further amendments of 2013 and 2017.

These apply regulatory controls over activities which may affect Scotland's water environment.

The regulations cover rivers, lochs, transitional waters (estuaries), coastal waters groundwater, and groundwater dependant wetlands.

The main aims of the Water Framework Directive (WFD) are to:

- prevent deterioration and enhance status of aquatic ecosystems, including groundwater;
- promote sustainable water use;
- reduce pollution;
- contribute to the mitigation of floods and droughts.

The WFD aim is for all water bodies to be at good status. Consideration of the WFD requirements is considered necessary for developments which may result in:

- cause or contribute to deterioration of status;
- jeopardise the water body achieving good status.

In the absence of guidance in Scotland in relation to WFD assessment the Environment Agency's *Clearing the Water For All*[1] guidance has been adopted for the process of this assessment.

The assessment incorporates 3 stages:

- Screening – Allows for exclusion of any activities that do not need to go through the scoping or impact assessment stages;
- Scoping – identifies the receptors that are potentially at risk from the activity and need for impact assessment;
- Impact assessment – considers the potential impacts of the activity, identifies ways to avoid or minimise impacts, and shows if the activity may cause deterioration or jeopardise the water body achieving good status.

The following report details the findings of the noted assessment stages.

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[1] https://www.gov.uk/guidance/water-framework-directive-assessment-estuarine-and-coastal-waters

3 SCREENING

The following activities are identified as activities that do no require to progress to scoping stage:

- a self-service marine licence activity or an accelerated marine licence activity that meets specific conditions;
- maintaining pumps at pumping stations – if you do it regularly, avoid low dissolved oxygen levels during maintenance and minimise silt movement when restarting the pumps;
- removing blockages or obstacles like litter or debris within 10m of an existing structure to maintain flow;
- replacing or removing existing pipes, cables or services crossing over a water body – but not including any new structure or supports, or new bed or bank reinforcement;
- ‘over water’ replacement or repairs to, for example bridge, pier and jetty surfaces – if you minimise bank or bed disturbance.

It is considered that the wet basin infill works does not fall under these noted categories and therefore requires to be further assessed under the Scoping Stage.

4 SCOPING

On the basis of the location of the proposed works at Govan Wet Basin the following potential key receptor has been identified:

Surface Water

- Clyde Estuary - Inner (inc Cart).

Groundwater assessment is not considered a requirement in relation to the marine infilling works.

Table 4-1 provides a summary of relevant data for the Clyde Estuary Inner (inc Cart):

Table 4-1 Summary of Water Body Information[2]

Parameter	Description
Water Body Name	Clyde Estuary – Inner (Inc Cart)
Water Body ID	200510
Water Body Type	Transitional
Water Body Total Area	4.4 km^2
Overall Water Body Status	Moderate (2020)
Ecological Status	Poor (2020)
Chemical Status	Poor (2020)
Hydromorphological Status	Poor - The water body has been designated as a heavily modified water body on account of physical alterations that cannot be addressed without a significant impact on navigation and from an increased risk of subsidence or flooding.
Other Parameters Rated at Good Status	Biological Elements, Fish, Copper and Unionised Ammonia
Other Parameters Rated Below Good Status	Dissolved Inorganic Nitrogen, Chromium, Morphology

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[2] https://www.sepa.org.uk/data-visualisation/water-environment-hub/

The scoping stage identification of activity's potential risks to each receptor within the identified water bodies that may be impacted. The receptors to be considered are:

- hydromorphology;
- biology – habitats;
- biology – fish;
- water quality;
- protected areas.

The following section details the findings of the Scoping Stage.

4.1 Hydromorphology

Hydromorphology is the physical characteristics of estuaries and coasts. It includes the size, shape and structure of the water body, and the flow and quantity of water and sediment.

The following table summarises the key considerations at scoping stage with respect to potential for impact to hydromorphology associated with the development.

Table 4-2 Hydromorphology Scoping Assessment

Consider if the activity	Yes	No	Hydromorphology Risk Issue
Could impact on the hydromorphology (for example morphology or tidal patterns) of a water body at high status		No, Clyde Inner Estuary is rated as Poor for hydromorphology	No
Could significantly impact the hydromorphology of any water body	There is potential in change to localised hydromorphology		To be further assessed
Is in a water body that is heavily modified for the same use as your activity	Yes, the water body is heavily modified, the proposed use is related to an existing harbour facility		To be further assessed

As noted above, the potential for impact to the hydromorphology will be taken further for discussion in the Impact Assessment section,

4.2 Biology

4.2.1 Habitat

At the initial stage of the assessment there is a requirement for consideration of presence of high risk habitats within the receiving water. High risk habitats include:

- chalk reef
- clam, cockle and oyster beds
- intertidal seagrass
- maerl
- mussel beds, including blue and horse mussel
- polychaete reef
- saltmarsh
- subtidal kelp beds
- subtidal seagrass

In addition, the assessment considers potential for impact to lower sensitivity habitats which include:

- cobbles, gravel and shingle
- rocky shore
- subtidal boulder fields
- subtidal rocky reef
- subtidal soft sediments like sand and mud

The following table summarises the findings of the scoping assessment.

Table 4-3 Biology - Habitat Scoping Summary

Consider if the footprint of your activity is	Yes	No	Biology Habitats Risk Issue
0.5km^2 or higher		No, the area of the basin is 4.57 Ha (0.0045km^2)	No
1% or more of the water body's area		No the area of the basin is 0.0045 km^2 (the Clyde Estuary – Inner is 4.4 km^2)	No
Within 500m of any higher sensitivity habitat		Whilst the wider Clyde Estuary – Inner does incorporate areas that would be deemed higher sensitivity habitats none are considered to be within 500m of the wet basin (see Figure 1 below)	No

1% or more of any lower sensitivity habitat		On the basis of the overall Clyde Estuary predominantly representing an area of lower sensitivity the wet basin (and any potential associated sediment plumes from the works) is considered to be less than 1% in area	No

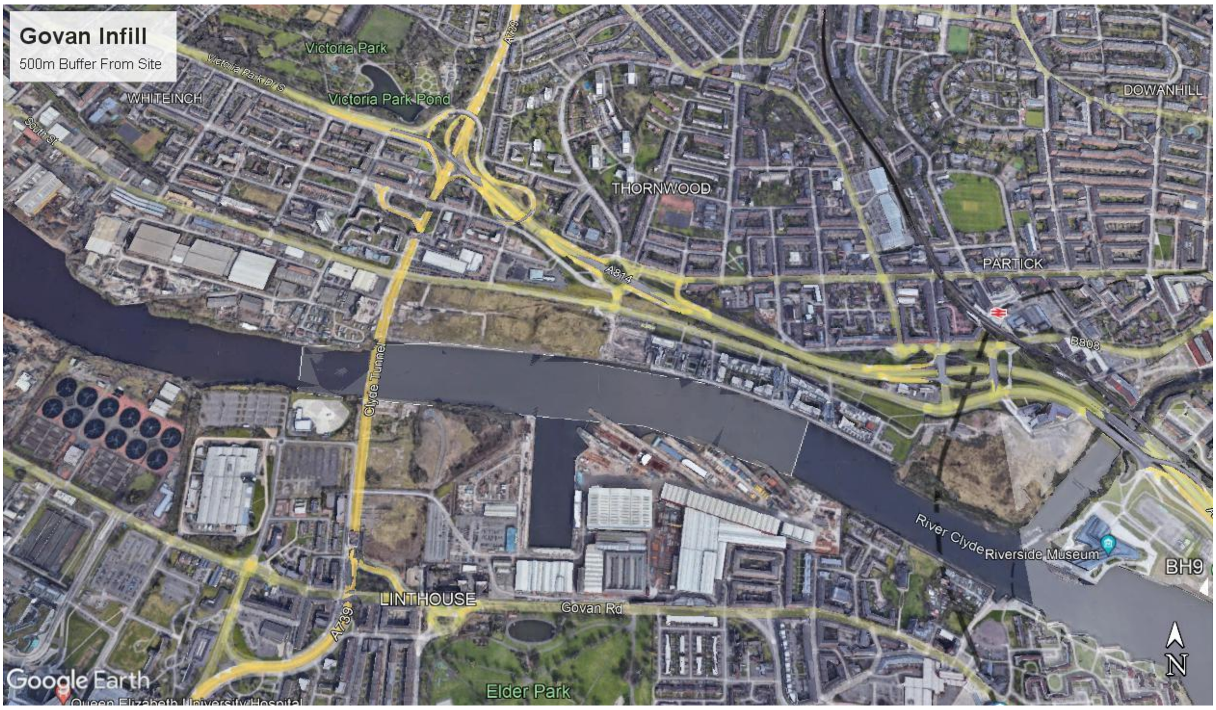

Figure 4-1 500m Buffer From Wet Basin Infill

Figure 4-1 shows an approximate 500m buffer along the Clyde Estuary Inner (upstream and downstream) from the Wet Basin. Both sides of the Clyde in this area are heavily modified incorporating the existing Govan BAE shipyard, derelict land and housing. There are no identified highly sensitive habitats considered to be associated with this section of the Clyde Estuary.

On the basis of the scoping assessment it is considered that the proposed development works do not represent a significant risk of impact to Biology-Habitat.

4.2.2 Fish

The Clyde catchment supports 33 species of freshwater fish and valuable fisheries for Atlantic salmon, sea trout, resident brown trout, grayling (an introduced species) and 'coarse' species (those types of freshwater fish other than game fish). A number of scientifically important and endangered species are also present (sea lamprey, river lamprey, brook lamprey and European eel). Those recorded in the River Clyde include: river lamprey, European eel, barbel (non-native; the River Clyde catchment represents the most northerly population in the world), common minnow, three-spined stickleback, stone loach, Atlantic salmon, brown trout/sea trout and grayling.

The following table summarises the scoping assessment in relation to the potential for risk to fish associated with the proposed development.

Table 4-4 Biology -Fish Scoping Summary

Consider if the activity	Yes	No	Biology Fish Risk Issue
Is in an estuary and could affect fish in the estuary, outside the estuary but could delay or prevent fish entering it or could affect fish migrating through the estuary	Yes, the site form part of the Clyde Estuary – Inner		See next question
Could impact on normal fish behaviour like movement, migration or spawning (for example creating a physical barrier, noise, chemical change or a change in depth or flow)	Yes, the basin infill itself will result in impact and there is potential for associated short term impact to water quality during the infill works		Take forward to impact assessment
Could cause entrainment or impingement of fish	Yes, the basin infill could result in entrainment of fish		Take forward to impact assessment

Following completion of Biology scoping assessment, Biology-Habitat has not been identified for further impact assessment on the basis of the current site location and surrounding habitat type. Biology-Fish has been identified for further impact assessment.

4.3 Water Quality

4.3.1 Phytoplankton Status and Harmful Algae

The following table details the summary with respect to Water Quality- Phytoplankton risks.

Table 4-5 Water Quality - Phytoplankton Scoping Summary

Consider if the activity	Yes	No	Water Quality Risk Issue
Could affect water clarity, temperature, salinity, oxygen levels, nutrients or microbial patterns continuously for longer than a spring neap tidal cycle (about 14 days)	Yes, the works has potential to impact on water clarity and oxygen level in relation to potential for release of suspended solids during the infill works. These works will carry on beyond 14 days		To be taken forward to impact assessment
Is in a water body with a phytoplankton status of moderate, poor or bad		No, phytoplankton not assessed	No impact assessment required
Is in a water body with a history of harmful algae		No, no known history of harmful algae	No impact assessment required

4.3.2 Water Quality Impact Through Chemical Release

For the purposes of the scoping assessment in relation to potential for chemical release existing information on the sediment quality within the Govan Wet Basin has been reviewed,

Sediment cores were recovered from the Govan Wet Basin and tested for the Marine Scotland Suite to assess suitability with respect to disposal at sea. A copy of the analytical results for these two cores are provided in Appendix B. The results sheet identify that this historic sediment within the basin exceeded Marine Scotland Action Level 1 concentrations for a range of contaminants including heavy metals, poly aromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs). It is noted that this material has since been dredged and disposed of, however on the basis of conservative assessment itis assumed that current sediment within the basin may also have chemicals of concern present.

The table below summarises the scoping assessment.

Table 4-6 Water Quality - Chemical Impact Summary Scope

If your activity uses or releases chemicals (for example through sediment disturbance or building works) consider if:	Yes	No	Water Quality Risk Issue
The chemicals are on the Environmental Quality Standards Directive (EQSD) list	The exact source of infill material is not known at stage of assessment. The historic sediment testing within the basin confirmed that sediment contains chemicals of the EQSD list.		Taken forward to impact assessment
It disturbs sediment with contaminants above Marine Scotland Action Level 1	As noted above, sediment within the basin has historically been identified as containing chemical concentrations which exceed Marine Scotland Action Level 1.		Taken forward to impact assessment

Following scoping review in relation to risks from water quality impact various elements have been taken forward to impact assessment.

4.4 WFD Protected Areas

Designated sites of note are described in Table 4-7.

Table 4-7 Statutory Designated Sites

Site Name	Designation	Distance & Orientation at Closest Point	Reason for Designation	Level of Importance
Internationally Designated Sites within 10km of the site boundary				
Black Cart	SPA	6.2km west	Non-breeding whooper swan (*Cygnus cygnus*)	International
Inner Clyde	Ramsar	6.4km northwest	Non-breeding redshank (*Tringa totanus*)	International
Inner Clyde	SPA	6.4km northwest	Non-breeding redshank	International
Nationally designated sites within 5km of the site boundary				
Possil Marsh	SSSI	5.0km north	Mesotrophic loch	National
Locally designated sites within 5km of the site boundary				
Dawsholm	LNR	3.0km north	Plantation woodland and the associated populations of birds	Local

*SAC (Special Area of Conservation); SSSI (Site of special Scientific Interest); NNR (National Nature Reserve).

The following table summarises the findings of the Protected Area scoping assessment.

Table 4-8 Protected Area Scoping Summary

Consider if your activity is:	Yes	No	WFD Protected Area Risk Issue
Within 2km of any WFD protected area		No statutorily designated sites within 2km of the wet basin	No impact assessment required

4.5 Invasive Non-Native Species (INNS)

Risks of introducing or spreading INNS include:

- materials or equipment that have come from, had use in or travelled through other water bodies
- activities that help spread existing INNS, either within the immediate water body or other water bodies

The following table summarises the scoping assessment in relation to INNS.

Table 4-9 INNS Scoping Summary

Consider if your activity could:	Yes	No	WFD Protected Area Risk Issue
Introduce or spread INN	The site works will incorporate the use of a dredger which may have mobilised through other water bodies. There is potential for reuse of dredge arisings from elsewhere within the Clyde Estuary within the basin infilling,		Taken forward to impact assessment

4.6 Summary

The following table summarises the findings of the scoping assessment.

Table 4-10 Scoping Summary Table

Receptor	Potential Risk To Receptor	Risk Identified
Hydromorphology	Yes	The development works could impact on water hydromorphology and is located in an area that is already heavily modified for similar use
Biology- Habitats	No	
Biology-Fish	Yes	There is potential for impact to fish associated with chemical change in the water body and entrainment of fish during the basin infill stage of the works.
Water Quality	Yes	There is potential for impact to water clarity and dissolved oxygen that may extend over a 14 week period. There is potential for impact to chemical quality associated with use of materials to infill the basin and disturbance of the existing sediment.
Protected Areas	No	

INNS	Yes	There is potential for spread of INNS associated with mobilisation of plant coming from other water bodies and potential for spread of INNS from elsewhere in the Clyde Estuary associated with reuse of dredge arisings to infill the basin.

5 IMPACT ASSESSMENT

5.1 Hydromorphology

The local reach of the River Clyde is classified by SEPA as a transitional water (Clyde Estuary – Inner; ID: 200510) and is tidally influenced. The reach is designated as a heavily modified water body on account of physical alterations that cannot be addressed without a significant impact on navigation and from an increased risk of subsidence or flooding. It is classified as having poor hydromorphology rating.

The banks of the River Clyde in the vicinity of the project site are heavily engineered, with dock and quay structures present on either bank and the channel is disconnected from surrounding floodplains. The navigation channel is subject to routine dredging to maintain depth of water for shipping. A number of weir and bridge structures are present, further impacting sediment transport processes. The site is currently located in an active ship building facility.

It is considered on the basis of the current site use and its surrounds that the proposed infilling of the wet basin will not lead to further deterioration in the hydromorphological status of the Clyde Estuary – Inner (Inc Cart). It is also not considered to result in an impact that would prevent the water body from meeting these objectives in the future.

5.2 Biology Fish

The Clyde Estuary -Inner (inc Cart) is currently classified as Good in relation to fish.

The proposed development works has potential to impact fish both in relation to impact to water quality from release of suspended sediment (including potentially contaminated sediment) during the infilling works, and entrainment of fish during the basin infill.

A Marine Mammal and Fish Risk Assessment has been developed for the project and is provided in Appendix C. The assessment reviewed risks related to underwater noise, suspended sediment release and entrainment once the basin is isolated from the main stem of the river.

An underwater noise risk assessment concluded that the risk to fish was very low from the proposed development works.

The risk assessment did identify potential for impact in relation to release of suspended sediment and entrainment, The following mitigation measures were identified with respect to protection of fish.

- Fish rescues and translocations will take place at the outset of construction to reduce fish mortality. This will commence following installation of a silt curtain/bubble screen or barrier across the wet basin to prevent fish re-entering the wet basin infill area.
- A Fish Rescue Method Statement will be agreed in advance with the relevant Statutory Nature Conservation Bodies (SNCBs) to target fish species which may inhabit the basin.
- The presence of the silt curtain/bubble screen or barrier will also restrict the potential for release of suspended sediment outwith the construction area.

It is considered that implementation of the identified mitigation measures will ensure that the development does not result in a deterioration of the Good status of the Clyde Estuary Inner (Inc Cart). Following completion of the site works the development is not considered to pose a risk that will impact the water body from retaining the classification of Good going forward.

5.3 Water Quality

The construction phase for the basin infill will incorporate placement of imported materials (potentially incorporating dredge arisings from other areas of the Clyde Estuary) directly onto the existing sediment within the basin. During these works there is therefore potential for an increase in suspended solids in the basin and immediate surrounds related to release from both the infill material and potential for disturbance of the existing sediment.

An increase in suspended solids within the water column can have the potential to decrease dissolved oxygen concentrations, primarily if the suspended material is rich in organic material which is likely to be the case for the existing sediment. The Clyde Estuary – Inner (Inc Cart) is currently classified as Moderate with respect to dissolved oxygen.

As noted previously, historic sampling of the wet basin has identified concentrations of contaminants that exceed Marine Scotland Action Level 1. The parameters of concern included heavy metals, PAHs and PCBs. The key contaminants with potential to impact water quality are considered to be metals as these have the potential to dissolve/desorb from sorption sites, whereas the organic contaminants (PAHs and PCBs) have a greater affinity for the organic materials which they are bound to, and are more likely to remain strongly bound to the sediment, or if they become dissolved, quickly adsorbed onto organic matter. With respect to the contaminants of concern there are limited existing WFD classifications with the exception of Copper (currently rated as Good) and Chromium (currently rated as Fail). The historic sediment results indicate that both copper and chromjum exceed Action Level 1 within the sediment.

As noted in the Impact Assessment for fish, the proposed construction works will incorporate mitigation measures to restrict the release of suspended solids during the infilling works. This will incorporate installation of a silt curtain, bubble screen or barrier at the outset of the works which will be present during the infilling exercise. These barriers will result in restricting the potential for release of suspended sediment outwith the infill area (should a bubble screen be adopted then there will also be an increase in dissolved oxygen in the water column).

Based on the implementation of the mitigation measures it is considered that the infilling of the wet basin will not result in deterioration of the Clyde Estuary – Inner with respect to Water Quality. Once the basin infill is completed the development will not have any future impact on Water Quality that would impact on the Clyde Estuary – Inner meeting the WFD targets.

5.4 Invasive Non Native Species

The Clyde Estuary – Inner (Inc Cart) was recorded as having a High classification in relation to freedom from invasive species in 2014 and 2021. Other areas of the Clyde Estuary are known to have been impacted by INNS historically, the Firth of Clyde Forum developed a Biosecurity Plan[3] in 2012-2016 identifying existing and potential INNS issues to be considered going forward. At the time of the report the carpet sea squirt *Didemnum vexillum* was identified as a high environmental risk within the Clyde Estuary.

The works will incorporate use of a dredge vessel that may have been mobilised from other water bodies. The Clyde is regularly dredged for maintenance requirements and as such the risks related to the wet basin infill are not considered to be different to current routine operation within the river.

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[3] Firth of Clyde Forum Biosecurity Plan 2012-2016

Adoption of best practice in line with existing Biosecurity Plans and guidance and appropriate equipment maintenance would result in the risk from INNS introduction to be low.

The works may involve dredging from one area of the Clyde Estuary with the material subsequently forming part of the infill material for the basin. As such there is potential for transfer of benthic INNS from one area of the Clyde to the basin. Given that during the basin infill a silt curtain, bubble screen or barrier will be present to isolate the basin from the river (primarily to restrict release of suspended sediment and entrance of fish into the basin) then any INNS that may be transferred will be entrained within the basin during the infill operation.

The wet basin infill is therefore not considered to result in a deterioration with respect to INNS, and following completion of the project it is not considered to represent a future risk to the water body for meeting its WFD targets.

6 CONCLUSION

The development work at the BAE Govan site incorporating infilling of the existing wet basin has been assessed with respect to potential for impact on WFD parameters. The assessment has concluded that the proposed works will not have any significant impact to the Clyde Estuary – Inner (Inc Cart) which would result in a deterioration of its current condition as long as proposed mitigation measures are adopted during the works. Following the development completion, it is also not considered to represent a risk to the water body from achieving WFD targets in the future.

7 REFERENCES

Environment Agency (July 2022) Clearing the Waters for All - https://www.gov.uk/guidance/water-framework-directive-assessment-estuarine-and-coastal-waters

Firth of Clyde Forum Biosecurity Plan 2012-2016

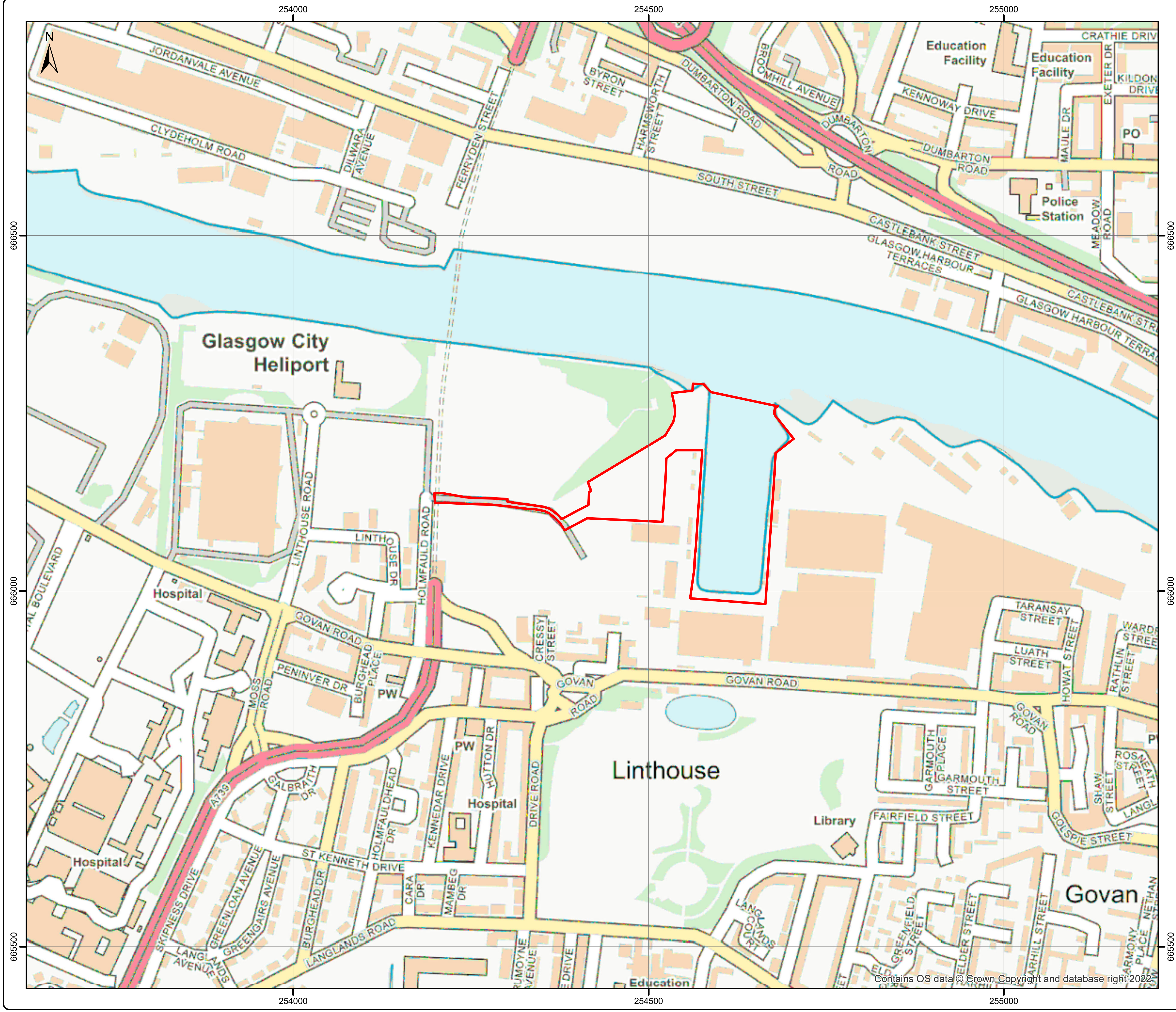
SEPA Water Environment Hub (July 2022) https://www.sepa.org.uk/data-visualisation/water-environment-hub/

Marine Scotland Pre-disposal Sampling Guidance Version 2 – November 2017

Marine Scotland Information Hub (July 2022) https://marine.gov.scot/

APPENDICES

A FIGURES



Legend

▭ Site Boundary

Do not scale this map

Client
Arch Henderson

Project
Govan Facilities Investment

Title
Site Location Plan

Status
Final

Drawing No.	Revision	Date
175756-GIS001	-	18 May 2022
Drawn	**Checked**	**Approved**
AH	GD	GD

Scale
1:5,000 @A3

0 25 50 100 150 Metres

Rev	Date	Amendment	Initials

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B HISTORIC SEDIMENT SAMPLE RESULTS

Summary Table - Govan

	AL1	AL2	BAC	<ERL	ISQG/TEL	PEL	SS4 0-0.5	SS4-0.5-1.0	SS5 0-0.5	SS5 1.25-1.75	SS5 2.0-2.5	Average	No. Exceed Al1?	No. Exceed Al 2?	No.Exceed BAC?	No. Exceed ERL	No. Exceed PEL?
Source			**CSEMP**	**CSEMP**	**Canada**												
Arsenic	20	70	25	-	7.2	41.6	4	3.2	14.5	14.9	16.2	10.6	0	0	0	N/A	0
Cadmium	0.4	4	0.31	1.2	0.7	4.2	0.17	0.09	1.23	1.42	1.12	0.8	5	0	5	2	0
Chromium	50	370	81	81	52.3	160	24	18.5	161.8	202.7	165.9	114.6	5	0	4	4	**3**
Copper	30	300	27	34	18.7	108	21.2	17.1	103	125.4	100.5	73.4	5	0	5	5	1
Mercury	0.25	1.5	0.07	0.15	0.13	0.7	0.06	<0.015	0.65	0.61	0.65	0.5	3	0	5	5	0
Nickel	30	150	36	-	-	-	18.2	17.7	40.8	44.5	38.4	31.9	3	0	3	N/A	-
Lead	50	400	38	47	30.2	112	19.4	8.4	176.4	193.5	201.3	119.8	5	0	5	3	**3**
Zinc	130	600	122	150	124	271	48.3	34.9	392.9	446	379.9	260.4	5	0	5	5	**3**
Napthalene	0.1		0.08	0.16	-	0.319	0.19	0.00	0.25	0.37	2.42	0.6	5	-	5	5	2
Acenaphthylene	0.1		-	-	0.00587	0.128	<0.02	<0.001	0.05	0.11	0.06	0.1	2	-	-	-	1
Acenaphthene	0.1		-	-	0.00671	0.0889	0.28	0.01	0.17	0.52	0.87	0.4	5	-	-	-	5
Fluorene	0.1		-	-	0.0212	0.144	0.20	<0.001	0.24	0.52	1.10	0.5	5	-	-	-	5
Phenanthrene	0.1		0.032	0.24	0.0867	0.544	0.37	0.00	0.73	1.48	2.22	1.0	6	-	6	6	4
Anthracene	0.1		0.05	0.085	0.0469	0.245	0.14	<0.001	0.28	0.51	0.87	0.4	5	-	6	5	4
Fluoranthene	0.1		0.039	0.6	0.113	1.494	0.66	0.0014	1.45	2.73	2.06	1.4	6	-	6	6	2
Pyrene	0.1		0.024	0.665	0.153	1.398	0.62	0.0020	1.40	2.45	1.98	1.3	6	-	7	4	3
Benzo(a)anthracene	0.1		0.016	0.261	0.0748	0.693	0.35	0.0013	0.78	1.45	0.94	0.7	6	-	6	5	3
Chrysene	0.1		0.02	0.384	0.108	0.846	0.42	0.0025	0.86	1.62	1.00	0.8	6	-	6	0	3
Benzo(b)fluoranthene	0.1				-	-	0.36	0.0023	0.93	1.55	0.87	0.7	6	-	-	-	-
Benzo(k)fluoranthene	0.1				-	-	0.23	<0.001	0.37	0.71	0.38	0.4	5	-	-	-	-
Benzo(a)pyrene	0.1		0.03	0.384	0.0888	0.763	0.37	0.001	0.88	1.71	0.94	0.8	6	-	6	3	3
Indeno(1,2,3cd)pyrene	0.1		0.103	0.24	-	-	0.25	<0.001	0.61	1.22	0.61	0.7	5	-	5	4	-
Benzo(ghi)perylene	0.1		0.08	0.085	-	-	0.28	0.003	0.69	1.27	0.68	0.6	5	-	5	33	-
Dibenzo(a,h)anthracene	0.01				0.00622	0.135	0.05	<0.001	0.12	0.25	0.12	0.1	3	-	-	-	1
					-	-								-	-	-	-
PCBs (Total)	0.02	0.18			0.0215	0.189	0.001	0.001	0.928	0.175	0.080	0.24	4	0	-	-	2
TBT	0.1	0.5			-	-	<0.005	<0.005	0.01	<0.005	<0.005	0.01	0	0	-	-	-
Units mg/kg												0.31	0.15				

C MARINE MAMMAL AND FISH RISK ASSESSMENT

BAE Govan
Wet Basin Infill EPS and Fish Risk Assessment

July 2022

BAE Govan
Wet Basin Infill EPS and Fish Risk Assessment

Client: Arch Henderson

Document number: 10124
Project number: 175756
Status: Final

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Reviewer: Campbell Stewart

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1 INTRODUCTION

EnviroCentre were contracted to produce a European Protected Species (EPS) and Fish Risk Assessment document in relation to the proposed infill of the wet basin located in the BAE Govan facility. A site location plan and design drawings for the infill are provided in Appendix A.

This risk assessment has been produced in line with the Chapter 2 of Marine Scotland's The protection of Marine European Protected Species from injury and disturbance Guidance for Scottish Inshore Waters (July 2020).

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The information and recommendations contained within this report have been prepared in the specific context stated above and should not be utilised in any other context without prior written permission from EnviroCentre.

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2 BASELINE INFORMATION

2.1.1 Marine Mammals

The site lies approximately 50km upstream of the Firth of Clyde, a marine environment known to support cetaceans and pinnipeds. Though cetaceans and pinnipeds are recorded to navigate the River Clyde with historic records of common dolphin (Delphinus delphis), white-beaked dolphin (Lagenorhynchus albirostris), and harbour seal (Phoca vitulinav) and a recent record of grey seal (Halichoerus grypus) all identified within the desk study within 2km of the site.

As there is no physical barrier between the wet basin on site and the River Clyde, there is potential for aquatic and semi-aquatic mammals to utilise the site for foraging and commuting purposes.

All cetaceans found in Scottish territorial waters on the on the Scottish Biodiversity List, and all are protected under the Conservation (Natural Habitats) Regulations 1994 (as amended in Scotland) against damage destruction to breeding or rest sites, harm and disturbance to individuals.

Whilst in Scottish waters, seals are protected under the Marine (Scotland) Act 2010 from intentional or reckless killing / injury, they are also protected from disturbance at significant haul-out sites under the Protection of Seal (Designation of Haul-out Sites) (Scotland) Order 2014. Common seal are also on the Scottish Biodiversity List.

Aquatic and semi-aquatic mammals are considered be of up to International importance. However, the value of the site to support cetaceans and pinnipeds is local. With respect to EPS the Firth of Clyde area is populated by both resident and visiting cetaceans. The most common species in the River Clyde area is considered to the harbour porpoise, however there is also one solitary common dolphin . Sightings of them as far upstream as Govan are considered rare.

Table 2-1 below details the furthest recorded upstream sightings of cetaceans in the River Clyde. It is noted that the majority of the sightings are downstream of the Govan area, principally in the Greenock and Erskine Bridge section of the River.

Table 2-1 EPS Sightings in Clyde

Date		Common Name	Scientific Name	Location Sighted	Passed Govan
Oct 2020		Bottlenose Whale	Hyperoodon ampullatus	Glasgow Harbour Area (Partick)	Yes
Feb 2011/July 2021		Harbour Porpoise	Phocoena phocoena	Tidal weir at Glasgow Green	Yes
August 2020		Bottlenose Dolphin	Tursiops truncatus	Off Greenock Esplanade	No
April 2018		Killer Whale	Orcinus orca	Erskine Bridge	No

2018		Short-beaked Common Dolphin	Delphinus delphis	Between Fairlie and Cumbrae	No

Only two EPS species were recorded in an area of the river beyond Govan. They include a record of a single harbour porpoise trapped at the weir at Glasgow Green in 2011.

In 2020 a pod of bottlenose whales were recorded as far up the Clyde as Glasgow Harbour. Given that these species feed on deep dwelling prey their presence was considered an anomaly as a result of disorientation. Unfortunately, 2 of the pod became stranded and perished which indicates the unsuitability of this portion of the River Clyde for this species. Bottlenose whales are therefore not considered a significant species in relation to the general baseline of the Govan area.

Given the urban nature of the upper stretches of the River Clyde it is considered that the presence of EPS within the river would generally be recorded, with the aforementioned sightings being reported in the national press.

On the basis of the available information it is considered that there is unlikely to be a significant presence of EPS within the proposed development area however on a precautionary basis there may be a low potential for presence of transitory/disoriented harbour porpoise and as such further assessment of risk to this species is considered.

The available information for harbour porpoise indicates that the frequency of occurrence in this area of the River Clyde is rare, on this basis there is no clear seasonality or spatial pattern in relation to their presence. It is considered that the most likely reason for the presence of EPS in the shallow and narrow upper stretches of the River Clyde is due to prey movement and/or loss of orientation.

2.1.2 Fish

The nearest Special Area of Conservation (SAC) designated for fish species (Atlantic salmon, brook lamprey and river lamprey) is the River Endrick, which discharges via the River Leven approximately 20km downstream within the Clyde estuary.

Desk study has identified European eel (*Anguilla Anguilla*), Atlantic salmon (*Salmo salar*), grayling (*Thymallus thymallus*), brown trout (Salmo trutta), brook lamprey (*Lampetra planeri*), sea lamprey (*Petromyzon marinus),* river lamprey (*Lampetra fluviatilis*), Smelt (*Osmerus eperlanus*), common minnow (*Phoxinus phoxinus*), stone loach (*Barbatula barbatula*), and three-spined stickleback (*Gasterosteus Aculaeatus)* within the River Clyde. In addition, the Marine Scotland National Marine Plan Interactive Map highlights the River Clyde as a salmonid river .

Atlantic salmon, brown (sea) trout, European eel, river lamprey and sea lamprey will all be present in the area with different life stages and species are likely to be present at different times of year and possibly at different states of the tide, etc.

The wet basin provides opportunities for migrating spawning fish, though due to the heavy modification of the river spawning habitat is likely to be limited.

Atlantic salmon, smelt, sea trout, brown trout, Arctic charr, brook lamprey, river lamprey, sea lamprey and eel are all listed as priority species on the SBL. Atlantic salmon and brook lamprey and both also listed on Annex II of the Habitats Directive. Therefore, all species aforementioned are of National (Scotland) importance.

3 DEFINING IMPACTS

It is envisaged that construction works will involve the activities listed below. A visual description of the works is provided in Drawing No 225010-BAE-AHN-ZZ-XX-DR-C-0004.

1. Enabling works including:
    a. Area to west of the site to be cleared of all debris to set up the contractor compound;
    b. Separate contractor access to be created from entrance roadway to allow construction traffic to be segregated from operational shipyard traffic;
2. Deployment of a silt curtain/ bubble curtain or isolating barrier across the wet basin entrance (including a demountable section to allow passage of the barge if required);
3. Initial infill by long reach excavator from a barge which will place a 2 m layer of fill to cover existing sediment on the basin bed;
4. Infilling continuing using a combination of barge and excavators or self-discharging vessels. The infill material will extend beyond the line of the proposed quay wall;
5. Installation of a carrier drain around the existing basin quay wall to collect discharge from existing outfalls and direct to new outfalls protruding through the coffer dam;
6. Hydraulic compaction of infill material below mean sea level and dynamic compaction using rollers above mean sea level;
7. Land based piling through the infill material to create the outer quay wall. The work entails:
    a. Tubular piles being driven/vibrated into deep strata. These piles may need anchored by using a concrete pile toe bored into the rock through the tubular pile section;
    b. Sheet piles installed between the steel tubular piles. Sheet piles expected to be driven to shallower depths than the tubular piles;
    c. Reinforced concrete capping beam is installed to complete the quay wall.
8. Existing quayside at tie locations will be broken out and new tie ins installed between existing quay and the new cofferdam;
9. Basin infill taken up to design level by barged material placed over the new cofferdam and pushed into place by dozers;
10. Fill in front of cofferdam wall removed and berth pocket dredged to current maintenance dredge level.

It is anticipated that construction works will take a total of circa 34 weeks. Within this period piling to create the outer quay wall is estimated to last circa 14 weeks.

The majority of the above activities are considered to be similar in nature to typical activity in the River Clyde, incorporating the use of vessels and dredging activity. These are not considered any different to activities such as the regular maintenance dredging on the river to maintain the navigation channel or berthing. Given that as noted in the previous section that presence of harbour porpoise in the Govan area is rare (i.e. it is not an important area of porpoise/cetacean/marine mammal activity) the majority of the works are not considered to represent a significant risk of impact to the receptor.

3.1 Likelihood of Potential Impact to Harbour Porpoise and Fish

3.1.1 Impact from Underwater Noise

The piling works required as part of the basin infill are identified as a potential source of anthropogenic sound. It should be noted that the approach to construction incorporates the piles being driven through the infill material (i.e. the surface water will not be in direct contact with the piles during installation). As such the infill material itself is considered to provide a degree of sound absorption.

An underwater noise assessment was undertaken by Irwin Carr in July 2022, a copy of the assessment report is provided in Appendix B.

The report incorporated assessment of potential impact to harbour porpoise, grey and harbour seal, otter and salmon related to the proposed impact and vibratory piling to be undertaken as part of basin infill and development of new quay wall.

The assessment concluded that the overall risk of direct acoustic impact on the assessed species from the piling works to be very low

Given that harbour porpoise are rarely present in the River Clyde in the Govan area, and the findings of the underwater noise assessment it is considered that the potential for potential impact to occur is low.

In relation to potential impact to fish, again on the basis of the underwater noise impact assessment it is considered the likelihood of potential impact is low.

3.1.2 Habitat Disturbance

Habitat disturbance will occur as a result of the infilling process. As previously noted, the presence of harbour porpoise is rare in the Govan area, as such the infilling of the wet basin is not considered to result in a significant likelihood of potential of impact with respect to harbour porpoise habitat.

Fish species such as the Atlantic salmon, brown (sea) trout, European eel, river lamprey and sea lamprey are known to be present in the River Clyde area, as such the infilling of the dock may present some localised habitat disturbance for these species.

The banks of the River Clyde in the vicinity of the project site are heavily engineered, with dock and quay structures present on either bank and the channel is disconnected from surrounding floodplains. The navigation channel is subject to routine dredging to maintain depth of water for shipping. A number of weir and bridge structures are present, further impacting sediment transport processes. The site is currently located in an active ship building facility. The WFD assessment for the site has not identified that impact to habitat to be a significant issue related to the development.

3.1.3 Suspended Sediment

There is potential for an increased suspended sediment concentration within the water column associated with the infilling and construction works, with potential for mobilisation of existing sediment during placing infill material or release from the proposed infill material itself.

As per habitat disturbance given that harbour porpoise are rare in the Govan area there is considered to be low likelihood of significant impact related to suspended sediment. Fish species are known to be present in the River Clyde as such there is a likelihood of localised impact associated with an increase of suspended sediment.

3.2 Magnitude of Impact, Spatial Extent and Intensity

Given that presence of harbour porpoise in the Govan area is considered rare it is not considered that there will not be any significant impact on distribution and abundance of the species associated with any of the identified sources of impact.

On this basis the magnitude of the impact is low. There is considered to be a very low chance of presence of harbour porpoise in the area of impact during the works. As noted previously the most likely reason for presence would be as a result of following of prey and disorientation.

With respect to impact to fish the key source of concern with respect to impact and impact from suspended solids. The impact from suspended solids will be focussed to within the basin and potential for release to the main river channel with impact extending beyond the basin.

3.3 Duration and Frequency of Impact

The duration of the impact will be limited to the period of the dock infilling

3.4 Timing of Impact

The programme of works is still to be confirmed, as such the works may occur any period.

3.5 Location of Impact

The impact will be focussed to the wet basin and river channel in close proximity to the wet basin

3.6 Temporal Changes of Impact

The infilling of the basin will result in a permanent loss of this area as habitat, the impact from suspended sediment will be limited to the construction period only.

3.7 Cumulative Impacts

There are no known nearby works which are considered to result in potential for cumulative impacts.

4 MITIGATION MEASURES

Fish rescues and translocations will take place during construction to reduce fish mortality. This will commence following installation of a silt curtain/bubble screen or barrier across the wet basin to prevent fish re-entering the wet basin infill area.

A Fish Rescue Method Statement will be agreed in advance with the relevant Statutory Nature Conservation Bodies (SNCBs) to target fish species which may inhabit the basin.

The presence of the silt curtain/bubble screen or barrier will also restrict the potential for release of suspended solids outwith the infill area.

5 RISK TO EPS AND FISH

On the basis of the above information, the following information can be concluded:

The presence of EPS within or close to the proposed construction site at Govan is considered to be very rare. The most common EPS in the River Clyde is the harbour porpoise (generally located further downstream of the river) and on this basis, whilst their presence is considered to be very rare, from a precautionary point of view their presence cannot be completely discounted and they are therefore identified for a very low risk of impact.

The proposed works at Govan are generally not considered to represent a significant risk of disturbance or injury to harbour porpoise.

There is potential for impact to fish related to localised increase in suspended solids during the infill

On the basis of the use of the mitigation measures detailed in Section 4 the significance of the impact to fish is considered to be low.

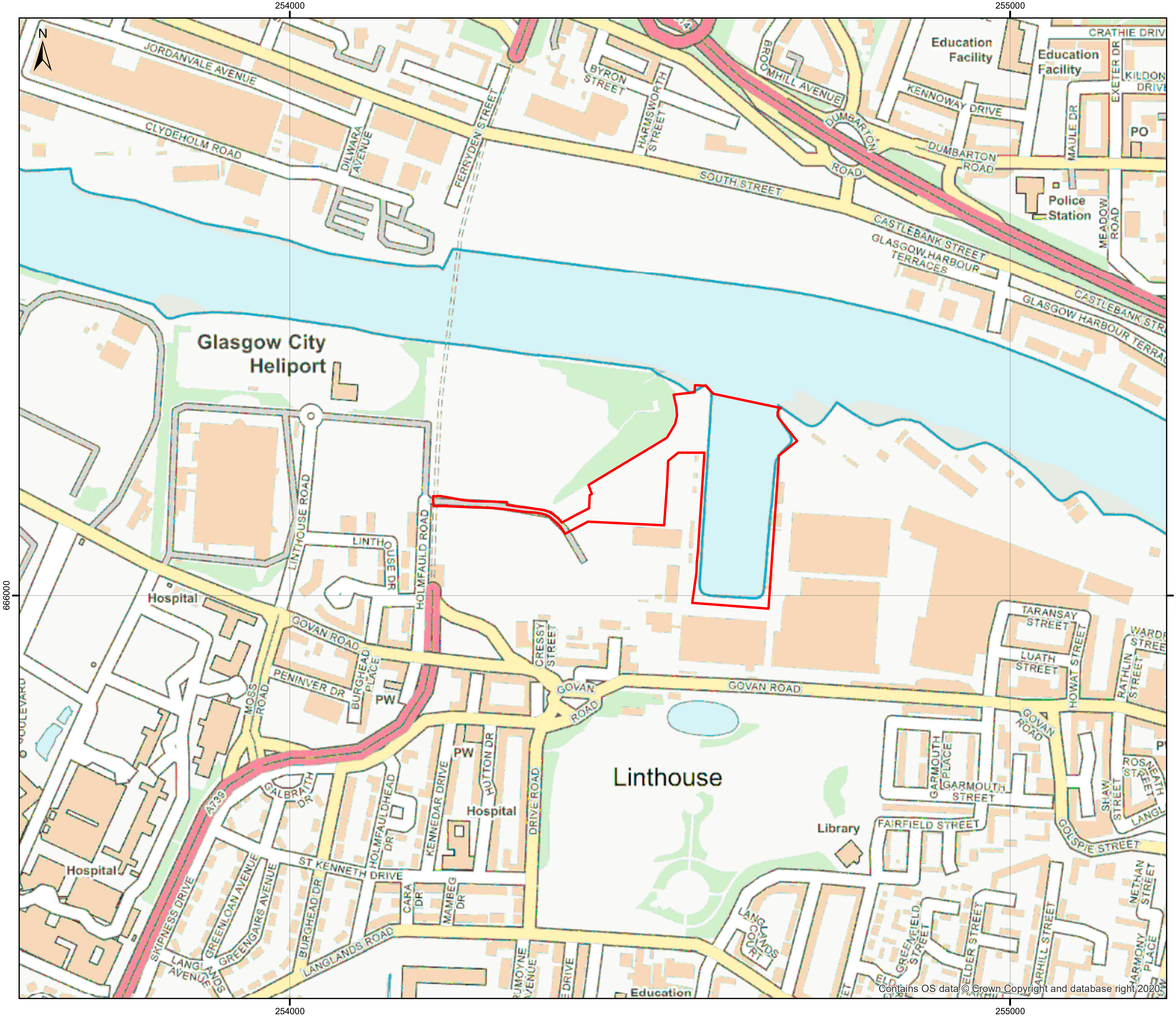
REFERENCES

Marine Scotland (July 2020) The protection of Marine European Protected Species from injury and disturbance Guidance for Scottish Inshore Waters

Statutory nature conservation agency protocol for minimising the risk of injury to marine mammals from piling noise JNCC (August 2010.

APPENDICES

A FIGURES



Legend

▭ Site Boundary

Do not scale this map

Client
Arch Henderson

Project
Govan Facilities Investment

Title
Site Location Plan

Status
Final

Drawing No.	Revision	Date
175756-GIS001	-	18 May 2022
Drawn	**Checked**	**Approved**
AH	GD	GD

Scale
1:5,000 @A3
0 25 50 100 150 Metres

Rev	Date	Amendment	Initials

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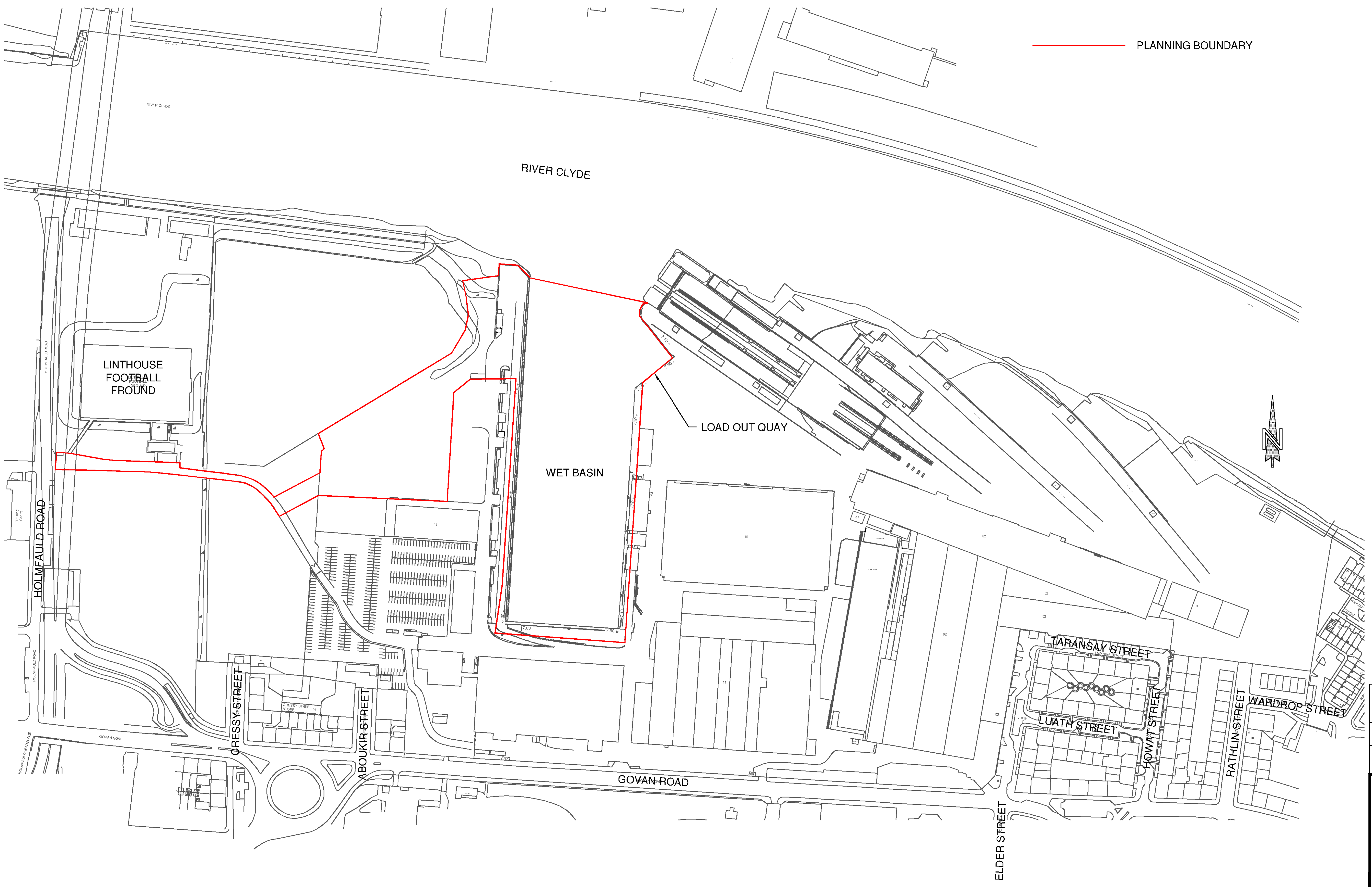

― PLANNING BOUNDARY

P01	11.05.22	ISSUED FOR COMMENT	CAB	TR
REV	DATE	REVISION DESCRIPTION	DRN	VER

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PROJECT :
BAE Surface Ships Limited - Govan
Wet Basin Infill

TITLE :
Location Plan

DRAWN : CAB
DATE : 17.05.22
VERIFIED : TR
APPROVED : GB
SCALE : (A1) 1:2500
DRAWING STATUS : S0
DRAWING No : 225010-BAE-AHN-ZZ-XX-DR-C-0001
REV : P01

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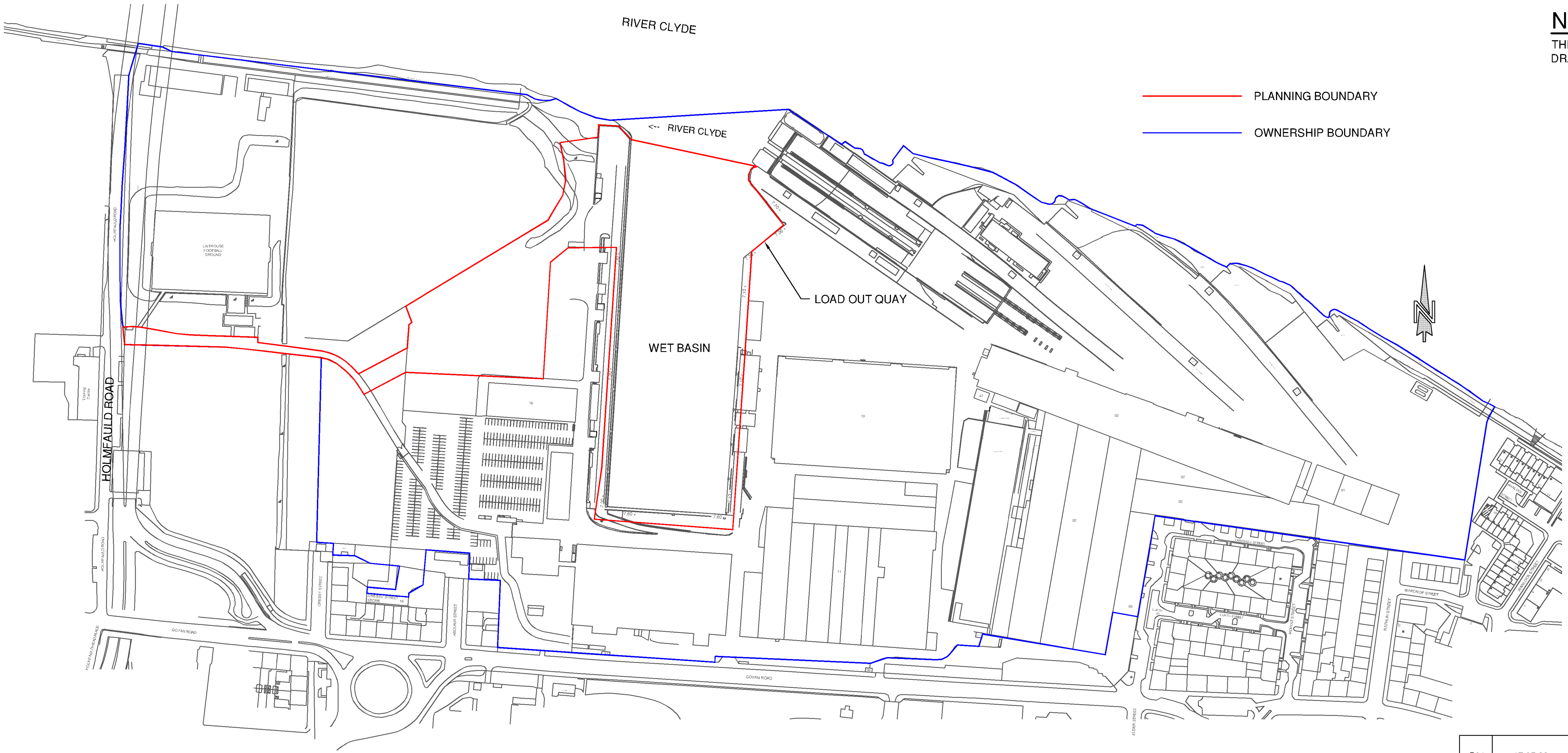

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PROJECT :
BAE Surface Ships Limited - Govan
Wet Basin Infill

TITLE :

Site Ownership Boundary

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CAB	17.05.22	TR	GB

SCALE : (A1) 1:2500

DRAWING STATUS : S0

DRAWING No : 225010-BAE-AHN-ZZ-XX-DR-C-0002

REV : P01

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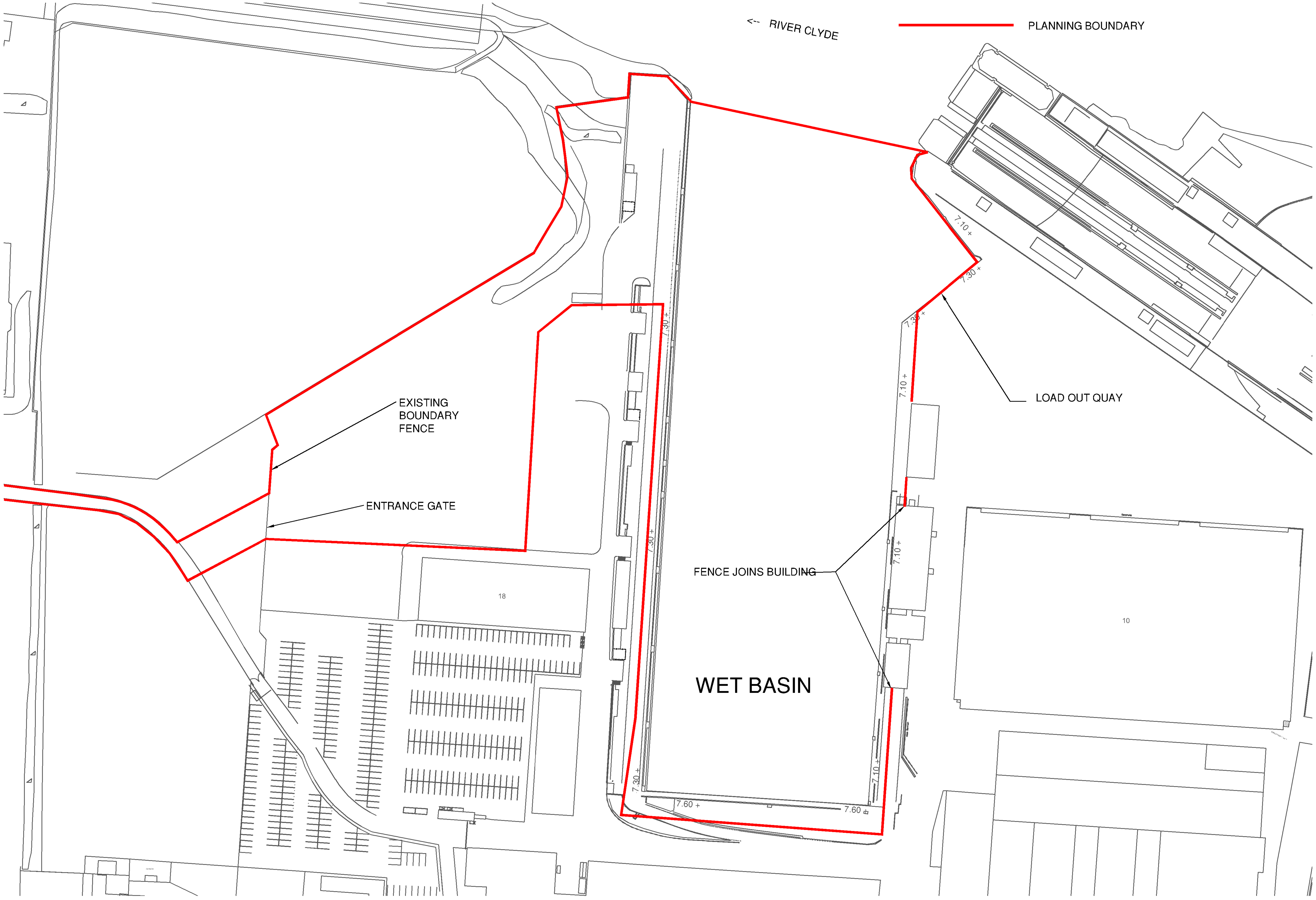

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PROJECT :
BAE Surface Ships Limited - Govan
Wet Basin Infill

TITLE :
Site Compound and Access

DRAWN : CAB	DATE : 17.05.22	VERIFIED : TR	APPROVED : GB
SCALE : (A1) 1:1250		DRAWING STATUS : S0	
DRAWING No : 225010-BAE-AHN-ZZ-XX-DR-C-0003			REV : P01

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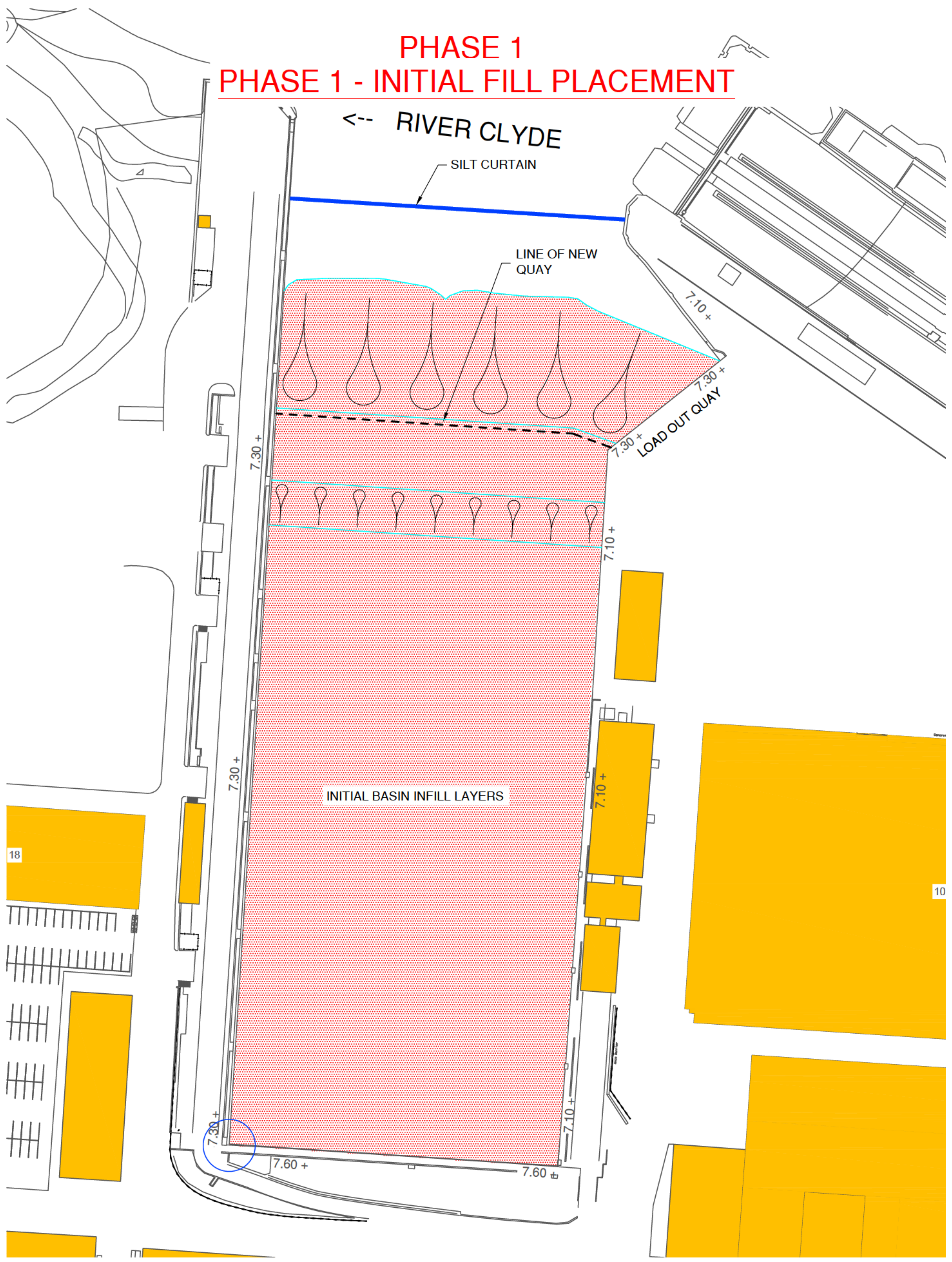
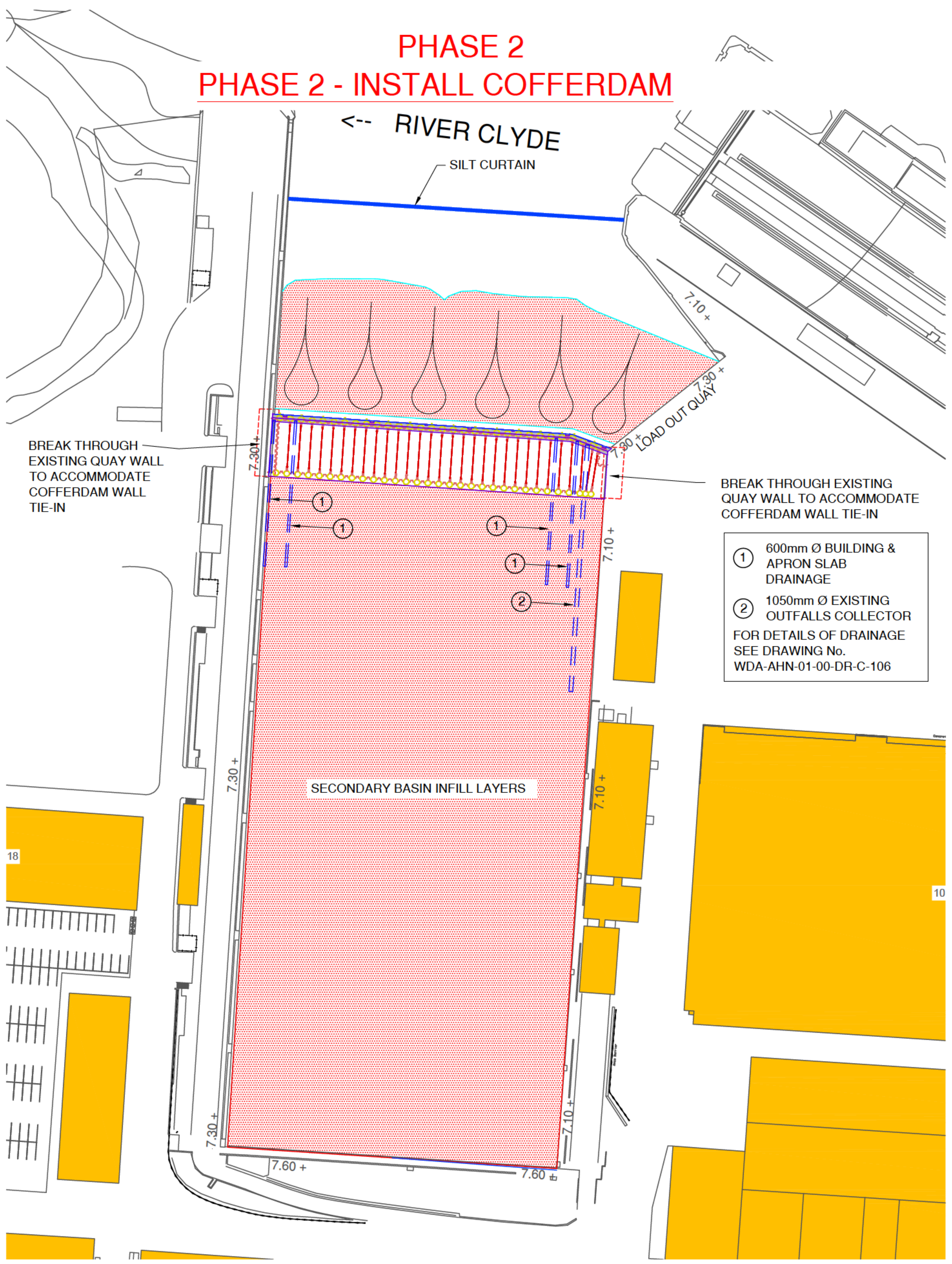
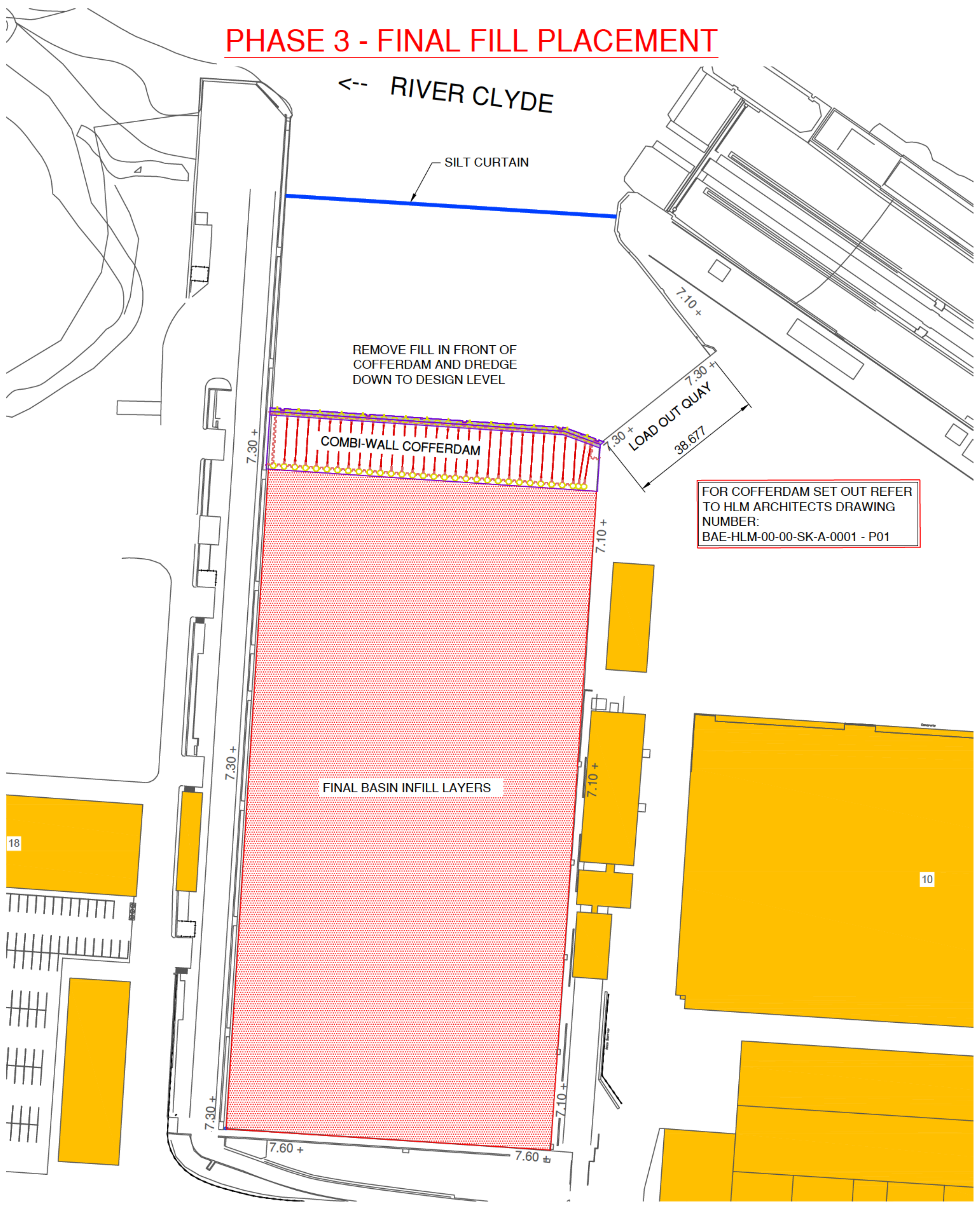
PHASE 1
PHASE 1 - INITIAL FILL PLACEMENT



PHASE 2
PHASE 2 - INSTALL COFFERDAM



PHASE 3 - FINAL FILL PLACEMENT



1. INSTALL SILT CURTAIN AND / OR BUBBLE CURTAIN AT ENTRANCE TO GOVAN BASIN.
2. BERM OF MATERIAL PLACED AT FRONT OF BASIN TO HELP CONTAIN ANY SUSPENDED SEDIMENT. HEIGHT TO BE DETERMINED BASED ON FINAL METHODOLOGY.
3. UP TO 2m INFILL PLACEMENT TO COVER EXISTING BASIN SEDIMENT.
4. CONTINUE TO FILL USING BARGE AND EXCAVATOR OR SPLIT HOPPER BARGE, OR HYDRAULIC DISCHARGE FROM PIPELINE.
5. PLACE MATERIAL, PLACEMENT BY BARGE AND EXCAVATOR AND PUSHING MATERIAL ACROSS BASIN USING DOZER IF NECESSARY.

1. INFILL TO PRE DETERMINED LEVEL AND INFILL WEDGE VOID BEHIND EXISTING SHEET PILE WALL CONCURRENTLY. THIS MAY REQUIRE LOCAL DEMOLITION OF THE EXISTING COPE BEAM AND CUTTING DOWN OR EXTRACTION OF SHEET PILES.
2. INSTALL COFFERDAM

1. REMOVE STONE BUND FROM FRONT OF COFFERDAM.
2. INFILL TO +6.5m.

P05	25.08.22	REVISED AS PER CLIENT COMMENTS.	GB	TR
P04	24.08.22	COFFERDAM LOCATION REVISED. CONSTRCTION SEQUENCE REVISED. MARINE LICENCE APPLICATION.	GB	TR
P03	26.05.22	CONSENT ISSUE	CAB	TR
P02	26.05.22	ISSUED FOR DESIGN BRIEF	CAB	TR
P01	19.05.22	ISSUED FOR COMMENT	CAB	TR
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CONSENT

GENERAL NOTES

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FOR SECTION THROUGH WORKS, REFER TO DRAWING NUMBER BAE-AHN-XX-XX-DR-C-0005

PROJECT :
BAE Surface Ships Limited - Govan
Wet Basin Infill

TITLE :
Draft Phasing Plans

DRAWN : CAB
DATE : 11.05.22
VERIFIED : TR
APPROVED : GB
SCALE : (A1) AS SHOWN
DRAWING STATUS : LICENCE
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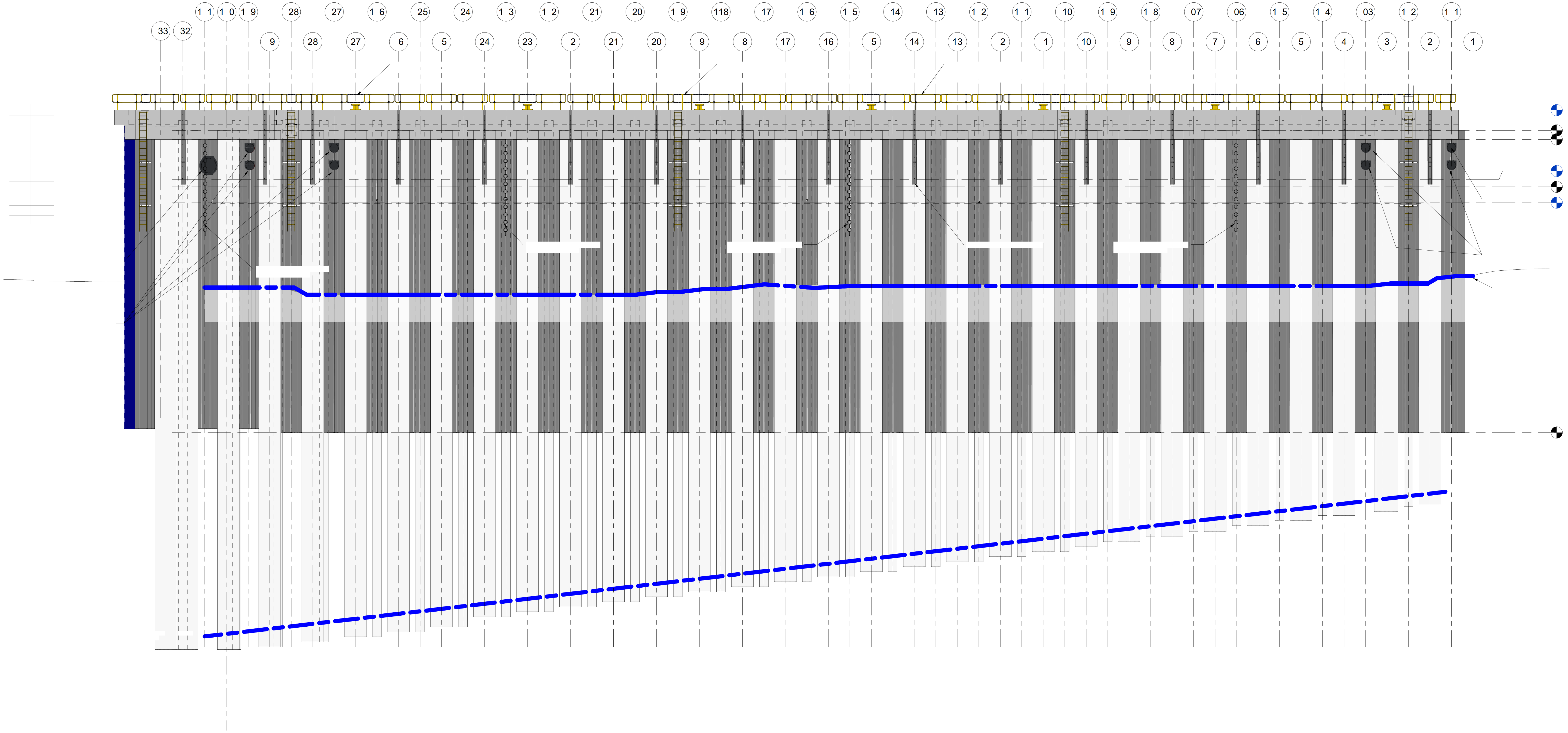
DRAWING No : 225010-BAE-AHN-ZZ-XX-DR-C-0004
REV : P05



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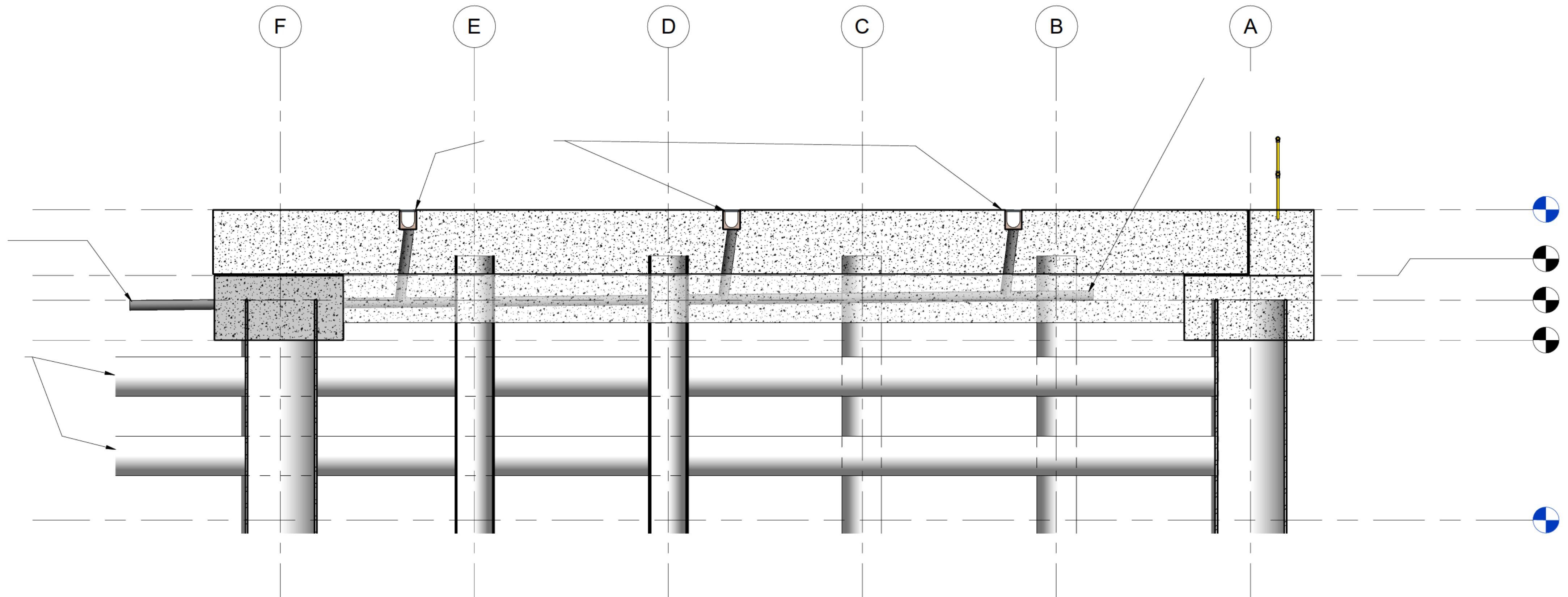

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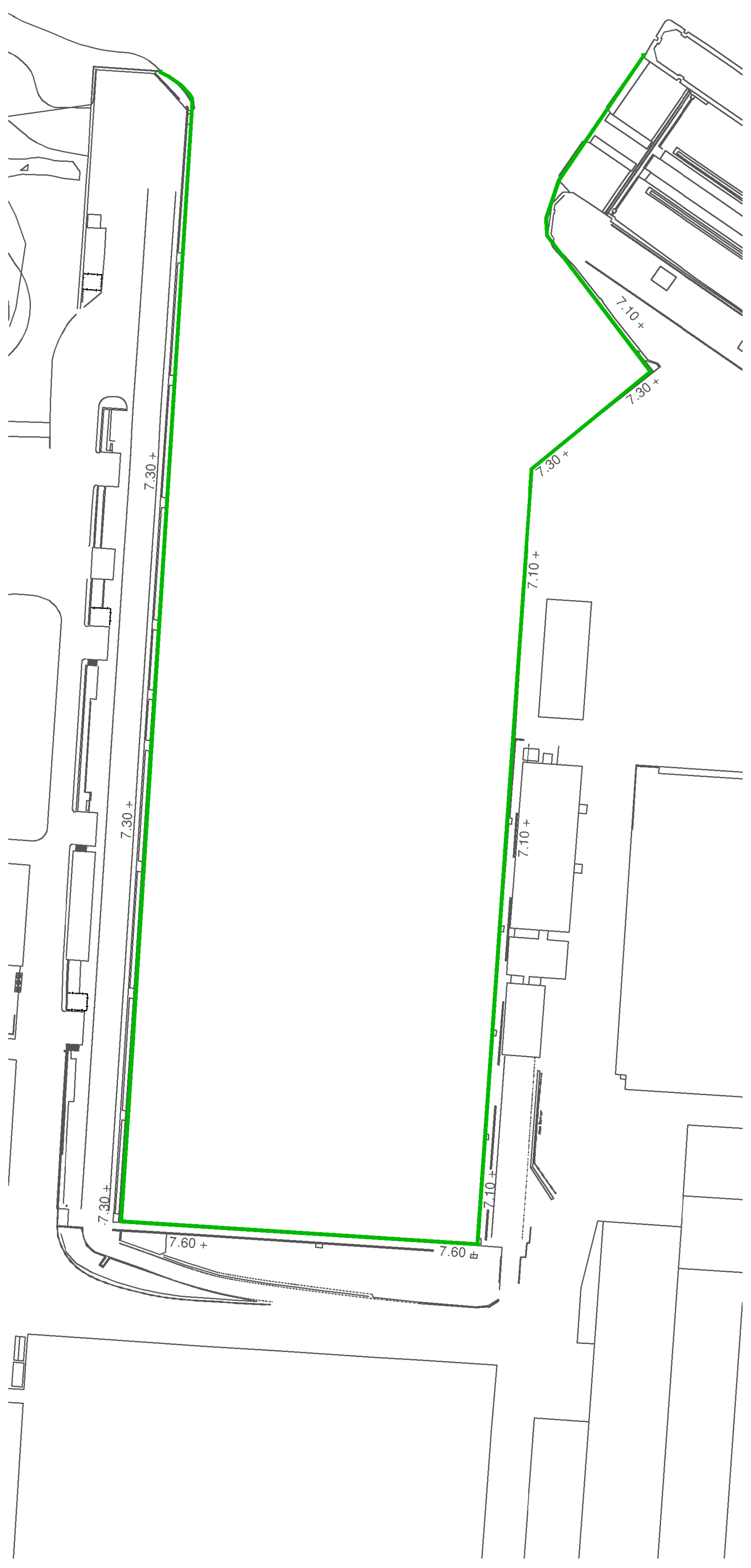

EXISTING EXTENTS OF MHWS
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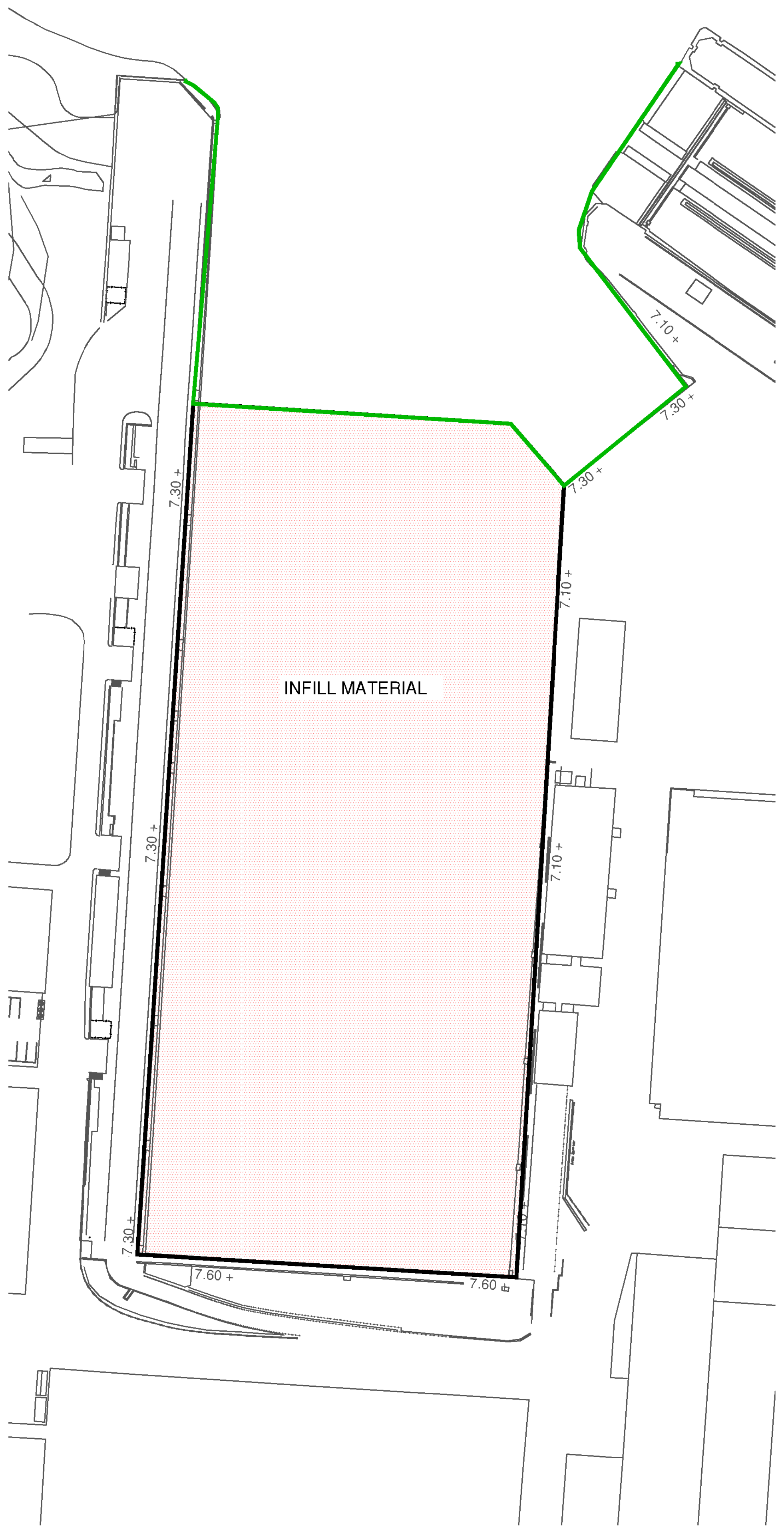

MHWS EXTENTS AFTER INFILL WORKS
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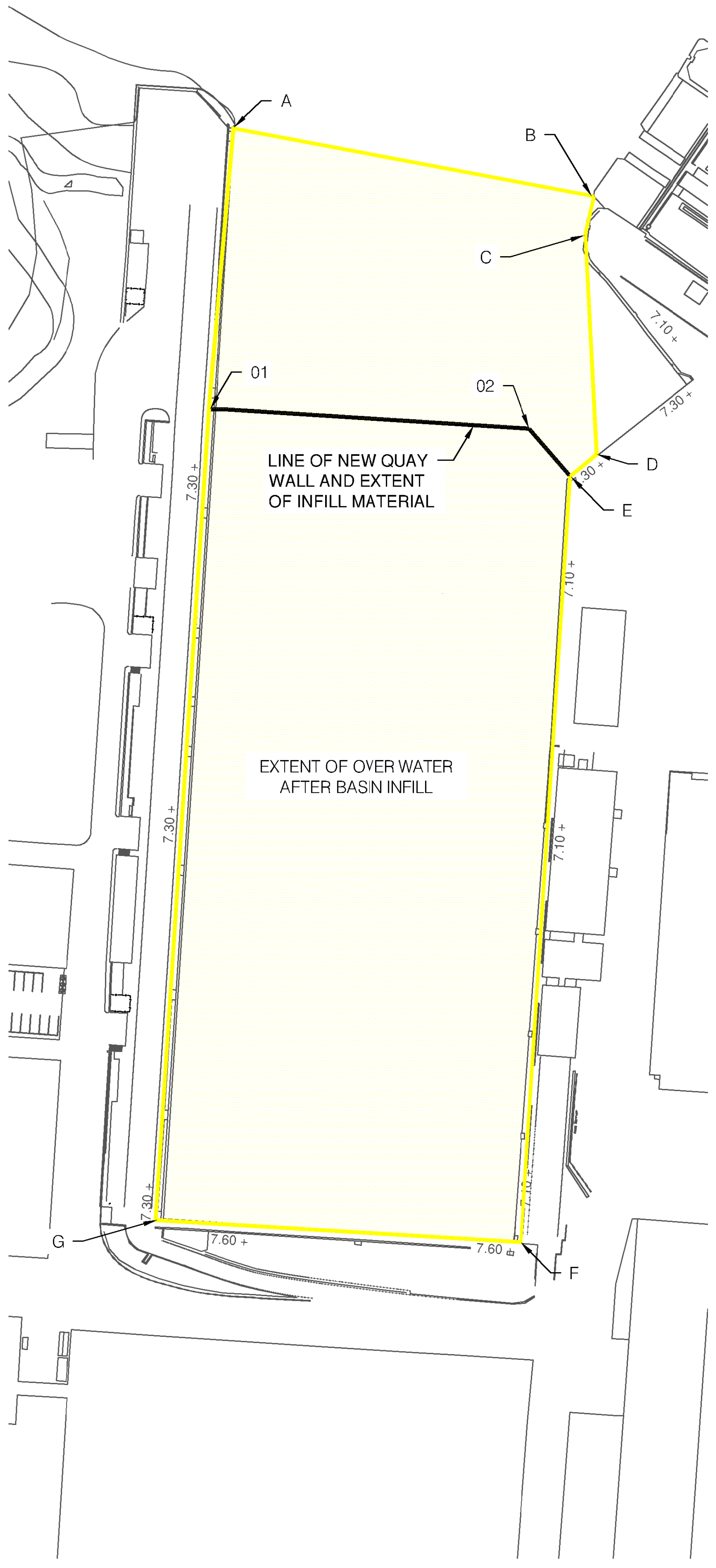

OVER WATER SITE BOUNDARY
SCALE 1:1250

NOTES

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KEY:

🟩 SEA COVERAGE AT MHWS
🟨 OVER WATER SITE BOUNDARY

COFFERDAM WALL SET OUT COORDINATES

	LAT	LONG	EASTING	NORTHING
01	N55:52:01.27	W4:19:26.79	254662	666203
02	N55:52:01.34	W4:19:31.51	254580	666208

OVER WATER SET OUT COORDINATES

	LAT	LONG	EASTING	NORTHING
A	N55:52:03.67	W4:19:31.31	254586	666280
B	N55:52:03.19	W4:19:25.98	254678	666262
C	N55:52:02.87	W4:19:26.08	254676	666252
D	N55:52:01.06	W4:19:25.80	254679	666196
E	N55:52:00.83	W4:19:26.19	254672	666189
F	N55:51:54.51	W4:19:26.50	254660	665994
G	N55:51:54.57	W4:19:31.91	254566	665999

P01	19.05.22	ISSUED FOR COMMENT	CAB	TR
REV	DATE	REVISION DESCRIPTION	DRN	VER

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PROJECT :
BAE Surface Ships Limited - Govan
Wet Basin Infill

TITLE :
Site Boundaries

DRAWN : CAB	DATE : 19.05.22	VERIFIED : TR	APPROVED : GB
SCALE : (A1) 1:25		DRAWING STATUS : D1	
DRAWING No : 225010-BAE-AHN-ZZ-XX-DR-C-0007			REV : P01

DO NOT SCALE

B UNDERWATER NOISE ASSESSMENT

Govan Piling

Glasgow, Scotland

Rp001 2022157 (Govan Piling, Glasgow)

14 July 2022

PROJECT: GOVAN PILING, GLASGOW

PREPARED FOR: ENVIROCENTRE
GLASGOW (REGISTERED OFFICE)
8 EAGLE STREET,
CRAIGHALL BUSINESS PARK,
G4 9XA, GLASGOW
SCOTLAND

ATTENTION: GRAEME DUFF

REPORT NO.: Rp001 2022157 (Govan Piling, Glasgow)

Document Control

Status:	Rev:	Comments	Date:	Author:	Reviewer:
Draft	1.0		14 July 2022	Rasmus Sloth Pedersen	Shane Carr
				[redacted]	[redacted]

EXECUTIVE SUMMARY

BRIEF DESCRIPTION OF WORK

- Describe environment of the site in terms of modelling relevant parameters (water and sediment properties).
- Model the sound source (impact and vibro piling) from reasonable pile dimensions and hammer characteristics.
- Model transmission losses for a single installation, both for single blows and multiple blows as relevant to local fauna impact.
- Show results on maps for both unweighted noise and weighted noise (local species).
- Contextualise results by including background noise and moving receivers.

CONCLUSION

We conclude that the overall risk of direct acoustic impact on assessed species following the piledriving is very low.

The main reasons are:

- A conservative approach: Using upper 90th percentile source levels & and mean high water spring tide (MHWS), leading to elevated received levels.

- The results show some risk of hearing injury (PTS) only at prolonged exposure (>10 min) in a very confined area (immediately outside the berth).

- Slow-moving (0.5 m/s) receivers are not expected to experience PTS.

Additionally, the confined nature of the site means that acoustic masking is limited to a relatively short section of the river; ~2 km over background noise level and ~1500 m >120 dB SPL.

We note that the noise might deter an animal from moving past the site while its active, meaning the activity could lead to other, not directly acoustic, impacts on animals' fecundity.

RESULTS SUMMARY

Impact Piling

L_P – Peak pressure

For the acute injury risk from peak pressure the VHF-group (Harbour Porpoise) has the largest risk range, 65 m to TTS risk (ignoring range into the berth), coinciding spatially with the mouth of the berth.

All other groups have negligible risk ranges for TTS and PTS (both <25 m).

L_E – Exposure level

For groups VHF and PW (Harbour porpoise, Harbour Seal and Grey Seal) there is possible PTS after ~10 min exposure if animals remain in the area directly outside the berth, keeping in mind that for a moving animal this is an overestimate of the impact. From the received levels from a moving animal (section 7.3.2, p. 44 & 7.3.3, p. 45) it seems that for the worst-case source level some TTS is likely at low swimming speeds (0.5 m/s), while it's unlikely for the mean-case, where the source level is ~12 lower.

For group OW (Otter) there is low risk of TTS after >10 min of piling, but even after 40 minutes, the risk of PTS remains low (section 7.2.4, p. 35). For a slow-moving animal (0.5 m/s) there is little to no risk of auditory injury (section 7.3.4, p. 45).

The P- group (Salmon), might experience some TTS after ~10 min with a little risk of PTS after ~40 min (section 7.2.5, p. 39). For a moving animal this risk of any auditory injury is low (section 7.3.1, p. 44).

Vibratory Piling

Given the substantially lower levels estimated for the vibro piling we have not included a separate assessment for this activity.

The SPL for vibro piling is 189 dB SPL, this is 19 dB below the assessed 208 dB SPL of the Impact piling and would lead to negligible risk zones.

The L_P for vibro piling is likewise significantly below the L_P for impact piling (218 versus 245) and is not of concern in relation to direct acoustic impact o the assessed species.

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Abbreviations and Definitions:

SSP	Sound Speed Profile
Hearing group	Refers to the Southall 2019 hearing groups (Southall, et al., 2019).
“,” and “.”	Comma “,” is used as thousands separator, while dot “.” Is used as decimal separator.
TL, PL	Transmission Loss, Propagation Loss. Used interchangeably in this document.
Psu	Practical salinity unit, equivalent to parts per thousand as g/kg, mass of salts per mass of water.
Noise	Sound that causes, or is assumed to cause, annoyance or disadvantage. No automatic significance of impact is associated with this term.
Solver	Mathematical algorithm for calculating sound transmission losses in water.
[]	Square brackets are used throughout to denote units, e.g.: “Pressure [Pa]” means pressure in Pascals.
Degrees	Either angular degrees (0-360) or degrees Celsius
3rd octave, decidecade	Refers to the subdivision of octaves (doublings of frequency) and decades (10x frequency). Using the appropriate base frequency, the two are identical for practical purposes.
Worst case	Used as “reasonable worst case”. E.g. use of MHWS instead of historical maximum for max water level. Or 90th percentile as representative of worst-case.
Mean case	The expected case, both median and mean values will inform this.
Signature	When in relation to a sound, this refers to the time-pressure signal associated with that sound, normally as a time-series of pressures relative to ambient pressure, in pascals.
Vibro	Vibration pile driving

1 INTRODUCTION

In connection with the infilling in of a berth in Govan Area of Galway a “combi-wall” consisting of tubular piles and sheet piles will be installed to restrain and protect the infill from erosion from the river Clyde. The installation of the piles will be noisy, and potentially have negative impact on local fauna. We note that the piling installation for this project will be done *through* a bund/mound of material constructed prior to the piling. This means that piling noise will be attenuated significantly as it passes from the pile through the bund and into the river water. After the piling is complete the bund material on the river side of the pile wall will be removed.

This report presents the source modelling, underwater noise propagation modelling and noise impact modelling of the pile installation.

The impact modelling will be based on “mean-case” and “worst-case” scenarios for the activity.

1.1 Underwater Acoustics Basics

Underwater acoustics modelling is the application of physical models to characterise the behaviour of sound in environments under the surface of the sea and in the top layers of the seabed. As some familiarity with in-air acoustics is assumed the focus here is on key differences between in-air acoustics and underwater acoustics, making waterborne propagation more efficient than airborne propagation.

This chapter only gives reader a quick overview, please see APPENDIX B – Underwater Acoustics Basics APPENDIX *for more detail.*

1.1.1 SOUND SPEED

Water is much harder to compress than air, and a soundspeed of 1500 m/s is often used as a standard soundspeed in water[1] much as 340 m/s is in air.

The soundspeed changes with depth, “sound speed profile”, this is quite important in sound propagation, as refraction (changes in propagation angle) will occur when sound moves between layers of water with varying sound speed. These effects can lead to profoundly inhomogeneous sound fields and SOFAR channels.

The same relationships are valid in the sediment, though sediments commonly have soundspeeds higher than water. Soundspeeds from 1700 m/s (fine sand/silt) to 2500 m/s (gravel) are common for non-solid sediments, with solid sediments (rocks) having much higher soundspeeds 2800 m/s (Calcarenite) to 6000 m/s (some granite).

1.1.2 SPREADING LOSS

Most of the propagation loss (loss in dB from source to receiver, “PL”) that occurs initially is governed by “spreading loss”. It is the simple “thinning out” of acoustic energy as it spreads away from the source, usually in all directions – spherically. This means a reduction in received level of 6 dB per doubling of distance

At longer ranges the medium is no longer unbounded. We reach ranges where the sound has interacted with the surface (near perfect acoustic reflector) or the seabed (lossy acoustic reflector). Here we expect spreading loss to be ~3 dB per doubling of distance.

1.1.3 ABSORPTION

Besides the “thinning out” of the sound energy as described above, the sound is also dissipated into heat by the way the pressure changes interact with water, molecules and particles in its path. This absorption is salinity dependant. Frequencies under 1 kHz experiences almost no absorption, while high frequencies, over 10 kHz, can be attenuated by over 10 dB / km.

Small bubbles, wind or wave induced, will further attenuate especially the high frequencies.

1.1.4 SEDIMENT

Depending on the incident angle of the sound, the frequency and the acoustic properties of the sediment, sound can either mostly penetrate the sediment or mostly be reflected by it.

---

[1] Varies from 1450 m/s at 0° to 1550 m/s at 30° at salinity of 35 psu.

In shallow areas with soft sediment (acoustically similar to water), it is typical to find that close to the source, at high incidence angles and at low frequencies (<250 Hz) the sound will penetrate into the sediment and dissipate there, leading to very high transmission losses for these frequencies.

1.1.5 SOUND LEVEL UNITS

All references to sound pressure levels, peak pressure levels and sound exposure levels refer to a logarithmic ratio between a reported/measured pressure or exposure and a reference pressure or exposure. As an example, a level of 220 L_p (decibel zero-to-peak) is equal to a peak pressure of 100000 Pascals (Pa) over ambient pressure, while 120 L_p is equal to 1 Pa over ambient pressure.

To avoid dealing with these large numbers as pascals (as a linear scale), they are converted to a decibel ratio (Table 1 for definitions). Besides compressing large numbers to a smaller scale this also corresponds better to how animals are thought to perceive sound, namely as relative steps. This means that an increase from 1 to 2 Pa *sounds like* the same increase as from 100 to 200 Pa, even though the first step was only 1 Pa, while the second was 100 Pa. This is better reflected in a logarithmic scale based on ratios, where both steps are equal, here 3 dB.

However, while dBs are practical, they can be hard to compare between studies, due to vague definitions, and so we have adopted the standards set by ISO 18405-2017 (Table 1 below).

For ease of reference please see following overview for unit definition.

Table 1: Definitions.

Unit	Definition	Comments
SPL (dB$_{RMS}$) ISO 18405- 2017: 3.2.1.1	$SPL = 10 \cdot Log_{10}\left(\frac{\frac{1}{t_2 - t_1} \cdot \int_{t_1}^{t_2} p(t)^2 dt}{1 \cdot 10^{-12} Pa}\right)$	Functionally equivalent to deprecated $20 \cdot Log_{10}\left(\frac{RMS}{1 \cdot 10^{-6} Pa}\right)$
L_p (dB$_{z\text{-}p}$) ISO 18405- 2017: 3.2.2.1	$L_p = 20 \cdot Log_{10}\left(\frac{Pa_{max}}{1 \cdot 10^{-6} Pa}\right)$	This assumes that Pa_{max} is equal or greater than $\sqrt{Pa_{min}{}^2}$
$L_{p\text{-}p}$ (dB$_{p\text{-}p}$)	$L_{p-p} = 20 \cdot Log_{10}\left(\frac{Pa_{max} - Pa_{min}}{1 \cdot 10^{-6} Pa}\right)$	Often[2] equivalent to $L_P + 6.02\ dB$
L_E (dB$_{SEL}$) ISO 18405- 2017: 3.2.1.5	$L_E = 10 \cdot Log_{10}\left(\frac{\int_{t_1}^{t_2} p(t)^2 dt}{1 \cdot 10^{-12} Pa}\right)$	For continuous sound this is equivalent to $SPL + 10 \cdot Log_{10}(t_2 - t_1)$ "t" is seconds

Unless otherwise stated SPL has an averaging period of 1 second, and L_E for the duration of the specified event, sometimes indicated as $L_{E\text{-“time”}}$ or $L_{E\text{-single blow}}$.

If the averaging period for SPL is equal to the total even duration then SPL is equal to "Leq" the "equivalent constant level".

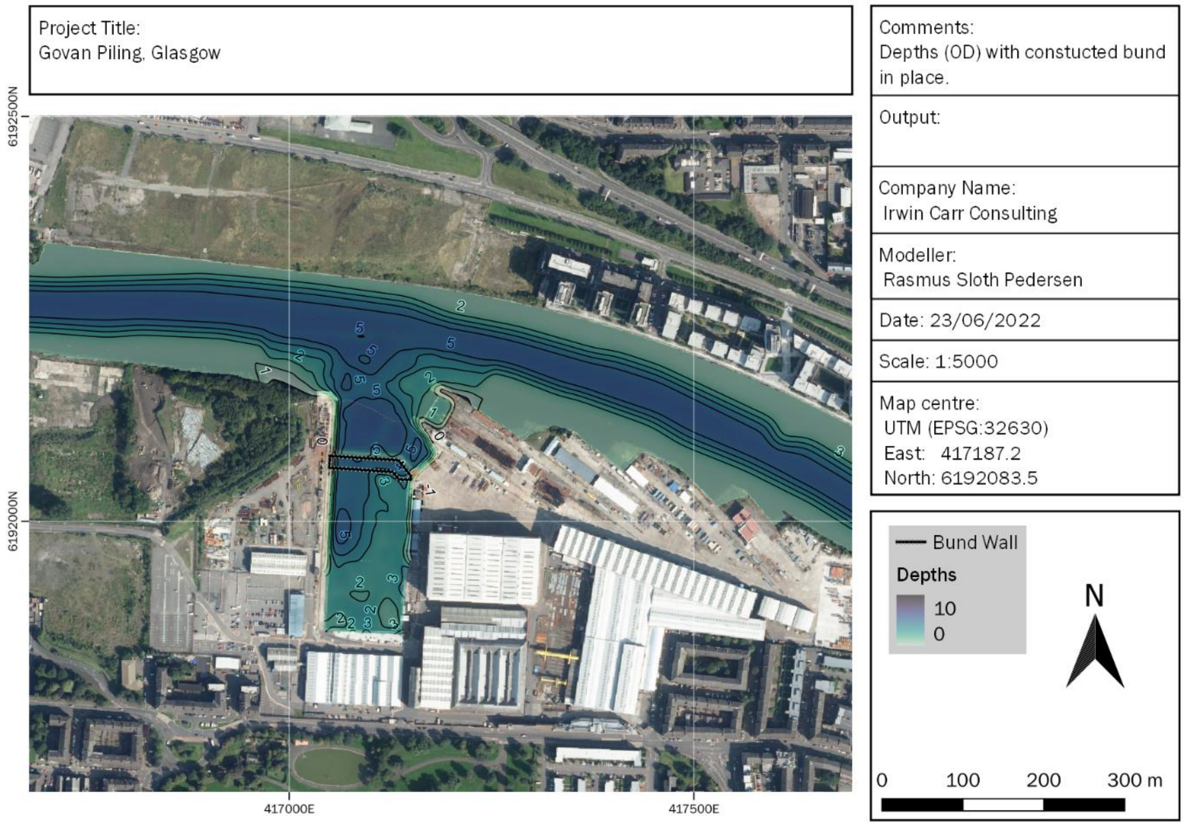
When source levels are presented, the same units are used, and it is implicit that all source levels are given as if recorded 1 m from an omnidirectional mono-point source, unless otherwise specified.

---

[2] If maximum pulse rarefaction is below ambient pressure and compression and rarefaction phases are of equal size.

2 Site and local environment

The site is located in Govan, Glasgow at Lat: 55.86701601, Lon: -4.32469555, (6192072 N, 417101 E, UTM 30N), in the mouth of the berth. Mean water depths 2-6 m.



2.1 Depth, Bathymetry

The depths in the berth are from a multibeam survey carried out by “Aspect Surveys” in February 2022. It was converted from an xyz point file to a 0.5 m resolution raster files by converting the point vector layer to an area layer (Voronoi method), and then smoothing over the depths with a gaussian filter, to avoid shar discontinuities present in the original point data.

Depths in the river Clyde are interpolated from nautical charts such as http://fishing-app.gpsnauticalcharts.com

The two data sources’ depths were first converted to a common depth reference, OD[3] (Ordnance datum), before they were merged to one dataset.

For the “worst case” scenario the MHWS (Mean High Water Spring) level is used (deeper water decreases noise transmission loss). MHWS is assumed equal to OD+2.17 m at this site.

2.2 Water properties

The site is located in Glasgow, Scotland, and is part of the estuarine part of the river Clyde (the weir at Glasgow Green is seen as inner limit of estuary).

Given the confined nature of this site the water properties will have comparatively little effect on the final conclusion as TL from spreading and sediment absorption/scattering will dominate.

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[3] Functionally equivalent to mean sea level, MSL.

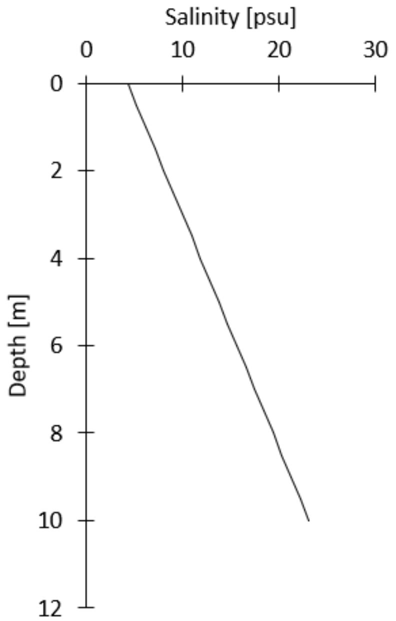
2.2.1 TEMPERATURE

We have used the online resource: https://www.seatemperature.org/europe/united-kingdom/erskine.htm to estimate water temperature for the site. According to this data source common minimal temperature for this site 6.3 °C in March and maximal temperature of 15.4 °C in July. As higher water temperatures generally favour sound transmission we have assumed a water temperature of **15.4 °C** throughout.

2.2.2 SALINITY

This part of the river is estuarine as displays a layering of water, with less saline water on the surface and denser more saline water closer to the bottom. We have relied on a local model (Chen, 2001) to generate a salinity profile for the site. The salinity is important for absorption and the sound speed.

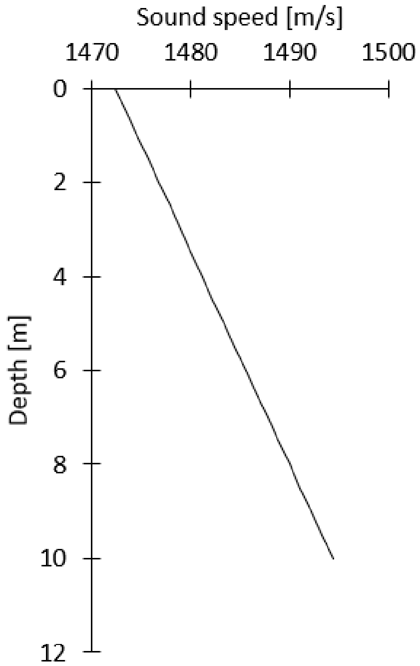
Figure 1. Varying salinity with depth at site.



2.2.3 SOUNDSPEED PROFILE

The sound speed profile is based on a widely used model for sound speed in water (Leroy, Robinson, & Goldsmith, 2008), with input of temperature, depth and salinity.

Figure 2. Sound speed profile at site.



2.3 Sediment properties

Based on sediment cores from the site the sediment is a layered combination of silt, sand and gravel with significant components of clay mixed in. Two borehole location are available, but one (BH9) contains significant amounts of "made ground" (manmade substrate) and has been discarded as not representative for the sediment profile in general.

Figure 3. Acoustic properties of the sediment. Values have been smoothed (requirement for model).

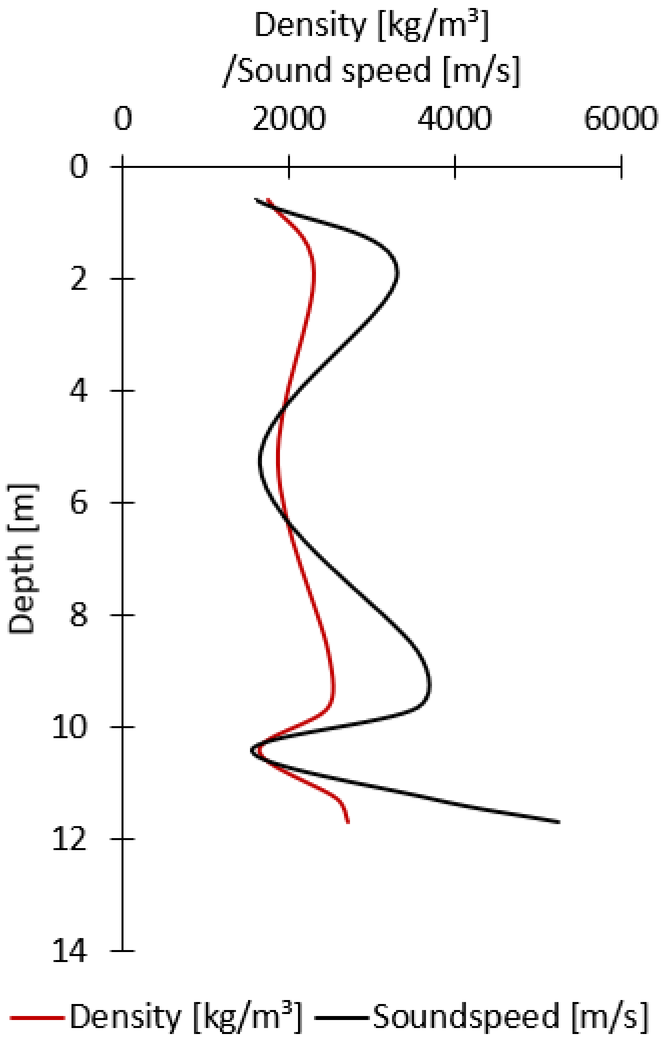


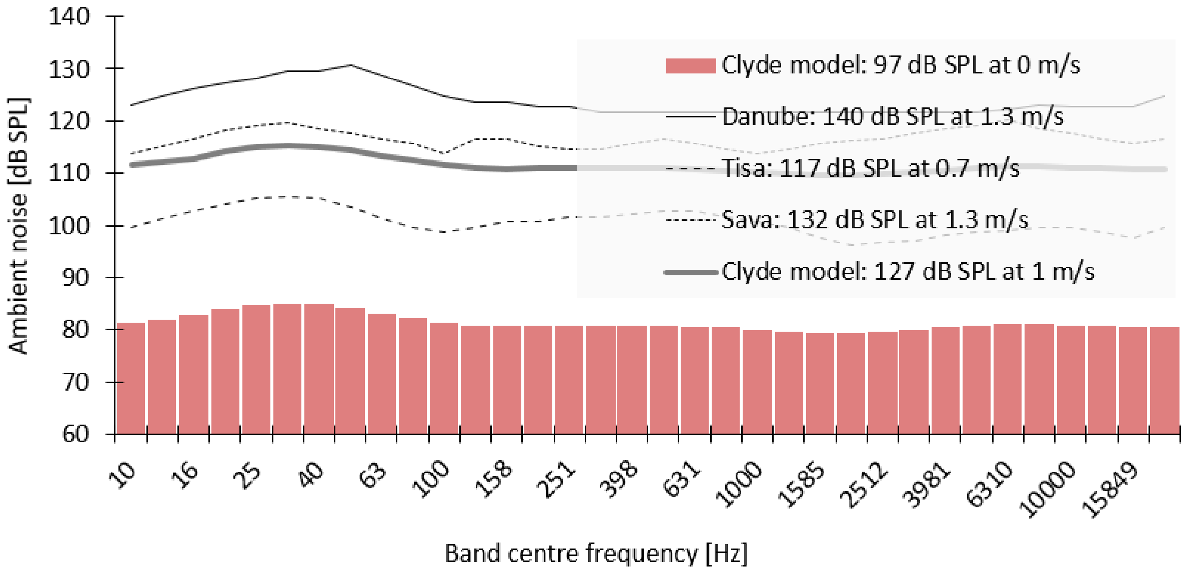
Figure 4. Sediment profile for borehole in berth.

Depth below bottom [m]	Sediment type PRIMARY (secondary)	Sound speed [m/s] (compressional)	Density [kg/m³]	Absorption [dB/wavelength] (compressional)
0-1.15	SILT (sand)	1597	1749	1.2
1.15-2.6	SAND (some gravel)	3309	2294	1.6
2.6-8	SAND (clay)	1648	1866	1.1
8-10	SAND (gravel)	3556	2465	1.6
10-10.85	CLAY (gravel)	1553	1645	0.4
10.85-11.7	GRAVEL (some sand)	3695	2562	1.7
>11.7	Rock/boulder SANDSTONE assumed	5250	2700	0.1

2.4 Background/Ambient Noise

Due to the site's placement, relatively far into the Clyde estuary we don't expect that there will be excessive background noise from large vessels (there are very few docking points further upriver). The occasional fast light vessel might be present, but we expect the site to be dominated by flow noise. In an effort to find reasonable ambient noise levels we use measurements from other large rivers (Vracar & Mijic, 2011) as well as the flow rate in the Clyde (Chen, 2001) (here set to "0 m/s" as a conservative measure), to estimate the likely ambient noise level.

Figure 5. Various river ambient noise level at various flow speeds. Columns are the band levels used here for the Clyde when there is no flow (0 m/s)



3 SOUND SOURCE MODELLING

The impact piling is modelled considering multiple factors, presented in Table 2 below in column "Round piles".

The source model also uses the water and sediment properties, see section 2 p. 9 for details.

The vibration piling model is simpler as we don't have good source models for the kind of piling (section 3.2 below)

Table 2. Input values to impact piling source model. Water and sediment properties listed in sections above.

Item	Round piles	Sheet piles
Length [m]	25-35 (30 assumed)	
Radius/largest dimension [m]	1.575	0.86
Installation length/final penetration depth [m]	Length-2.5 m (27.5 assumed)	
Steel Young's modulus [GPa]	210	210
Wall thickness [mm]	25	12.5
Hammer type/model	CG300	ICE 1412C
Hammer rating [kJ]/[kN]	294 kJ	2300 kN
Blow rate [Hz]	0.57	Up to 23
Hammer blow energy, first blow [kJ]	30	-

3.1 Impact Piling Model

Our impact piling model uses a combination of analytical models and empirical data fitting to generate broad band single blow level, 3rd octave bands and time-pressure impulse for every blow during the installation (source levels change during installation, with pile free length and blow energy).

Additionally, being a partially empirical model, we know the uncertainty of the result as this has been established for a large variety of hammer ratings, pile sizes and sediment types.

The general structure is:

1. Model required blow energy using models for soil resistance and pile carrying capacity. (Alm, 1998; Maynard, 2019; Li, Wu, Liu, & Lehane, 2021; Fang, Wang, & Fang, 2020; Gregg Drilling & Testing, Inc., 2008; Knut H. Andersen & Schjetne, 2013; P. Doherty BE, 2010; RANDOLPH, DOLWIN, & BECK, 1994; White, 2002; Yan & Yuen, 2010).
2. Account for hammer size (energy rating) and calculate forcing function.
3. Appy sediment and water properties to calculate a transmission factor from the hammer to the water (via the pile and sediment) and sediment (via the pile), by combing relations from APPENDIX B – Underwater Acoustics BasicsAPPENDIX with fitting to empirical data to estimate source signature.
4. Use pile dimensions to account for dominant frequencies and spectra content of emitted noise.
5. Determine frequency content in decidecade bands.

For this report we will use two source levels. These will be the median level from the source model, 199 dB L_E broadband, and the 90th percentile level, 210 dB L_E broadband.

Table 3. Impact piling source levels summary.

	Mean case [dB]	Worst case [dB]
L_P	233	245
L_E (broadband)	199	210
SPL_{90} (duration of 90 % of energy in signature)	211	239
$SPL_{1\ sec}$	196	208

Figure 6. Source time-series signature for a single blow at range of 1 m in the source model.

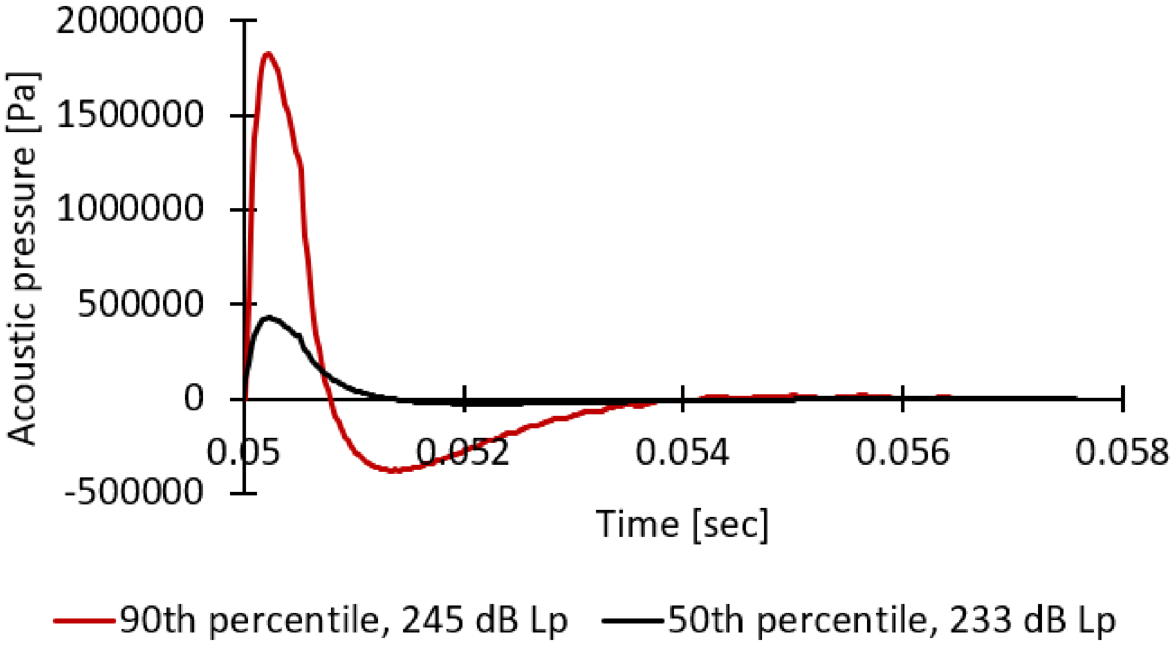
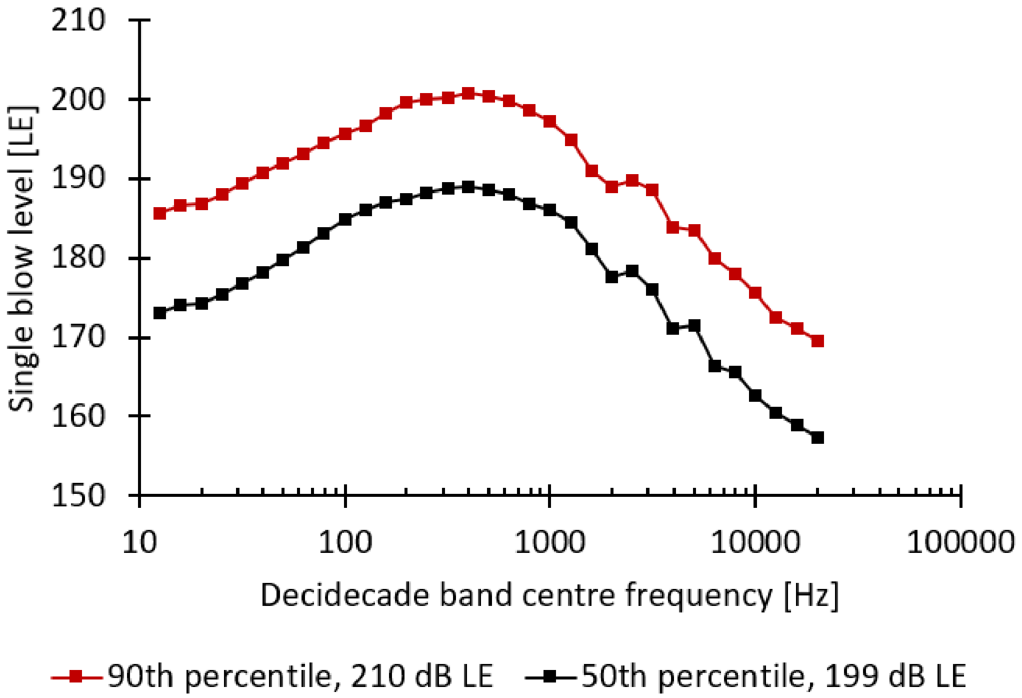


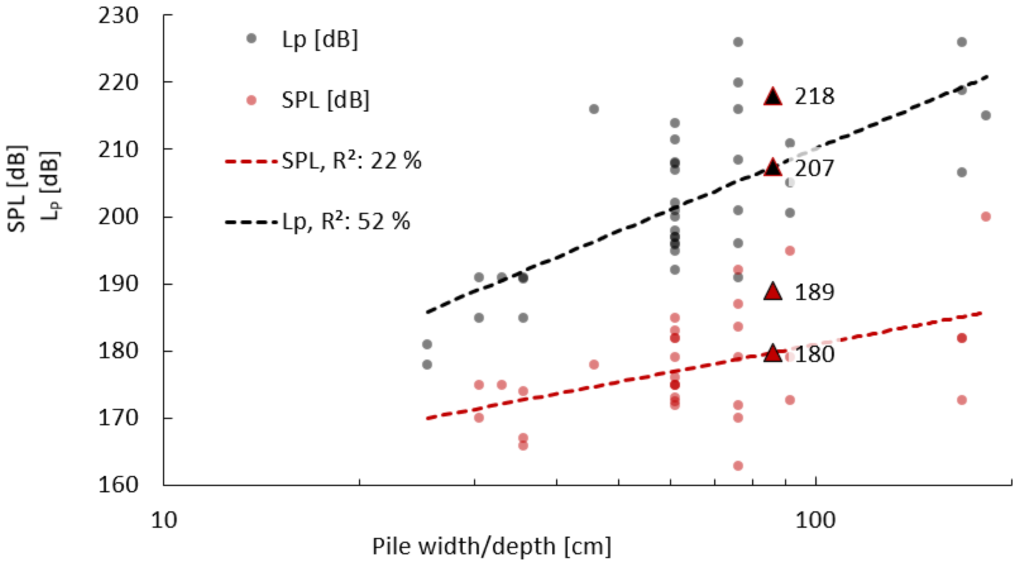
Figure 7. Decidecade band levels of the 90th percentile band levels (red) and median band levels (black).



3.2 Vibration Piling Model

We only have a few recordings from vibration piling and have no dedicated source model for this type of piling. Instead, we rely on published recorded levels as from CalTrans (CalTrans, 2015).

Figure 8. Basis of vibro piling broad band source level as a function of pile size.



Given the low confidence we have in this approach (low R^2 values) we use the 90th percentile level as the broadband source level. L_P is estimated to be 218 dB and SPL 189 dB. The frequency content is assumed to be identical to that of the impact piling.

Table 4. Vibro piling source levels summary.

	Mean case [dB]	Worst case [dB]
L_P	207	218
$SPL_{1\ sec}$	180	189

4 TRANSMISSION LOSS MODELLING

Transmission loss modelling is done using dBSea underwater noise modelling software.

This software is partially developed by us and is fully capable of carrying out all the requested modelling tasks. The dBSea software can model frequencies from 10 Hz to 168 kHz, normally as 3rd octave bands, but any logarithmic band-spacing can be used. All solvers are range dependent (meaning all conditions can change with range not just depth).

Further details of this modelling software package can be found in APPENDIX A - dBSea.

5 ASSESSMENT CRITERIA

5.1 Reporting units

All references to sound pressure levels, peak pressure levels and sound exposure levels refer to a logarithmic ratio between a reported/measured pressure or exposure and a reference pressure or exposure. As an example, a level of 220 L_p (decibel zero-to-peak) is equal to a peak pressure of 100000 Pascals (Pa) over ambient pressure, while 120 L_p is equal to 1 Pa over ambient pressure.

To avoid dealing with such large numbers as pascals (as a linear scale), they are converted to a decibel ratio (Table 5 for definitions). Besides compressing large numbers to a smaller scale this also corresponds better to how animals are thought to perceive sound, namely as relative steps. This means that an increase from 1 to 2 Pa *sounds like* the same increase as from 100 to 200 Pa, even though the first step was only 1 Pa, while the second was 100 Pa. This is better reflected in a logarithmic scale based on ratios, where both steps are equal, here 3 dB.

However, while dBs are practical, they can be hard to compare between studies, due to vague definitions, and so we have adopted the standards set by ISO 18405-2017 (Table 5 below).

For ease of reference please see following overview for unit definition.

Table 5: Definitions.

Unit	Definition	Comments
SPL (dB_{RMS}) ISO 18405- 2017: 3.2.1.1	$SPL = 10 \cdot Log_{10}\left(\frac{\frac{1}{t_2 - t_1} \cdot \int_{t_1}^{t_2} p(t)^2 dt}{1 \cdot 10^{-12} Pa}\right)$	Functionally equivalent to deprecated $20 \cdot Log_{10}\left(\frac{RMS}{1 \cdot 10^{-6} Pa}\right)$
L_p ($dB_{z\text{-}p}$) ISO 18405- 2017: 3.2.2.1	$L_p = 10 \cdot Log_{10}\left(\frac{{Pa_{max}}^2}{1 \cdot 10^{-12} Pa}\right)$	This assumes that Pa_{max} is equal or greater than $\sqrt{{Pa_{min}}^2}$
$L_{p\text{-}p}$ ($dB_{p\text{-}p}$)	$L_{p-p} = 20 \cdot Log_{10}\left(\frac{Pa_{max} - Pa_{min}}{1 \cdot 10^{-6} Pa}\right)$	Often[4] equivalent to $L_P + 6.02\ dB$
L_E (dB_{SEL}) ISO 18405- 2017: 3.2.1.5	$L_E = 10 \cdot Log_{10}\left(\frac{\int_{t_1}^{t_2} p(t)^2 dt}{1 \cdot 10^{-12} Pa}\right)$	For continuous sound this is equivalent to $SPL + 10 \cdot Log_{10}(t_2 - t_1)$ "t" is seconds. "SEL" is often used, but is deprecated as ISO unit.

Unless otherwise stated SPL has an averaging period of 1 second, and L_E for the duration of the specified event, sometimes indicated as $L_{E\text{-"time"}}$ or $L_{E\text{-single blow}}$.

If the averaging period for SPL is equal to the total event duration then SPL is equal to "Leq", the "equivalent constant level".

---

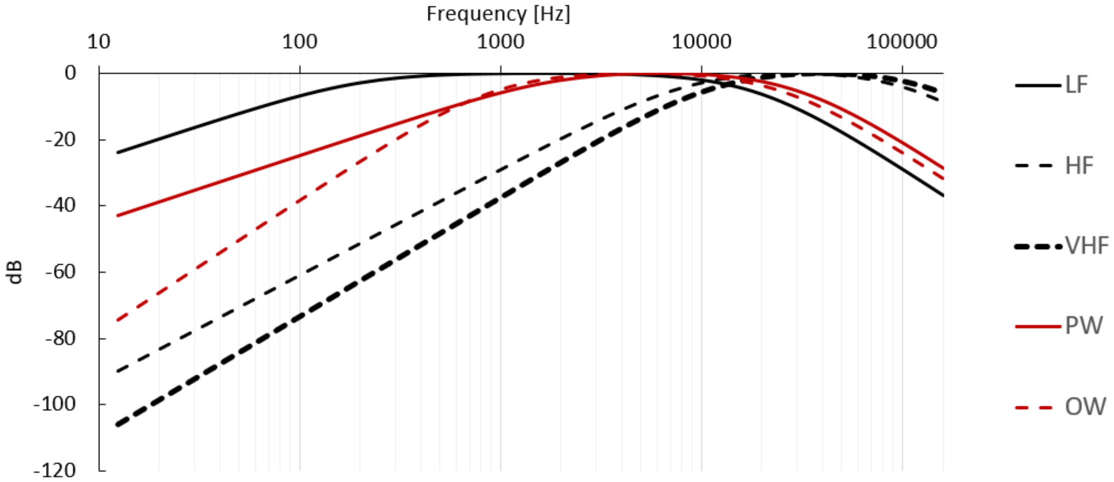
[4] If maximum pulse rarefaction is below ambient pressure and compression and rarefaction phases are of equal size.

When source levels are presented, the same units are used, and it is implicit that all source levels are given as if recorded 1 m from an omnidirectional mono-point source, unless otherwise specified.

5.2 Weighting of Noise Levels

When not reporting L_p or $L_{p\text{-}p}$ levels, the noise levels are often weighted according to a generalised hearing sensitivity profile for up to ten different hearing groups. This is done to better reflect the actual impact on the species in question, much like dB(C) level unit for humans.

Figure 9. Weightings for various hearing groups. For L_E levels, the weightings are applied to the noise level to give the weighted noise level (similar to dB(A) or dB(C)-weighted noise for humans).
See Table 6, p.18 for full group names and limits.



5.2.1 MARINE MAMMAL WEIGHTINGS

For the marine/aquatic mammals present we will adhere to the thresholds described in “Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing” (National Marine Fisheries Service, 2018), which determines impact from an assessment of area wherein the noise will induce either “Temporary Threshold Shift” (TTS) or “Permanent Threshold Shift” (PTS)[5] as judged by the weighted SEL level ($L_{E\text{-}24}$) over a typical 24-hour period or by L_P levels, for the different hearing groups.

Please note that the Southall 2019 thresholds and weightings are identical to the NMFS 2018 criteria, only the nomenclature has changed (Southall, et al., 2019; National Marine Fisheries Service, 2018).

Were relevant we might use the thresholds for behavioural disruption as set by NOAA fisheries[6]. These are 120 dB RMS[7] for continuous noise and 160 dB SPL[8] for impulsive noise.

The hearing groups from the Southall 2019 and the NMFS 2018 guidance were specified by collating available information on marine mammal hearing and generalising their hearing sensitivity into representative groups. This grouping represents a significant research effort and are reviewed by the leading experts (academic, industrial and conservation) on the topic. Because of the large amount of work this represents and the widespread acceptance of the method, the thresholds and the methodology associated, have become de-facto standards for assessing noise impact on marine mammals and represents best available knowledge and practise.

Along with weighting curves, similar in function to the human dB(C) curves, a set of thresholds for hearing impact and injury is associated with the framework and allows for conversion of threshold

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[5] TTS/PTS. A temporary/permanent change in hearing sensitivity caused by acoustic stimuli.

[6] Available from: https://archive.fisheries.noaa.gov/wcr/protected_species/marine_mammals/threshold_guidance.html

[7] Here taken as meaning “SPL”

[8] Assumed to be SPL of 90 % of energy in one impulse or SPL of total duration (L_{EQ}).

exceedance into ranges with risk of impact. E.g. we might see that the PW group (true seals) has a risk of PTS at ranges shorter than 50 meters, and a risk of TTS at ranges shorter than 200 meters.

All marine mammal species are covered by the hearing groups and a full list of species in the different groups can be found in the “Marine Mammal Noise Exposure Criteria: Updated Scientific Recommendations for Residual Hearing Effects“ (Southall, et al., 2019), but in general the groups cover the following species:

Table 6. Summary of Southall 2019 thresholds and groups with species examples. For full species list see source (National Marine Fisheries Service, 2018; Southall, et al., 2019)

Hearing group	Species examples	Non-impulsive TTS/PTS threshold [$L_{E\text{-}24\ hours}$]	Impulsive TTS/PTS threshold [$L_{E\text{-}24\ hours}$]	Impulsive TTS/PTS threshold [L_p]
PW	Weddell Seal, Leopard Seal, Harbour Seal, Grey Seal	181/201	170/185	212/218
OW	Fur seals, Sea Lions, Otters, Polar Bear	199/219	188/203	226/232
LF	Fin Whale, Minke whale, Humpback whale, Right Whale	179/199	168/183	213/219
HF	Sperm Whale, Common dolphin, Bottlenose Dolphin, Killer Whale, Beaked Whales, Pilot Whales	178/198	170/185	224/230
VHF	Porpoises, Hourglass Dolphin	153/173	140/155	196/202

It's important to note that the assessment is thus based on the received level of receptors with the above-described auditory sensitivity and not based on the sensitivity of the individual species.

5.3 Fishes etc.

Impacts of noise on fishes is less well established than for marine mammals, but a review from 2014 (Popper, et al., 2014) provides guidelines on exposure limits for fish and turtles. The report does not directly use the PTS nomenclature (as above for mammals) as many fish have the capacity to repair structural damage to their ear, and even structural damage then cannot be said to be “permanent”.

We use “PTS” here to cover the categories “Mortality and potential mortal injury” and “Recoverable injury”.

TTS is directly used in the report, and we use it in the same way here.

Table 7. Overview of Impact piling thresholds from (Popper, et al., 2014) (Table 7.3 in report)

Hearing group	Species examples	Impulsive TTS/PTS threshold [$L_{E\text{-}24\ hours}$]	Impulsive TTS/PTS threshold [L_p]
P* (Fish with no swim bladder)	Sharks, Rays	186/216	TTS not specified/213
P- (Fish with swim-bladder, but not involved in hearing)	Salmon, Trout, Cod, Herring	186/203	TTS not specified/207
P+ (swim-bladder used in hearing)	Carp, Catfish	186/203	TTS not specified/207

5.4 Threshold Interpretation

5.4.1 THRESHOLD TYPES

The three threshold types refer to different ways that sound can affect the hearing of an animal and are ***important to keep in mind*** when evaluating the results of this report:

5.4.1.1 Non-impulsive, $L_{E\text{-}24\ hours}$

The threshold, over which an effect (TTS/PTS) occurs, taking into account ***continuous***[9] sound received by the animal over a typical 24-hour period as sound exposure, L_E.

When presented as a zone on a map, this refers to the area, within which, an animal would suffer the effect, if it stayed there for 24 hours (or the full duration of the activity or as otherwise specified). We thus identify areas given by this limit as areas of TTS-**risk** or PTS-**risk** respectively, i.e., an animal within the area has a risk of suffering from either TTS or PTS within the zone.
Alternatively this can be thought of as the total sound-dose limit over 24 hours.
Weightings are applied for non-impulsive L_E (for mammals only[10]).

5.4.1.2 Impulsive, $L_{E\text{-}24\ hours}$

The threshold, over which an effect (TTS/PTS) occurs, taking into account ***impulsive*** sound received by the animal over a typical 24-hour period as sound exposure, L_E.
When presented as a zone on a map, this refers to the area, within which, an animal would suffer the effect, if it stayed there for 24 hours (or the full duration of the activity or as otherwise specified). We thus identify areas given by this limit as areas of TTS-**risk** or PTS-**risk** respectively, i.e., an animal within the area has a risk of suffering from either TTS or PTS within this zone.
Alternatively this can be thought of as the total sound-dose limit over 24 hours.

5.4.1.2.1 Impulsive $L_{E\ single\ impulse}$ / $L_{E\ \#\ impulses}$

It is sometimes useful to assess the impact of a single/a number of impulse(s). When we do this, we will refer to it as "LE single impulse / LE # impulses".
Like for the Lp, when single-impulse LE is presented as an impact zone, this refers to the area, within which, an animal would suffer the effect acutely/instantly.

Weightings are applied for Impulsive L_E (for mammals only).

---

[9] Please see (National Marine Fisheries Service, 2018) for definitions of "non-impulsive" and "impulsive". For quick reference, if a sound is shorter than 1 second and is clearly intermittent in nature, it is impulsive – otherwise, it's continuous.

[10] When assessing for fish groups levels are not weighted.

5.4.1.3 Impulsive, L_p

The threshold over which an effect (TTS/PTS) occurs, taking into account ***impulsive*** sound received by the animal at any instant as maximal peak pressure.
When presented as a zone on a map, this refers to the area, within which, an animal would suffer the effect acutely/instantly and from just one exposure.
Weightings are ***not*** applied for Impulsive L_P.

5.4.2 MASKING

Levels that are not over threshold can still cause significant impact, if that noise makes foraging, navigation or communication harder due to masking or where biologically relevant sounds are “drowned out” by the anthropogenic noise. Continuous noise is more likely than impulsive noise to cause this form of impact.

5.4.3 DISPERSAL

Many animals can recognise sounds and might be dispersed from an area at noise levels well below TTS limits. Quantifying a level of dispersal from desk-spaced studies is very challenging and not done here.

6 CONCLUSION

We conclude that the overall risk of direct acoustic impact on assessed species following the piledriving is very low.

The main reasons are:

- A conservative approach: Using upper 90th percentile source levels & and mean high water spring tide (MHWS), leading to elevated received levels.
- The results show some risk of hearing injury (PTS) only at prolonged exposure (>10 min) in a very confined area (immediately outside the berth).
- Slow-moving (0.5 m/s) receivers are not expected to experience PTS.

Additionally, the confined nature of the site means that acoustic masking is limited to a relatively short section of the river; ~2 km over background noise level and ~1500 m >120 dB SPL.

We note that the noise might deter an animal from moving past the site while its active, meaning the activity could lead to other, not directly acoustic, impacts on animals' fecundity.

7 RESULTS

The reader should note that the “risk zones” are to be interpreted as areas where, if the receiver is within that zone for the prescribed number of blows/duration of time, the impact is likely to occur. Thus, a moving receiver (animal) might not spend e.g., 10 minutes in the same area, and therefore receive lower noise exposure than pictured in the maps.

7.1 Summary

7.1.1 IMPACT PILING

7.1.1.1 L_P – Peak pressure

For the acute injury risk from peak pressure the VHF-group (Harbour Porpoise) has the largest risk range, 65 m to TTS risk (ignoring range into the berth), coinciding spatially with the mouth of the berth.

All other groups have negligible risk ranges for TTS and PTS (both <25 m).

7.1.1.2 L_E – Exposure level

For groups VHF and PW (Harbour porpoise, Harbour Seal and Grey Seal) there is possible PTS after ~10 min exposure if animals remain in the area directly outside the berth, keeping in mind that for a moving animal this is an overestimate of the impact. From the received levels from a moving animal (section 7.3.2, p. 44 & 7.3.3, p. 45) it seems that for the worst-case source level some TTS is likely at low swimming speeds (0.5 m/s), while it’s unlikely for the mean-case, where the source level is ~12 lower.

For group OW (Otter) there is low risk of TTS after >10 min of piling, but even after 40 minutes, the risk of PTS remains low (section 7.2.4, p. 35). For a slow-moving animal (0.5 m/s) there is little to no risk of auditory injury (section 7.3.4, p. 45).

The P- group (Salmon), might experience some TTS after ~10 min with a little risk of PTS after ~40 min (section 7.2.5, p. 39). For a moving animal this risk of any auditory injury is low (section 7.3.1, p. 44).

7.1.2 VIBRATORY PILING

Given the substantially lower levels estimated for the vibro piling we have not included a separate assessment for this activity.

The SPL for vibro piling is 189 dB SPL, this is 19 dB below the assessed 208 dB SPL of the Impact piling and would lead to negligible risk zones.

The L_P for vibro piling is likewise significantly below the L_P for impact piling (218 versus 245) and is not of concern in relation to direct acoustic impact o the assessed species.

7.2 Impact Piling

As well as the “mean-case” and “worst-case” scenarios, the impact piling has been split into 3 different durations/blow-counts:

- A single blow - think of this as the acute injury risk.
- 10 minutes, assumed to be ~340 blows. This is the time it would take an animal swimming at 0.5 m/s to pass the site.
- 40 minutes, assumed to be 1334 blows and the full installation of a single pile[11].

Note that all results assume water depth as Mean-High-Water-Spring (MHWS) tide level, this is a conservative measure as shallower water will lead to higher transmission losses, for this type of scenario.

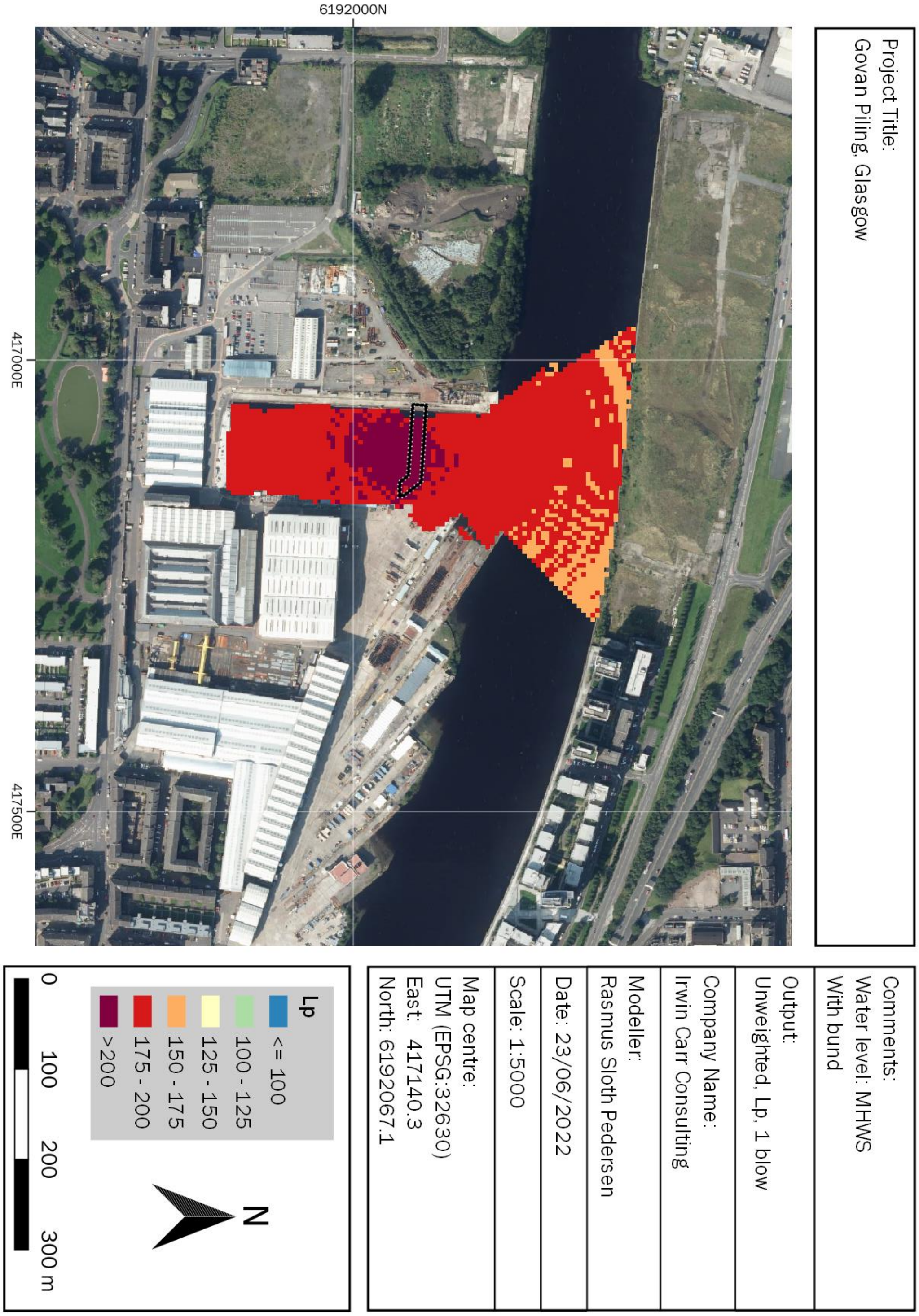
---

[11] It’s the blow count that matters for the exposure, so if the final installation time is longer per pile, but the blow count is similar, the results maps are still appropriate.

7.2.1 UNWEIGHTED

For unweighted noise levels the minimal level that it makes sense to display is the SPL of the background noise level, 97 dB[12] (Figure 5, p. 12)). For 40 minutes the background noise is thus equivalent to 131 dB L_E.

7.2.1.1 L_P



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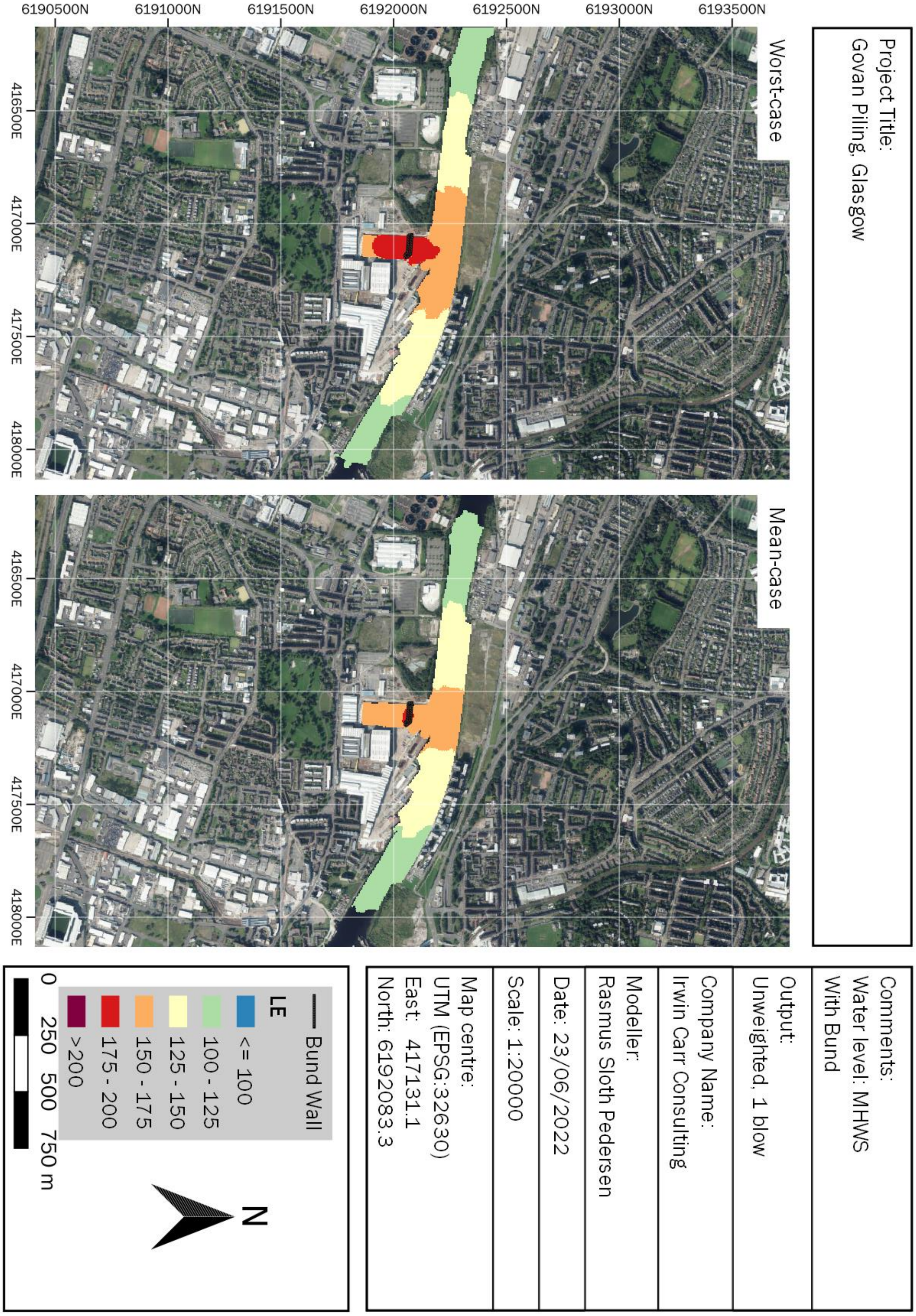
[12] The SPL of the impact pile driving is $L_E + 10Log_{10}$(blow rate) = $L_E + 10Log_{10}(0.57) = L_E - 3$ dB.

7.2.1.2 L_E Single blow



Project Title:
Govan Piling, Glasgow

Comments:
Water level: MHWS
With Bund

Output:
Unweighted, 1 blow

Company Name:
Irwin Carr Consulting

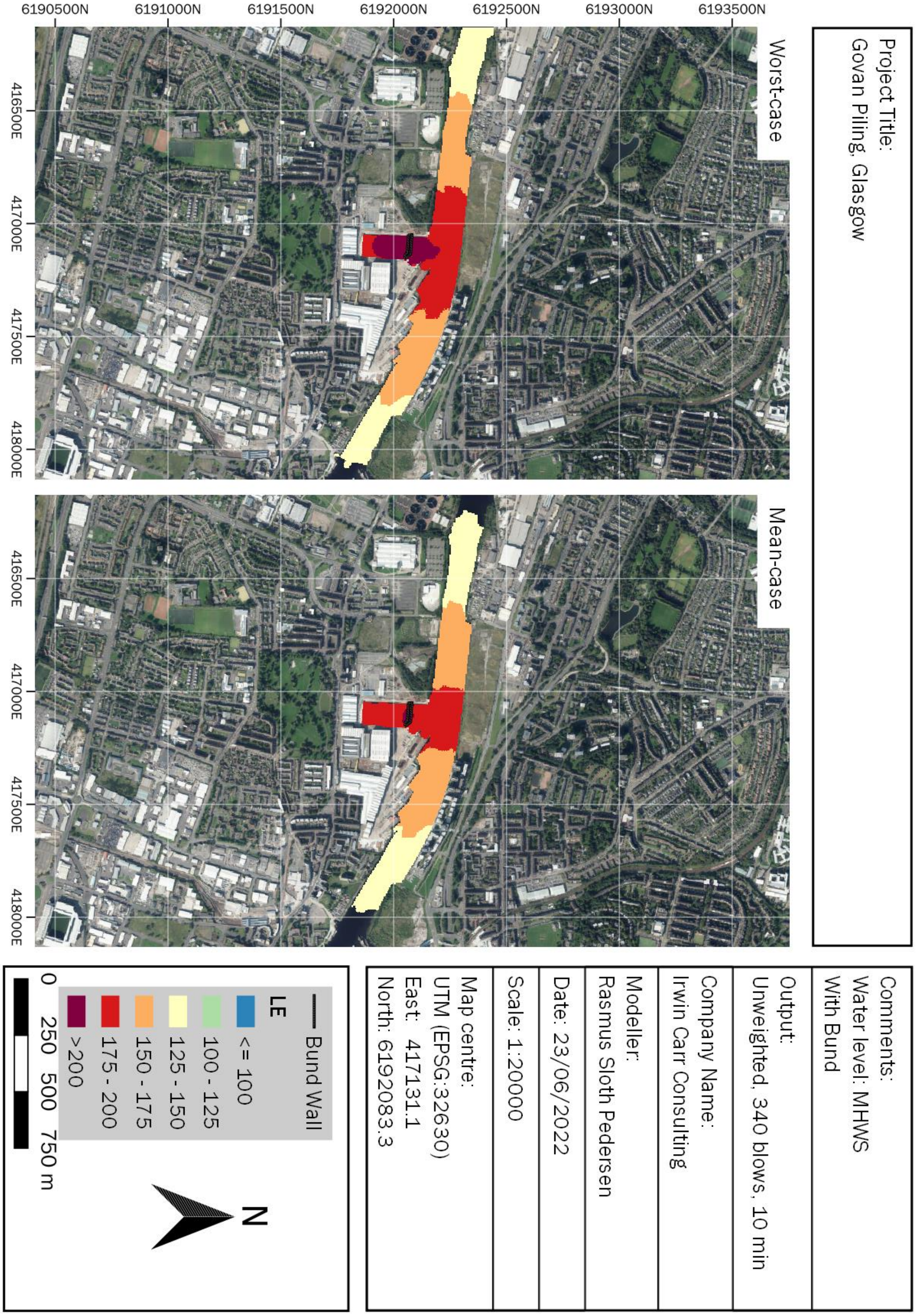
Modeller:
Rasmus Sloth Pedersen

Date: 23/06/2022

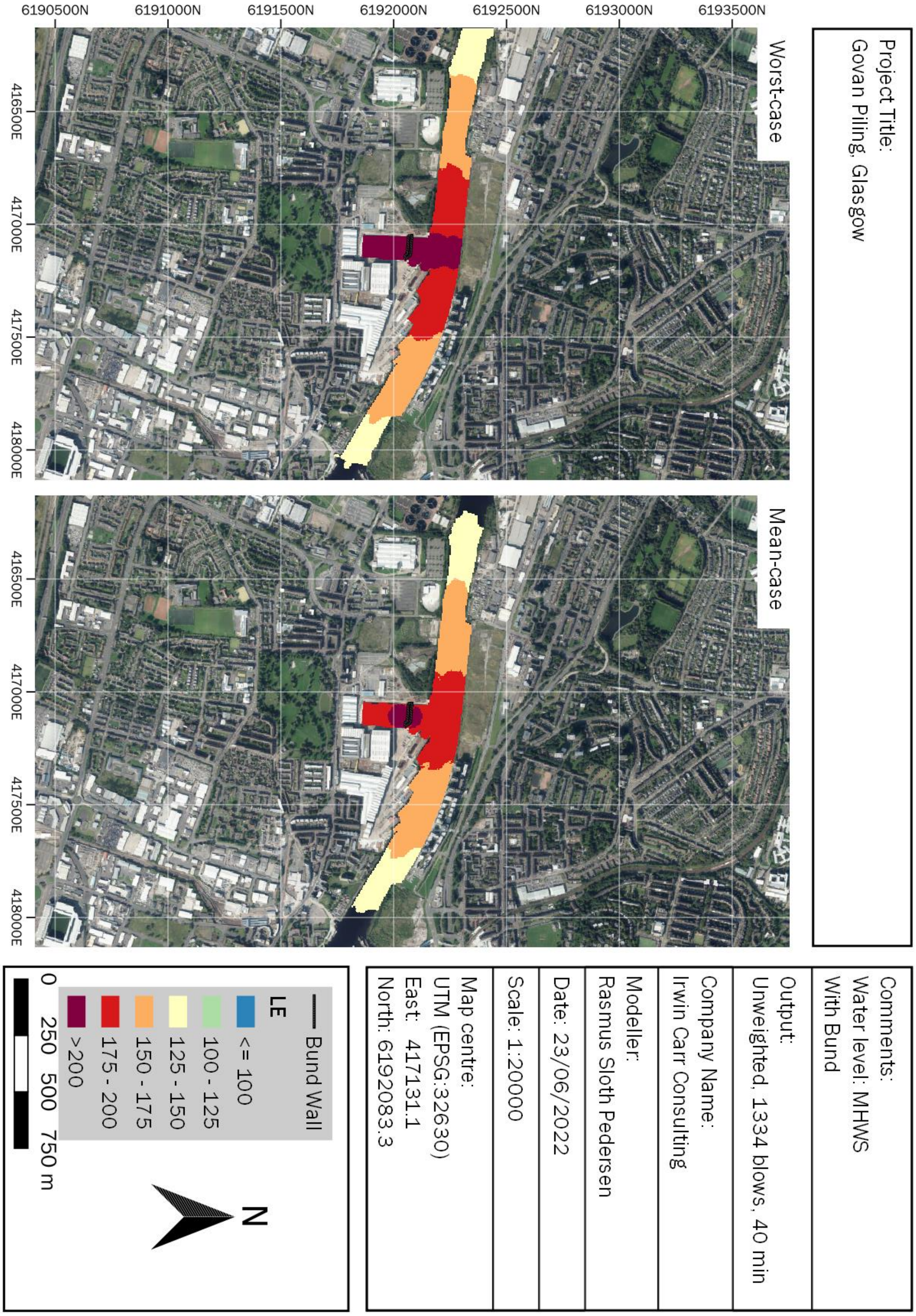
Scale: 1:20000

Map centre:
UTM (EPSG:32630)
East: 417131.1
North: 6192083.3

7.2.1.3 L$_E$ 340 blows, 10 minutes



7.2.1.4 L_E 1334 blows, 40 minutes



Project Title:
Govan Piling, Glasgow

Comments:
Water level: MHWS
With Bund

Output:
Unweighted, 1334 blows, 40 min

Company Name:
Irwin Carr Consulting

Modeller:
Rasmus Sloth Pedersen

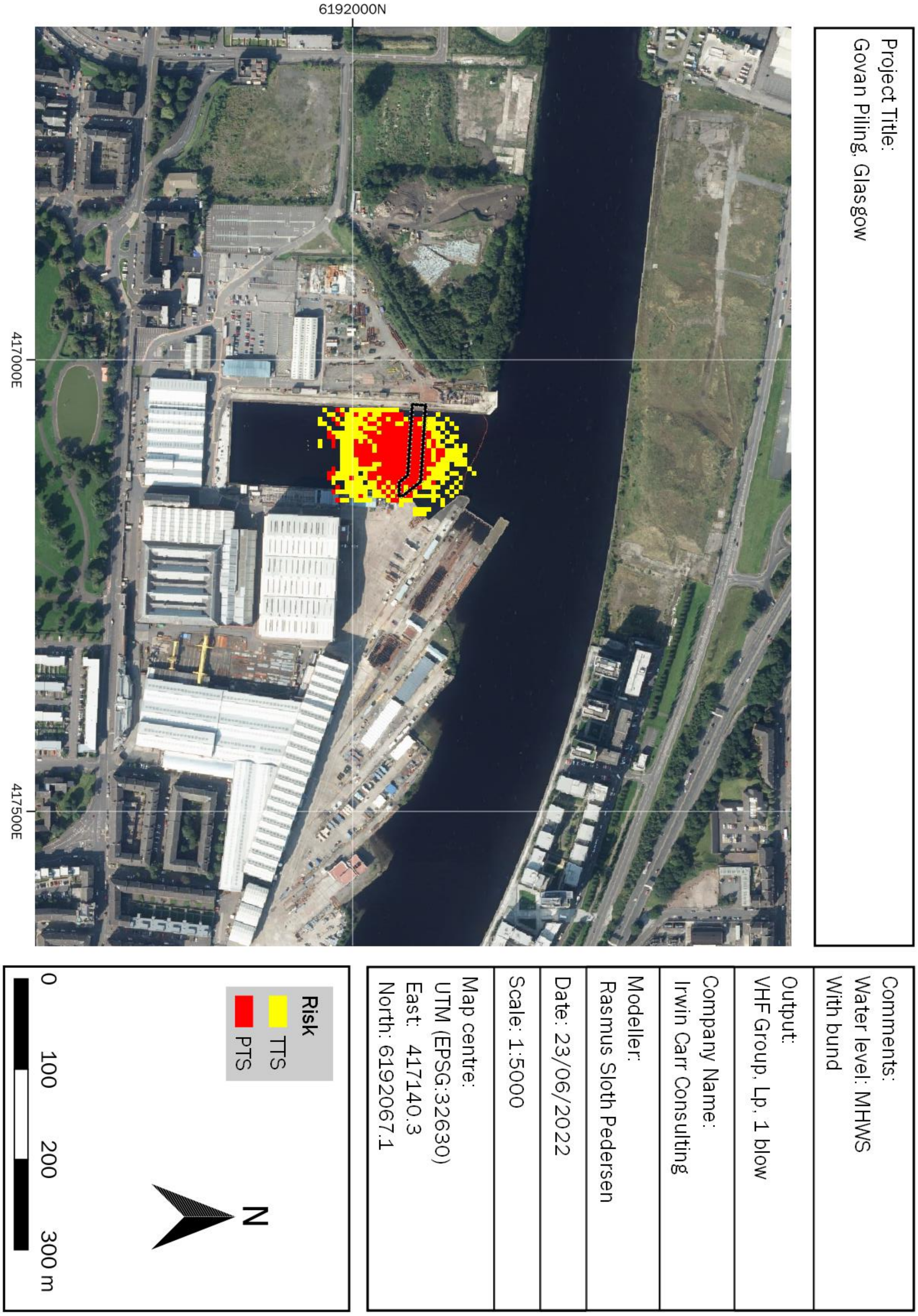
Date: 23/06/2022

Scale: 1:20000

Map centre:
UTM (EPSG:32630)
East: 417131.1
North: 6192083.3

7.2.2 WEIGHTED (VHF) – HARBOUR PORPOISE

7.2.2.1 L_P



Project Title:
Govan Piling, Glasgow

Comments:
Water level: MHWS
With bund

Output:
VHF Group, Lp, 1 blow

Company Name:
Irwin Carr Consulting

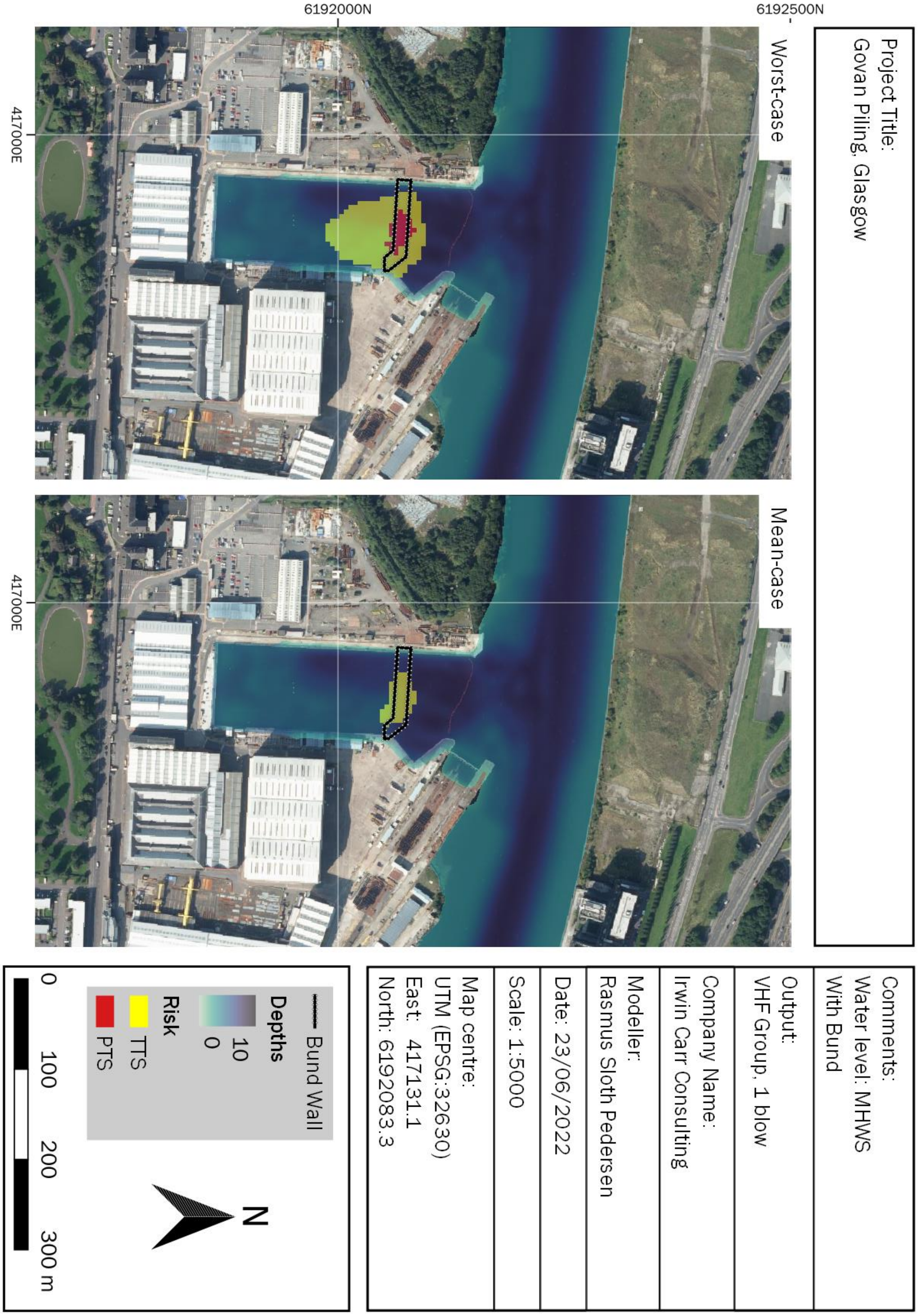
Modeller:
Rasmus Sloth Pedersen

Date: 23/06/2022

Scale: 1:5000

Map centre:
UTM (EPSG:32630)
East: 417140.3
North: 6192067.1

7.2.2.2 *L$_E$ Single blow*



Project Title:
Govan Piling, Glasgow

Comments:
Water level: MHWS
With Bund

Output:
VHF Group, 1 blow

Company Name:
Irwin Carr Consulting

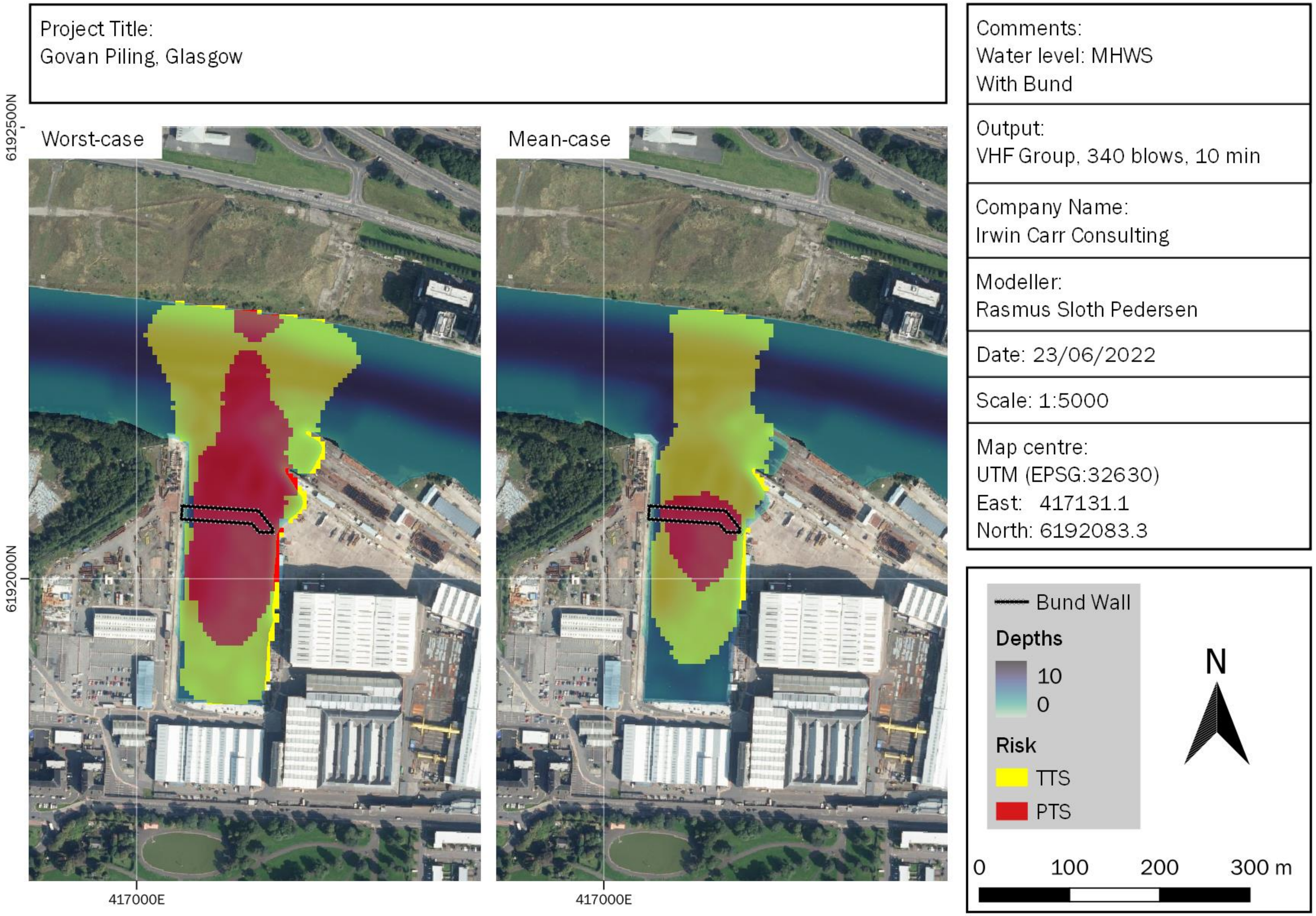
Modeller:
Rasmus Sloth Pedersen

Date: 23/06/2022

Scale: 1:5000

Map centre:
UTM (EPSG:32630)
East: 417131.1
North: 6192083.3

7.2.2.3 L_E 340 blows, 10 minutes



Project Title:
Govan Piling, Glasgow

Comments:
Water level: MHWS
With Bund

Output:
VHF Group, 340 blows, 10 min

Company Name:
Irwin Carr Consulting

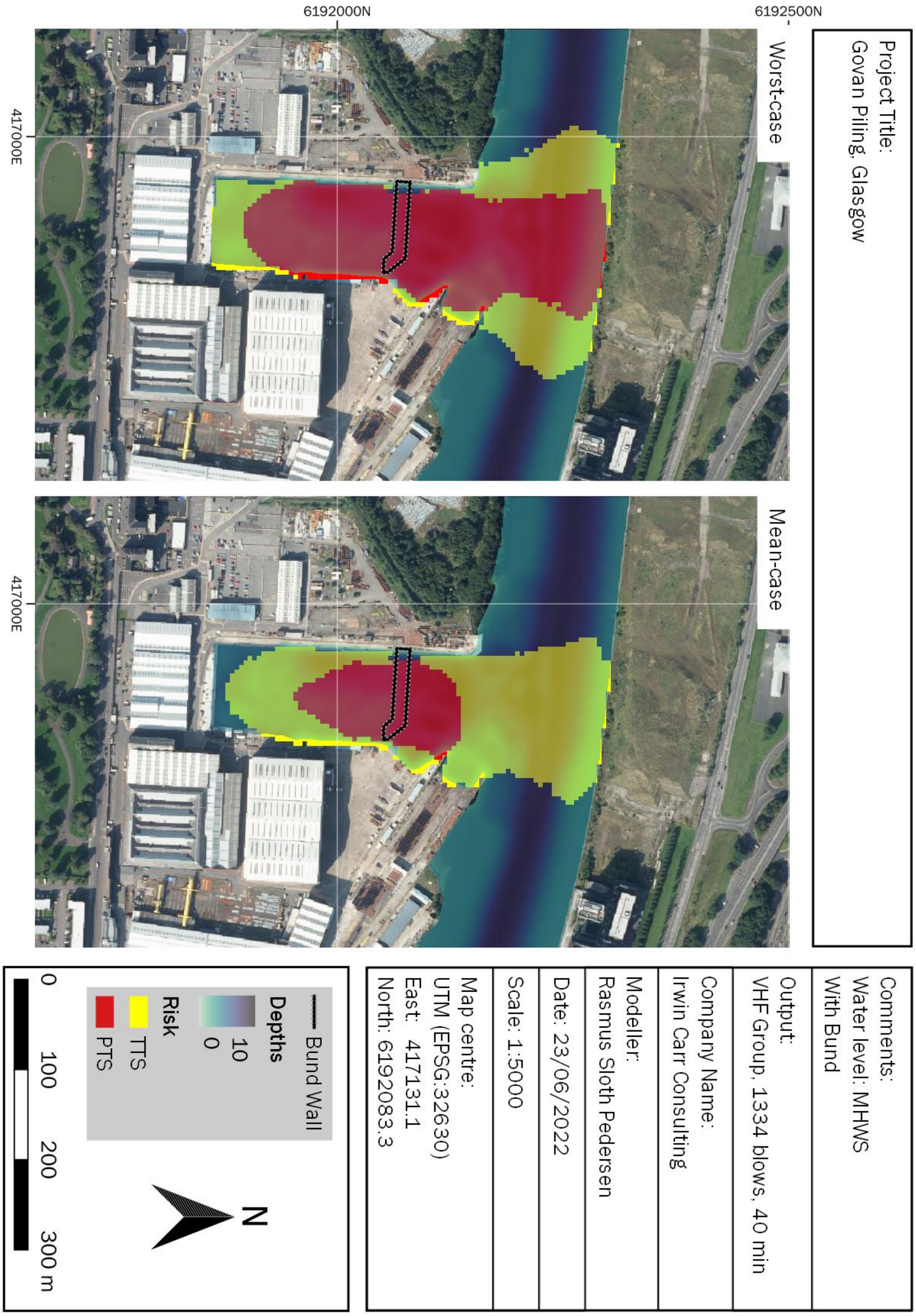
Modeller:
Rasmus Sloth Pedersen

Date: 23/06/2022

Scale: 1:5000

Map centre:
UTM (EPSG:32630)
East: 417131.1
North: 6192083.3

7.2.2.4 L$_E$ 1334 blows, 40 minutes



Project Title:
Govan Piling, Glasgow

Comments:
Water level: MHWS
With Bund

Output:
VHF Group, 1334 blows, 40 min

Company Name:
Irwin Carr Consulting

Modeller:
Rasmus Sloth Pedersen

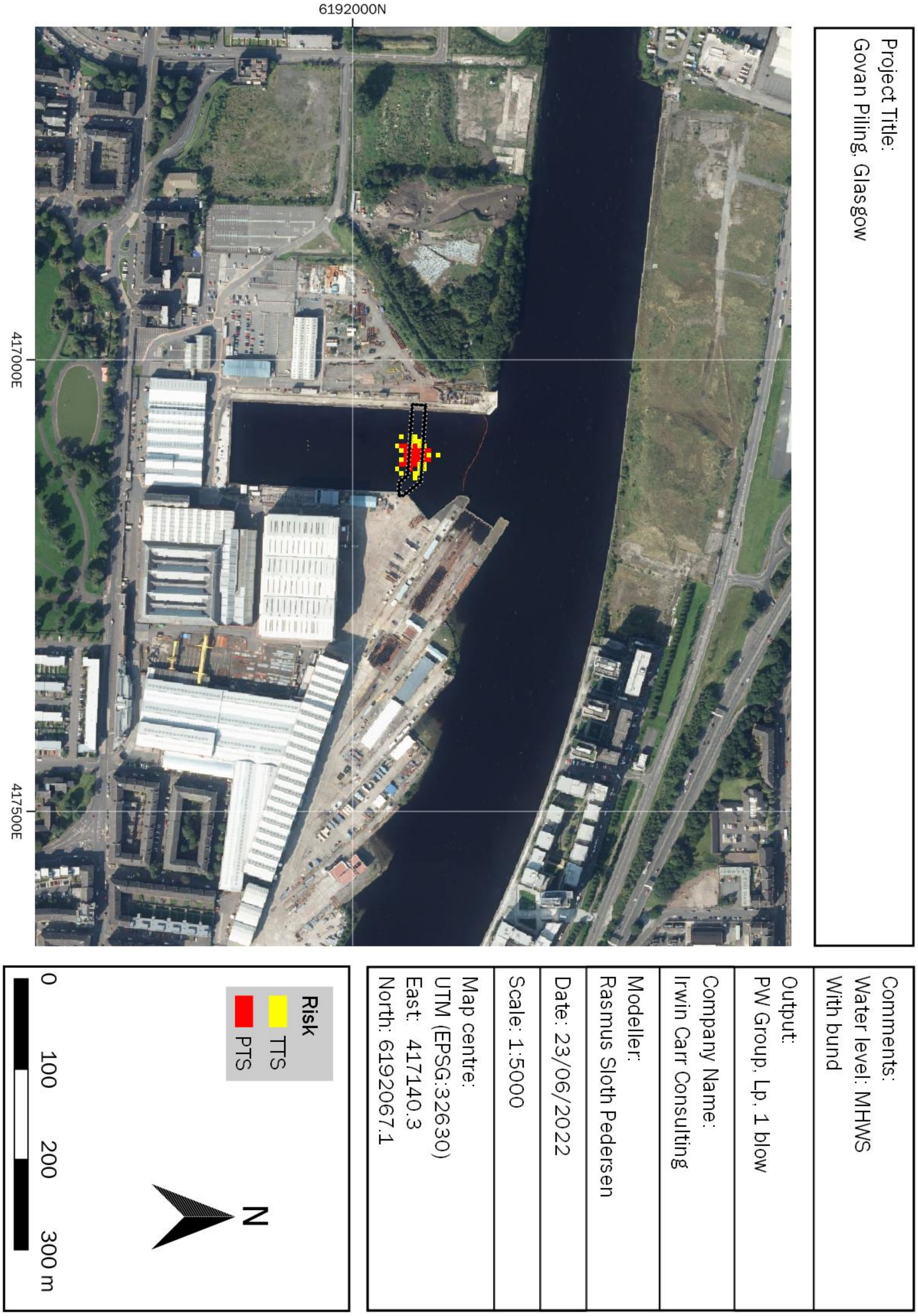
Date: 23/06/2022

Scale: 1:5000

Map centre:
UTM (EPSG:32630)
East: 417131.1
North: 6192083.3

7.2.3 WEIGHTED (PW) - SEALS

7.2.3.1 L_P



Project Title:
Govan Piling, Glasgow

Comments:
Water level: MHWS
With bund

Output:
PW Group, Lp, 1 blow

Company Name:
Irwin Carr Consulting

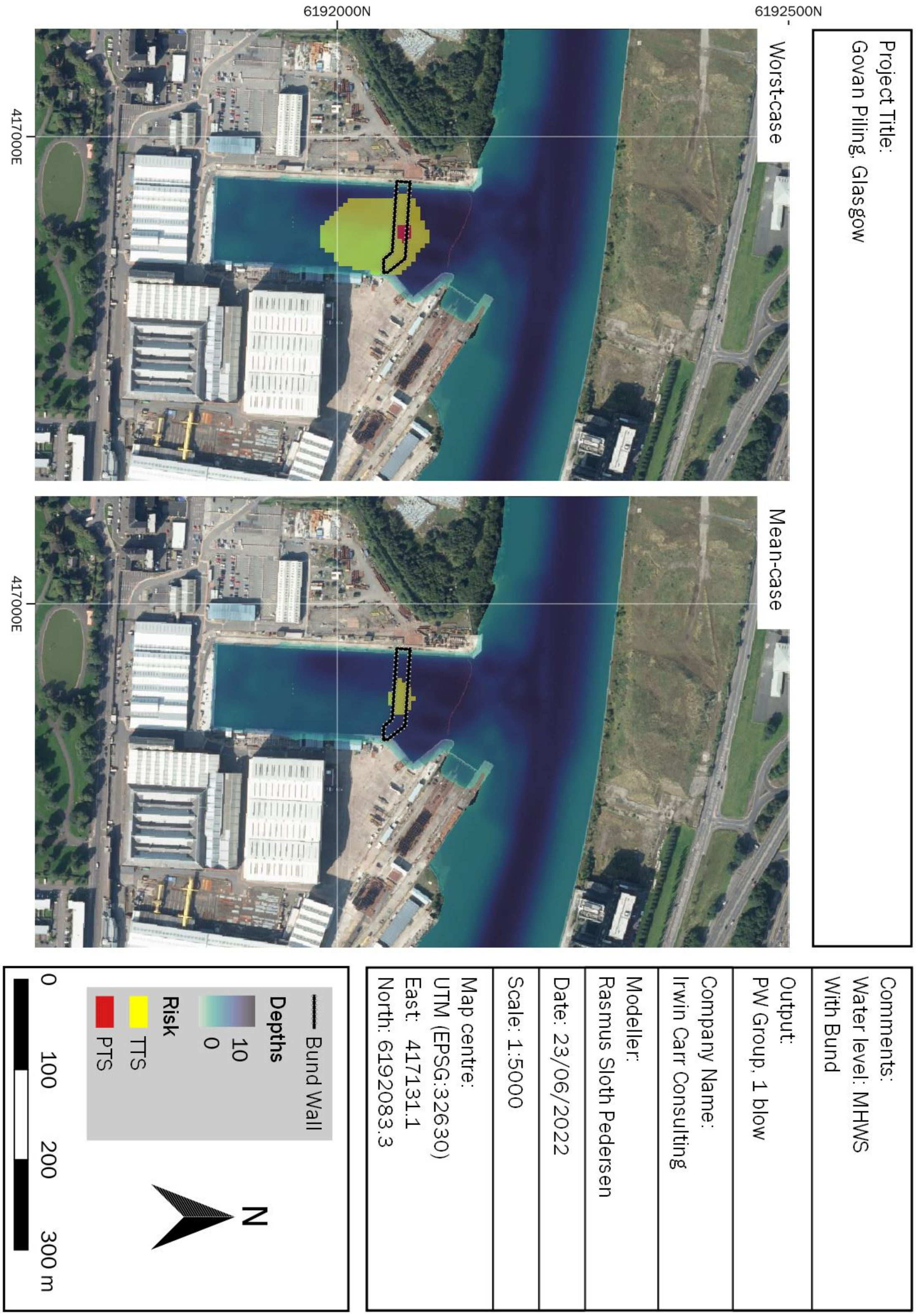
Modeller:
Rasmus Sloth Pedersen

Date: 23/06/2022

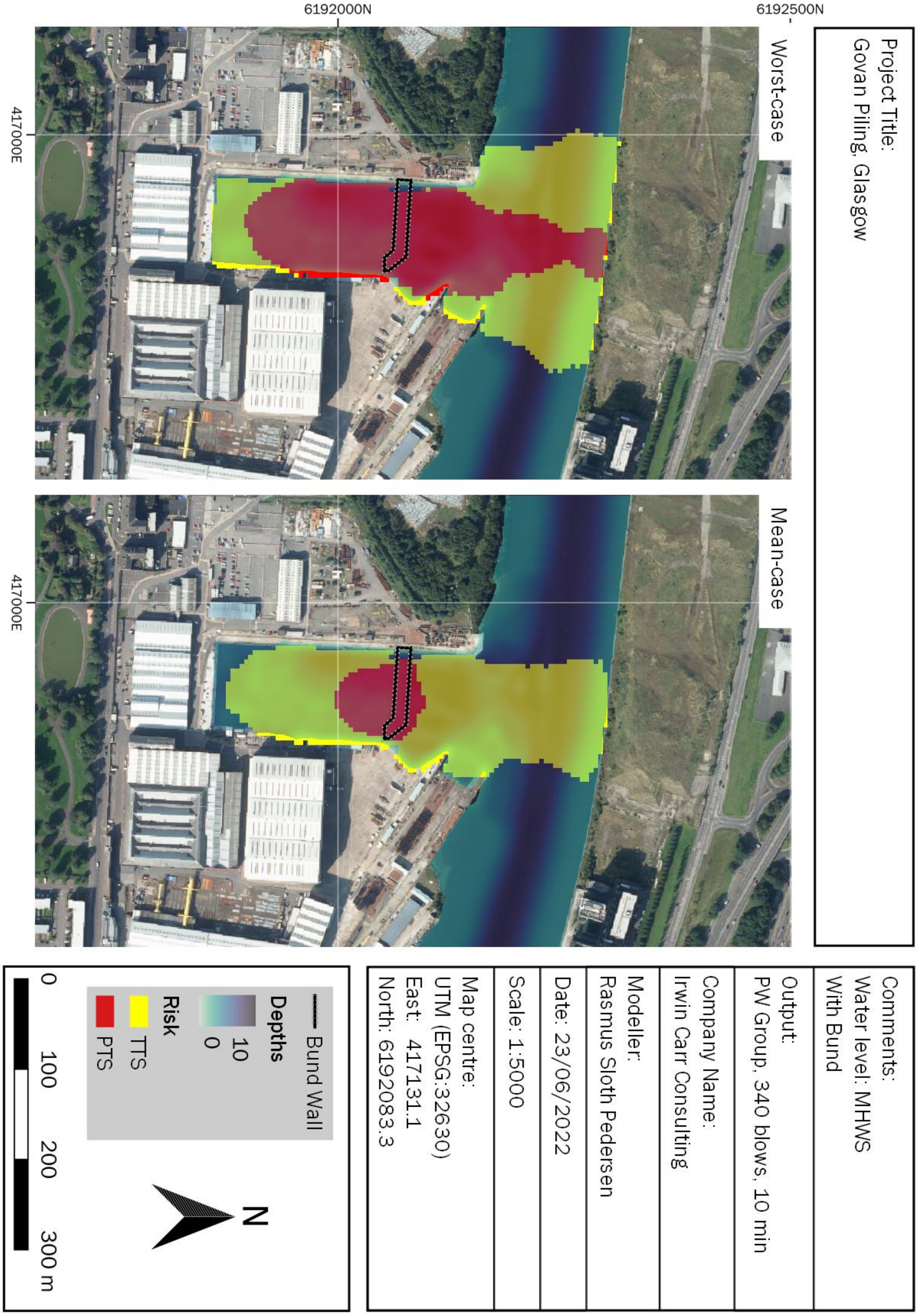
Scale: 1:5000

Map centre:
UTM (EPSG:32630)
East: 417140.3
North: 6192067.1

7.2.3.2 L_E Single blow



7.2.3.3 L_E 340 blows, 10 minutes



Project Title:
Govan Piling, Glasgow

Comments:
Water level: MHWS
With Bund

Output:
PW Group, 340 blows, 10 min

Company Name:
Irwin Carr Consulting

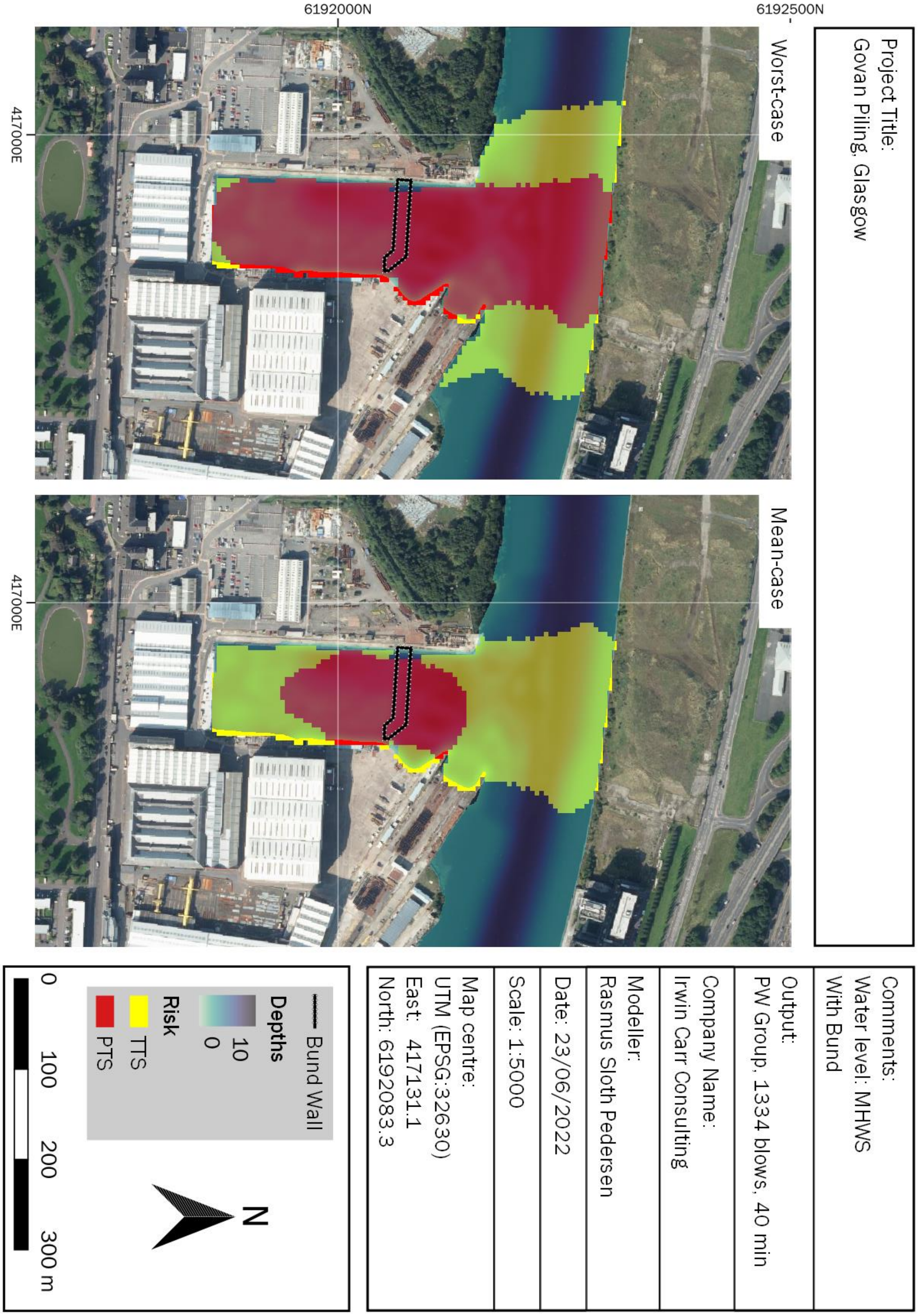
Modeller:
Rasmus Sloth Pedersen

Date: 23/06/2022

Scale: 1:5000

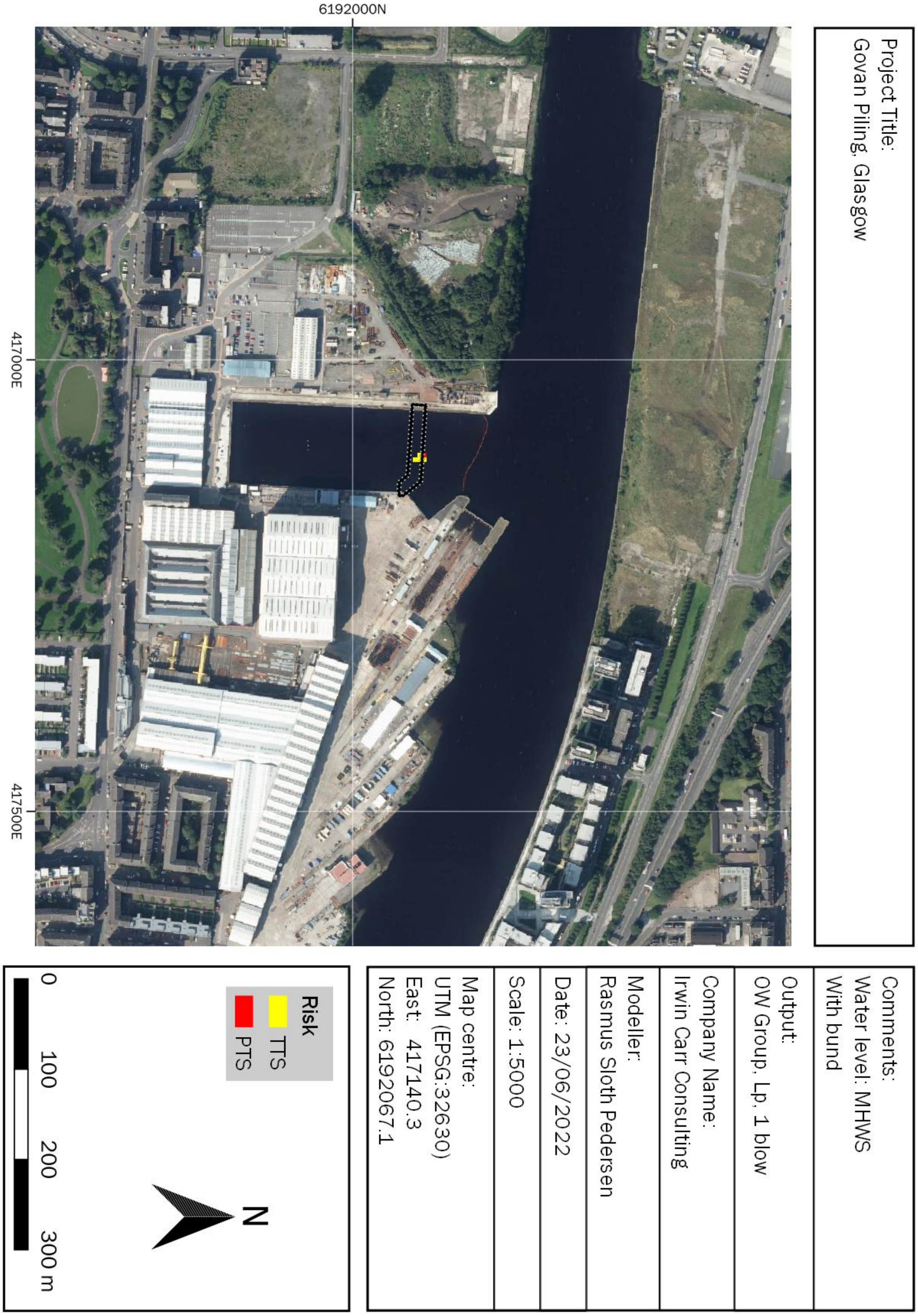
Map centre:
UTM (EPSG:32630)
East: 417131.1
North: 6192083.3

7.2.3.4 L_E 1334 blows, 40 minutes



7.2.4 WEIGHTED (OW) - OTTER

7.2.4.1 *L_P*



7.2.4.2 L_E Single blow

Project Title:
Govan Piling, Glasgow

Comments:
Water level: MHWS
With Bund

Output:
OW Group, 1 blow

Company Name:
Irwin Carr Consulting

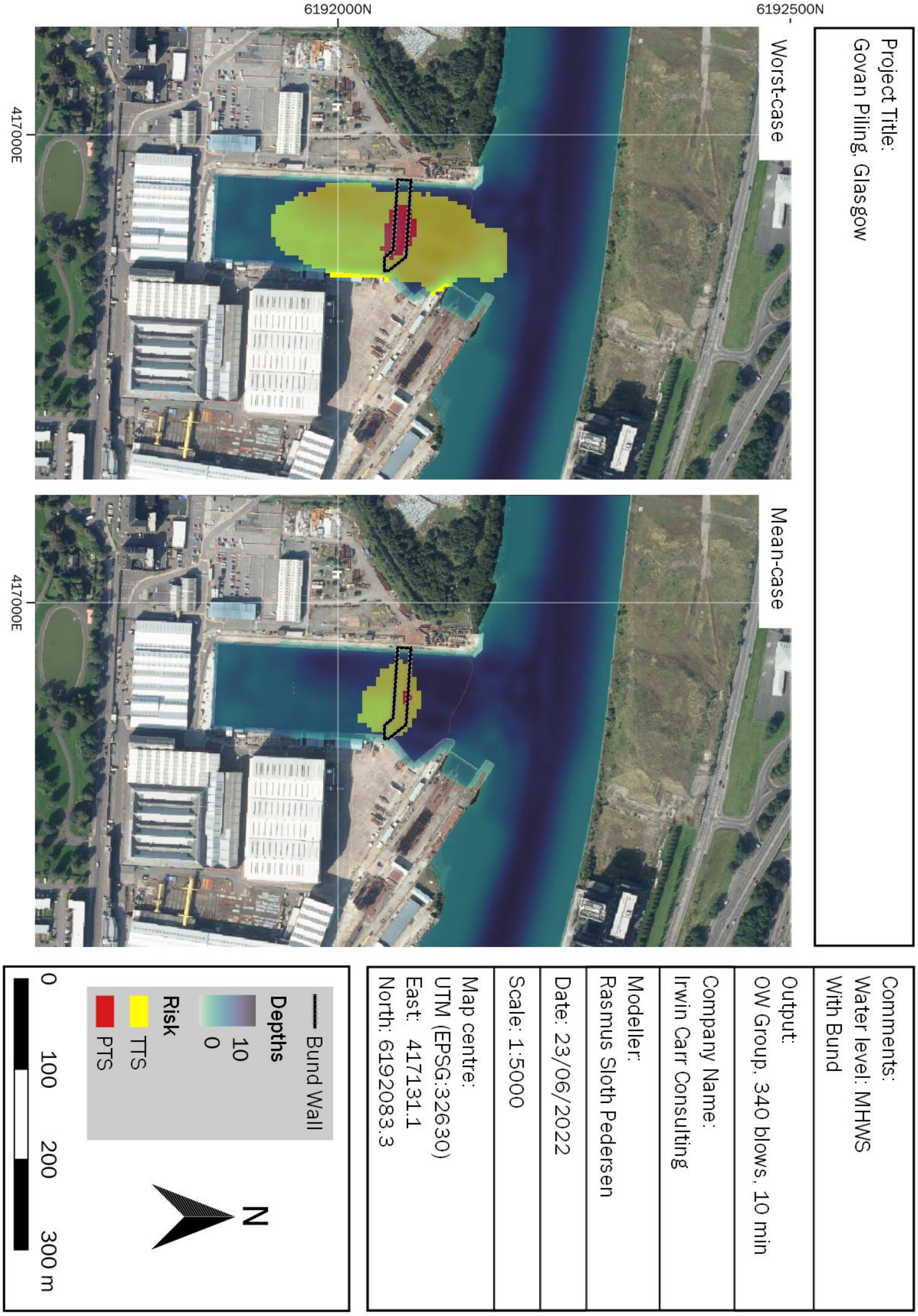
Modeller:
Rasmus Sloth Pedersen

Date: 23/06/2022

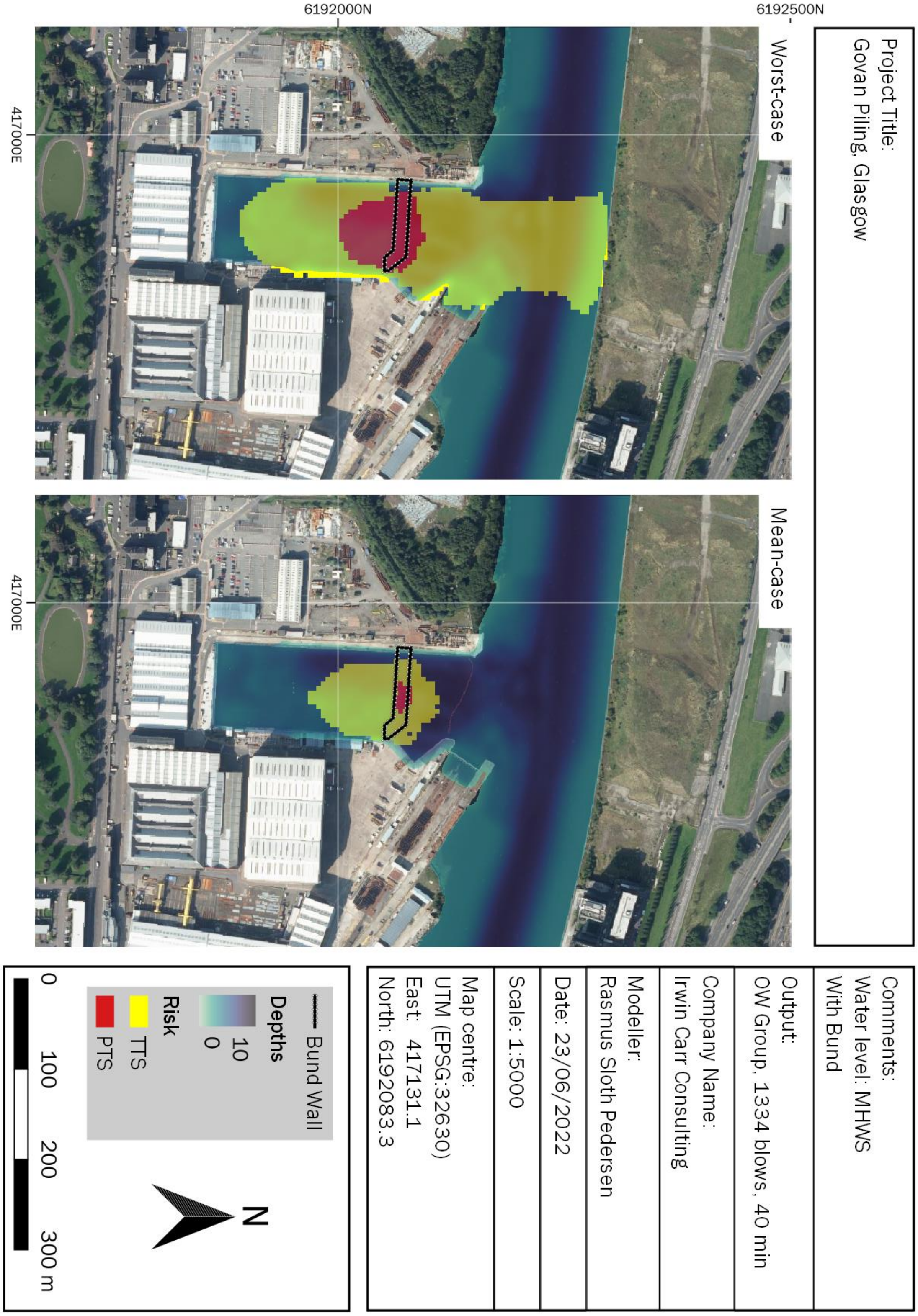
Scale: 1:5000

Map centre:
UTM (EPSG:32630)
East: 417131.1
North: 6192083.3

7.2.4.3 L_E 340 blows, 10 minutes

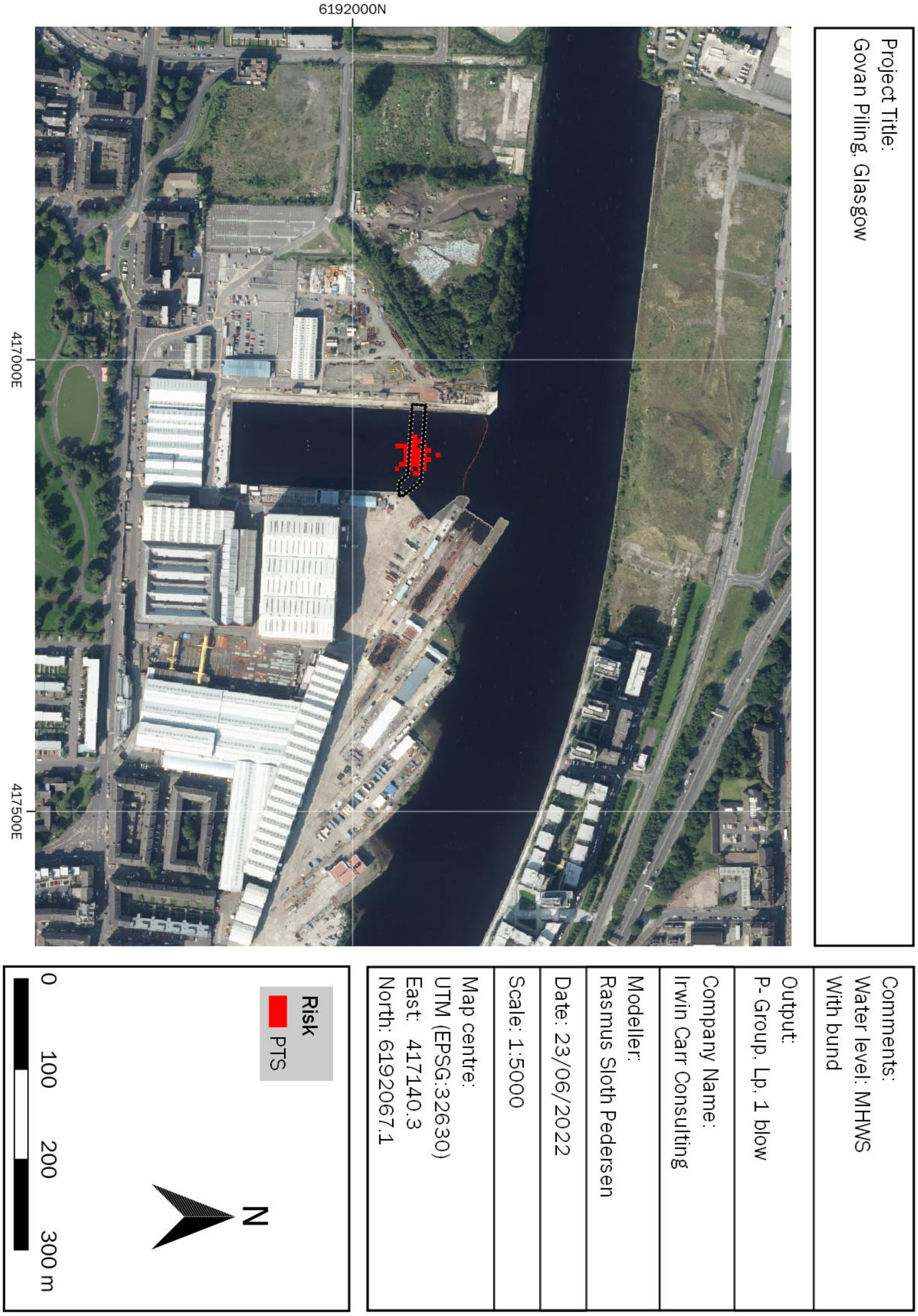


7.2.4.4 L_E 1334 blows, 40 minutes



7.2.5 UNWEIGHTED (P-) - SALMON

7.2.5.1 L_P



Project Title:
Govan Piling, Glasgow

Comments:
Water level: MHWS
With bund

Output:
P- Group, Lp, 1 blow

Company Name:
Irwin Carr Consulting

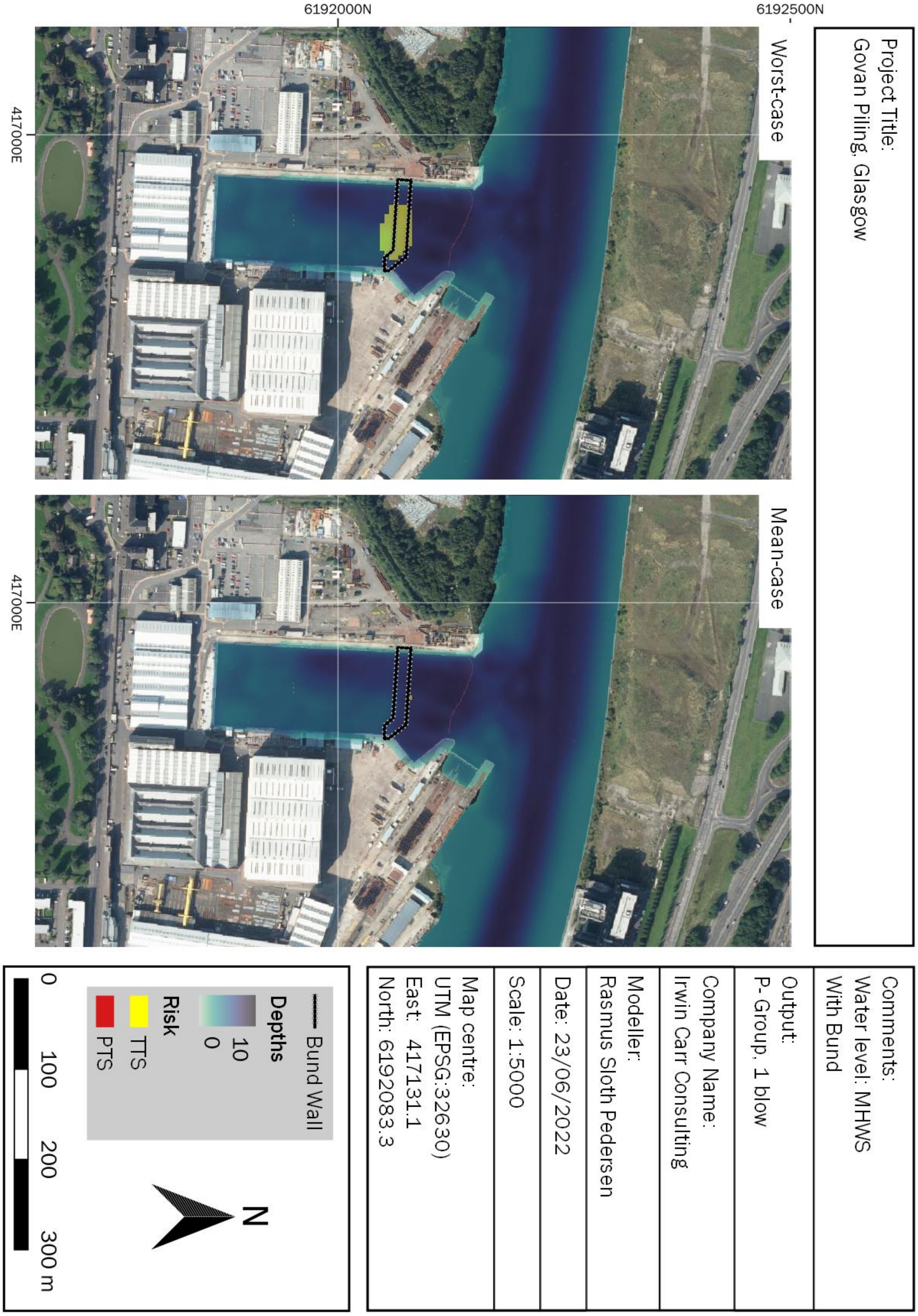
Modeller:
Rasmus Sloth Pedersen

Date: 23/06/2022

Scale: 1:5000

Map centre:
UTM (EPSG:32630)
East: 417140.3
North: 6192067.1

7.2.5.2 L_E Single blow



Project Title:
Govan Piling, Glasgow

Comments:
Water level: MHWS
With Bund

Output:
P-Group, 1 blow

Company Name:
Irwin Carr Consulting

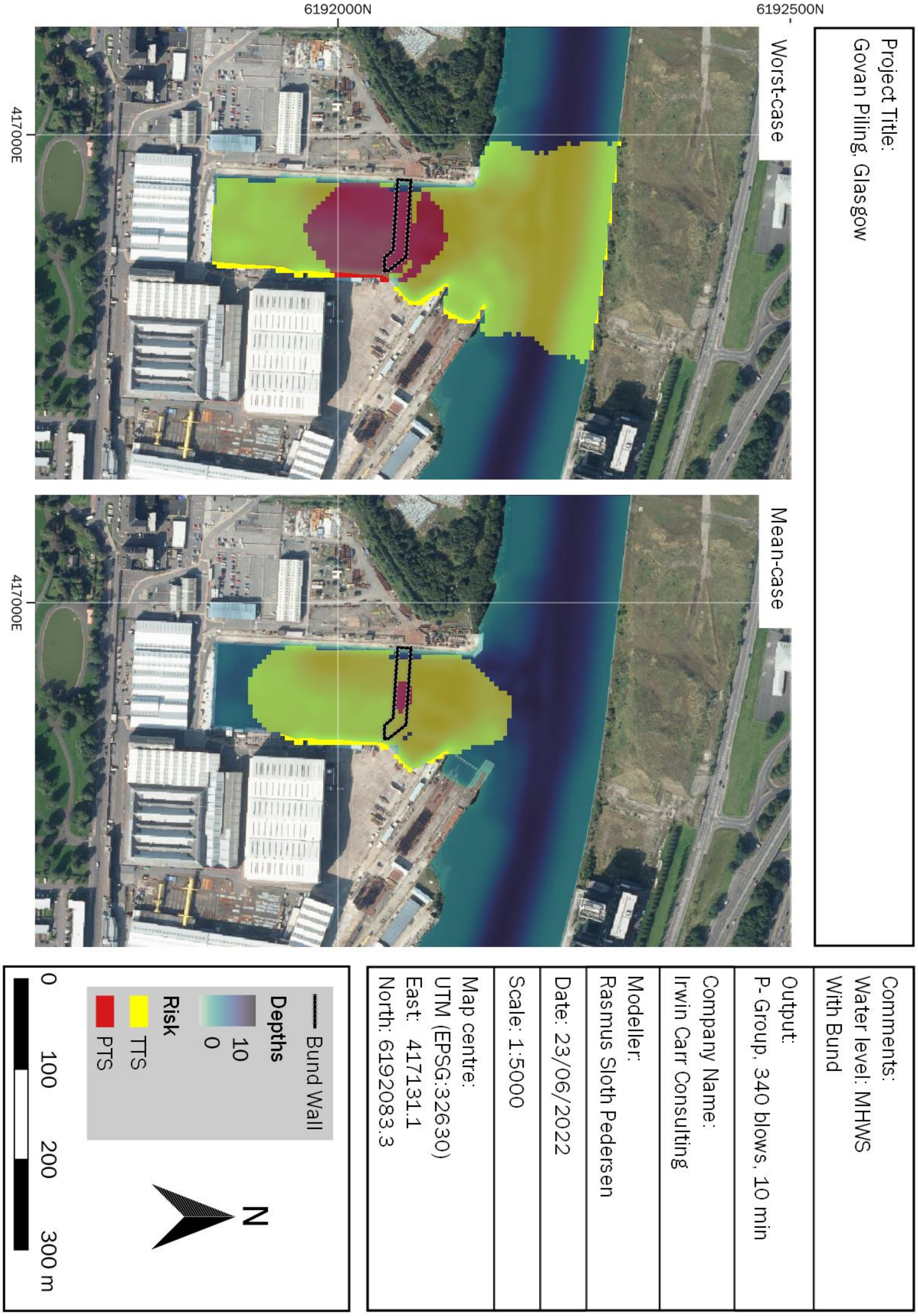
Modeller:
Rasmus Sloth Pedersen

Date: 23/06/2022

Scale: 1:5000

Map centre:
UTM (EPSG:32630)
East: 417131.1
North: 6192083.3

7.2.5.3 L_E 340 blows, 10 minutes



Project Title:
Govan Piling, Glasgow

Comments:
Water level: MHWS
With Bund

Output:
P-Group, 340 blows, 10 min

Company Name:
Irwin Carr Consulting

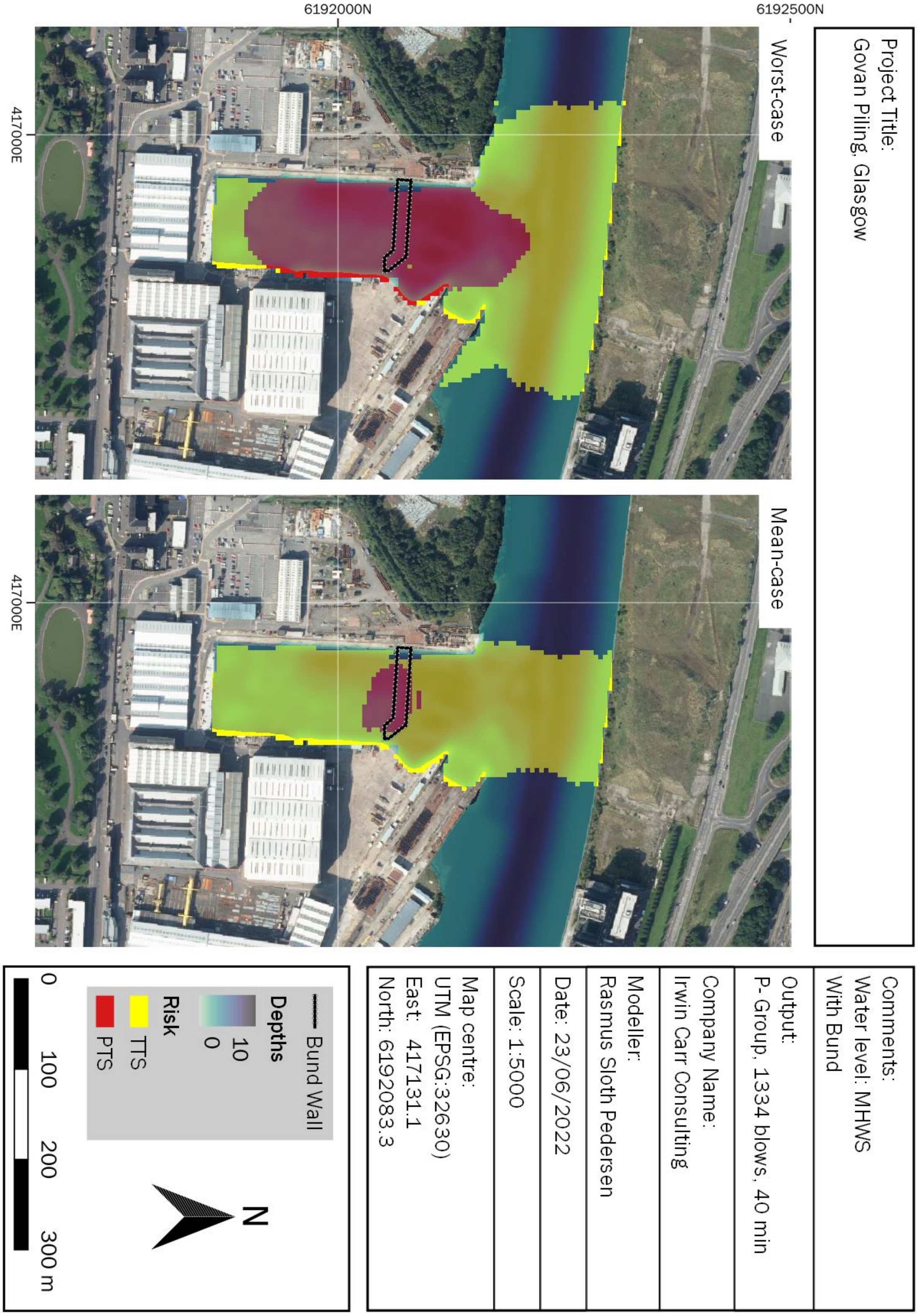
Modeller:
Rasmus Sloth Pedersen

Date: 23/06/2022

Scale: 1:5000

Map centre:
UTM (EPSG:32630)
East: 417131.1
North: 6192083.3

7.2.5.4 *L_E 1334 blows, 40 minutes*

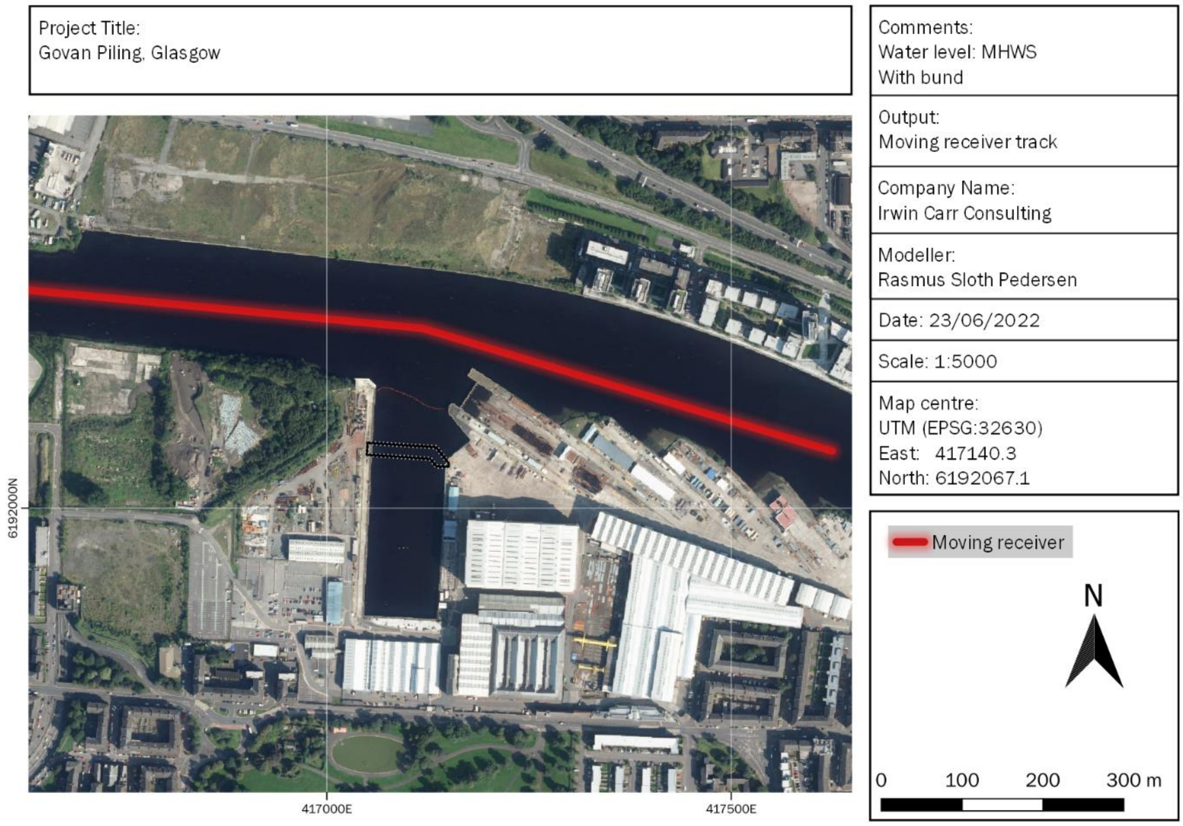


7.3 Moving Receivers

To better understand the results in the context of non-stationary receivers we include an example of a moving receiver passing the active site at a swimming speed of 0.5 m/s. We have used the max level at any depth on the track to avoid ambiguity over dive profiles. The chosen track follows the middle of the river, a track closer to the site would have higher received level, while one following the opposite shore will have lower received levels. Surface tracks tend to have lower received levels than deeper tracks.

This example uses the worst-case source level and water depth of MHWS. Using the mean-case would have lowered all received levels by ~12 dB.

Figure 10. Track of moving receiver passing active site.



Project Title:
Govan Piling, Glasgow

Comments:
Water level: MHWS
With bund

Output:
Moving receiver track

Company Name:
Irwin Carr Consulting

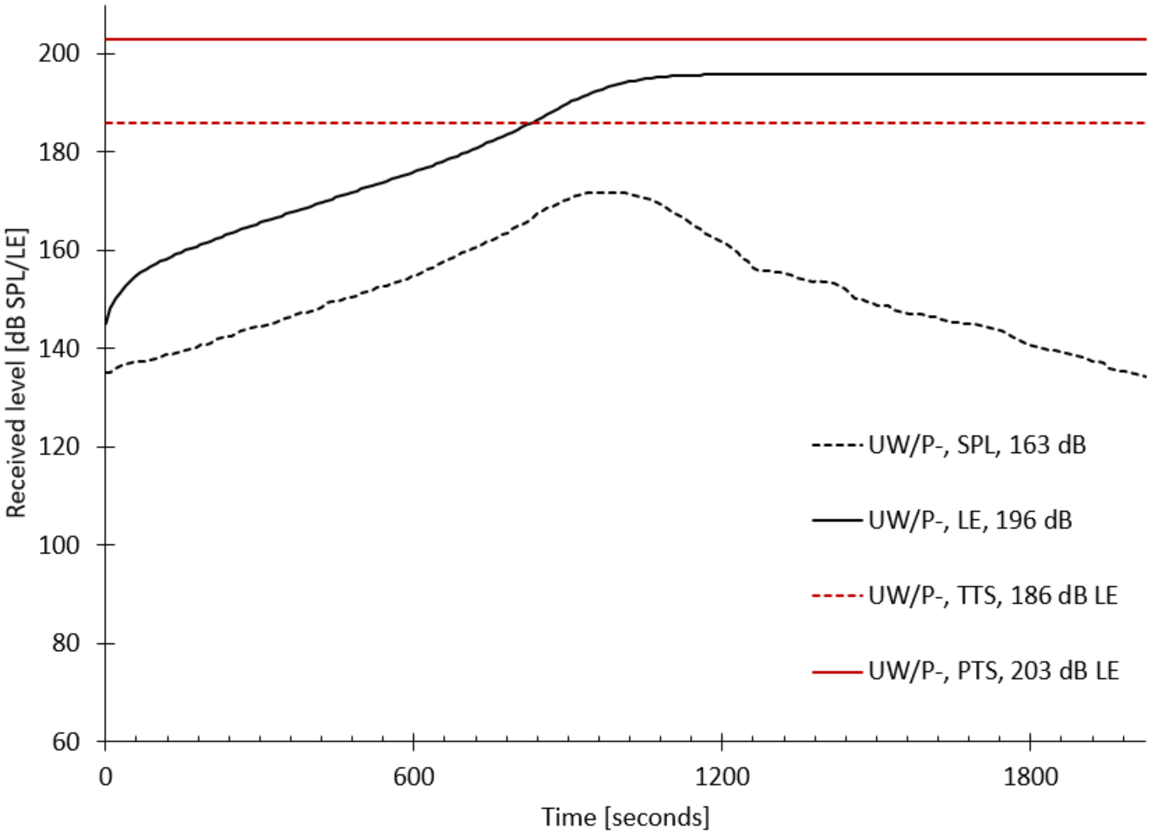
Modeller:
Rasmus Sloth Pedersen

Date: 23/06/2022

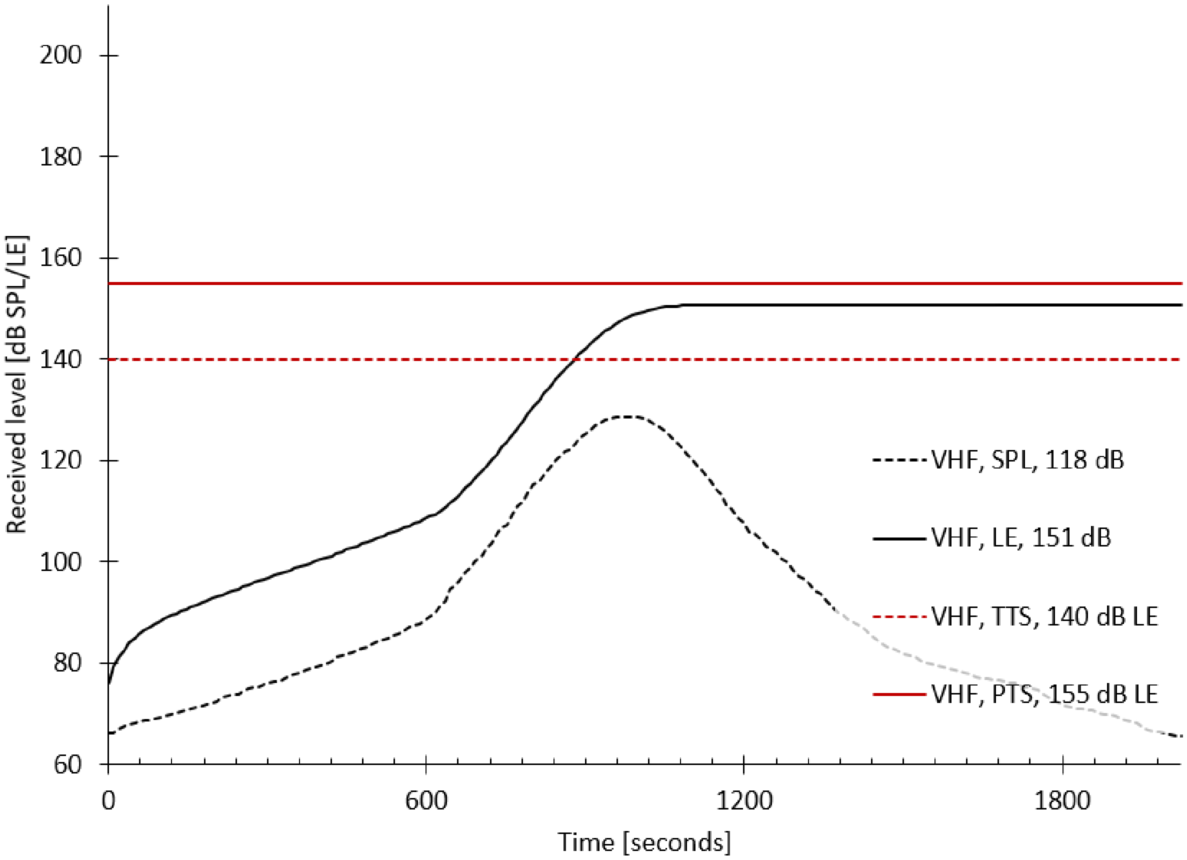
Scale: 1:5000

Map centre:
UTM (EPSG:32630)
East: 417140.3
North: 6192067.1

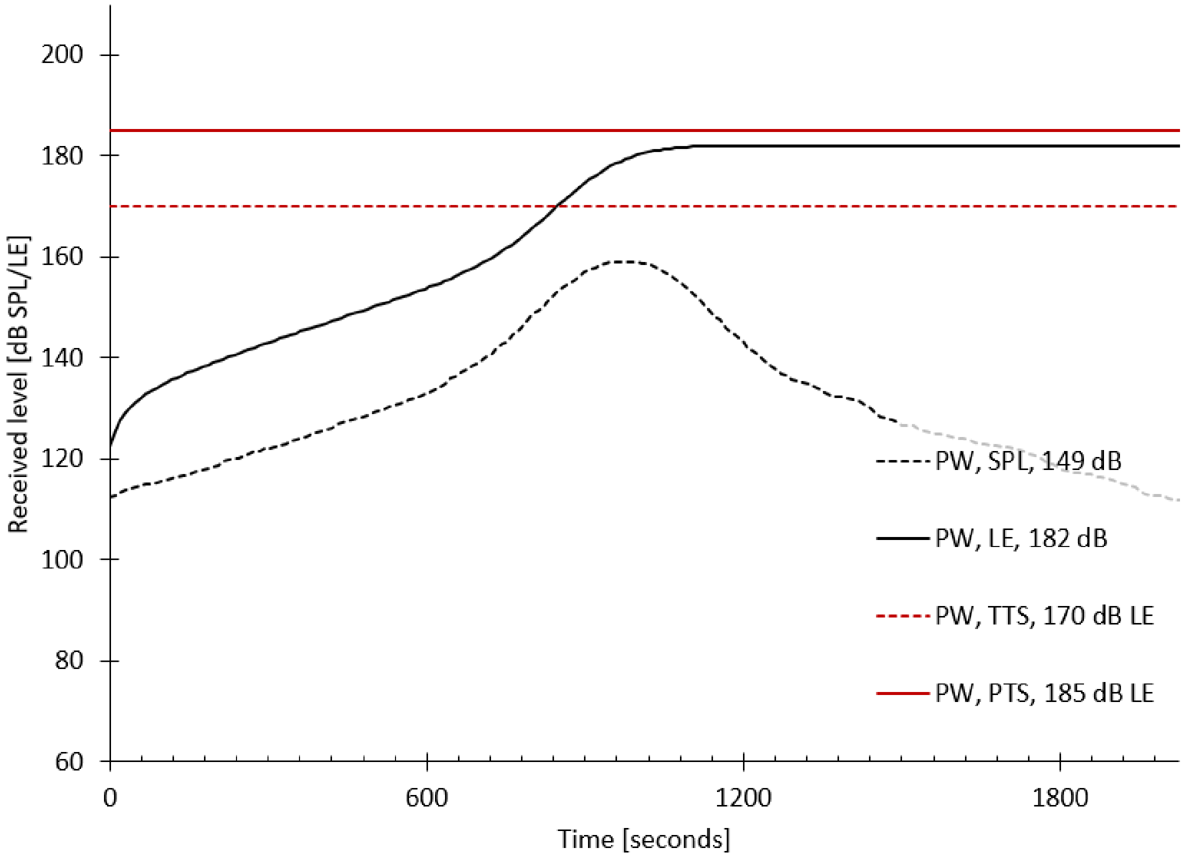
7.3.1 UNWEIGHTED (P-) – SALMON



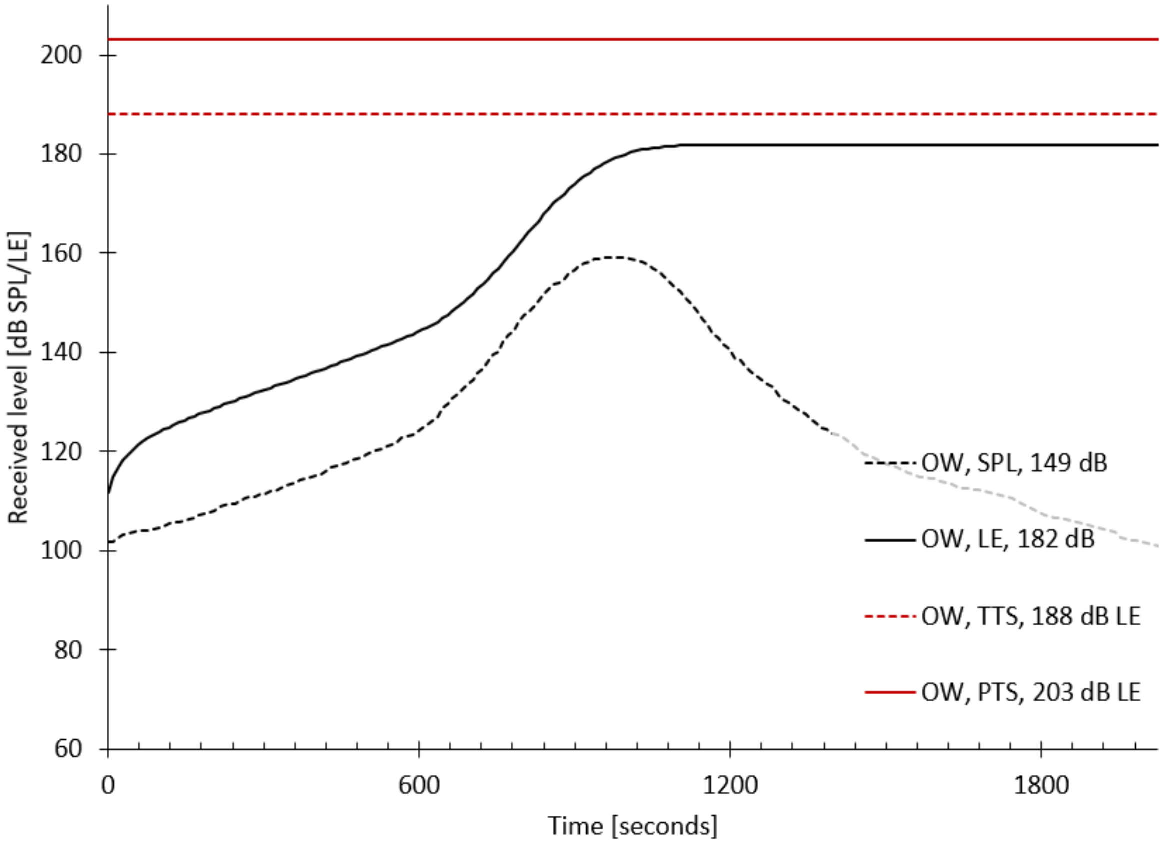
7.3.2 WEIGHTED (VHF) – HARBOUR PORPOISE



7.3.3 WEIGHTED (PW) – SEALS



7.3.4 WEIGHTED (OW) – OTTER



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APPENDIX A - DBSEA

A summary of dBSea's models in standard scenarios can be found in the document (online): http://www.dbsea.co.uk/media/30782/dBSea-Benchmark-Testing.pdf
(also see Figure 13, p. 49 for one example).

All solvers in dBSea are based on Jensen et al. 2011 (Jensen, Kuperman, Porter, & Schmidt, 2011)

dBSea has four primary models of calculation:

- **Range dependent Parabolic Equation model - dBSeaPE**
  dBSeaPE uses a split-step, wide angle parabolic equation method. It uses either Greene's approximation or several Padé terms (as set by user) to get very wide propagation with low phase error.

  dBSeaPE is best suited to deeper scenarios (>50 m) or where sediment interaction is not dominant relative to sound speed profile. The model is very efficient for low frequencies and only suffers a small efficiency penalty for higher frequencies.

  dBSeaPE will generally be used for deeper/long range scenarios in the frequency interval 10-1000 Hz.
- **Range dependent Normal Modes model - dBSeaModes**
  dBSeaModes is especially suited to shallower and sediment dependent scenarios and will typically be used where water is shallower than 50 m and depth changes are a large proportion of the total depth, or where sediment effects are thought to play a significant role. dBSeaModes incurs a significant efficiency-penalty at high frequencies and will normally be used in the frequency range 10-1000 Hz.
- **Ray tracing**
  dBSea uses a Gaussian raytracing method, dBSeaRay, to calculate transmission losses for higher frequencies (scenario dependent, but normally from 500 Hz). dBSeaRay compares favourably with the opensource BELLHOP model, in that it is accurate to lower frequencies and agrees well with PE and NM models.
- **Full waveform propagation**
  dBSeaRay also supports full waveform propagation in the frequency range 10 Hz to 168 kHz (limited by the waveform sample rate). Used in this way dBSeaRay takes into account all scenario range dependence (as models above) as well as the arrival time, phase information and transmission loss of all significant paths to any number of receivers in the scenario (the results grid).

General notes:

- dBSea is an "Nx2D" solver, meaning it models transmission losses in "N" number of vertical radial slices from the source (Figure 12, p. 48). There is no backwards propagation towards the source, and no sideways reflection/refraction (We're testing dBSea with full 3D solvers currently).

- dBSea models the sediment propagation only for compressional waves, not for shear waves. This generally means that the transmission loss will be slightly underestimated as no energy is transferred into shear waves, and also means that dBSeaRay does not propagate into the sediment, but relies on a complex reflection coefficient (calculated from the sediment layers) to calculate the reflection/refraction properties of the sediment. Given that dBSeaRay is generally only used for higher frequencies, this has very little practical effect, as higher frequencies will only interact weakly with deeper layers of the sediment.

- The individual sources in a scenario are modelled radially (radial coordinates) from the source at several depths. In post-processing levels are transferred to a cartesian "results grid". This results grid stores levels from all sources so that the cumulative level at any point in the scenario can be investigated immediately.

- Levels can be, and are often post-processed to apply a conservative margin and smooth results (Figure 11, p. 48). Radial smoothing (triangular kernel of variable width) is carried out to mitigate modelling artefacts arising from low environment sampling density or chance occurrences. Levels are often made to decrease monotonically from the source to make general trends more visible and decrease the risk of misinterpreting impact ranges.

- When refereeing to a level at a certain range, this usually refers to the greatest level at any depth at that range (unless specifically mentioned otherwise).

Figure 11. Post-processing to eliminate artefacts and ease interpretation. Level are radially smoothed by default, and are made to be monotonically decreasing with increasing range from the source.

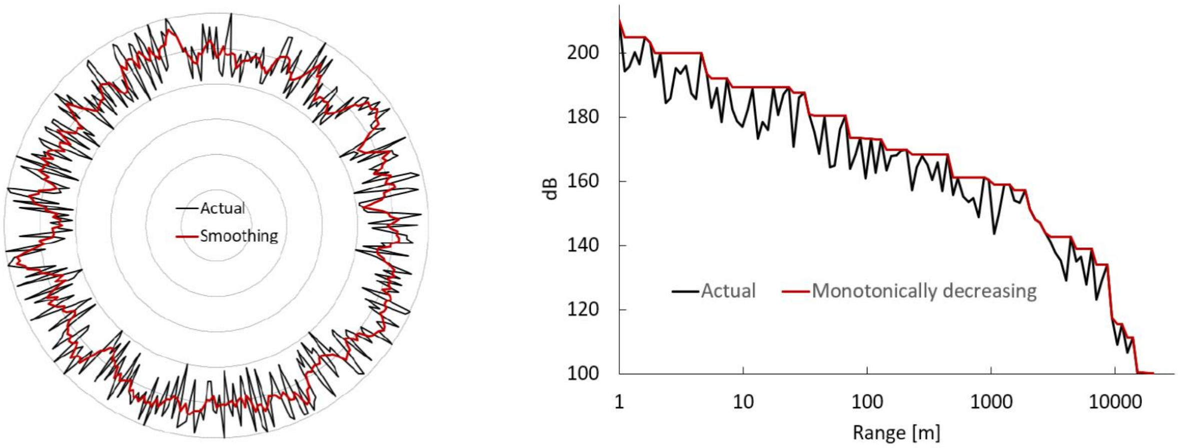


Figure 12. Low resolution schematic of the dBSea modelling space. Source transmission loss is modelled radially from the sources at a number of depths. Results are extracted from a "square" 3D grid that hold cumulative levels from all sources in the scenario.

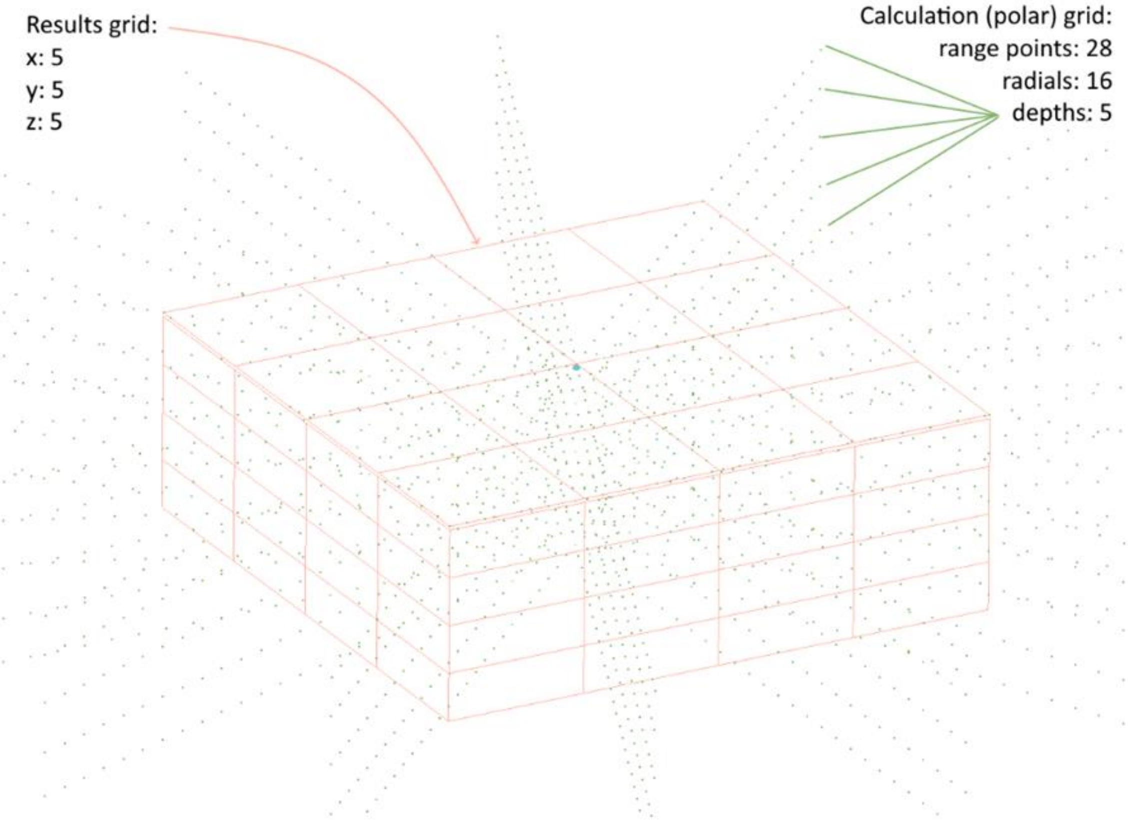
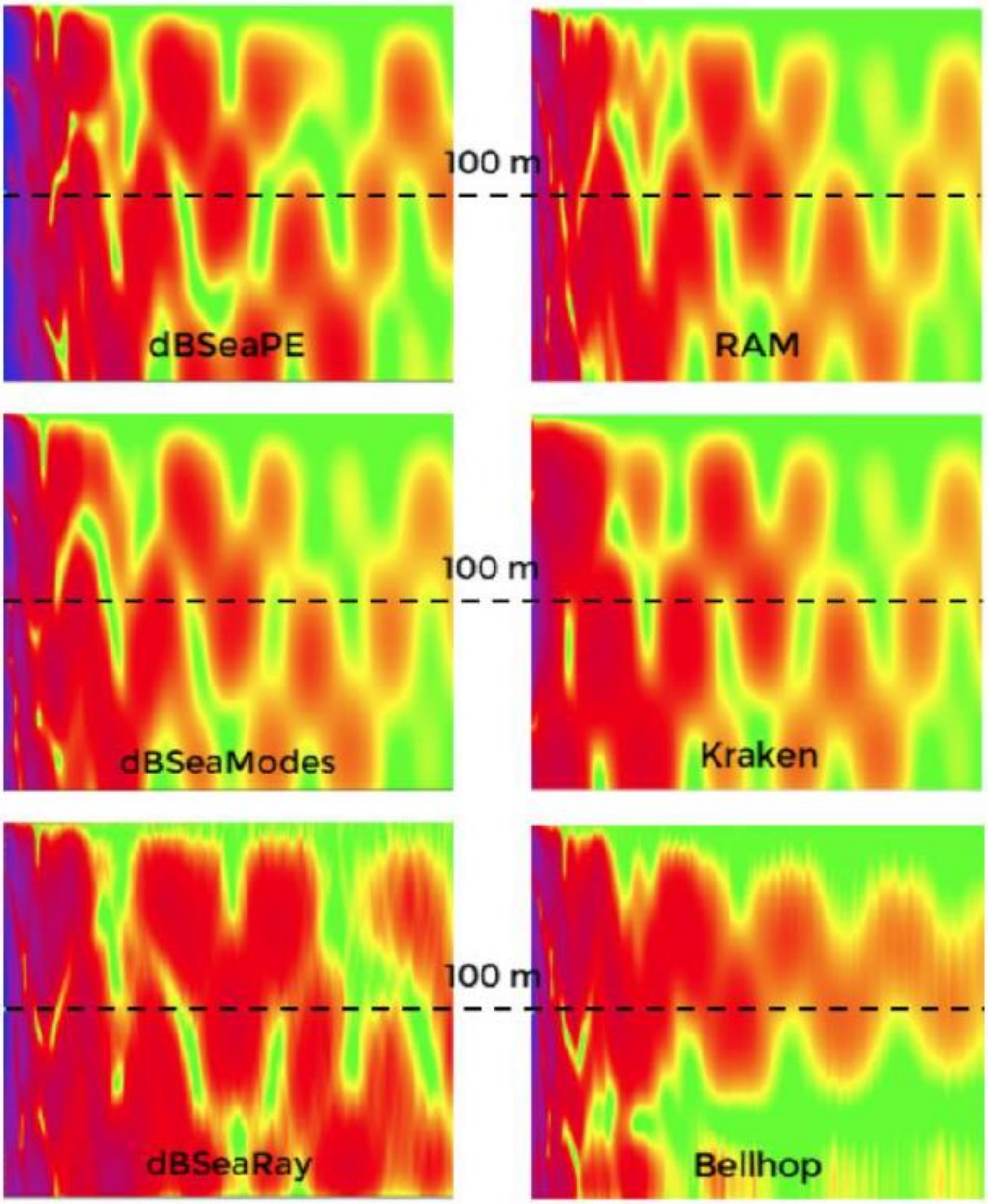


Figure 13. the “Pekeris” standard problem, a low frequency problem. Note that due to sediment effects, neither dBSeaRay nor Bellhop should be relied upon for low frequency problems, and are only include for completeness.



APPENDIX B – UNDERWATER ACOUSTICS BASICS

Sound Speed

Water is much harder to compress than air, and a soundspeed of 1500 m/s is often used as a standard soundspeed in water[13] much as 340 m/s is in air. Soundspeed is given by the following equation:

$$c = \frac{Z}{\rho}$$

$$Soundspeed\ [m/s] = \frac{Acoustic\ impedance\ \left[\frac{kg}{m^2 \cdot s}\right]}{Specific\ density\ [kg/m^3]}$$

Because changes to pressure, salinity and temperature occur with changes in depth, the specific density and acoustic impedance of water changes with depth, and thus the soundspeed changes as well.

The soundspeed profile is quite important in sound propagation, as refraction (changes in propagation angle) will occur when sound moves between layers of water with varying sound speed. This change is quantified in “Snell’s Law” and results in sound being “bent” towards the depth of minimal soundspeed. These effects can lead to profoundly inhomogeneous sound fields and SOFAR channels.

The same relationships are valid in the sediment, though sediments commonly have soundspeeds higher than water. Soundspeeds from 1700 m/s (fine sand/silt) to 2500 m/s (gravel) are common for non-solid sediments, with solid sediments (rocks) having much higher soundspeeds 2800 m/s (Calcarenite) to 6000 m/s (some granite).

Spreading loss

Most of the propagation loss (loss in dB from source to receiver, “PL”) that occurs initially is governed by “spreading loss”. It is the simple “thinning out” of acoustic energy as it spreads away from the source, usually in all directions – spherically.

For a sound source in an unbound medium the initial PL will be dominated by spherical PL:

$$Received\ level = Source\ level_{at\ reference\ range} - 20 \cdot \log_{10}\left(\frac{range}{reference\ range}\right)$$

This means a reduction in received level of 6 dB per doubling of distance and explains the rapid reduction in received levels often seen close to the source, e.g.: with a reference range of 1 m, at 16 meters range, there has been 4 doublings of distance, and thus 24 dB loss (4×6 dB).

At longer ranges the medium is no longer unbounded. We reach ranges where the sound has interacted with the surface (near perfect acoustic reflector) or the seabed (lossy acoustic reflector). Also, at greater ranges a doubling of distance is no longer trivial as the PL from spherical spreading loss from 500 m to 1000 m is also just 6 dB.

Sound Channels and Wave guides

In bounded mediums where the sound energy is confined to cylindrical spreading, the PL (ignoring absorption) is often well-characterised by:

$$Received\ level = Source\ level_{at\ reference\ range} - 10 \cdot \log_{10}\left(\frac{range}{reference\ range}\right)$$

This means a reduction of received level of 3 dB per doubling of distance. Depending on the sediment this kind of “waveguide” can sustain efficient transmission of sound over long ranges, provided the sediment is acoustically hard and there is low absorption (such as is the case for low frequencies or in low salinity).

In absence of a bounding from the surface or the seabed, a soundspeed profile with a clear low-speed region, surrounded by higher soundspeeds can act a sound channel, by focusing the sound towards a single depth (with lower soundspeed), limiting the PL from spherical to cylindrical (a SOFAR channel is formed).

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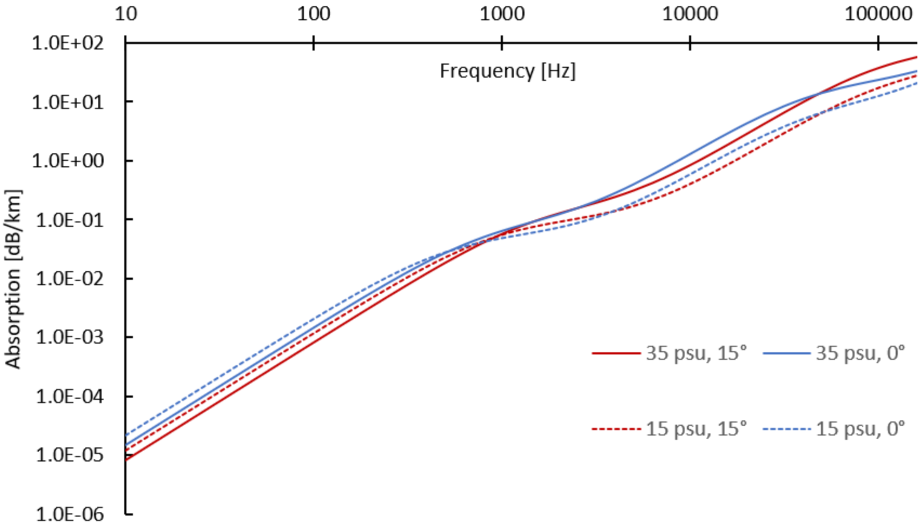
[13] Varies from 1450 m/s at 0° to 1550 m/s at 30° at salinity of 35 psu.

Absorption

Besides the “thinning out” of the sound energy as described above, the sound is also dissipated into heat by the way the pressure changes interact with water, molecules and particles in its path. This absorption is mostly governed by the concentration of boric acid and magnesium sulphate and is very dependent on the frequency, with lower frequencies, <1 kHz, experiencing almost no absorption, while high frequencies, > 10 kHz, can be attenuated by over 10 dB / km.

Figure 14. Absorption comparison at salinities of 35 psu & 15 psu and temperatures of 0° and 15°. Both scales are logarithmic. Note how increased salinity increases high-frequency absorption (solid v dashed lines), while a decrease in temperature increases absorption at lower frequencies (red v blue lines).



Small bubbles, wind or wave induced, will further attenuate especially the high frequencies, but as modelling is often done to estimate a worst-reasonable case, or for weather sensitive activities, fair weather with little wind and waves are assumed, thus ignoring this attenuation effect.

Sediment

Depending on the incident angle of the sound, the frequency and the acoustic properties of the sediment, sound can either mostly penetrate the sediment or mostly be reflected by it.

In shallow areas with soft sediment (acoustically similar to water), it is typical to find that close to the source, at high incidence angles and at low frequencies (<250 Hz) the sound will penetrate into the sediment and dissipate there, leading to very high transmission losses for these frequencies. This effect coupled with the high absorption at high frequencies often leads to the soundscape being dominated by frequencies from a few hundred hertz to a few thousand hertz. In deeper water, or with an upward refracting soundspeed profile, low frequencies will tend to dominate the soundscape away from sound sources, as there is no efficient mechanism for attenuating them.

A “cut-off[14]” frequency, below which, there will be high sediment-associated attenuation can be approximated by:

$$f_{cut-off} = \frac{c_{water}}{4 \cdot D \cdot \sqrt{1 - \left(\frac{c_{water}}{c_{sediment}}\right)^2}}$$

With “C_{water}” and “$C_{sediment}$” being the soundspeed in the water and the sediment respectively, and “D” the local depth (Jensen, Kuperman, Porter, & Schmidt, 2011).

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[14] The cut-off is not an immediate loss of energy in frequencies under this frequency, but rather something like a high pass, 1st-order, Butterworth filter (Audoly, 2020).

In water with lower salinity and less absorption, the soundscape will tend to have a relatively higher content of high frequencies as these are absorbed much less efficiently when the salinity is lower.

Sound transmission Across Interfaces

Sound waves are reflected and refracted (Snell's law) as they travel through interfaces. Also, depending on acoustic impedance and interface angles only a proportion of the incident acoustic energy is transmitted through that interface (the rest is reflected).

In the following: W: Watt; Pa: Pascal; s: second; m: metre; N: Newton; J: Joule; θ: angle; v: soundspeed; Z: acoustic impedance; p: pressure from ambient;

Snell's law:

$$\frac{\sin\theta_{in}}{\sin\theta_{out}} = \frac{v_{in}}{v_{out}}$$

- rearranged to give transmission angle from incidence angle and soundspeeds:

$$\sin^{-1}\left(\frac{\sin\theta_{in}}{\frac{v_{in}}{v_{out}}}\right) = \theta_{out}$$

Transmission fraction of sound pressure for plane waves (part of the Fresnel equations):

$$\frac{p_{out}}{p_{in}} = \frac{2 \cdot Z_{out} \cdot \cos\theta_{in}}{Z_{out} \cdot \cos\theta_{in} + Z_{in} \cdot \cos\theta_{out}}$$

Reflection fraction of sound pressure for plane waves (part of the Fresnel equations):

$$\frac{p_{out}}{p_{in}} = \frac{Z_{out} \cdot \cos\theta_{in} - Z_{in} \cdot \cos\theta_{out}}{Z_{out} \cdot \cos\theta_{in} + Z_{in} \cdot \cos\theta_{out}}$$

It follows from these relations that for transmission from an acoustically relatively slow medium like water to an acoustically faster medium here exists an incident angle above which there is total reflection, and thus no transmission of acoustic energy through the interface (real interfaces are rugged and lumpy, and perfect reflection is not realistic).

For the water/sediment interface presented here (sediment is sand with a soundspeed of 2000 m/s) this occurs at 0.84 radians (~48.5 degrees) from normal incidence.

The fraction of pressure transmission from water (soundspeed 1500 m/s) to sediment (2000 m/s) is around 146 % at normal incidence and drops as the incidence angle increases away from normal, much faster for water-to-sediment than for sediment-to-water.

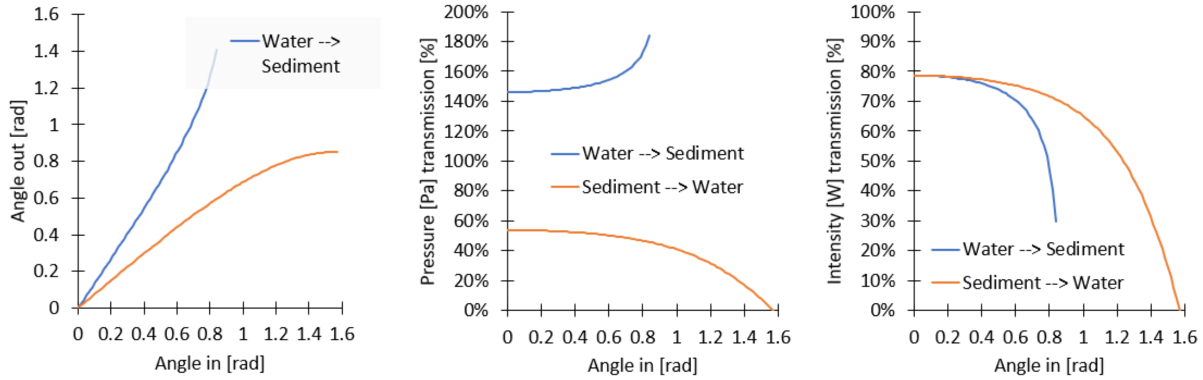
While it may seem counter-intuitive that pressure can increase after transmission over an interface, remember that the energy in the sound is a function of pressure *and* acoustic impedance:

$$I = \frac{p^2}{Z}$$

$$With\,units\colon [W] = \frac{[Pa]^2}{\left[\frac{Pa \cdot s}{m^3}\right]} = \frac{\frac{N^2}{m^4}}{\frac{\frac{N}{m^2} \cdot s}{m^3}} = \frac{N^2 \cdot m^3}{m^4 \cdot \frac{N}{m^2} \cdot s} = \frac{N}{m \cdot m^{-2} \cdot s} = \frac{J \cdot m}{m^{-1} \cdot s} = \frac{J}{s} = W$$

Thus, if the transmitted intensity fraction is 80 % then the reflected intensity is 20 %; there is energy conservation.

Figure 15. Transmission angles [radians] and fractions as function of incident angle between water and sediment (sand). Note that total reflection from water to sediment occurs around incident angle of 0.84 [rad] (48.5 degrees), meaning there is no transmission of sound at greater incidence angles.



Sound Level Units

All references to sound pressure levels, peak pressure levels and sound exposure levels refer to a logarithmic ratio between a reported/measured pressure or exposure and a reference pressure or exposure. As an example, a level of 220 L_p (decibel zero-to-peak) is equal to a peak pressure of 100000 Pascals (Pa) over ambient pressure, while 120 L_p is equal to 1 Pa over ambient pressure.

To avoid dealing with these large numbers as pascals (as a linear scale), they are converted to a decibel ratio (Table 1 for definitions). Besides compressing large numbers to a smaller scale this also corresponds better to how animals are thought to perceive sound, namely as relative steps. This means that an increase from 1 to 2 Pa *sounds like* the same increase as from 100 to 200 Pa, even though the first step was only 1 Pa, while the second was 100 Pa. This is better reflected in a logarithmic scale based on ratios, where both steps are equal, here 3 dB.

However, while dBs are practical, they can be hard to compare between studies, due to vague definitions, and so we have adopted the standards set by ISO 18405-2017 (Table 1 below).

For ease of reference please see following overview for unit definition.

Table 8: Definitions.

Unit	Definition	Comments
SPL (dB$_{RMS}$) ISO 18405- 2017: 3.2.1.1	$SPL = 10 \cdot Log_{10}\left(\frac{\frac{1}{t_2 - t_1} \cdot \int_{t_1}^{t_2} p(t)^2 dt}{1 \cdot 10^{-12} Pa}\right)$	Functionally equivalent to deprecated $20 \cdot Log_{10}\left(\frac{RMS}{1 \cdot 10^{-6} Pa}\right)$
L$_p$ (dB$_{z\text{-}p}$) ISO 18405- 2017: 3.2.2.1	$L_p = 20 \cdot Log_{10}\left(\frac{Pa_{max}}{1 \cdot 10^{-6} Pa}\right)$	This assumes that Pa_{max} is equal or greater than $\sqrt{{Pa_{min}}^2}$
L$_{p\text{-}p}$ (dB$_{p\text{-}p}$)	$L_{p-p} = 20 \cdot Log_{10}\left(\frac{Pa_{max} - Pa_{min}}{1 \cdot 10^{-6} Pa}\right)$	Often[15] equivalent to $L_P + 6.02\ dB$
L$_E$ (dB$_{SEL}$) ISO 18405- 2017: 3.2.1.5	$L_E = 10 \cdot Log_{10}\left(\frac{\int_{t_1}^{t_2} p(t)^2 dt}{1 \cdot 10^{-12} Pa}\right)$	For continuous sound this is equivalent to $SPL + 10 \cdot Log_{10}(t_2 - t_1)$ "t" is seconds

Unless otherwise stated SPL has an averaging period of 1 second, and L$_E$ for the duration of the specified event, sometimes indicated as L$_{E\text{-“time”}}$ or L$_{E\text{-single blow}}$.

If the averaging period for SPL is equal to the total even duration then SPL is equal to “Leq” the “equivalent constant level”.

When source levels are presented, the same units are used, and it is implicit that all source levels are given as if recorded 1 m from an omnidirectional mono-point source, unless otherwise specified.

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[15] If maximum pulse rarefaction is below ambient pressure and compression and rarefaction phases are of equal size.