Fortescue Future Industries (FFI)

Holmaneset Green Ammonia Project

Material Take Off (MTO) for all Earthworks

NOR1101-0800-CI-MTO-0001

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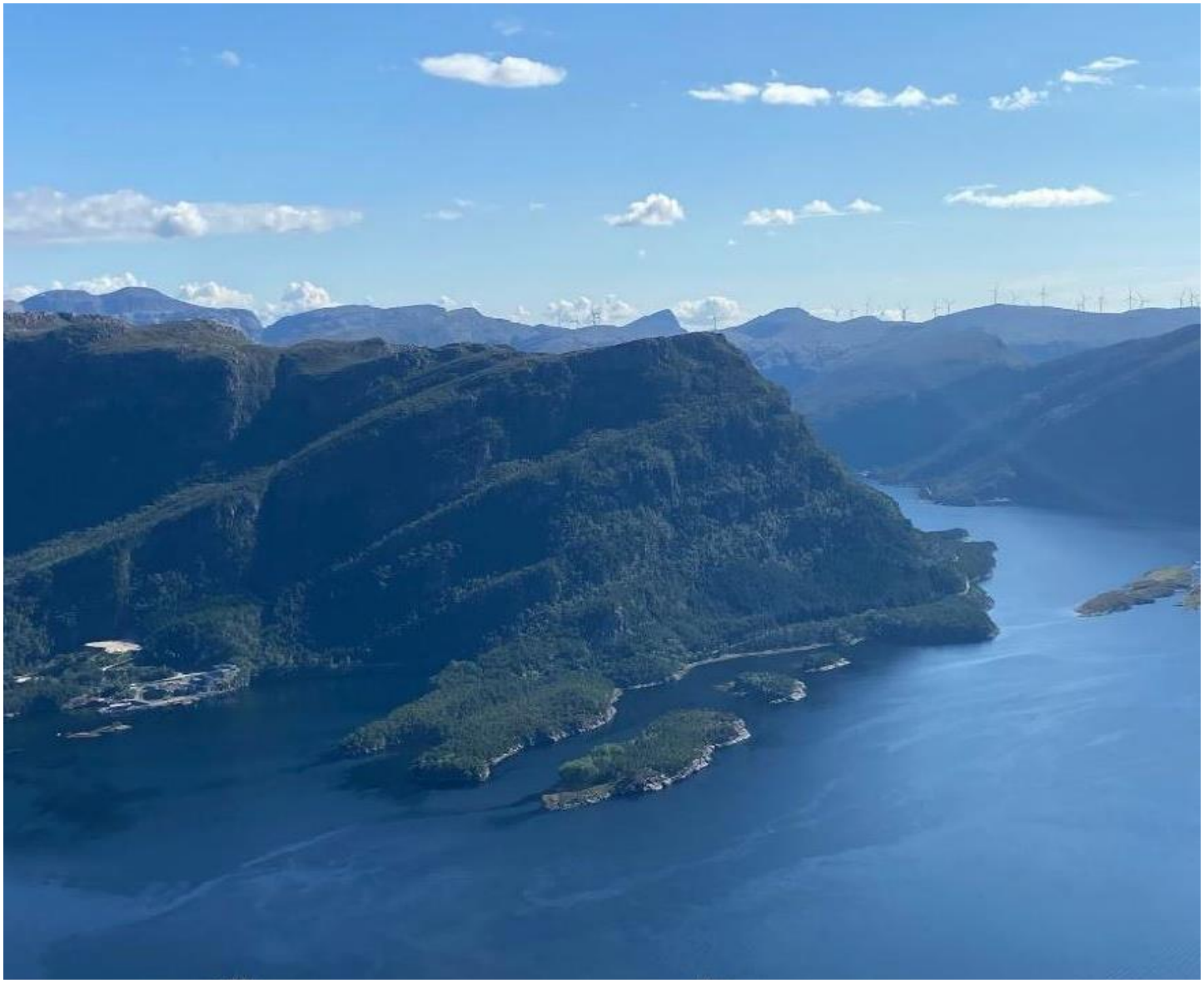

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Contents

1 Introduction

1.1 Purpose

This document provides the Material Take Off (MTO) for earthworks for the Holmaneset Green Ammonia Project, prepared by Norconsult on behalf of FFI. The main objective of this MTO is to accurately quantify and list all the necessary materials for the earthwork activities in the project. It involves a detailed assessment and estimation of the quantities of various materials required. The MTO includes materials from cut, fill, removal of seabed, as well as high-quality materials essential for rock armour, foundations, roads, and other components that are integral to the construction process.

The Material Take Off presented in this document serves as a versatile tool that can support various aspects of the project and further work on such as cost estimation, procurement planning, project scheduling, and resource allocation.

1.2 Scope of Work and Limitations

This document is based on Scope of Services chapter 5.6.1, results from site investigations, available documents from FFI and experiences from similar projects. The level of detail and accuracy reflects the current project's phase and provide the necessary information for further planning and detailing in the feasibility phase.

We have in this prefeasibility phase only considered the main quantity of earthworks materials required for the construction. This mainly includes cutting and filling.

1.3 Referenced documents

Table 1 Referenced documents

Document number	Document Title
NOR1101-0000-LG-PLN-0001	Materials Management Plan
NOR1101-0000-LG-REP-0001	Material Freight Profile & Construction, Transport and Logistics Report
NOR1101-0000-GE-REP-0002	Site Reconnaissance and Geological Mapping Report - Site visit to Holmaneset
NOR1101-0000-GE-REP-0001	Geological and geotechnical Desktop Study Report
NOR1101-0000-GE-REP-0005	Earthworks, Reclamation and Material Sourcing Study
NOR1101-0000-CN-REP-0001	Constructability Workshop Report
NOR1101-0800-CI-DGA-0002	Typical Site Section Drawings
NOR1101-0800-CI-DEW-0001	Bulk earthworks layout drawing
NOR1101-0800-CI-DAL-0005	Bulk Earthworks Model illustrating Cut & Fill Volumes
NOR1101-0000-GE-REP-0004	Geotechnical Interpretative Report

2 Requirements and assumptions

This chapter outlines the necessary assumptions and basis for estimating quantities for earthworks.

2.1 Conversion factors

Indicative conversion factor for the volume of material in relation to its theoretical solid mass is shown in the table below. These are average values based on R761 /1/ that may vary slightly depending on factors such as blasting method and rock type.

Table 2 conversion factor.

Material type	Solid (s)	Loose (l)	Placed (p)
Blasted rock	1,00	1,60	1,35
Sand, gravel etc	1,00	1,25	1,10
Clay, silt	1,00	1,15	1,00

Based on our experiences from blasting-works and rock material handling, we have chosen an expansion factor of 1.35 for all placed blasted rock material on land and in sea.

Typically, the expansion factor for blasted rock materials in the sea is slightly higher than on land. Considering the level of detail for a pre-feasibility phase, we have used the same expansion factor for land and sea for simplification purposes.

Definitions for states:

- Solid state (s) refers to the state of materials before blasting, loosening, or loading.
- Loose state (l) refers to the state of materials after loosening and during storage and transportation.
- Placed state (p) refers to the state of materials when they have been positioned and compacted.

2.2 Calculation of quantities

Quantities for cut, fill and removal of seabed are mainly based on the design of the final PFS plant layout alternative 2C, and the 3D model for earthworks and land reclamation. Some materials are based on rough estimates, such as quantities for vegetation, logging, bog, topsoil, aggregates for concrete and rock armour. Materials with strict quality requirements, such as those intended for road construction, foundations, infrastructure, etc., are assumed based on area usage and similar project experiences and need to be detailed further in the next phase of the project. The quantities that have been determined are largely influenced by the goal of achieving balance of mass in the project.

Slope angles and the size of the site are indicated in deliverables Bulk earthworks layout drawing, Typical Site Section Drawings and Bulk Earthworks Model illustrating Cut & Fill Volumes.

The quantities to be blasted and excavated will be highly representative of the current plant layout, and the lower blasting level indicated in the model and on drawings is assumed to be the average level for blasting, taking into account slope- and level requirements and outer boundaries. The drawings and model take into account necessary considerations as mentioned in the Scope of Services, including factors such as flood considerations, landscape features, space for infrastructure and drainage.

Topsoil

The thickness of the topsoil has been determined based on the findings of the Site Reconnaissance and Geological Mapping Report from the site visit to Holmaneset. It is estimated to have an average thickness of 20 cm. Considering the area covered, this corresponds to a total volume of 20,000 m3. Assumptions for the handling of topsoil are that minor quantities will be used locally on-site, and the major part will be transported and deposited off-site. Topsoil will locally be used to prepare areas along the access roads, create green spaces, and for filling with planting soil in the surrounding areas adjacent to the facility. Figure 2 and attachment 1 illustrates quantities and the locations for the local reuse and off-site deposition of topsoil.

Bog material

The quantities and location of bog materials on Holmaneset are based on the Geotechnical Interpretative Report and the Site Reconnaissance and Geological Mapping Report - Site visit to Holmaneset section 2.3.1 and figure 45 and are estimated to be approximately 30 000 sm^3.

Vegetation & logging

The quantities of vegetation and logging materials have been determined based on the findings of the Site Reconnaissance and Geological Mapping Report, as well as the calculation of the forested area, estimated to be approximately 130 000 m^2.

Removal of seabed

The quantities of seabed that need to be removed are calculated from the 3D model. The quantities are assumed as a “worst-case scenario”. It is likely that the quantities may be reduced, as some areas around Holmaneset may not require seabed removal.

Rock armour

Quantities for rock armour and erosion protection have been estimated manually based on the 3D model and the plant layout. Figure 1 provides additional information about the extent of erosion protection and its placement.

Aggregates for concrete

The quantities for concrete aggregates are based on the planned consumption of on-site casted concrete during construction. Often, as much as 60-75% of the final concrete consists of aggregates. The planned consumption of concrete in this project is estimated to be 18 500 m^3, requiring approximately 12 000 m^3 of concrete aggregate.

Contaminated materials

The quantities of contaminated materials from the construction period are unknown. The current geotechnical and engineering geological reports do not indicate any contaminated materials that require special disposal. However, during the construction period, some contaminated materials may arise from oil spills, water sedimentation, etc., which will require delivery to approved facilities. Estimates for quantities will need to be provided in a later phase, and the final figures will not be known until the project is completed.

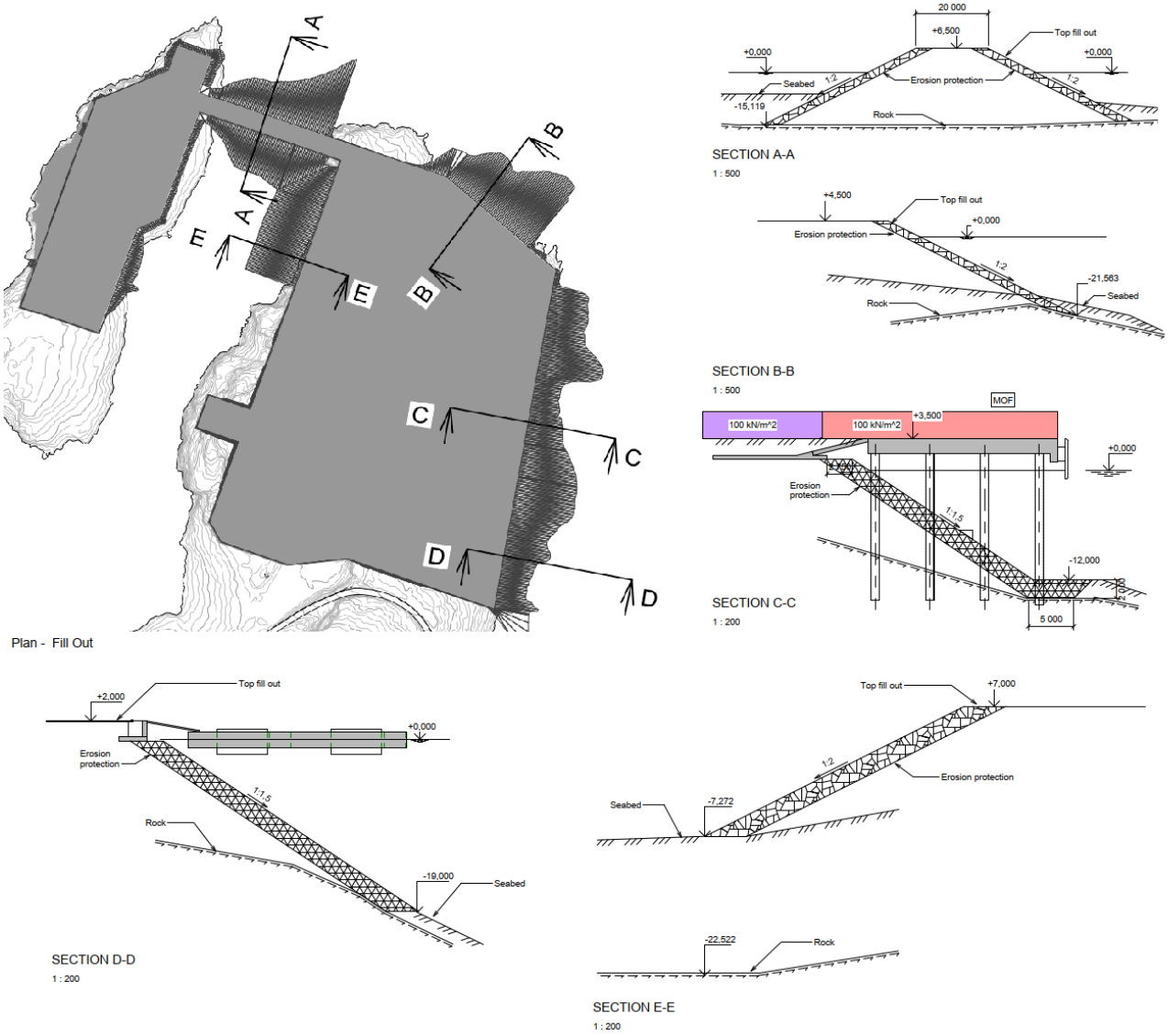


Figure 1 Erosion protection on Holmaneset

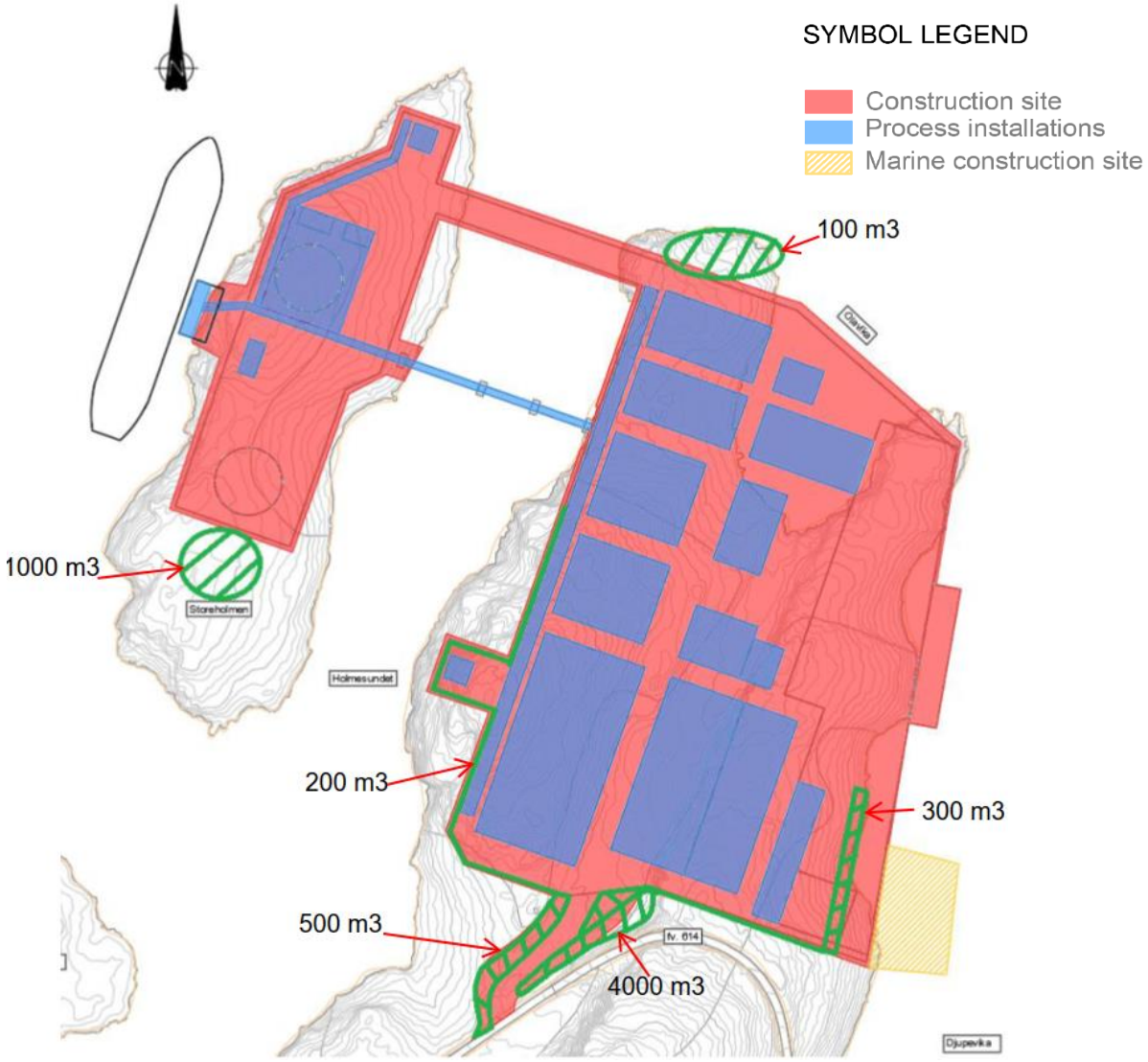


Figure 2 Local placement of topsoil on the site

3 Quantities

3.1 Cut

Overview of the quantities to be cut on site.

Table 3 Onsite cutting.

Type of material	Solid (m^2/sm^3)	Placed (pm^3)
Vegetation & logging	130 000 m^2	-
Topsoil material	20 000 sm^3	22 000 pm^3
Bog-material	30 000 000 sm^3	30 000 pm^3
Blasted rock	638 000 sm^3	860 000 pm^3
Removal of seabed	400 000 sm^3	-

3.2 Fill

Overview of the quantities to be filled on site.

Table 4 Onsite filling.

Type of material	Placed (pm^3)
Land fill	320 000 pm^3
Subaqueous fill	400 000 pm^3
MOF	30 000 pm^3
Filter-layer for rock armour	8 000 pm^3
Rock armour	15 000 pm^3
High-quality materials (roads, foundation etc.)	60 000 pm^3

3.3 Imported materials

Overview of the quantities to be imported to site.

Table 5 Estimated need for imported materials

Type of material	Placed (pm^3)
Imported rock fill	130 000 pm^3
Imported aggregates for concrete	12 000 pm^3
Rock armour	12 000 pm^3

3.4 Materials disposed of off-site

Overview of quantities that needs to be disposed off-site.

Table 6 Estimated quantities for materials needed to be disposed off-site.

Type of material	Placed (m^2/pm^3)
Removal of seabed	400 000 pm^3
Vegetation & logging materials	130 000 m^2
Contaminated material	Unknown
Bog material	29 000 pm^3
Topsoil	16 000 pm^3
Surplus rock material	170 000 pm^3

3.5 Cut to fill balance

Overview of mass balance calculation.

Table 7 Estimated balance of rock materials

Type of material	Placed (pm^3)
Imported rock fill	+ 130 000 pm^3
Blasted rock	+ 860 000 pm^3
Filter-layer for rock armour	- 8 000 pm^3
Rock armour (assumed 20% can be produced at site)	-3 000 pm^3
High-quality materials (roads, foundation etc.)	-60 000 pm^3
Land fill	-320 000 pm^3
Subaqueous fill	-400 000 pm^3
MOF	-30 000 pm^3
Surplus rock material	**+170 000 pm^3**

The balance in Table 7 is to illustrate the surplus of rock materials and how quantities that needs to be managed on-site or transported away from Holmaneset when construction is completed. Concrete aggregates and rock armour will be used onsite and will not affect the surplus and are therefore not included.

In order to align with the project's schedule demands and facilitate an early commencement of land reclamation and sea-based material filling, it is imperative to initiate the import of 130 000 pm^3 rock materials. This early importation is crucial, among other reasons, for the timely completion of the MOF construction and meeting the module delivery deadlines.

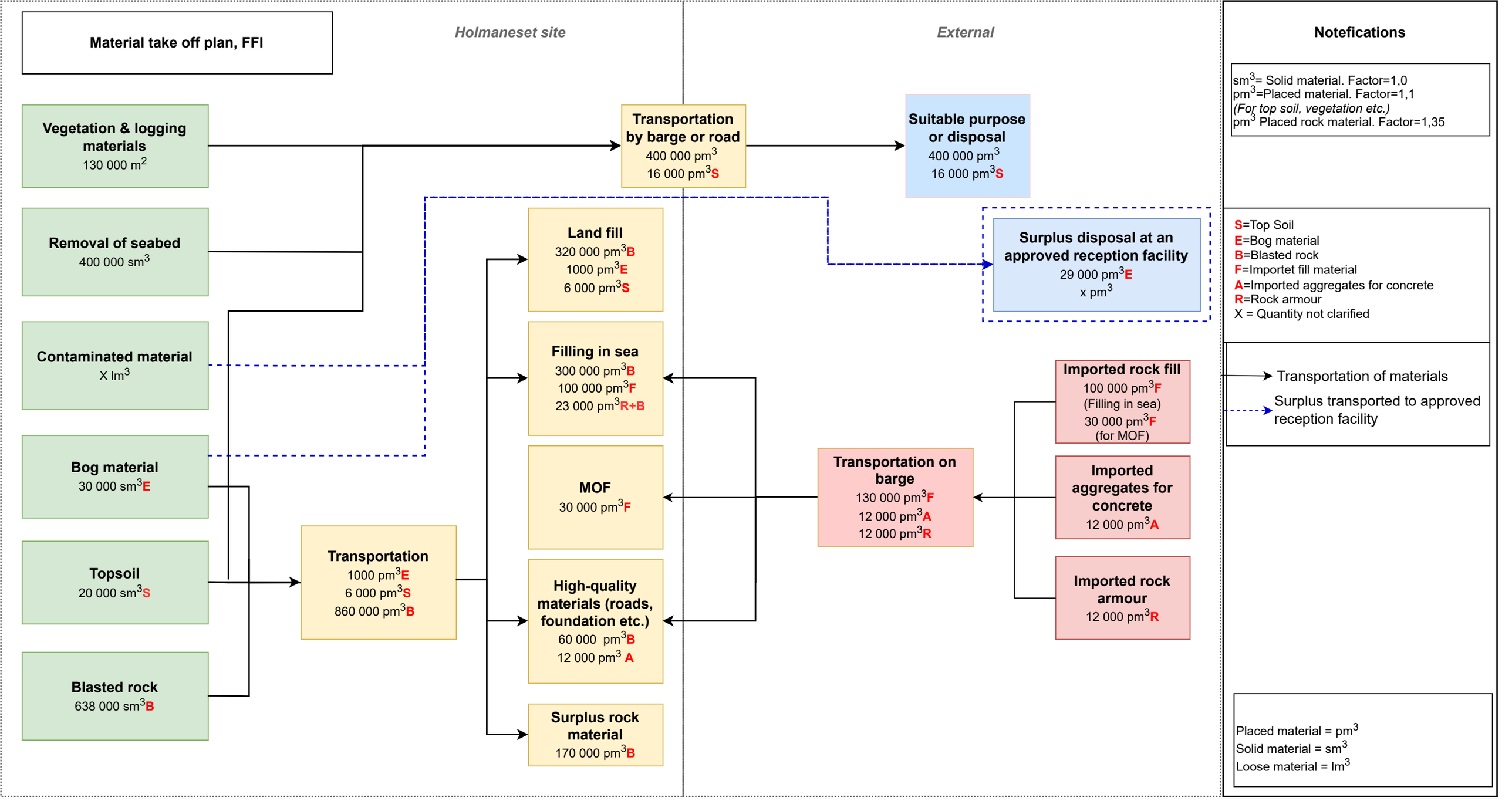
The design we have settled on in this PFS results in a surplus of 170 000 pm^3 rock materials in addition to the quantities that will result from the removal of the seabed. In next phase we believe that there are still optimization opportunities in the project to minimize the surplus from the removal of the seabed and reduce the surplus of rock materials. Nevertheless, we would recommend planning for a slight surplus in the cut to fill balance instead of aiming for exact balance. A surplus of 170,000 pm^3 is excessive and is a result of planning with imported materials and limited time for layout development and design refinement. A range between 10,000 pm^3 and 20,000 pm^3 is considered a reasonable amount of surplus in the cut to fill balance. The excess material must be transported and deposited off-site or alternative solutions for on-site reuse should be explored.

4 Attachments

1. Flowchart for materials

5 References

/1/ Standard beskrivelsestekster for vegkontrakter (Håndbok R761) _2018


Material take off plan, FFI
Holmaneset site
External
Vegetation & logging materials
130 000 m2
Removal of seabed
400 000 sm3
Contaminated material
X lm3
Bog material
30 000 sm3E
Topsoil
20 000 sm3S
Blasted rock
638 000 sm3B
Transportation by barge or road
400 000 pm3
16 000 pm3S
Suitable purpose or disposal
400 000 pm3
16 000 pm3S
Surplus disposal at an approved reception facility
29 000 pm3E
x pm3
Land fill
320 000 pm3B
1000 pm3E
6 000 pm3S
Filling in sea
300 000 pm3B
100 000 pm3F
23 000 pm3R+B
MOF
30 000 pm3F
High-quality materials (roads, foundation etc.)
60 000 pm3B
12 000 pm3 A
Surplus rock material
170 000 pm3B
Transportation
1000 pm3E
6 000 pm3S
860 000 pm3B
Transportation on barge
130 000 pm3F
12 000 pm3A
12 000 pm3R
Imported rock fill
100 000 pm3F
(Filling in sea)
30 000 pm3F
(for MOF)
Imported aggregates for concrete
12 000 pm3A
Imported rock armour
12 000 pm3R
Notefications
sm3= Solid material. Factor=1,0
pm3=Placed material. Factor=1,1
(For top soil, vegetation etc.)
pm3 Placed rock material. Factor=1,35
S=Top Soil
E=Bog material
B=Blasted rock
F=Importet fill material
A=Imported aggregates for concrete
R=Rock armour
X = Quantity not clarified
Transportation of materials
Surplus transported to approved reception facility
Placed material = pm3
Solid material = sm3
Loose material = lm3