

Hong Kong Offshore LNG Terminal - Works associated with the subsea gas pipeline for Lamma Power Station (LPS) and the associated Gas Receiving Station (GRS) in LPS

Silt Curtain Deployment Plan

24 November 2020

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Silt Curtain Deployment Plan



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Environmental Certification Sheet

FEP-02/558/2018

Reference Document/Plan

Document/ Plan to be Certified/ Verified:	Silt Curtain Deployment Plan
Date of Report:	24 November 2020
Date received by ET:	24 November 2020
Date received by IEC:	24 November 2020

Reference EP Requirement

EP Condition:	Condition No. 2.10 of FEP-02/558/2018
Content:	<i>Silt Curtain Deployment Plan</i>
<p>The Permit Holder shall, no later than 1 month before the commencement of marine works including construction of the subsea gas pipeline, deposit with the Director 3 hard copies and 1 electronic copy of a silt curtain deployment plan. The silt curtain deployment plan shall include but not limited to the details of the design, installation, testing, operation and maintenance of the silt curtains to be deployed during construction of the Project to avoid and minimize the water quality impact due to the dredging and jetting works for laying and burying the subsea gas pipeline. Pilot tests on the efficiency of silt curtain system shall be conducted during the early stage of construction to confirm the removal efficiency of the silt curtains. The deposited silt curtain deployment plan shall be fully and properly implemented during construction of the Project.</p>	

ET Certification

I hereby certify that the above referenced document/ plan complies with the above referenced condition of FEP-02/558/2018.	
Mr Raymond Chow, Environmental Team Leader:	 Date: 24 November 2020

IEC Verification

I hereby verify that the above referenced document/ plan complies with the above referenced condition of FEP-02/558/2018.	
Mr Arthur Lo, Independent Environmental Checker:	 Date: 24 November 2020

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1. INTRODUCTION

1.1 Background

To support the increased use of natural gas in Hong Kong from 2020 onwards, Castle Peak Power Company Limited (CAPCO) and The Hongkong Electric Co., Ltd. (HK Electric) have identified that the development of an offshore liquefied natural gas (LNG) receiving terminal in Hong Kong using Floating Storage and Regasification Unit (FSRU) technology ('the Hong Kong Offshore LNG Terminal Project') presents a viable additional gas supply option that will provide energy security through access to competitive gas supplies from world markets. The Hong Kong Offshore LNG Terminal Project will involve the construction and operation of an offshore LNG import facility to be located in the southern waters of Hong Kong, a double berth jetty, and subsea pipelines that connect to the gas receiving stations (GRS) at the Black Point Power Station (BPPS) and the Lamma Power Station (LPS).

The Environmental Impact Assessment (EIA) Report for the Hong Kong Offshore LNG Terminal Project was submitted to the Environmental Protection Department (EPD) of the Hong Kong Special Administrative Region Government in May 2018. The EIA Report (EIAO Register No. AEIAR-218/2018) was approved by EPD and the associated Environmental Permit (EP) (EP-558/2018) was issued in October 2018. An application for Further Environmental Permits (FEP) was made on 24 December 2019 to demarcate the works between the different parties. The following FEPs were issued on 17 January 2020 and the EP under EP-558/2018 was surrendered on 5 March 2020:

- the double berth jetty at LNG Terminal under the Hong Kong LNG Terminal Limited, joint venture between CAPCO and HK Electric (FEP-01/558/2018);
- the subsea gas pipeline for the BPPS and the associated GRS in the BPPS under CAPCO (FEP-03/558/2018); and
- the subsea gas pipeline for the LPS and the associated GRS in the LPS under HK Electric (FEP-02/558/2018).

The location plan for the works associated with the subsea gas pipeline for LPS and the associated GRS in LPS ('the Project') is provided in **Figure 1.1**.

1.2 Objectives of the Silt Curtain Deployment Plan

This *Silt Curtain Deployment Plan* for the Project has been prepared in accordance with Condition 2.10 of the Further Environmental Permit FEP-02/558/2018.

FEP No. FEP-02/558/2018, Condition 2.10:

"The Permit Holder shall, no later than 1 month before the commencement of marine works including construction of the subsea gas pipeline, deposit with the Director 3 hard copies and 1 electronic copy of a silt curtain deployment plan. The silt curtain deployment plan shall include but not limited to the details of the design, installation, testing, operation and maintenance of the silt curtains to be deployed during construction of the Project to avoid and minimize the water quality impact due to the dredging and jetting works for laying and burying the subsea gas pipeline. Pilot tests on the efficiency of silt curtain system shall be conducted during the early stage of construction to confirm the removal efficiency of the silt curtains. The deposited silt curtain deployment plan shall be fully and properly implemented during construction of the Project."

The key objective of this *Silt Curtain Deployment Plan* is to include the details of the design, installation, testing, operation and maintenance of the silt curtains to be deployed during construction of the Project to avoid and minimize the water quality impact due to the dredging and jetting works for laying and burying the subsea gas pipeline. Based on the latest design, the pre-installed pipeline at KP 17.4 will be used for the LPS Pipeline tie-in and cofferdam construction works are not required for

the LPS Pipeline shore approach. Therefore, this *Silt Curtain Deployment Plan* focuses on the silt curtains to be deployed for the dredging and jetting works for the Project.

The *Silt Curtain Deployment Plan* will be reviewed and updated as appropriate, throughout the course of the construction works to confirm that it remains current with the latest detailed information and works practice.

1.3 Overview of Silt Curtain Deployment

As stipulated in Condition 3.3 of FEP-02/558/2018, silt curtains shall be properly installed, tested, operated and maintained during construction of the subsea gas pipeline in accordance with the Silt Curtain Deployment Plan deposited under Condition 2.10 of FEP-02/558/2018. Cage-type silt curtain shall be installed enclosing the grab dredger and jetting machine during construction of the subsea gas pipeline. No silt curtain installation shall encroach onto the existing marine parks and the proposed South Lantau Marine Park.

Two types of silt curtains will be deployed for the dredging and jetting works of the Project:

- Cage-type silt curtain will be installed enclosing the grab dredger / jetting machine during dredging / jetting works for the construction of the subsea gas pipeline; and
- Floating double layer silt curtain will be deployed prior to the jetting works at KP0.1 – KP5.0 in order to minimize potential water quality impacts of the proposed South Lantau Marine Park. Specific location of the pipeline construction works requiring the deployment of floating double layer silt curtains is illustrated in **Figure 1.2**. The floating double layer silt curtain will be deployed outside the eastern boundary of the proposed South Lantau Marine Park.

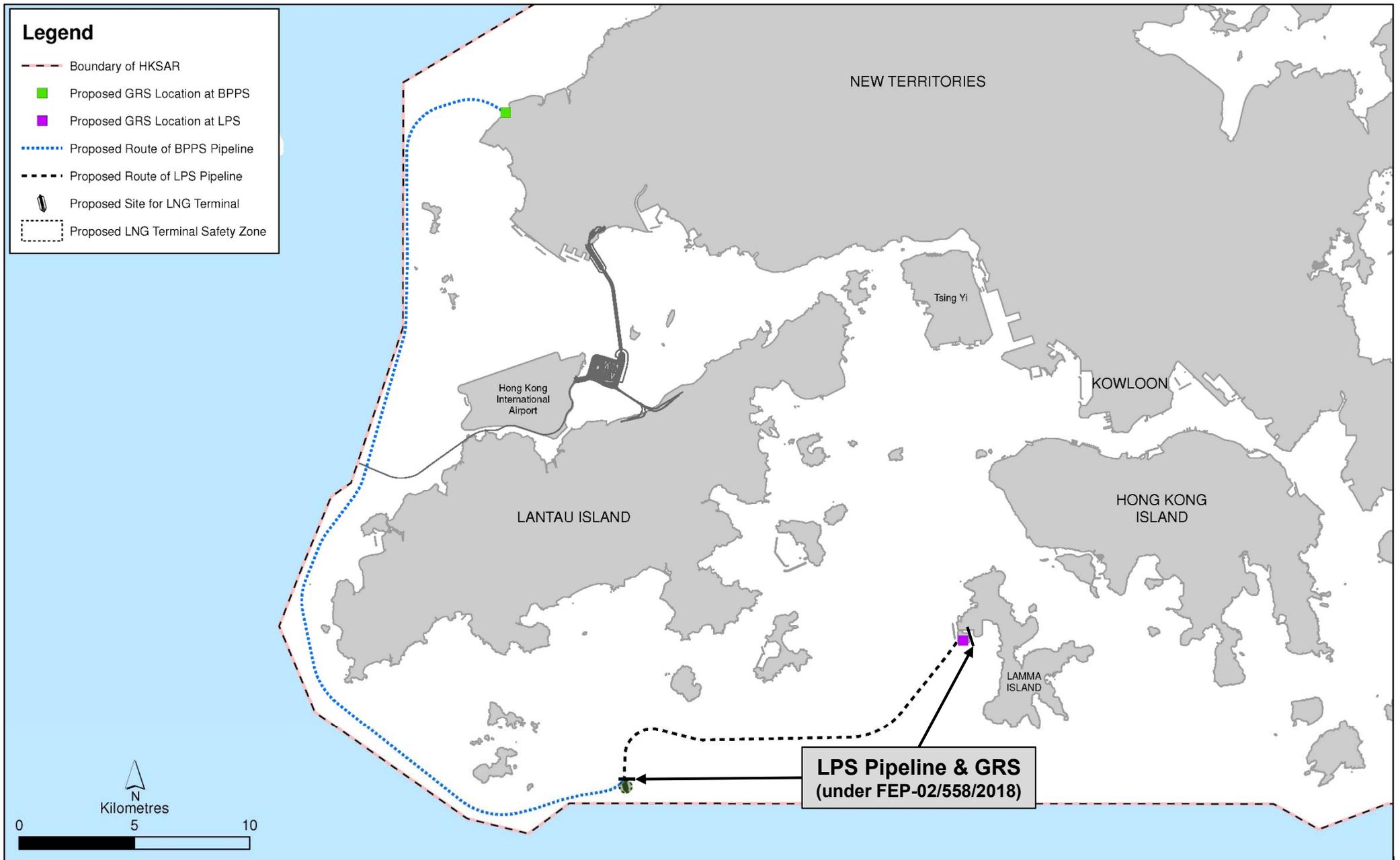


Figure 1.1

Indicative Location of Key Project Components

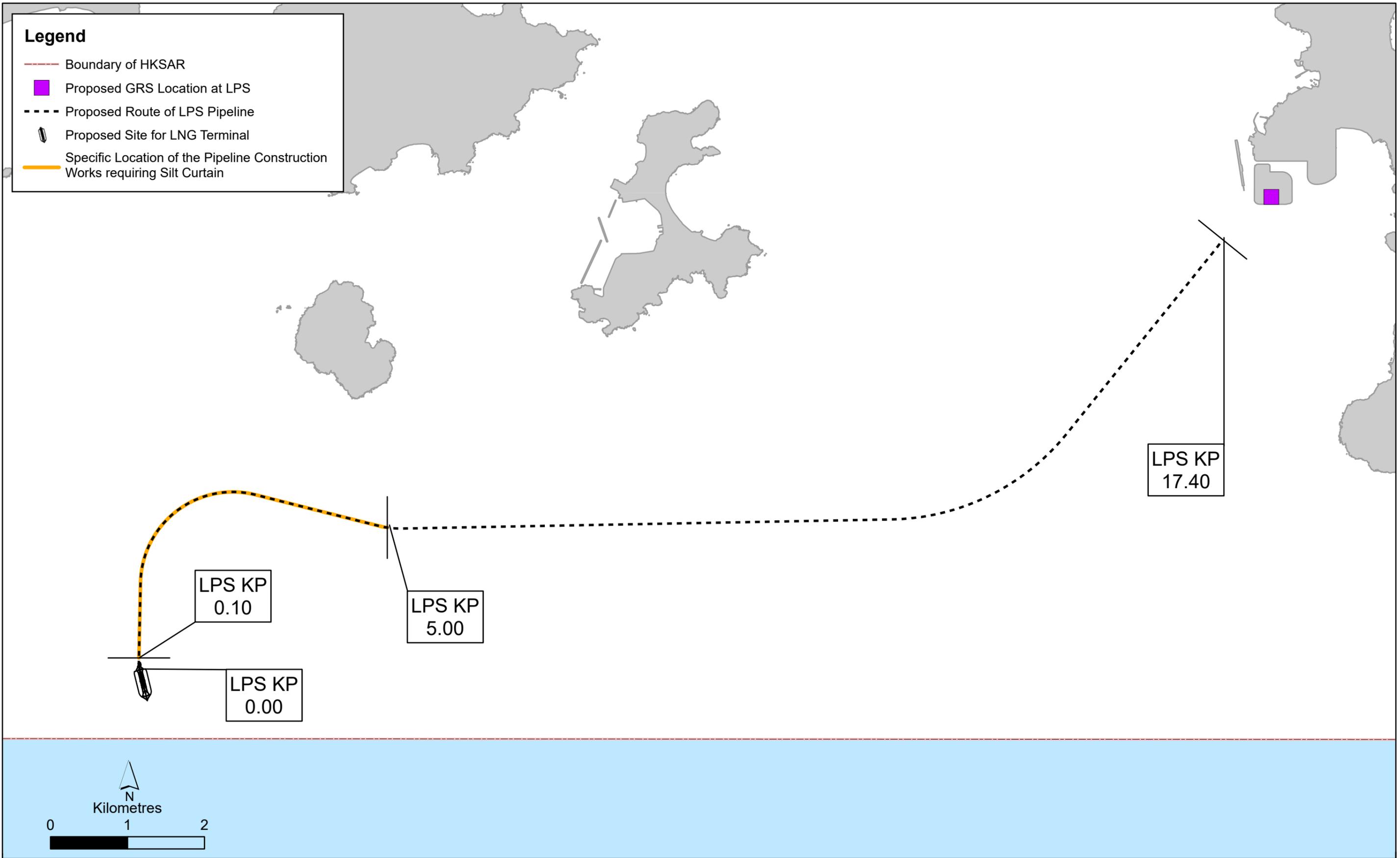


Figure 1.2

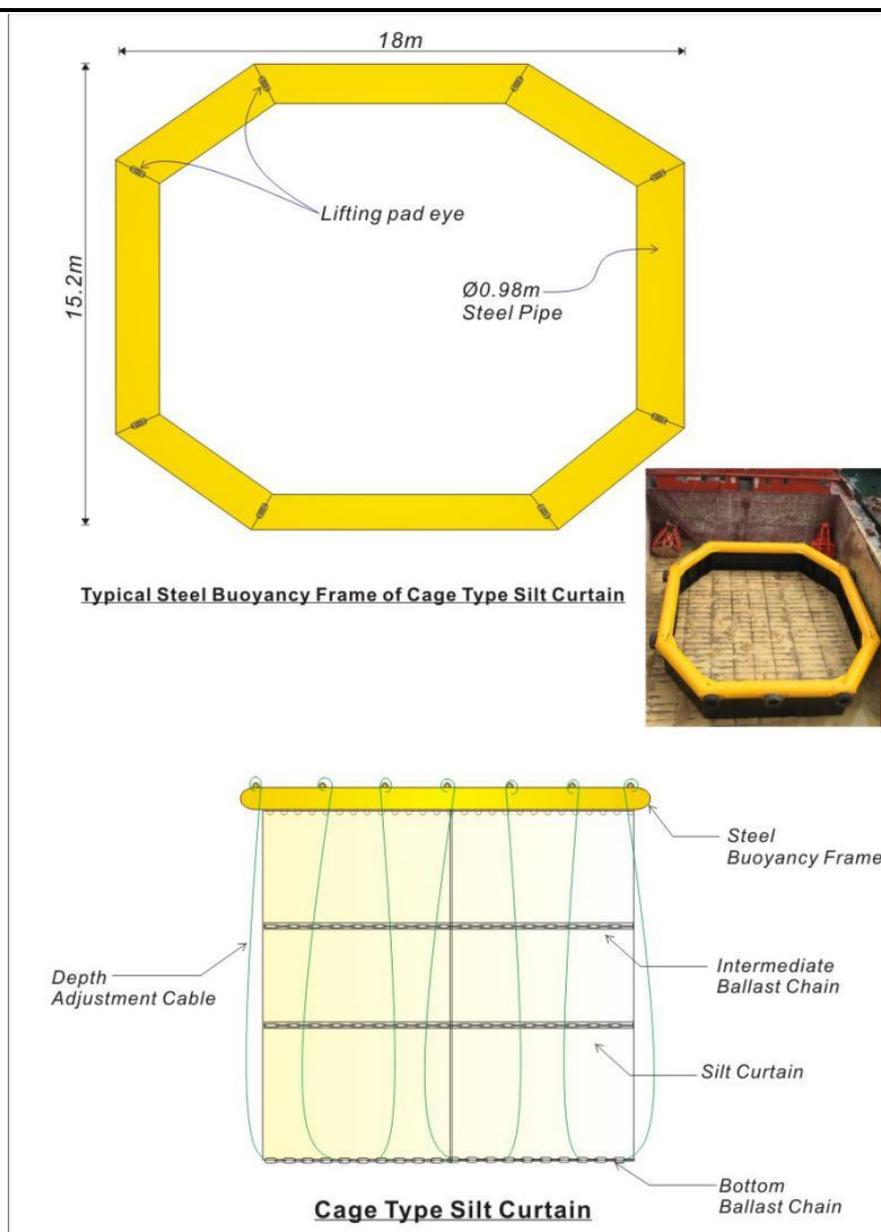
Specific Location of the Pipeline Construction Works requiring Deployment of Floating Double Layer Silt Curtain

2. DESIGN OF SILT CURTAINS

2.1 Cage-type Silt Curtain

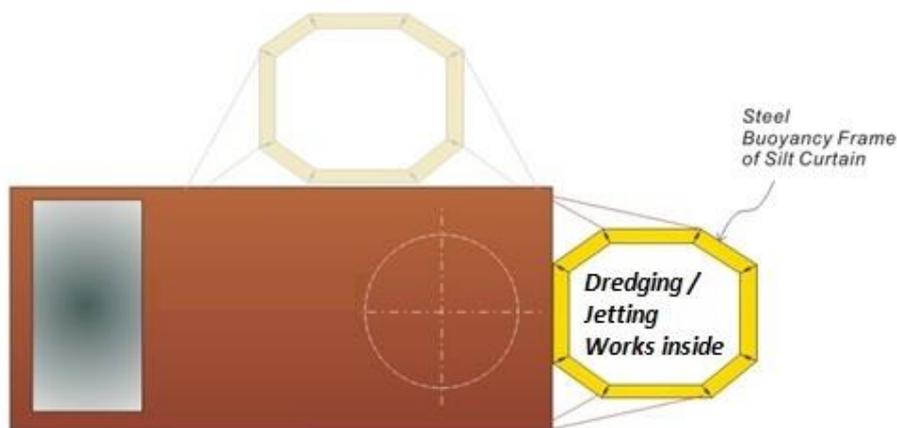
Cage-type silt curtain will be installed for dredging and jetting activities for the pipeline construction works. A cage-type silt curtain consists of a layer of geotextile tied on a steel pipe surface buoyancy frame with pipe diameter of ~1,000 mm. The geotextile will be secured from water surface to seabed level by steel chain ballast. Sufficient length of the geotextile will be provided such that the silt curtain can be extended from the water surface to the seabed level during high tide condition. Silt curtain with various curtain depth and curtain strength of around 110 kN/m will be deployed. The bottom part of the silt curtain will be kept away from the seabed by a distance of ~0.3m in order to avoid disturbing the seabed. The indicative design of cage-type silt curtain is illustrated in **Figure 2.1** and the typical arrangement of cage-type silt curtain installed on a work barge is illustrated in **Figure 2.2**.

Figure 2.1 Cage-type Silt Curtain Indicative Design

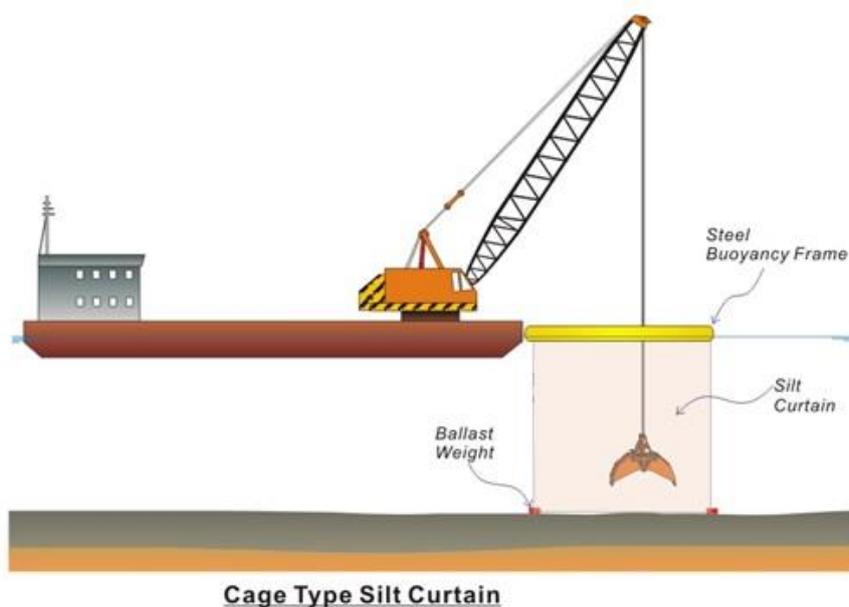


Remark: The shape and dimension of the cage-type silt curtain are indicative and subject to modification depending on site conditions.

Figure 2.2 Typical Arrangement of Cage-type Silt Curtain



Typical Arrangement of Cage Type Silt Curtain



2.2 Floating Silt Curtain

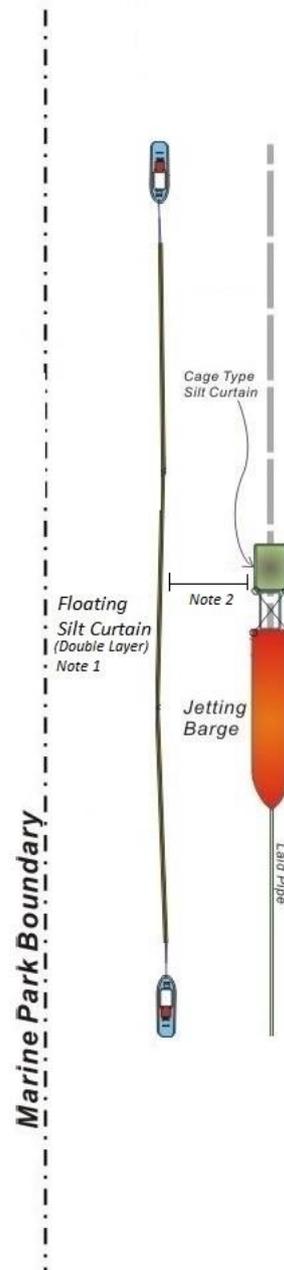
Floating silt curtain will be deployed along the eastern boundary of the proposed South Lantau Marine Park during the jetting works at Double Berth Jetty to South of Shek Kwu Chau (KP0.1-5.0). No silt curtain installation will encroach onto the existing and proposed marine parks.

The floating silt curtain consists of two layers of geotextile mounted onto polystyrene foam float with diameter of ~500 mm with polyethylene protective hard shell cover. The geotextile will be extended slightly above the seabed level and secured by steel chain ballast or equivalent (e.g. concrete sinkers) to avoid the bottom part of the silt curtain from touching the seabed and causing unnecessary disturbance of seabed sediment. The bottom part of the silt curtain will be kept away from the seabed by a distance of ~0.3m in order to avoid disturbing the seabed.

The length of the silt curtain deployed at the active jetting location will be determined considering the findings of the EIA Report, the potential impact to existing marine traffic for review by the Marine Department and the performance of the pilot test (see details in *Section 4*) upon agreement with the Environmental Team (ET) and the Independent Environmental Checker (IEC). The floating silt curtain will be pulled at both ends by tug boats to maintain tension. Surface structure of the floating silt curtain will be linked to a towing rope instead of being towed by motor tugs directly for manoeuvring in order to reduce the tension of the floating silt curtain during towing. Flashlight will be installed on marker buoys and tug boats for alerting marine operators at night. Should the floating silt curtain be necessary to be separated into sections, a distance of ~150m overlapping between two sections of the floating silt curtain will be maintained as far as practicable to mitigate potential water quality impacts between two floating silt curtain sections. The floating silt curtain will be shifted during jetting depending on the location of jetting operation. Should there be any unacceptable water quality impacts to the water sensitive receivers at the proposed South Lantau Marine Park from the impact water quality monitoring, the Contractor(s) will propose remediation measures (e.g. checking of silt curtain integrity, extension of floating silt curtain) in consultation with the ET and the IEC.

The indicative arrangement for floating silt curtain is illustrated in **Figure 2.3**. The indicative arrangement for floating silt curtain in sections is illustrated in **Figure 2.4**. The specification of the proposed geotextile is shown in **Table 2.1**. The details of manufacturer / supplier's specifications and project references are shown in **Annex D**.

Figure 2.3 Indicative Arrangement of Floating Silt Curtain



Notes:

- 1) Preliminary 1000m length, subject to site conditions and trial.
- 2) Distance between silt curtain and metal frame will be subject to site condition and trial.

Figure 2.4 Indicative Arrangement of Double Layer Silt Curtain in Sections

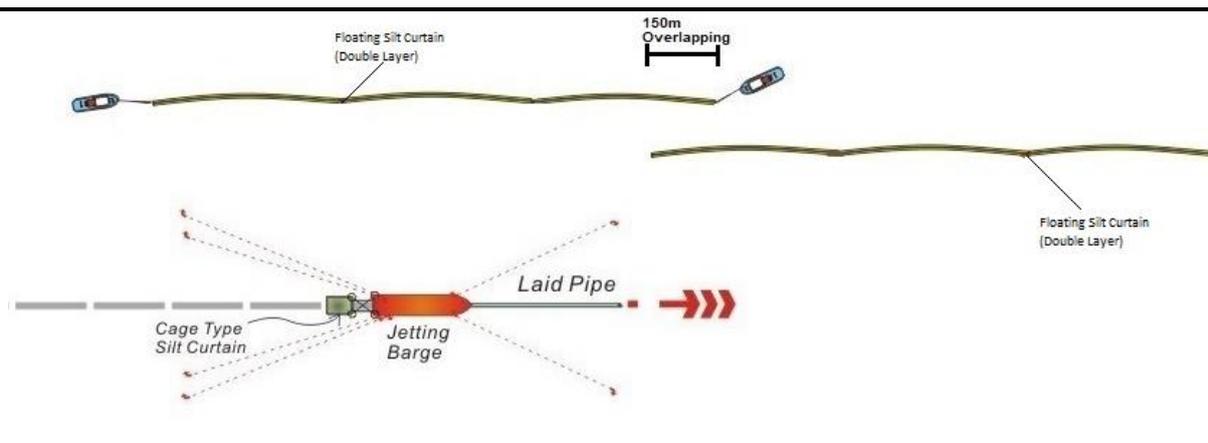


Table 2.1 Specification of the Proposed Geotextile

<i>Technical Data Sheet</i>			
Polymer	Density	Melting Point	Construction
100% Polypropylene	0.91 kg/dm ³	165 °C	Tapes
<i>Properties</i>			
Mechanical Properties	Standard	Performance	Tolerance
Tensile strength - MD	EN ISO10319	110 kN/m	-9.9 kN/m
Tensile strength - CMD	EN ISO10319	110 kN/m	-9.9 kN/m
Elongation at maximum load - MD	EN ISO10319	10 %	+/- 2.3 %
Elongation at maximum load - CMD	EN ISO10319	8 %	+/- 1.8 %
Static puncture resistance (CBR)	EN ISO12236	12.5 kN	-2.5 kN
Dynamic perforation resistance (cone drop)	EN ISO13433	10 mm	+2.0 mm
Tensile strength at 2% elongation - MD	EN ISO10319	15 kN/m	
Tensile strength at 2% elongation - CMD	EN ISO10319	25 kN/m	
Tensile strength at 5% elongation - MD	EN ISO10319	45 kN/m	
Tensile strength at 5% elongation - CMD	EN ISO10319	60 kN/m	
Hydraulic Properties	Standard	Performance	Tolerance
Water permeability normal to the plane (Vlh50)	EN ISO11058	25 l/m ² s	-8 l/m ² s
Characteristic Opening Size (O90)	EN ISO12956	230 µm	+/- 69.0 µm
Physical Properties	Standard	Performance	Tolerance
Weight	EN ISO9864	464 g/m ²	+/- 46.4 g/m ²
Length (+/- 1%) x width (+/- 1%)	-	100 x 5.25 m	-
Truck Load Volume (+/- 10%)	-	30,450 m ²	-
Roll diameter (+/- 10%)	-	45 cm	-
Durability	Standard	Performance	
Predicted minimal durability in years in natural soils with 4 <pH < 9 and soil temperature <25°C	EN ISO13438 - A2	25 years	
Maximum allowed time between installation and covering of the geosynthetic	EN 12224	2 weeks	

3. INSTALLATION OF SILT CURTAINS

3.1 Cage-type Silt Curtain

Cage-type silt curtain will be fixed and hung underneath the frame by nylon rope on deck of crane barge after the completion of fabrication of steel buoyancy frame. The skirt of cage-type silt curtain will be coiled by tightening rope for easy deployment.

The entire steel buoyancy frame with cage-type silt curtain will be lifted and erected to the grab dredger or jetting machine when the rigging structure or mounting brace is ready. The coiling ropes will be cut at the steel buoyancy frame and the curtain skirt will be released to the seabed for enclosure.

Cable ropes pre-installed at the bottom of the cage-type silt curtain will be lifted up and tightened at the steel buoyancy frame to adjust the depth of curtain skirt on site from time to time.

3.2 Floating Silt Curtain

Floating silt curtain will be delivered to the location for fixing by flat top/crane barge. All vertical joints of each span of the floating silt curtain will be connected and tied up and coiled with ropes in a tube-form pattern by workers working on deck of the barge.

Steel chain ballast or equivalent (e.g. concrete sinkers) will be deployed at the designated positions along the route by crane barge equipped with real-time global positioning system when the position of floating silt curtain is confirmed.

One of the ends of the towing rope will be picked up and the floating silt curtain will be lowered down slowly into the water by the main towage front tug when the floating silt curtain is available for deployment.

Coiling rope will be cut by small work boat, and the curtain skirt and ballast chain will be released into the water after the other end of towing rope is secured at the back tug and all tugs are in position.

3.3 Works Activities requiring Deployment of Silt Curtains

The works activities (i.e. dredging / jetting works) requiring deployment of silt curtains in the corresponding locations are shown in **Table 3.1**.

Table 3.1 Locations of Deployment of Silt Curtain

Work Location	Cage-type Silt Curtain	Floating Silt Curtain
LPS Pipeline Riser (LPS KP0.0-0.1)	Yes	No
Double Berth Jetty to South of Shek Kwu Chau (LPS KP0.1-5.0)	Yes	Yes (at Eastern Boundary of the Proposed South Lantau MP)
South of Shek Kwu Chau to West Lamma Channel (LPS KP5.0-14.5)	Yes	No
West Lamma Channel (LPS KP14.5-17.4)	Yes	No

4. TESTING OF SILT CURTAINS

4.1 Background of the Pilot Test

As stated in Condition 2.10 of FEP-02/558/2018 and Section 5.3.2 of the Updated EM&A Manual of the Hong Kong Offshore LNG Terminal Project, pilot tests on the efficiency of silt curtain system shall be conducted during the early stage of construction to confirm the removal efficiency of the silt curtains. The pilot test will be conducted by measuring turbidity and suspended solids (SS) at selected stations within and outside silt curtains to be discussed below.

The pilot test on silt curtain systems will include the following tests:

- Silt curtain at grab dredger (testing of silt removal efficiency of 75% or higher);
- Silt curtain at jetting machine (testing of silt removal efficiency of 85% or higher); and
- Double layer of silt curtains at sensitive receivers (testing of silt removal efficiency of 80% or higher).

The results of the pilot tests to be conducted during the early stage of construction will be applicable to dredging / jetting works for the Hong Kong Offshore LNG Terminal Project, i.e. the subsea gas pipeline for BPPS under FEP-03/558/2018 and the subsea gas pipeline for LPS under FEP-02/558/2018.

4.2 Arrangement for Pilot Test

During the pilot test, dredging/ jetting works shall be actively undertaken within the works areas with the silt curtains deployed, and shall be operated at or close to the maximum productivity. The surrounding environment will be controlled as far as practicable such that there would be no other major construction activities with potential of generating suspended solids being operated concurrently.

4.2.1 Locations of Pilot Test

The pilot test covers two different types of silt curtains proposed, the cage-type silt curtain and the floating silt curtain.

4.2.1.1 Cage-type Silt Curtain during Dredging and Jetting

There will be five monitoring stations of which one will be inside the cage while the rest will be outside the silt curtain in four directions. The indicative monitoring locations for cage-type silt curtain during dredging and jetting are shown in **Table 4.1** and **Figure 4.1**.

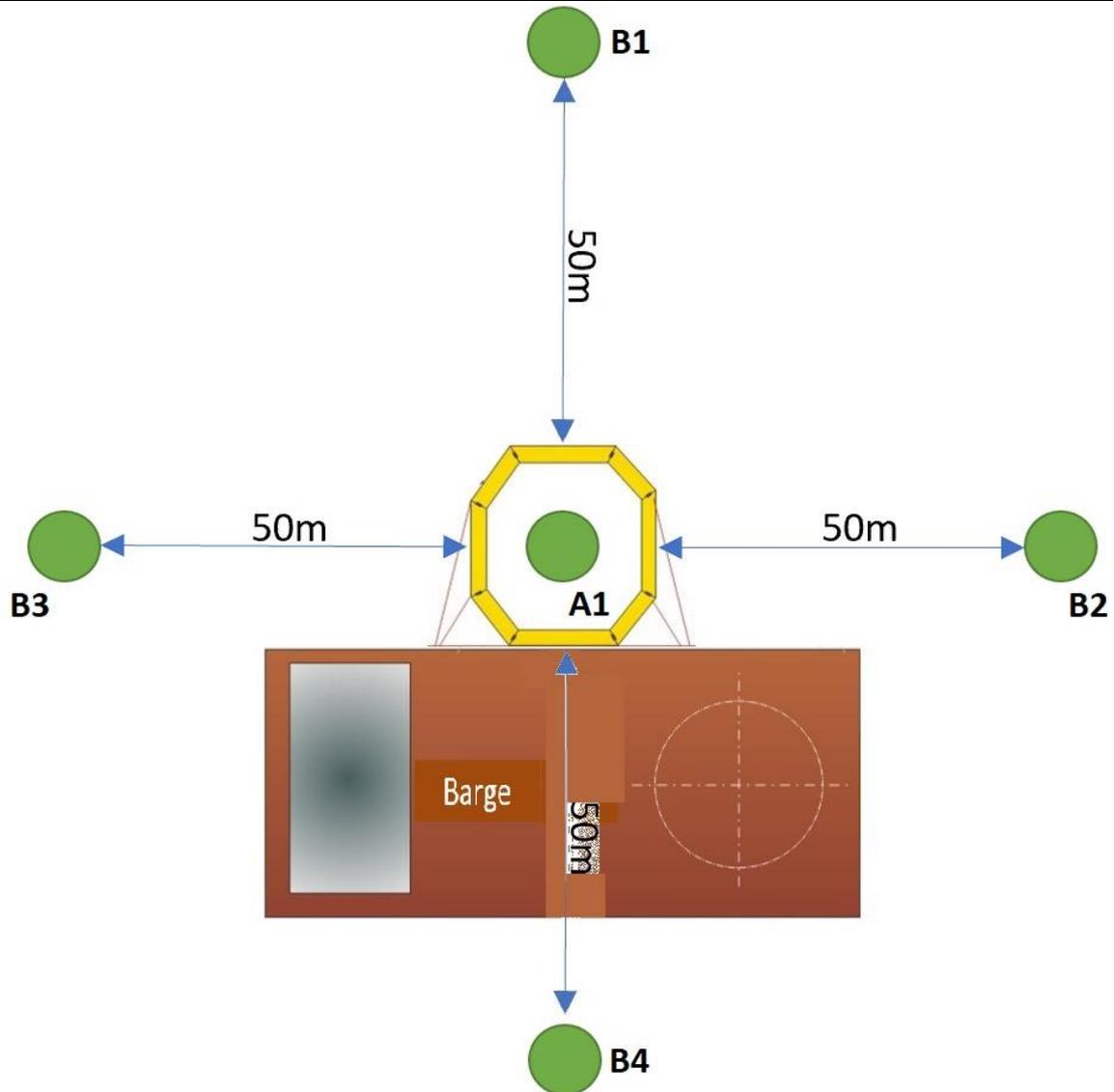
Table 4.1 Indicative Monitoring Locations for Cage-type Silt Curtain during Dredging and Jetting

Monitoring Station	Location	Description
A1	Within silt curtain	One monitoring station will be located inside the cage
B1	Outside silt curtain	Four monitoring stations will be located at four sides of silt curtain and within ~50 m from the silt curtain boundary
B2		
B3		
B4		

Remark: Each applicable station will be sampled and measurements/ water samples will be taken at three depths, 1m below the sea surface, mid-depth and 1m above the seabed. For stations that are less than 3m in depth, only the mid-depth sample shall be taken. For stations that are less than 6m in depth, only the sea surface and bottom samples shall be taken. For *in-situ* measurements, duplicate

readings shall be made at each water depth at each station. Duplicate water samples shall be collected at each water depth at each station.

Figure 4.1 Indicative Monitoring Locations for Cage-type Silt Curtain during Dredging and Jetting



Note: The actual monitoring locations will be determined on site considering the locations of the cage-type silt curtain, anchor wires of the barges and nearby marine traffic conditions.

4.2.1.2 Floating Silt Curtain

There will be six monitoring stations of which three will be near the marine works area while the rest will be at the other side of the silt curtain. As the floating silt curtain will be placed at water sensitive receivers, the distance between the emission source and the silt curtain for the pilot test is expected to be ranged from ~20 m to ~100 m depending on the location where the pilot test will be conducted in the vicinity of water sensitive receivers (e.g. the proposed South Lantau Marine Park). The indicative monitoring locations for floating silt curtain are shown in **Table 4.2** and **Figure 4.2**.

Table 4.2 Indicative Monitoring Locations for Floating Silt Curtain

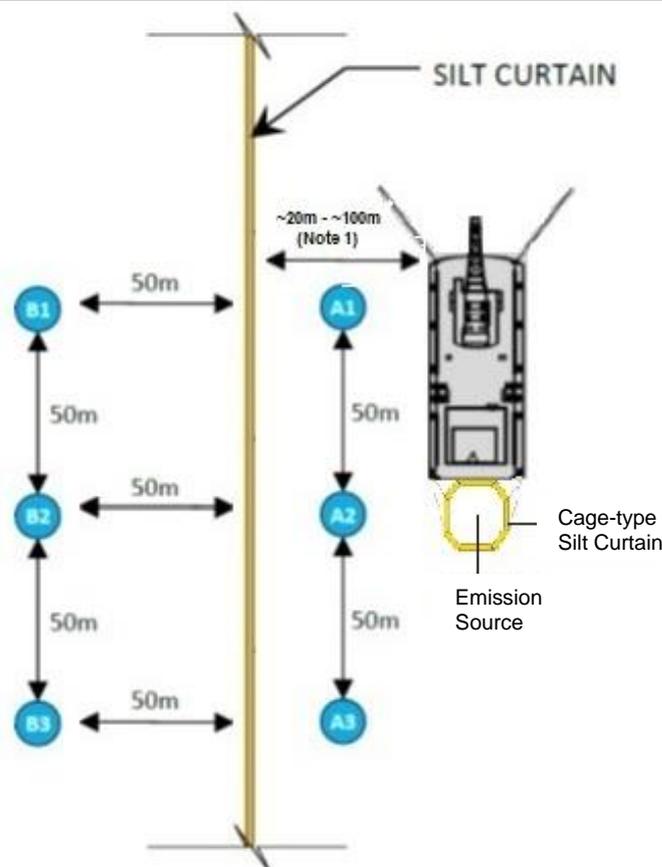
Monitoring Station	Location	Description
A1	Near marine works area	Three monitoring stations will be ~50 m apart from each other and situated between marine works area and the silt curtain boundary
A2		
A3		
B1	The other side of silt curtain	Three monitoring stations will be ~50 m apart from each other and situated at ~50 m from the other side of silt curtain boundary
B2		
B3		

Remarks:

1) Each applicable station will be sampled and measurements/ water samples will be taken at three depths, 1m below the sea surface, mid-depth and 1m above the seabed. For stations that are less than 3m in depth, only the mid-depth sample shall be taken. For stations that are less than 6m in depth, only the sea surface and bottom samples shall be taken. For *in-situ* measurements, duplicate readings shall be made at each water depth at each station. Duplicate water samples shall be collected at each water depth at each station.

2) Measurements/ water samples will be taken at representative tidal condition during which the direction of water currents will be from marine works area towards silt curtain.

Figure 4.2 Indicative Monitoring Locations for Floating Silt Curtain



Note 1: The distance will depend on the location where the pilot test will be conducted in the vicinity of water sensitive receivers.

4.2.2 Testing Parameters for Pilot Test

The testing parameters for the pilot test are shown in **Table 4.3**. Other relevant data will also be measured and recorded during the pilot test, including the location of the monitoring stations, water depth, time, weather conditions, sea conditions, tidal state, current direction and velocity, special phenomena and dredging / jetting rate during the pilot test. The monitoring equipment to be used, sampling / testing protocols, laboratory measurement and analysis will follow the requirements as stated in the Updated EM&A Manual.

Table 4.3 Testing Parameters and Equipment for Pilot Test

Parameter	Unit	Abbr.	Equipment	Reporting Unit
<i>In-situ measurements</i>				
Turbidity	NTU	-	Instrumental, CTD	0.1
<i>Laboratory measurements</i>				
Suspended solids	mg L ⁻¹	SS	APHA 2540E	1.0

4.2.3 Timing and Duration

The pilot test will be scheduled to be conducted during the early stage of construction:

- three rounds within a single monitoring day covering mid-ebb and mid-flood tides for cage-type silt curtain for dredging works. Each round of monitoring will be conducted when dredging works are operated at or close to the maximum productivity and the measurement at each monitoring station between any two rounds will be separated by at least 1 hour. The monitoring will be scheduled when relatively high current speed condition is expected on the day of testing, as far as practicable;
- three rounds within a single monitoring day covering mid-ebb and mid-flood tides for cage-type silt curtain for jetting works. Each round of monitoring will be conducted when jetting works are operated at or close to the maximum productivity and the measurement at each monitoring station between any two rounds will be separated by at least 1 hour. The monitoring will be scheduled when relatively high current speed condition is expected on the day of testing, as far as practicable; and
- three rounds within a single monitoring day for floating silt curtain. Each round of monitoring will be conducted when jetting works are operated at or close to the maximum productivity and the measurement at each monitoring station between any two rounds will be separated by at least 1 hour. The monitoring will be scheduled when the representative tide with relatively high current speed condition is expected on the day of testing, as far as practicable. Measurements/ water samples will be taken at representative tidal condition during which the direction of water currents will be from marine works area towards silt curtain for the pilot test for floating silt curtain.

Given the monitoring design of the pilot test is to measure near-field water quality around the emission source to determine the silt-retaining effectiveness of the silt curtain system, the proposed pilot test monitoring frequency (i.e. three rounds within a single monitoring day when relatively high current speed condition is expected on the day of testing and during representative tide with relatively high current speed condition which the direction of water currents will be from marine works area towards floating silt curtain to represent worst case scenario for the silt curtain system in terms of the silt-retaining capacity and integrity) is considered adequate.

During the pilot test, the dredging / jetting works shall be actively conducted within the works areas at a representative work rate not exceeding the allowed maximum work rate as stated in the Updated EM&A Manual. The surrounding environment should be controlled as far as practicable such that there would be no other major SS-generating construction activity operating concurrently in the vicinity that may influence the pilot test results.

4.2.4 Reporting

Considering that the pilot test will be conducted during the early stage of construction, the findings of the pilot test will be reported in the corresponding monthly EM&A report for the month in which the pilot test would be conducted, and the following information will be reported:

- Location plan(s) showing the monitoring stations for the corresponding silt curtains;
- Results of *in-situ* and laboratory measurement (in summary and full dataset); and
- Findings from the evaluation of pilot test results and recommendations for improvements, if any.

4.3 Determination of Silt Curtain Efficiency

Silt curtain efficiency is determined by the difference between the SS level ⁽¹⁾ near marine works area and that outside silt curtain. The following equation is adopted to determine silt curtain efficiency:

$$\text{Silt Curtain Efficiency (\%)} = \frac{SS(\text{inside}) - SS(\text{outside})}{SS(\text{inside})} \times 100\%$$

where, SS (inside) is determined by averaging the SS levels inside the marine works area (e.g. the average of A1 to A3 for floating silt curtain); SS (outside) is determined by averaging the SS levels at monitoring stations outside the silt curtains (i.e., the average of B1 to B3 for floating silt curtain; the average of B1 to B4 for cage-type silt curtain).

Should the efficiency of the silt curtain system to be adopted did not satisfy the requirements in the approved EIA Report, the Contractor shall propose further measures / improvements to the silt curtain system for consideration by HK Electric, the ET and the IEC. However, regardless of the measured efficiency of the silt curtain system, the Event and Action Plan established in the Updated EM&A Manual shall only be based on the monitoring results of the construction phase water quality monitoring at the impact monitoring stations.

(1) Turbidity may also be used to determine silt curtain efficiency as necessary.

5. OPERATION AND MAINTENANCE OF SILT CURTAIN

The Contractor will check the condition of the silt curtain (both cage type and floating silt curtain) before commencement of works every day. Refuse around the silt curtains will be collected regularly and as needed on a daily basis so that water behind the silt curtains will be kept free from floating debris. Sufficient spare geotextile will be kept on site for replacing damaged silt curtains. The spare geotextile shall be kept appropriately to avoid direct contact with water and sunlight.

Underwater silt curtain inspection will be carried out after adverse weather (e.g. Typhoon Signal No. 3 or above). Underwater silt curtain inspection will also be conducted after installation / re-installation / relocation of silt curtains / suspected sediment release due to ineffectiveness of silt curtain (e.g. from the impact water quality monitoring results to be conducted by the ET, observations by the Contractor(s), HK Electric, ET or IEC). Underwater silt curtain inspections shall cover at least a 10m length of silt curtain or one whole silt curtain panel (whichever is greater) at each location, and at intervals of at least every 200m along the length of silt curtains deployed. The underwater inspections shall check that the silt curtain fabric is intact, the silt curtain depths and ballast weight (for cage-type silt curtain) and steel chain ballast or equivalent (e.g. concrete sinker) (for floating silt curtain) positions are correct, and there is no damage / breakage in ballast weights/ steel chain ballast or equivalent and load lines. Photographic records shall be taken during each underwater inspection. All identified defects / damage shall be photographed and the position recorded on GPS to enable the affected areas to be subsequently located for in-situ repair where appropriate. An inspection checklist will be prepared and filled in by the Contractor, and endorsed by HK Electric. All checklists will be kept on site for record purpose.

In the event of silt curtain being damaged and/or requiring repairing works at the corresponding works locations, the related dredging / jetting works will be suspended immediately until the rectification works for the silt curtain is completed subject to the satisfaction by HK Electric.

Samples of Silt Curtain Daily Inspection Checklist and Underwater Inspection Checklist are shown in **Annex A** and **Annex B**, respectively.

ANNEX A

SILT CURTAIN DAILY INSPECTION CHECKLIST

Project Title:

Client:

Main Contractor:

Silt Curtain Daily Inspection Checklist

Silt Curtain ID: _____ **Location:** _____

Inspection Date and Time: _____

Item	Description	Condition		Immediate Action Required?*		Target Rectification Date	Remarks
		Yes	No	Yes	No		
1	Any floating debris / refuse within silt screen / curtain?						
2	Supporting frame / buoys in good condition?						
3	Tying rope in good condition?						
4	Geotextile intact and in good condition?						
5	Sinkers in good condition?						
6	Any obstruction to water flow between geotextile?						
7	Flashlight inspection?						
Follow up:							

Checked by:

Endorsed by:

*Note: For silt curtain with defects which need to be rectified immediately, related marine works have to be stopped until rectification works are completed to the satisfaction of the Company

ANNEX B

UNDERWATER INSPECTION CHECKLIST

Project Title:

Client:

Main Contractor:

Diver Inspection Checklist for Silt Curtain

Silt Curtain ID: _____ **Location:** _____

Inspection Date and Time: _____

Item	Description	Condition		Immediate Action Required?*		Target Rectification Date	Remarks
		Yes	No	Yes	No		
Part A - Geotextile							
1	Curtain remains intact and without gap						
2	Curtain in upright position						
3	Curtain has no loose / flapping parts						
4	Curtain is securely attached at joints						
5	Curtain fittings (e.g. chains, bands, plates, joint connectors etc.) are intact and in position						
6	Curtain extends to within 30cm from seabed level (for floating type)						
7	Curtain hem is not weighted down by sediment deposition						

Item	Description	Condition		Immediate Action Required?*		Target Rectification Date	Remarks
		Yes	No	Yes	No		
Part B - Ancillary Components							
1	Anchors (i.e. ballast weights/ steel chain ballast or equivalent) are undamaged and positions are correct						
2	Anchor (ballast weights/ steel chain ballast or equivalent) lines are properly attached to the buoys / connectors of the silt curtain						
3	No parts are detached from the silt curtain						

Checked by:

Endorsed by:

*Note: For silt curtain with defects which need to be rectified immediately, related marine works have to be stopped until rectification works are completed to the satisfaction of the Company

ANNEX C

IMPLEMENTATION SCHEDULE OF RECOMMENDED MITIGATION MEASURES

TABLE C.1 IMPLEMENTATION SCHEDULE OF RECOMMENDED MITIGATION MEASURES

EIA Reference	EM&A Reference	Recommended Environmental Protection Measures/ Mitigation Measures	Location/ duration of recommended measures & timing of completion of recommended measures	Implementation Agent	Implementation Stage ¹			Relevant Legislation & Guidelines
					D	C	O	
Water Quality								
S7.9.1	S5	Adoption of appropriate dredging and jetting rates, plant numbers and silt curtains at the plant and WSRs, where applicable (Table 7.18 of the EIA Report, reprovided as Table C.2 below).	Marine Dredging & Jetting for the LPS Pipeline / During construction	Contractor(s)		✓		-
S7.9.1	S5	Cofferdam construction and removal at landfall of LPS (where required) should not be conducted concurrently with the nearby pipeline dredging section (LPS KP17.4-18.2). Silt curtain surrounding the works areas for cofferdam construction and removal at pipeline landfall of the LPS should also be implemented.	Pipeline landfall for the LPS Pipeline / During construction	Contractor(s)		✓		-

⁽¹⁾ D = Design Phase, C = Construction Phase, O = Operational Phase

EIA Reference	EM&A Reference	Recommended Environmental Protection Measures/ Mitigation Measures	Location/ duration of recommended measures & timing of completion of recommended measures	Implementation Agent	Implementation Stage ¹			Relevant Legislation & Guidelines
					D	C	O	
S7.9.1/ S7.9.2	S5	<p>The following measures shall be followed for provision of silt curtain:</p> <ul style="list-style-type: none"> The silt curtain shall be formed and installed in such a way that tidal rise and fall are accommodated, with the silt curtains always extending from the surface to the bottom of the water column and held with anchor blocks. Schematic diagrams on silt curtain deployment are provided in Figures 7.4 and 7.5 of the EIA Report. The contractor shall regularly inspect the silt curtains and check that they are moored and marked to avoid danger to marine traffic. Regular inspection on the integrity of the silt curtain should be carried out by the contractor and any damage to the silt curtain shall be repaired by the contractor promptly. Relevant marine works shall only be undertaken when the repair is fixed to the satisfaction of the engineer. 	Marine Dredging & Jetting for the LPS Pipeline / During construction	Contractor(s)		✓		-
Ecology								
S9.11.3	S7	Silt curtain deployment during Project construction and maintenance dredging will avoid encroachment into the existing and proposed marine parks.	Marine works (on existing, planned and potential marine parks) / During construction / During operation	Contractor(s)/ Project Proponent		✓	✓	-

EIA Reference	EM&A Reference	Recommended Environmental Protection Measures/ Mitigation Measures	Location/ duration of recommended measures & timing of completion of recommended measures	Implementation Agent	Implementation Stage ¹			Relevant Legislation & Guidelines
					D	C	O	
S9.11.3	S7	Silt curtain will be checked and maintained to ensure its effectiveness in mitigating water quality impacts on existing, planned and potential marine parks.	Marine works / During construction / During operation	Contractor(s) / Project Proponent		✓	✓	-

**TABLE C.2 SUMMARY OF MITIGATION MEASURES FOR PIPELINE
CONSTRUCTION WORKS**

Work Location	Plants Involved	Allowed Maximum Work Rate	Silt Curtain at Plants	Silt Curtain at WSRs	Other Measures
LPS Pipeline					
Pipeline shore approach at LPS (KP17.4-18.2)	1 Grab Dredger	1,600m ³ day ⁻¹ for 24 hours each day	Yes	Not required	
West Lamma Channel (KP14.5-17.4)	1 Jetting Machine	1,000m day ⁻¹ for 24 hours each day	Yes	Not required	
South of Shek Kwu Chau to West Lamma Channel (KP5.0-14.5)	1 Jetting Machine	7,000m day ⁻¹ for 24 hours each day	Yes	Not required	
Double Berth Jetty to South of Shek Kwu Chau (KP0.1-5.0)	1 Jetting Machine	720m day ⁻¹ for 24 hours each day	Yes	Two layers at Eastern Boundary of the Proposed South Lantau MP (KP0.1-5.0)	Daily maximum of 12 hours with daylight (0700 – 1900)
Pipeline Riser Section at Double Berth Jetty					
Pipeline Riser (KP0.0 – 0.1)	1 Grab Dredger	8,000m ³ day ⁻¹ for 24 hours each day	Yes	Not required	Daily maximum of 12 hours with daylight (0700 – 1900)

ANNEX D

DETAILS OF MANUFACTURER/ SUPPLIER'S SPECIFICATION AND PROJECT REFERENCES



SG WOVEN GEOTEXTILES

we under^{cover} the world

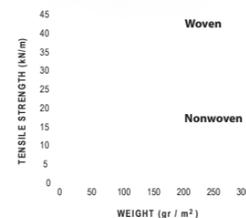
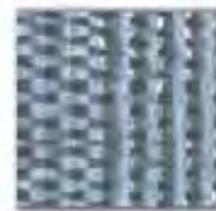
A TOTAL RANGE OF GEOTEXTILES

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 BELGIUM
 T.: +32 (0) 52 457 487
 F.: + 32 (0) 52 457 495
 E-MAIL: geotextiles@bonartf.com

For UK and Ireland:
BONAR YARNS & FABRICS Ltd
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 Dundee Scotland
 DD3 7EU
 T.: +44 (0)1382 346102
 F.: +44 (0)1382 229238
 E-MAIL: geotextiles@bonaryarns.com

website: www.bonartf.com

bontec
 woven and nonwoven geotextiles



SEPARATION



REINFORCEMENT



Other geotextiles available within the Bontec range include Highflow, High strength Wovens and Thermally Bonded & Needle-punched Nonwovens

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www.bonartf.com

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 E-MAIL: geotextiles@bonaryarns.com

SG Woven Geotextiles PRODUCT PROFILE

“An exciting range of Standard Grade geotextiles that offer the perfect solution to your Separation requirements. With tensile strengths ranging from 10 to 300 kN/m you can be certain that an SG fabric will be available with the performance that you are looking for.”

DAILY SEPARATION, SOIL STRENGTHENING OR GROUND REINFORCEMENT?

Bontec SG woven geotextiles are manufactured from polypropylene tapes & yarns, and exhibit an excellent chemical resistance to commonly encountered acids and alkalis at ambient temperatures. Available in a lightweight range with products from 80 to 200g/m², and a heavyweight range from 200 to 800g/m².

Bontec SG facts include:

Tensile strengths up to 300 kN per metre (kN/m) width
 CBR Puncture Strengths ranging from 1.800 N to 12.500 N

SG Mechanical Properties that offer maximum strength at minimal cost and ensure the products survivability both against installation damage and in the longer term.

Lightweight woven geotextiles typically offer greater mechanical strengths per unit weight than comparable nonwoven grades. This makes lightweight woven geotextiles the ideal choice for separation

Waterflows normal to the plane that are generally several times more than that required by design

A range of consistent opening sizes suited for use in soils ranging from clay to coarse granular fill.

SG hydraulic properties that are suited to the demands of everyday separators.

Available ex-stock in 4.5m and 5.25m wide rolls or other widths to order

Typical applications for SG woven geotextiles include:

As a general purpose separator for use under site access roads and areas of hardstanding.

As a separation and strengthening layer under new roadways, car parks, industrial units etc.

As an erosion control layer under heavy rock armour in coastal defence projects. For any separation application where there exists a need to prevent the intermixing of soft foundation soils with good clean granular fill.

SG Woven Geotextiles have been manufactured as a cost effective solution to your soil separation and stabilisation applications. They are manufactured from highly durable polypropylene polymer and have a long life expectancy when used in permanent structures.

For further product information, be it a technical data sheet or to discuss your project with one of our in-house geotextile experts please do not hesitate to contact one of our offices listed below.

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 T.: +32 (0) 52 457 487 | F.: + 32 (0) 52 457 495
 E-MAIL: geotextiles@bonartf.com

Bontec® SG 110/110

Heavy weight Polypropylene Woven Geotextiles

Technical data sheet

Product description

Polymer	Density	Melting Point	Construction
100% Polypropylene	0,91 kg/dm ³	165 °C	Tapes

Properties

Mechanical Properties	Standard	Performance	Tolerance
Tensile strength - MD	EN ISO 10319	110 kN/m	-9,9 kN/m
Tensile strength - CMD	EN ISO 10319	110 kN/m	-9,9 kN/m
Elongation at maximum load - MD	EN ISO 10319	10 %	+/-2,3 %
Elongation at maximum load - CMD	EN ISO 10319	8 %	+/-1,8 %
Static puncture resistance (CBR)	EN ISO 12236	12,5 kN	-2,5 kN
Dynamic perforation resistance (cone drop)	EN ISO 13433	10 mm	+2,0 mm
Tensile strength at 2% elongation - MD	EN ISO 10319	15 kN/m	
Tensile strength at 2% elongation - CMD	EN ISO 10319	25 kN/m	
Tensile strength at 5% elongation - MD	EN ISO 10319	45 kN/m	
Tensile strength at 5% elongation - CMD	EN ISO 10319	60 kN/m	

Hydraulic Properties	Standard	Performance	Tolerance
Water permeability normal to the plane (Vlh50)	EN ISO 11058	25 l/m ² s	-8 l/m ² s
Characteristic Opening Size (O90)	EN ISO 12956	230 µm	+/-69,0 µm

Physical Properties	Standard	Performance	Tolerance
Weight	EN ISO 9864	464 g/m ²	+/-46,4 g/m ²
Length (+/- 1%) x width (+/- 1%)		100 x 5,25 m	
Truck Load Volume (+/- 10%)		30450 m ³	
Roll diameter (+/- 10%)		45 cm	

Durability	Standard	Performance	Tolerance
Predicted minimal durability in years in natural soils with 4 < pH < 9 and soil temperatures < 25°C	EN ISO 13438 - A2	25	
Maximum allowed time between installation and covering of the geosynthetic	EN 12224	2 weeks	

The Quality Management System of Bonar has been approved to the ISO 9001 Quality Management System Standard. Certificates are available on request.



The information set forth in this data sheet reflects the best knowledge at the time of publication. The document is subject to change pursuant to new developments and findings. The same reservation applies to the properties of the products described. No liability is undertaken for results obtained by usage of the products and information.

Version date: 1/11/2014

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Version n°



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Date	September 2016
Project	Contract No. NE/2015/02 Tseung Kwan O - Lam Tin Tunnel Road P2 and Associated Works
Client	Civil Engineering and Development Department
Consultant	AECOM Asia Company Limited
Main Contractor	CRBC-Build King Joint Venture Hong Kong River Engineering
Works	Silt Curtain
Material	Woven Geotextile Bontec SG110/110
Quantity	11,025 sqm



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Date	Jan 2016
Project	Proposed revitalization of Avenue of Star and east TST Promenade Waterfront
Client	New World Development
Main Contractor	Kaden Construction Ltd
Works	Silt Protector
Material	Woven Geotextile Bontec SG110/110
Quantity	1,050 sqm



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Date	January 2015
Project	Contract No. SCL1121 Shatin to Central Link - NSL Cross Harbour Tunnel
Client	MTR Corporatin
Consultant	AECOM Asia Co. Ltd
Main Contractor	Penta Ocean - China State JV
Works	Silt Curtain
Material	Woven Geotextile Bontec SG110/110
Quantity	22,575 sqm



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Date	May 2014
Project	HY/2012/07 Tuen Mun - Chek Lap Kok Link- Sothern Connection Viaduct Section
Client	Highway Department
Consultant	AECOM Asia Co. Ltd
Main Contractor	Gammon Construction Ltd
Material	Woven geotextile Bontec SG110/110
Works	Silt Protector
Quantity	8,925 sqm



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Date	Nov 2014
Project	Contract No. HY/2010/08 Central-Wanchai Bypass - Tunnel (Slip Road 8 Section)
Client	Highway Department
Consultant	AECOM Asia Co Ltd
Main Contractor	China State Construction Engineering (HK) Ltd
Works	Silt Curtain
Material	Woven Geotextile Bontec SG110/110
Quantity	1,575 sqm



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Date	May 2013
Project	Contract No. HK/2012/08 Wan Chai Development Phase II - Central Wan Chai Bypass at Wan Chai West
Client	Civil Engineering and Development Department
Consultant	AECOM Asia Co. Ltd
Main Contractor	China State Construction Engineering Co. Ltd Hong Kong River Engineering Co Ltd
Works	Silt Curtain
Material	Woven Geotextile SG110/110
Quantity	42,525 sqm



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Date	June 2013
Project	Contract No: HY/2011/03 HK-Zhuhai Macau Bridge Hong Kong Link Road - Scenic Hill and Hong Kong Boundary Crossing Facilities
Client	Highway Department
Consultant	Ove Arup & Partners HK Ltd
Main Contractor	China State Construction Engineering
Works	Tailor-made Silt Protector
Material	Woven Geotextile Bontec SG110/110



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Date	Jan 2014
Project	Contract No. CV/2013/02 Maintenance contract for seawalls and navigation channels
Client	CEDD
Consultant	CEDD
Main Contractor	China Harbour Engineering Co Ltd
Works	Silt Protector
Material	Woven Geotextile Bontec SG110/110



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Date	Feb 2014
Project	Contract No. DC/2011/04 Reconstruction, improvement and rehabilitation of Kai Tak River from Wong Tai Sin Police Station to Tung Tau II Estate
Client	Drainage Service Department
Consultant	Scott Wilson Limited
Main Contractor	Leader - Sunnic JV
Works	Silt Curtain to Kai Tak Nullah
Material	Woven Geotextile Bontec SG110/110
Quantity	525 sqm



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Date	Dec 2011
Project	Contract No. HY/2010/02 HK-Zhuhai-Macau Bridge - HK Boundary Crossing Facilities
Client	Highway Department
Consultant	Ove Arup & Partners HK Ltd
Main Contractor	China Harbour Engineering Co Ltd
Works	Silt Curtain Fabrication
Material	Woven Geotextile Bontec SG110/110



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Date	November 2005
Project	Contract No. HY/2002/26 Stonecutters Bridge
Client	Highway Department
Consultant	Ove Arup and Partners HK Ltd
Main Contractor	Hong Kong River Engineering Co Ltd Maeda - Hitachi - Yokogawa - Hsing Chong Joint Venture
Material	Woven geotextile Bontec SG110/110
Works	Tailor-made Silt Curtain
Size	1,050 sqm



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Date	May 2011
Project	Contract No. DC/2009/22 Drainage Improvement Works in Shuen Wan, Tai Po
Client	Drainage Service Department
Consultant	AECOM (Asia) Ltd
Main Contractor	Kwan Lee - Kuly Joint Venture
Works	Separation
Material	Woven geotextile SG110/110
Quantity	2,625 sqm



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Date	June 2013
Project	Contract No. HY/2009/15 Central-Wanchai Bypass-Tunnel (Causeway Bay Typhoon Shelter Section)
Client	Highway Department
Consultant	AECOM Asia Co. Ltd
Main Contractor	China State Construction Engineering (HK) Limited
Works	Tailor-made Silt Curtain
Material	Woven Geotextile Bontec SG110/110



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Date	March 2014
Project	Contract No. HK/2009/02 Wan Chai Development Phase II Central - Wan Chai Bypass Wan Chai East
Client	Civil Engineering and Development Department
Consultant	AECOM (Asia) Ltd
Main Contractor	Chun Wo Construction & Engineering Co.Ltd
Application	Silt Protector
Material	Woven Geotextile SG110/110
Quantity	6,825 sqm



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Date	March 2010
Project	Contract No. HK/2009/01 Wan Chai Development Phase II -Central - Wanchai Bypass at Hong Kong Convention and Exhibition Centre
Client	Civil Engineering and Development Department
Consultant	AECOM Asia Co. Ltd
Main Contractor	Chun Wo - Leader Joint Venture
Works	Intake Silt Curtain
Materials	Woven Geotextile SG110/110
Size	34,125 sqm



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Date	March 2010
Project	KL/2009/01 Site formation for Kai Tak Cruise Terminal Development
Client	CEDD
Consultant	Scott Wilson Ltd
Main Contractor	Penta-Ocean Construction Co. Ltd
Materials	SG110/110
Size	1,050 sqm



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Date	May 2014
Project	HY/2012/07 Tuen Mun - Chek Lap Kok Link- Sothern Connection Viaduct Section
Client	Highway Department
Consultant	AECOM Asia Co. Ltd
Main Contractor	Gammon Construction Ltd
Works	Silt Curtain
Material	Woven geotextile Bontec SG110/110



Date	March 2010
Project	Contract No. DC/2007/01 Drainage Improvement Works in Ki Lun Tsuen, Kwu Tung, Ma Tso Lung and Sha Ling
Client	Drainage Services Department
Consultant	Mott MacDonald
Main Contractor	Shanghai Urban Construction (Group) Corporation
Works	Soil filter
Material	Woven Geotextile Bontec SG110/110 Woven Geotextile Bontec SG40/40
Quantity	SG110/110 - 7,875 sqm SG40/40 - 71,925 sqm



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Date	April 2011
Project	Contract No. HY/2009/11 Central - Wanchai Bypass - North Point Reclamation
Client	Highways Department
Consultant	AECOM Asia Ltd
Main Contractor	China Harbour Engineering Company
Works	Tailor-made Silt Curtain
Materials	Woven Geotextile SG110/110
Quantity	22,066 sqm



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Date	May 2004
Project	Contract No. CV/2001/12 Reconstruction of Cheung Chau and Wu Kai Sha Public Piers
Client	Civil Engineering and Development Department
Engineer	Civil Engineering and Development Department
Main Contractor	Hong Kong and Macau Scent On Engineering & Construction Ltd
Works	Tailor-made Silt Curtain
Material	Woven Geotextile Bontec SG110/110



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Date	October 2006
Project	Lamma Island Cable Landing
Client	Hong Kong Electric Co Ltd
Consultant	Hong Kong Electric Co Ltd
Main Contractor	United Marine Co Ltd
Works	Tailor-made Silt Curtain
Material	Woven Geotextile SG110/110
Quantity	2,100 sqm



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Date	March 2006
Project	Contract No. HY/2005/06 Castle Peak Road Improvement West of Tsing Lung Tau
Client	Highway Department
Consultant	Mouchel Halcrow JV
Main Contractor	Chun Wo Construction & Engineering Co., Ltd.
Material	Woven Geotextile Bontec SG110/110
Works	Tailor-made Silt Curtain
Quantity	1,050 sqm



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website: www.g-and-e.com



Date	February 2005
Project	Contract No. CV/2003/06 Stanley Waterfront Improvement Project - Construction Pier &
Client	Civil Engineering and Development Department
Consultant	Civil Engineering and Development Department
Main Contractor	Sun Fook Kong (Civil) Ltd
Works	Silt Curtain - SG110/110
Quantity	2,080 sqm



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Date	May 2011
Project	Contract No. DC/2009/13 Construction of Sewage Treatment Works at Yung Shue Wan and Sok Kwu Wan
Client	Drainage Service Department
Consultant	Scott Wilson CDM Joint Venture
Main Contractor	Leader Civil Engineering Corp Ltd
Material	Bontec SG110/110 woven geotextile
Works	Silt Curtain
Quantity	1,575 sqm



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Date	Jan 2005
Project	Contract No. HK/12/02 Central Reclamation Phase III Engineering Works
Client	Civil Engineering and Development Department
Consultant	Atkins China Ltd
Main Contractor	Leighton - China State - Van Oord JV
Material	Woven Geotextile Bontec SG110/110
Works	Silt Curtain
Quantity	3,655 sqm



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Date	January 2010
Project	KL/2008/07 Kai Tak Development-Infrastructure works at Southern part of former runway, Stage 1
Client	CEDD
Consultant	AECOM
Main Contractor	Friendly Benefit Engineering Ltd
Works	Fabrication of Silt Curtain
Materials	SG110/110



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Date	March 2013
Project	Contract No. 1017EM10 Seawall Modification Work at Outfall Area at Kai Tak Development
Client	Civil Engineering and Development Department
Consultant	AECOM
Main Contractor	Crown Asia Engineering Ltd
Works	Silt Curtain
Material	Woven geotextile Bontec SG110/110
Quantity	1,050 sqm