DEPARTMENT OF CIVIL ENGINEERING
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DELOS WP 1.1 Inventory on LCS, detailed description

According to DELOS WP 1.1 an inventory for existing low crested structures (LCS) must be established. As low crested structure we mean structures designed to be submerged or regularly overtopped by waves. The detailed inventory (described below) concerns shore parallel structures including shore-attached structures, which are perpendicular to shoreline if part of the scheme. This inventory will be established through a digital questionnaire located at www.delos.dk

The inventory is established in the following way:

- A brief description is given for each LCS (another document). This description should be given for all kinds of LCS.
- Some structures/locations are selected for further investigations
- A more detailed description is given for the selected structures/locations (this document). This part shall focus on shore parallel structures including shore-attached structures, which are perpendicular to shoreline if part of the scheme.

Both the brief and the detailed descriptions will be presented on www.delos.dk
For each structure the following information should be given.

A: Formalities **3**
B: Geometry and construction materials **4**
C: Local meteomarine conditions at the structure **10**
D: Sea bed and beach characteristics, incl. sediment transport **11**
E: Structural performance ..... Error! Bookmark not defined.
F: Socio-economic aspects **12**
G: Ecological aspects ..... Error! Bookmark not defined.
H: Coastal protection performance **14**
I: Problems in general ..... Error! Bookmark not defined.

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How to use this document

In this document, you can give a detailed description of a specific LCS. The description must be completed within this digital document. Just type the text in the tables, insert relevant pictures, drawings, sketches etc. and save the document. Only relevant information should be included in the document; existing non-used tables, sketches etc. present in this document must be deleted. The existing figures etc. are meant to be guidelines that can be changed for a specific environment. But please keep the structure of the document intact.

When completed, please attach the document to an email and send it to i5mkr@civil.auc.dk.

The filenames for the documents must include the participant code, the Country Code (as used on the Internet for Country Code Domains) and a Location-number between 001 and 999. It is very important that the same Location-number is used as for the brief description. The letters "det" must also be included to indicate that the detailed version of the questionnaire is used. The filenames for UB collecting information from East Italy (see special Country Code below) will therefore be "UB_EIT_det_001.doc" till "UB_EIT_det_999.doc". Each participant must provide a map of the country showing all the locations of the sites of interest, the Location-numbers must appear on this map.

Inputs come from:
UPC: Spain (Country Code ES)
DHI: Denmark (Country Code DK)
MOD & UR3: West Italy (Country Code WIT)
UB: East Italy (Country Code EIT)
AUTH: Greece (Country Code GR)
INF: Holland (Country Code NL)
UCA: non European LCS by literature study (Country Code nonEU)
UoS: U.K. (Country Code UK)

A: Formalities

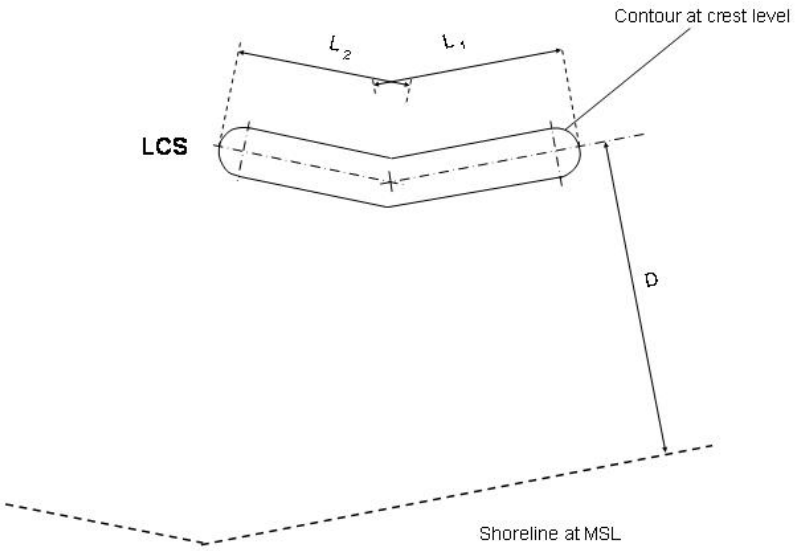
Participant code and who to contact.	UPC-ES José María Alsina Torrent
E-mail	jose.alsina@upc.es
This date (today, mm:dd:yyyy) and revision number (A..Z).	December 19th 2002
Location of LCS.	"La Laja" beach is located 10 km south of Las Palmas city (Canary Islands).
Start date, length and/or end of works. Have there been any later changes? If so, when?	The works were finished end of 1993.
Design life - the minimum length of time the beach management scheme is designed to last.	
Which tools and regulations are used for the design formulae (mathematical models, model tests, engineering experience, standards, recommendations).	standars
Who fund the work (e.g. Public Administration or private company)?	Public Administration: "Ministerio de Obras Públicas"
Costs.	4662667.57 Euros

B: Geometry and construction materials

B1 System layout (aerial view)

Are shore attaching structures present (e.g. groins)?	☒ Yes ☐ No
Are emerging head islands present?	☐ Yes ☒ No

The following sketch concerns only shore parallel LCS; if the layout is different you must insert another sketch and specify parameters like the ones suggested. If a picture is available please insert it too.



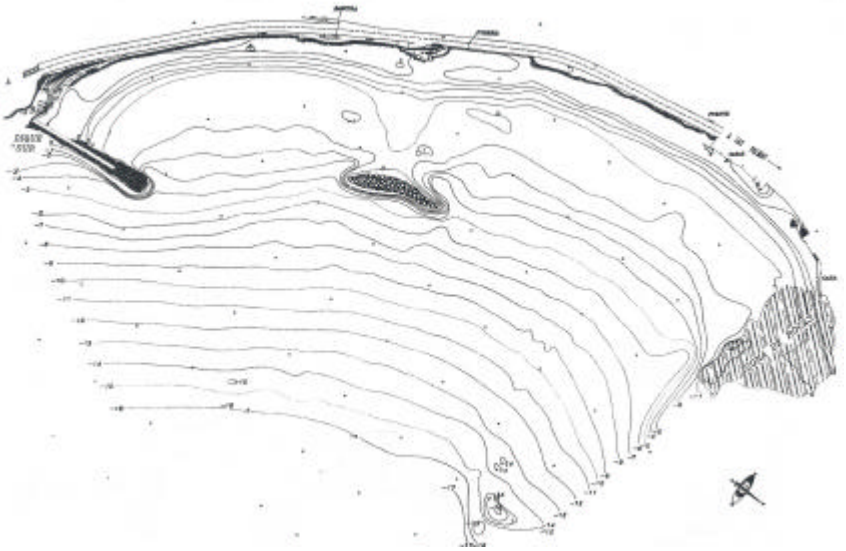
The typical layout is given at Sea Bed (index SB) and at Crest Level (index CL).

Parameter	Description	Fill in box	unit
D	Distance from shoreline	135	meters
L_1	Length of section 1 at crest level	80	meters
L_2	Length of section 2 at crest level	73	meters
$L_{CL\,1}$	Length of section 1 at sea bed	93	meters
$L_{CL\,2}$	Length of section 1 at sea bed	91	meters
n	Number of LCS in system	1	

Remarks
The LCS was built in two sections L_1 parallel to south side of the beach and L_2 one parallel to north side.

B2 Bathymetry of sea bed and beach

Please insert a dimensioned sketch if possible.

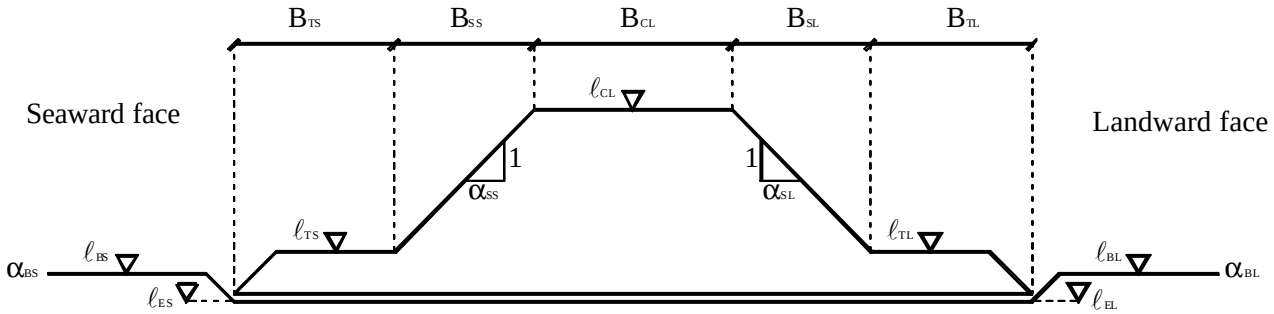


Description of bathymetry when LCS were build
Is detailed information (measurements) available? If so, please explain.

"La Laja" beach is limited by a shallow rocky bottom at its northernmost edge, and by a groin at its southernmost side.

B3 Trunk cross section/contour geometry – outer profile

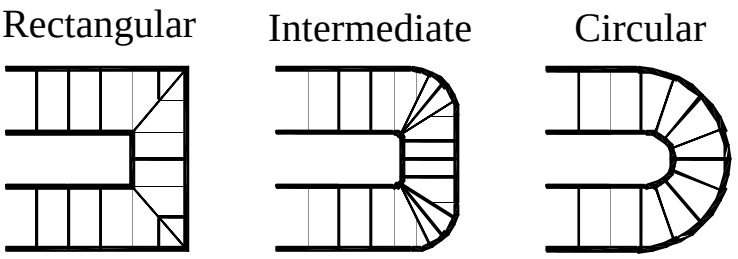
If shore attached structures perpendicular to shoreline are present, please insert a sketch with typical longitudinal section and typical selected cross sections. Specify parameters as the ones given below. If the layout does not fit the following sketch please insert another sketch.



Parameter	Description	Fill in box	unit
α_{BS}	Steepness of sea bed, seaward	2.8	%
α_{BL}	Steepness of sea bed, landward	5.0	%
α_{SS}	Steepness of slope, seaward	2	
α_{SL}	Steepness of slope, landward	2	
ℓ_{BS}	Level of sea bed at seaward toe	-6.0 -6.50	meters
ℓ_{ES}	Level of excavation, seaward	0	meters
ℓ_{TS}	Level of toe, seaward	-4.0 -4.5	meters
ℓ_{CL}	Level of crest	+1.0	meters
ℓ_{BS}	Level of sea bed at landward toe	-4.0 -5.5	meters
ℓ_{ES}	Level of excavation, landward	0	meters
ℓ_{TS}	Level of toe, landward	-2.0 -3.5	meters
B_{TS}	Width of toe, seaward	10.0	meters
B_{SS}	Width of slope, seaward	7.0	meters
B_{CL}	Width of crest	20.0	meters
B_{SL}	Width of slope, landward	7.0	meters
B_{TL}	Width of toe, landward	10.0	meters

Remarks (e.g. different layout along shoreline, other important parameters).
All levels are referee at lowest astronomical level

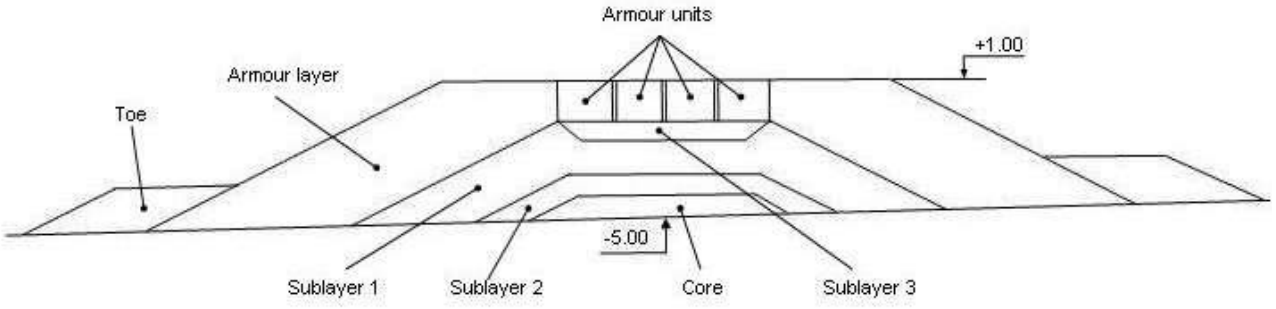
B4 Round head contour geometry



What is the shape of the round head?
☐ Rectangular
☐ Intermediate
☒ Circular

B5 Description of layers

Please insert a dimensioned sketch with the typical cross-section composition.



For each layer, please provide the following information.

ARMOUR LAYER CHARACTERISTICS			
Parameter	**Description**	**Fill in box**	**unit**
	Concrete		
	Cubes		
	Weight of cubes	18	Ton
	Layer thickness	3.91	meters
	Geotextile between layers?	☐ Yes ☒ No	

ARMOUR UNITS CHARACTERISTICS			
Parameter	**Description**	**Fill in box**	**unit**
	Concrete		
	Cubes		
	Size of cubes	1.75 x 2.25 x 2.25	meters
	Geotextile between layers?	☐ Yes ☒ No	

SUBLAYER 1 CHARACTERISTICS			
Parameter	**Description**	**Fill in box**	**unit**
	Stones		
	quarry rock		
	Weight of stones	900-1800	kg
	Layer thickness	2.35	meters
	Geotextile between layers?	☐ Yes ☒ No	

SUBLAYER 2 CHARACTERISTICS			
Parameter	**Description**	**Fill in box**	**unit**
	Stones		
	Quarry rock		
	Weight of stones	70-135	kg

	Layer thickness	1.00	meters
	Geotextile between layers?	☐ Yes ☒ No	

SUBLAYER 3 CHARACTERISTICS			
Parameter	**Description**	**Fill in box**	**unit**
	Stones		
	Quarry rock		
	Weight of stones	500	kg
	Layer thickness	0.75	meters
	Geotextile between layers?	☐ Yes ☒ No	

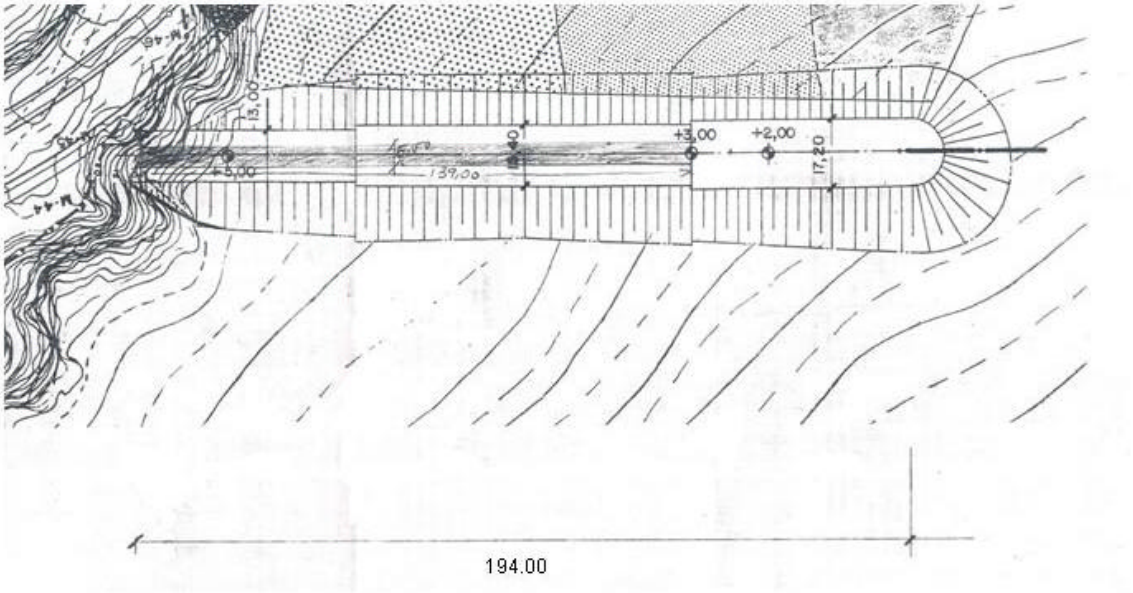
TOE CHARACTERISTICS			
Parameter	**Description**	**Fill in box**	**unit**
	Stones		
	Quarry rock		
	Weight of stones	3	Ton
	Geotextile between layers?	☐ Yes ☒ No	

CORE CHARACTERISTICS			
Parameter	**Description**	**Fill in box**	**unit**
	Core Material		
	Quarry rock		
	Geotextile between layers?	☐ Yes ☒ No	

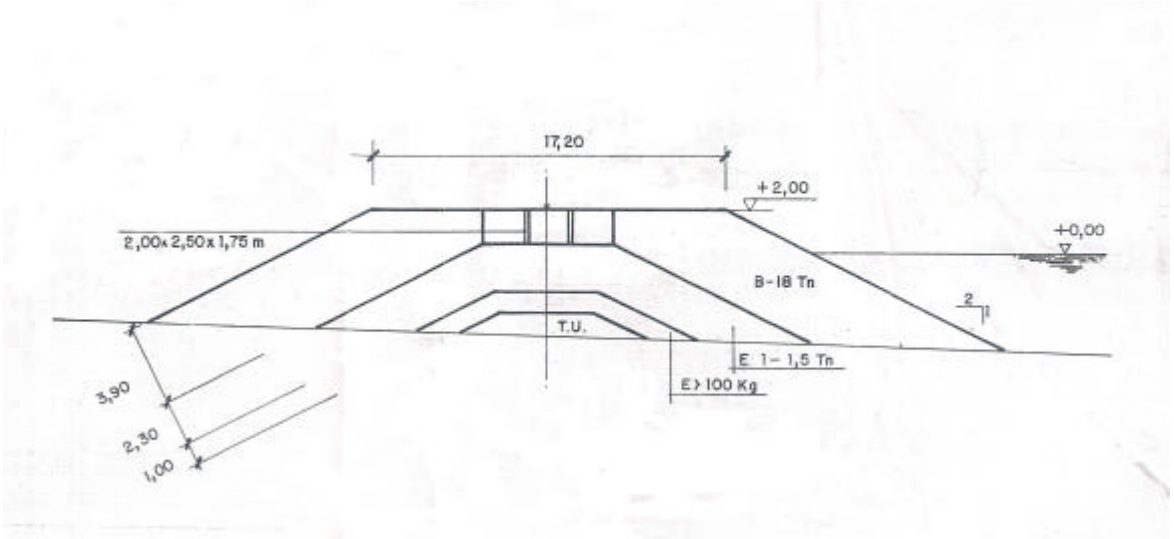
Remarks (e.g. details on geotextile)

Scheme layout of groin allocated at south side of the beach. Cross section and aerial view of the perpendicular structure.

Aerial view:



Cross section:



B6 Construction method

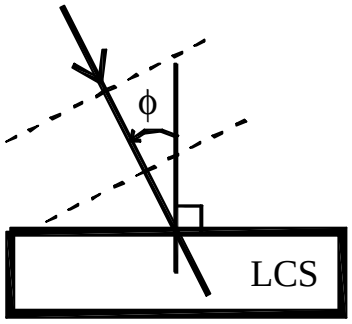
How have the stones been placed?

☐ Dumped with barges ☐ Placed with barges ☒ Land based operation ☐ Other:

Remarks
The first construction was the southernmost groin, followed by the beach nourishment. Finally, the LCS was build up as follows. First, a path was built from the shore to the LCS to allow engines transit until the +4.00 level (referred to the lowest astronomical level), at which the breakwater structure started being built. Once the LCS was finished, the breakwater structure level was reduced to the final +1.00 level and the connecting path to the shoreline was removed.

C: Local meteomarine conditions at the structure

C1 Waves



Parameter	Description	Fill in box	unit
H_S	Design significant wave height	6.40	meters
T_P	Design peak period	14.00	seconds
ϕ	Design wave incidence angle	45	degree

Remarks (provide information on wave statistics and wave spectra if available, e.g. H_S corresponding to return periods 1 month, 1 y, 10 y, 50 y. Please specify the source of the data)
The design significant wave height is calculated from Goda´s formulae.

C2 Water levels

Water level statistics
The data available is only that of tidal range = 2.80 m

D: Sea bed and beach characteristics, incl. sediment transport

Description of the coast (e.g. bar type coast with gentle slope or plane coast with steep slope)
"La Laja" is considerated a shell-shape beach with a mean slope of about 3%.

D1 Natural sea bed material at surface

Remarks (provide grain distribution if available)
No information on sea bed material before the nourishment is available.

D2 Natural beach material at surface

Natural supply?	☐ Yes ☐ No
Supplied by beach nourishment?	☒ Yes ☐ No

Remarks (provide grain distribution if available)

D3 Artificial beach nourishment

Description of nourishment
The nourishment was made of 403000 m^3 of sand with a medium grain diameter of 0.40 mm emplaced along 1200 meters of beach.

Parameter	Description of artificial nourishment	Fill in box	unit
	Material (e.g. quartzite)		
ρ_r	Mass density of material		kg/m^3
D_{n50}	Nominal diameter	0.0004	meters
Gr	Grading of the material (D_{85}/D_{15})		

Remarks (provide grain distribution if available)

F: Socio-economic aspects

What regime of property has the coast at this site?
Private ☐, Public full free access ☒, Public limited access ☐, Natural reserve ☐, Don't know ☐,
Other (please specify):

Who decided that an LCS should be built at that site?
Individual, acting for private purpose ☐
Individual, acting for public purpose (e.g. Natural park administrator) ☐
Local authority (e.g. city council) ☐
Regional authority (e.g. province level) ☐
National authority (e.g. ministry) ☒
Don't know ☐
Please give name of the authority whenever applicable:

What was the main motive for building the LCS?
Coast erosion ☐
Inducing or maintaining recreational activity ☒, please specify: Increase the sandy beach size
Environmental concern ☐, please specify:
Other ☐, please specify:
Don't know ☐

Was that LCS part of a larger coastal management plan?
Yes ☐, please specify:
No ☒, please specify:
Don't know ☐

Public opinion on that LCS:
Construction was accompanied by public protest ☐
The public did not react ☐
Public opinion asked for the LCS ☐
Local commerce asked for the LCS ☐
Don't know ☒
Other (please specify):

Description of the coast:
Urban ☐, Densely constructed ☐, Scarcely constructed ☒, No apparent construction ☐
Are there dunes? Yes ☐, No ☒
Has commercial activity changed significantly after construction of the LCS?
hotels construction: More hotels ☐, Less hotels ☐, Unaffected ☒, Don't know ☐
bars and similar construction: More ☐, Less ☐, Unaffected ☐, Don't know ☒
advertising for the area: More ☐, Less ☐, Unaffected ☐, Don't know ☒
other (specify): It has increased the recreational activity in this area

Visual impact of LCS not already described in Part B: Are there parts of the LCS visible under average conditions? Poles ☐, Cables ☐, Reefs ☐,
Others (please specify):

Water quality changes since LCS construction

Are there episodes of water turbidity since construction?

No ☐, Rare ☐, Often ☐, Permanent ☐

Were there episodes of water turbidity before construction?

No ☐, Rare ☐, Often ☐, Permanent ☐

Has water quality otherwise been affected (for example, more or less detritus accumulating)?

Please describe:

How would you qualify the following recreational activities at or around the LCS? (DK = Don't know)

Fishing (recreational)	Intense ☐	Moderate ☒	Scarce ☐	Absent ☐	DK ☐
Seafood collecting	Intense ☐	Moderate ☐	Scarce ☐	Absent ☐	DK ☒
Wildlife watching	Intense ☐	Moderate ☐	Scarce ☐	Absent ☒	DK ☐
Sunbathing and similar	Intense ☐	Moderate ☐	Scarce ☐	Absent ☒	DK ☐
Scuba diving	Intense ☐	Moderate ☐	Scarce ☐	Absent ☒	DK ☐
Sailing and similar	Intense ☐	Moderate ☐	Scarce ☐	Absent ☒	DK ☐
Other (specify)	Intense ☐	Moderate ☐	Scarce ☐	Absent ☐	DK ☐

Could you describe those recreational activities before the LCS was built? (DK = Don't know)

Fishing (recreational)	Intense ☐	Moderate ☒	Scarce ☐	Absent ☐	DK ☐
Seafood collecting	Intense ☐	Moderate ☐	Scarce ☐	Absent ☐	DK ☒
Wildlife watching	Intense ☐	Moderate ☐	Scarce ☐	Absent ☒	DK ☐
Sunbathing and similar	Intense ☒	Moderate ☐	Scarce ☐	Absent ☐	DK ☐
Scuba diving	Intense ☐	Moderate ☐	Scarce ☐	Absent ☒	DK ☐
Sailing and similar	Intense ☐	Moderate ☐	Scarce ☐	Absent ☒	DK ☐
Other (specify)	Intense ☐	Moderate ☐	Scarce ☐	Absent ☐	DK ☐

Has that LCS had an environmental impact assessment before being built? Yes ☐, No ☒, Don't know ☐

Could you give its references and location (specify)?

Has there been an economic study on that LCS,

before it was built? Yes ☐, No ☒, Don't know ☐, References:

after it was built? Yes ☐, No ☒, Don't know ☐, References:

H: Coastal protection performance

H1 Bathymetry and beach evolution

Description of historical beach evolution before LCS was built (10-20 years).

Description of beach evolution after LCS was built up to now.

There are information available of beach evolution after LCS was built until 1995 (the period of the study is between end1993 until 1995). The 0.00 m isobath (referred to the lowest astronomical level) has gained in horizontal extent seawards: on March 1994 it was on a salient position, leading to a tombolo position on September 1995. Therefore, nowadays, the beach shows a tombolo shape during the lowest astronomical tide, whereas the rest of the time appears as a salient. At higher levels than the +4.00 isobath the beach does not show any apreciate change in shape.