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LIFE SouPLess

Evaluation passive system for riverine micro- and macro-plastics removal

Report Project Catchy 2 B4
Task <DB.4.3>

LIFE17 ENV/NL/000339

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PROJECT OVERVIEW

1.1 Introduction

In 2021, Allseas finalized the design of the third plastic collection system (Action B4). In collaboration with the Municipality of Rotterdam, the location chosen was under the Erasmus bridge in the river Nieuwe Maas, in the centre of Rotterdam. The system was installed together with HEBO, a provider of maritime services, in March of 2022. For a 2 month period after the installation, Catchy 2 was monitored and improved by Allseas Engineering BV.

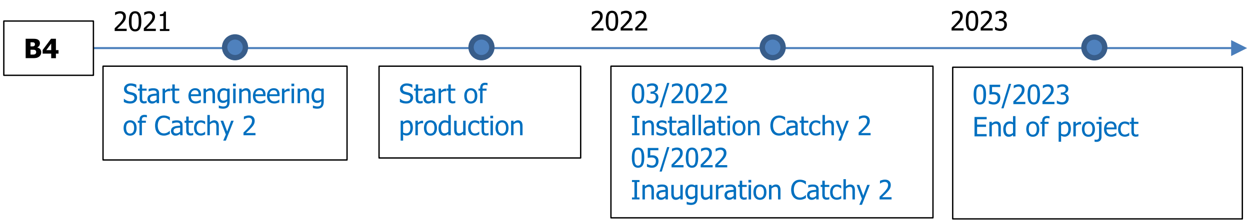
The scope of this project was the design, manufacturing, installation, and operation of a passive plastic catcher under the Erasmus bridge for a period of at least one year, starting officially with an opening ceremony in May 2022. The outer bend of the Nieuwe Maas river was chosen due to the river assessment tool, created in collaboration with Deltares, which indicated that this area was a hotspot for plastic litter. This decision was approved by the Municipality of Rotterdam and the EULife Programme.
A timeline of the project is given in section 1.2 below.

1.2 Project scope

Allseas designed Catchy 2, a passive waste collection system that captures macro- and microplastics. Catchy 2 is suited for installation in a river with tide, i.e., a river with currents in two directions. The system consists of 3 parts: booms to direct plastic to the plastic catcher, a collection cage in which plastic is collected, and a floating frame in which the cage is placed.

Catchy 2 is emptied once a month during the summer months when there is little to no rain. In the months with more rain, Catchy 2 is emptied twice a month. Representative batches of collected waste from different seasons were sampled and analysed. Tests were carried out which showed that during rainy seasons the plastic catcher should be emptied more frequently. A more in-depth explanation of the outcome of the tests is outlined further in section 2.3.

During the operation of Catchy 2, the functioning of the collection system was also examined. Optimisations of the system have been logged. The effectiveness of the collection system was investigated by performing different types of tests.



1.3 Project organisation

To best execute the different scopes of the project and obtain the best results, Allseas worked together with subcontractors.

During the production of Catchy 2, the following components were procured from subcontractors:

- Lankhorst, a manufacturer of mooring cables, supplied the cables and chains for the mooring and rigging of the system.
- Anodehuis, a supplier of cathodic protection, provided anodes for the cage.
- Beutech, a company that specialises in manufacturing of high-quality plastic products, supplied the high-density polyethylene doors and floaters.
- Itonavaids, a company that supplies a wide range of lanterns, supplied the lantern which works on solar energy.
- PPG, a provider of high-quality paints, coatings, and related products, supplied the paint.
- Stormboard, a supplier of recycled plastic plates, provided the plates which were later cut in a whale shape.
- HEBO supplied the booms.

The fabrication of the collection cage and the coupling rods that connect the floaters, was done in-house at the location of Allseas Fabrication B.V. in Heijningen. The hinges and locking mechanisms were produced at the Machinefabriek Schaap B.V., another location of Allseas Fabrication B.V.

Allseas safely installed the plastic catcher below the Erasmus Bridge together with HEBO. After the installation, the inauguration of Catchy 2 was held on one of Spido's ships. The Port of Rotterdam and Allseas currently work together to manage the emptying of Catchy 2. The monitoring of Catchy to is done by Spido, a tour boat company located next to Catchy 2. HEBO is responsible for the emptying as well as storing the collected waste. The waste is temporarily stored in a container belonging to Geocycle, a company that provides waste management solutions. When the container is full, the collected waste is co-processed by Geocycle and Holcim. Geocycle shreds the waste into small pieces so it can be processed by Holcim, a company active in the cement industry, see litter management guide report DB5.2.

1.4 Sponsors

The European Union LIFE program was the main sponsor of the Allseas project. The LIFE program is the European Union's funding instrument for environmental and climate related initiatives. It provides funding for projects that promote conservation of biodiversity, sustainable use of natural resources, and the transition to a low-carbon economy.

In order to increase the level of awareness and to reduce the costs of the project, Allseas worked together with several sponsors; companies and organisations that provided financial support and in-kind services. In return for their support, their logos are displayed on the sides of the system.

Allseas would like to thank the following companies and organizations for their contributions:

1. Rotterdam Circular
2. Port of Rotterdam
3. Holcim
4. Geocycle
5. Spido
6. BASF SE
7. Boluda Towage
8. The Standard Club Ltd
9. MS Amlin Ltd
10. Canusa-CPS Ltd

Figure 1: Logos from all sponsors visible on the whale shaped Stormboard

PROJECT EVALUATION

2.1 Technical overview of the system

Catchy 2 is the third system developed by Allseas. A lot of the lessons learned on Patje Plastic (task B2) in the Port of Antwerp and Catchy (task B3) in Vijfsluizerhaven were applied to optimise the system. The passive design principle was also implemented in the third design; this collection system does not require an external power source and works entirely on wind and current. The system is designed to capture meso-plastics (sizes 5 mm to 20 mm), macro-plastics (larger than 20 mm), and micro-plastics (particles between 3 mm and 5 mm) from the water surface and depths of up to one meter below the surface, regardless of the tide. Compared to Patje Plastic and Catchy, Catchy 2 is specially designed for a river with high current and tide and can catch waste in two directions. According to the river-assessment tool done by Allseas the amount of waste in the water is the same for ebb and flow.

The system consists of 3 parts:

- Two floating arms (Ref. (1) and (2) in Figure 2), both 20 meters long, that guide the waste to the collection system using wind and current during ebb and flow.
- A floating frame (Ref. (3) in Figure 2) supporting the collection cage.
- A collection cage (Ref. (4) in Figure 2) that holds the debris until it is lifted to be emptied.

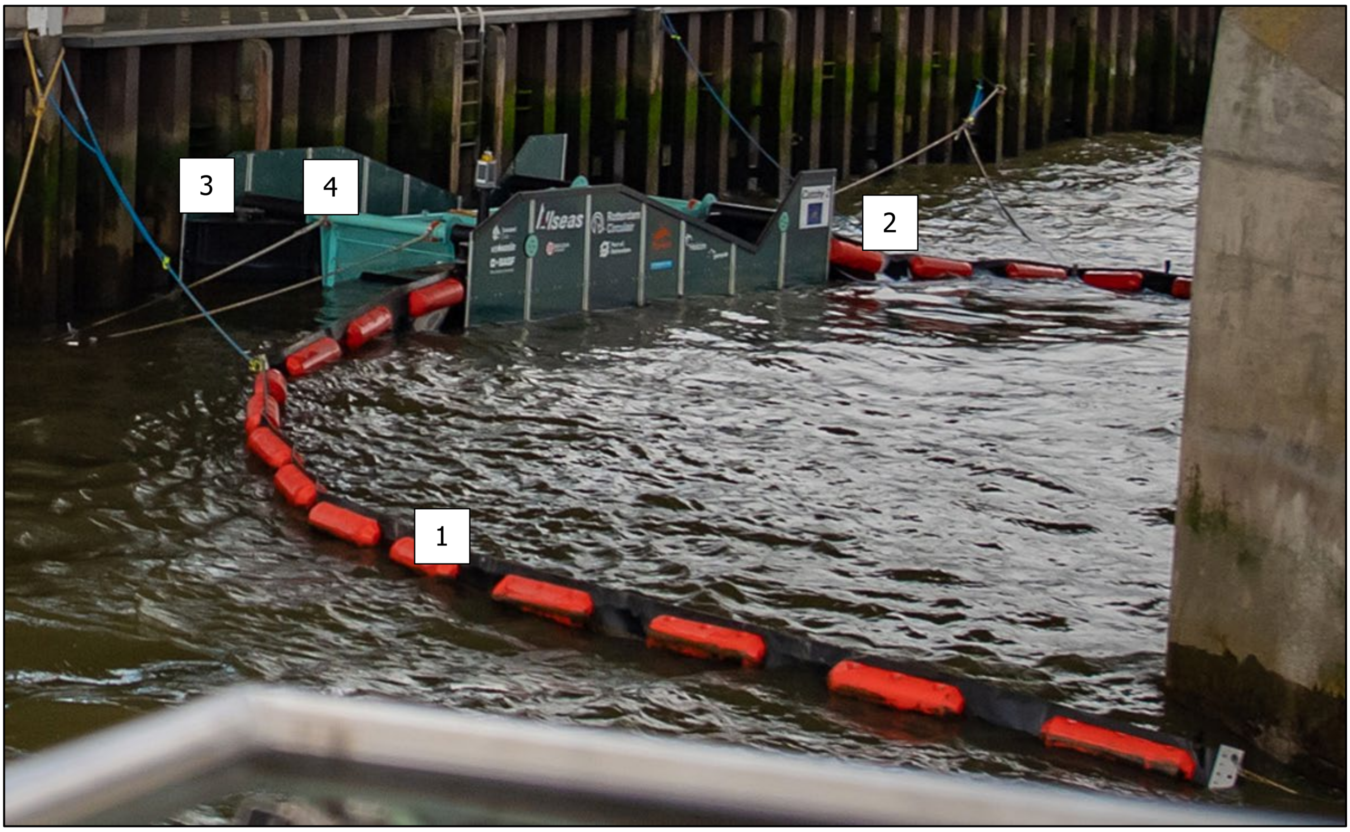


Figure 2:Catchy 2 below Erasmus bridge; Two floating arms which guide the river waste to the cage (Ref. 1 and 2), the floating frame (Ref. 3) supporting the cage and the collection cage (Ref. 4) that holds the debris until it is lifted to be emptied.

A cable around the bridge pillar, in conjunction with the mooring from the quayside, keeps the floating arms in place. Plastic and other waste is transported by the water current and guided by the floating arms, or booms, towards the cage. When the riverine litter reaches the collection cage, it enters the cage and is kept there by the two non-return doors placed in the cage, as shown on the left in Figure 4. The two non-return doors work in opposite directions, allowing the system to catch floating and levitating debris during both ebb and flow tides. The floating frame supports the collection cage and is moored to the quayside using mooring cables together with heavy chains. Because of the heavy chains the system can move vertically with the tide and remains in place despite different currents and wind-directions. When the collection cage needs to be emptied, it can be hoisted out of the floating frame, shown in Figure 4. After that, the cage can be emptied by using the locking mechanisms, shown in Figure 5. (ref. a) shows the initial state, (ref. b) depicts the doorframe unlocked and the non-return door secured to it, and (ref. c) illustrates the collection cage being lifted and emptied into a large bag using the swivel eyes on the cage to tilt it.

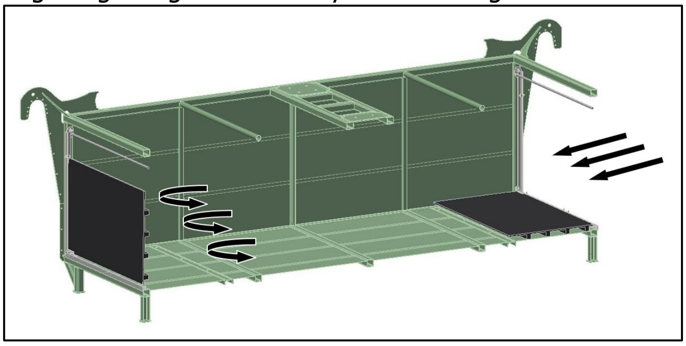


Figure 3: function of non-return doors

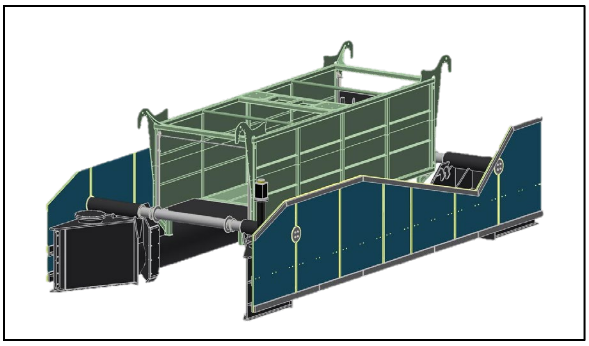


Figure 4: collection cage lifted out of frame

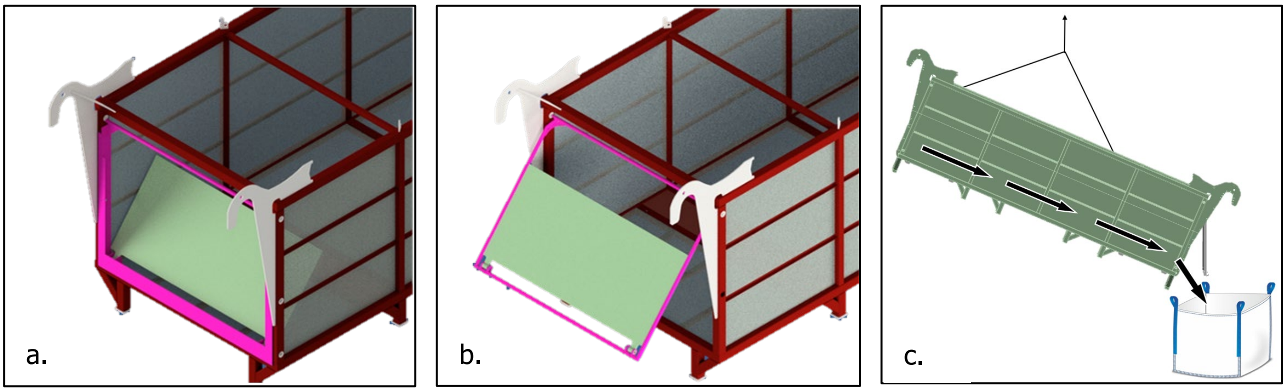


Figure 5: (ref. a) doorframe locked and non-return door unlocked, (ref. b) doorframe unlocked and non-return door locked to doorframe, (ref. c) emptying of collection cage in a big bag

The assembly of the Catchy cage was a challenge as the perforated plates, nuts, and bolts are all made of stainless steel. Therefore, all the bolted connections and perforated plates had to be isolated from the frame to prevent galvanic corrosion. The same difficulties occurred with *Patje Plastic*. Given the complexity of Patje Plastic and Catchy, Allseas decided to build the Catchy 2 collection cage entirely from mild steel to prevent galvanic corrosion. Manufacturing was done in-house, making communication during production and assembly easier.

The doors of Catchy 2 are fabricated from high-density polyethylene [HDPE], which differs from Catchy and Patje plastic, where the doors are both made from steel with plastic floaters. Because of this difference, doors on Catchy 2 are lighter, easier to produce and assemble. Additionally, HDPE can be recycled.

The booms are made from old conveyor belts and HDPE floaters, making them more environmentally friendly when looking at the life cycle analysis [LCA]. The forces that the booms can withstand are unknown by HEBO and are still to be determined. Partly because of this, Allseas made a risk & mitigation plan, see Appendix V – Risk & mitigation.

The mooring depends mainly on the location of the system. Just as with the Patje Plastic frame, the Catchy 2 frame is moored to a quay. The only difference with Patje Plastic is that Catchy 2 is moored in a river with tide whereas Patje Plastic is not. The frame has rods that connect the floaters with each other where the mooring grasps onto. For Catchy in Vijfsluizerhaven (B3) spud piles were used to moor the system in a harbour with tide. The installation of spud piles is much more complicated and costly.

As mentioned earlier, the booms from Catchy 2 are lashed around a pillar of the Erasmus bridge, see Figure 6. This method is used because Allseas is not allowed to permanently fasten anything to the bridge pillar and other methods such as a ground anchor or a mooring post are not possible at the location of Catchy 2. The bridge pillar inflicts friction on the cable, which causes the cable to wear out. This means the cable will have to be replaced after some time.

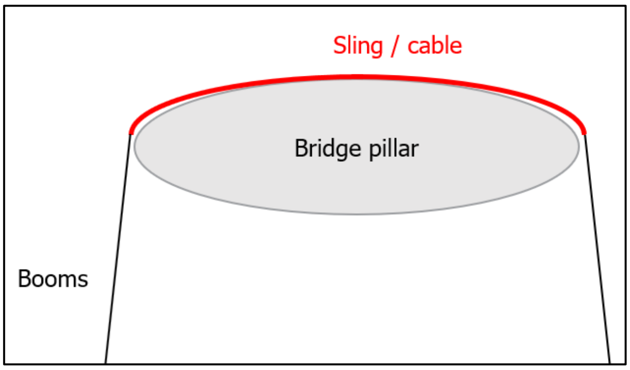


Figure 6: situation with cable and booms

The floating frame consists of two floaters made from HDPE and two plates made from recycled PE/PP. HDPE is a lightweight, corrosion resistant and durable material that gives the system its buoyancy. The floating frame can also be lowered, i.e. the centre of gravity can be changed by adding weight to one of the four ballast tanks in the frame.

Allseas designed and manufactured robust hinges and locking mechanisms for the non-return doors of Catchy 2 to ensure that it continues to function correctly. These hinges and locking mechanisms were later improved and reinforced.

2.2 Optimisations of the system

Since Catchy 2 was installed in March 2022, several optimisations have been applied to improve the overall performance and reliability of the system. The most significant improvements include:

1. The dimensions of the non-return doors were changed. The doors now have a higher freeboard, ensuring more litter is collected.

2. During high currents it was observed that the boom end was pulled into a diagonal position, which is not optimal for catching plastic. Therefore, the points of engagement for the mooring were changed to a lower position on the boom, resulting in a more vertical position of the boom.

3. The booms are moored around the bridge pillar using a cable. Together with Lankhorst, Allseas chose a wear-resistant cable that floats, so that the cable follows the water level. After a few months, the cable wore out and a more durable Dyneema cable was installed. Allseas is carefully monitoring the durability of the new cable. As of the time of writing it has been able to withstand over 6 months of the high friction that is applied by the current.

4. The locking mechanisms were still not strong enough to withstand the high currents beneath the Erasmus Bridge. This has increased the difficulty of emptying compared to the initial design. A bolt with washers and a locknut are used to keep the doorframes in place. There is not enough space for a more robust locking mechanism that can be used to lock and unlock the doorframes easily.

2.3 Summary results

To evaluate the performance of the system, the collected litter has been analysed and the efficiency of the system has been tested. For the litter analysis, batches from different seasons have been examined, with two having been done in 2022 and another one more to follow in 2023. With the two of three batches the results of a dry and rainy season are known. This gives us a good overview on the results and if they differ during different seasons or weather. It was expected that there will be no big difference in composition per season as this was also not the case with Catchy which lays in the same river. Therefor two samples can already give an good prognosis on the composition.

For the analysis, the same method was used as the monitoring campaign of Catchy (B3) in 2021; sorting litter into different categories by the OSPAR method (see APPENDIX I – Litter analysis). The effectiveness of Catchy 2 has also been tested with two different tests: the first test determined the effectiveness of the floating booms, and the second tested the effectiveness of the plastic collection cage (see APPENDIX II – Tests on effectiveness).

The litter analysis led to the following results:

1. The collection system functions as expected. Under the influence of wind and current, the system captures both floating and levitating debris. Macro-plastics and micro-plastics were collected.

2. A total of 1068 kg (wet weight) of waste is collected the first 7 months i.e., an average of 155 kg per month.

3. A lot of biomass was caught (e.g., branches, leaves, reeds, etc.), about 92% of the total weight collected.

4. Plastic represented 5% of the non-organic waste weight. The rest was other waste 3% (glass, metal, etc.).

5. After micro-pellets, the most found items were expanded polystyrene (EPS) pieces of sizes 2.5 cm to 50 cm, plastic bottles and cups or pieces of them, and soft foils of sizes 2.5 cm to 50 cm. In general, pieces of plastic were found more often than whole objects. Processed wood was also found but not taken into account and was seen as biomass.

6. By extrapolating the number of micro-plastics found in samples, it is estimated that around ~200,000 pieces of microplastics – mainly plastic pellets and EPS granules – were collected during the pilot project.

7. 39% (by weight) of plastic objects fell into the Packaging or Non-Packaging category. They were larger than 25 mm and were made of hard material (e.g., PE and PP). In principle, these objects can be recycled using existing technology.

The tests on the effectiveness of Catchy 2 lead to the following results:

- Tests on the effectiveness of the booms:
  - Effectiveness of the booms depends greatly on the wind direction. When the wind is in line with the current, 65-90% of tracers are collected. Otherwise, wind can create waves that interfere with the tidal current, resulting in fewer tracers being collected.

- Tests on the effectiveness of the collection cage:
  - After 1 week, 40-60% of the initial tracers leave the cage.
  - After 2 weeks, 60-70% of the initial tracers leave the cage.
  - After 3 weeks, 75-80% of the initial tracers leave the cage.
  - After 4 weeks, ~80% of the initial tracers leave the cage

Results of both the litter analyses are explained in more detail in APPENDIX I – I, APPENDIX III – and APPENDIX IV – IV.

APPENDIX II – provides a more detailed explanation of the results of the tests on effectiveness.

2.4 Awareness and PR

Creating awareness around plastic pollution is important as it is a global environmental issue that affects us all. Raising awareness of plastic pollution can help reduce the amount of plastic that is produced and used. It can also encourage people to use more sustainable alternatives to plastic, such as reusable bags and containers. Additionally, raising awareness can help educate people about the dangers of plastic pollution and the importance of reducing our reliance on single-use plastics.

Catchy 2 has had significantly greater success in creating awareness due to its visible location compared to the locations of Catchy and Patje Plastic. It is located next to Spido, under the Erasmus Bridge in Rotterdam, where many people and tourists pass by, see Figure 7. To make the problem of plastic pollution more tangible, the plastic collection system has been given the form of a whale. This is done by adding whale-shaped plates to the frame, as shown in Figure 1. These plates are made from recycled plastic. The plates also provide space for the logos of companies that sponsored Catchy 2.

An information board was placed at the location to inform the public about the system and the goal of collecting litter. For the official opening of Catchy 2, a large event was organized to which all partners and sponsors were invited, including the local press and the councillor of Rotterdam. Several articles were published. Allseas placed a post on its website and published it on LinkedIn to present Catchy 2 and the LIFE project. In addition, Allseas started an Instagram page where not only Catchy 2 but also Catchy and Patje Plastic are featured. The posts aim to be informative regarding the Allseas systems and the issue of plastic pollution.

Figure 7: tourists checking out Catchy 2

APPENDIX I – LITTER ANALYSIS

During the operation of Catchy 2, the riverine plastic recovery system under the Erasmus Bridge in Rotterdam, the collected litter has been weighed and two batches have been analysed so far. The first batch is from August/September 2022; this batch presents a dry month with little rain. The second batch is from September/October 2022, which presents a typical autumn month with a lot of rain. The third batch should be taken from a period decided depending on the first results, in winter (cold season) or spring (possibly more biomass) and has still to be done, therefore cannot be included into this report. The two batches gave already a good overview on the results and if they differ during different seasons. The main factor observed is rather the weather than the actual season. It is expected that there will be no big difference in composition per season as this was also not the case with Catchy which lays in a harbour connected to the same river. Therefor two samples can already give a good prognosis on the composition.

In Figure 8, the weights of the collected litter are shown for almost one year. The debris is weighed when wet. It can be concluded that more riverine waste is collected during the autumn and winter months. It is expected that waste accumulates on the riverbanks in summer when the water level is lower. Due to the increase in rainfall during the autumn and winter, the water level rises, and the waste ends up in the river. This, in combination with dying biomass, increases the weight collected by the plastic catcher.

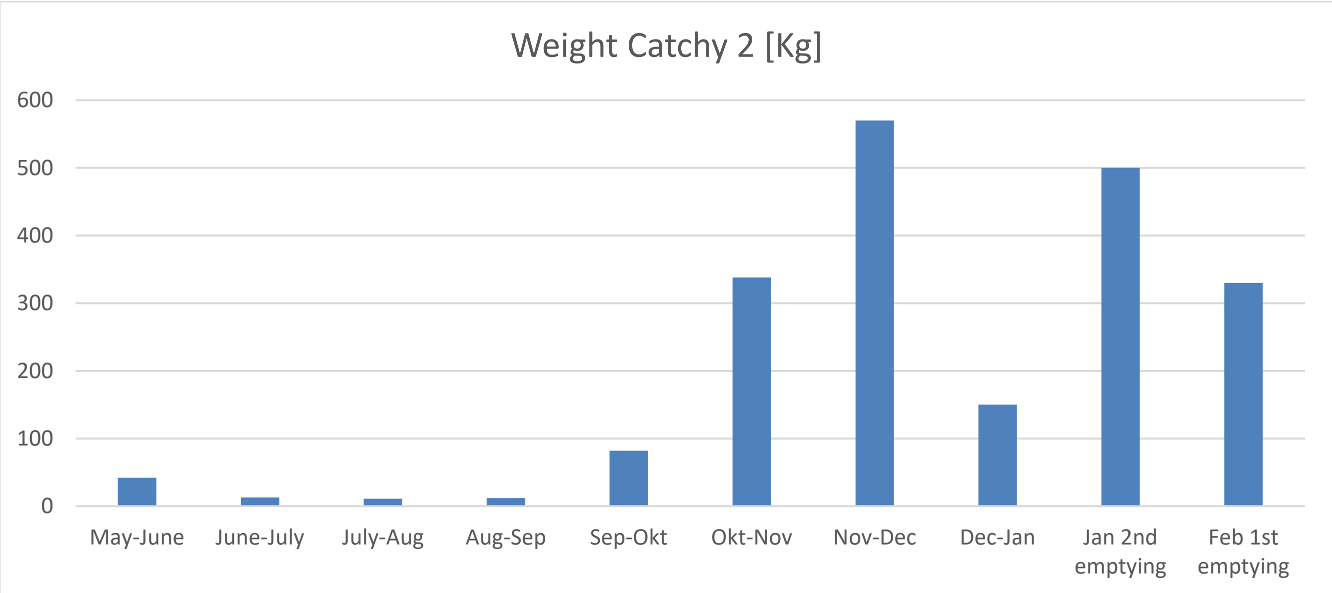


Figure 8, weight of collected litter

The two batches were analysed using the OSPAR method, the same method used for Catchy. All results of the sorting, as well as the analysis, have been documented in an Excel spreadsheet. The main conclusions at this stage, for these two samples, are provided here.

The items are sorted based on size and type. Each category is weighed to easily evaluate how much the proportion of different plastic types are. Considering the light weight of plastic information based on volume would be more relevant however not easy to measure. Therefore, the quantities are important to consider, which is why counting of subsamples was done as well. 1 kg of plastic can be a high number due to its light weight. Processed wood is excluded, as they are very large and heavy items, which would significantly distort the results.

This analysis refers to:

1. Global analysis of the composition
2. Overall composition of the plastic litter based on material and size
3. OSPAR analysis

As shown in Figure 9, the collected litter mainly consists of biomass. On average only 5% of the litter is plastic waste. The other 3% consists of glass and metal. These figures are based on dry weight. Looking back to Catchy this can mean that the biomass is about 30-40% heavier when wet.

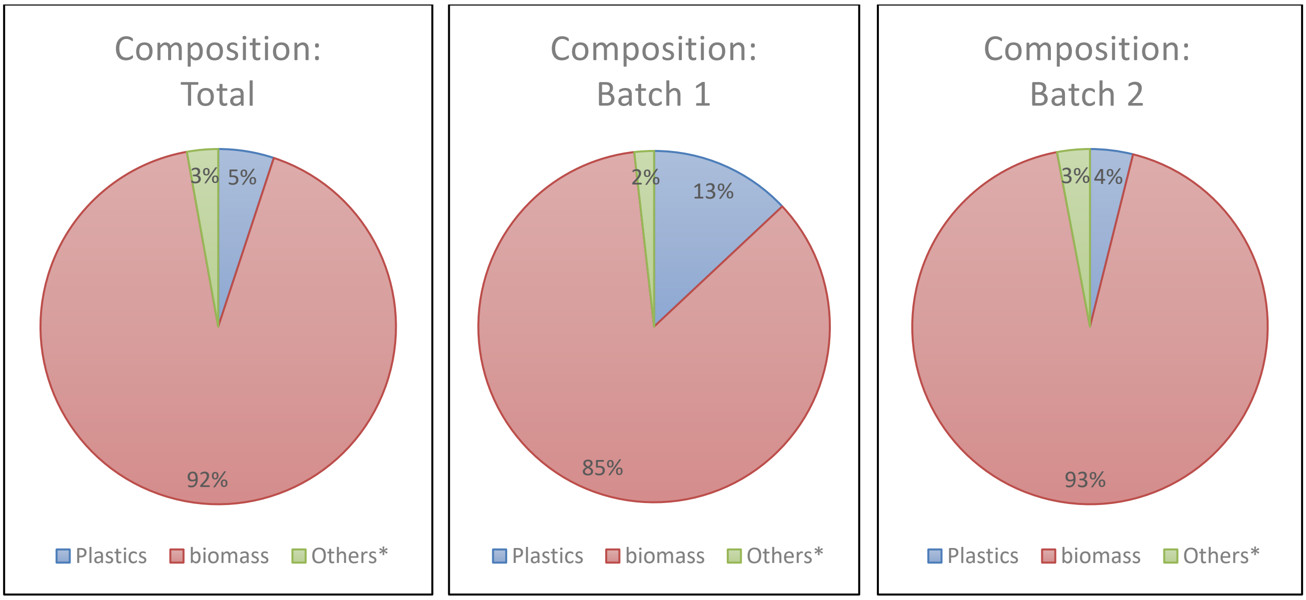


Figure 9, the composition of the collected litter

According to the litter analysis shown in Figure 10, Composition of the litter based on material and size 39% of plastic objects that are larger than 25 mm and made of hard materials such as PE and PP fell into the Packaging or Non-Packaging category. These objects can be recycled using existing technology.

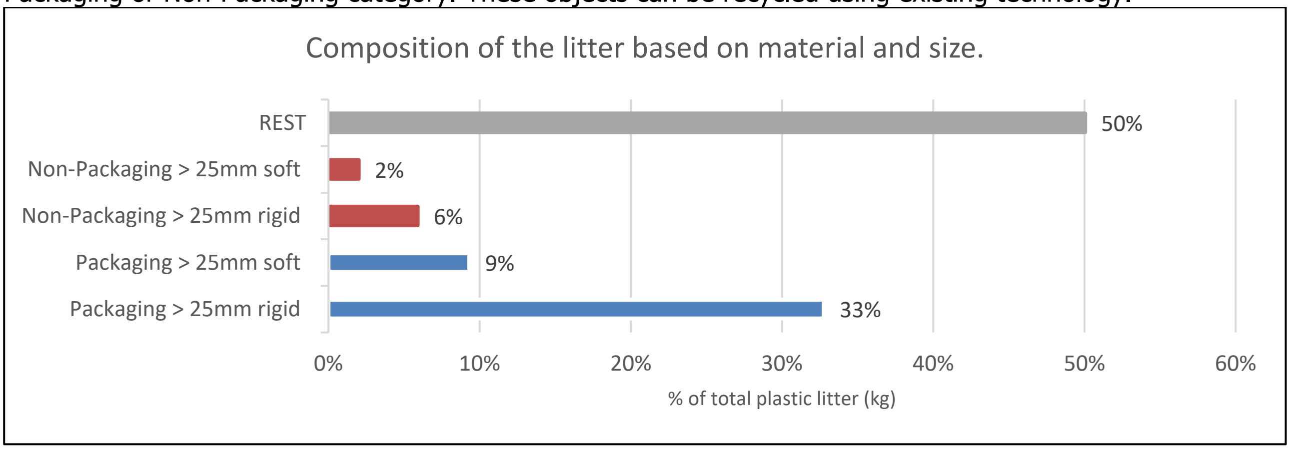


Figure 10, Composition of the litter based on material and size

Tables 1 and 2 of the OSPAR analysis show the top five items found, with plastic pellets being the most common items at approximately 300 per kilogram of collected litter. After plastic pellets, the most found items were plastic bottles and cups or pieces thereof, EPS pieces of sizes 2.5 cm to 50 cm, and soft foils of 2.5 cm to 50 cm. In general, pieces of plastic were found more often than whole objects. Processed wood was also commonly found but not taken into account.

Table 1, top 5 from OSPAR analysis for batch 1

Batch 1		
TOP 5 OSPAR		
1	Plastic pellets	3076
2	Plastic cups or parts thereof	10
3	Indefinable pieces of EPS 2.5-50 cm	8
4	Indefinable plastic pieces 2.5-50 cm (hard plastic)	5
5	Plastic foils or pieces thereof 2.5- 50 cm (soft plastic)	3

Table 2, top 5 from OSPAR analysis for batch 2

Batch 2		
TOP 5 OSPAR		
1	Plastic pellets	23326
2	Indefinable pieces of EPS 2.5-50 cm	124
3	Caps and lids	32
4	Bottles >< 1/2 litre	29
5	Plastic foils or pieces thereof 2.5- 50 cm (soft plastic)	28

APPENDIX II – TESTS ON EFFECTIVENESS

This document explains the tests that were performed to determine the effectiveness of Catchy 2. It is a total of two tests, one determines the effectiveness of the booms and the other the effectiveness of the collection system. At the end, the observations are discussed.

Execution Test 1

This test explains the effectiveness of the booms which direct the plastic towards the collection cage.

1. In this test floating objects, called tracers, are placed into the water during different weather conditions;
    a. Wind-direction
    b. Windspeed
    c. Current: Ebb or flow
    d. Water level

The tracers are placed into the water from the quayside, from different distances. This is done three times. The number of tracers collected were counted. The results are shown in Table 3, Table 4 and

2. Table 5.

Table 3: Results of the first test

Date:	**22/Sep**
wind direction:	N, NO
windspeed:	1 Bft
high/low tide:	High tide
Water level:	NAP+90cm
Distance [m]	35 m
Bamboo 100mm	*4 out of 5*
Bamboo 200mm	*5 out of 5*
Pinewood (50x44x44)	*4 out of 5*
Pinewood (100x44x44)	*5 out of 5*

Table 4: Results of the second test

Date:	**30/Sep**
wind direction:	S
windspeed:	2 Bft
high/low tide:	Ebb, decreasing tide
Water level:	NAP+90cm100cm
Distance [m]	40 m
Bamboo 100mm	*0 out of 5*
Bamboo 200mm	*0 out of 5*
Pinewood (50x44x44)	*0 out of 5*
Pinewood (100x44x44)	*0 out of 5*

Table 5: Results of the third test

Date:	**15/Nov**	
wind direction:	S-O	
windspeed:	4 Bft	
high/low tide:	Ebb, decreasing tide	
Water level:	NAP -51cm	
Distance [m]	40 m	55 m
Bamboo 100mm	*5 out of 5*	*2 out of 5*
Bamboo 200mm	*5 out of 5*	*3 out of 5*
Pinewood (50x44x44)	*3 out of 5*	*3 out of 5*
Pinewood (100x44x44)	*5 out of 5*	*5 out of 5*

For the first test the tracers were placed into the river at the yellow dot shown in Figure 11 below. The test took long so only one distance was tried after that the current changed to ebb. Circular flow (vortices) near the boom prevented certain tracers to enter the cage, see Figure 12.

The second test was done at the green dot in Figure 11. No tracers entered the cage. The booms did not work as the flow was in the wrong direction. Because of this the tracers ended up between the bridge pillar and boom, see Figure 13.

The third and last test was done during good wind and current conditions. The tracers were thrown in the water at the red dots in Figure 11. The conditions were good, but practice showed that some tracers ended up between the frame and the quayside. This could happen because there is some space between the quayside and the floating frame.

Figure 11, test locations

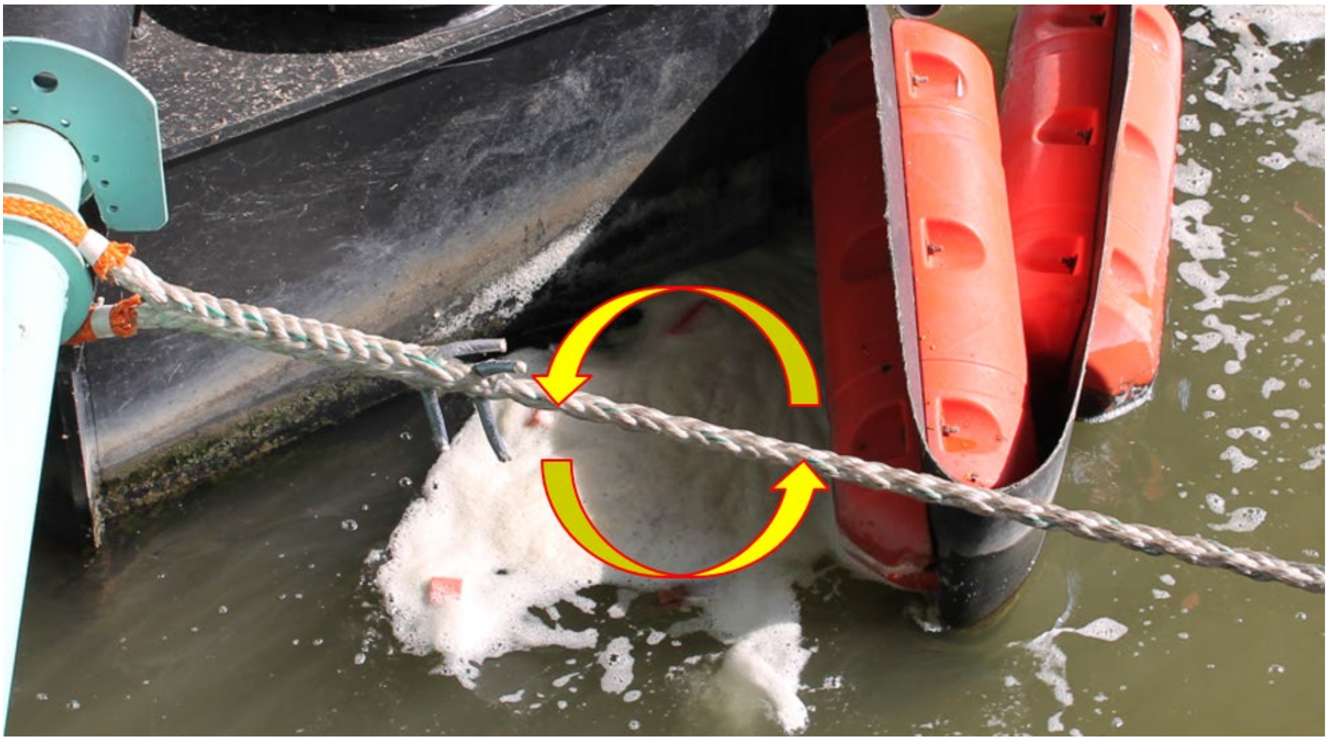


Figure 12: Circular flow behind booms

Figure 13: Tracers between bridge pillar and boom

Execution Test 2
Two times the number of tracers in the system were checked every 7 days until emptying and documented in the tables below. The bamboo was indistinguishable from the regular biomass in the cage so Allseas continued by only counting the pinewood blocks. The tests showed that a lot of the tracers leave the collection cage before it can be emptied.

Table 6: Results of the first test

Month	**Oct/Nov**				
Time [weeks]	**0**	**1**	**2**	**3**	**4 (emptying)**
Bamboo 100mm	5	0	0	0	0
Bamboo 200mm	5	0	0	0	0
Pinewood (50x44x44)	5	3	2	2	2
Pinewood (100x44x44)	5	1	1	0	0
percentage	100%	40%	30%	20%	20%

Table 7: Results of the second test

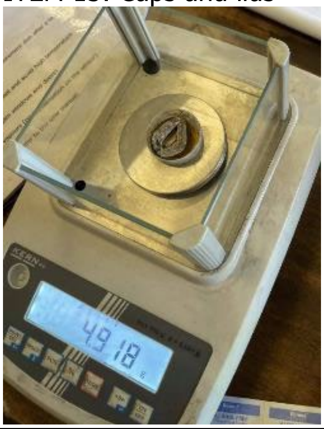
Month	**Nov/Dec**				
Time [weeks]	**0**	**1**	**2**	**3**	**4 (emptying)**
Bamboo 100mm	7	0	0	0	0
Bamboo 200mm	8	0	0	0	0
Pinewood (50x44x44)	6	4	2	2	1
Pinewood (100x44x44)	10	6	4	2	2
percentage	100%	63%	38%	25%	19%

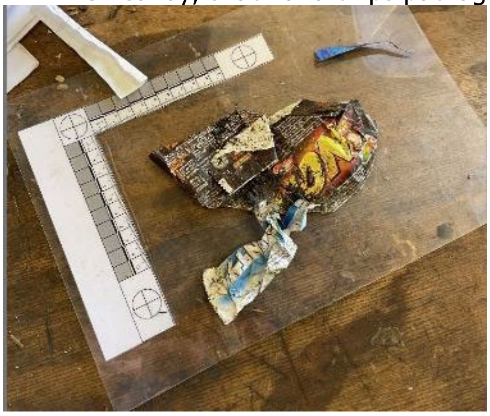
Conclusion
The following conclusions were reached based on the results of the tests outlined above:

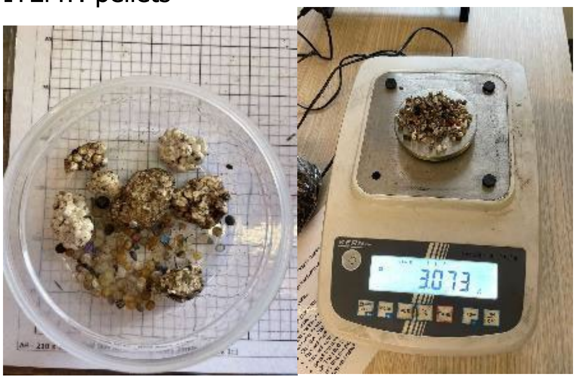
<u>Tests on the effectiveness of the booms:</u>
Effectivity of the booms highly depends on the wind direction
When the wind heads in the right direction 65 – 90% of tracers are collected.

<u>Tests on the effectiveness of the collection cage:</u>
After 1 week about 40-60% of the tracers leave the cage.
After 2 weeks 60-70% of the tracers leave the cage.
After 3 weeks 75-80% of the tracers leave the cage.
After 4 weeks ~ 80% of the tracers leave the cage

APPENDIX III – ITEMS OSPAR ANALYSIS AUGUST

ITEM 4,1: Bottles > ½ litre 	ITEM 4,1 (2): 
ITEM 4,2: Bottles >< ½ litre  	ITEM 7: Cosmetic packaging (e.g., shampoo, deodorant, sunscreen) 
ITEM 15: Caps and lids 	ITEM 15 (2): Caps and lids 

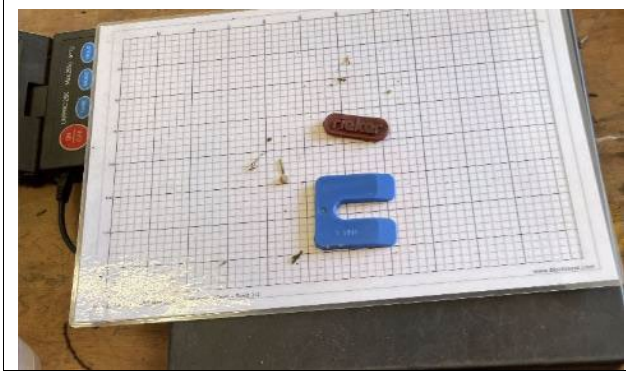
ITEM 16: lighters 	ITEM 19: Candy, snack and chips packaging 
ITEM 21: Plastic cups or parts thereof 	ITEM 46,1: Indefinable plastic pieces 2.5-50 cm (hard plastic) 
ITEM 46,2: Plastic foils or pieces thereof 2.5- 50 cm (soft plastic) 	ITEM 57/44: Shoes, boots and slippers 
ITEM 62,1: Beverage cartons (including juice, milk, yogurt drink) 	ITEM 65: 

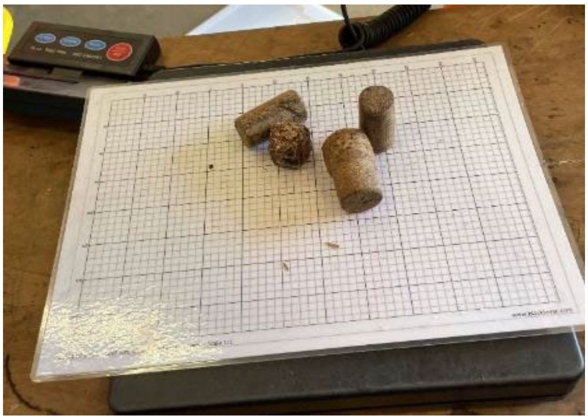
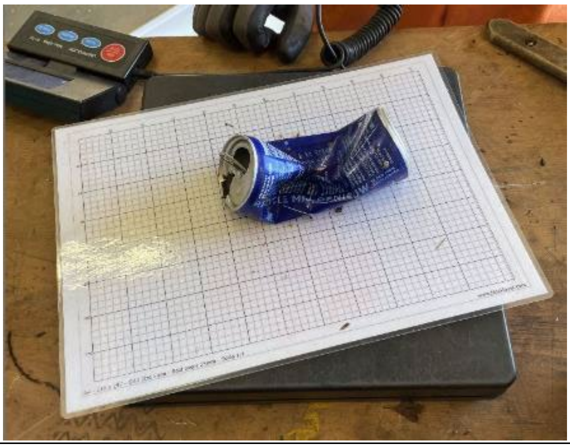
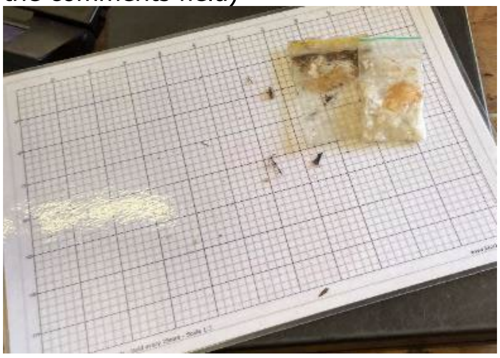
ITEM 78: cans 	ITEM 20: toys 
ITEM 32: Rope and cord diameter 1 cm 	ITEM 102,2: Sanitary / wet wipes 
ITEM 462: Indefinable pieces of EPS 2.5-50 cm (estimate) 	ITEM?: pellets 

APPENDIX IV – ITEMS OSPAR ANALYSIS SEPTEMBER

ITEM 3: plastic bags 	ITEM 4,1: Bottles > ½ litre 
ITEM 4,2: Bottles < ½ litre 	ITEM 5: Packaging of cleaning products (including washing-up liquid, all-purpose cleaner, etc.) 
ITEM 6,1: EPS food packaging (e.g., hamburger) 	ITEM 7: Cosmetic packaging (e.g., shampoo, deodorant, sunscreen) 

ITEM 14: car parts 	ITEM 15: Caps and lids 
ITEM 16: lighters 	ITEM 19: Candy, snack and chips packaging 
ITEM 20: toys 	ITEM 21: Plastic cups or parts thereof 
ITEM 31: Rope diameter > 1 cm 	ITEM 35: Sport fishing gear (including floats, bait trays, packaging of sport fishing products) 

ITEM 38 & 38,1: Plastic flower/plant pots, plant trays, buckets, or pieces thereof 	ITEM 40: Industrial packaging materials (including plastic tarpaulin, construction plastic, agricultural plastic) 
ITEM 40 (2): 	ITEM 46,1: Indefinable plastic pieces 2.5-50 cm (hard plastic) 
ITEM 46,2: Plastic foils or pieces thereof 2.5- 50 cm (soft plastic) 	ITEM 47,1: Plastic foils or pieces thereof >50 cm (soft plastic) 
ITEM 48: Other plastics (if recognisable, write a description of each found item in the comments field) 	ITEM 62,1: Beverage cartons (including juice, milk, yogurt drink) 

ITEM 68: corks 	ITEM 73: Brushes 
ITEM 78: cans 	ITEM 81,1: Capsules (e.g., coffee/ chocolate) 
ITEM 91: Bottles, jars or pieces thereof 	ITEM 103: Packaging (including pills, contact lenses and fluids) 
ITEM 64 & 105: Cigarette filters & Other medical (if recognisable, write a description of each found item in the comments field) 	ITEM 462: Indefinable pieces of EPS 2.5-50 cm (estimate) 

ITEM 462 (2)	ITEM 462 (3):
:	

APPENDIX V – RISK & MITIGATION

710339 - Catchy 2: Risk Analysis

Allseas

Booms	
Risk	*Mitigation*
The sling can break after some time, when the sling is not wear-resistant enough against the bridge pillar and the working of the tides.	Good monitoring so action can be taken timely. Connect the booms to pole 29 and 34 by using lifting sling and polyprop cable.
Connection points of the boom can break because of big forces i.e. storms.	With wind force 10 or higher it is advised to disconnect the booms. See memo for more information.
Collision with boats.	If it happens it is important that there is good monitoring so action can be taken timely. Afterwards make changes (if needed) to prevent it from happening again in the future.
Big floating objects and oil could damage the boom.	The system shall be monitored 7 days a week by Spido. When something is wrong spido will contact Allseas / Hebo.
Frame	
Risk	*Mitigation*
The recycled green plates or something else could break during a storm.	The system shall be monitored 7 days a week by Spido. When something is wrong spido will contact Allseas / Hebo.
The cage rests on the coupling rods , steel on steel. Which creates a rusty ring around the coupling rods.	Use flex milling cutter to mill out the hook and then fill it with hdpe cover or put heat shrink tubing on coupling rod. Or simply acccept rusty ring and inspect the coupling rods during emptying.
Cage	
Risk	*Mitigation*
With bad coating, rust could form a problem.	Keep a close eye on the cathodic protection below the cage and replace if needed. When something breaks because of rust, if needed replace it or find a better solution for it.
During emptying something could break. For example: the doors, hinges, and or locking mechanisms.	Repair on-site when possible otherwise do not put back the cage to avoid further damages.
Fish could enter the cage.	When a living fish is seen stuck in the cage, release it as soon as possible. When dead fish are seen in the cage, the cage could be emptied sooner by hebo.
Oil could enter the cage.	The system has to be cleaned as soon as possible.
Vandalism	
Risk	*Mitigation*
Breaking something, like the green plates.	Placing of prohibition sign. If necessary, contact the police and use insurance to cover costs.
Graffiti on the system.	
Stealing safety/no entry boards or lantern or anything else.	
Loosening mooring cables.	

APPENDIX VI – OPERATION PLAN

This document outlines the operational plan for the riverine plastic waste collection system; "Catchy 2". The plan is designed to ensure the continuation of plastic waste collection from rivers in an efficient, effective, and environmentally responsible manner.

The plan covers the monitoring, emptying, and maintenance of Catchy 2.

Monitoring

The monitoring of Catchy 2 is done by Koninklijke Spido BV. Occasionally, updates are given via WhatsApp. The contact person is Caroline Kool, see contact information. It is important that this is done 24/7 so actions can be taken swiftly.

Emptying

Emptying is done by HEBO Maritiemservice BV. The contact person for emptying is Pascal Cremers.
On the week of emptying, he will send the weight of the collected litter. If not ask for it via mail. If other things have to be done ask if this is possible one week before the week of emptying.

Below the schedule is given for emptying:
Two times in rainy months, one time in dry months

Maintenance

After a period of time, the following areas will need to be addressed for maintenance:

1. Replacing worn-out hinges. - Machinefabriek Schaap
2. Replacing the cable used for mooring booms. - Lankhorst
3. Tightening or replacing bolts and nuts. – Machinefabriek Schaap
4. Re-coating and/or replacing cathodic protection if rust increases. - Anodehuis

Below the schedule is given for maintenance:
Every 6 months.

All contact information

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