BATSECO-BOAT (CB637)

Best Available Technologies of SEwage COllecting for BOAt Tourism

BATSECO-BOAT FINAL SEMINAR

Organized online with invitations/registration

Registration: https://zoom.us/webinar/register/WN_LLSbUt0PS86Q3cW3kdeeXw

Host: Utvecklingscentrum för vatten/Ecoloop AB

Date: 17.02.2021

Time: **9-12 (SWE time)**, **10-13 (EST/FIN time)**

8.45 Opening of the platform and gathering of participants **9.45**

9.00 Opening of the final seminar – welcoming words (A. Kaski KAT) **10.00**

9.05 Brief introduction of the BATSECO-BOAT project (V. Pönni UTU) **10.05**

9.15 Description of the situation of sewage collecting services in the Central Baltic area before the BATSECO-BOAT project (M. Press/KEST and H. Haaksi/KAT) **10.15**

9.30 Introduction of concrete results from investment WP's of BATSECO-BOAT project (H. Haaksi/KAT, E. Åberg/Norrtälje, M. Press/KEST and E.Tamm/Viimsi) **10.30**

9.50 First break, 10 minutes! **10.50**

10.00 Mapping of the boat traffic based on AIS-data and estimation of the amount of collected sludge from leisure boats! (M. Johansson/Ecoloop) **11.00**

10.20 Review of current sewage collecting technology (D. Acquaviva/UCV) **11.20**

10.40 Second break, 10 minutes! **11.40**

10.50 Analyses of collected sludge (H. Schulte-Herbrüggen/Ecoloop) **11.50**

11.10 Modern wastewater treatment mobile solutions (Finnish VTT) **12.10**

11.30 Discussion of the results from BATSECO-BOAT **12.30**

11.55 Closing words by Samu Numminen / CB **12.55**

12.00 Closing the BATSECO-BOAT final seminar **13.00**

Interreg Central Baltic

EUROPEAN UNION
European Regional Development Fund

CB637 - BATSECO-BOAT
Improving the sewage collecting network for leisure boats in the Central Baltic area

17.2.2021

Veijo Pönni

Project Expert

Brahea Centre / Åbo universitet

CB637 BATSECO-BOAT – providing solutions for problems with sewage collecting services for leisure boats

- Discharging of leisure boats sewage (black waters) into the sea or into the lake has been banned in Finland ever since 2005 and in Sweden from 2015 onwards

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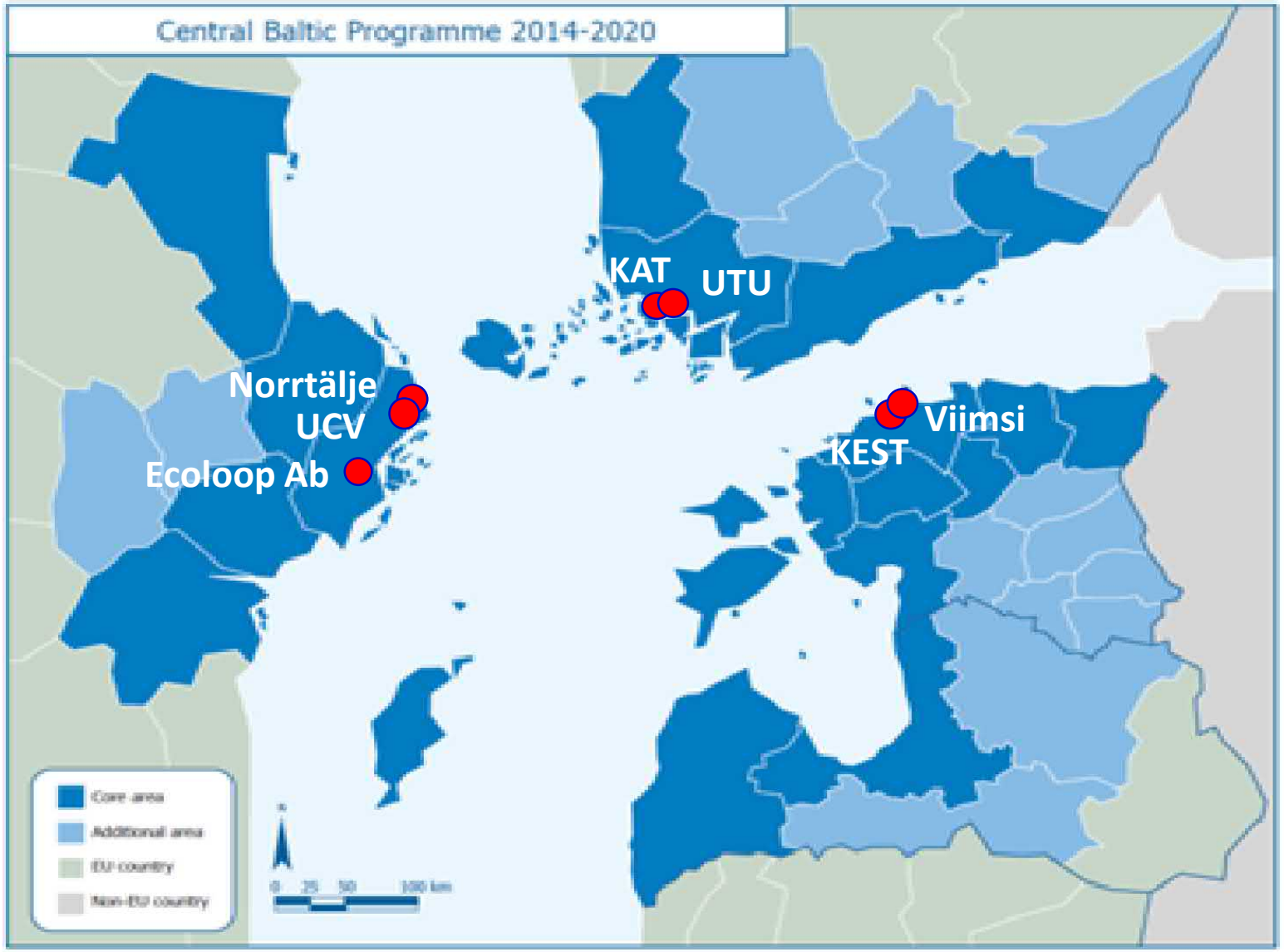
- A network of pump-out stations has been built in both countries, but several challenges have been occurred! Estonia has been lacking with this service for boaters.

- **BATSECO-BOAT project** aims to **improve capacity and service level of latrine sewage collection in small boat ports in Estonia, Finland and Sweden to facilitate mobility of leisure boaters! This happens through investments and by collecting the relevant up-to-date information to support the investment decisions and cope the challenges.**

- Projects total budget is **1,48 Meur, which of 1,14 Meur is EU Regional Development Funding.** Project duration is **42 months** (12/2017-5/2021, incl. 3 months closure period for the Lead Partner)

CB637 BATSECO-BOAT – partners on the map!



Thank you!

www.batseco-boat.eu

Veijo Pönni (veijo.ponni@utu.fi)
Brahea Centre / University of Turku

Sewage collecting services in the Central Baltic area before the BATSECO-BOAT project

BATSECO-BOAT Final Seminar, February 17th 2021

Marek Press, *Keep the Estonian Sea Tidy*

Keep the Estonian Sea Tidy
activity 1 in the BATSECO-BOAT project

Survey on Sewage Reception Facilities at Selected Central Baltic Small Ports - report

M. Press, A. Oja, February 2019

This report can be found on the project´s web site under Publications

Background, legislation

National law targeting the discharge of the untreated sewage generated by leisure craft

In Sweden and in Finland, all boats incl. leisure craft, are prohibited from discharging sewage into the territorial waters (12 nautical miles) of these two countries.

In Estonia there is no such national legislation yet.

Water Act, MARPOL, HELCOM, EU PRF Directive

Estonia – boating community smaller, navigation season shorter, approx. 50 harbours w mooring pl for guests, services targeted towards visiting foreign boaters

Objective, method

Overview of the readiness to receive the sewage generated on leisure craft.

The status of the small ports' sewage reception facilities was observed and assessed.

Limited to 24 small ports (8 in every country), their geographic location is important from the viewpoint of visits by leisure boaters.

- Background checks (websites, brochures, cruising guides, port databases)
- On-site examination
- Interviews with the port staff and port users

Results (2018)

Technical preparedness to receive sewage from small boats was generally better at the Finnish and Swedish ports.

The sewage reception system was working without problems at:

- 88% of the Finnish ports
- 75% of the Swedish ports
- 50% of the Estonian ports

at the time of the visits.

Estonian ports were prepared to organize a tank vehicle.

Main findings (2018)

67% of the ports in Sweden and Finland admitted technical problems with the equipment.

Information about the availability of service, user manuals missing or not adequate

Findings (2018)

Many Estonian guest harbours have acquired a mobile sewage pump-out cart, but they are seldom used.

Conclusion (2018)

Fairly good overview of the conditions for sewage reception at small ports in Estonia, Sweden and Finland

Many thanks!

Marek Press, Keep the Estonian Sea Tidy

Making investments in the sewage reception facilities; Estonia, KEST

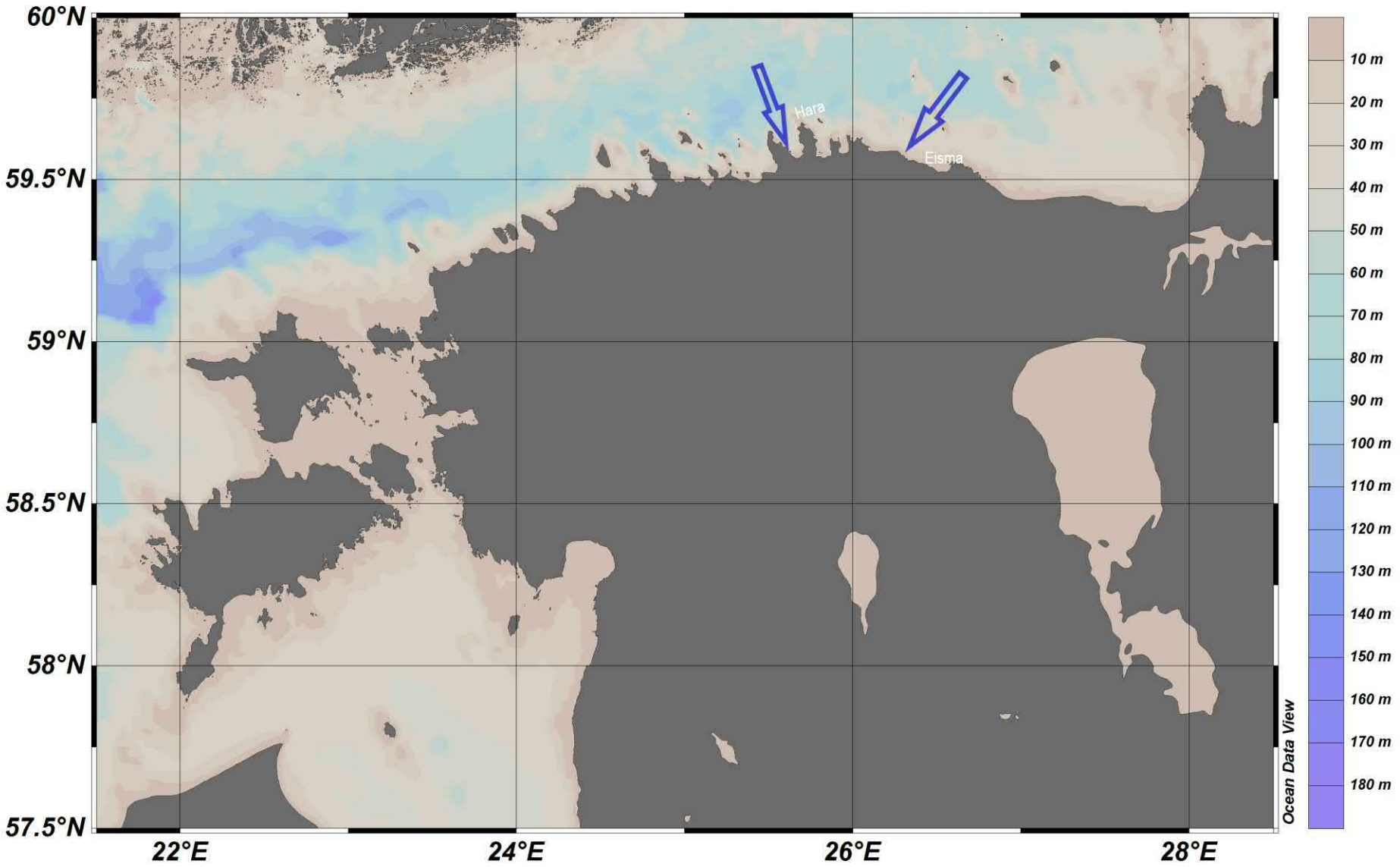
BATSECO-BOAT Final Seminar, February 17th 2021

Marek Press, *Keep the Estonian Sea Tidy*

Keep the Estonian Sea Tidy investments of the BATSECO-BOAT project

- KEST responsible for making investments in the sewage reception facilities in two of the Estonian guest harbours
- Geographic location important from the viewpoint of visits by leisure boaters
- The ports included have mooring places for visiting boats and they provide a selection of elementary port services for visitors
- Two harbours on the northern coast of Estonia were chosen
- Meet the criteria set out by the INTERREG CB programme
- High readiness to adopt the investment i.e., the main construction works like pipework and collection tanks, were carried out by the ports

Location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150 m
160 m
170 m
180 m
Ocean Data View

KEST

Investment 1 - Completed

Eisma Harbour

Equipment delivered by Top Marine

Manufacturer LeeStrom GmbH

(Germany)

KEST

Investment 2 - Completed

Hara Harbour

Equipment delivered by Top Marine

Manufacturer LeeStrom GmbH

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Thank you!

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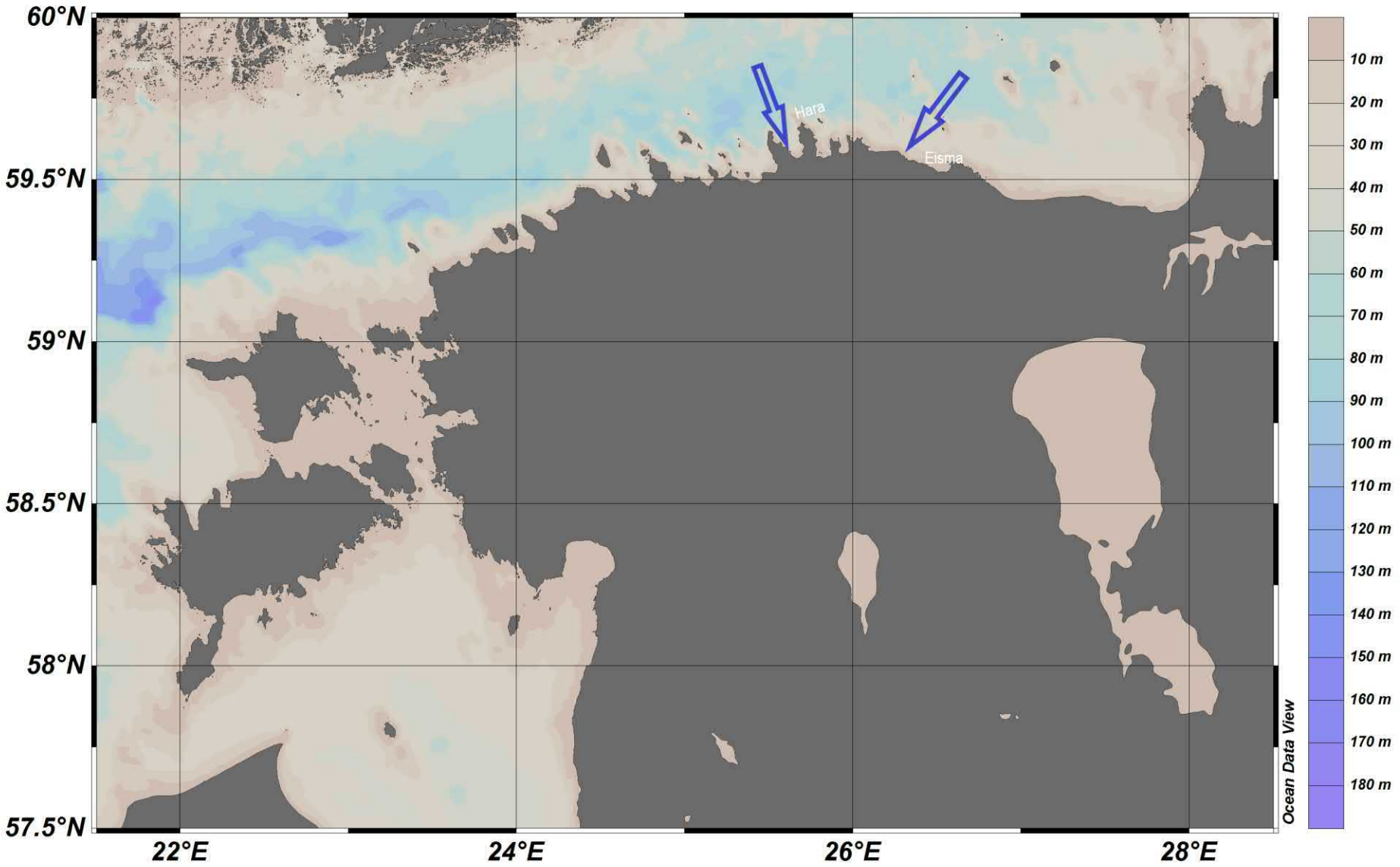
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Thank you!

Marek Press, Keep the Estonian Sea Tidy

2020: 3 new stations installed

- 10-12 m3 capacity
- 2 boats can dock at the same time (2 pumps)
- One side higher than the other (suits most boats and users better)
- Main material HDPE (used because of its durability)
- Locations: Aspö, Seili and Björkö
- See for locations: www.roopekartta.fi

2020: 3 new stations installed

2020: 3 new stations installed

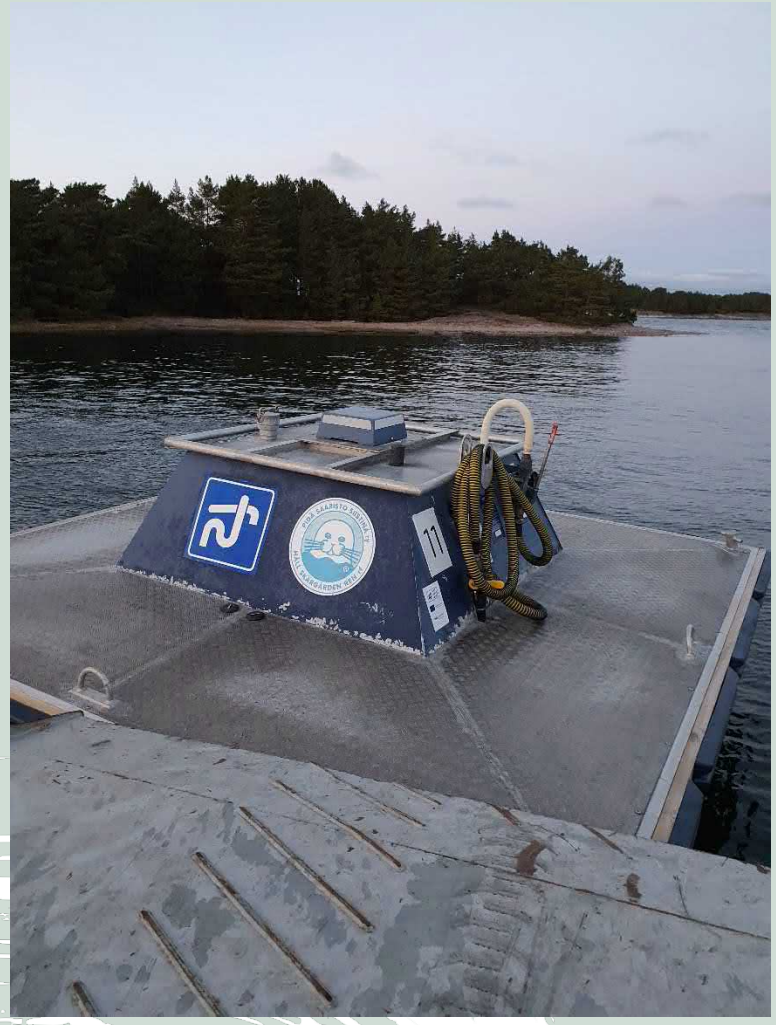
2020: 3 new stations installed

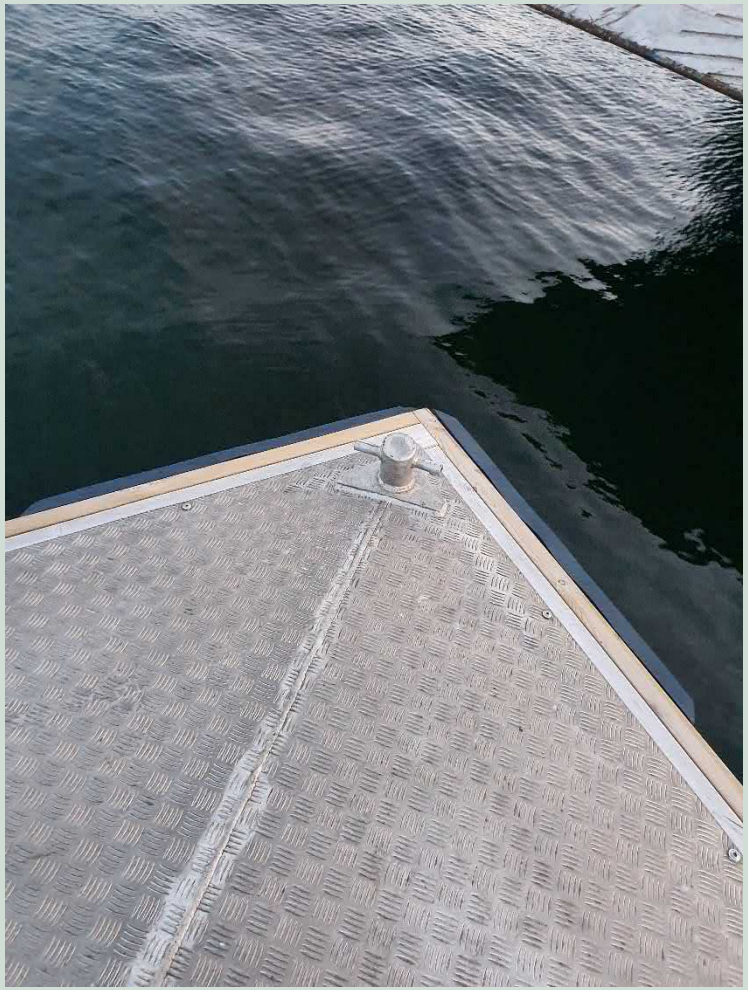
2020: all repaired stations in place

- Holes in the outer shell repaired
- New pumps
- New rubbing strips
- New weights
- See for locations: www.roopekartta.fi

2020: all repaired stations in place

2020: all repaired stations in place





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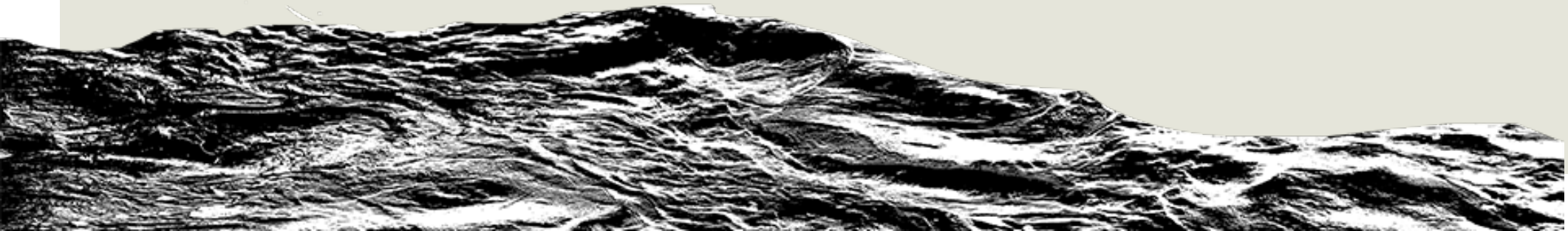


Results from Norrtälje municipality

Eva Åberg
Project manager, waste department

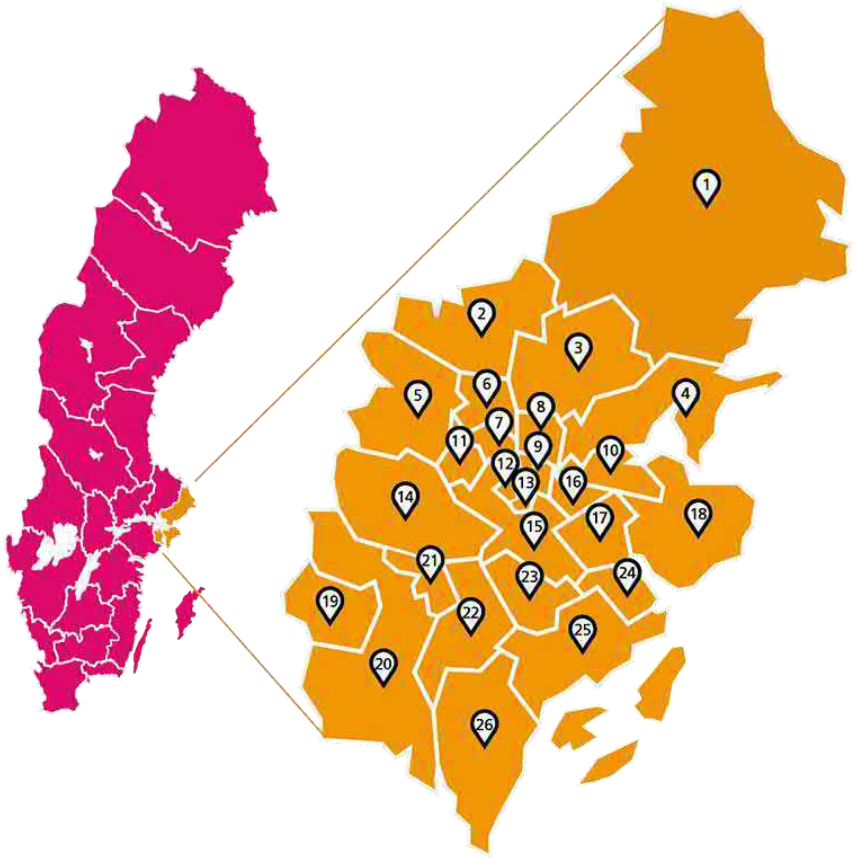
Norrtälje Municipality

Biggest municipality in Stockholm County

Landarea 2 000 km²

62 000 citizens all year around

120 000 citizens in the summer



Large archipelago

13 000 islands

66 islands with permanent residents

Almost 4 500 people live permanent on islands

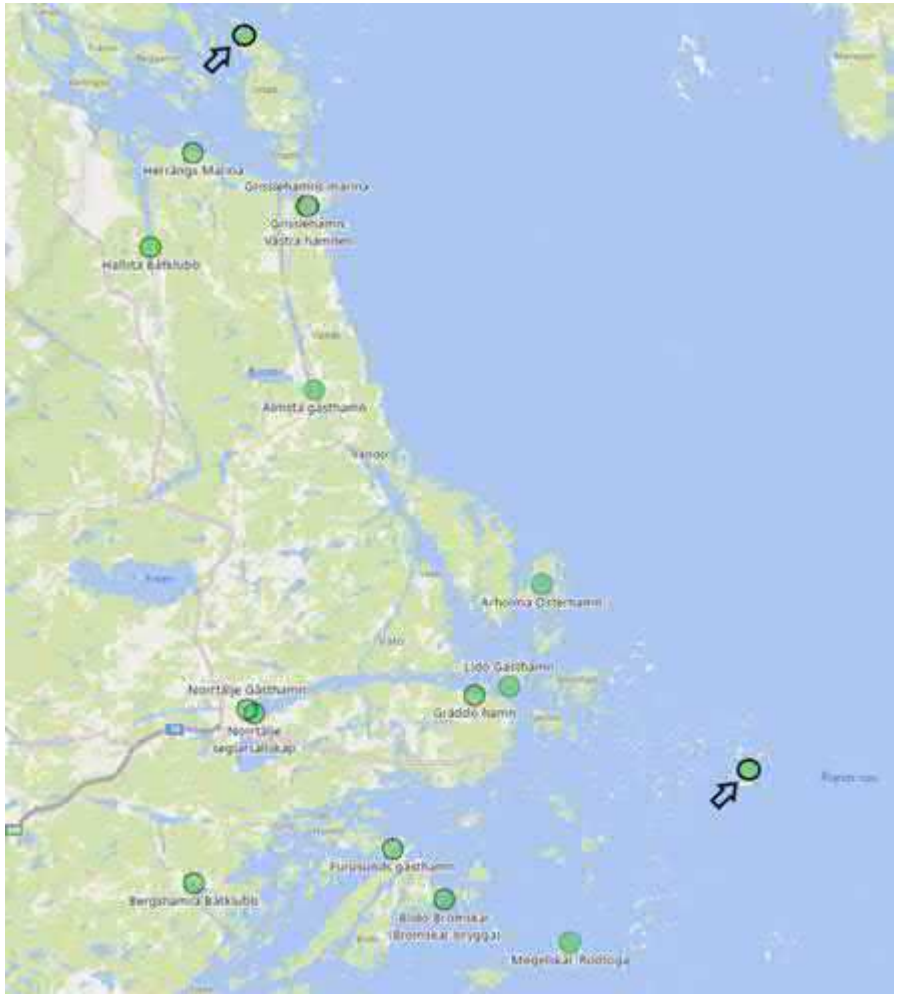
Our pump-out stations

Total of 15 stations in the municipality

5 are owned by the municipality;
1 fixed station and 4 floating stations

All 5 have closed tank that we empty

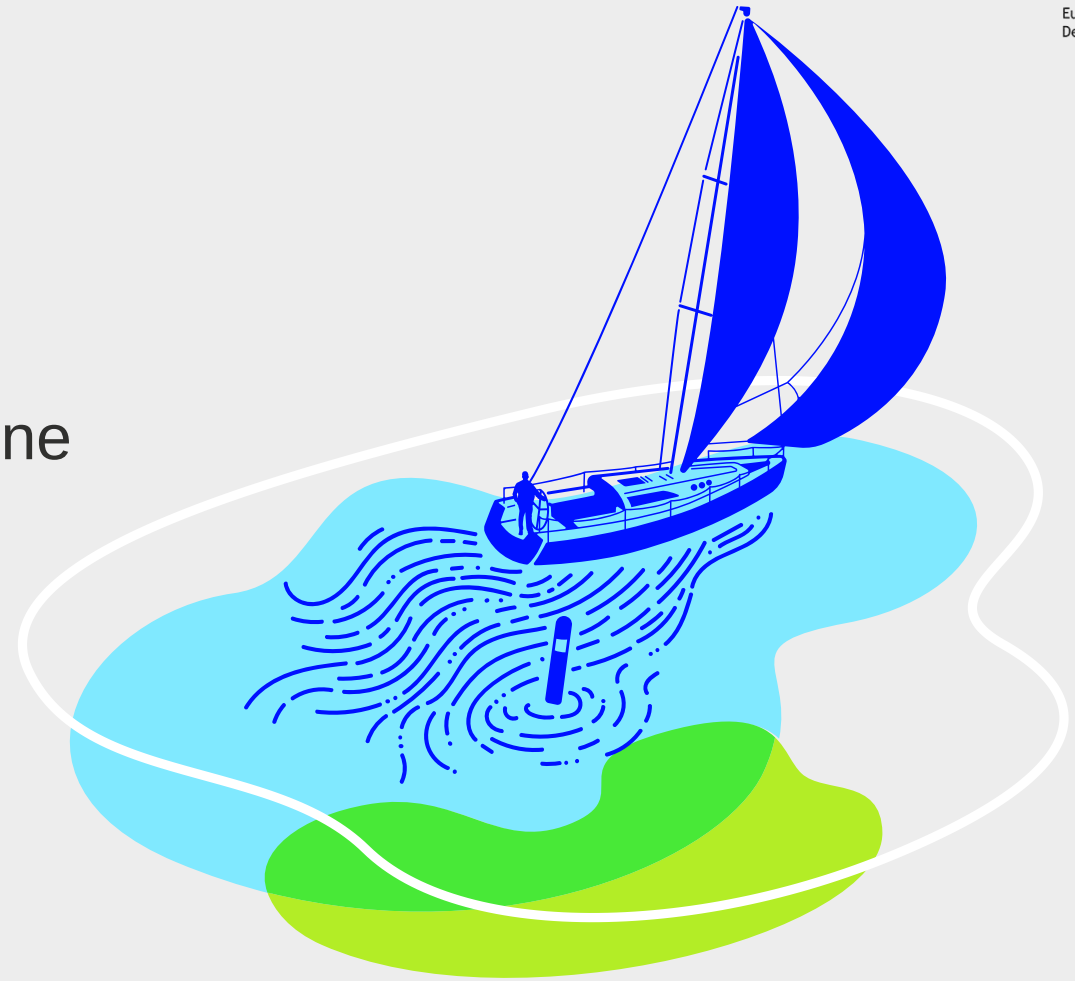
Placed the new stations based on the AIS-data – far from previous stations and where many boats pass



The procurement was ready in June 2020

Winner was Alfabryggan AB

The stations were delivered and installed in September 2020



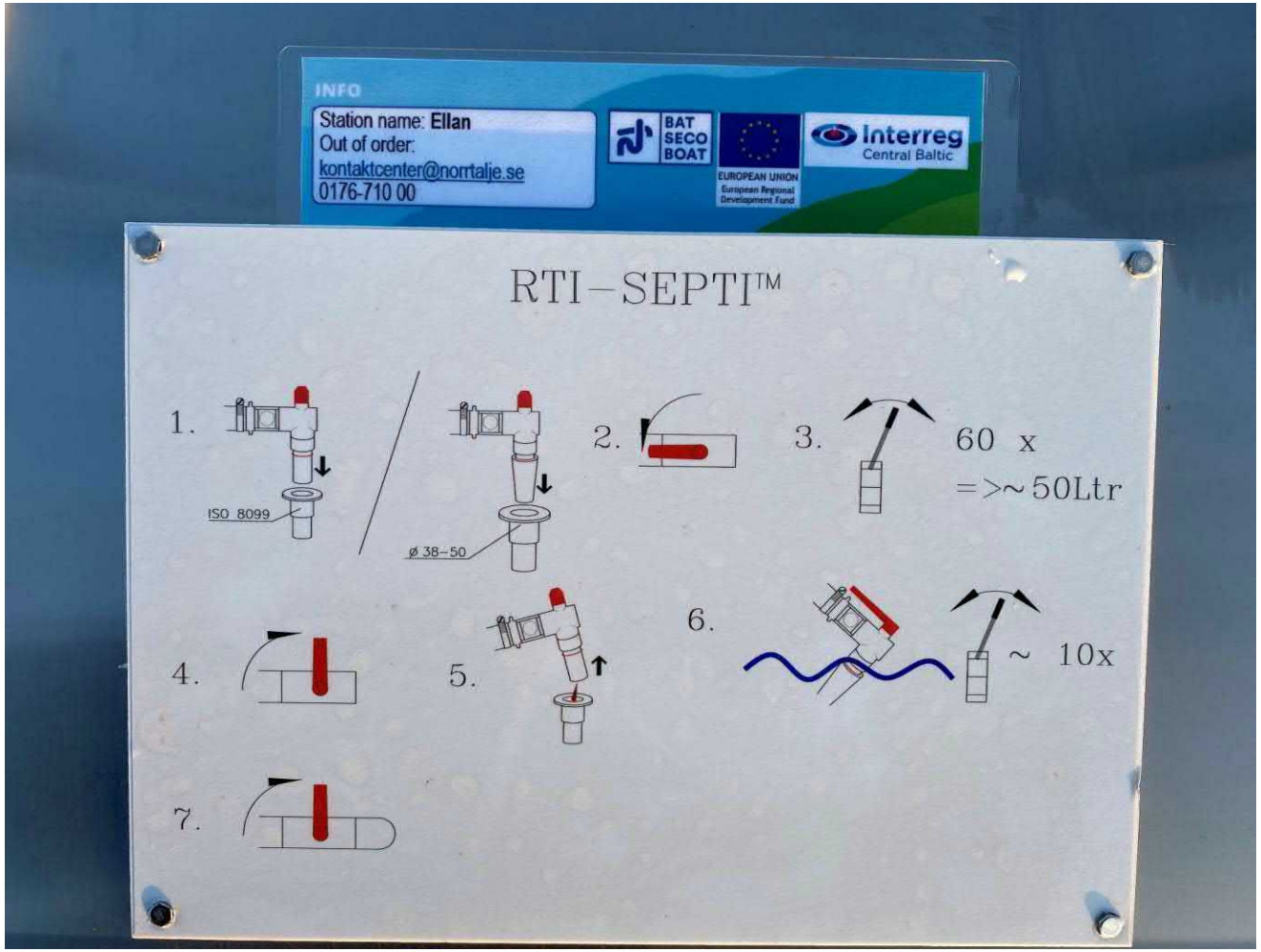
Resulted in two new stations

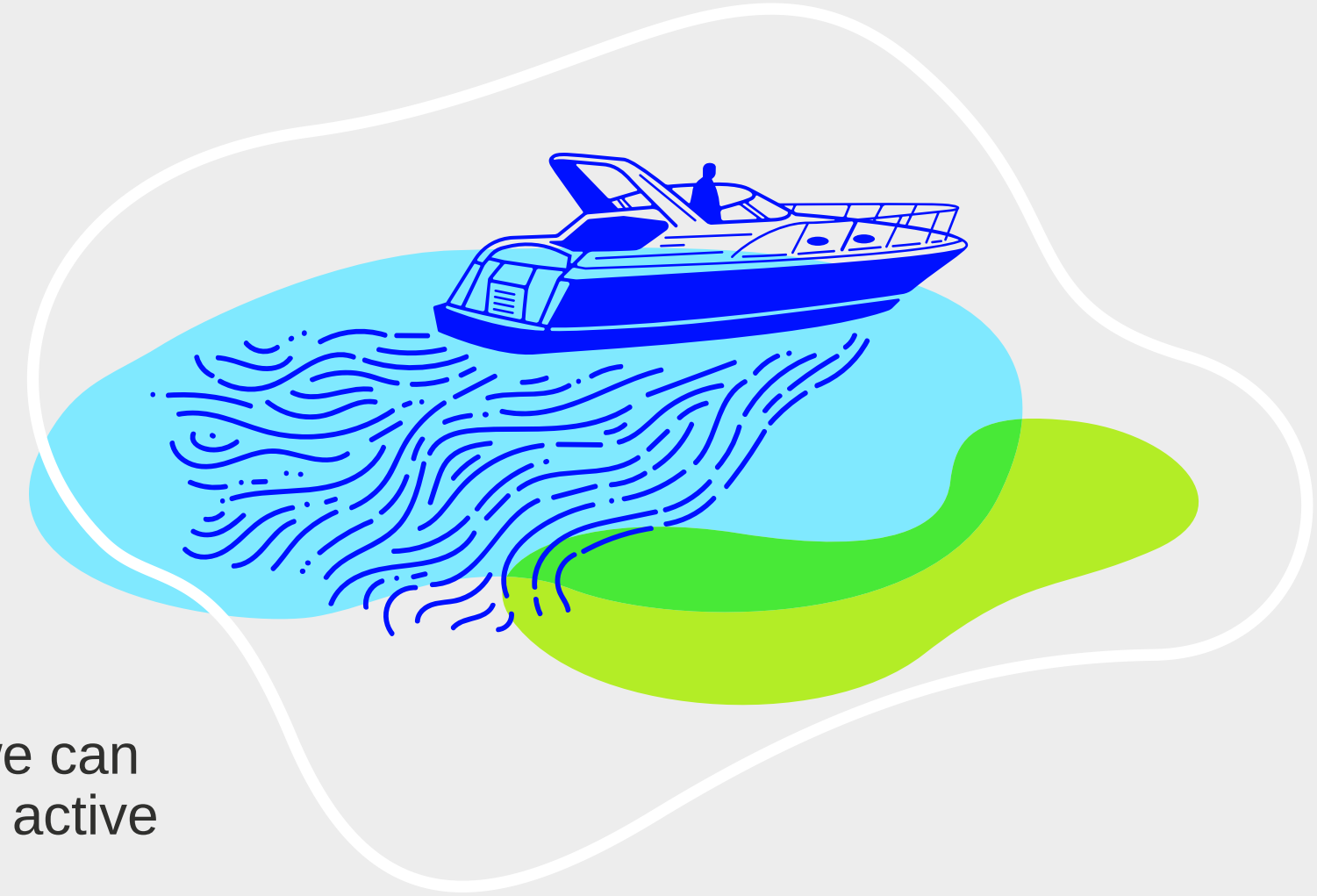
Stora Högskär

Ellan

Miljöbryggan Rti-10

Both stations have remotely read level meters





Total price:

1 260 000 SEK

With the help of the stations, we can create better conditions for the active outdoor life

Thank you!

NORRTÄLJE KOMMUN

BATSECO-BOAT

Best **A**vailable **T**echnologies of **S**ewage **Co**llecting for **Boat** Tourism

BATSECO BOAT aim

To improve capacity and service level of latrine sewage collection in small boat ports in Finland, Estonia and Sweden.

BATSECO-BOAT partners

University of Turku – Veijo Pönni

Ecoloop AB – Helfrid Schulte-Herbrüggen m fl

Utvecklingscentrum för Vatten – Donatella Acquaviva, Jonathan Alm

Keep the Archipelago Tidy – Hanna Haaksi

Hoia Eesti Merd – Marek Press

Viimsi vallavalitsus – Esta Tamm

Norrtälje kommun – Jan Paymer, Eva Åberg

Transportstyrelsen (ass. partner) – Lina Pettersson

Project work plan

- WP 1 – Project management (Åbo university)
- WP 2 – Mapping of needs, knowledge gaps, capacity and dissemination (Ecoloop)
- WP - 3-6 Implementation (Sweden, Åland, Finland, Estonia)
- WP 7 - Communication (Keep the Archepelago Tidy, Finland)

Implementation WP

- Mapping of actors: responsability and roles (ecoloop)
- Movement of leisure boats (ecoloop)
- User survey (KEST)
- Economic analysis (UTU)
- Review of available technology (UCV)
- Analysis of sewage waste (ecoloop)
- Scoping study: digital map (ecoloop)
- Calculation tool for waste flows (ecoloop)
- Compilation doc, guidelines (KEST/UTU)
- **Lessons learnt** (ecoloop)

Lessons learnt

Pump-out stations were installed in Sweden, Finland and Estonia.
Responsible actors were different in all 3 countries.

About the stations

Basics	Estonia (KEST)	Finland (KAT)	Sweden (Norrtälje)
Brand/Manufacturer/deliverd by	LS60W/ LeeStrom GmbH/ Top Marine OÜ	HL Metal	Miljöbrygga Rti-10/Reittitiimi Oy/ Alfabryggan AB
Capacity	50 l/min	10-12 m3	10 m3
Type	**Land-based** (1 emptied by truck, 1 connected to WWT facility)	**Floating**, emptied by boat	1 **floating** emptied by boat, 1 **land- based**, emptied by truck
Cost (rounded)	10 000 euro/station (station only)	45 000 euro (placed by KAT)	60 000 euro (installation incl)
When to empty?	Visual inspection	Visual inspection on KATs service trips	Schedule (digital metre present)

Motivation

Estonia: Desire to up-grade harbours and cater for foreign visitors + environmental concern

Sweden: a need for pump-out stations in the area

Finland: Old stations from 2006 needed upgrading

Ownership and maintenance

Estonia: the harbour owner will own, maintain and finance.

Sweden: Norrtälje municipality (waste dpt, but will be reorganised).

Finance: municipal tax.

Finland: KAT. Maintenance financed by KATs regular work

(mix of members, minstry of env, sponsorship)

How will boaters locate the stations?

Estonia: through the on-line port register (up-dated by harbour owner). Up-dated cruising guides (by Estonian association for guest harbours)

Sweden: the map by the national transport agency. https://hamnkartan.azurewebsites.net/

Finland: marked in map and through information to members. (https://www.roopekartta.fi/map)

Procurement process

Procurement	Estonia (KEST)	Finland (KAT)	Sweden (Norrtälje)
Specifikations	Specific technical requirements	Specific technical requirements and user aspects	Robustness and technical function
Language	English	Finnish	Swedish
Bids	3 (1 disqualified)	Round 1: 3 Round 2: 2	2 (swe and fin)
Winner	Complied requirements, lowest price. Also does maintenance	Complied with requirements, lowest price.	Complied with requirements, lowest price.

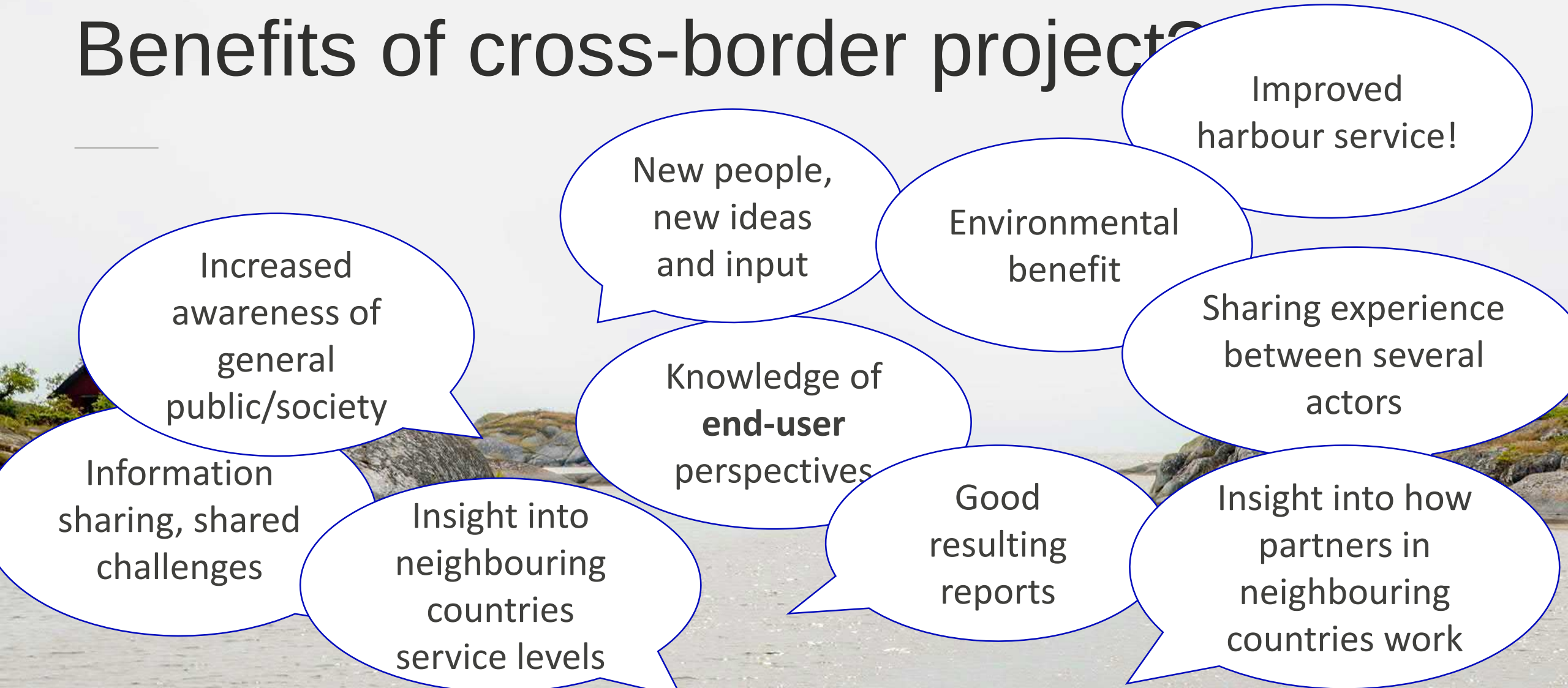
Lessons? What would you do differently?

Estonia: we would do the same. Contacting bidders directly rather than using national procurement process lowered the price and raised competition. Consulted the ministry of finance (dept of procurement), FLC and private law advisor to be sure the procedure complied with regulations.

Sweden: we had a lot of experience from old stations, so could specify our requirements for the procurement process well.

Finland: We used a procurement lawyer – very good experience! Used input from users of old stations to specify requirements.

Benefits of cross-border project?



Main drawbacks/challenges

Estonia: contacting harbours, not always a person available

Sweden: took a bit longer initially due to project admin (recieved good help from LP and FLC!)

Finland: none ☺

Needed?

Collaboration and information exchange between NGOs

More stations are needed!

Exchange of experience at all levels! Local to national authorities

Standardisation of connections between boat and pump-out station

A coordinated/ standardised map (*plotter?*)

Increased awareness among boaters of problem

Exchange of experience regarding maintenance issues

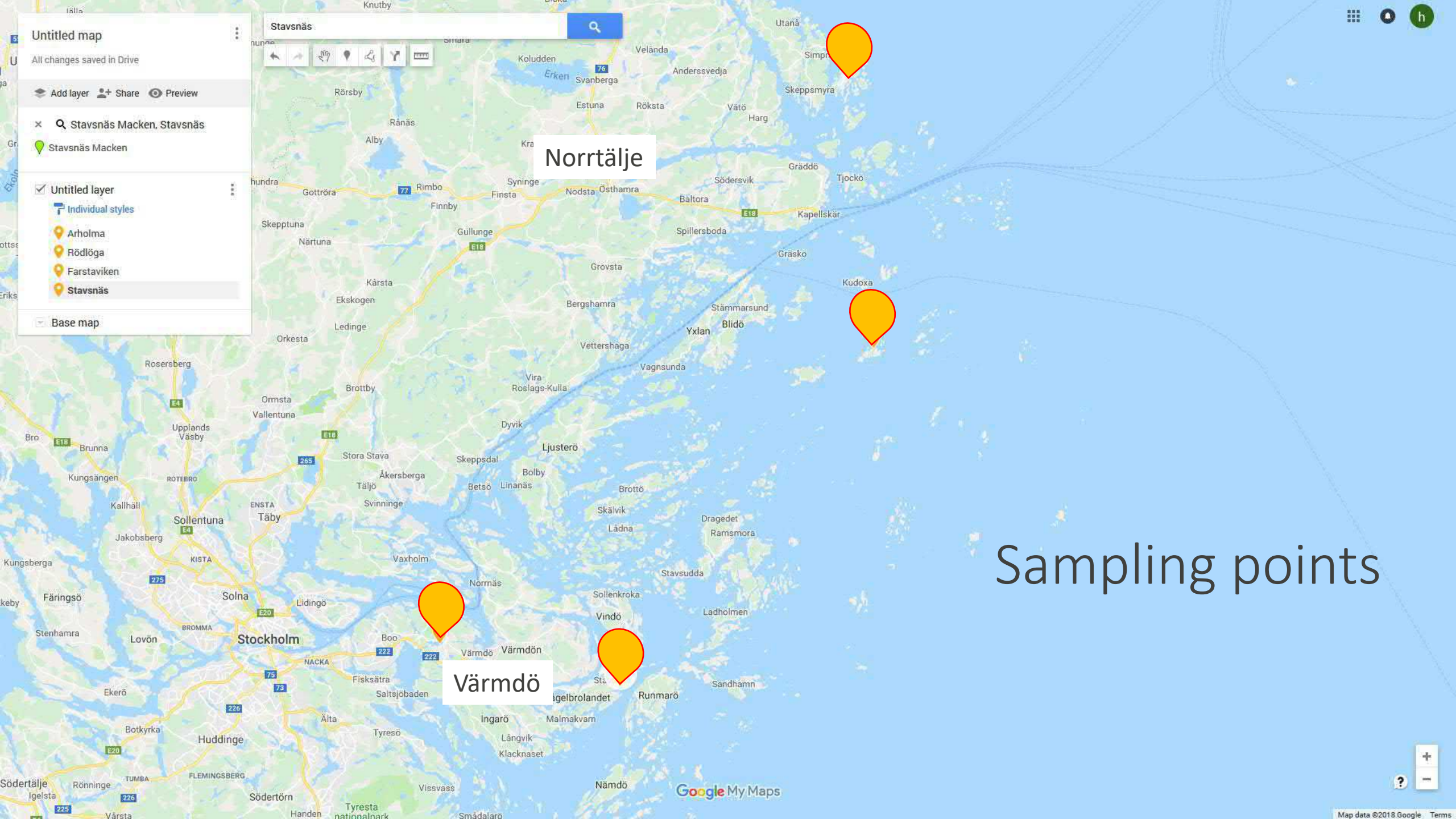
Other lessons

- Most harbour owners value the importance of good service
- Few toilets on boats
- Important with instructions on station
- Good consortium and mix of partners of different competence
- Need for more concrete investments

BAT SECO BOAT

EUROPEAN UNION
European Regional Development Fund

Interreg Central Baltic


Untitled map
All changes saved in Drive
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Untitled layer
Individual styles
Arholma
Rödlöga
Farstaviken
Stavsnäs
Base map
Stavsnäs
Norrtälje
Värmdö
Sampling points
Google My Maps
Map data ©2018 Google
Terms

- Arholma
- Rödlöga
- Stavsnäs
- Farstaviken

Analysis

- Nitrification inhibiting
- BOD/COD, tot-N, Tot- P
- Metals, chloride, ammona, oil-index
- pH, TS,

Results from sampling and analysis

- Nitrification inhibiting: yes, it is inhibiting to the process
- BOD/COD Varied between samples, indication of difficulty to decompose
- tot-N, tot- P Higher than conventional WW
- chloride Above guideline levels
- Ammonia Significantly above guideline/WW levels
- oil-index Below guideline
- Metals Cr och Zn, somewhat high at Rödlöga (confirmed in 2019)

Results of analysis

	Arholma	Rödlöga	Stavsnäs	Farstaviken	jämför
pH	8,1	7,5	7,5	7,5	6,5-10
Tot-N (mg/l)	900 / **1100**	920 / **1400**	620	680 / **880**	ARV: 35-100
Tot-P (mg/l)	15 / **7,4**	65 / **22**	35	2,3 / **15**	ARV: 5-25
BOD (mg/l)	1200 / **880**	620 / **1400**	6500	180 / **510**	ARV: 200-400
COD (mg/l)	2400 / **1900**	2800 / **4600**	7100	750 / **1300**	ARV: 400-1200
BOD/COD	0,5	0,22	0,92	0,24	0,3-0,5*

*svårnedbrytbart (NV = 0,43)

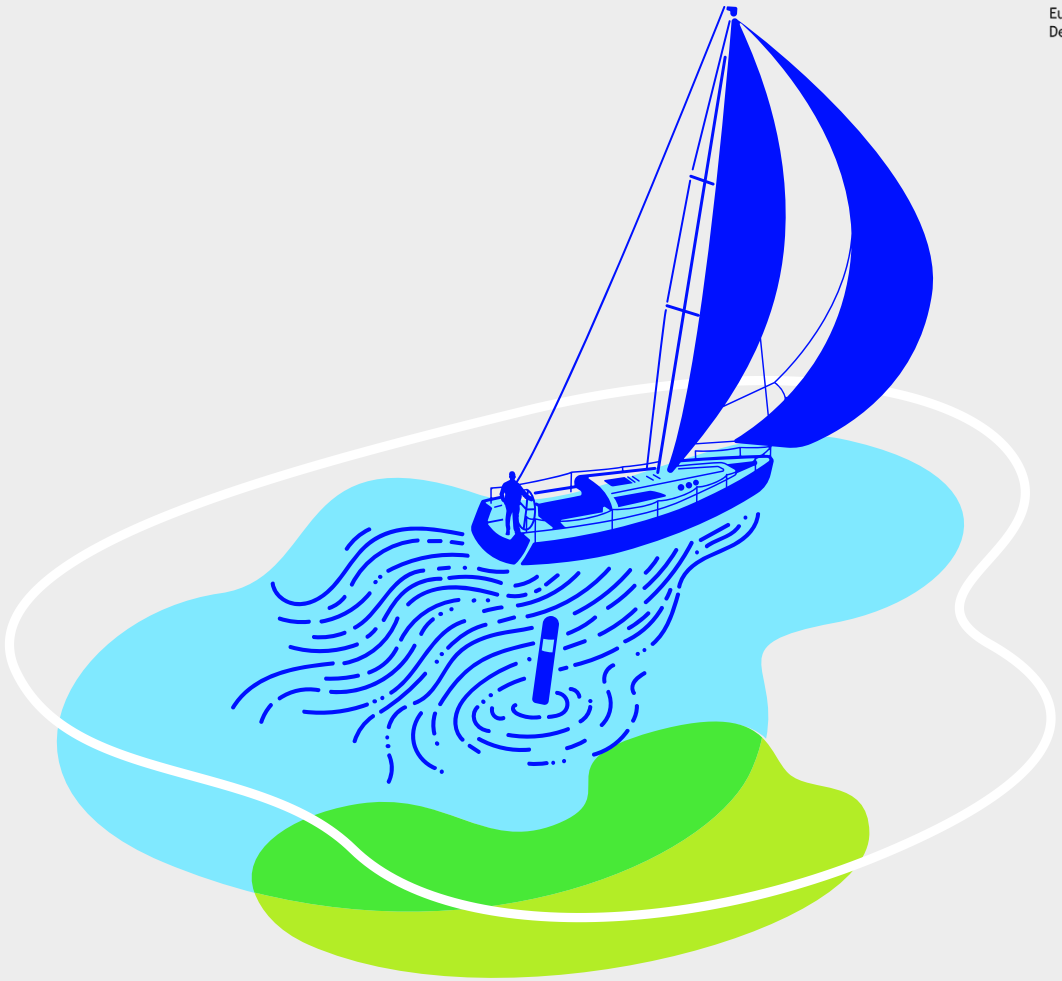
Results of analysis

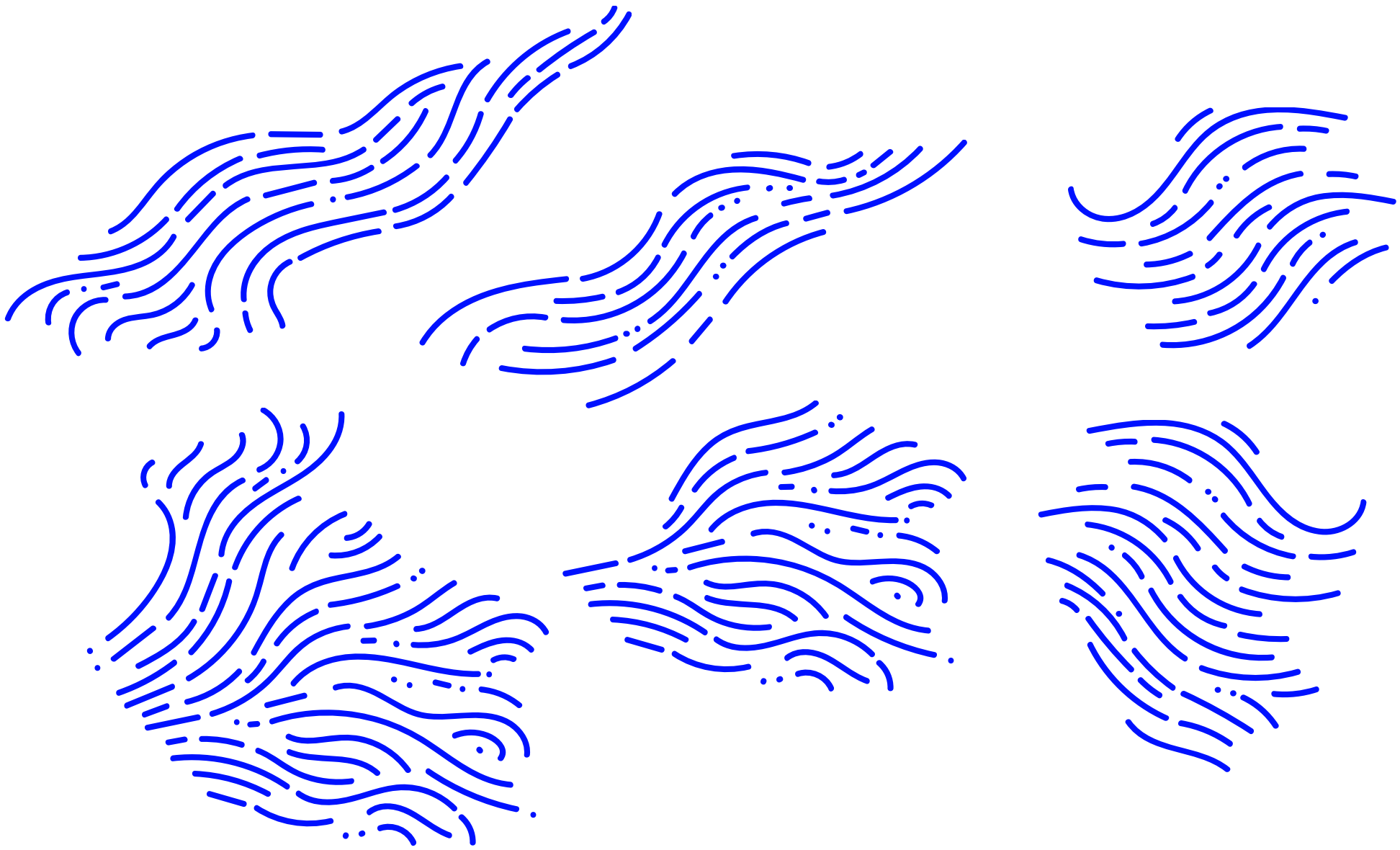
	Arholma	Rödlöga	Stavsnäs	Farstaviken	Varningsvärde
Chloride	2900 **/ 2800**	2900 **/ 3000**	2800	2500 / **2600**	*2500*
Ammonium-kväve	830 **/ 1000**	950 **/ 1100**	520	330 **/ 700**	*60* *ARV:22-60*
Olje index	4,4 / **7,5**	5,4 / **2,4**	2,4	0,81 / **5,3**	*5-50*
Nitrifikations hämmande (20%)	70 **/ 62**	24 / **44**	44	34 / **39**	*20*
Nitrifikations hämmande (40%)	100 **/ 100**	39 /**100**	80	54 **/ 69**	*50*

Results of analysis

	Arholma	Rödlöga	Stavsnäs	Farstaviken	warning
Bly (Pb)	0,0072 / **0,0049**	0,0074 / **0,016**	0,0012	0,0017 / **0,0042**	*0,05*
Cadmium (Cd)	0,00027/ **0,00015**	0,0014 / **0,0019**	0,00013	0,00016 / **0,00016**	*noll*
Koppar (Cu)	0,73 / **0,38**	**0,49**	0,088	**0,23**	*0,2*
Krom (Cr)	0,0052 / **0,0027**	0,91 / **0,00064**	0,0051	0,0015 / **0,011**	*0,05*
Nickel (Ni)	0,026 / **0,03**	0,16 **/ 0,069**	0,017	0,026 / **0,028**	*0,05*
Zinc (Zn)	0,33 / **0,24**	1,3 **/ 2,3**	0,15	0,22 **/ 0,97**	*0,2*
Kvicksilver (Hg)	< 0,00010	0,00023	< 0,00010	< 0,00010	*noll*

Thank you!





Technology assessment

- **Market Investigation**
- **Quality of the service**
- **Innovative solutions**

Technology assessment

- **Market Investigation**
- Quality of the service
- Innovative solutions

Technologies

Land based stations

- Located on a pier or on the bank
- Connected to the wwtp or have a collection tank
- Think carefully of their location

Portable stations

- Handy solutions
- Small volume (80-95 l)
- Require extra work

Floating stations

- Ok for places without sewage & electricity networks
- Anchored outside marinas, can be moved
- Large tank that must be emptied
- Cannot be used in coastline exposed to rough sea conditions

Market investigation

- Usually a non-core business
- Sweden & Finland: Several local and international brands
- Estonia: Smaller market

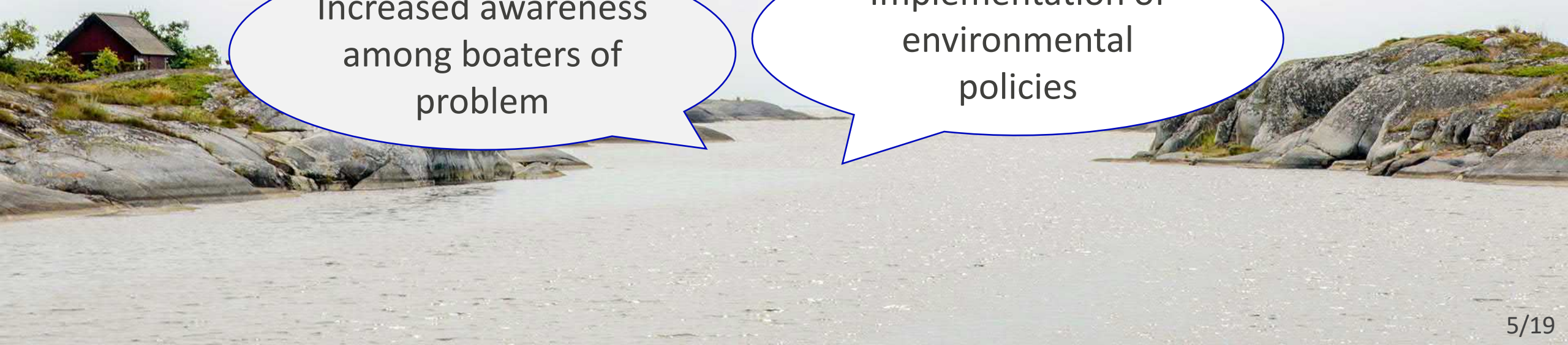
Needed?

More incentives to the market, the demand for pump-out stations has decreased

More stations are needed!

Increased awareness among boaters of problem

Implementation of environmental policies



Technology assessment

- Market Investigation
- **Quality of the service**
- Innovative solutions

Most common issues?

Problems experienced by:

- Users
- Port operators
- Wastewater treatment plant personnel

Some examples

Problem

Hose length & hose nozzle compatibility

Two standards:
ISO 4567 &
ISO 8099:2000 (now 2018)
Small craft- waste system

Suggestion

Choose the hose length carefully

Have different hose nozzle, conic nozzle works well

Some examples

Problem

Sharp edge of floating stations or pontoons

Suggestion

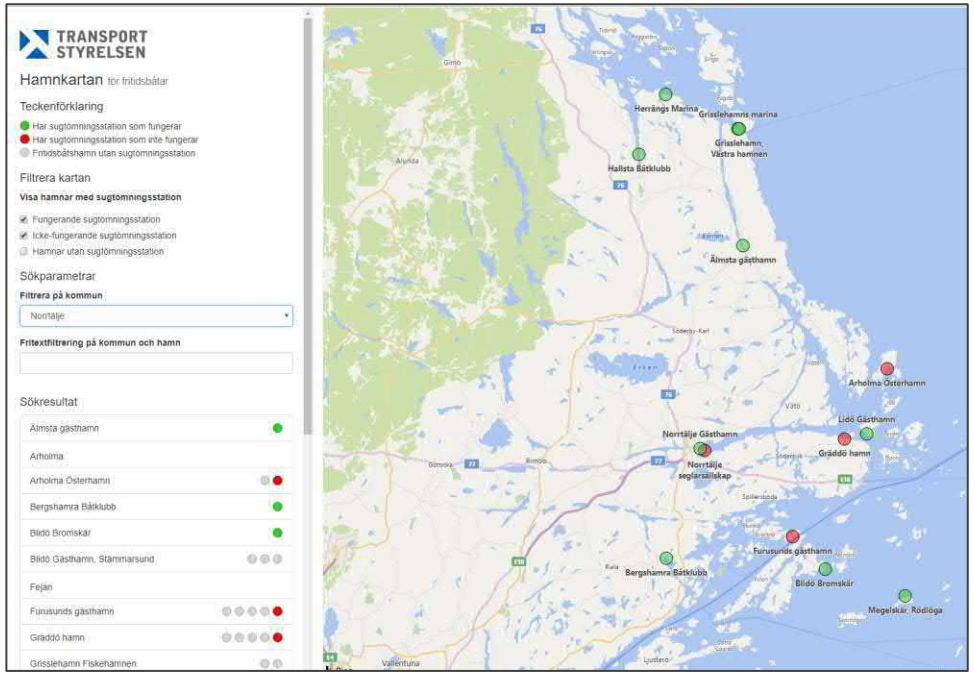
Shielding system!

Some examples

Problem

In Sweden the app is not updated.

How to know if the station works??



Suggestion

When a fault is reported the port operator should fix it ASAP and update the app.

Some examples

Problem

Delay in getting spare sparts

Suggestion

Keep a stock!

Some examples

Problem

Pargas, Finland: The boat sludge affected the wwtp processes (ca 2000 pe)

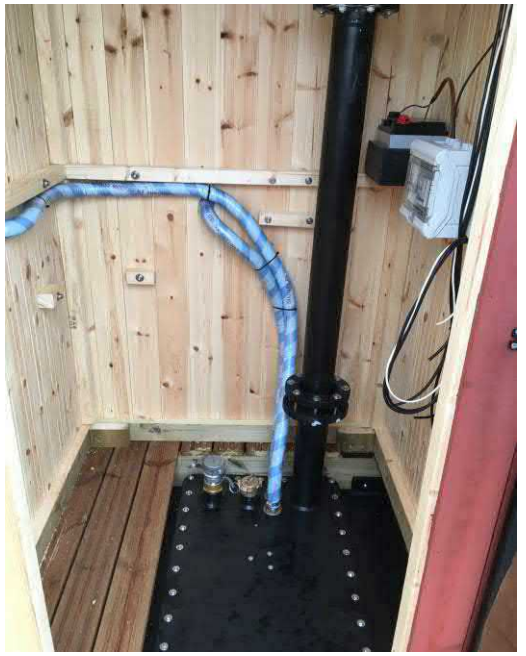
How they solved it

Buffer tank, boat sludge released slowly.

Suggestion for floating pump-out station

Pontoon big and sturdy

Guarantee that the tank is corrosion resistant or easy to replace



Requirements?

- **Spare parts**: maximum time to deliver them
- Avoid **sharp edges** of floating stations
- Pump-out station equipped with **alarms** to indicate when the tank is **full** and when the station is **out of service**
- **Maintenance** plan

In a nutshell

- Make it simple for the **port operators!**
- Make it simple for the **boaters!**
- Make it **work**!

Technology assessment

- Market Investigation
- Quality of the service
- **Innovative solutions**

Example of innovative solutions

Nauvo, Finland

Example of innovative solutions

Utö, Sweden

Innovative solutions

The lack of incentives is a hinder to innovation

Projects as instrument to promote innovation:
Ex. VTT project RESURSSIKONTTI 2 (Resource container 2)

UCV
Utvecklingscentrum för vatten
EN DEL AV CAMPUS ROSLAGEN AB

BAT SECO BOAT

EUROPEAN UNION
European Regional Development Fund

Interreg
Central Baltic

THANKS!

donatella.acquaviva@campusroslagen.se

Resource container

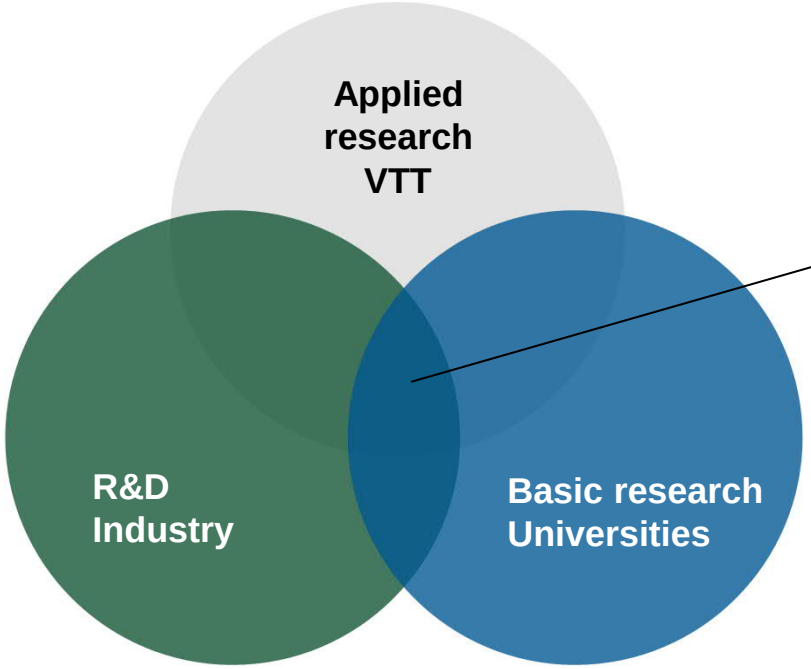
Batseco-Boat final event

Hanna Kyllönen, Eliisa Järvelä and Antti Grönroos

We connect local expertise to global markets

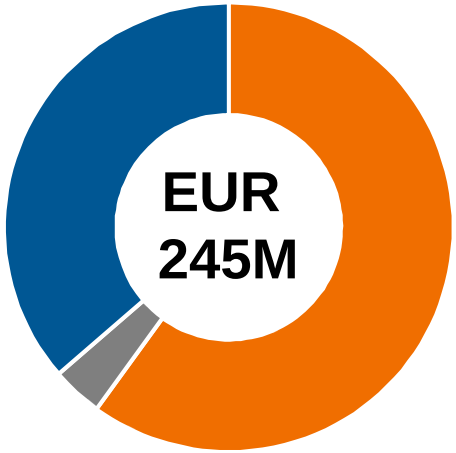
- We tackle global challenges and are a member in international research networks
- We enhance Finland's national and our customers' competitiveness on international markets
- We collaborate with local businesses and operators
- We are a significant employer

We turn science into practical innovations through applied research



The sweet spot where innovations are born

VTT today



147 M€ Turnover (parent 147 M€)

9 M€ Other operating income

89 M€ Government grant

2,103
employees

47%
of turnover from abroad*

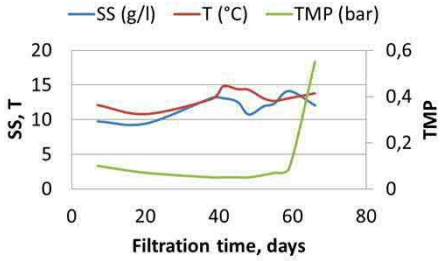
27%
of Finnish innovations have links with VTT's competences

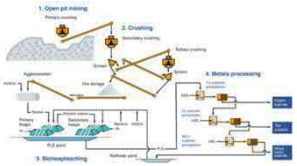
406
patent families

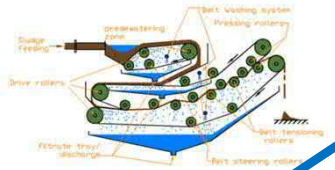
VTT
is under the state ownership steering of the Ministry of Economic Affairs and Employment

*VTT Group 2019

Separation team: From peat dewatering to circular economy







2020 Process chemicals circulation

Nutrients recovery

2010 Water circuits at mining sector

Technologies for potable water

2000 Fractionation for biorefinery

MBR at wastewater treatment

Development of thermal stimuli controlled filters

1990 Closing water circuits at P&P sector

Fouling control of membranes in wastewater filtration

Usable products from sludge and ash

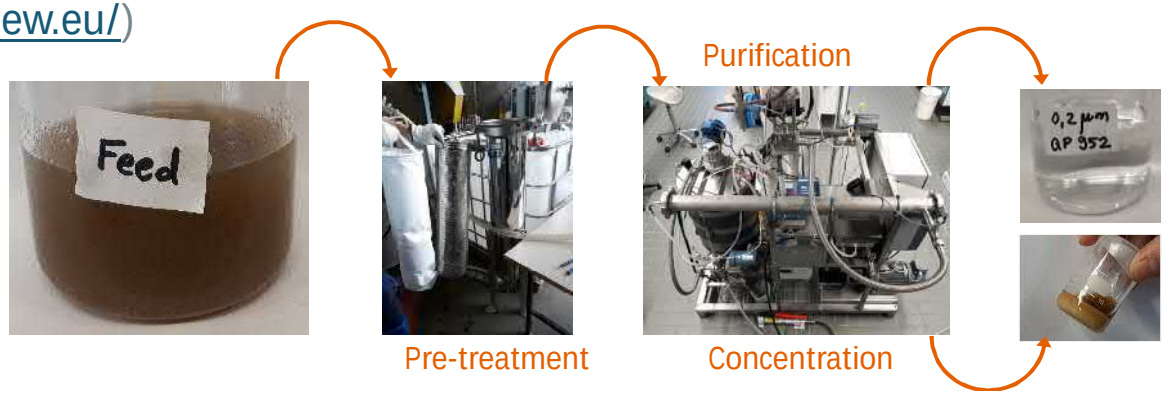
Mechanical dewatering and pre-treatment concepts for sludges

1980 Artificial dewatering methods for peat

Separation concept development case by case

Examples of circular economy applications based on membrane concepts:

- Wastewater purification with nutrient and carbon recovery in separate fractions (https://www.vtt.fi/sites/Resurssikontti)
- Scalants removal for RO water production combined with high grade NaOH and H_2SO_4 to be utilized at mine (From aqueous challenges at mines to valuable products, MinePro)
- Sulphate removal from mine water along with sulphide and sodium chemicals production (https://eitrawmaterials.eu/project/so4control/)
- Separate recovery of proteins, carbohydrates, phenolic products, and water from wastewaters of food industry (https://afterlife-project.eu/)
- Chlorine based biocide production from process water of pulp and paper industry (http://www.spotview.eu/)

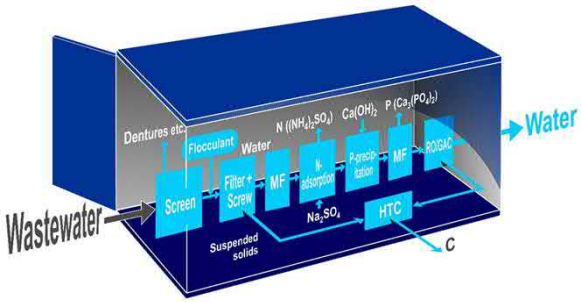


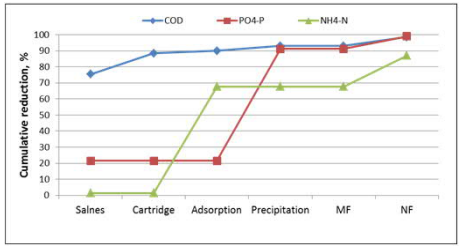
Case decentralized pure water production with full resource recovery

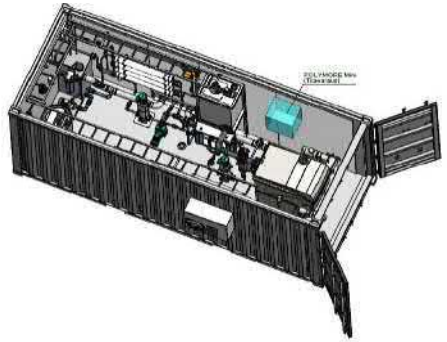
- Target: Preserve aquatic ecosystem by purifying water and recovering products from wastewater using physico-chemical units applicable for varying wastewater loads and temperatures
- Results:
  - Reductions: solids, COD and phosphorous 99%, nitrogen 95%
  - Products: nutrients as inorganic fertilizers, carbon as biochar and purified water for reuse
    - Production of fertilizers worthwhile if concentrations high enough
    - Solids are low in weight, thus possible to transport to centralized treatment

→ Plug-and-play resource container to be implemented in various scales locally or as seasonal solutions

https://www.vtt.fi/sites/Resurssikontti







Resource Container

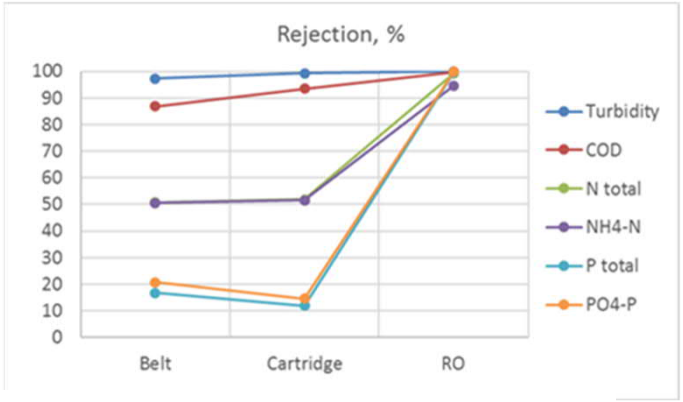
- Rated feed capacity 1 m^3/h
- Solid-liquid separation aided by flocculation
  - Salsnes SF1000
- Microfiltration
  - Two Cartridge filter SPE-5-9¾BB housings
- Membranes
  - 4 pressure vessels for membrane elements
  - Piping up to 16 bar
  - CIP
- Nitrogen recovery:
  - Liqui-Cell membrane contactor
- On-line measurements: Temperature, feed flows, permeate flows, trans membrane pressure, conductivity of membrane permeate

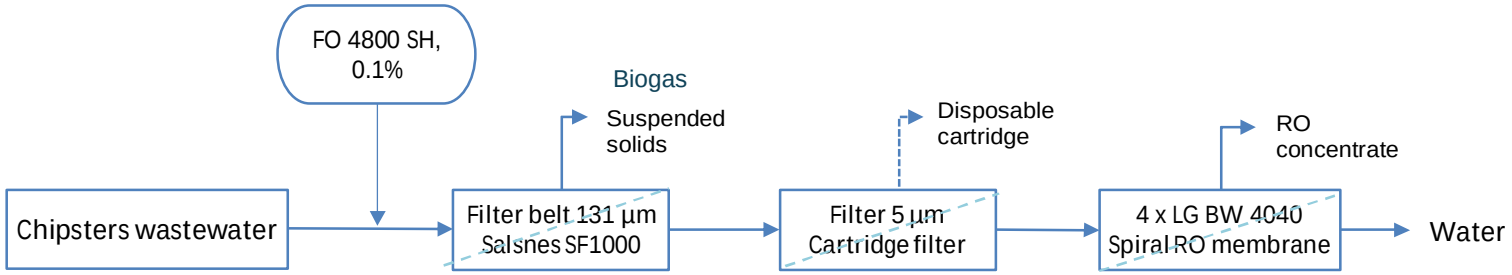
Manufactured by WatMan
https://watmanengineering.fi/en/

Piloted food industry water purification

- Food industry wastewater (Chipsters)
  - Process water purification
  - COD decrease before municipal WWTP
  - Water reuse (cleaning water)

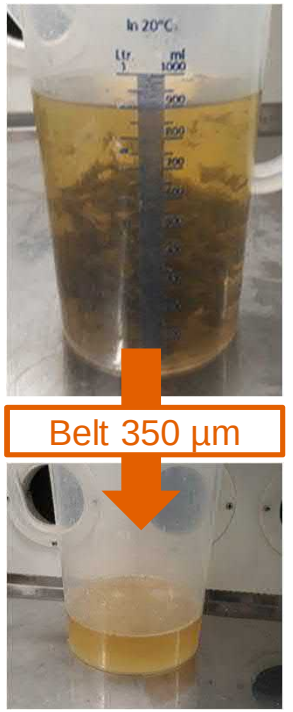
→ COD decrease enough already with belt filter
→ Water reuse after Membranes





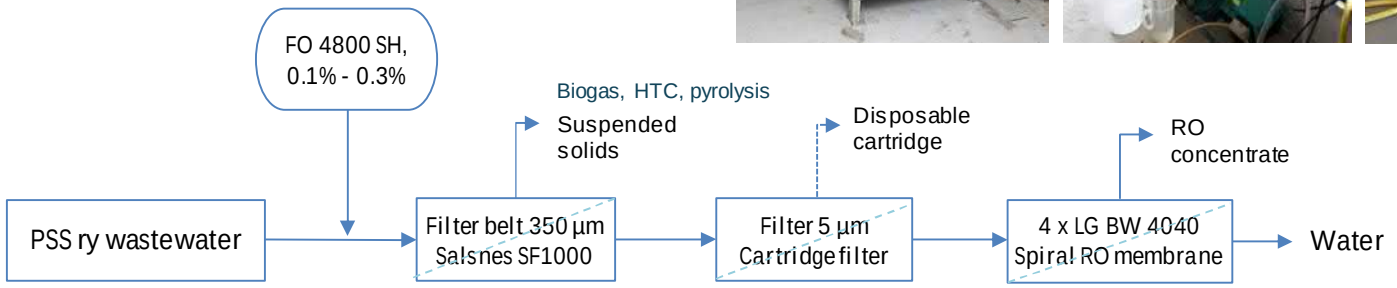
KAT (PSSry) - Flocculation lab tests before piloting

- Septic tank wastewater collected by KAT
  - Dry solids content ~8 g/l (8 kg/m^3)
- Belts 150 µm, 250 µm and 350 µm tested for floc removal
- Flocculant SNF Floerger FO 4800 SH
  - Dose increased until successful floc formation
  - Optimal dosage about 90 l/m^3 of 0.1% polymer, i.e. ~11 kg/t_{DS}



Pilot studies – equipment in water purification concept

- Belt 350 µm changed to Salsnes SF1000 filter
- Cartridge filter SPE-5-9¾BB with 5 µm pore size (nominal rating)
- RO membrane elements LG BW 4040 ES

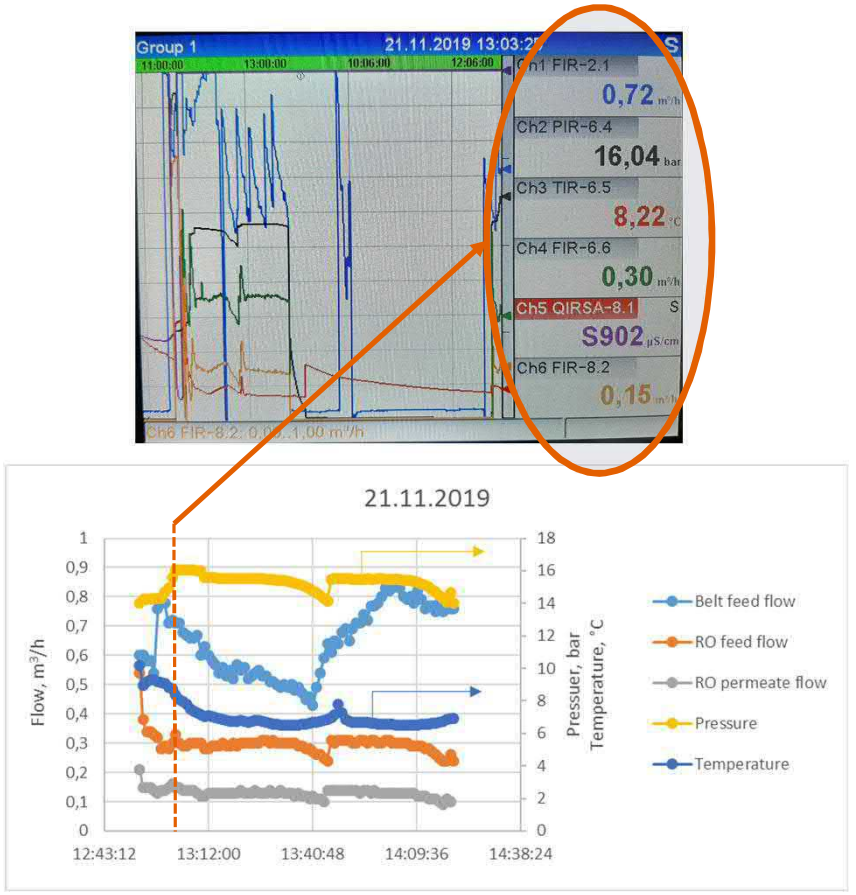


Piloting observations 1/2

- Belt 350 µm performed well if flocculation was successful, but polymer feed pumps were at maximum
- Flocculation may have performed not so well due to cold wastewater
- Cartridge filters clogged quite rapidly – to be improved by self cleaning micro filtration (MF)

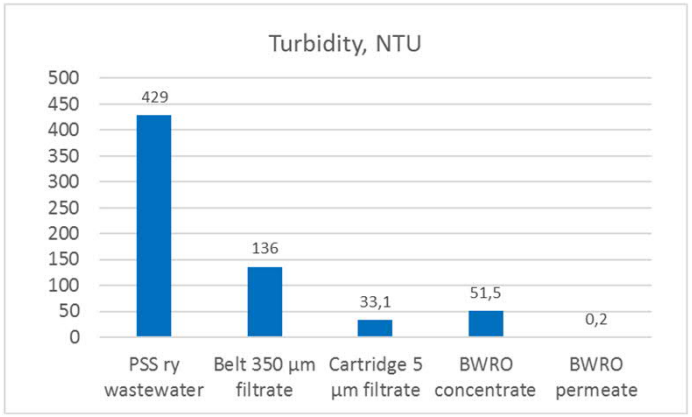
Piloting observations 2/2

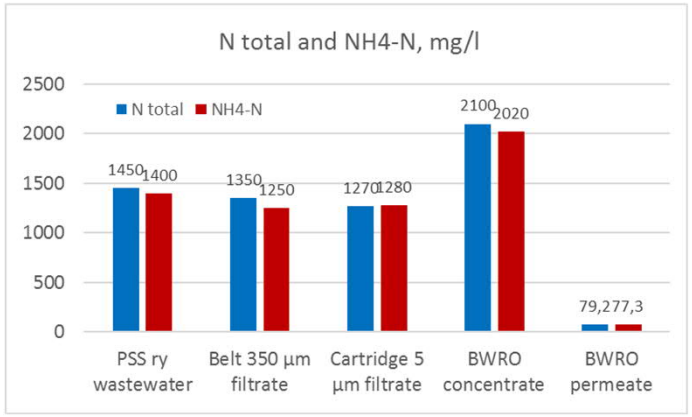
- Measurements as well as data manager and display were helpful
  - Flow measurement of belt feed, RO feed and RO permeate
  - RO pressure, wastewater temperature
  - RO permeate conductivity
- RO pressure was from 13 to 16 bar
- Water recovery in RO only 50% - to be improved by better MF

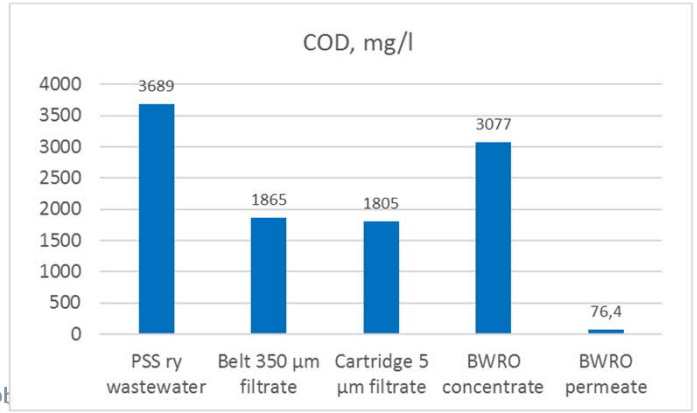


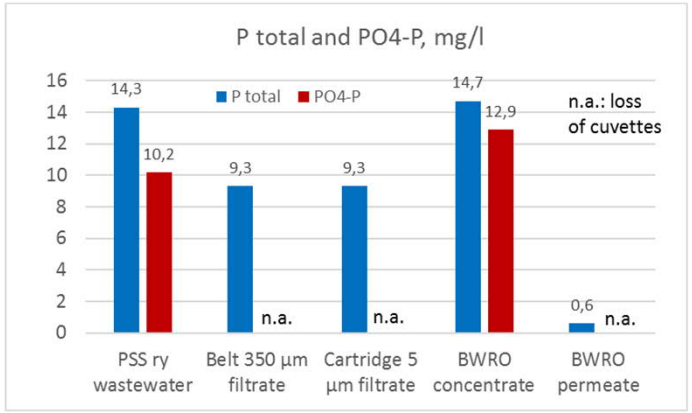
Piloting results – water purification

1. ”PSS ry wastewater”
2. Belt filtrate
3. Cartridge filtrate
4. RO concentrate
5. RO permeate



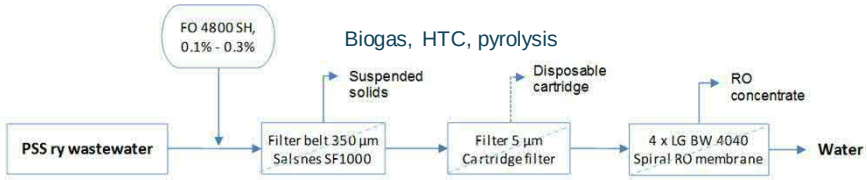


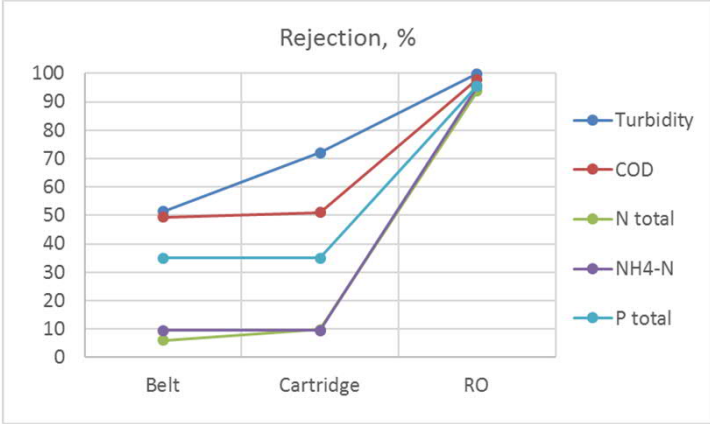




Piloting results – water purification

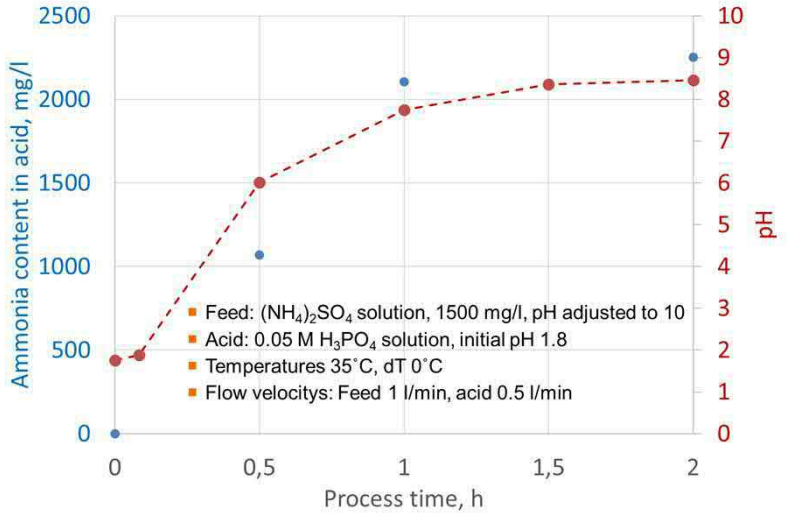
- Belt 350 µm with flocculation removes most of suspended solids and COD
- Cartridge filters remove remaining suspended solids
- RO concentrates nutrients to RO concentrate and produces water with quite low concentrations of COD, P and N
- Rejections of the container:
  - COD: 98%
  - Nitrogen: 95%
  - Phosporus: 96%

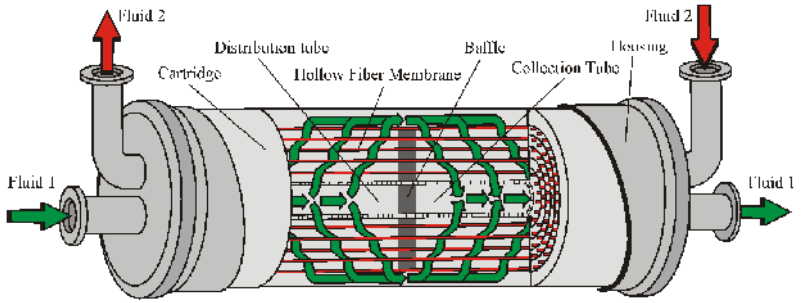




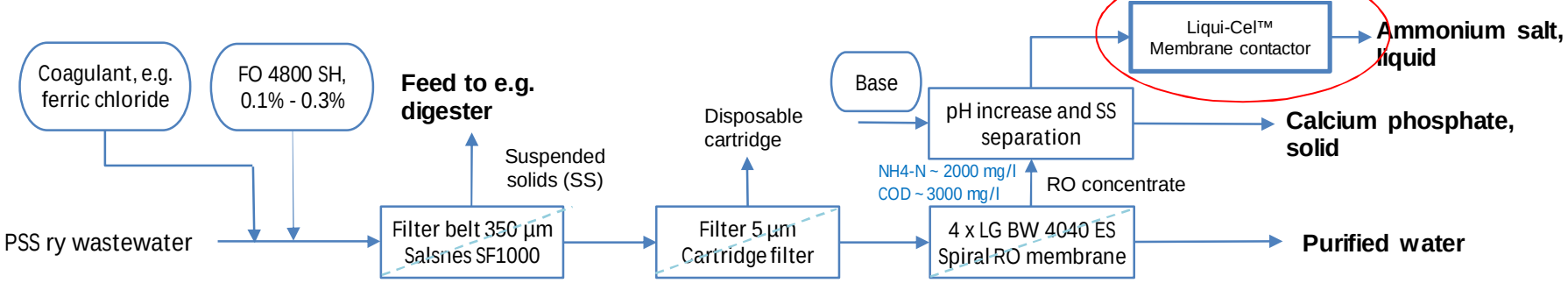
Nutrients recovery – results and concept

Ammonia recovery results :





- NH_3 inlet conc. >500 ppm
- Pre-filtration <10 µm
- Temperature 40-55°C
- Feed stream pH>10
- Acid stream pH<2



Conclusions – KAT (PSSry) collected wastewater piloting by Resource container

- Belt filter needs optimum flocculation for good performance, perhaps coagulant could be added in water purification concept
- Sludge can be directed to HTC or biogas production
- Cartridge filters with 5 µm nominal rating clogged rapidly, probably due to improper flocculation - change of cartridge filter to self-cleaning microfilter
- Low P and PO4-P concentrations in wastewater, no specific recovery actions are recommended – P can be precipitated before N recovery
- NH4-N concentration is high and can be recovered, studies using membrane contactor and NH4-N adsorbent
- Water recovery in RO must be increased
- Water purification processing costs without investments and investment related costs 3,4 - 6,9 €/m3
- Resource container investment costs ~ 150 000 €

VTT

beyond

the obvious

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