



Global Aquatic Passive sampling (AQUA-GAPS)

Passive Sampling Protocol: Application to open sampling cage

Version V5
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This **protocol** describes the deployment and retrieval of passive samplers using an open cage system.

Open cage deployment of passive samplers optimally uses the local water dynamics to achieve the highest uptake rate. The eye for hanging the cage allows rotation of the cage in case some object will bump on it.

Samplers made from polydimethylsiloxane (SSP¹) and/or low density polyethylene (LDPE) are applied as sheets of 9.5 × 5.5 cm. In these sheets two holes are punched which allows them to be placed on two stems where after the sheets are secured by sliding a rod through the hole in the thinner part of the stem. The rod is fixed to the holder with a cable tie.

After deployment passive samplers will be covered with little or severe fouling. After retrieval samplers are kept under local water, cleaned under local water and after quick patting them-dry with paper tissue transferred to the diffusion proof glass jar they were received in and stored at <-18°C.



Figure 1 Aqua-gaps open sampling cage with 4 sample holders.

¹ Silicone Special Products, USA





!! IMPORTANT

Before travelling to the field site:

- **Read all sections of this Guide**
- **Ensure that you have all necessary materials (listed in the guide)**

Providing feedback or pictures that can help to improve this guidance is highly appreciated

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1 Packages for the sampling

Deployment cage

In case you do not have equipment suitable for deploying Aqua-gaps passive sampler sheets you will have been provided a sampler cage with 4 sampler holders, that each can accommodate 6 sampler sheets (**Figure 1**), i.e. 24 in total. When organizing sampling at multiple locations you will have received a sampler cage for each location. The cage is to be reused sequentially for yearly samplings at the same station. The location to expose the samplers is upon agreement with the Aqua-gaps coordination team, but you will be the only one who can estimate the practical aspects and the risk of theft or vandalism. This may lead to exposure at locations that may not be scientifically ideal, but so be it. In case such a compromise is not possible we may consider a disposable sampler frame configuration; this can be discussed with the coordination team.

How to deploy the cage is also something you can best decide. Some options are given below in section 7. After deployment the cage will be fouled and can be cleaned with high pressure water or scrubbing. When used at the same station again a full cleaning like new is not necessary as the attached fouling is part of the environment we measure.

Passive sampler material (supplied by AQUA-gaps team)

Whilst delivery of the deployment cage is (hopefully) a one-time event, the passive sampler material you will receive on a regular, mostly yearly, basis. **Figure 2** shows an example of what it looks like. Sampler sheets (usually 16²) arrive in glass jars packed in protective tubing. The majority of the sheets (always 12) will be deployed while the remainder (usually 4 or 6) function as field control that you will pack in a separate jar, also supplied. SSP and LDPE will be deployed in parallel. Passive sampler materials are always **stored in a freezer** when not in transit or deployed. Together with each passive sampler package a pre-extracted scourer is supplied to be used for cleaning the sampler from fouling after retrieval. Passive samplers are sent back to the analysing laboratory using the same tubing for packaging. Ensure you save them in a known place, e.g. with the field controls, or with the other materials you will need for retrieval.

² The number of sheets may vary

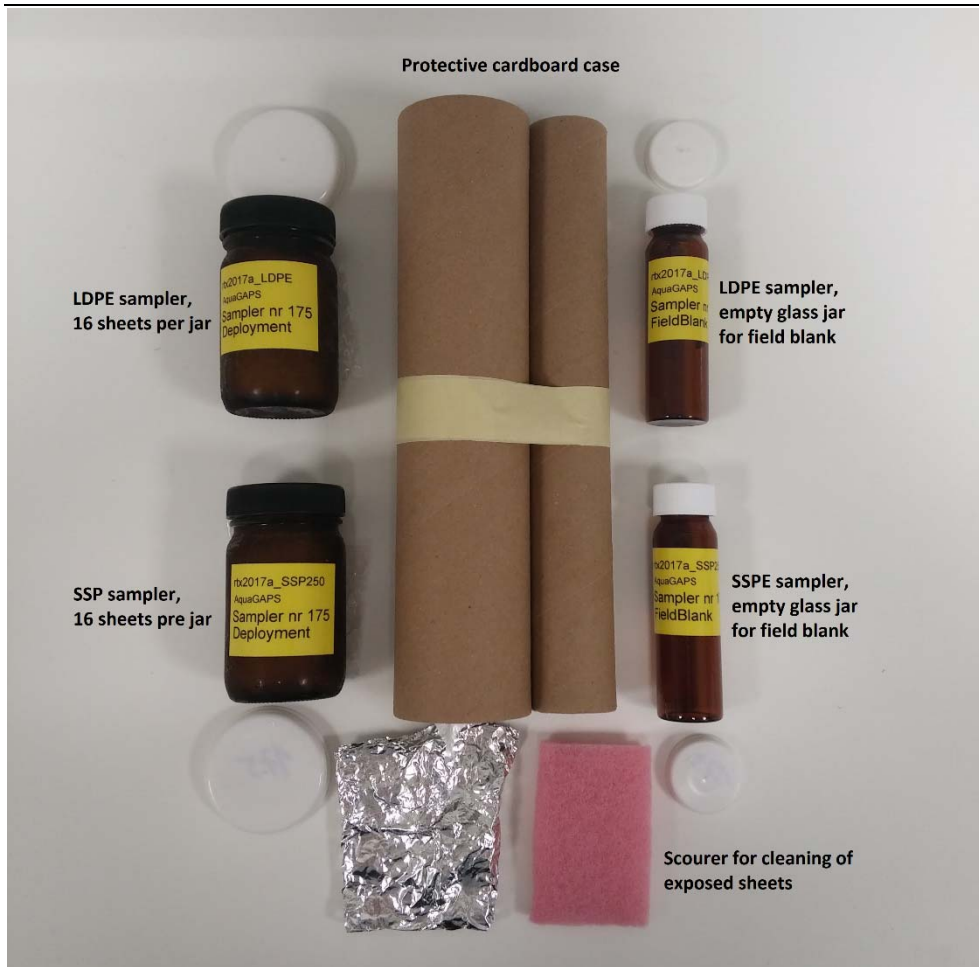


Figure 2: Example of sampling set: protective tubes for sending containing jars/vials with samplers, each jar/vial labelled with “aqua-gaps”, polymer type, and a sequence number, & a scourer packed in aluminium foil



Figure 3 : Some of the materials required for deployment and retrieval of passive samplers. A full list is given in section 2.



2 *Items needed for sampler deployment and retrieval (NOT supplied)*

1. Two clean stainless steel or glass trays and optionally a coarse steel mesh can be used to sort the samplers on. Note that any other shape, i.e. large size cooking pan may be appropriate. Any plastic type should NOT be used.
2. Glass or stainless steel beaker/bucket to sample some local water.
3. Two clean one-liter or larger wide mouth jars may come in handy for temporally storing the samplers (LDPE and SSP separately) if mounting needs to be delayed for unexpected reasons.
This also applies if after retrieval sampler cleaning to remove fouling cannot be done immediately, or needs to be done somewhere else
4. Clean disposable laboratory gloves
5. Non-sharp tweezers
6. Clean lab paper tissues
7. Thermometer, conductivity or salinity meter. For the latter alternatively a water sample can be taken to the lab.
8. Cable ties in various sizes.
9. Side cutter or scissors to cut cable ties

See also *Figure 3*

3 *Sampling cage and deployment gear*

The **sampling cage** (**Figure 1**) with sampler holders fixed in it is made of stainless steel and has a free rotating fixing eye that allows the frame to turn around and gives flexibility when hanging on a buoy, bridge or quay. The 4 sampler holders in the sampling cage can altogether accommodate 24 sheets. Holders should be fixed with two nuts or a locknut. Verify proper fixing. Also check if the rod securing the sampler sheets is of the appropriate length, slides easily through the holes, and is nice and round at the end. A sharp end may easily cut the sampler sheet.

Be sure to have **sufficient gear**, buoys, anchors, etc. to fix the sampling cage at the intended location. The sampling cage can be deployed with a combination of anchor and float/buoy, but could also hang from a navigation buoy, or from a pier/dock/quay (examples in section 7). The rotating fixing eye allows flexibility to accommodate whatever local arrangements you have for deploying the samplers. If using navigation buoys, make sure that the deployments do not interfere with the buoy maintenance schedule. Long ropes will wind up around nearby objects. Use secure systems that you think are appropriate for the specific location and its dynamics. **Knots in ropes can be secured with cable ties.**

Sampling Depth: Typically, a sampling depth of 4 m below the surface is appropriate for surface waters (unless agreed otherwise). If the local water depth is less than 7 m, then the half depth can be chosen, but sampling depth should be at least 1 m.



4 **Sampler deployment**

- 1 **Preparation.** Before *deployment* make sure the material you use is cleaned. Prepare all the fixing gear to fix the samplers before mounting the sheets. If possible, test the cage deployment without the sheets to be sure everything is as required. Sheets should be mounted just before deployment in the shortest time possible and removed from the sampling cage immediately after recovery.
- 2 Of the 16 sampler sheets packed together, 4 are used for field control and 12 are mounted on the

A **field control** is a sampler that goes through the same procedure as deployed sheets but without contact with the medium (water) to be sampled. It is suggested to expose the sheets in a stainless steel (SS) tray for about the time required for deployment, and again the same field control sheets exposed during retrieval

cage for deployment. Please note that 16 sheets are standard, but the number can deviate. Whilst the procedure is the same for SSP and LDPE sheets, do not mix them or allow contact between LDPE and SSP sheets. In the case of the standard sampler cage, SSP are mounted from bottom to top on one side and LDPE similarly on the other side of the cage.

- 3 Prepare a clean working surface (for example on aluminium foil) and lay out the stainless steel or aluminium trays for organising the samplers on for mounting (in a place out of the sun). Work with clean gloved hands and tweezers. It is best to have two people performing the mounting; one person keeping clean gloved hands handling and mounting the sampler sheets and the second performing all activities that would contaminate the colleague's clean gloved hands. Ensure all the materials listed in section 2 are organized and accessible for use.

Mounting the sampler sheets.

- 4 Register the start time. Unpack the SSP sampler sheets from the jar, taking care not to lose the stainless steel liner in the lid. Take the sampler sheets out from the jar all at once by taking them with the tweezers and rotating the jar. The sheet(s) will wind around the tweezers and can be taken out of the jar into the tray. Separate them using tweezers.
- 5 Then 12 sheets are mounted on the stems of the sampler holders on one side of the cage using two sets of non-sharp tweezers and fixed by feeding the fixing rod through the holes in the stems. The fixing rod is secured with a cable tie. Figure 4 shows the steps for mounting the sheets. (Additionally, a [video](#) is available). When done put the tray with the SSP field controls aside (make sure the wind does not take them, cover under stainless steel mesh or some non-plastic weight)
- 6 Repeat the procedure above for the LDPE sampler sheets using the second tray. Be even more careful of wind blowing LDPE sheets away. When also the 12 LDPE sampler sheets are mounted the cage is deployed immediately and the field control sheets of SSP and LDPE are put back in the jar they came from. Register the end time.



- 7 Field controls are taken back to the laboratory and stored in the freezer to be exposed again during retrieval. Uptake from air is a source of contamination, so the amber 100mL jars need to be firmly closed as indicated in Figure 5.

Keeping the empty jars together with the field control sampler sheet jars in the freezer is the best way to ensure they are available for sampler retrieval. This also holds for the scourer.

Trouble shouting- tips and tricks. *If you do not have an SS tray, then use large diameter SS cooking pan or aluminum foil. Be aware that SSP sampler sheets are very sticky to aluminum foil (slightly to SS); this can be reduced by adding local water to the foil or tray for deployed sheets (NOT for field control). Sorting the sheets on a metal wire mesh/netting is convenient. Note that if for some reason mounting of the sampler sheets should be delayed after unpacking save the sheets under local water in the tray or the one-liter jar. As LDPE will float, in the tray sink them using the tweezers as weight or put the jar upside down. If samplers were already partly mounted hang the sampler cage in the water until ready to complete mounting. In case the number of sampler sheets is insufficient or one, or more, were lost, reduce the number for the field control but as a minimum two field control sheets should remain. If some sheets were damaged use these for field control.*

- 8 Recording Sampling Information: A Sampling information form (SIF) is provided on the last page of this guide. Make copies if additional SIFs are required. Record the requested sampling data on the [Sampling information form](#) downloaded from aqua-gaps.passivesampling.net List the time field controls were exposed, the time the sampler cage is deployed into the water, and all relevant observations and document with some photographs. Also note any interruptions on the sample log sheet, and record the timing so the duration of the deployment process is approximately known. Note GPS coordinates of the deployment location, site depth (if possible), and depth the samplers are deployed at. If possible, measure and record air and water temperature, pH, and salinity/conductivity. These data are not essential but please provide what can be measured. Use field meters for this, or a water sample can be taken to the laboratory.



Slide the sheet over the stems



Since holes are slightly tight sheets will not fall off



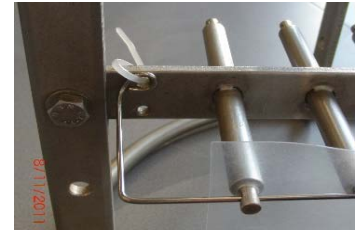
Feed the fixing rod through the holes on the stems



Feed the cable tie through the ring a hole in the holder



Fix the cable tie



Job done

Figure 4 Fixing the sheets on the sampler holder.



Note stainless steel lining easily falls out



This grip does not allow firm closing



Put pressure in full circle to open and close firmly

Figure 5 : Sampler jar with stainless steel lined lid, tightening procedure



5 *Sampler retrieval*

- 1 Take all materials used for deployment, and from the freezer the field controls, empty jars and the scourer supplied.
- 2 Prepare a clean working surface for field controls and empty jars/vials as for deployment, and set out a stainless-steel tray/pan/pot with 1 L or more of local lake water. Again, it is best to have two people, one person with clean gloved hands handling the sampler sheets and the other performing all other activities.
- 3 Remove the SSP field controls from the jar and expose them in a dry tray (again, weigh them down to prevent the wind taking them); record the time.
- 4 Remove the sampler cage from the water. Record the fouling by photographs. Then cut the cable tie, remove the securing rod and transfer the SSP sheets to the tray with local water (do not mix with LDPE).
- 5 Then either return the sampler back to the water while processing the SSP sheets, or also immediately retrieve the LDPE sampler sheets and store them temporarily in the one-liter glass jar filled with local water (upside down).
- 6 If hard shell fouling is present on the samplers break this by rolling the sampler sheet. Then using the supplied scourer (wrapped in foil that came with the sampler jars), under the local water, scrub fouling off the SSP sheets as well as possible and in the shortest time possible. Cleaner is better than shorter. Water may or should be refreshed when needed.
- 7 Dry each sheet with clean lab tissue, and roll all together into the 100 mL amber jar for SSP. Then also wipe the field control sheets with a dry tissue and transfer them back to the field control jar. Tight the lids firmly as indicated in Figure 5. Record the time.
- 8 Expose the LDPE field controls in a dry tray (again, weigh them down to prevent the wind taking them). Take fresh local water in the tray and clean the LDPE sheets in a similar way as the SSP. Dry the LDPE sheets with tissue and transfer them rolled together to the 60mL jar (wrap this in aluminium foil). Wipe the field controls with dry tissue and put them rolled together in the amber 40mL vial. Record the time.
- 9 Similar as for the deployment, record the requested sampling data on the same SIF. List the time field controls were exposed, the date/time the samplers were retrieved from the water, and all other relevant observations and document with some photographs, especially to indicate the level of fouling (of the housing on retrieval and the samplers before scrubbing). If possible, measure and record air and water temperature, pH, and salinity/conductivity.
- 10 Store sampler and field control jars in the freezer until shipment to the laboratory for analysis. Be sure to keep the protective cardboard tubes that the jars/vials were received in for return shipping. **Send copies of the sampling information forms, photo selection, and a (optional) sampling report to aqua-gaps@passivesampling.net.**



6 Shipping Instructions

Samplers should be sent to the analysing laboratory. Although storage is always done in a freezer, no cooling with dry ice or another form of cooling is applied during sending. Use the protective tubes the samplers came in for safe sending of the samplers. Except for sending between countries within a union in most cases the sending should be accompanied by a pro forma invoice. Inquire at the company that provides the transport service. A simple template is available <http://aqua-gaps.passivesampling.net/proformainvoicetemplate.docx>

Sending can be done for individual stations or grouped per region, if participants are geographically close. Always announce shipment of samplers beforehand at aqua-gaps@passivesampling.net and smedes@recetox.muni.cz and once posted send a track-code as soon as your courier took it. Sending off on Monday is preferred to assure they are not stuck in weekends. Also mind holidays in the receiving country.

The sending address is:

Research Centre for Toxic Compounds in the Environment (RECETOX) Faculty of Science, Masaryk University Att F. Smedes or RECETOX representative Kamenice 753/5, pavilion A29 625 00 Brno Czech Republic +420 549 493 097
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Note to use always the Institute name as addressee as otherwise the transporter may only want to deliver to the person. Further stick a label saying: "**Store in freezer upon arrival**" so the one accepting the package will know where to put it.

Please also send the completed [Sampling information form](#) to aqua-gaps@passivesampling.net

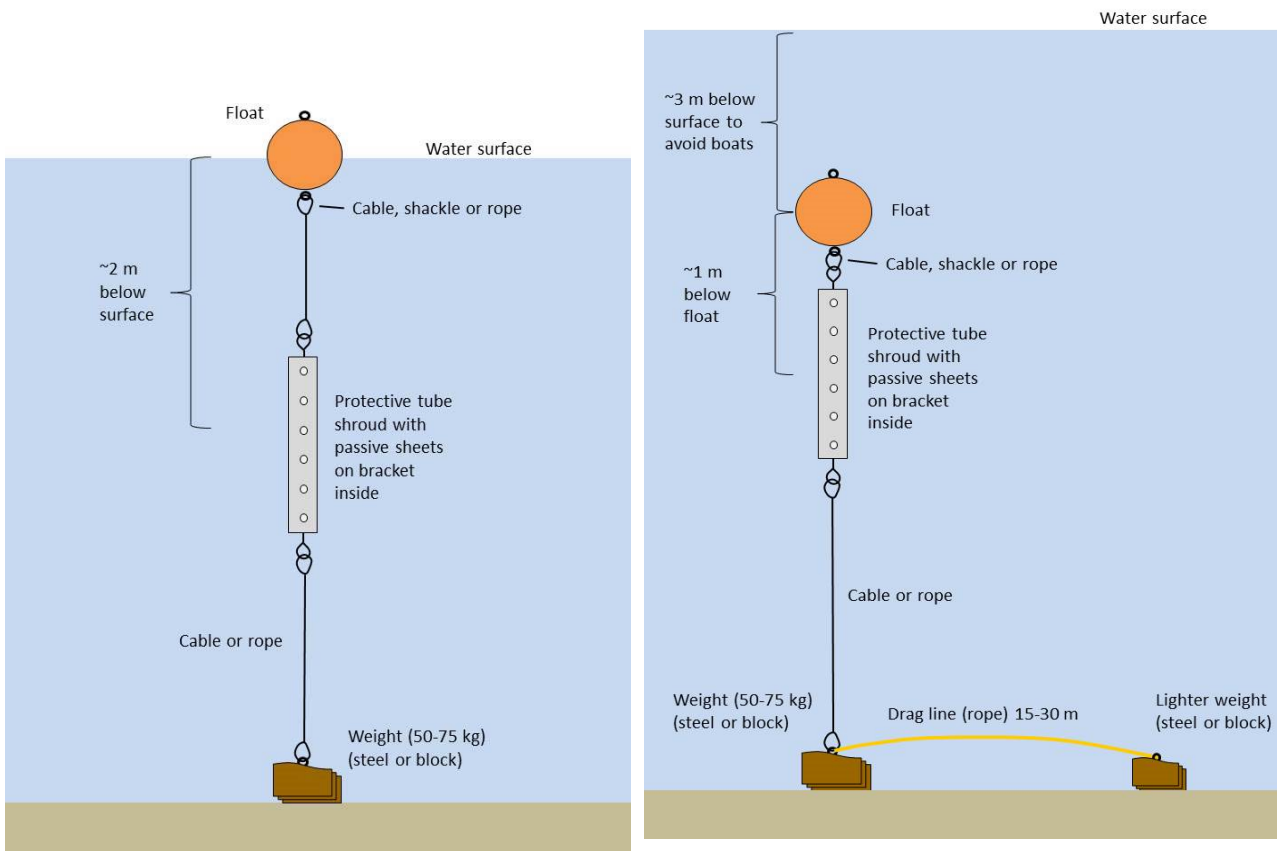
Email smedes@recetox.muni.cz
Phone ++420 549 493 097 (work)

7 Choosing Deployment Locations

Ideally sampler housings will be deployed in open lake waters accessing the location by boat. This reduces potential interference by curious people, and ensures the sampling location is set away from direct sources.

If deploying along the shoreline, attempt to find a pier, jetty, dock or quay that ensures the sampler is out into the water as much as possible. The risk of vandalism or theft should be considered, and appropriate measures should be taken to minimize this risk (e.g. by hiding, camouflaging, using secure areas, or using locks).

Please find a location that is not directly impacted by a local source (avoid river mouths, sewer discharges and other outfalls). In the sampling report a satellite image from eg Google maps can be included to indicate the chosen location and its immediate surroundings.



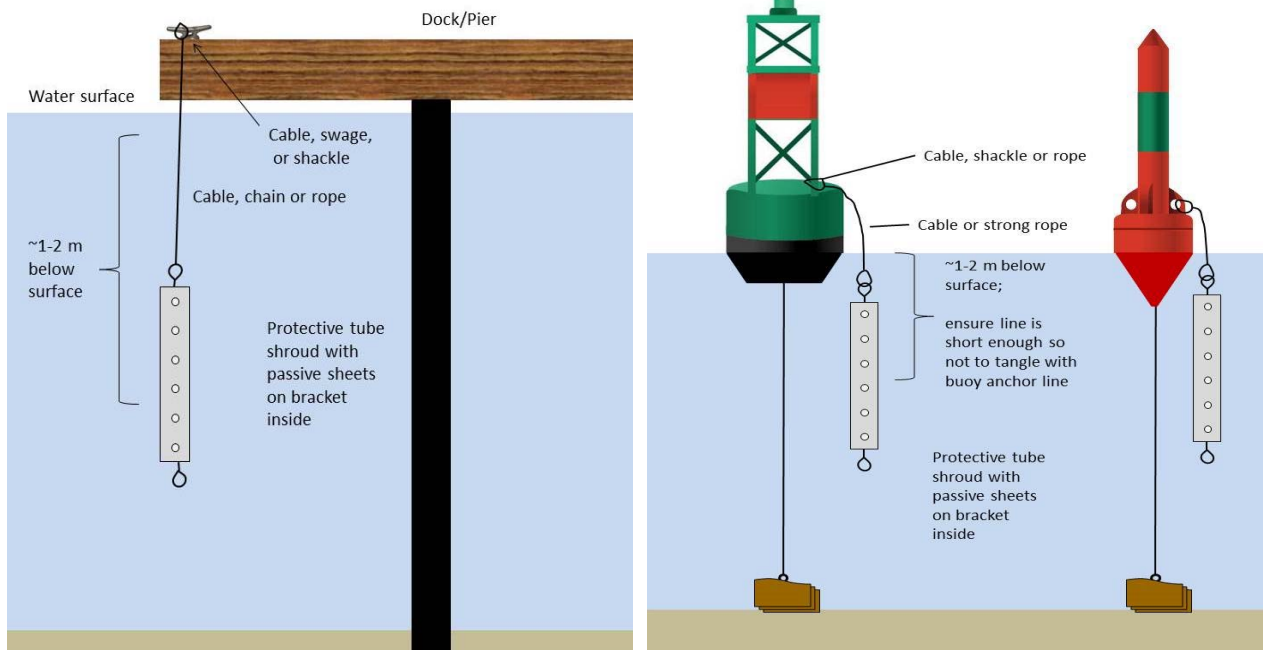


Figure 6: Possible deployment configuration options. Ensure deployment lines are not so long that they tangle with other anchor lines or dock/pier components.

Sample Information Form (SIF)

SAMPLER code and sequence number(s) on the label:

SSP Sample Jar Number:

LDPE Sample Jar Number:

Sampling site		
GPS coordinates	Latitude	Longitude
	DEPLOYMENT	RETRIEVAL
Names of staff deploying / retrieving		
Dates Deployment / Retrieval)		
Start times	(time removed from jars)	(time samplers out of water / controls out of jars)
End times	(time samplers in water / controls away)	(time samplers and controls sealed in jars/vials)
Site Details / Notes		
Site Water depth (m)		
Sampler Depth from Surface (m)		
Conductivity/salinity (note units)		
pH		
Water (and air) temperature		
Flow / Turbulence indications (e.g. wave height)		
Photos at deployment (#), Retrieval & before cleaning (#)		
Remarks		