REGIONAL MONITORING
PROGRAM FOR WATER QUALITY
IN SAN FRANCISCO BAY
sfei.org/rmp

2021 RMP Water Cruise Plan

Prepared by:

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1. Introduction

This report details plans associated with the annual Regional Monitoring Program for Water Quality in the San Francisco Estuary (RMP) water cruise. The RMP water sampling program was redesigned in 2002 to adopt a randomized sampling design at thirty-one sites in place of the twenty-six base program stations sampled previously. In 2007, the number of sites was decreased to twenty-two stations, and it remains as such for 2021. The analytes for 2021 have been modified based on the Status and Trends (S&T) Review process that started in 2020. The analytes that are being removed from the program include selenium and methylmercury (dissolved and particulate), while bisphenols and organophosphate esters (OPEs) have been added to S&T monitoring.

2. Key Personnel and Approvals

Oversight of the 2021 Water Cruise is by AMS and SFEI senior managers shown in Table 1. These key personnel have indicated their approval of the Cruise Plan by adding their initials and date in the far right column.

Personnel participating in the cruises are shown on Table 2. AMS staff will be responsible for oversight of sampling operations, compliance with the cruise plan and quality assurance guidelines, maintenance of the sample field log, chain-of-custody procedures, and CTD profiling. Captain Pat Conroy will be responsible for vessel operation and safety. SFEI staff will conduct trace metal, CEC, and ancillary sampling. Other representatives of program sponsors may be aboard the *R/V TomCat* during portions of the cruise to observe sampling operations.

Contact information for participating laboratories is shown in Table 3.

Table 1. Approvals of Cruise Plan

Name	Affiliation	Duties	Cell	Initial and Date to Indicate Approval of Plan
Paul Salop	AMS	Cruise Manager	510-323-6523	PDS 09/20/2021
Melissa Foley	SFEI	RMP Manager / Cruise Planner	831-566-7816	MMF 09/20/2021
Jay Davis	SFEI	RMP Lead Scientist	530-304-2308	
Don Yee	SFEI	RMP QA Officer	510-508-2995	
Rebecca Sutton	SFEI	RMP Scientist (CECs)	510-701-7050	RAS 09/20/2021

Table 2. Personnel for Water Cruise

Name	Affiliation	Duties	Cell
Paul Salop	AMS	Cruise Manager (9/20)	510-323-6523
Clifton Herrmann	AMS	Cruise Manager (9/20-9/24)	916-612-8718
Don Yee	SFEI	Field Sampling (9/20-9/21)	650-530-0603
Diana Lin	SFEI	Field Sampling (9/20-9/21)	714-932-8085
Martin Trinh	SFEI	Field Sampling (9/20-9/24)	864-913-8237
Ezra Miller	SFEI	Field Sampling (9/21- 9/24)	505-239-6931
Melissa Foley	SFEI	Field Sampling (9/20, 9/24)	831-566-7816
Adam Wong	SFEI	Field Sampling (9/22-9/24)	530-400-5192
Lawrence Sim	SFEI	Field Sampling (backup, except 9/21)	818-606-8467
Luis Martinez	MARE	Captain, R/V TomCat	415-272-5830
Dirk Rosen	MARE	1st Mate, R/V TomCat	
TBD	Angels Courier	Logistics	510-732-1500

Table 3. Laboratory Contact Information

Lab / Company	Name	Phone	email	Shipping Address
BAL	Amy Goodall	(206) 632-6206, ext 110	amy@brooksapplied.com	18804 North Creek Parkway, Suite 100 Bothell, WA 98011
CalTest	Sonya Allahyari	(707) 258-4000	sonya_allahyari@CaltestLabs.com	1885 North Kelly Road Napa, California 94558
SGS-AXYS	Sean Campbell	(250) 655-5834	sean.campbell@sgs.com	2045 Mills Road Sydney, BC, Canada V8L5X2
ALS	Wendy Hyatt / Ralph Poulsen	(520) 573-1061	wendy.hyatt@alsglobal.com ralph.poulsen@alsglobal.com	ALS 4208 S Santa Rita Avenue Tucson, Arizona 85714
Eurofins	Carla Hollowell	(714) 895-5494	Carla.Hollowell@eurofinset.com	Eurofins 7440 Lincoln Way Garden Grove, CA 92841
UW	Ed Kolodziej / Melissa Gonzalez	(253) 254-7030 x8009	kolo j@uw.edu melisg07@uw.edu	Center for Urban Waters Attn: Melissa Gonzalez/Ed Kolodziej 326 East D St. Tacoma, WA 98421
U of MN	Bill Arnold / Anna Mahony	(612) 625-8582	arnol032@umn.edu mahon445@umn.edu	Department of Civil, Environmental, and Geo-Engineering University of Minnesota 500 Pillsbury Dr. SE Minneapolis, MN 55455

Table 4. SFEI Staffing Schedule

Table 5. Combined Site-Parameter List and Handling Instructions

3. Cruise Plan

3.1. Sample Process Design

All sampling will be conducted from the *R/V TomCat*. The objectives of the sampling effort are to collect the following:

Collect Real-time Data on Field Parameters

1. Real-time data over the duration of sampling for conductivity, temperature, optical backscatter (OBS), and dissolved oxygen (DO) by AMS (1 meter CTD cast for duration of sampling, plus a full water column profile where water depth allows).
2. Water samples from 22 sites for on-board (field meter) measurement of DO, pH, salinity, conductivity, and temperature by SFEI.
3. Document current and recent weather conditions at each site.

Collect Water Samples - Total Fraction (Unfiltered water samples)

4. 22 sites (and 2 replicates and 1 blank) for analysis of Weak Acid Dissociable (WAD) Cyanide (CalTest)
5. 22 sites (and 2 replicates and 1 blank) for analysis of SSC (BAL)
6. 22 sites (and 2 replicates and 1 blank) for analysis of Chl-a (CalTest)
7. 22 sites (and 2 replicates and 2 blanks) for analysis of bisphenols (SGS-AXYS)
8. 22 sites (and 2 replicates and 2 blanks) for analysis of organophosphate esters (SGS-AXYS)
9. 22 sites (and 2 replicates and 2 blanks) for analysis of PFAS (SGS-AXYS)
10. 6 sites (and 1 replicate and 1 blank) for analysis of stormwater CECs (UW)
11. 6 sites (and 6 replicates and 1 blank) for analysis of quaternary ammonium compounds (UMN)

Collect Water Samples - Particulate Fraction (Filters)

12. 22 sites (and 2 replicates and 1 blank) for Particulate Organic Carbon (POC) (ALS)
13. 22 sites (and 2 replicates and 1 blank) for analysis of Cu (BAL)

Collect Water Samples - Dissolved Fraction (Filtrate)

14. 22 sites (and 2 replicates and 1 blank) for analysis of Dissolved Organic Carbon (DOC) (Eurofins)
15. 22 sites (and 2 replicates and 1 blank) for analysis of hardness (BAL)
16. 22 sites (and 2 replicates and 1 blank) for analysis of Cu - column chelation (BAL)
17. 22 sites (and 2 replicates and 1 blank) for analysis of Cu - reductive precipitation (BAL)

3.2. Sampling Methods

Field Parameters

CTD Profiler

The following steps describe the CTD deployment and data management process:

1. Initialize CTD via laptop.
2. Disconnect communication cord from CTD and replace rubber cap.
3. Ensure that rope is securely fastened to vessel and to CTD containment cage.
4. Ensure that DI syringe is disconnected from CTD input.
5. Turn CTD on by moving switch completely to on position (fully up).
6. Place CTD into the water, with intake approximately 1 meter below water surface (typically a bit lower in the column to allow for any seas).
7. Leave CTD deployed for duration of sampling.
8. When sampling is completed, slowly lower CTD to the bottom (at a rate less than 1' per second) until rope goes slack or the end of the rope is reached. With strong currents, the rope may extend at a severe angle precluding its reaching the bottom. As soon as the CTD reaches the bottom, immediately begin moving to surface so as to minimize the amount of sediment pulled into the intake. The CTD can be moved to the surface at any rate as data is only collected on the downcast.
9. When CTD is at the surface, return to the vessel deck and place the switch in the off position (fully down).
10. Download the data between stations.
11. At day's end (or after stations where CTD intake may have become fouled with sediment or vegetation) rinse the CTD with distilled water, flush the intake with a minimum of three syringes full of distilled water, and store the CTD with a full syringe of DI inserted onto the intake and partially emptied into the CTD.
12. Replace batteries when the battery level drops below 7 volts.

YSI Hand-Held Field Meter

Field parameters (DO, conductivity, salinity, and pH) will be collected using a YSI water quality meter provided by SFEI. The YSI meter should be calibrated for conductivity, pH, and DO at the start of each day, and calibration results recorded on the station field sheet and laptop access form. When recording field readings, the sampler should ensure that the YSI electrode is fully submerged and not surrounded by any bubbles.

The following steps describe the YSI deployment and data management process:

Programming the YSI

1. Hit 'Esc' to go to menu
2. Arrow down to "Logging Setup"
3. Go to 'edit site list' – delete old sites or just add in new sites
4. Enter sites then press enter to store the site
5. Hit 'esc' to get out of the menu

Calibrating the YSI

- Calibrate the YSI for conductivity, pH and DO once per day at the beginning of the day prior to sampling
    - Conductivity
        - fill the calibration cup 1/3 full with 12,800 uS/cm standard (enough to submerge both the metal tip probe with no trapped air pocket in the side port – note that the port assembly has substantial volume and may overflow the cup if it is overfilled)
        - submerge the probe in the calibration cup, and allow the meter reading to equilibrate
        - hit 'esc' to go to menu, go to 'calibrate,' and choose 'Specific Conductance' (NOT 'Conductivity')
        - set the calibration standard to 12.8 mS/cm, and press enter to calibrate
    - pH
        - fill the calibration cup 1/4 full with pH 7 buffer (probe is near the tip)
        - submerge the probe in the calibration cup, and allow the meter reading to equilibrate
        - hit 'esc' to go to menu, go to 'calibrate,' choose 'pH', and choose '2 point'
        - set the calibration standard to 7, and press enter to calibrate
        - pour out the pH 7 buffer, rinse the cup and probe, and repeat with pH 10 buffer
    - DO
        - fill the calibration cup about 1/8 full with DI water, screw on to the probe, and shake vigorously to wet the DO probe
        - unscrew the cup and pour out the water
        - loosely screw the cap back onto the probe, and allow the meter reading to equilibrate
        - hit 'esc' to go to menu, go to 'calibration,' choose 'DO 2 mil PE (Blue),' choose 'DO %,' and set the barometric pressure to 760 mmHg (sea level)
        - press enter to calibrate

- Rinse the probe and calibration cup with DI water in between calibrations. Make sure the calibration cup is dry before adding new calibration solution.
- No calibration is needed for salinity or temperature

Running the YSI

1. hit ‘esc’ to go to the menu
2. go to logging setup menu and set the logging interval to 5 minutes
3. go to ‘start logging’ and press enter
4. select site from site list and press enter
5. screw the metal cage onto the probe sensor assembly
6. lower the probe sensor assembly to 1 m below the water surface, and fix cable to the boat railing to keep the probe at that depth for the duration of the time on station
7. to stop logging – go to ‘stop logging’ and hit enter
8. record DO, pH, salinity, conductivity, temperature, site code, and sampling date/time on the YSI field sheet, usually requested near start or middle of time on station

Lab Parameters

Sample labeling

AMS field staff will print out and provide sample labels to sampling personnel prior to arrival on station. The sample ID naming convention is as follows:

RMP-21WC-xxxx

where xxxx is a four-digit number assigned by the sample tracking and labeling application.

For double bagged samples, printed labels are dropped inside the outer bag, and a sharpie is used to write the site code and fraction (T or D) on the label on the outer bag (except for PFAS samples - NO SHARPIE). Labels should be attached directly to bottles without bags, and the site code, analyte, and fraction should be written on the bottle lid.

POC filters should be placed in the plastic petri dishes provided by ALS, which will be placed inside ziplock bags. The ziplock bag should be labeled with the filtered volume.

Blank sample collection

For the majority of analytes, blanks will be taken at the beginning of the day, before any other sample collection, to ensure the sample is collected using a clean sampler (i.e., no site water contamination). Prior to field blank sample collection, sample tubing is rinsed with lab blank water for at least 30 seconds (may vary depending on how much water is provided by labs and how much is required for analyses - pump rate is about 1 L per minute).

A field blank will be collected in the morning before sampling begins on September 21 for stormwater CECs. The field blank water is DI water, which must pass through sample tubing via the ISCO into the sample collection container, consistent with field sample collection.

A field blank will be collected in the morning before sampling begins on September 23 for trace metals and ancillary parameters.

- One 10 L carboy of ultra pure reagent water will be provided by BAL for metals and ancillary parameter blanks.
- DOC/POC - use blank water provided by the lab
- Chla - use the leftover BAL water

A field blank will be collected at the same time as field samples are collected on September 21 and September 23 for bisphenols, OPEs, and PFAS. Collecting field blanks for these samples involves opening pre-filled containers while the field sample is being collected.

A field blank will be collected at the same time as field samples are collected on September 21 for QACs. The field blank for QACs is collected by pouring DI water into a sample container during sample collection.

Sample Collection

Sample tubing must be rinsed with site water prior to any sample collection for at least a minute prior to collecting total fraction samples and for one minute prior to collecting dissolved fraction samples (to not clog the filter). The overflow sink drains to a 5 gallon bucket or water jug to avoid contaminating the site with water flowing off the boat deck. If a blank sample will be collected that day, do not attach the float and weight or flush the sampler until after the blank sample has been collected.

The “clean hands” sampler will rinse ancillary and trace metal sample bottles without preservative at least twice with site water before filling; sample bottles for bisphenols, OPEs, PFAS, and QACs should NOT be rinsed. To rinse, partially fill a bottle (5-10 seconds, enough to rinse the interior surface), close the cap, shake/swirl thoroughly, and dispose of the rinsate. Bottles with preservatives are filled directly, without overflowing. Bottles that will be frozen are filled to 3/4 of the total bottle volume (bisphenols, OPEs, PFAS, QACs). See Table 5 for a list of sample bottles by parameter and bottle handling instructions.

To limit procedural contamination during sample collection, some common products must be avoided on the vessel. Do not use QAC-based antimicrobial products (i.e., Lysol disinfecting sprays, Clorox wipes). Alcohol-based hand sanitizer is acceptable. Clean gloves should be worn during sampling and avoid touching gloves with materials that are waterproof (e.g., waterproof clothing, waterproof paper) or greaseproof (e.g., food packaging materials, including food wrap, paper towels, aluminum foil), because these materials are likely to contain PFAS. The eating area should be separate from the sampling area.

Sampling Stations

Metals and ancillary parameters samples will be collected with a pump and pre-cleaned sampling tubing assembly.

DOC/POC samples will be collected as whole water samples at the metals sampling station, and will be filtered using a vacuum pump and pre-ashed filters inside the boat cabin.

Staff will be roughly assigned to sampling stations in the following order:

- Staff 1 - Station 1 “clean hands”
- Staff 2 - Station 1 and Station 2 “dirty hands”
- Staff 3 - “Super dirty hands” to help set up sampling stations, filtering station, and CTD sampling
- Staff 4 - “Clean hands” for Station 2 (CEC sampling)

Additional staff will assist with sample labeling, organization, and equipment cleaning.

Station 1: Metals & Ancillary parameters

A low-volume peristaltic pump will be provided by SFEI and nine sampling tube assemblies (one each for 5 sampling dates and 4 backups) will be provided by SFEI and pre-cleaned by BAL. Each tubing assembly consists of 16 ft of PVDF and 3 ft of silicone tubing attached with zip ties.

Samples should be collected using clean hands-dirty hands technique in the order listed below. Bagged samples should be collected before unbagged samples within each group (unfiltered samples, and later for in-line filtered samples).

A. Unfiltered Water Samples

1. DOC/POC

Samples are collected from the pumping station into clean 1-L sample bottles ("dirty hands sampler") and either filtered immediately in the cabin or put on ice to be filtered in the lab at the end of the day.

2. Stormwater CECs

Collect site water using the pump. Rinse 2.5 L amber glass container 3x with site water, then fill completely (no headspace). Sampling occurs only in the Lower South Bay (6 sites, 1 field blank, 1 field duplicate) and cannot occur on Thursday or Friday (due to hold time requirements). New tubing should be used for each site.

The field blank for the stormwater CECs is DI water run through the ISCO and into the sample collection bottle at the beginning of the day, prior to any field sampling. Store samples on ice but DO NOT FREEZE.

Samples must be shipped overnight on ice as soon after collection as possible.

3. CN-WAD

Samples are collected from the pumping station. Bottles should NOT be rinsed. Bottles are pre-loaded with NaOH pellets.

4. SSC

Collect a minimum of 250 mL at each station. As a rule of thumb: at any stations deeper than 20 ft with only a hint of color in the POC water bottle (Central Bay, Golden Gate), collect 1 L. If the sample is slightly cloudy, collect around 500 mL or a bit less (½ full). If the water is cloudy (brownish around the boat, less than 6 ft deep, rocked by wind/waves) collect around 250ml (¼ full). Most sites should be in the slightly cloudy category.

5. Chlorophyll-a

Collect three, 1000-ml amber HPDE bottles per site plus a lab/field duplicate sample each day (28 samples total: 22 sites, 1 field blank, and 5 lab/field duplicates).

Completed water samples are kept refrigerated or chilled in coolers with wet ice or ice packs (0 to 5°C)

B. Dissolved (or Filtered) Water Samples

After collecting whole water samples, the “clean hands” sampler should attach a pre-cleaned filter provided by BAL to the end of the tubing. The “dirty hands” sampler should use a clamp to hold the filter in place. The filter should be flushed for approximately one minute before collecting the first dissolved sample.

Fill the containers for the parameters listed below. Bagged samples should be collected before unbagged samples.

1. **Copper (samples for two methods)**

   Collect one 60 mL sample and one 1 L sample.

2. **Hardness**

   Collect one 125-mL sample.

Completed water samples are kept refrigerated or chilled in coolers with wet ice or ice packs (1 to 5° C)

<u>Station 2: CECs: Organophosphate esters, bisphenols, PFAS, and QACs</u>
Only remove the cap with clean hands in nitrile gloves. Bottles have been pre-cleaned by the respective laboratories.

Water samples will be collected by deploying a stainless steel bailer over the side of the vessel via a cotton rope. A stainless steel painter’s pole will be used to keep the bailer away from the side of the vessel during deployment and retrieval. The bailer will be deployed once as a site water rinse, then will be used to fill sample containers. Sample containers will be handled with nitrile gloves. Do not overfill containers, as they may be frozen after collection.

1. **Bisphenols**

   Collect site water using the stainless steel bailer. Fill the 500 mL wide-mouth amber glass container 2/3rds full with site water (minimum sample size 300 mL).

2. **Organophosphate esters**

   Collect site water using the stainless steel bailer. Fill the 1 L amber glass container to the shoulder with site water.

3. **PFAS**

   Collect site water using the stainless steel bailer. Fill the 500 mL HDPE container to the shoulder with site water.

4. **QACs**

   Collect site water using the stainless steel bailer. Fill the two 1 L polycarbonate containers to the shoulder with site water. The second container will serve as a field duplicate.

Between sites, the bailer will be cleaned by scrubbing with a horse hair brush and Alconox detergent, then multiple DI rinses, then two methanol rinses, then two UPLC grade water rinses.

Field blanks for PFAS, OPEs, and bisphenols are collected by opening a container of lab-supplied water during collection of a field sample, then closing the container. The field blank for QACs is collected by pouring DI water into a sample container during sample collection.

Completed water samples are chilled in coolers with wet ice or ice packs (1 to 5^{o}C), and may be frozen prior to shipping for best preservation of sample.

<u>Station 3: POC and DOC filtering</u>

Wear nitrile gloves and filter samples inside the boat cabin to protect the samples from the sun. DOC/POC filtering will serve as rinsing between trace particulate metals filtering, so avoid contamination.

Particulate organic carbon

1. Rinse with site water and collect samples into clean 1 L sample bottles (metals sampling station, “dirty hands” sampler)
2. Rinse filter apparatus with squirts of ~100 mL of lab DI water. Separate the funnel from the frit and rinse the funnel (potentially with carryover particulates from prev station/cabin environment, especially on the shoulder and/or bottom edge in contact with filter). Rinse the fritted glass support from bottom to top to flush any possible particles that slipped through the filter; keep the funnel from touching the glass support unless there is a filter in between.
3. Place a pre-ashed filter on the filter apparatus with the grid side facing down. The grid side will have a faint imprint or cross-hatching from resting on a screen during manufacture. That side should stay down in sampling.
   Remove filters from packaging using forceps only
   i. Be sure not to knock filter off center when placing funnel on
   ii. If filter repeatedly moves off center, briefly turn on vacuum to suck it into position while attaching funnel
4. Swirl sample and pour out measured volume of water using graduated cylinders. Record volume and pour all contents into the funnel. If filtering is fast, quickly prepare for the next addition.
5. Swirl sample bottle, and add water in 20-100 mL increments to graduated cylinder (add less each time as filter slows), record volume, and dump entire grad

cylinder contents into the funnel. Repeat until the filter clogs. Drip rate of around 1 drop per second is indicative of enough material on the filter.

   i. As fluid level approaches the shoulder of the funnel, check for settled material. Especially if the filter nearly clogged during the last addition, swirl to knock material off the sides of the funnel.
   ii. **Do not let the filter run dry between additions. Turn off the pump/release sidearm clamp well in advance as the residual vacuum continues to pull quickly, especially when the filter is not clogged. Do not add water too quickly or in large volumes; water may become trapped on top of a clogged filter and the process will have to start over if the water does not drain through the filter. On the final addition for a given filter, the filter can run dry.**

6. Keep track of the total amount of water filtered and record this amount on the field sheet. Also record the pre-assigned number of the filter on the field sheet.
   i. If you did not accurately record the volume filtered and there is a balance on board, weigh the filtration flask with the water when done filtering (after packaging the filter) and then weigh the flask without the water. Determine the volume of water by difference (convert weight to volume based on station salinity).
7. Carefully lift filter funnel/funnel straight up to avoid knocking off filtered material. Leaving the filter pump on can help prevent filter lifting with the funnel.
8. Fold the filter in half carefully to not expose any filtered material, and take care not to touch filtered material with forceps. Use a second pair of forceps or the filter funnel if necessary to flatten/fold the ilter. Try to observe the dominant grain of fibers; the filter will fold more easily along that direction.
9. Place individual filters in the plastic petri dishes provided by ALS using forceps, and place these petri dishes inside ziplock bags along with the pre-printed label.
10. Label the ziplock bags with the filtered volume and immediately freeze the sample on dry ice.
11. At the end of the day, rinse collection bottles with DI. Close collection bottles to avoid collecting dust overnight.

Dissolved organic carbon

1. Pour some of the filtrate (water in the bottom of the flask after the POC sample has been collected on the filter) into 250-mL bottles (this will be the DOC fraction).
   *Make sure there is no head space, but do not overfill to keep the preservative intact.
2. Refrigerate the DOC, do not freeze.
3. *(skip if particulate metals to be done)* Rinse filtration apparatus with DI between stations, and wipe off and rinse with DI any material accidentally left on forceps when done.

Particulate copper

1. Rinse the filter apparatus with 10% HCl on the boat deck (or into the boat sink) at the beginning of each sampling day. Thoroughly rinse with DI after.
2. Collect samples into cleaned (1x DI rinsed and drained between stations, then 3x rinsed in site water at current site) 1 L HDPE bottles from BAL for metals.
3. *(skip if DOC/POC done immediately prior)* Rinse filter apparatus with squirts of ~100 mL of lab DI water. Separate the funnel from the frit and rinse the funnel (potentially with carryover particulates from prev station/cabin environment, especially on the shoulder and/or bottom edge in contact with filter). Rinse the fritted glass support from bottom to top to flush any possible particles that slipped through the filter; keep the funnel from touching the glass support unless there is a filter in between.
4. Place polycarbonate plankton filter on the filter apparatus.
   Remove filters from packaging using forceps only
   i. Be careful to not knock the filter off center when placing funnel
   ii. If filter repeatedly moves off center, briefly turn on vacuum to suck it into position while attaching the funnel
5. *(skip if DOC/POC done immediately prior)* Pour 100 mL of lab DI water through the filter. Discard that water.
6. Swirl sample bottle and fill graduated cylinder with ~250 mL sample (we will filter as much water as reasonable through each filter. Collect one filter per sample. Based on experience with the POC sample, guess the amount of sample that will easily filter. The polycarbonate filters usually have ~25% less capacity, so add less based on best judgement if the POC was already clogged at 250 ml.
   i. Swirl the sample holding bottle and add to the graduated cylinder in 20-100 mL increments (amount based on how slow the filter already is), record the amount in the graduated cylinder, and dump the entire grad cylinder content into the funnel. Repeat until the filter clogs. Drip rate of around 1 drop per second is an indication of enough material on the filter.
   ii. As the fluid level approaches the shoulder of the funnel, check for settled material getting stuck on the side of the funnel. Especially if the filter nearly clogged on the last addition, swirl the sample to knock material off the sides of the funnel.
   iii. **Do not let the filter run dry between additions. Turn off the pump/release sidearm clamp well in advance as the residual vacuum continues to pull quickly, especially when the filter is not clogged. Do not add water too quickly or in large volumes; water may become trapped on top of a clogged filter and the process will have to start over if the water does not drain through the filter. On the final addition for a given filter, the filter can run dry.**
7. Keep track of the total amount of water filtered and record this amount on the field sheet. Record the pre-assigned number of the filter on the field sheet IF there is one (more likely for POC than metals filters).
   i. If you did not accurately record the volume filtered and there is a balance on board, weigh the filtration flask with the water when done filtering (after packaging the filter) and then weigh the flask without the water. Determine the volume of water by difference (convert weight to volume based on station salinity).

8. Carefully lift filter funnel/funnel straight up to avoid knocking off filtered material. Leaving the filter pump on can help prevent filter lifting with the funnel.
9. Fold the filter in half carefully to not expose any filtered material, and take care not to touch filtered material with forceps. Place the filter in a 50 mL centrifuge tube.
    i. Repeat steps 4-9 for the second and third filters. BAL is fine with all filters in one tube, final volume for all filters combined recorded.
10. For duplicate samples, set up two filtration stations with Y connector attached to two filtration flasks with pinch locks on each set up tubing to allow independent control*. Be careful to keep track of volume filtered through each filter.
    i. The pinch lock may be counterintuitive if one of the filters gets clogged. When a filter gets clogged, the pinch traps the vacuum in the sidearm flask. If in doubt, turning off the vacuum and opening all pinch locks will (eventually) get to ambient pressure. When running two stations simultaneously, really focus on the faster flowing station until it's kind of slow. It may be wise to just do one (other pinched closed) until slow enough to not need to do panic speed refills.
11. Once completed, all filters go into freezer/on dry ice
12. At the end of the day rinse off collection bottles, filter units, and filter flasks with DI. Close collection bottles to avoid collecting dust overnight.

3.3. Cruise Schedule

Sampling activities for the 2021 RMP Water Cruise are shown in Table 6. The tentative schedule assumes that an average of forty-five minutes will be required for sampling at each station. Sampling times may also vary depending on suspended sediment loads, number and type of samples collected, and other factors. The schedule is for planning purposes only, and may be revised during sampling operations to reflect weather conditions, equipment performance, or other factors. Any sites unable to be sampled at the scheduled time will be rescheduled later in the cruise if possible, or will be replaced with the first available site within the segment from the current 2021 sampling schedule (see Appendix A for site locations). A record of all sites not able to be sampled and why will be maintained as part of the cruise recordkeeping.

There are no target sites for 2021 within close proximity to sensitive areas. AMS personnel have arranged to check in with USCG Command Center **(415-399-3547)** as needed in an attempt to minimize disruptions to sampling. After each sampling effort, any SFEI field staff will record all hours spent on the water in the navigable waters log.

Table 6. Tentative Schedule for 2021 RMP Water Cruise

Date	Time	Activity
Sep 17	0900-1200	AMS and SFEI personnel mobilize sampling equipment and load aboard vessel *R/V TomCat* at **Richmond Harbor.**
Sep 28	0730-1530	Mobilize sampling gear aboard vessel at **Emeryville Marina (Sportfish dock)**. Sample CB054W (**+field dup**), SB079W, SB077W, CB052W (**+field dup for chl-a**), and BC10 (high tide 4.7' at 7:55 am). Return to **Ballena Isle Marina** and demobilize vessel.
	1500-1730	Caltest meets vessel Ballena Isle Marina to retrieve samples. Angels Courier retrieves all remaining samples for transfer to AMS.
Sep 29	0700-1600	Mobilize sampling gear aboard vessel at**Emeryville Marina (Sportfish dock)**. Sample BA30 **(+field blank)**, SB078W, LSB079W, LSB081W (**+field dup**), LSB083W, LSB082W, and LSB080W (low tide 4.2' at 13:45). Return to **Ballena Isle Marina** and demobilize vessel. Vessel transits to Richmond.
	1600-1800	SFEI staff meets vessel and retrieves all samples requiring next day shipping. Caltest meets vessel at Ballena Isle Marina to retrieve samples. Angels Courier retrieves all remaining samples for transfer to AMS.
Sep 30	0630-0730	Vessel transits to Benicia Marina to meet SFEI / AMS personnel.
	0730-1300	Mobilize sampling gear aboard vessel at **Benicia Marina (266 E B St, Benicia)**. Sample SPB051W (+field blank), SPB049W (**+field dup**), and SPB050W (high tide 4.6 at 9:48 am, low tide 3.5' at 14:50). Return to Benicia and demobilize vessel.
	1300-1500	Caltest meets vessel at Benicia Marina to retrieve samples. Angels Courier retrieves all remaining samples for transfer to AMS.

Oct 1	0730-1500 1430-1630	Mobilize sampling gear aboard vessel at **Benicia Marina**. Sample SU059W (**+field dup for chl-a**), SU060W, SU058W, BG20, and BG30. Transit to Benicia Marina to offload samples and staff. Vessel transit to Richmond Caltest meets vessel at Benicia Marina to retrieve samples. Angels Courier retrieves all remaining samples for transfer to AMS.
Oct 5	0800-1300 1300-1500	Mobilize sampling gear aboard vessel at **Emeryville Marina (note: meet at launch ramp, must pay to park)**. Sample BC20 and CB053W. Return to **Emeryville Marina** and demobilize vessel. Caltest meets vessel in Emeryville to retrieve samples. SFEI staff meets vessel and retrieves all gear to return to SFEI. Angels Courier retrieves all remaining samples for transfer to AMS.
Oct 6	TBD	Contingency day, as needed.

3.4. Vendors

Addresses for local dry ice vendors are shown in Table 7.

Table 7. Dry Ice Vendors Proximate to RMP Water Cruise Berthing Locations.

Port City	Vendor	Address / Phone	Hours (M-F)
Alameda	AM/PM Market	889 West Grand Oakland 510-465-4450	24 hrs
Benicia	Concord Airgas	1825 Arnold Industrial Concord 925-825-8822	0700-1700
Oakley	Raley's	2077 Main Street Oakley 925-625-0744	0600-2300

3.5. Sampling Sites

2021 target sampling sites are shown in Figures 1 and 2 and listed in Table 8. All coordinates are in NAD83 datum. The replacement-site pool is shown in Appendix A.

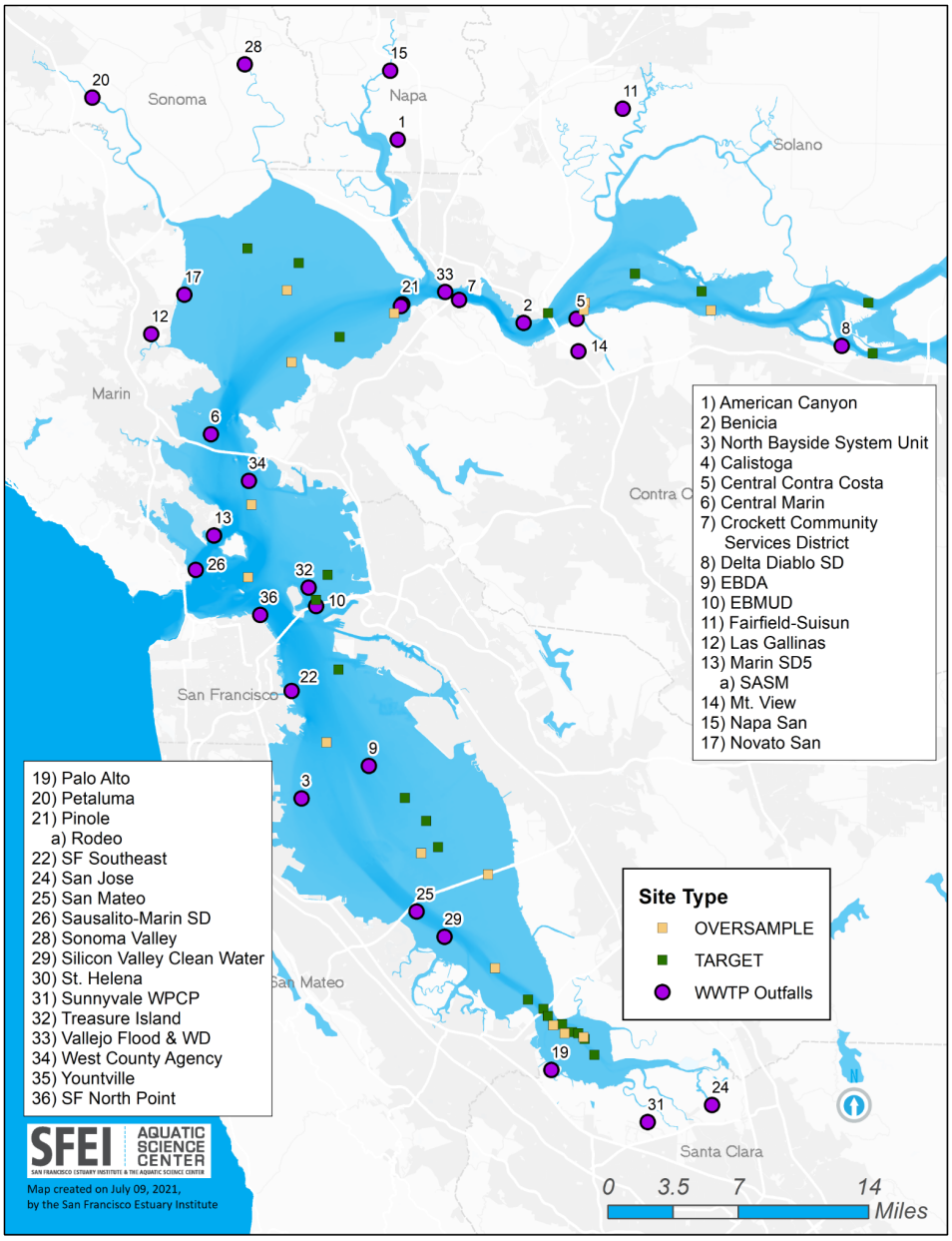

Figure 1. 2021 RMP Water Cruise sites south of Bay Bridge (targets shown as green squares, overample sites as orange squares; purple circles show locations of WWTP outfalls)

There are no target sites that were removed from the site list during planning due to accessibility issues. However, one site may require anchoring away from target coordinates in order to avoid restricted areas:

- SB078W, a target sampling site, is located approximately 100 m north of the Dumbarton Bridge just north of the pathway of electrical transmission lines (Figure 2).

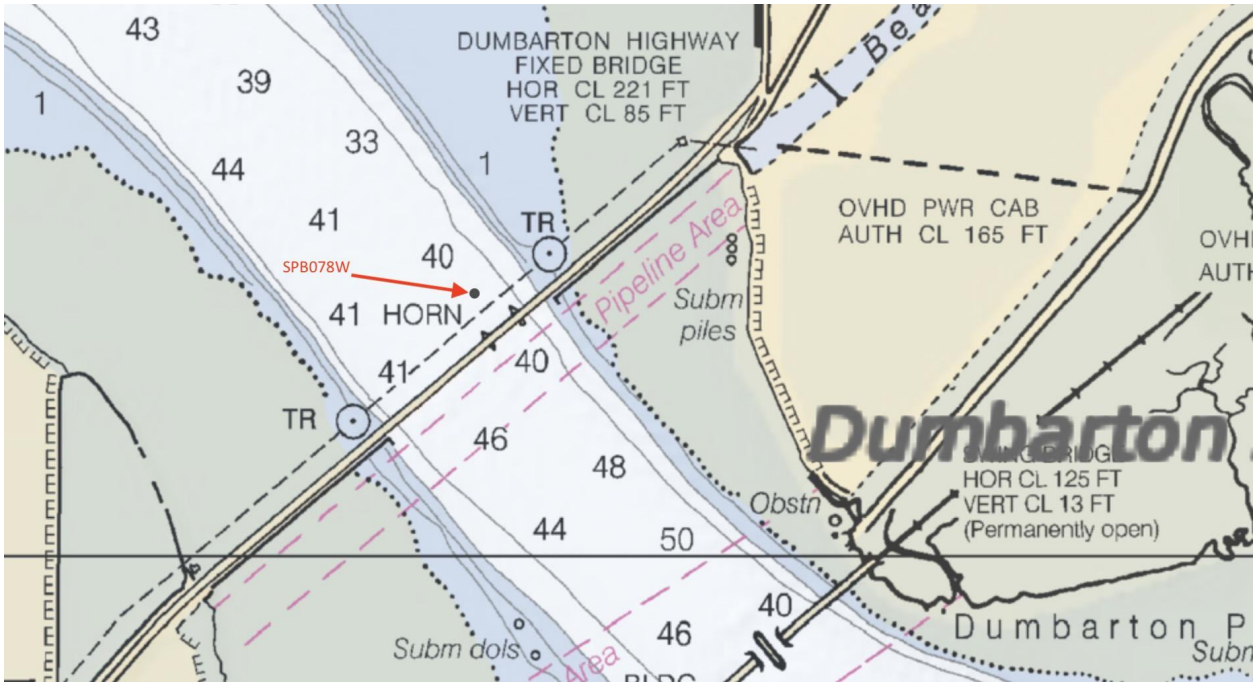

Figure 2. Location of 2021 RMP Target Station SB078W.

Coordinates for two potential oversample sites also fall within restricted areas:

- Oversample site SB080W lies within the restricted zone around the San Mateo Bridge (Figure 3). Given the location directly below the bridge footprint, shallow water (1' MLLW) at the coordinates, and a relatively long transit across a shallow mudflat required for sampling, this site has been excluded from consideration as a potential replacement option.
- Oversample site SU063W lies just inside the shipping channel immediately in front of the Tesoro Refinery in Martinez Figure 4). This site should be sampleable if needed, but likely will need to be adjusted slightly north to avoid anchoring in the shipping channel.

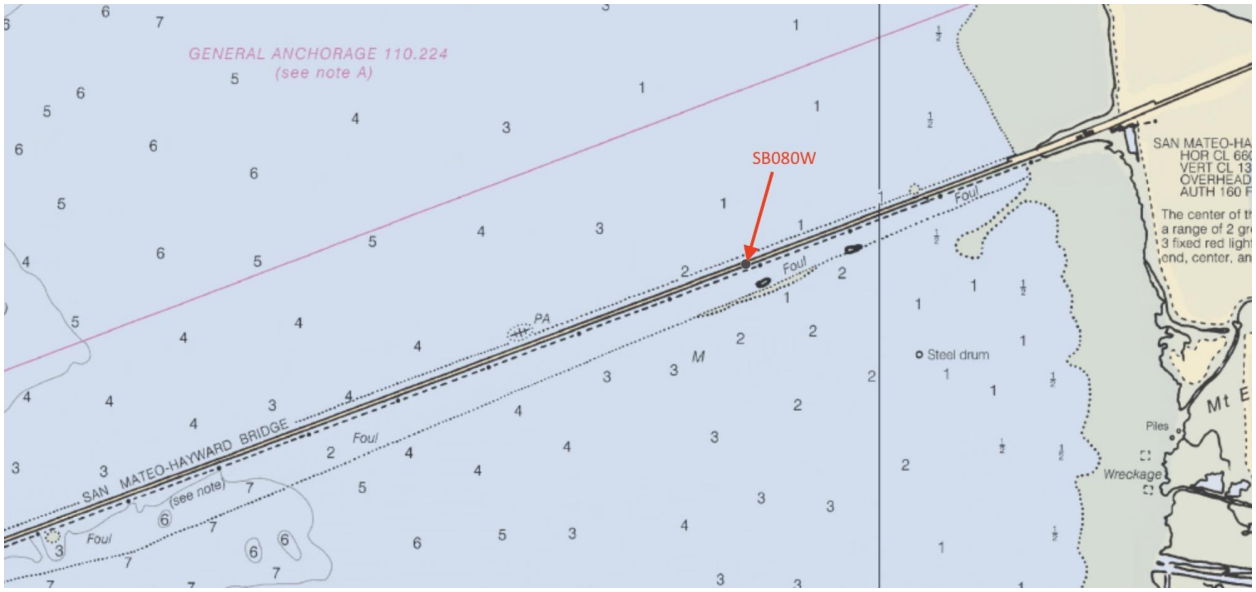

Figure 3. Location of 2021 RMP Oversample Station SB080W Below the Dumbarton Bridge.

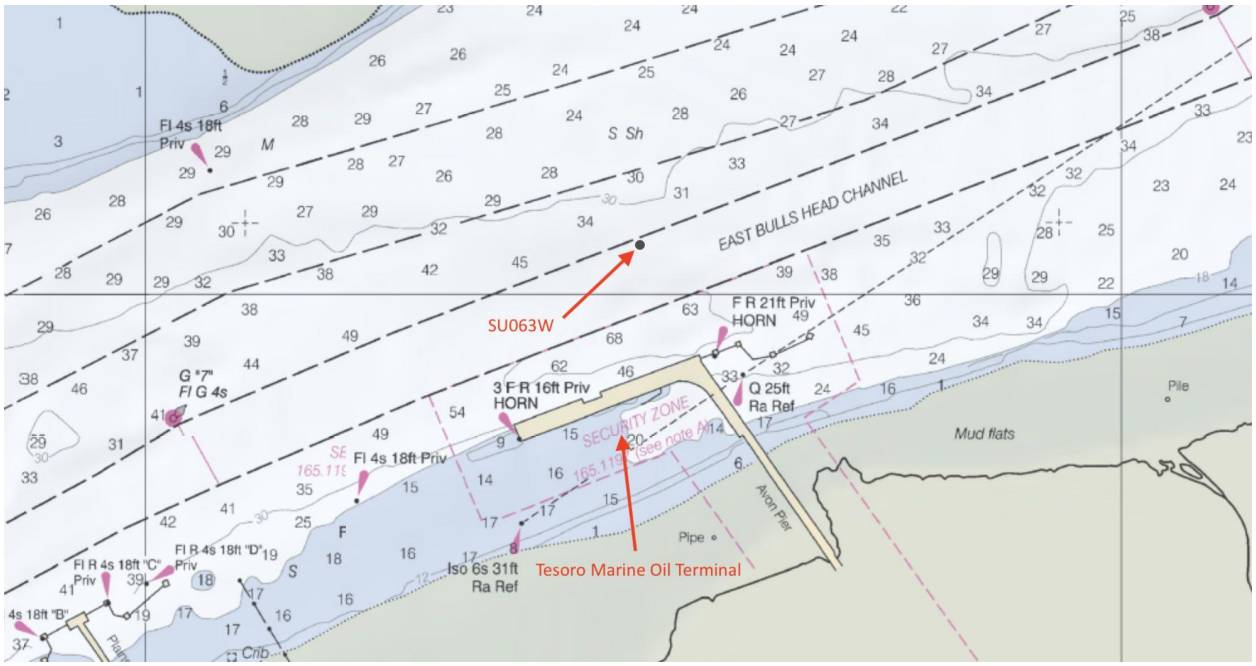

Figure 4. Location of 2021 Oversample Station SU083W.

Table 8. Location of 2021 RMP Water Cruise Target Sampling Sites. Coordinates are in the NAD83 datum. The goal is to navigate to within 100 meters of these coordinates. If not possible, the lead scientist on the boat can make the call to accept a larger offset if it is "close enough" and the costs of rejecting the site and taking a replacement site are "too high". If the offset is greater than 200 meters, the station is rejected and replaced with a replacement site.

Region	Site Code	Site Type	Target Latitude	Target Longitude	Depth (ft)
SB	BA30	Historic	37.513750	-122.134620	NULL
CB	BC10	Historic	37.821580	-122.349500	NULL
CB	BC20	Historic	37.791500	-122.673330	12+
RIV	BG20	Historic	38.059700	-121.811270	12+
RIV	BG30	Historic	38.020540	-121.806270	12+
CB	CB052W	Random	37.76768915	-122.3262211	12+
CB	CB053W	Random	37.84109007	-122.3386014	6 to 12
CB	CB054W	Random	37.66886577	-122.2587495	12+
LSB	LSB079W	Random	37.49517904	-122.1008844	12+
LSB	LSB080W	Random	37.48905324	-122.0910141	12+
LSB	LSB081W	Random	37.471667	-122.066667	3 to 6
LSB	LSB082W	Random	37.4883313	-122.084904	12+
LSB	LSB083W	Random	37.48386444	-122.0785539	12+
SB	SB077W	Random	37.63117488	-122.2252381	6 to 12
SB	SB078W	Random	37.50678656	-122.1193548	12+
SB	SB079W	Random	37.65138323	-122.2373287	6 to 12
SPB	SPB049W	Random	38.08321723	-122.3732145	6 to 12
SPB	SPB050W	Random	38.02634871	-122.3315422	6 to 12
SPB	SPB051W	Random	38.09369595	-122.4239863	3 to 6
SU	SU058W	Random	38.06673825	-121.9757828	12+
SU	SU059W	Random	38.04792049	-122.1266968	6 to 12
SU	SU060W	Random	38.07955305	-122.0417149	6 to 12

APPENDIX A

2021 Replacement Sites. All coordinates are in the NAD83 datum.

Region	Site Code	Target Latitude	Target Longitude	Depth (ft)
SU	SU061W	38.05637305	-122.0907059	6 to 12
SU	SU062W	38.05199174	-121.9662923	12+
SU	SU063W	38.05064522	-122.0915058	12+
SPB	SPB052W	38.00580427	-122.378393	3 to 6
SPB	SPB053W	38.0617928	-122.3843544	6 to 12
SPB	SPB054W	38.0454402	-122.278271	6 to 12
CB	CB055W	37.89452074	-122.414973	12+
CB	CB056W	37.7109171	-122.3366612	12+
CB	CB057W	37.83800752	-122.4166926	12+
SB	SB081W	37.62614703	-122.2415785	6 to 12
SB	SB082W	37.53781718	-122.1673059	12+
SB	SB083W	37.64899746	-122.2645994	12+
LSB	LSB084W	37.50138479	-122.1149447	12+
LSB	LSB085W	37.48810322	-122.0983243	3 to 6
LSB	LSB086W	37.49421001	-122.1094145	12+