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

2023 RMP Dry Season Water Cruise Plan

Prepared by:

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1. Introduction

This report details plans associated with the 2023 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 stations in place of the twenty-six base program stations sampled previously. In 2007, the number of stations was decreased to twenty-two stations, and it remains as such for 2023. The analytes for 2023 are based on the Status and Trends (S&T) Review process that started in 2020.

2. Key Personnel and Approvals

Oversight of the 2023 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 Luis Martinez 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	PS 8/27/2023
Amy Kleckner	SFEI	RMP Manager / Cruise Planner	415-531-3390	AK 8/27/2023
Jay Davis	SFEI	RMP Lead Scientist	530-304-2308	
Don Yee	SFEI	RMP QA Officer	650-530-0603	DY 2023/08/27
Rebecca Sutton	SFEI	RMP Scientist (CECs)	510-701-7050	RAS 8/27/2023

Table 2. Personnel for Water Cruise

Name	Affiliation	Duties	Cell
Paul Salop	AMS	Cruise Manager 9/21, 9/28, 10/1	510-323-6523
Jackie Mohay	AMS	Cruise Manager, 9/21, 9/22	571-274-8059
Theresa Venello	AMS	Cruise Manager, 9/28, 10/2	609-202-4030
Ellen Goldenberg	AMS	Sampling support 9/26	925-989-3646
Don Yee	SFEI	Field Sampling 9/21-9/22, 10/3	650-530-0603
Kayli Paterson	SFEI	Field Sampling 9/28, 10/2-10/3	541-598-6285
Martin Trinh	SFEI	Field Sampling 9/21-22, 9/28, 10/2	864-913-8237
Ezra Miller	SFEI	Field Sampling 9/21-9/22, 10/2-10/3	505-239-6931
Kyle Stark	SFEI	Field Sampling 9/22	540-333-4874
Amy Kleckner	SFEI	Field Sampling 9/21, 9/28, 10/2	415-531-3390
Helen Casendino	SFEI	Field Sampling 9/28	925-951-7540
Jennifer Dougherty	SFEI	Field Sampling 9/21-9/22	650-814-3403
Shira Bezalel	SFEI	Photography 9/28	510-761-3321
Luis Martinez	MARE	Captain, R/V Tomcat 9/21, 9/22	415-272-5830
Dirk Rosen	MARE	R/V Tomcat 9/28, 10/2-10/3	510-495-5298
Abby Nickels	MARE	R/V Tomcat 9/21, 9/22	408-515-6115
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	13751 Lake City Way NE Suite 108, Seattle, WA 98125
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 West Sacramento	Chanell Slaughter	(925) 596-1576	Chanell.Slaughter@et.EurofinsUS.com	Eurofins West Sacramento 880 Riverside Parkway, West Sacramento, CA 95605
CCSF	Tony Rattinetti	(415) 920-4965	trattonetti@sfwater.org	SFPUC, Water Quality Division, 750 Phelps Street, San Francisco, CA 94124
Enthalpy	Jennifer Christmann	O: (916) 673-1520 M:	Jennifer.Christmann@enth	Enthalpy Analytical 1104 Windfield Way

		(916) 995-5171	alpy.com	El Dorado Hills, CA 95762
UMN	William 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
GEM	Chong Chen	+852 5668 0812	chonchen@cityu.edu.hk	P5840, Yeung Kin Man Academic Building (AC1) City University of Hong Kong 83 Tat Chee Avenue, Kowloon Hong Kong

Table 4. SFEI Staffing Schedule

Table 5. Combined station-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. Logged data from 22 stations for on-board (field meter) measurement of DO, pH, salinity, conductivity,turbidity, and temperature by AMS.
3. Document current and recent weather conditions at each station.

Collect Water Samples - Total Fraction (Unfiltered water samples)

4. 22 stations (and 2 field replicates and 1 field blank) for analysis of Weak Acid Dissociable (WAD) Cyanide (CalTest)
5. 22 stations (and 2 field replicates and 1 field blank) for analysis of SSC (CalTest)
6. 5 stations (and 1 field split for lab dupe) for analysis of SSC (CCSF)
7. 22 stations (and 2 field replicates) for analysis of Chl-a (CalTest)
8. 22 stations (and 2 field replicates and 2 field blanks and 2 matrix spikes) for analysis of bisphenols (SGS-AXYS)
9. 22 stations (and 2 field replicates and 2 field blanks and 2 matrix spikes) for analysis of organophosphate esters (SGS-AXYS)
10. 22 stations (and 2 field replicates and 2 field blanks and 2 matrix spikes) for analysis of PFAS (SGS-AXYS)

11. 22 stations (and 2 field replicates and 2 field blanks) for analysis of TOP (SGS-AXYS)
12. 1 station for analysis of PFAS (Eurofins West Sacramento)
13. 1 station for analysis of PFAS (Enthalpy)
14. 5 stations (and 2 field blanks) for analysis of quaternary ammonium compounds (UMN)
15. 4 stations (and 1 field blank and 1 [field-prepared] lab control spike and 4 field replicates) for analysis of pharmaceuticals (GEM; Global Estuaries Monitoring)

Collect Water Samples - Particulate Fraction (Filters)

16. 22 stations (and 2 field replicates and 1 field blank) for Particulate Organic Carbon (POC) (ALS)
17. 22 stations (and 2 field replicates and 1 field blank) for analysis of particulate Cu (BAL)
18. 5 stations (plus matrix spike and lab dupe filters at one station) for analysis of particulate Cu (CCSF)

Collect Water Samples - Dissolved Fraction (Filtrate)

Whole water sample collected and to be filtered in the cabin:

19. 22 stations (and 2 replicates and 1 blank) for analysis of Dissolved Organic Carbon (DOC) (ALS)

Water collected after attaching pre-cleaned filter provided by BAL to the end of the tubing:

20. 22 stations (and 2 replicates and 1 blank) for analysis of hardness (BAL)
21. 22 stations (and 2 replicates and 1 blank) for analysis of dissolved Cu - column chelation (BAL)
22. 5 stations for analysis of hardness (CCSF)
23. 5 stations for analysis of dissolved Cu - column chelation (CCSF)

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 the vessel and to the CTD containment cage.
4. Ensure that DI syringe is disconnected from CTD input.
5. Turn CTD on by moving the switch completely to the 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 the 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 the 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 station list' – delete old stations or just add in new stations
4. Enter stations then press enter to store the station
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 a 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 station from station 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, station code, and sampling date/time on the YSI field sheet, usually requested near start or middle of time on station

Field Turbidimeter

The field turbidity measurement will be used to choose sample volume for SSC (collected for SFPUC). Target solids mass is 2-7mg per bottle (250mL x 28mg/L = 7mg)

1. Calibrate the meter following the manufacturer instructions
2. Rinse sample vial with site water
3. Wipe and dry vial outside, invert several times, and perform measurement

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-23WC-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 station code and fraction (T or D) on the label on the outer bag (except for PFAS samples - Only use Ultra Fine Point Sharpie). Labels should be attached directly to bottles without bags, and the station code, analyte, and fraction should be written on the bottle lid.

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

GEM pharmaceutical water sample containers and filter sample bags should be labeled with the labels provided (see Appendix B), and covered with transparent tape for water-proofing.

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 station 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 9/21 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 (ALS)

A field blank will be collected at the same time as field samples are collected on 9/21 (LSB087W or alternate LSB site) and 10/2 (BC10) for bisphenols, OPEs, PFAS and TOP. 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 9/21 (LSB087W or alternate LSB site) and 10/2 (BC10) for QACs. The field blank for QACs is collected by pouring DI water into a single sample container during sample collection. Note that the QAC field blank is a single container (1 L), while field samples consist of 3 containers (3 L total).

A field blank sample and a matrix spike sample will be collected at the same time as field samples are collected on 10/2 (BC10) for pharmaceuticals. The field blank for pharmaceuticals is collected by using the field blank syringe to aspirate the full volume of the field blank water provided, then attaching a glass filter to the syringe and aspirating this water into the appropriate sample container. The same process is used for the matrix spike. Each filter is placed in the appropriate labeled bag, and all samples (water and filter) are placed on ice to

chill, but not frozen. Additional pharmaceutical sample collection information is linked in Appendix B.

Sample Collection

Sample tubing must be rinsed with station 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 station 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 station water before filling; sample bottles for bisphenols, OPEs, PFAS, TOP, 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 80% of the total bottle volume (bisphenols, OPEs, PFAS, TOP, QACs). See Table 5 for a list of sample bottles by parameter and bottle handling instructions.

Pharmaceuticals samples from a subset of stations will be collected using a stainless steel bailer provided in the sample kit if possible; if not, the SFEI bailer can be used. The bucket should be rinsed three times with site water prior to sample collection. Sample containers should NOT be rinsed.

To limit procedural contamination during sample collection, some common products must be avoided on the vessel.

Nitrile gloves are essential; latex is prohibited. Avoid touching gloves with materials that are waterproof (e.g., waterproof clothing and shoes, including but not limited to Coated Tyvek®, Gore-Tex®, Scotchgard™, and RUCO®; waterproof paper and notebooks such as Rite in Rain®) or greaseproof (e.g., food packaging materials, including food wrap, paper towels, aluminum foil), because these materials may contain PFAS. The eating area should be separate from the sampling area. Avoid touching gloves with first aid adhesive wrappers. Avoid touching gloves to your face or exposed skin, as some personal care products and sunscreens may contain PFAS. Avoid regular and thick sized markers of any brand (fine and ultra-fine are acceptable), sticky notes, and plastic clipboards. Avoid anti-fogging lens spray, wipes, or solutions for glasses or safety goggles. Avoid new (unwashed) clothing, and any clothes recently treated with fabric softeners, fabric protectors, insect resistance and water/stain/dirt-resistant chemicals.

Do not use QAC-based antimicrobial products (i.e., Lysol disinfecting sprays, Clorox wipes). Alcohol-based hand sanitizer is acceptable. Avoid touching gloves with clothing that has been washed/dried with fabric softeners or dryer sheets.

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” and GEM sampling
- Staff 3 - “Super dirty hands” to help set up sampling stations, filtering station, CTD
- Staff 4 - “Clean hands” for Station 2 (CEC and GEM 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. CN-WAD

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

3. SSC

Collect bottles of 1L and 250 mL at each station for Caltest. As a rule of thumb: at any stations deeper than 20 ft with only a hint of color in the POC water bottle or <10 mg/L (Central Bay, Golden Gate), totally fill both bottles If the water is cloudy (brownish around the boat, less than 6 ft deep, rocked by wind/waves) collect partially filled bottle (1/2 or 1/3 full for both 1L and 250mL bottles). Most stations should be in the slightly cloudy category. Report field turbidity to Caltest to assist their bottle processing selection.

For SFPUC adjust fill level to achieve ~2-7 mg in the larger (250mL) bottle. Fill 125mL bottle with half the volume of the larger bottle (e.g. if turbidity is 60 mg/L,

collect 110mL in a large bottle, 55mL in a small bottle). If field turbidity is low, <10 mg/L, collect additional 250mL or 500mL bottle(s) to get target solids mass.

4. **Chlorophyll-a**

   Collect three, 1000-ml amber HDPE bottles per station plus lab/field duplicate samples at designated stations each day (24 samples total: 22 stations, and 2 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 / Hardness (common container):**

   Collect one 60 mL sample for BAL.

2. **Copper**

   Collect one 1 L sample for CCSF at select stations

3. **Hardness**

   Collect one 250 mL sample for CCSF at select stations

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, TOP, QACs, and pharmaceuticals</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 station water rinse, then will be used to fill sample containers. For 1 L sample containers, an alternate approach is to use the AMS sample container holder attached to a painters pole. For the

pharmaceuticals sample, a separate stainless steel bailer is provided, and we can use this if possible, rinsing three times with site water before collecting samples. Sample containers will be handled with nitrile gloves. Fill containers to ~80% to allow for expansion as they will be frozen after collection.

1. **Organophosphate esters**

   Collect station water using the AMS 1L sample container holder or the SFEI stainless steel bailer. Fill the 1 L wide-mouth amber glass container to ~80% with station water (minimum sample size 700 mL).

2. **Bisphenols**

   Collect station water using the AMS 1L sample container holder or the SFEI stainless steel bailer. Fill the 1 L wide-mouth amber glass container to ~80% with station water (minimum sample size 300 mL).

3. **PFAS**

   Collect station water using the SFEI stainless steel bailer. Fill the 500 mL HDPE container to 80% with station water.

4. **TOP**

   Collect station water using the SFEI stainless steel bailer. Fill the 60 mL HDPE container 80% with station water.

5. **QACs**

   Collect station water using the AMS 1L sample container holder or the SFEI stainless steel bailer. Fill the three 1 L polycarbonate containers to 80% with station water.

6. **Pharmaceuticals**

   Collect station water using the kit-provided stainless steel bailer and rope, if possible. The SFEI bailer can be used if there are any problems with the kit bailer. Samples will be filtered using the plastic syringe and glass filter in the kit; only one syringe filter is needed at each location.

   Rinse the provided plastic syringe once by aspirating 20 mL of the water samples from the sampling bucket. Prime the GFF glass microfiber syringe filter to the plastic syringe. Rinse the filter and the amber glass vials once with 5 mL of the filtrate. Discard the filtrate as waste. Water samples are then collected in duplicate and each sample should contain 20 mL of filtrate. The water volume should be accurately controlled as it can burst the glass vial upon freezing. Seal the sample collection vials with the bottle cap and sealing film, and store the filter in the labeled seal bag. Filters for each sample are placed in individually labeled plastic bags. Once collected, samples (water and filter) are kept chilled, but not frozen. Additional pharmaceutical sample collection information is linked in Appendix B.

Update the GEM pharmaceuticals data log (see Appendix B) with environmental factors including water pH, water temperature, water salinity, and dissolved oxygen (DO). Record the sampling time and sampling location GPS. An electronic copy of the data log will be uploaded to the GEM team. Observe and photograph the surrounding environments of the sampling location, including the upstream, downstream, sampling location, surrounding environment, and potential discharges.

Between stations, the SFEI 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. The GEM pharmaceuticals bailer may also be cleaned this way, though it is not required.

Field blanks for PFAS, TOP, 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 single sample container during sample collection. The field blank and control spike for pharmaceuticals are collected by using the field blank syringe to aspirate the full volume of the field blank or spiked water, respectively, then attaching a glass filter to the syringe and aspirating this water into the appropriate sample container. Each filter is placed in the appropriate labeled bag, and all samples (water and filter) are placed on ice to chill, but not frozen.

Completed water samples for PFAS, TOP, OPEs, and bisphenols, and QACs are chilled in coolers with wet ice or ice packs (1 to 5^{o}C), and will be frozen prior to shipping for best preservation of sample. Pharmaceuticals samples (water and filter) are chilled on ice and then refrigerated prior to shipping, not frozen, to prevent glass breakage.

<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 station 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 filter. Try to observe the dominant grain of fibers; the filter will fold more easily along that direction.
9. Place individual filters in the foil sheets provided by ALS using forceps, and place these foil wrapped filters 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 headspace, 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 (rinse separately to avoid putting particulate from chimney into the fritted part, and rinse fritted part inverted (from inside/bottom) to dislodge any particles). Thoroughly rinse with DI after.
2. Collect samples into cleaned (1x DI rinsed and drained between stations, then 3x rinsed in station water at current station) 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 the funnel. Be careful not to poke a hole in the membrane. Discard and replace if in doubt.
   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 two filters per station. 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 judgment 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 filter. 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 2023 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 stations 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 station within the segment from the current 2023 sampling schedule (see Appendix A for station locations). A record of all stations not able to be sampled and why will be maintained as part of the cruise recordkeeping.

There are no target stations for 2023 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..

Table 6. Tentative Schedule for 8/25-10/2, 2023 RMP Water Cruise

Date	Time	Activity
8/25	10:00 - 11:30	Mobilize sampling equipment aboard RV *TomCat* at 1290 Sanderling Island, Richmond.,
9/21	0730-1630	Mobilize remaining equipment aboard vessel at Westpoint Harbor Marina (101 Westpoint Harbor Drive, Redwood City). Conduct safety briefing. Sample BA30, LSB086W, LSB085W, LSB087W, LSB088W, and LSB089W. Return to Westpoint Harbor and demobilize vessel.
	1630-1800	SFEI staff / Caltest courier meets vessel upon return and retrieves all short hold-time samples. Angels Courier retrieves all remaining samples for transfer to AMS.
9/22	0730-1400	Mobilize remaining equipment aboard vessel at Westpoint Harbor Marina. Conduct safety briefing. Sample SB082W, SB081W, SB083W, and CB056W. Transit to Safe Harbor Marina (3310 Powell St, Emeryville) and demobilize vessel.
	1400-1600	SFEI staff / Caltest courier meets vessel upon return and retrieves all short hold-time samples. Angels Courier retrieves all remaining samples for transfer to AMS. ??? transports sampling personnel from Emeryville to Redwood City to retrieve personal vehicles.
9/28	0700-1400	Mobilize remaining equipment aboard vessel at Safe Harbor Marina. Conduct safety briefing. Sample BC20. Return to Safe Harbor Marina and demobilize vessel.
	1400-1600	SFEI staff / Caltest courier meets vessel upon return and retrieves all short hold-time samples. Angels Courier retrieves all remaining samples for transfer to AMS.
10/2	0700-1400	Mobilize remaining equipment aboard vessel at Safe Harbor Marina, Richmond (1340 Marina Way S, Richmond). Conduct safety briefing. Sample

	1430-1630	CB057W, BC10, CB055W, SPB052W, SPB053W, and SPB054W. Transit to Benicia Marina (266 East B St., Benicia) and demobilize vessel. SFEI staff / Caltest courier meets vessel at Benicia Marina and retrieves all short hold-time samples. Angels Courier retrieves all remaining samples for transfer to AMS.
10/3	0730-1500 1330-1430	Mobilize remaining equipment aboard vessel at Benicia Marina (266 East B St.). Conduct safety briefing. Sample SU063W, SU061W, SU062W, BG20, and BG30. Transit to Pittsburg Marina fuel dock (51 Marina Blvd, Pittsburg) and demobilize vessel. Transit to Benicia Marina to deposit personnel at vehicles (?). SFEI staff / Caltest courier meets vessel upon return and retrieves all short hold-time samples. AMS / courier retrieves all remaining samples and sampling equipment for transfer to AMS.
10/4	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)
Redwood City	Safeway	1071 El Camino Real Redwood City 650-306-1900	0600-2400
Emeryville	AM/PM Market	889 West Grand Oakland 510-465-4450	24 hrs
Martinez	Concord Airgas	1825 Arnold Industrial Concord 925-825-8822	0700-1700

3.5. Sampling stations

2023 target sampling stations are shown in Figures 1 and 2 and listed in Table 8. All coordinates are in NAD83 datum. The replacement-station pool is shown in Appendix A.

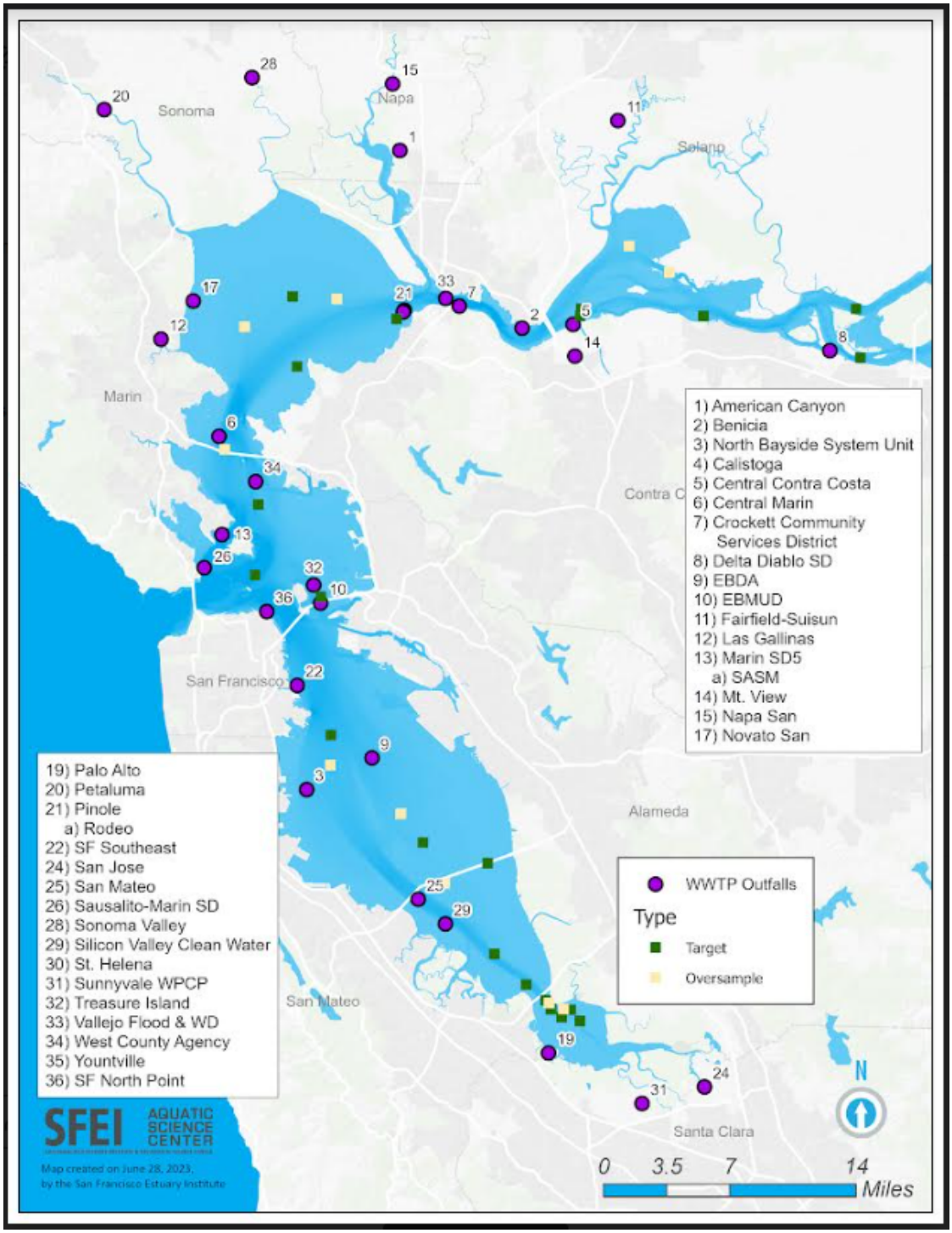

Figure 1. 2023 RMP Water Cruise stations south of Bay Bridge (targets shown as green squares, overample stations as yellow squares; purple circles show locations of WWTP outfalls)

Two stations were removed from the site list during planning due to accessibility issues::

- LSB084W, a target sampling station, is located in an area between the Dumbarton Highway and Railroad bridges, which contains a number of pipelines as well and offers limited area for anchoring. It was replaced with oversample site LSB089W (Figure 2).

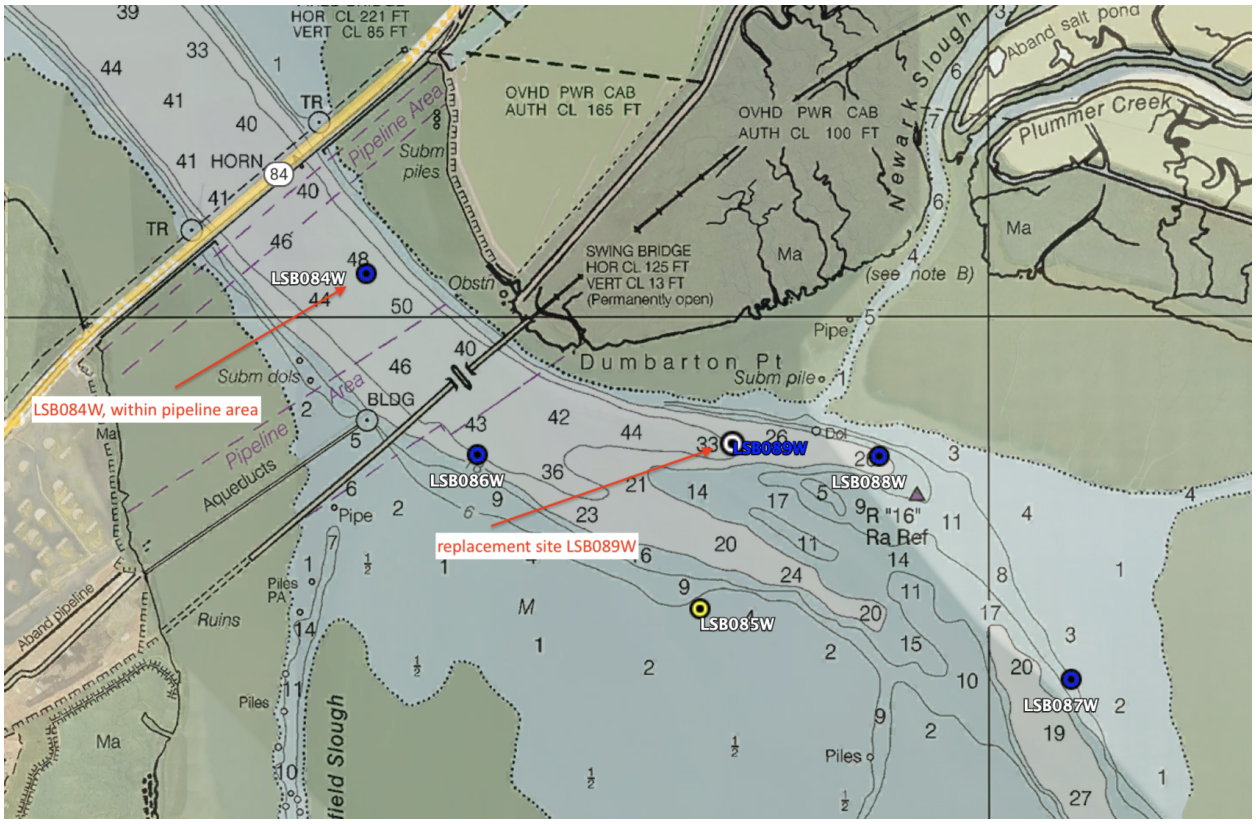

Figure 2. Location of 2023 RMP Target Station LSB084W and Replacement Site LSB089W.

- SB080W, a target sampling station, is located below the San Mateo Bridge. The restricted area around the bridge extends over 150 m to the south of the bridge, which precludes anchoring and sampling of the station. The site was therefore replaced with oversample site SB083W (Figure 3).

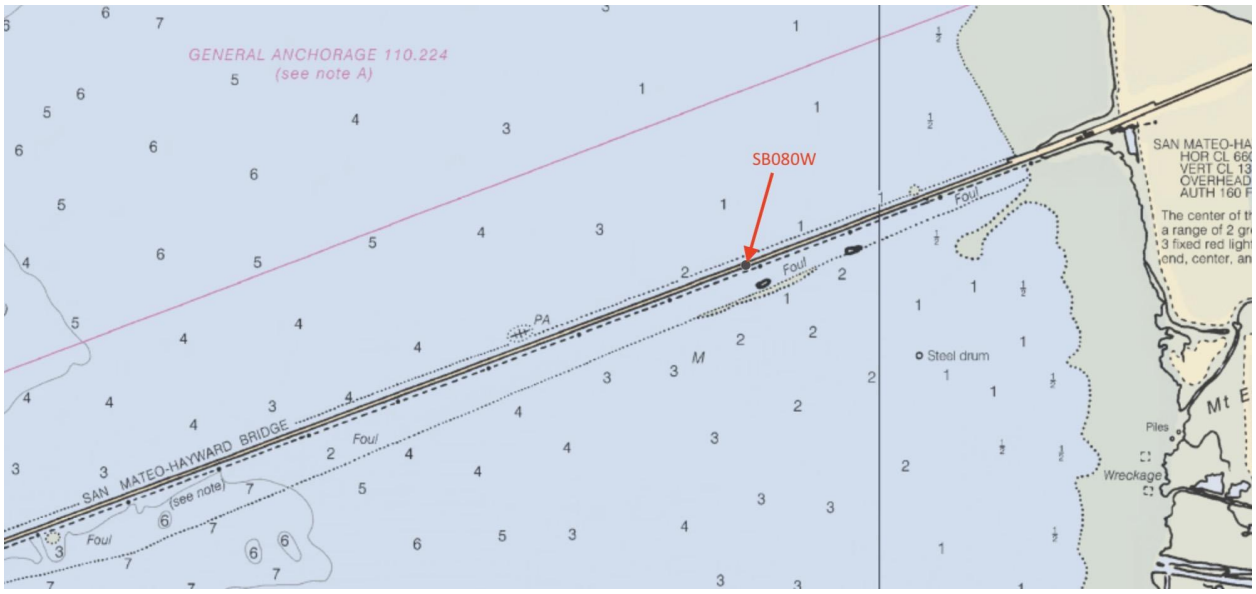

Figure 3. Location of 2023 RMP Target Station SB080W Below the Dumbarton Bridge.

In addition, 2023 target station SU063W lies just inside the shipping channel immediately in front of the Tesoro Refinery in Martinez (Figure 4). This station should be sampleable but likely will need to be adjusted slightly north to avoid anchoring in the shipping channel.

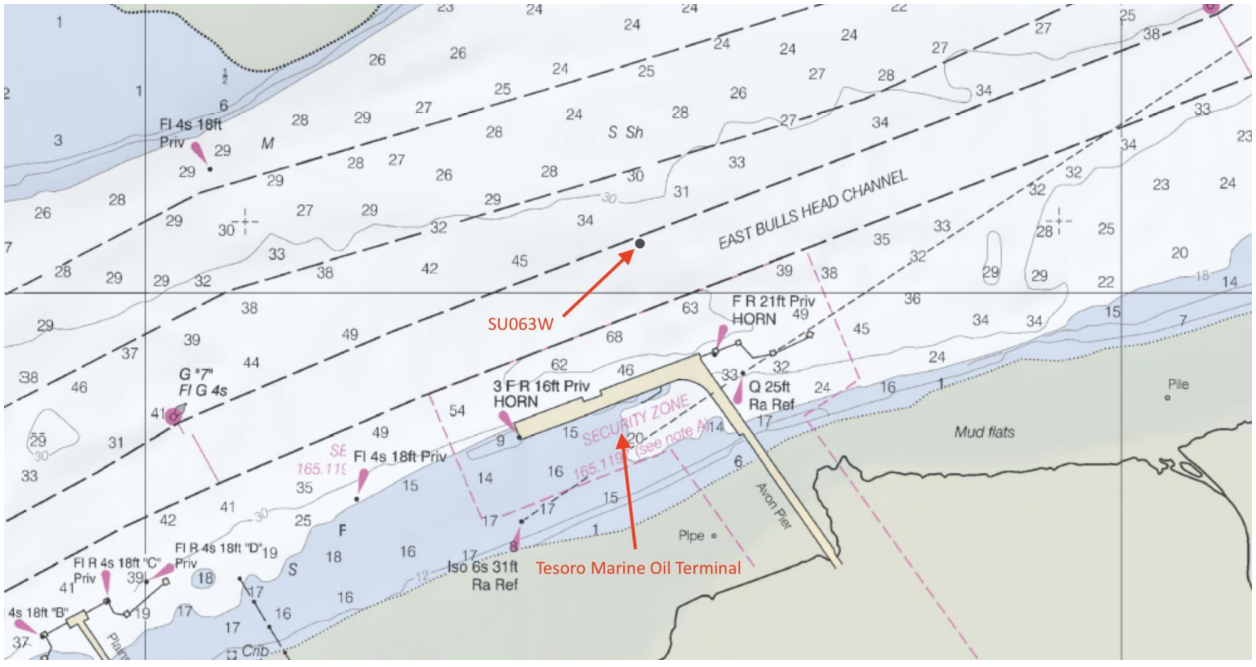

Figure 4. Location of 2023 Target Station SU083W.

Table 8. Location of 2023 RMP Water Cruise Target Sampling stations. 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 station and taking a replacement station are "too high". If the offset is greater than 200 meters, the station is rejected and replaced with a replacement station.

Region	Station Code	Station Type	Target Latitude	Target Longitude	Depth (ft)
RIV	BG20	Historic	38.05969966	-121.8112677	12+
RIV	BG30	Historic	38.02054094	-121.806267	12+
SU	SU061W	Random	38.05637305	-122.0907059	6 to 12
SU	SU062W	Random	38.05199174	-121.9662923	12+
SU	SU063W	Random	38.05064522	-122.0915058	12+
SPB	SPB052W	Random	38.00580427	-122.378393	3 to 6
SPB	SPB053W	Random	38.0617928	-122.3843544	6 to 12
SPB	SPB054W	Random	38.0454402	-122.278271	6 to 12
CB	BC10	Historic	37.8215833	-122.3495	NULL
CB	BC20	Historic	37.7915	-122.67333	12+
CB	CB055W	Random	37.89452074	-122.414973	12+
CB	CB056W	Random	37.7109171	-122.3366612	12+
CB	CB057W	Random	37.83800752	-122.4166926	12+
SB	BA30	Historic	37.51375	-122.1346166	NULL
SB	SB083W	Random	37.64899746	-122.2645994	12+
SB	SB081W	Random	37.62614703	-122.2415785	6 to 12
SB	SB082W	Random	37.53781718	-122.1673059	12+
LSB	LSB089W	Random	37.49465708	-122.0966843	12+
LSB	LSB085W	Random	37.48810322	-122.0983243	3 to 6
LSB	LSB086W	Random	37.49421001	-122.1094145	12+
LSB	LSB087W	Random	37.4852904	-122.0798239	12+
LSB	LSB088W	Random	37.49413414	-122.0893841	12+

APPENDIX A

2023 Replacement stations. All coordinates are in the NAD83 datum.

Region	Station Code	Station Type	Target Latitude	Target Longitude	Depth (ft)
SU	SU064W	Random	38.08657758	-122.0016039	12+
SU	SU065W	Random	38.1072472	-122.0430653	6 to 12
SPB	SPB055W	Random	38.03679347	-122.4325152	6 to 12
SPB	SPB056W	Random	38.06045282	-122.339393	6 to 12
CB	CB058W	Random	37.68675594	-122.3366612	12+
CB	CB059W	Random	37.93810845	-122.4501642	12+
SB	SB084W	Random	37.5938381	-122.2187876	3 to 6
LSB	LSB090W	Random	37.49938788	-122.1112846	12+

APPENDIX B

GEM Pharmaceuticals Sampling Resources.

Global Estuaries Monitoring Programme Sampling Protocol

Tutorial Video (scroll down)

Data Log Template (and example data log)

Sample Labels (planned) and label template

- Location 1 or A: BG20 (9/1)
- Location 2 or B: BC10 (8/30) - also field blank and lab control spike
- Location 3 or C: BA30 (8/28)
- Location 4 or D: LSB087W (8/28)

Project Website