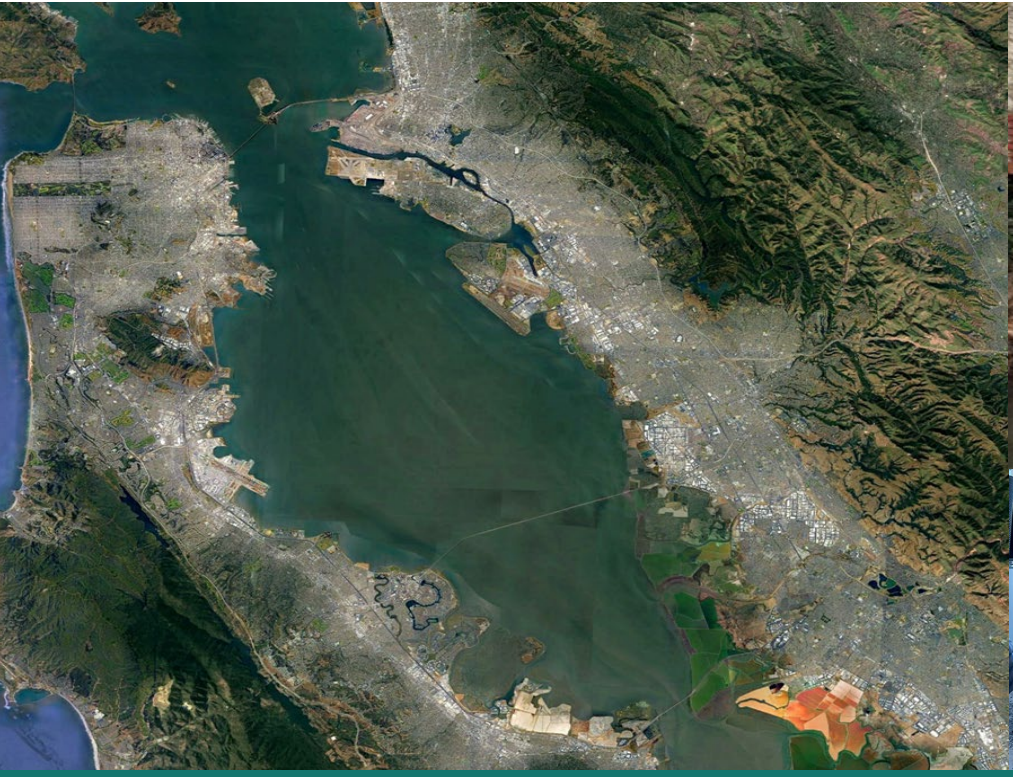

Watching Our Watersheds (WOW) Regional Trash Monitoring Project

Funded through USEPA Grant #98T61401

Receiving Water Trash Monitoring Quality Assurance Project Plan

FINAL July 31, 2024

Submitted in compliance with provision C.8.h.iii.(2) of NPDES Permit No. CAS612008, Order No. R2-2022-018

Prepared on behalf of:

- Alameda Countywide Clean Water Program
- Contra Costa Clean Water Program
- San Mateo Countywide Water Pollution Prevention Program
- Santa Clara Valley Urban Runoff Pollution Prevention Program
- Solano Stormwater Alliance

cleanwater PROGRAM

SAN MATEO COUNTYWIDE Water Pollution Prevention Program
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Solano Stormwater Alliance

Santa Clara Valley *Urban Runoff* Pollution Prevention Program

CONTRA COSTA CLEAN WATER PROGRAM

EPA United States Environmental Protection Agency

1. Project Management

1.1. Title and Approval Page (EPA QA/R-5 A1)

Program Title	Watching Our Watersheds Regional Trash Monitoring Project
Lead Organization	City and County Association of Governments of San Mateo County
Primary Contact	Paul Randall
Effective Date	October 1, 2024
Responsible Organization	BAMSC
Revision Number	1

Approval Signatures:

Table 1-1. Project Team Approval Signatures

Title	Name	Signature	Date
C/CAG Project Mgr	Reid Bogert		
Project Team Project Mgr.	Paul Randall		
TAG Coordinator	Chris Sommers		
Water Board Rep	For Eileen White		
Monitoring Coordinator	Eric Donaldson		
Quality Assurance Officer	Paul Salop		

Table 1-2. EPA Approval Signatures

Title	Name	Signature	Date
EPA Project Mgr	Luisa Valiela		
EPA QA Officer	TBD		

1.2. Table of Contents (EPA QA/R-5 A2)

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List of Acronyms

Acronym	Definition
ACCWP	Alameda Countywide Clean Water Program
AMS	Applied Marine Sciences, Inc.
BASMAA	Bay Area Stormwater Management Agencies Association
BAMSC	Bay Area Municipal Stormwater Collaborative
CBI	Catch Basin Insert
C/CAG	City and County Association of Governments of San Mateo County
CCCWP	Contra Costa Clean Water Program
COC	Chain of Custody
CPAR	Corrective and Preventative Action Report
CPS	Connector Pipe Screen
DM	Data Manager
DMA	Drainage Management Area
DQI	Data Quality Indicator
DQO	Data Quality Objective
EOA	EOA, Inc.
EPA	US Environmental Protection Agency
ETAP	Escaped Trash Assessment Protocol
FC	Field Crew
FTC	Full Trash Capture System
FTCE	Full Trash Capture System Equivalency
GPM	EPA Grant Project Manager
HDS	Hydrodynamic Separator
IMR	Integrated Monitoring Report
LID	Low Impact Development
LOE	Level of Effort
MC	Monitoring Coordinator
MP	Monitoring Plan
MQO	Measurement Quality Objective
MRP	Municipal Regional Stormwater Permit
MRP 3	Municipal Regional Stormwater Permit, Reissued May 11, 2022
MS4	Municipal Separate Storm Sewer System
NPDES	National Pollutant Discharge Elimination System
OVTA	On-land Visual Trash Assessment
PM	Project Manager
PPE	Personal Protective Equipment
QA	Quality Assurance
QAO	Quality Assurance Officer
QAPP	Quality Assurance Project Plan
QC	Quality Control
RPD	Relative Percent Difference
RWMP	Receiving Water Monitoring Plan
SCVURPPP	Santa Clara Valley Urban Runoff Pollution Prevention Program
SFRWQCB	Regional Water Quality Control Board, San Francisco Region
SMCWPPP	San Mateo Countywide Water Pollution Prevention Program
SOP	Standard Operating Procedure
SPM	Stormwater Program Manager
SSA	Solano Stormwater Alliance
TAG	Technical Advisory Group
UCMR	Urban Creeks Monitoring Report

Acronym	Definition
WBL	Water Board Liaison
WOW	Watching our Watersheds Regional Trash Monitoring Project
WQIF	Water Quality Improvement Fund Grant
WY	Water Year

1.3. Distribution List (EPA QA/R-5 A3)

Table 1-3. QAPP Distribution List

Title	Name and Affiliation	Contact Information (Telephone; Email)	QAPP #
EPA Grant Project Mgr	Luisa Valiela, EPA	415-972-3400 valiela.luisa@epa.gov	1
EPA QA Officer	TBD EPA	TBD	2
Water Board Rep	For Eileen White SFRWQCB	510-622-2314 Eileen.White@waterboards.ca.gov	3
TAG Coordinator	Chris Sommers, EOA, Inc.	510-832-2852 x109 csommers@eoainc.com	4
PMT Rep / SPM	Jim Scanlin, City of Newark / ACCWP	510-578-4539 James.scanlin@newark.org	5
PMT Rep / SPM	Rinta Perkins, CCCWP	925-313-2194, Rinta.Perkins@pw.cccounty.us	6
PMT Rep / SPM	Adam Olivieri, SCVURPPP	510-832-2852, awo@eoainc.com	7
PMT Rep / SPM	Reid Bogert, SMCWPPP, C/CAG PM	650-599-1433, rbogert@smcgov.org	8
PMT Rep / SPM	Emily Corwin, SSA	510-778-4544 ecorwin@fssd.com	9
Project Mgr	Paul Randall, EOA, Inc.	510-832-2852 x1 prandall@eoainc.com	10
Monitoring Coordinator	Eric Donaldson, Balance Hydrologics	510-704-1000 x210 edonaldson@balancehydro.com	11
Quality Assurance Officer	Paul Salop, AMS, Inc.	925-373-7142 salop@amarine.com	12

1.4. Project Organization (EPA QA/R-5 A4)

The Bay Area Municipal Stormwater Collaborative (BAMSC) was organized in June 2021 by the Bay Area Stormwater Management Agencies Association (BASMAA) Board of Directors to continue the information sharing and permittee advocacy functions of BASMAA in an informal manner after BASMAA's dissolution. BAMSC has taken on an organizing role in supporting the Bay Area stormwater Programs in meeting the permit requirements of the re-issued Municipal Regional Stormwater Permit (MRP 3) issued May 2022 (Order No. R2-2022-0018, NPDES Permit No. CAS612008, SWRCB 2022).

Section C.8.e of MRP 3 specifies permit requirements associated with trash monitoring. MRP 3 identifies specific monitoring efforts to be completed during the permit term in two main study areas (1) outfall trash monitoring conducted per MRP 3 Provision C.8.e.ii.(1); and (2) receiving water trash monitoring conducted per MRP 3 Provision C.8.e.ii.(2). The two components will be conducted on a parallel track, and there will be some overlap between the two efforts, but the two will have separate management structures, monitoring objectives, and sampling protocols.

To support implementation of regional trash monitoring and assessment efforts, the City / County Association of Governments of San Mateo County (C/CAG) applied for and was awarded a US Environmental Protection Agency (EPA) Water Quality Improvement Fund (WQIF) grant to implement the *Watching Our Watersheds Regional Trash Monitoring Project* (WOW) on behalf of C/CAG's member agencies and the other Phase II MRP countywide stormwater programs represented by BAMSC. The primary goal of WOW is supporting countywide and regional trash monitoring efforts and best ensuring compliance with trash reduction milestones during the current MRP 3 permit term. Development and implementation of receiving water monitoring is just one component of the overall WOW effort and the subject of this QAPP.

The total WOW Project cost is estimated at $6,372,000. $3,366,000 is allocated to the overall Project by EPA from the WQIF grant. An additional $3,366,000 is being provided to the Project by BAMSC Project partners[1] as in-kind match. In addition to the receiving water monitoring component, the Project contains other areas of investigation that are covered by a separate QAPP where applicable (e.g., optimization of On-land Visual Trash Assessments, OVTA). The term of the Project is anticipated to run from April 3, 2023 to June 30, 2028. The knowledge and experience gained and the lessons learned during WOW implementation will be promoted and made readily available to inform future trash monitoring and control efforts elsewhere in California and the United States.

Receiving water monitoring will be supported by a Technical Advisory Group (TAG) convened to assist with planning and implementation. TAG members will not be responsible for data collected through Project implementation but will support overall monitoring design and adaptive management.

Figure 1-1 shows the organization structure for the WOW Grant Project. Table 1-3 contains contact information for key Project participants. Responsibilities of key Project personnel are detailed in the sections that follow.

1.4.1. EPA Grant Project Manager Role

The EPA Grant Project Manager (GPM) will be responsible for oversight of the overall Program for EPA Grant compliance.

[1] Alameda Countywide Clean Water Program, Contra Costa Clean Water Program, San Mateo Water Pollution Prevention Program, Santa Clara Valley Urban Runoff Pollution Prevention Program, and Solano Stormwater Alliance.

1.4.2. Project Manager Role

The WOW Project Manager (PM) will be responsible for coordinating efforts associated with implementation of receiving water monitoring conducted for the WOW Project. They will be responsible for coordination and management of all WOW Project Team activities, including budget, schedule, and oversight of all contractors.

1.4.3. Project Management Team / Stormwater Program Lead Role

The WOW Project Management Team (PMT) will provide guidance to C/CAG and oversee Project implementation to ensure compliance with the EPA Grant. PMT members will also serve as the Stormwater Program Manager (SPM) for each Program they represent to ensure Project implementation achieves MRP 3 permit requirements for each respective Program.

1.4.4. Technical Advisory Group Role

The PM will be assisted in design and implementation of programmatic activities by a Technical Advisory Group (TAG) consisting of representatives from academia, regulatory and resource management agencies, and other acknowledged experts in the field of trash monitoring. TAG members will assist the PM in developing a monitoring design that can both practical and informative while best ensuring compliance with MRP 3 permit requirements.

1.4.5. TAG Coordinator Role

The WOW TAG Coordinator (TC) will serve as the liaison between the Project Team and TAG. The TC will also be responsible for convening the TAG and supporting TAG members in completion of required efforts.

1.4.6. Monitoring Coordinator

The Monitoring Coordinator (MC) will be responsible for receiving water monitoring data collection, management, and reporting.

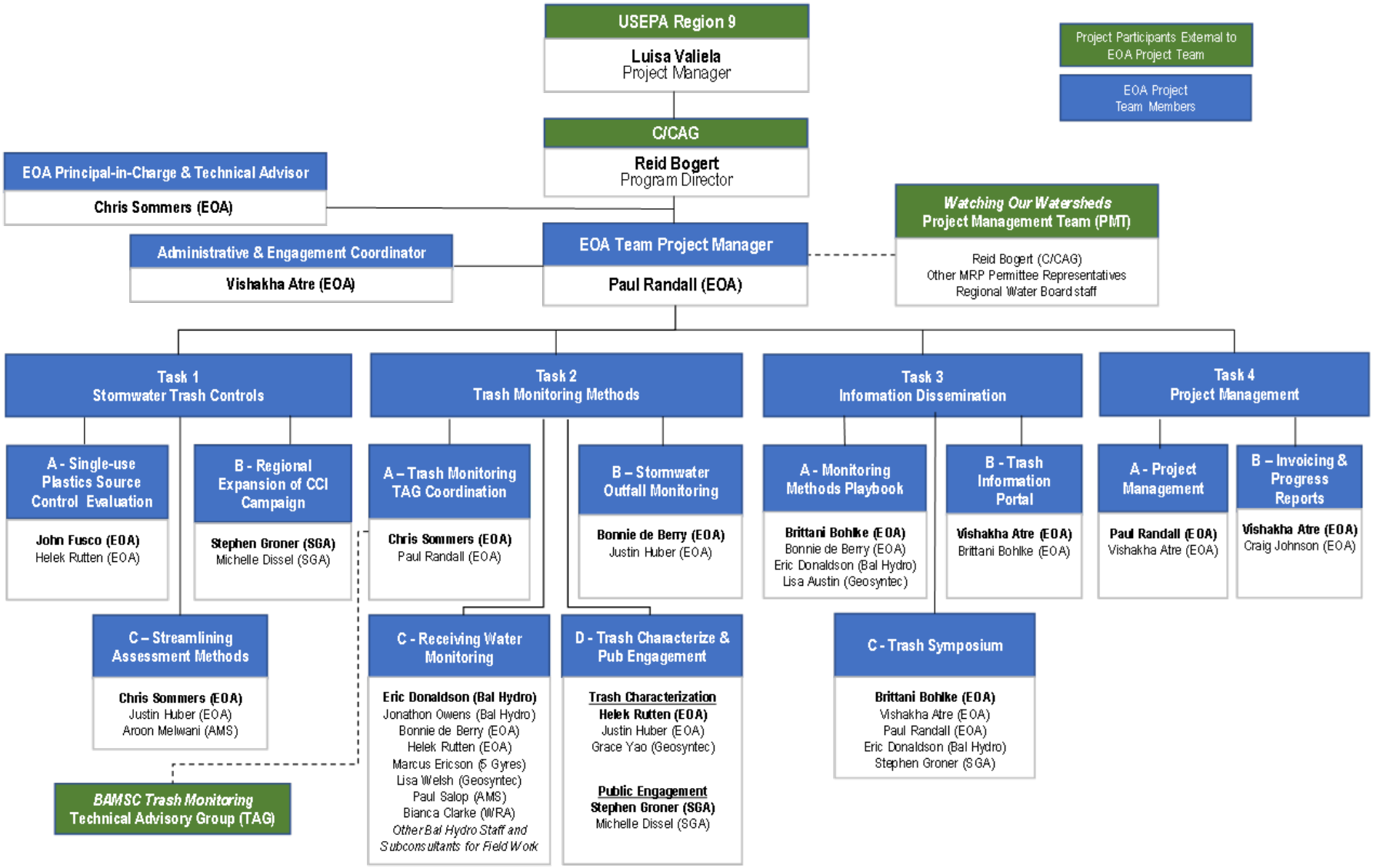
1.4.7. Quality Assurance Officer

The Quality Assurance Officer (QAO) will be responsible for development of the QAPP and any proposed revisions going forward. The QAO may provide technical input on proposed sampling design and characterization techniques, and will be responsible for conduct of field audits and review of characterization data prior to submittal.

1.4.8. Water Board Liaison Role

The Water Board Liaison (WBL) will be responsible for oversight of the overall Program for NPDES Permit compliance. The Liaison will also serve as initial point of contact for stormwater Programs as part of the adaptive management component of monitoring program design and implementation.

Figure 1-1. WOW Project Organizational Structure



1.5. Problem Definition/Background (EPA QA/R-5 A5)

Problem Statement

Although many individuals living in California properly dispose of and recycle huge volumes of waste each day, many California creeks, rivers, lakes, and coastal areas are still impacted by trash. Once in receiving waters, trash can degrade water quality and adversely affect humans, fish, wildlife, and aquatic habitats (i.e., beneficial uses). Specific to the San Francisco Bay Area, the MRP 3 Fact Sheet Findings identify that trash is "a pervasive problem within San Francisco Bay, as well as in creeks and shoreline areas throughout the Bay Area" and that "trash adversely impacts the public's enjoyment of the Bay, Ocean, and their watersheds and poses a serious threat to aquatic life and habitat." MRP 3 further finds that "pollutant control actions and further pollutant impact assessments by the Permittees are warranted and required."

Over the last decade, public agencies in the Bay Area have invested significant resources in developing and implementing trash assessment and control measure tracking programs to meet permit performance standards for trash reduction. However, the tracking and assessment methods to demonstrate that their actions have resulted in positive environmental outcomes have been constrained to indirect measurements, including mapping trash reduction measures and collecting trash assessment data on streets, sidewalks, and parking lots to estimate improvements in trash generation. The tasks proposed under the WOW Grant project will result in development and testing of new monitoring protocols and networks that directly measure the levels of trash in stormwater discharges and in receiving waters.

1.6. Program/Task Description and Schedule (EPA QA/R-5 A6)

A total of six receiving water locations will be sampled three times per year for the Project. All samples will be collected as discrete or integrated samples collected over the course of storm events. Monitoring personnel will select sampling events and duration to meet criteria identified in the RWMP (BAMSC 2024).

Most sampling will be conducted during wet seasons for each year of Project implementation.[2] Sample events are anticipated to target the rising limb of hydrographs for all sample collections to start out. Sample events will be concluded by either changing environmental conditions (e.g., return to base flow), safety concerns, or limits on staffing availability.

After conclusion of individual sampling events, samples will be returned to a secure location for dewatering. After dewatering has concluded, sampling personnel will separate trash from organic debris, and dispose all organic matter appropriately. Sampling personnel will then place remaining trash in a secure sample container(s) until time of characterization.

Project Schedule

The schedule of activities related to Project planning, fieldwork, and reporting deliverables is summarized in Table 1-4.

[2] Dry season sampling may be incorporated as time and budget allows.

Table 1-4. Schedule of Project Activities.

Activity	Date of Initiation	Planned Date of Completion	Deliverable
Project initiation	-	6/24/23	Grant award
Selection of monitoring consultant	6/24/23	12/15/23	Consultant team contract
Sampling site selection	2/5/24	5/15/24	
Sampling method selection		3/15/24	Literature review Technical Memo
Trash Monitoring TAG meeting #3	-	3/4/24	
Develop draft RWMP	3/1/24	5/10/24	Draft RWMP
Develop draft QAPP	3/1/24	5/10/24	Draft QAPP
Draft RWMP, QAPP to TAG/Co-permittees	-	5/13/24	
Trash Monitoring TAG meeting #4	-	5/15/24	
TAG review draft QAPP to EPA	-	6/5/24	
Trash Monitoring TAG review draft MP, QAPP to BAMSC steering com	-	6/27/24	
Submit final MP, QAPP to EPA and Water Board Staff	-	7/31/24	Approved RWMP, QAPP
Monitoring planning and prep	7/1/24	9/30/24	Permitting, equipment procurement, construction
WY 2024 status update	1/1/25	3/31/25	Trash Monitoring Status Report in UCMR
WY 2025 monitoring	10/1/24	4/30/25	MRP 3 §C.8.e.iii(2) minimum LOE (QAPP Table 2-4)
WY 2025 data mgmt. and reporting	5/1/25	3/31/26	Data mgmt., quality assurance, interpretation
WY 2025 status update	1/1/26	3/31/26	Trash Monitoring Status Report in UCMR
WY 2025 electronic data delivery	-	3/31/26	Data delivery to Water Board
WY 2026 monitoring	10/1/25	4/30/26	MRP 3 §C.8.e.iii(2) minimum LOE (QAPP Table 2-4)
WY 2026 data mgmt. and reporting	5/1/26	3/31/27	Data mgmt., quality assurance, interpretation
WY 2026 status update	1/1/27	3/31/27	Trash Monitoring Status Report in UCMR
WY 2026 electronic data delivery	-	3/31/27	Data delivery to Water Board
WY 2027 monitoring	10/1/26	4/30/27	MRP 3 §C.8.e.iii(2) minimum LOE (QAPP Table 2-4)

Activity	Date of Initiation	Planned Date of Completion	Deliverable
WY 2027 data mgmt. and reporting	5/1/27	3/31/28	Data mgmt., quality assurance, interpretation
WY 2027 status update	1/1/28	3/31/28	Trash Monitoring Status Report in UCMR
WY 2027 electronic data delivery	-	3/31/28	Data delivery to Water Board

1.7. Quality Objectives and Criteria for Measurement Data (EPA QA/R-5 A7)

1.7.1. Objectives and Project Decisions

Permittees have implemented or caused to be implemented a number of trash control measures to achieve MRP 3 trash load reduction benchmarks and prevent trash from reaching receiving waters. Trash control measures incorporated to-date have included Full Trash Capture (FTC) systems installed to address trash at the storm drain inlet/catch basin level (e.g., catch basin inserts (CBIs), connector pipe screens (CPSs)) and at the catchment or sub-catchment level (e.g., hydrodynamic separators (HDSs), and low impact development (LID) features sized to FTC system design standards. Non-structural control measures (e.g., street sweeping) have also been used to control trash levels to a full trash capture equivalency (FTCE) level in specific areas where structural controls have not been installed.

MRP 3 has established trash load reduction benchmarks from 2009 levels of 90% reduction by June 30, 2023 and a 100% reduction by June 30, 2025. The Project objective is to verify whether trash control measures have effectively prevented trash from being discharged into receiving waters via stormwater. There are two main management and two monitoring questions re: receiving water monitoring that will be addressed through Project implementation (in conjunction with other efforts external to the EPA Grant efforts):

Management Questions

- Have Permittees' trash management actions effectively prevented trash from their jurisdictions from discharging to receiving waters?
- Are discharges of trash from areas within Trash Management Areas controlled to a low trash generation level causing and/or contributing to adverse trash impacts in receiving waters?

Monitoring Questions

- What is the trash condition and approximate level of trash (volume, type, and size) within receiving waters in areas that receive MS4 runoff controlled to a low trash generation via the installation of full trash capture devices, or the implementation of other trash management actions equivalent to full trash capture systems?
- Does the level of trash in the receiving water correlate strongly with the conditions of the tributary drainage area of the MS4?

Information generated through Project implementation will be used to address these management questions and therefore help Permittees better understand the effectiveness of control actions currently being implemented. Specific outcomes of Project implementation are expected to include:

- The Project will expand engagement with environmental organizations via the characterization and analysis of trash monitoring data that will inform future trash source control implementation.
- The Project will disseminate the data-driven outcomes and conclusions with Bay Area stakeholders about effective trash controls and monitoring results. Information gained through Project implementation will help the Project partners, Water Board, and EPA to better evaluate trash levels in stormwater discharges and assess whether mandated trash load reduction goals are being achieved.

1.7.2. Action Limits / Levels

The activities encompassed by the WOW receiving water monitoring are intended to support decision making by helping develop and standardize methods for in-stream trash monitoring and trash characterization protocols. Unlike contaminant monitoring projects, there are no quantitative standards / criteria that results of trash monitoring and characterization efforts can be compared against to assess water quality and identify impairments. Therefore, there are no existing action limits to which trash monitoring data will be compared against. Rather, data generated from Project implementation will be used to establish understanding of baseline conditions in different environments that can be used in the future to help assess trash condition in these and other locations.

When practical, field sampling will include collection of water quality measurements. Table 1-5 provides additional information related to the field measurements to be collected for the Project. No national water quality standards apply to these field measurements. The measurement ranges and sensitivities associated with each field parameter (based on information provided in the respective equipment manufacturers identified in Table 2-5) are deemed acceptable to meet the Project objectives.

Table 1-5. Specifications for Receiving Water Monitoring Field Measurements

Measurement	Project Action Limit	Measurement Range	Detection Limit
Velocity	NA	0-20 feet/sec	NA

1.7.3. Measurement Performance Criteria / Acceptance Criteria

The quantitative measurements that estimate the true value or concentration of a physical or chemical property always involve some level of uncertainty. The uncertainty associated with a measurement generally results from one or more of several areas: (1) natural variability of a sample; (2) sample handling conditions and operations; (3) spatial and temporal variation; and (4) variations in collection or analytical procedures. Stringent QA and QC procedures are essential for obtaining unbiased, precise, and representative measurements and for maintaining the integrity of the sample during collection, handling, and analysis, and for measuring elements of variability that cannot be controlled. Stringent procedures also must be applied to data management to assure that accuracy of the data are maintained.

In order to support Project decision-making, data generated must be of known and acceptable quality. To define acceptable data quality for this Project, data quality indicators (DQIs) were identified for each analytical parameter, and decisions were made regarding how each DQI would be assessed. The DQIs include: precision, accuracy/bias, representativeness, comparability, completeness, and sensitivity. The general approach to assessing each DQI is described below. Some DQIs will be assessed quantitatively, while others will be assessed qualitatively. For quantitative assessments, example calculations have been provided. The frequency of the QC samples and the measurement performance criteria for each QC sample for each phase of sample collection and characterization are listed in Table 6-1.

For field measurements, the DQIs to be assessed quantitatively include precision and accuracy alone. The associated acceptance criteria (types & frequencies of QC checks and acceptance limits) for the Project are summarized in Table 6-2.

Precision

Precision is used to measure the degree of mutual agreement among individual measurements of the same property under prescribed similar conditions. Overall precision usually refers to the degree of agreement for the entire sampling, operational, and analysis system and is typically expressed as the relative percent difference (RPD) or relative standard deviation (RSD). Given Project constraints, the assessment of precision will be limited to the characterization phase of implementation. Analytical (or characterization) precision for a given trash category will be assessed from duplicate characterizations of bulk field samples by parties not involved in the original characterization.

Analytical precision is expressed as the RPD for duplicate measurements within a given characterization category:

$$RPD = ABS([X1 - X2] / [(X1 + X2) / 2])$$

Where: X1 = the first sample result
X2 = the duplicate sample result.

Analytical precision will be assessed on a minimum of 5% of all sampling events conducted over the course of Project implementation.

Accuracy / Bias

There are no standards / certified reference materials for trash identification. Therefore, accuracy will not be assessed for the Project. In order to support accurate trash characterizations, collaborating Programs have developed a photo library of representative items for proposed trash categories, included as an appendix to the RWMP (BAMSC 2023).

Representativeness

The representativeness of data is the ability of the sampling locations and the sampling procedures to adequately represent the true condition of the sample sites. Field personnel will strictly adhere to the field sampling protocols in the RWMP to ensure sample representativeness, and prevent sample contamination. The most important aspects of quality control associated with sample collection are as follows:

- Field personnel will be thoroughly trained in the proper use of sample collection equipment and will be able to distinguish acceptable versus unacceptable samples in accordance with pre-established criteria as identified in the Project RWMP.
- Field personnel are trained to recognize and avoid potential sources of sample contamination (e.g., not transferring sampled debris from the trawls to intermediate containers in a controlled environmental and allowing loss or gain of extraneous materials).
- Trash collected associated with a particular monitoring event should represent a significant and known proportion of that sampling event. Given Project constraints (e.g., duration of target storms, staffing safety concerns, budgetary), monitoring will not be expected to be conducted over the duration of larger storms. Monitoring will instead be targeted toward portions of the hydrograph likely to generate greatest trash volumes; deviations from this may be incorporated with approval of Project participants to generate increased understanding of other portions of the hydrograph. In any event, reporting will identify the portion of the hydrograph represented by each monitoring event at each location.
- Our understanding of the representativeness of target sampling methods will be informed by collection of field duplicate samples for a minimum of 5% of sampling events. Duplicate samples will be collected by a second field team operating concurrently with the standard field sample collections, but in a different part of the channel flow (e.g., margins rather than thalweg). This is not a true precision calculation, but rather provides additional understanding into what is represented by characterization results associated with a given sampling event.

Comparability

Comparability is the degree to which data can be compared directly to other relevant studies. For this investigation, sampling and characterization methods were adapted from those employed for similar investigations to sample and characterize trash on land and in receiving waters (e.g., 5 Gyres, Rapid Trash Assessment (RTA) protocol, BASMAA Regional Trash Generation Project, BASMAA Trash Receiving Waters Monitoring Project, BASMAA Tracking California Trash project, Ocean Protection Council (OPC) Trash Playbook).

Completeness

Completeness is defined as the percentage of valid data collected and analyzed compared to the total expected to be obtained under normal operating conditions. Overall completeness accounts for both sampling (field measurements / assessments) and assessment (post-field analyses).

Completeness is expressed as overall completeness for a given parameter for each component of the Project. Under ideal circumstances, the objective is to collect 100 percent of all field samples desired, with successful characterizations on 100 percent of trash samples (including QC samples). However, circumstances surrounding sample collections and handling are influenced by numerous factors, including weather, equipment failure, shipping / transportation damage, and sampling crew error. Any loss due to one of these factors is expected to be made up over the course of the Project. To assess the term quantitatively, % completeness will be calculated by the following equation:

% completeness = (N/T) * 100

Where: N = the number of usable results (i.e., successful sampling events)
T = the number of sample events required for permit compliance

An overall completeness of 100% of the minimum requirement for trash sampling and characterization events by Countywide Program at the end of the Permit term is considered acceptable for the Project in order to achieve MRP 3 permit compliance. A secondary completeness requirement of 90% applies to all other Project-related data collection activities (e.g., flow data).

Sensitivity

For the purpose of this Project, trash is defined as material that cannot pass through a 5 mm mesh screen. Therefore, material smaller than that size is likely to be excluded from characterization efforts. The means for achieving the sensitivity DQI for the Project is by use of sampling devices with maximum 5 mm mesh size for all sampling equipment employed in monitoring. It is understood that micro-particles may be entrained on sampling equipment or trash collected, but this material is not required to be measured or characterized.

For field measurements, the sensitivity is defined by the instrument manufacturer.

1.8. Special Training Requirements / Certification (EPA QA/R-5 A8)

All monitoring fieldwork will be performed by contractor staff that has appropriate levels of experience and expertise to conduct the work, as determined by the MC. As appropriate, a subset of sampling personnel may be required to undergo or have undergone training / certification for use of specific sampling-related equipment.

Additional task-specific training on specific field-related efforts will be provided on an as-needed basis. These may include training on data collection, handling of trawls, and required safety-related information (e.g., handling of potentially hazardous materials).

Staff conducting trash characterization efforts will be trained in the use of the specific characterization protocol and standard operation procedures. The MC will be responsible for maintaining all training records associated with Project implementation.

1.9. Documents and Records (EPA QA/R-5 A9)

Procedures for overall management of Project documents and records are summarized below.

1.9.1. QAPP Distribution

Proposed revisions to the QAPP will be approved by the EPA and Water Board representatives (or their designees).The revised draft QAPP will be accompanied by a memorandum compiling and summarizing the proposed changes and with instructions indicating that the revision supersedes earlier versions of the QAPP. It is the responsibility of the QAO to prepare and maintain amended versions of this QAPP and to distribute the revised QAPP to the individuals listed in Section 1.3.

1.9.2. Field Documentation and Records

In the field, records will be documented in several ways, including field logbooks, photographs, pre-printed forms (such as field datasheets, sample labels, and chain of custody forms), corrective action reports, and field audit checklists and reports. Field activities will be conducted consistent with protocols identified in the RWMP (BAMSC 2024). It is the responsibility of the MC to maintain updated versions of the RWMP and any supporting SOPs at all times, and to distribute updated versions as appropriate. All documentation generated through Project implementation will be maintained by the MC or their designee.

All hard copy field data gathered for the Project are to be recorded in field datasheets (Appendix B) and field notebooks, and scanned or transcribed to electronic documents as needed to permit easy access by Project staff and other appropriate parties. An electronic data form using the Fulcrum application (or equivalent) will be considered as well.

Aspects of the field documentation program are described in more detail below.

Sampling Plans, COCs, and Sampling Reports

Field sampling, handling, and reporting procedures will be conducted in accordance with the RWMP. Field sampling crews will generate records of sample collection and will be responsible for maintaining these records in an accessible manner and submitting to the MC.

Field Datasheets

Field personnel will collect a variety of information in the field to support interpretive efforts, including qualitative assessments of site characteristics, storm-event associated data, and status of all Project-related equipment and its functioning. All field data gathered by this Project will be recorded on standardized field data entry forms and maintained by the MC. The RWMP describes protocols for use with field datasheets or electronic field data forms.

Field Notebooks

In addition to completing field datasheets, sampling personnel will record other relevant information in bound logbooks or using electronic devices. The RWMP describes protocols for use with field logbooks.

Photographic Documentation

Digital photographs will be taken associated with each sampling and characterization event. The photographs will serve to document information recorded into field logbooks and datasheets. The RWMP describes protocols for handling photographic documentation.

Video Documentation

Video will be captured during sampling events, ideally for the entire sampling event. Video will be archived by date and sample location. Video will serve to document water surface trash transport and methods, and likely only used to better understand and interpret anomalies found within the physical trash sampling data. The RWMP describes details of the video sampling procedure.

Labels

All samples collected will be labeled in a clear and precise way for proper identification in the field and for tracking at the dewatering facility. At a minimum, the sample labels will contain the following information: station ID, date, and time of collection. Site IDs are listed in Table 6.1. Details of sample ID naming convention are described within the RWMP.

Field Quality Control Sample Records

All field quality control samples collected (i.e., duplicate samples) will be identified like field samples. The sample ID will be appended with "Duplicate" and the sample location will be identical to the field sample. Sampling personnel shall note the in-stream location of sample collection for the duplicate sample relative to the field sample to distinguish the two (e.g., right bank vs. thalweg).

1.9.3. Characterization Documentation and Records

Separate from the field efforts, trash assessment personnel will be responsible for identifying all trash collected for a given site / event combination consistent with the selected characterization protocol. All characterization data gathered by the Project will be recorded on standardized field data entry forms. The RWMP (BAMSC 2024) includes the datasheet template and describes protocols for use with field datasheets or electronic field data forms. Characterization templates are also contained within Appendix C.

Following conclusion of individual or multi-event characterization efforts, the QAO or their designee will conduct a review of completeness, errors, and general QA/QC. Once this review is completed, all results meeting data quality objectives (DQOs) and results having satisfactory explanations for any identified deviations shall be reported in tabular format on electronic media, in a format modeled upon the EPA Escaped Trash Assessment Protocol (ETAP) reporting spreadsheet.[3]

1.9.4. Quarterly and / or Final Reports

The PM will be responsible for development of quarterly progress updates to EPA to be submitted in January, April, July, and October of each year of Project implementation. The PM will also be responsible for development and submittal of annual financial reports each September of Project implementation and

[3] https://www.epa.gov/trash-free-waters/epas-escaped-trash-assessment-protocol-etap.

a final Grant project report in July 2028.

The PM will also be responsible for development of regional annual reporting products to be submitted to Water Board by March 31st of each year, consistent with implementation of receiving water monitoring provisions of MRP 3.

1.9.5. Project Information Archival

Persons responsible for maintaining records for the Project are shown in Table 1-6. A back-up copy of all electronic records will maintained off-site.

Table 1-6. Document and Record Retention, Archival, and Disposition

Type	Retention (years)	Archival	Disposition
Field Datasheets (hard copy)	5	MC	Recycling
Chain of Custody Forms (hard copy)	5	MC	Recycling
Calibration Logs (hard copy)	5	MC	Recycling
Characterization Datasheets (hard copy)	5	MC	Recycling
Electronic Data	NA	MC/PM	Maintain indefinitely
QAPP, MP, Project Reports	NA	PM	Maintain indefinitely

The MC will oversee the actions of all personnel with records retention responsibilities and will arbitrate any issues relative to records retention and decisions to discard records.

2. Data Generation and Acquisition

The Project is designed to address the Management Questions listed in Section 1.7 and to comply with the monitoring methods prescribed in MRP 3 §C.8.e. Sample locations and the timing of sample collection will be selected using the directed, or targeted, sampling design principle. This is a deterministic approach in which points are selected deliberately based on knowledge of their attributes of interest as related to the environmental site being monitored. Individual monitoring aspects are summarized below and will be described in more detail in the RWMP.

2.1. Sampling Design (Experimental Design) (EPA QA/R-5 B1)

A total of six locations will be sampled three times per year for the Project. All are located in areas that were selected to satisfy a variety of selection criteria, including a bridge or overpass from which to deploy equipment, defensible space for sampling personnel, and location of a nearby flow monitoring station. Monitoring locations are summarized in Table 2-1, shown in Figure 2-1, and described in detail in the RWMP (BAMSC 2024).

All samples will be collected as integrated samples collected over the course of a multi-hour sampling event during wet weather. Monitoring personnel will select sampling events and duration to meet criteria identified in the RWMP (BAMSC 2024). Mobilization time for each individual sampling activity will be used to conduct all the preparations and training sessions needed to get the field crews ready and equipped. The sampling events will be conducted at varying frequencies and times dependent on Project needs and requirements; exact timing will be determined based upon Project needs, weather conditions, equipment functionality, and catchment characteristics. Sampling events may be concluded by either changing environmental conditions (e.g., return to base flow), safety concerns, or budgetary concerns.

Immediately after conclusion of individual sampling events, samples will be returned to a secure location for dewatering. Once sample material has dried sufficiently to allow for processing, sampling personnel will separate trash from vegetative debris. Sampling personnel will then measure the volume of vegetative debris and dispose of appropriately. Sampling personnel will then place collected trash in a secure sample container(s) until time of characterization.

Trash characterization efforts will be coordinated with outfall trash monitoring efforts detailed in MRP 3 Provision C.8.e.iii(1), anticipated to be conducted at annual characterization efforts accessible to the general public, and the above-mentioned reporting products will provide and interpret findings of characterization efforts. The RWMP will provide additional detail on each of these activities.

Table 2-1. Prospective Monitoring Locations

Site ID	Channel	County	Upstream Watershed Size (ac)	Rationale for Sampling Design
SC-LPA	Lower Penitencia Creek	Santa Clara	2,748	Bridge near existing stream gage, suitable for sampling receiving water, no known direct discharge trash sources in tributary drainage area.
SC_ADO	Adobe Creek	Santa Clara	6,752	Bridge near existing stream gage, suitable for sampling receiving water, no known direct discharge trash sources in tributary drainage area.
SM-COL	Colma Creek	San Mateo	7,834	Bridge near existing stream gage, suitable for sampling receiving water, no known direct discharge trash sources in tributary drainage area. Previously sampled for trash by 5 Gyres 10 years ago.
CC_ROD	Rodeo Creek	Contra Costa	6,252	Bridge near existing stream gage, suitable for sampling receiving water, no known direct discharge trash sources in tributary drainage area.
AC_CRA	Crandall Creek	Alameda	2,769	Bridge near existing stream gage, suitable for sampling receiving water, no known direct discharge trash sources in tributary drainage area.
AC_ALM	Alamo Canal	Alameda	18,362	Bridge near existing stream gage, suitable for sampling receiving water, no known direct discharge trash sources in tributary drainage area. Co-located with outfall monitoring site in same creek.

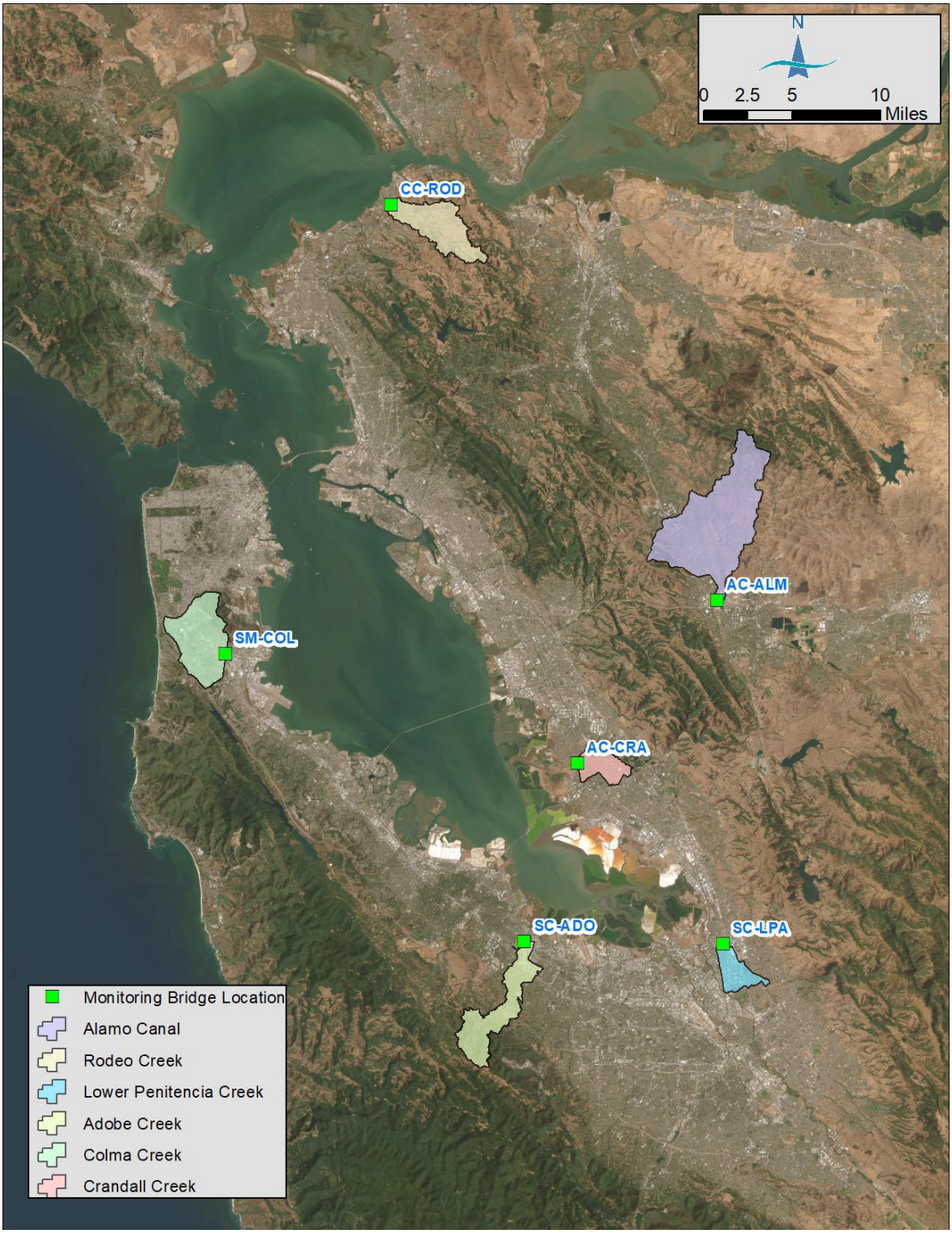


Figure 2-1. Receiving Water Trash Monitoring Sites

2.1.1. Sampling Rationale

Project operations will be conducted in selected watersheds within the San Francisco Bay region, within the counties of Alameda, Contra Costa, San Mateo, and Santa Clara. Sites selected for Project implementation were identified through a rigorous review process that canvassed Project participants and identified a small number of sites throughout the region that achieved specific criteria, such as accessibility, defensible space for sampling personnel, location of sampling setup relative to water level, and availability of proximate flow monitoring station among others; full details of the selection process are available in the RWMP. Rationale for inclusion of each monitoring location is described below by MRP 3 stormwater Program and individual monitoring location.

ACCWP

ACCWP Project-related activities will be conducted at two locations within the cities of Dublin and Fremont. The first site, (AC-ALM), located on Alamo Canal, drains an approximately 18,362 acre watershed area that includes a small area of City of Dublin in Alameda County and the City of San Ramon in Contra Costa County. The upper watershed includes undeveloped areas within unincorporated Contra Costa County (Figure 2-1). The watershed area is 58% urban land uses. For just the urban portion of the watershed area, the baseline trash generation rates are approximately 97% low, 2% moderate, and 1% very high. A total of 10% of the watershed area is controlled to a low trash designation using full trash capture systems; less than 1% is controlled by high-flow capacity systems, 3% is controlled by catch basin inserts, and 6% is controlled by multi-benefit stormwater treatment systems.

The second site (AC-CRA), located on Crandall Creek, drains an approximately 2,769-acre watershed just south of Alameda Creek (Figure 2-1). Land use in the watershed comprises 91% urban land use by area. For just the urban portion of the watershed area, the baseline trash generation rates are approximately 81% low, 13% moderate, 3% high, and 3% very high. A total of 15% of the watershed area is controlled to a low trash designation using full trash capture systems; all full trash capture is accomplished through use of catch basin inserts. All FTC areas are within jurisdictional area.

CCCWP

Site CC-ROD, located on Rodeo Creek at Hawthorne Drive, drains an approximately 6,252-acre watershed area in Rodeo and the surrounding open space to the east (Figure 2-1). The watershed area is 32% urban land uses. For just the urban portion of the watershed area, the baseline trash generation rates are approximately 89% low, 2% moderate, 1% high, and 8% very high. Approximately 72% of the trash generation rates greater than low are located in non-jurisdictional areas. Less than 1% of the watershed area is controlled to a low trash designation using full trash capture systems; 100% of full trash capture devices is through use of catch basin inserts and connector pipe screens. All FTC areas are within jurisdictional area.

SMCWPPP

SMCWPPP Project-related activities will be conducted at one location (SM-COL) on Colma Creek at Orange Ave. in South San Francisco (Figure 2-1). The upstream drainage area, approximately 7,834-acres, drains portions of South San Francisco, Colma, Daly City, and San Bruno Mountain. The watershed area is 83% urban land uses. For just the urban portion of the watershed area, the baseline trash generation rates are approximately 74% low, 14% moderate, 7% high, and 5% very high. A total of 13%

of the watershed area is controlled to a low trash designation using full trash capture systems; less than 1% is controlled by high-flow capacity systems, 12% controlled by catch basin inserts, and less than 1% controlled by multi-benefit stormwater treatment systems.

SCVURPPP

SCVURPPP Project-related activities will be conducted at two locations within the cities of Milpitas and Palo Alto. Site SC-LPA, located on Lower Penitencia Creek at Machado Avenue, encompasses an approximately 2,748-acre watershed area in Milpitas and Northern San Jose (Figure 2-1). The watershed area is 100% urban land uses. For just the urban portion of the watershed area, the baseline trash generation rates are approximately 69% low, 25% moderate, 2% high, and 3% very high. A total of 6% of the watershed area is controlled to a low trash designation using full trash capture systems; with 5% of the overall area controlled by catch basin inserts, and 1% controlled by multi-benefit stormwater treatment systems.

Site SC-ADO, located on Adobe Creek at Middlefield Road, encompasses an approximately 6,854-acre watershed area in Palo Alto and the Santa Cruz Mountains to the south (Figure 2-1. The watershed area is 60% urban land uses. For just the urban portion of the watershed area, the baseline trash generation rates are approximately 84% low, 11% moderate, 4% high, and 2% very high. A total of 7% of the watershed area is controlled to a low trash designation using full trash capture systems; 6% is controlled by high-flow capacity systems, less than 1% controlled by catch basin inserts, and less than 1% controlled by multi-benefit stormwater treatment systems.

2.1.2. Sampling Detail

The Project will include deployment of weighted box trawl (or similar) devices with removable 5 mm mesh netting from bridges / overpasses above target receiving water monitoring locations (or deployed by hand in moderate flow conditions). The Project will monitor a prescribed number of storm events per monitoring year as summarized in Table 2-2; if the minimum number of storms is unable to be achieved in a given year due to lack of rainfall or other factors, it may be made up in successive monitoring years.

Table 2-2. Minimum Annual Level of Monitoring Effort by County.

County	Min. # of Sites	Min. # of Wet Weather Monitoring Events per site per year[1,2]
Alameda	2	3
Contra Costa	1	3
San Mateo	1	3
Santa Clara	2	3
Solano	0	0

Notes: [1]Subject to availability of a minimum number of qualifying storm events
[2]Duplicate samples will be collected at a minimum of 5% of sample events conducted per year

Data collection efforts will include quantitative assessments of trash collected through trawling efforts associated with individual storm events. Data collection efforts will also incorporate flow measurement data collected over the course of the wet season to allow extrapolation of volume of trash from individual monitoring events to total outflow from a given catchment. Flow data will be obtained from publicly-accessible flow measurement data available for each sampling site (see section 2.9) and short-term velocity measurements may also be collected associated with sampling events as conditions allow.

2.1.3. Constraints

Delays in regulatory permitting, equipment procurement, and emergency / unforeseen construction problems impacting access to the planned monitoring locations for a given storm, vandalism or equipment failure at flow gages, or unanticipated safety concerns could result in fewer locations or samples being reported in a given year or across the permit term.

Another constraint is the uncertainty associated with sampling wet weather events. This Project is complicated by the uncertain relationship between precipitation pattern, timing, and intensity and the onset and duration of elevated flow at the Project stations. Communication with the MC will limit the probability of false starts, but due to the nature of the station set up, number of personnel required, and equipment availability, go / no-go decisions may need to be made several days in advance of the storm events. First flush events may also happen before the start of a given water year. Storms that are predicted as design storm events may also not present in that manner. Given that three storm events per year are required, the Project team will err on the side of caution in selection of storm events, prioritizing completing sampling of three events over waiting for near certainty in selection of a design storm.

A final constraint is monitoring blackout dates surrounding holidays when monitoring will not take place despite the presence of a qualifying storm event. Following are the typical wet season monitoring blackout periods:

- Thanksgiving holiday (Wednesday through Sunday)
- Christmas / New Year's Day holiday period (Christmas Eve through New Year's Day)
- President's Day Weekend (Saturday and Sunday)
- Easter Weekend (Saturday and Sunday)

2.2. Sampling Methods (EPA QA/R-5 B2)

2.2.1. Sampling Error

There are multiple sources of potential sampling uncertainty associated with the Project, including: (1) measurement error; (2) natural (inherent) variability; (3) sample misrepresentation (or poor representativeness); and (4) sampling bias (statistical meaning). Measures incorporated to address these areas of uncertainty are discussed below:

(1) Measurement error combines all sources of error related to the entire sampling and analysis process (i.e., to the measurement system). All aspects of dealing with uncertainty due to measurement error are described elsewhere within this QAPP.

(2) Natural (inherent) variability occurs in any environment monitored, and is often much wider than the measurement error. Previous studies have demonstrated the high degree of variability in environmental media and especially the heterogeneous nature of stormwater runoff and trash load it transports. This will be taken into consideration when interpreting results of the monitoring.

(3) Sample misrepresentation happens at the level of an individual sample or field measurement where an individual sample collected or measurement taken is a poor representative for overall conditions encountered. This will be taken into consideration when interpreting results of the monitoring.

(4) Sampling bias relates to the sampling design employed and whether the appropriate statistical design is employed to allow for appropriate understanding of environmental conditions. To a large degree, the sampling design required for the Project is judgmental, which will therefore incorporate an unknown degree of sampling bias into the Project. This bias will need to be taken into consideration when interpreting results of the various investigations.

Further detail on measures implemented to reduce uncertainty will be described in the Project literature review on (Donaldson and Owens, 2024) and RWMP.

2.2.2. Field Health and Safety Procedures

A Project-specific Health and Safety Plan (HSP) has been prepared and is included as Appendix E.

2.2.3. Trash Sample Collection

The Project involves the collection of trash samples in receiving waters (i.e., creeks and flood control channels) associated with storm events that produce appreciable runoff. These methods are summarized below and presented in more detail in the RWMP (BAMSC 2024). To the extent practicable, the Project will utilize previously-developed Standard Operating Procedures (SOPs) (Table 2-3) to reflect understanding gained through previous, related projects. If an SOP is updated or revised, the updated or revised SOP will be used for the subsequent sampling event(s). Any revisions to the SOPs will be documented in an amendment to the QAPP.

SOPs expected to be used as part of implementation and are included in Table 2-3.

Table 2-3. List of Project SOPs

SOP	Location
Standard Operating Procedure for Trash Characterization	Appendix C
Outfall and Receiving Water Trash Characterization Photo Library	Appendix F

In addition, contractor-specific plans and procedures may be required for specific aspects of Project implementation (e.g., health and safety plans, disposal procedures for hazardous items). Prior to initiation of monitoring events, field staff will collect measurements at the sampling locations and install durable equipment required to support receiving water monitoring activities.

The MRP identifies the need to include monitoring of the first significant storm event of each water year, as well as one storm per year forecast to exceed the full capture design standard storm (i.e., one-year, one-hour storm event), and must be preceded by at least 48 hours of limited or no trash discharge.

Balance, in coordination with EOA, will review the relevant weather forecasting tools, including National Weather Service forecasts (http://www.weather.gov/), and track potential rainfall events. The type of storm that is targeted for a particular sampling event may vary based on the characteristics of the tributary drainage area, the prior storms monitored at a given location, information gained through previous monitoring, or other factors.

In general, the Project will follow these guidelines to target storms for receiving water monitoring:

1. Quantitative precipitation forecast (QPF) of approximately 0.25 inches or greater over a 6-hour period, even if the prior 6-hour contiguous period has precipitation, but less than 0.25 inches;
2. Probability of precipitation (POP) of 70% or greater; and
3. Antecedent dry period of approximately 48 hours or greater (defined as no separate event exceeding 0.1 inches of cumulative rainfall within a 24-hour period).

While the Program aims to target one "full trash capture design standard storm" per year forecasted to exceed the design standard at each station, the uncertainties related to wet years and dry years, as well as weather forecasting, may preclude collection of these events on an annual basis.

Once a target storm has been identified, receiving water trash samples will be collected from during storm events using a Modified Weighted Box Trawl (Box Trawl) with 18-inch opening. The trawl will be suspended from a bridge using a USGS Type A bridge crane and a USGS A-55 sounding reel (or similar). A 10- to 12-foot-long net with a 5mm mesh size will be attached to the trawl. Upon conclusion of a sampling event, samples will be transferred to mesh nets for transportation and storage before being characterized.

See BAMSC 2024 for additional detail on sampling techniques. A summary of field sample collections is provided in Table 2-4 below.

2.2.4. Velocity Measurements

Velocity measurements will be made using float test methods[4]. Float tests involve using a stopwatch to time neutrally buoyant biodegradable markers, often oranges, placed in the channel over a known length of channel. Float tests will occur while the trawl is in the water, or directly before or after, depending on the amount of time the trawl is in the water (e.g., high trash loads may result in short deployment times that do not allow enough time to perform float tests while the trawl is in the water). Laterally across the channel, float tests will occur directly adjacent to the area of the trawl (ideally with between one and five feet from the trawl) so as to collect velocity data that is representative of the velocity at the trawl opening. Longitudinally along the channel, the measured distance over which the markers are timed should pass through the location of the trawl or start near the location of the trawl. Float tests will be performed three times, and the resulting velocity from each float test will be averaged. For mid-column samples, a multiplier will be used to convert surface velocity to an estimate of velocity at the box trawl depth.

2.2.5. Flow Measurements

For five of the initial sample sites, discharge records will be obtained for the Project from publicly-accessible flow gaging stations. One site, Adobe Creek at Middlefield Road, is located approximately 5500 feet downstream of the nearest publicly-operated streamflow gaging station. At that station Balance will establish a temporary streamflow gaging station using the existing station infrastructure and stage-streamflow rating curve (Gage was recently relocated but stilling wells remain in place and rating curve is still applicable). Details are provided in Section 2.9 describing non direct measurements.

2.2.6. Sample Equipment Cleaning

Nets should be inspected for accumulated trash, rips, or wear as they are emptied into temporary storage containers, and again prior to re-installation for each successive sampling event. Field staff should follow

[4] Measurements would ideally be made with a velocity meter attached to a long pole, however bridge heights preclude safe use of a meter on a pole and 5 Gyres found that mounting the flow meter on the trawl did not function accurately or reliably due to fouling by trash.

manufacturer's recommendations provided for cleaning and inspection to best ensure viability of the product.

2.2.7. Field Variances

As conditions in the field dictate, it may become necessary to implement minor modifications to the sampling procedures and protocols described in this QAPP. If and when this is necessary, the PM will notify the QAO of the situation and the situation will be reviewed as a potential one-off or finding requiring modification to the RWMP or QAPP. Depending on the magnitude of the modification(s), the PM may also be required to notify the WB Liaison. The PM will include documentation of modifications in Quarterly Reports to GPM.

2.2.8. Disposal of Residual Waste

In the process of collecting trash samples for the Project, various types of waste will be generated, which may include the following:

- Used PPE
- Biohazards
- Disposable containers or equipment
- Vegetative debris

EPA's National Contingency Plan requires that management of the wastes generated during sampling comply with all applicable or relevant and appropriate requirements to the extent practicable. Residuals generated for this project will be handled in a manner consistent with the Office of Emergency and Remedial Response (OERR) Directive 9345.3-02 (May 1991), which provides the guidance for the management of wastes. In addition, other legal and practical considerations that may affect the handling of the wastes will be considered, as follows:

- Used PPE and disposable containers / equipment will be double-bagged and placed in a municipal refuse dumpster. These wastes are not considered hazardous and can be sent to a municipal landfall.
- Biohazards will be stored temporarily in leak-proof containers intended for this usage. Biohazards will then be disposed of properly at an appropriate disposal site per local regulations.
- Vegetative debris is not considered hazardous and can be sent to a municipal composting facility.

2.2.9. Collection of Field QC Samples

The Project will attempt to collect duplicate samples for a minimum of 5% of measurements, if feasible. Duplicate samples will consist of concurrent sampling conducted during one event at one location per year. A second sampling team will collect replicate samples at the same times and approximate depths (surface or mid-column) as the original sampling team during the event, adjacent to the sampler deployed by the original team but at a location approximately half-way between the original sampler and the edge of water.

Table 2-4. Minimum Number of Field and QC Samples to be Collected Annually

Matrix	Analysis	No of sampling locations	No. of Sampling Events	No. of Field Replicate Events	Total # of Samples	Comment
Trash (>5 mm)	Trash Characterization	6	3	1	19	Field duplicate location to be rotated over course of Project

2.3. Sample Handling and Custody (EPA QA/R-5 B3)

Unlike many water quality monitoring projects, there is no requirement for sampling containers to be non-contaminating (other than being free of waste prior to usage). Sampling containers will be sized to fit material accumulating at a given site / event combination and will only be required to have the integrity to store the sampled material without loss and free of debris that could be confused with accumulated material. Field staff will be responsible for ensuring integrity of the containers. If sampling containers lose their integrity during the sample handling process they will be discarded and replaced with a spare container. Examples of sample COC forms are included in Appendix B. Details of sampling containers to store field samples prior to characterization are identified in the RWMP.

2.3.1. Sample ID Numbers

Every sample must have a unique sample number so that the analytical results from each sample can be differentiated from every other sample. This information should follow the sample through the chain-of-custody (COC), assessment, and interpretation and reporting processes. The naming convention is described within the RWMP.

2.3.2. Responsibility and Corrective Actions

If monitoring equipment fails, sampling personnel will report the problem in the comments section of their field notes and will not record data values for the variables in question. Actions will be taken to replace or repair broken equipment as soon as possible after their identification. For custom-manufactured equipment, extra units will be ordered at the outset of the project.

2.4. Analytical Methods (EPA QA/R-5 B4)

Trash characterization methodology is described in the previously-referenced SOP (Appendix C).

2.5. Quality Control Requirements (EPA QA/R-5 B5)

Data collected during Project implementation fall in two main categories: (1) trash characterization and (2) velocity measurement. Quality control aspects for each facet of monitoring are discussed in detail in the sections that fallow.

2.5.1. Trash Characterization Quality Control

Trash characterization QC samples must satisfy Project MQOs and frequency requirements. MQOs are specified in Appendix A. Due to the relatively small number of samples generated for the Project and

anticipated number of characterization events, frequency requirements are completed on an annual basis for the entire Project. Different aspects of the trash characterization QC program are summarized below.

Calibration, Volumetric

For trash volumetric measurements recorded as a part of Project implementation, Project-related measurement tools will be specified and employed as a means of incorporating measurement consistency over time. Given the variation in catchment sizes represented within the overall Project and the number of trash categories to be assessed, there is likely to be a range of volumetric measurement tools required to support implementation. Therefore, for all characterization efforts, Project personnel will have available a variety of containers for obtaining measurements. These will range in size from 100 mL graduated cylinders to 5-gallon (approx. 19 L) buckets. For those containers that do not contain internal measurement gradations, staff performing characterizations will estimate category volumes by measuring depth of accumulated trash in the container as a proportion of overall depth and apply in proportion to container volume (e.g., a container filled to 60% of its depth will generate a volumetric measurement estimated as 60% of its capacity). Trash will not be compacted prior to collecting measurements. For larger trash items with known volumes (e.g., plastic bottles, cups), the container volume is multiplied by the number of items in the sample. These volumes are then added to the volume of smaller items that were measured using the bucket method described above. Characterization staff will use the Trash Characterization Data Collection Form to record the total volume of each trash category.

Field Replicate Assessments

The Project will adopt the same terminology as SWAMP in defining replicate samples, wherein replicate analyses are distinguished from duplicate analyses based simply on the number of involved analyses. Duplicate analyses refer to two sample preparations, while replicate analyses refer to three or more.

Field duplicate analyses will be conducted on specific site / event combinations at a frequency identified in Appendix A. As described previously, a separate sampling team from the one collecting standard field sample will be responsible for collecting duplicate samples. As there is no expectation that the trash generated from the field duplicate will mimic that of the field sample, there are no control limits applied for comparison of the two samples. This information is to be used for interpretive purposes only and may be used to inform modifications to future Project sampling events.

Laboratory Replicate Assessments

Duplicate analyses / characterizations will be conducted on specific site / event combinations at a frequency identified in Appendix A. A separate assessment team from the one conducting initial analyses will be responsible for conducting duplicate analyses. Assuming replicate analyses meet Project requirements for precision, the results from the original analysis will be used for interpretative purposes.

2.5.2. Velocity Measurement Quality Control

Field QC results must meet the MQOs and frequency requirements specified in Appendix A, where frequency requirements are provided. Specific field quality control samples may also be required by the method or SOP selected for sample collection and analysis. If Project MQOs conflict with those prescribed in the utilized method or SOP, the more rigorous of the objectives must be met.

Currently, the Project anticipates utilizing the float test method for collecting stream velocity data during trash sampling at all sites, and a USGS AA velocimeter for collecting flow measurements at Adobe Creek. Prior to initial measurement, utilized instruments must be calibrated following the procedures outlined in the relevant manufacturer's user manual or SOP. Each reference must specify acceptance criteria that demonstrate instrument stability and an acceptable calibration. If instrument calibration does not meet the specified acceptance criteria, the measurement process is not in control and must be halted. The instrument must be successfully recalibrated before collecting measurements.

2.5.3. Field Corrective Action

The field organization is responsible for responding to failures in their sampling and field measurement systems. If monitoring equipment fails, personnel are to record the problem according to their documentation protocols. Failing equipment must be replaced or repaired prior to subsequent sampling events (or as soon as possible for continuous measurements). It is the combined responsibility of all members of the field team organization to determine if the performance requirements of the specific sampling method have been met, and to collect additional samples if necessary.

2.6. Instrument/Equipment Testing, Inspection and Maintenance (EPA QA/R-5 B6)

Any field measurement equipment used will be checked for operation in accordance with manufacturer's specifications. This includes battery checks and routine replacement and cleaning of parts as specified by the manufacturer. All equipment will be inspected for damage when first employed and again when returned from use. As required, maintenance logs will be kept and each piece of equipment will have its own log that documents the dates and description of observed problems, the action(s) taken to correct problem(s), maintenance procedures, system checks, follow-up maintenance dates, and the person responsible for maintaining the equipment. A list of anticipated field measurement equipment to be used for Project monitoring is shown in Table 2-5. The RWMP will describe in detail what equipment will be used and the testing, inspection, and maintenance of the associated equipment.

Table 2-5. Testing, Inspection and Maintenance of Field Sampling Equipment

Instrument / Equipment	Test / Maintenance	Frequency of Checking	Responsible Person
Velocity Measurement – USGS AA velocimeter	Spin test	Before each deployment	Field team lead for each site
Pressure transducer	Battery check	Before deployment, every download	Field team lead for each site
Weighted Box Trawl	Net security and attachment	Before and after each deployment	Field team lead for each site
Weighted Box Trawl	Net integrity (holes, tears, etc.)	Before and after each deployment	Field team lead for each site
Bridge Crane	Mechanical integrity	Before and after each deployment	Field team lead for each site
Bridge Crane	Reel, confirm release and brake are functioning	Before each deployment	Field team lead for each site

2.7. Instrument / Equipment Calibration and Frequency (EPA QA/R-5 B7)

2.7.1. Field Measurements

Any monitoring equipment used should be visually inspected during mobilization to identify problems that would result in loss of data. The RWMP will describe calibration of the flow monitoring equipment used for the Project.

2.7.2. Laboratory Analyses

Not applicable.

2.8. Inspection/Acceptance Requirements for Supplies and Consumables (EPA QA/R-5 B8)

Each sampling and characterization event conducted for Project will require use of appropriate consumables to maintain the integrity of samples and safety of sampling personnel. The MC or their designee will be responsible for ensuring that all supplies are appropriate prior to their use. Inspection requirements for sampling consumables and supplies are summarized in Table 2-6.

Table 2-6. Inspection / Acceptance Testing Requirements for Consumables and Supplies

Project-related Supplies	Inspection / Testing Specifications	Acceptance Criteria	Frequency	Responsible Person Sampling Containers
Box Trawl	Visual	No evident damage	Each purchase and use	MC
Consumables	Visual	No evident contamination or damage	Each purchase and use	MC

2.9. Data Acquisition Requirements (Non Direct Measurements) (EPA QA/R-5 B9)

In order to apply findings from sampled storm events to seasonal loading estimates, the Project will make use of data generated through existing flow gaging stations operating by Project participants or third parties. A list of prospective monitoring stations and their associated flow monitoring station is included in Table 2-7.

At the Adobe Creek at Middlefield Road station, Balance will re-occupy (install equipment and manage data at) the streamflow gaging station previously operated by Valley Water, but no longer in use. Balance will use supplemental data from this re-established station at Middlefield Road to develop a record of flow that will be used in combination with correlated flow from Valley Water's station on Adobe Creek at El Camino Real (Sensor 5135) to refine the record of flow at Middlefield Road.

Balance will install two self-contained pressure transducers along with a self-contained barometric pressure logger. Water levels will be measured using two pressure transducers located in the Adobe Creek

channel (less the barometric pressure signal). Water levels will be adjusted to staff plate elevations using observations taken during trash sampling. Valley Water operated the gage for many years and has a stage-discharge rating curve which will be used to convert stage to discharge. Balance will perform up to two additional (non-trash sampling) visits per year to collect staff height measurements and measure flow, likely using a Price AA meter and wading rod (Following methods in Rantz 1982). These measurements will be used to confirm and/or potentially adjust the existing Valley Water stage-discharge rating curve for the site. The gaging effort at Middlefield Road will focus on moderate flows using methods laid out in Rantz (1982). As a QA/QC step, the Valley Water owned gage on Adobe Creek near El Camino will be compared to the flow data derived by the station Balance establishes at Middlefield Road.

Table 2-7. Flow Gage Data Sources for Project Implementation

County	Site ID	Sample Location	Flow Gage ID	Flow Gage Source
Alameda	AC-CRA	Crandall Creek at Access Road, Fremont	Crandall Creek at Deep Creek Road	Alameda County Flood Control District
Alameda	AC-ALM	Alamo Canal at Dublin Boulevard, Dublin	Alamo Canal near Pleasanton and Line J below Dublin Boulevard	Zone 7 Water Agency
Contra Costa	CC-ROD	Rodeo Creek at Hawthorne, Rodeo	Rodeo Creek at Hawthorne	Contra Costa County Flood Control District
San Mateo	SM-COL	Colma Creek and West Orange Avenue, South San Francisco	Colma Creek at W. Orange Avenue	City of South San Francisco (Formerly USGS gage location)
Santa Clara	SC-LPA	Lower Penitencia Creek at Machado Avenue, Milpitas	Lower Penitencia Creek at Machado (Sensor 5000.1) – Valley Water	Valley Water (Sensor 5000.1)
Santa Clara	SC-ADO	Adobe Creek at Middlefield Road, Palo Alto/Mountain View	Adobe Creek at El Camino Real (Sensor 5135) – Valley Water	Valley Water (Sensor 5135)

Notes
[1] Streamflow will be estimated by subtracting flows at Line J from that at Alamo Canal near Pleasanton, and scaling the flow to Dublin Boulevard. Line J is on a tributary to Alamo Canal very near Dublin Boulevard.

2.10. Data Management (EPA QA/R-5 B10)

The MC or their designee will be responsible for management of all data generated in the field and laboratory throughout the data collection, management, and reporting process for the Project.

2.10.1. Field Data Management

Record keeping of field measurement data for the Project will employ standard record-keeping and tracking practices. Manual field measurements will be entered in bound log books and/or field datasheets while in the field, or equivalent electronic devices; relevant field measurement data will be entered into an Excel file and then quality control (QC) checked for entry errors by a different person. Backup copies of all data files will be made by the person performing data entry on the same day that the files were generated or that changes were made to them.

Field measurement data entered into electronic devices will be downloaded in Excel format and then QC checked by field personnel familiar with the data that was collected. Following processing, electronic field data will be transferred to the MC for archival.

2.10.2. Trash Characterization Data Management

Record keeping of characterization data for the Project will employ standard record-keeping and tracking practices. All characterization data will be manually recorded on standardized worksheets, or entered directly into equivalent electronic devices. All manually-recorded data will be transferred to Excel worksheets as soon as possible following characterization activities. All characterization data will be manually checked for data entry errors before forwarding to the MC for archival.

Field datasheets employed for the Project are formatted consistent with a Microsoft Excel® spreadsheet that is used for electronic data entry. Once data are entered into the spreadsheet and assigned an appropriate event code (consisting of site ID + date), the MC will be responsible for short-term storage and long-term archival of data. A compilation of all Project characterization data will be generated using R Studio code, running R version 4.0.2 (R Core Team 2020) to include data for all monitoring events into a single password-protected Excel® spreadsheet.

Video recorded during sampling events will be archived and referenced when trash sampling data present anomalies. When videos are reviewed, video logs will be created with timestamps (local and video) and notes will accompany relevant timestamps.

3. Assessment and Oversight

3.1. Assessments / Oversight and Response Actions (EPA QA/R-5 C1)

As Project sampling activities are anticipated to involve working in potentially hazardous conditions (storm events, high flow conditions, night time, etc.), any Project participant will have the authority to issue stop work orders at any time as conditions dictate.

Specific aspects of assessments and oversight are described below. Identified deficiencies at any stage of Project implementation will be documented in a Corrective and Preventative Action Report (CPAR, see template in Appendix B), which will be submitted to the PM and QAO (if not generated by the QAO).

3.1.1. Mobilization

The MC or their designee will review field equipment, instruments, containers, and paperwork to ensure that everything is ready prior to each sampling event. Sampling personnel will be given a brief review of the goals and objectives of the sampling event and the sampling procedures and equipment that will be used to achieve them. It is important that field equipment be prepped and ready to use when it is needed. Therefore, prior to using sampling and field measurement equipment, each piece of equipment will be checked to affirm that it is in proper working order. Equipment maintenance records will be checked to ensure that all field instruments have been properly maintained and that they are ready for use. Essential items (e.g., datasheets, laptop, labels, waterproof pens) will be checked before each field event to affirm that there are sufficient supplies to successfully support each sampling event.

It is important that all field activities and measurements are properly recorded in the field. Therefore, prior to starting each field event, necessary paperwork such as logbooks and chain of custody forms will be checked to ensure that sufficient amounts are available for the field event. In the event that a problem is discovered during mobilization it will be noted in the field logbook and corrected before the field crew is deployed. The actions taken to correct the problem will also be documented in the field logbook.

3.1.2. Field Audits

During a minimum of 5% of sampling events and at least once annually, the QAO will conduct a field audit to assess the sample collection methodologies, field measurement procedures, and record keeping of the field team to ensure that activities are being conducted as planned per the RWMP and this QAPP. Any deviations identified will be corrected immediately to the extent possible. The QAO will have the authority to stop any sampling activities that could potentially compromise data quality. Findings from field audits will be reported in writing to the PM in a Field Audit Report.

3.1.3. Demobilization

At the conclusion of field sampling events, the MC should debrief sampling personnel and, as necessary, document any problems that arose during sampling activities, along with recommendations for correcting the problem(s). These reviews will ensure that any deviations from planned methodologies are documented and addressed.

3.2. Project Data Reviews

The MC or their designee will be responsible for reviewing flow and trash characterization data for completeness and performance against Project MQOs. The data will also be checked to affirm that appropriate methods were used and that all required QC data are available. Data reviews will be conducted following receipt of each data package to ensure that all information is complete and any deviations from planned methodologies are either corrected or the reasons for deviations are documented. Any data that is discovered to be incorrect or missing will immediately be reported to the both the MC and respective SPM. The SPM and MC have the authority to request re-processing of any data if the review reveals any factors that would compromise the quality of the data and resulting conclusions from the Project or MRP 3 permit compliance for a given stormwater Program.

3.3. Reports to Management (EPA QA/R-5 C2)

The anticipated reporting requirements associated with the Project are described below and summarized in Table 3-1. The MC is expected to stay in close communication with PM and SPMs on Project progress, but no formal reporting mechanisms are required to document that communication.

3.3.1. Data Delivery

Results of characterization process will be delivered by each assessment team to the MC at the conclusion of each assessment effort. The QAO shall review the draft results against QAPP requirements and identify deficiencies requiring resolution. At the point where there are no remaining QA concerns, the reporting template will be considered final and will be submitted to PM.

Velocity measurement data will be delivered by field team staff to the MC at the conclusion of each monitored event or periodic time interval as appropriate. The MC or their designee shall review the draft results against QAPP requirements and identify deficiencies requiring resolution. At the point where there are no remaining QA concerns, the reporting template will be considered final and able to be used for interpretative purposes in Project reports.

3.3.2. Progress Reports

Progress reports pursuant to MRP 3 Provision C.8.e will be reported annually through the updates submitted by each Program as part of UCMR and IMR reporting requirements. Financial and progress reports developed for EPA will be submitted on a schedule consistent with Grant Project requirements. This information is summarized in Table 3-1 below. Draft or final reports may also be made available upon request to Project participants not listed below, including municipalities and TAG members.

Table 3-1. Reports to Management

Type of Report	Frequency	Projected Delivery Dates(s)	Person(s) Responsible for Report Preparation	Report Recipients
Grant quarterly reports	Quarterly	Jan, April, July, Oct of each Project Year	MC	GPM
Annual federal financial report	Annually	Sept of each Project year	MC	GPM
Interim progress reports (UCMR)	Annual	March 31st of each monitoring year (except 2026)	SPM	WB
Integrated Monitoring Report (IMR)	Once	March 31, 2026	SPM	WB
Final Grant report	Once	July 2028	MC	GPM

4. Data Review and Usability

4.1. Data Review, Verification, and Validation Requirements (EPA QA/R-5 D1)

Defining data review, verification, and validation procedures helps to ensure that Project data will be reviewed in an objective and consistent manner. Data review is the in-house examination to ensure that the data have been recorded, transmitted, and processed correctly. The MC will assign a designee responsible for data review. This includes checking that all technical criteria have been met, documenting any problems that are observed and, if possible, ensuring that deficiencies noted in the data are corrected.

In-house examination of Project data will be conducted to check for typical types of errors. This includes checking to make sure that the data have been recorded, transmitted, and processed correctly. The kinds of checks that will be made will include checking for data entry errors, transcription errors, transformation errors, calculation errors, and errors of data omission.

Data generated by Project activities will be reviewed against MQOs that were developed and documented in Appendix A.

QA/QC requirements are documented in Section 1.7 and the data will be checked against this information. Checks will include evaluation of duplicate analyses for trash characterizations and standard checks on field measurement data for flow measurements.

Field data consists of all recorded information obtained during sample collection and field measurements, including that documented in field log books and/or recording equipment, photographs, and chain of custody forms. Checks of field data will be made to ensure that it is complete, consistent, and meets the data management requirements documented in Section 1.9.

Data verification is the process of evaluating the completeness, correctness, and conformance / compliance of a specific data set against the method, procedural, or contractual specifications. The Project will conduct independent data verification, as described in Section 2.5.

Data validation is a process that evaluates the information after the verification process to determine data quality and any limitations. Data validation evaluates whether data are of acceptable quality with respect to the intended end use as described in Section 1.7.1 (Objectives and Project Decisions).

Data will be separated into three categories: (1) data that meet all acceptance requirements, (2) data determined unacceptable for use, and (3) data that may be conditionally used and but are qualified as to their deficiencies.

4.2. Verification and Validation Methods (EPA QA/R-5 D2)

Defining the methods for data verification and validation helps to ensure that Project data are evaluated objectively and consistently. Many of these methods have been described in 4.1. Additional information is provided below.

Trash characterization data will be checked as part of the verification methodology process. Results of replicate analyses will be the main means of assessing validity of the characterization data. Results of calibrations will be the main means of assessing accuracy of velocity measurement data.

Any data that are discovered to be incorrect or missing during the verification or validation process will immediately be reported to the MC and respective SPM. The MC will be responsible for reporting and correcting any errors that are found in the data during the verification and validation process.

If there are any data quality problems identified, the MCs and PM will coordinate to try to identify whether each problem is a result of Project design, sampling, staff training, or other issues. If the source of the problems can be traced to one or more of these basic activities then the person or people in charge of the areas where the issues lie will be contacted and efforts will be made to immediately resolve the problem. If the issues are too broad or severe to be easily corrected then the appropriate people involved will be assembled to discuss and try to resolve the issue(s) as a group. The PM has the final authority to resolve any issues that may be identified during the verification and validation process.

4.3. Reconciliation with User Requirements (EPA QA/R-5 D3)

The purpose of this Project is to generate an improved understanding of the effectiveness of stormwater management practices in the Bay Area in relation to trash management. Information from field personnel, reviews of data versus MQOs, data verification reports, data validation reports, independent data checking reports, and error handling reports will be used to determine whether or not the Project's objectives have been met. Characterization and flow / discharge measurement data will be analyzed for completeness to ensure that Project DQOs are met. The field statistical data will be compared against the MQOs documented in Section 1.7 and Appendix A.

Data from all characterization efforts will be summarized in tables. Additional data may also be represented graphically when it is deemed helpful for interpretation purposes.

Project data will be collected from a wide variety of sites with differing land use conditions, trash controls, and sampling environments.

The above evaluations will provide a comprehensive assessment of how well the Project meets its objectives.

The data obtained through Project implementation will improve stormwater management efforts in the San Francisco Bay area by expanding our collective understanding of trash presence in receiving waters and trash control effectiveness. The products and information from this Project will inform efforts to effectively allocate resources to reduce the volume of trash reaching receiving waters.

It is understood that the Project represents an early effort in the field of characterizing trash in local

receiving waters and is meant to inform our understanding and shape monitoring methods going forward. Therefore, some degree of uncertainty associated with quantitative findings from Project implementation is anticipated and should not be expected to negatively affect its successes or failures.

5. References

5 Gyres. 2016. Tracking California's Trash Project – Testing trash "flux" monitoring methods in flowing water bodies. Report prepared for the Bay Area Stormwater Management Agencies Association and funded by State Water Resources Control Board Grant Agreement Number 12-420-550. 65 p. + appendices.

BAMSC, 2024. Regional Trash Monitoring Program Receiving Water Monitoring Plan, Version 1.0. Month 2024.

Donaldson, E., and Owens, J., 2024. Literature Review on Methods for Receiving Water Monitoring: Watching Our Watersheds Regional Trash Monitoring Project. Prepared for the City / County Association of Governments of San Mateo County. February 16, 2024.

Rantz, S.E., 1982. Measurement and computation of streamflow (Vol. 2175). US Department of the Interior, Geological Survey.

R Core Team. 2020. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. https://www.R-project.org/ (https://www.R-project.org/).

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6. Appendix A – Measurement Quality Objectives for Field and Characterization Measurements

Table 6-1. Measurement Quality Objectives for Trash Collections and Characterizations

Quality Control Metric	Frequency of Analysis	Measurement Quality Objective
Field Sampling Precision -- Trash Category Volume (per category)[1]	Minimum 5% of total samples collected annually	N/A, for interpretive purposes only
Trash Characterization Precision - Trash Category Volume (per category)[1]	Minimum 5% of total samples collected annually	RPD<25% (n/a for any category with <100 mL recorded volume)

[1] Precision will be assessed at least annually by comparing measurements of replicate units under the same conditions. Relative Percent Difference (RPD) is the difference between two repeated measurements expressed as a percentage of their average. *%RPD = (sample result - duplicate result) * 100*

Table 6-2. Measurement Quality Objectives for Project Field Measurements

Analyte	Units	Accuracy[1] (unit)	Precision (unit or RPD) [1]	Resolution[1]
Water velocity (Float test)	feet/s	±15%[2]	±11%[2]	NA
Water level (Solinst Levelogger)	feet	0.075 feet	NA	0.015 feet
Water velocity (USGS AA meter)	feet/s	Variable - likely 2% over the anticipated range of velocities[3]	NA	NA

[1] These terms used to assess if an instrument or method is useful to a study and are provided by the manufacturer.
[2] King, T., Hundt, S., Simonson, A. and Blasch, K., 2022. Evaluation of select velocity measurement techniques for estimating discharge in small streams across the United States. JAWRA Journal of the American Water Resources Association, 58(6), pp.1510-1530.
[3] https://water.usgs.gov/osw/pubs/currentmeter.html accessed on April 24, 2024.

7. Appendix B – Project Data Collection and Assessment Forms

BAMSC Trash Monitoring Chain of Custody

Project / Program ID:				Results to (Org.):			
WY:				Results to (Contact):			
Sampled by (org & initials):							
Sample ID	Site Name	Date	Time	Sampling Component			Comments
				# containers	Outfall	Receiving Water	
Relinquished by:		Date/time:		Received by:		Date/time:	
Relinquished by:		Date/time:		Received by:		Date/time:	
Relinquished by:		Date/time:		Received by:		Date/time:	

Watching our Watersheds Receving Water Field Data Log Sheet version 1

Site location including station ID (e.g. SM-CRA):_____

Arrival Date/time:_____ Departure Date/time:_____ Sheet _____ of _____

Field Personnel:_____

Variable #												
1	Sample number for event											
2	Recorder											
3	Collection date											
4	Event ID (low, high, flood)	Low-flow High-flow Flood			Low-flow High-flow Flood			Low-flow High-flow Flood			Low-flow High-flow Flood	
5	Location in water column	Surface mid-column channel bed			Surface mid-column channel bed			Surface mid-column channel bed			Surface mid-column channel bed	
6	Replicate ID (0,1,2,3,4)											
7	Device (e.g. Box Trawl)	Box Trawl bedload sampler (3 or 6 inch)			Box Trawl bedload sampler (3 or 6 inch)			Box Trawl bedload sampler (3 or 6 inch)			Box Trawl bedload sampler (3 or 6 inch)	
8	Deployment Strategy (wade, bridge crane)	Bridge Crane Wading			Bridge Crane Wading			Bridge Crane Wading			Bridge Crane Wading	
9	Total stream width (ft)											
10	Sample location (Station from right bank, note if	☐ Thalweg _____ feet from right bank			☐ Thalweg _____ feet from right bank			☐ Thalweg _____ feet from right bank			☐ Thalweg _____ feet from right bank	
11	Staff plate reading											
12	Flow estimate											
13	Calculate depth											
14	Angle of bridge board cable (degrees)	Previous sample:		Current sample:	Previous sample:		Current sample:	Previous sample:		Current sample:	Previous sample:	Current sample:
15	Sample depth (surface, or actual depth; use look-up table)											
16	Sample start time (e.g. 1200)											
17	Surface flow velocity at sample location during sampling (take three and average)	Dist:_____ Time:_____ Vel:_____	Dist:_____ Time:_____ Vel:_____	Dist:_____ Time:_____ Vel:_____	Dist:_____ Time:_____ Vel:_____	Dist:_____ Time:_____ Vel:_____	Dist:_____ Time:_____ Vel:_____	Dist:_____ Time:_____ Vel:_____	Dist:_____ Time:_____ Vel:_____	Dist:_____ Time:_____ Vel:_____	Dist:_____ Time:_____ Vel:_____	Dist:_____ Time:_____ Vel:_____	Dist:_____ Time:_____ Vel:_____
18	Sample end time (e.g. 1221)											
19	If composited, show how samples are composited	Sample _____ of_____			Sample _____ of_____			Sample _____ of_____			Sample _____ of_____	
21	If composited, start and end of composite time											
22	Photograph: Person and photo time											
23	Number of containers											
24	Container number(s)											
25	Sample ID											
26	Comments											

Table D-1: Sample sheet variable descriptions

<table>
<tr><th>Variable number</th><th>Variable to Record</th><th>Definition and Instructions</th></tr>
<tr><td>1</td><td>Sample number for event</td><td>Chronological sample numbering. Mulitiple sheets may be used, make sure that subsequent field logs are numbered continuously for the sampling event. This number should tally the number of samples/composites for the entire event.</td></tr>
<tr><td>2</td><td>Recorder</td><td>A unique ID given to each person who is recording the data consisting of the first and last name of the person.</td></tr>
<tr><td>3</td><td>Collection date</td><td>The beginning date of the sample. Recorded as Year-Month-Day (e.g., 2024-12-31).</td></tr>
<tr><td>4</td><td>Event ID (circle 1)</td><td>Baseflow, High, Flood event</td></tr>
<tr><td>5</td><td>Location in water column</td><td>One of surface, midcolumn, bedload.</td></tr>
<tr><td>6</td><td>Replicate ID (circle one)</td><td>1, 2, 3, 4, Put in zero if no replicate</td></tr>
<tr><td>7</td><td>Device (e.g. Box trawl)</td><td>Name the device used. Likely to be Box Trawl or USGS bedload sampler (3 inch or 6 inch)</td></tr>
<tr><td>8</td><td>Deployment strategy (wade, bridge crane)</td><td>Wading or bridge deployment for sample</td></tr>
<tr><td>9</td><td>Total stream width</td><td>The total stream width (ft) across the cross section during the sample.</td></tr>
<tr><td>10</td><td>Sample location (Station from right bank, note if thalweg)</td><td>Call out if sample is taken at the thalweg (Thalweg will be identified prior to each season and marked on the bridge), also mark station from right edge of water.</td></tr>
<tr><td>11</td><td>Staff plate reading</td><td>Read staff plate installed or painted on bridge</td></tr>
<tr><td>12</td><td>Flow estimate (cfs)</td><td>Estimate flow, or look up the adjacent gage. Report in cubic feet per second (cfs)</td></tr>
<tr><td>13</td><td>Calculate depth</td><td>Use offset from staff plate to thalweg (measured prior to wet season)</td></tr>
<tr><td>14</td><td>Angle of bridge board cable (degrees)</td><td>Measure angle of bridgeboard cable during sampling with inclinometer. The exact angle will vary depending on the depth, so using the previous measurement or test is acceptable to estimate the angle of the cable for the current sample for the purpose of estimating depth to the midcolumn sample.</td></tr>
<tr><td>15</td><td>Sample Depth</td><td>The discrete depth location of the sample intake center in feet from the surface down (e.g., 1 feet). The surface sample is 0 ft. Use look up table for cable length:
<table>
<tr><th>Angle of bridge board cable (from horizontal, (degrees)</th><th>Multiplier to get actual depth</th></tr>
<tr><td>0</td><td>0.00</td></tr>
<tr><td>10</td><td>0.17</td></tr>
<tr><td>20</td><td>0.34</td></tr>
<tr><td>30</td><td>0.50</td></tr>
<tr><td>40</td><td>0.64</td></tr>
<tr><td>50</td><td>0.77</td></tr>
<tr><td>60</td><td>0.87</td></tr>
<tr><td>70</td><td>0.94</td></tr>
<tr><td>80</td><td>0.98</td></tr>
<tr><td>90</td><td>1.00</td></tr>
</table></td></tr>
<tr><td>16</td><td>Sample start time (e.g. 1200)</td><td>For net samples only, the ending reading on the intake flow meter.</td></tr>
<tr><td>17</td><td>Surface flow velocity at sample location</td><td>Measure velocity during sampling, either by timing trash or using oranges along a measured reach of stream. For measurements taken mid-column, a multiplier will be used to estimate the velocity at the trawl based the the surface velocity.</td></tr>
<tr><td>18</td><td>Sample end time (e.g. 1221)</td><td>The total number of containers collected for the sample.</td></tr>
<tr><td>19</td><td>If composited, show how samples are composited</td><td>Mark the number of the sample within the composite. At larger streams/flows, samples will be composited every hour. Ideally, this would remain consistent across each event, but it is acceptable to change to meet changes in conditions.</td></tr>
<tr><td>20</td><td>If composited, start and end of composite time</td><td>For longer hydrographs samples will be laid out on a tarp and composited every hour. Label the start and end time for the compositing period here, aim for every hour, on the hour.</td></tr>
<tr><td>21</td><td>Photograph: Person and photo time</td><td>Take a photo of the sample (or composited sample) before it is bagged and tagged and record the time of the photo to compare to the photo metadata. Alternatively, field staff can take a photo of the sample with the Sample ID in frame.</td></tr>
<tr><td>22</td><td>Number of containers</td><td>How many mesh bags contain the sample, samples collected into multiple bags should be collected into larger net bags</td></tr>
<tr><td>23</td><td>Container number(s)</td><td>Number of containers containing the whole sample</td></tr>
<tr><td>24</td><td>Sample ID (SITE-YYYYMMDDTTTT-R-CC)</td><td>SITE = Site ID (e.g., AC-CRA)
YYYYMMDDTTTT = Starting date and time for the sample
R = Replicate. 0 if not a replicate, 1-4 depending on replicate number associated with the sample.
CC = Monitoring component (receiving water [RW] or outfall [OF])</td></tr>
<tr><td>25</td><td>Comments</td><td>Comments on +B13:C28the sample, site conditions (rising flows, falling flows, rainfall conditions, etc.) Any important information relevant to the sample collection, equipment, or location.</td></tr>
</table>

BAMSC Trash Monitoring
Corrective and Preventative Action Report

Stormwater Program:	Date:
Reporting Party:	Date:

Non-conformance Type ☐ Sample collection / handling ☐ Laboratory analysis ☐ QA	☐ Data mgmt. / reporting ☐ Other

Subject:
Description of Problem:
Proposed Corrective / Preventative Action:
Affected Data (if applicable):
Dispensation of Data (if applicable):
Follow up:
Responsible Party:
Additional Comments:

_____
Program Mgr / Date

8. Appendix C – Trash Characterization SOP and Datasheet

Standard Operating Procedure (SOP) for Trash Characterization

The following provides procedures for evaluating trash collected from receiving water trash monitoring sites described in Table 3.1 and Appendix C of the Receiving Water Monitoring Plan.

Trash Evaluation

There are two trash evaluation steps:

- Step 1: Sort Trash
- Step 2: Measure Volume of Trash

When conducting trash evaluations, the following steps should be performed in the order presented below.

Sort Trash

Sort trash on a large table (Note: avoid periods of time during the day that are susceptible to wind). Sort all trash items into the 13 trash categories described in Table C.1. A photo library that identifies common trash items that occur within each category will be used to assist field staff in the sorting process (see end of this SOP). If an observed trash item is not on the list, the best professional judgment will be used to determine the category for the item. While sorting, trash items/pieces will be placed in separate buckets (i.e., 2.5-quart, 2.5 gallon and 5 gallons in size) or plastic graduated beakers (50 mL to 1000 mL in size) based on the 11 trash categories for trash volume measurement. The size of the bucket used should be based on the volume of trash within the category. The smallest sized bucket/beaker possible should be used for each category to avoid overestimating trash volumes.

Measure Volume of Trash

After the trash sorting is completed and trash items have been placed in buckets or beakers, ensure that the trash is evenly distributed within the bucket/beaker, while avoiding compaction to the extent possible. For buckets, measure the depth of trash in each bucket of a known volume using a ruler. Calculate the trash volume based on the measured depth of the trash and the diameter of the bottom of the bucket and using the equation for volume of a cylinder ($Vol = \pi r^2 \; x \; h$). For example, if trash is measured at 3" in a 5-gallon bucket that has a diameter of 12", the volume of trash within the bucket would be $\pi \; x \; 6^2 \; x \; 3$ = 339.29 in^3 (1.47 gallons). To determine the volume in beakers, read the lines on the side indicating the volume contained. When measuring the volume of trash, ensure that it is un-compacted.

For larger trash items with known volumes (e.g., plastic bottles, cups), the container volume is multiplied by the number of items in the sample. These volumes are then added to the volume of smaller items that were measured using the bucket method described above. Some trash items such as re-useable plastic bags and plastic bottles with CRV will be enumerated. Use the Trash Characterization Data Collection Form to record the total volume of each trash category. All measurements will be recorded using the Trash Characterization Field Data Form included at the end of this SOP.

All biohazards and hazardous waste need to be handled and disposed of according to conventional practices (e.g., syringes with needles need to be disposed into biohazard/sharps containers). The project health and safety plan will include specific measures to protect trash sorting staff.

After quantification is complete and data forms reviewed, all non-hazardous trash shall be placed into garbage bags for disposal. Garbage bags should not be overfilled to prevent tearing. If material contains sharp or large objects, the material should be double-bagged as necessary.

Table C-1. Categories for Trash Characterization.

Category	Description
Single-Use Carryout Plastic Bags	Single-use carryout grocery-type bags (or pieces of bags) prohibited from point-of-sale distribution in accordance with SB 270/Prop 67. Re-usable plastic bags and plastic bags without handles will be included as "Other, Plastic".
Expanded Polystyrene (EPS) Foam, Food Service Ware	Items (or pieces of items) made of EPS foam (e.g., Styrofoam™) that are associated with food and beverage related items.
(EPS) Foam Other	Other Styrofoam material associated with packing material, coolers.
Single Use Plastic, Food Service Ware	Any items made of plastic, including certified compostable plastic, associated with food service. This includes plastic beverage containers, lids, straws, cutlery, and all containers, bowls, plates, trays, and other items designed for one-time use for prepared food. This category does not include "single use food service accessories" (e.g., condiment packets).
Smoking Products, Traditional	Includes cigarette and cigar butts related to traditional smoking products.
Smoking Products, Other	All remaining materials related to traditional or electronic smoking products. Includes plastic tips, matches, and packaging associated with each. Lighters are excluded here and included in category of other plastic items.
Other plastic Items / Pieces	All other types of plastic items (or pieces of items), including but not limited to those made of soft plastic, hard plastic, rubber, vinyl, mylar, film materials coated with plastic.
Organic / Paper	Items (or pieces of items) solely made of paper, including paper beverage containers e.g., coffee cups and aseptic containers), newspapers / magazines, parking tickets / receipts, books, cardboard, paper towels, envelopes, paper food containers (both clean and soiled) and labels, food packaging, wooden utensils (toothpicks, stirrers, chopsticks), wood pieces (toys), bulk paper, food scraps, and hair. Yard waste is not included.
Fabric	Items (or pieces of items) made of organic or synthetic materials and produced by weaving or knitting fibers.
Metal	Items (or pieces of items) made of metal, including aluminum, copper, zinc, lead, etc.
Glass	Items (or pieces of items) made of glass.
Mixed	All items that contain more than one type of material described previously or don't otherwise fit in other categories. Examples may include foil-backed fiberglass, demolition debris, and circuit boards.
Biohazard	Items (or pieces of items) that may have the potential for presence of dangerous bacteria or viruses, including those associated with medical waste or human waste.

For sites intended for replicate analysis, garbage bags will be labeled, sealed, and segregated for immediate or future processing. Replicate analysis will be conducted at the frequency specified in the QAPP (BAMSC 2024).

Characterization Data Collection Form

ID #:_____ **Staff:**_____

Sample Event Date:_____ **Time:**_____

Trash Category (Bold)	# Items	Volume(s) of Items	Container Size (gal/qt/ml)	Depth (in/ml)	Total Volume (ounce)	Additional Information
Single-Use Carryout Plastic Bags						
Expanded Polystyrene (EPS) Foam, Food Service Ware						
(EPS) Foam - Other						
Single Use Plastic, Food Service Ware						
Containers/Cups						
Lids/straws						
Smoking Products, Traditional						
Smoking Products, Other						
Other plastic Items / Pieces						
Plastic bags (re-useable)						
Plastic Bottles (CRV)						
Plastic Bottles (non-CRV)						
Organic / Paper						
Fabric						
Metal						
Metal cans						
Glass						
Mixed						
Biohazard						

9. Appendix D – Flow Meter User Manual

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Techniques of Water-Resources Investigations
of the United States Geological Survey

Chapter B2

CALIBRATION AND MAINTENANCE OF VERTICAL-AXIS TYPE CURRENT METERS

By George F. Smoot and Charles E. Novak

Book 8

INSTRUMENTATION

UNITED STATES DEPARTMENT OF THE INTERIOR

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PREFACE

The series of manuals on techniques describes procedures for planning and executing specialized work in water-resources investigations. The material is grouped under major subject headings called books and further subdivided into sections and chapters; Section B of Book 8 is on instruments for measurement of discharge.

The unit of publication, the chapter, is limited to a narrow field of subject matter. This format permits flexiblity in revision and publication as the need arises.

Provisional drafts of chapters are distributed to field offices of the U.S. Geological Survey for their use. These drafts are subject to revision because of experience in use or because of advancement in knowledge, techniques, or equipment. After the technique described in a chapter is sufficiently developed, the chapter is published and is sold by the U.S. Geological Survey, 1200 South Eads Street, Arlington, VA 22202 (authorized agent of Superintendent of Documents, Government Printing Office).

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SYMBOLS AND UNITS

Symbol	*Definition*	*Unit*
C	Constant.	
K	Proportionality constant.	
N	Angular velocity of meter rotor.	revolutions/sec
V	Velocity.	ft/sec

CALIBRATION AND MAINTENANCE OF VERTICAL-AXIS TYPE CURRENT METERS

By George F. Smoot and Charles E. Novak

Abstract

The purpose of this chapter is to describe the procedures used in the manufacture and calibration of current meters and to present in detail information pertinent to their proper maintenance and repair. Recent intensive studies on the calibration of current meters and the effects of wear of the component parts on the performance of the meters have led to the adoption of new procedures for the manufacture, calibration, maintenance, and repair of meters. This chapter, therefore, updates the provisional manual "Care and Rating of Current Meters" (1957) by including these new procedures.

Introduction

Precision instruments and their proper use and maintenance are prerequisites for the collection of accurate data. Current meters are precision instruments and their proper use and maintenance are doubly important because of the hard usage often received by them in measuring stream velocities. The following quotation from an earlier provisional manual emphasizes the importance the Water Resources Division attaches to this aspect of streamflow measurements:

> The operation of a current meter, as of any scientific instrument, will be largely affected by the way in which it is used. While the design, material, and construction of the meter may be large factors in its successful operation, these factors may not prevent errors due to improper care and use of the instrument. In this connection each fieldman is urged to use the greatest possible care to see that his meter is kept in proper condition.

The condition of the fieldman's current meter is one of the most important building stones in the foundation of good streamflow records. Routine servicing, inspection for minor damage, and proper lubrication should be standard operating procedure. The amount of pride taken in maintaining his meter in optimum condition is also a measure of the pride a man can be expected to take in other areas of his work.

This chapter updates the provisional manual "Care and Rating of Current Meters" (1957, out of print).

Description of the Small Price Current Meter

Rotating-element current meters can be broadly classified into two general categories according to the orientation of the revolving axle; the axis may be vertical, or it may be horizontal and parallel to the direction of flow. Current meters having horizontal axes with propeller—shaped rotors and those having vertical axes with cup or vane-type rotors have been experimented with extensively to determine their respective advantages and disadvantages.

Although many characteristics of different current meters are still unknown, the experiments and investigations thus far conducted are conclusive in one respect, namely, that current meters of either the horizontal- or vertical- axis type when carefully designed and constructed, and when used under favorable conditions, will measure accurately the velocity of flowing water.

When streamflow investigations were undertaken by the Geological Survey in 1888, engineers of the Survey began experimenting with the various types of current meters available at that time to find one that could be used under a wide variety of field conditions. About 1896, as a re-

sult of these investigations, they developed a meter containing certain features of the Price acoustic and the large Price electric meters. This meter, which was called the small Price (fig. 1), has since been used by the Survey almost exclusively because of its adaptability to general stream gaging.

The small Price current meter probably has been used more extensively and has been subjected to more investigation than any other type of current meter. As a result of this extensive investigation and because of the natural advantages afforded by the type, the small Price has been perfected in its details; the type-AA Price meter is now better suited to general use than any other meter. It is light and yet strong, sensitive yet durable. It will measure with a high degree of accuracy velocities ranging from 0.1 foot per second to more than 20 feet per second. It is easily repaired, it can be quickly taken apart for cleaning and oiling, and it can be quickly reassembled without change in rating.

To properly use and care for a current meter, the user must be familiar with all of its parts, as well as with the assembled meter. If any part fails completely because of excessive wear or damage, the condition is usually obvious, but small irregularities that may introduce large percentage errors in velocity determinations are not always readily detected. For this reason the parts of the type-AA meter and their functional characteristics are described; the numbers assigned to the various parts in this description correspond to the numbers used in the assembly diagram of the type-AA current meter shown in figure 2.

Yoke

The yoke (8) is a 1-piece horseshoe-shaped casting made of chromium-plated bronze. A short horizontal rear extension contains a hole for connection of the tailpiece. This extension contains two bosses—one which is slotted vertically and and drilled horizontally for the hanger and hanger screw, and one which is drilled vertically for the keeper screw of the tailpiece. The slot for the hanger is of such dimensions as to limit the tilting of the meter so that neither the yoke nor the tailpiece will strike the weight. The upper arm of the yoke is drilled to receive the stem of the P-shaped contact chamber; the lower arm is drilled to receive the pivot. These holes are coaxial so as to properly aline the rotor assembly and the pivot. The contact chamber and pivot are held in position by a keeper screw having a knurled fillister head.

Tailpiece

The tailpiece is made of a hard-rolled nickel-plated brass, and it consists of two separate vanes which, when assembled, are locked together at right angles to each other by means of a lever arrangement. This two-piece construction permits the tailpiece to be taken apart readily for convenience in packing. The nosepiece of the tail fits into the rear extension of the yoke. A means to balance the meter assembly is provided in the lower part of the tailpiece by a long horizontal slot containing a short heavy screw that may be adjusted to the proper position to obtain the desired balance.

Bucket wheel

The bucket wheel (21) consists of six cone-shaped cups soldered to a frame to form a symmetrical and balanced assembly 5 inches in diameter and 2 inches high. The cups and frame are made of nickel-plated hard rolled brass. The frame is centrally drilled for the shaft and notched for a dowel pin. The letter "S" is stamped on the frame to identify the top side of the bucket wheel. The year of manufacture is also identified—S–67, S–68, for example.

Bucket-wheel hub

The bucket-wheel hub (13) encases the pivot bearing and the lower end of the shaft and supports the bucket wheel. The hub is threaded in three places: (1) for the bucket-wheel hub nut, (2) for the bucket-raising nut, and (3) for the shaft. A small dowel pin maintains the bucket wheel in a fixed position with reference to the bucket-wheel hub. The bucket-raising nut is provided so that the pivot bearing can be raised from the pivot when the meter is not is use.

Shaft

The shaft (12) is made of stainless steel and is of sufficient length to extend from the bucket-wheel hub to a point 0.008 inch below the cap of the

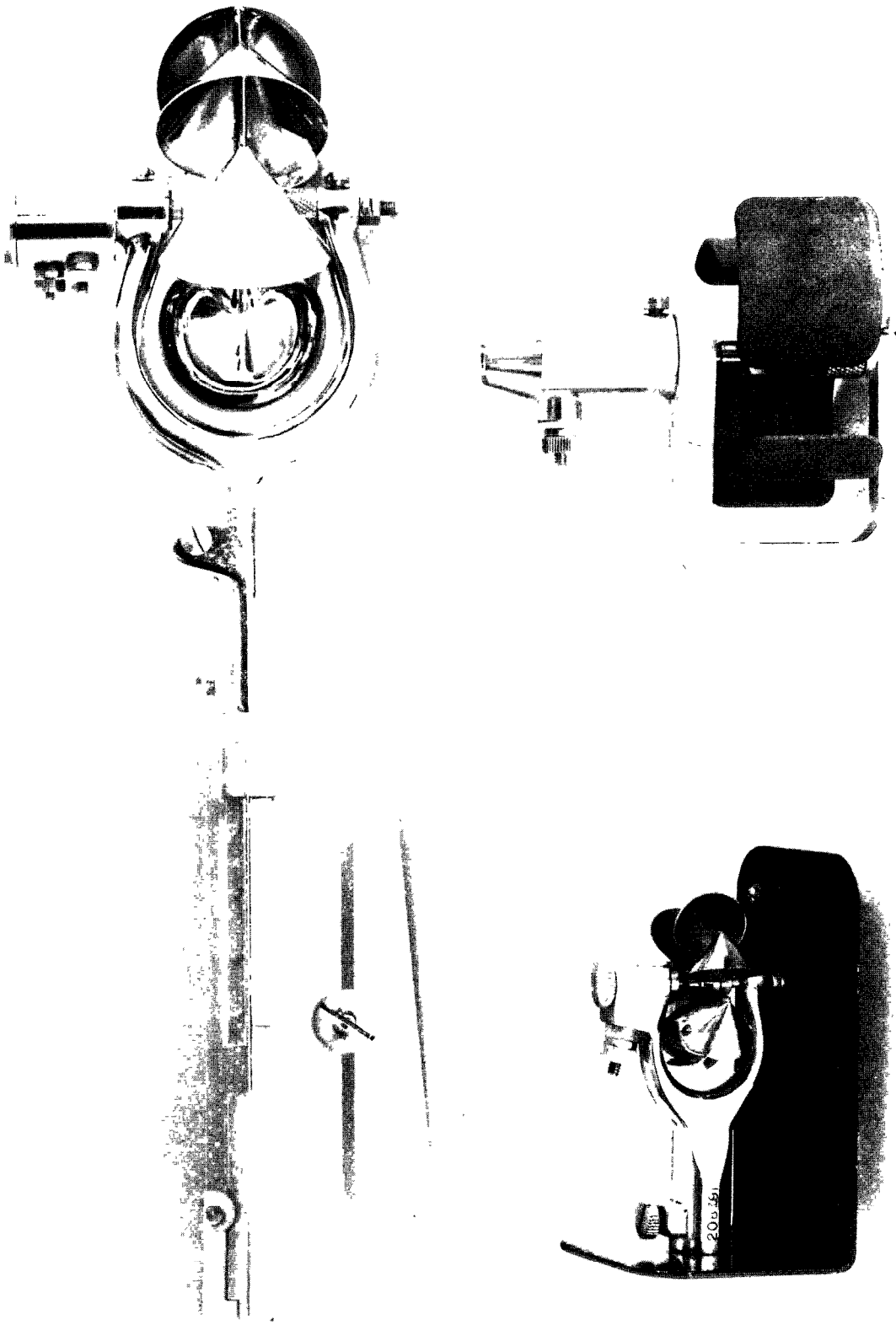


Figure 1.—Small Price (above), pygmy (lower left), and ice (lower right) meters.

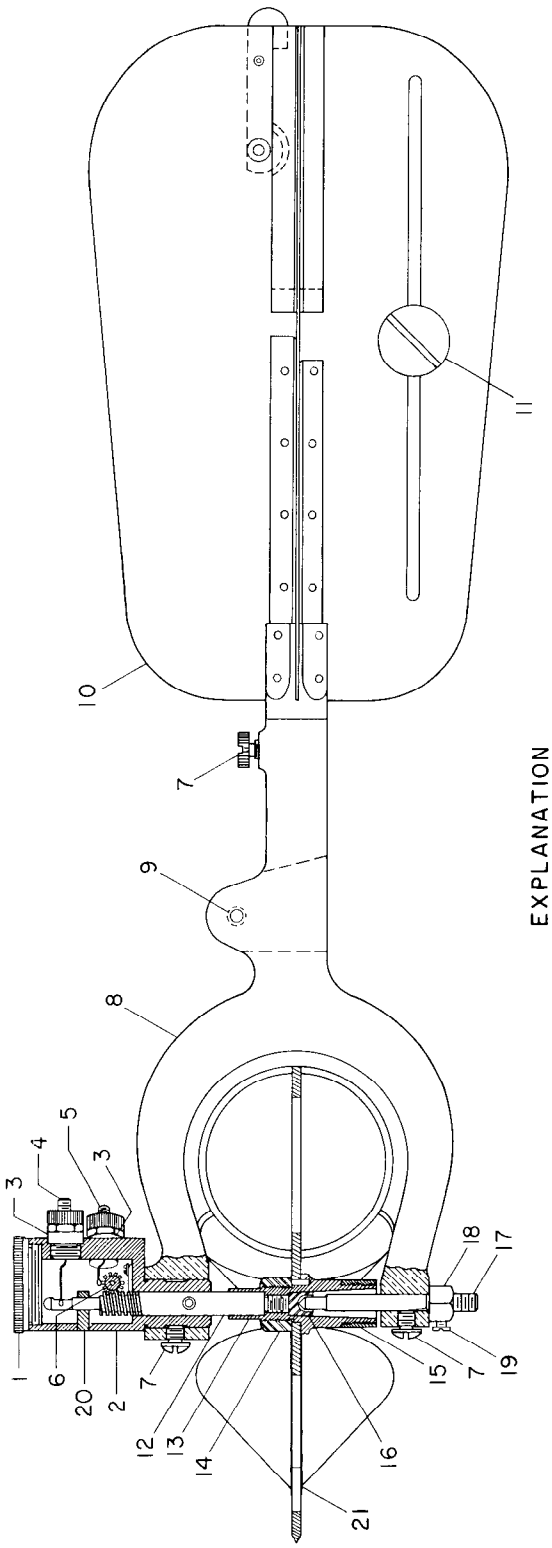


Figure 2.—Assembly diagram of type-AA Price current meter.

contact chamber. The upper one-half inch of the shaft is turned to 0.125-inch diameter and is rounded at the top to provide a smooth bearing surface for the thrust of the shaft against the bottom of the contact-chamber cap. An eccentric is cut in the 0.125-inch diameter part of the shaft to provide a means for making an electrical contact for each revolution of the bucket-wheel hub. The shaft also contains an acme thread that meshes with the penta gear within the contact chamber. A small hole is drilled at about the midpoint of the shaft to facilitate the use of a pin for tightening the shaft into the bucket-wheel hub.

Pivot

The pivot (17) is made of tempered, precipitation-hardening stainless steel. The upper end of the pivot is ground and polished to form an angle of 90° and the point rounded to a radius of 0.005 inch. The lower end of the pivot is threaded to provide for the hexagonal stainless-steel nut that is used to adjust the clearance between the pivot point and the pivot bearing. A slightly tapered flat surface on the pivot above the threads serves as a contact surface for the pivot-keeper screw.

Pivot bearing

The pivot bearing (16) is made of tungsten carbide and has highly polished bearing surfaces. It is pressed into the cylindrical recess in the lower end of the bucket-wheel hub. The bearing being of greater hardness than the pivot causes the major part of the wear to take place on the pivot which is easily replaceable.

Penta gear

The penta gear (6) is made of stainless steel and is fitted to mesh smoothly with the acme threads on the shaft. The gear makes one complete revolution for each 10 revolutions of the bucket wheel. Two gear teeth, 180° apart, are extended beyond the others to provide a means for making two electrical contacts for each revolution of the gear, with the result that contacts are made at each fifth revolution of the bucket wheel. The gear is mounted in a bronze frame in a horizontal position, and the assembly is housed in the contact chamber where it is held in place by means of a brass screw. The base of the frame through which this screw passes is slotted to permit the adjustment of the gear teeth with the worm on the shaft.

Contact chamber

The contact chamber (2) is a P-shaped chromium-plated brass unit which houses the penta gear, the upper part of the shaft, the shaft bearing, and the single- and penta-contact binding posts. The upper end of the chamber is drilled and threaded internally to carry a knurled cap. A small phosphor-bronze lug, brazed to the chamber wall, serves as the upper bearing for the shaft. The stem of the contact chamber extends through the upper arm of the yoke and is drilled axially so that the shaft can pass into the chamber with ample clearance. The cap is tightly fitted so that the chamber serves as an air trap to prevent silty water from entering the bearing.

Binding posts

Two stainless-steel binding posts (4) and (5) are placed at the rear of the contact chamber. One post is designed to contact the eccentric of the shaft and the other to contact the two extended teeth of the penta gear. They are identical in construction except for the lengths of the slender stainless steel cables that terminate in beads of silver solder through which the contacts are made. Each binding post is insulated from the contact chamber by a bushing (3) made of nylon.

Calibration of Current Meters

The principal of operation of a rotating-element type velocity meter is based on the proportionality between the local flow velocity and the resulting angular velocity of the meter rotor. The velocity of the water is determined by counting the number of revolutions of the rotor during a measured interval of time and consulting the meter calibration table.

If an ideal current meter, that is, one equipped with a correctly shaped rotor and a frictionless bearing mechanism, were to measure the flow velocity of a perfect liquid, the relation between the flow velocity and the rotor speed would be very simple:

$$V = KN \quad (1)$$

where V denotes the local flow velocity, K is the proportionality constant, and N is the rotor speed expressed in revolutions per unit of time. In actual practice there are resistances opposing rotation caused by friction between the liquid and the rotor and by the mechanical friction of the bearings. Consequently, this simple relationship does not exist, and one must be determined empirically. The establishment of this relation, known as "rating the current meter," is done for the Survey by the National Bureau of Standards.

The current-meter rating station operated by the National Bureau of Standards in Washington, D.C., consists of a sheltered reinforced concrete basin 400 feet long, 6 feet wide, and 6 feet deep. Atop the vertical walls of the basin and extending its entire length are steel rails that carry an electrically driven rating car. This car is operated to move the current meter at a constant rate through the still water in the basin. Although the rate of travel can be accurately adjusted, the average velocity of the moving car is determined for each run by making an independent measurement of the distance it travels during the time that the revolutions of the bucket wheel are electrically counted. A scale graduated in feet and tenths is used for this purpose.

A small Price meter is rated by towing it at eight different velocities (0.25, 0.50, 0.75, 1.10, 1.50, 2.20, 5.00, and 8.00 feetp er second). A pair of runs are made at each velocity. A pair consists of two traverses of the basin, one in each direction. The data obtained consists of 16 observations of the velocity of the car (V) and revolutions per second of the rotor (N). The meter rating is determined from these data and is expressed as two linear equations:

For N less than 1.00,

$$V = K_1N + C_1, \quad (2)$$

For N greater than 1.00,

$$V = K_2N + C_2, \quad (3)$$

where

$$K_2 = K_1 + C_1 - C_2. \quad (4)$$

Because there is rigid control in the manufacture of the small Price meter, virtually identical meters are produced and, for all practical purposes, their rating equations are identical.

Therefore, there is no need to calibrate each meter individually. Instead, a standard rating is established by calibrating a large number of meters that have been constructed according to Survey specifications, and this rating is then supplied with each meter.

To insure that all small Price meters are virtually identical, dies and fixtures for their manufacture were purchased by the Water Resources Division and supplied to the manufacturer in 1967 for use in constructing meters. These same dies and fixtures will be supplied to the successful bidder in subsequent years. All rotors manufactured by use of the standard dies and fixtures are stamped "S" on the top side of the bucket wheel. The year of manufacture is also identified—S–67, S–68, for example. To further insure that all meters are identical, quality control procedures are followed, including the rating of a sample of meters from each new group procured.

For convenience in field use, the data from the current-meter ratings are reproduced in tables, a sample of which is shown in figure 3. The velocities corresponding to a range of 3–350 revolutions of the bucket wheel within a period of 40–70 seconds are listed in the tables. This range in revolution and time has been found to cover general field requirements. To provide the necessary information for the few instances where extensions are required, the equations of the rating table are shown in the spaces provided in the heading. Because of limited space, the equations are presented in an abbreviated form.

The expression V = 2.140N + 0.015 (2.155) V = 2.150N + 0.005 shown in the heading of the table in figure 3 is to be interpreted as follows:

V represents velocity in feet per second.

N represents the number of revolutions of the bucket wheel per second.

That part, V = 2.140N + 0.015, to the left of the parentheses is the equation used for computing velocities shown in the table less than 2.155 feet per second.

That part, V = 2.150N + 0.005, to the right of

DEPARTMENT OF THE INTERIOR - GEOLOGICAL SURVEY

Water Resources Division

RATING TABLE FOR TYPE AA CURRENT METER

EQUATIONS: V = 2.140N + 0.015 (2.155) V = 2.150N + 0.005 . . . . STANDARD RATING NO. . . . X . . . .

Time in Seconds	VELOCITY IN FEET PER SECOND — Revolutions									Time in Seconds	Time in Seconds	VELOCITY IN FEET PER SECOND — Revolutions									Time in Seconds
	3	5	7	10	15	20	25	30	40			50	60	80	100	150	200	250	300	350	
40	.176	.282	.390	.550	.818	1.09	1.35	1.62	2.15	40	40	2.69	3.23	4.30	5.38	8.07	10.76	13.44	16.13	18.82	40
41	.172	.276	.380	.537	.798	1.06	1.32	1.58	2.10	41	41	2.63	3.15	4.20	5.25	7.87	10.49	13.11	15.74	18.36	41
42	.168	.270	.372	.525	.779	1.03	1.29	1.54	2.05	42	42	2.56	3.08	4.10	5.12	7.68	10.24	12.80	15.36	17.92	42
43	.164	.264	.363	.513	.762	1.01	1.26	1.51	2.01	43	43	2.50	3.00	4.00	5.00	7.50	10.00	12.50	15.00	17.50	43
44	.161	.258	.355	.501	.745	.988	1.23	1.47	1.96	44	44	2.45	2.94	3.91	4.89	7.33	9.78	12.22	14.66	17.11	44
45	.158	.253	.348	.491	.728	.966	1.20	1.44	1.92	45	45	2.39	2.87	3.83	4.78	7.17	9.56	11.95	14.34	16.73	45
46	.155	.248	.341	.480	.713	.945	1.18	1.41	1.88	46	46	2.34	2.81	3.74	4.68	7.02	9.35	11.69	14.03	16.36	46
47	.152	.243	.334	.470	.698	.926	1.15	1.38	1.84	47	47	2.29	2.75	3.66	4.58	6.87	9.15	11.44	13.73	16.02	47
48	.149	.238	.327	.461	.684	.907	1.13	1.35	1.80	48	48	2.24	2.69	3.59	4.48	6.72	8.96	11.20	13.44	15.68	48
49	.146	.233	.321	.452	.670	.888	1.11	1.33	1.76	49	49	2.20	2.64	3.51	4.39	6.59	8.78	10.97	13.17	15.36	49
50	.143	.229	.315	.443	.657	.871	1.09	1.30	1.73	50	50	2.16	2.58	3.44	4.30	6.46	8.60	10.76	12.90	15.06	50
51	.141	.225	.309	.435	.644	.854	1.06	1.27	1.69	51	51	2.11	2.53	3.38	4.22	6.33	8.44	10.54	12.65	14.76	51
52	.138	.221	.303	.427	.632	.838	1.04	1.25	1.66	52	52	2.07	2.49	3.31	4.14	6.21	8.27	10.34	12.41	14.48	52
53	.136	.217	.298	.419	.621	.823	1.02	1.23	1.63	53	53	2.03	2.44	3.25	4.06	6.09	8.12	10.15	12.17	14.20	53
54	.134	.213	.292	.411	.609	.808	1.01	1.20	1.60	54	54	2.00	2.39	3.19	3.99	5.98	7.97	9.96	11.95	13.94	54
55	.132	.210	.287	.404	.599	.793	.988	1.18	1.57	55	55	1.96	2.35	3.13	3.91	5.87	7.82	9.78	11.73	13.69	55
56	.130	.206	.282	.397	.588	.779	.970	1.16	1.54	56	56	1.93	2.31	3.08	3.84	5.76	7.68	9.60	11.52	13.44	56
57	.128	.203	.278	.390	.578	.766	.954	1.14	1.52	57	57	1.89	2.27	3.02	3.78	5.66	7.55	9.43	11.32	13.21	57
58	.126	.199	.273	.384	.568	.753	.937	1.12	1.49	58	58	1.86	2.23	2.97	3.71	5.56	7.42	9.27	11.13	12.98	58
59	.124	.196	.269	.378	.559	.740	.922	1.10	1.47	59	59	1.83	2.19	2.92	3.65	5.47	7.29	9.12	10.94	12.76	59
60	.122	.193	.266	.372	.550	.728	.907	1.09	1.44	60	60	1.80	2.15	2.87	3.59	5.38	7.17	8.96	10.76	12.55	60
61	.120	.190	.261	.366	.541	.717	.892	1.07	1.42	61	61	1.77	2.12	2.82	3.53	5.29	7.05	8.82	10.58	12.34	61
62	.119	.188	.257	.360	.533	.705	.878	1.05	1.40	62	62	1.74	2.09	2.78	3.47	5.21	6.94	8.67	10.41	12.14	62
63	.117	.185	.253	.355	.526	.694	.864	1.03	1.37	63	63	1.71	2.06	2.74	3.42	5.12	6.83	8.54	10.24	11.95	63
64	.115	.182	.249	.349	.517	.684	.851	1.02	1.35	64	64	1.69	2.02	2.69	3.36	5.04	6.72	8.40	10.08	11.76	64
65	.114	.180	.245	.344	.509	.673	.838	1.00	1.33	65	65	1.66	1.99	2.65	3.31	4.97	6.62	8.27	9.93	11.58	65
66	.112	.177	.242	.339	.501	.663	.826	.988	1.31	66	66	1.64	1.96	2.61	3.26	4.89	6.52	8.15	9.78	11.41	66
67	.111	.175	.239	.334	.494	.654	.814	.973	1.29	67	67	1.61	1.93	2.57	3.21	4.82	6.42	8.03	9.63	11.24	67
68	.109	.172	.235	.330	.487	.644	.802	.959	1.27	68	68	1.59	1.90	2.53	3.17	4.75	6.33	7.91	9.49	11.07	68
69	.108	.170	.232	.325	.480	.635	.790	.945	1.26	69	69	1.57	1.88	2.50	3.12	4.68	6.24	7.79	9.35	10.91	69
70	.107	.168	.229	.321	.474	.626	.779	.932	1.24	70	70	1.54	1.85	2.46	3.08	4.61	6.15	7.68	9.22	10.76	70
	3	5	7	10	15	20	25	30	40			50	60	80	100	150	200	250	300	350	

Figure 3.—Sample current-meter rating table.

the parentheses is the equation used for computing the values for V more than 2.155 feet per second.

The term within parentheses (2.155) is the velocity common to both equations.

Data do not indicate that there is any significant difference between a rod rating and a cable suspension rating when Columbus-type weights and hangers are properly used with the meter. Therefore, no suspension coefficient is indicated, and none should be used.

Assembly and Disassembly of the Small Price Current Meter

To provide the proper care to a current meter, which is of extreme importance as pointed out earlier, each fieldman should become thoroughly acquainted with all the component parts as well as with the assembled meter. He should also be familiar with the steps outlined below, which are necessary to assemble or disassemble a meter.

Assembly

The procedure in assembling the small Price current meters may best be followed by referring to figure 2 which shows a sectional view of a type–AA meter and the names of the parts.

1. Assemble the two vanes of the tailpiece (10).

2. Insert the tailpiece assembly, with balance weight underneath, into the yoke (8) and tighten the tailpiece set screw (7).

3. Place the bucket wheel (21) onto the bucket-wheel hub (13) with the side marked "S" upward, and with the dowel pin on the hub fitting the notch in the bucket-wheel frame. These parts are held together by means of the bucket-wheel hub nut.

4. Place the bucket-wheel assembly within the arms of the yoke (8) and pass the shaft (12) through the hole in the upper arm of the yoke. Screw the shaft directly into the bucket-wheel hub (13), then insert a pin into the hole in the shaft and use the pin to tighten the shaft in the hub.

5. Loosen the penta gear (6) in the contact chamber (2) by a **single** turn of the small screw that passes through the adjusting slot of the gear pad. **Do not remove this screw completely as it is difficult to replace.**

6. Slip the contact chamber, with the cap (1) removed, over the upper end of the shaft and into the hole in the upper limb of the yoke. This should be done with great care in order not to damage either the threaded shaft or the penta gear.

7. Aline the contact chamber with the yoke by making the centerline of the yoke bisect the angle formed by the two contact binding posts. Some meters have been provided with grooved marks on the front of the contact chamber and on top of the upper arm of the yoke; making these marks coincide insures the proper alinement.

8. Tighten the yoke set screw (7) to hold the contact chamber in place.

9. Screw the cap (1) onto the contact chamber.

10. Insert the pivot (17) through the hole in the lower arm of the yoke after placing a drop of oil in the lower bearing and on the pivot.

11. Adjust the pivot as described in table 1. This adjustment allows a vertical play of 0.008 inch, the amount of play used when the meter is rated.

12. Return the meter to an upright position, and remove the cap from the contact chamber. Adjust the penta gear to mesh properly with the threads on the shaft and tighten the small (unnumbered) screw which holds the penta gear assembly.

13. Spin the bucket wheel rapidly while

Table 1. Adjustment of pivot

Sequence	*Operation*
1	Make sure that the meter has been properly oiled; then hold meter in inverted position with pivot uppermost.
2	Release keeper screw (19) for pivot adjusting nut (18) and unscrew the nut a few turns.
3	Release set screw (7) and advance pivot until all vertical play of the hub assembly is eliminated.
4	Tighten set screw (7) temporarily and advance pivot adjusting nut (18) until it touches the yoke.
5	Release set screw (7) (not too far because the pivot should not revolve) and advance the pivot adjusting nut one-fourth turn. Then tighten keeper screw (19).
6	Push the pivot inward as far as it will go and tighten set screw (7).

watching the action of the penta gear to make sure that there is complete freedom of action between the gear and the threads on the shaft. Then apply oil to the penta gear and to the three bearing surfaces (one drop on the vertical shaft and two on the horizontal shaft that supports the gear).

14. Adjust the contact wires so that these wires touch the edge of the single and penta eccentrics very lightly. Then replace the cap on the contact chamber and listen with a headset for a sharp click.

15. Place the assembled meter on a solid surface with the shaft vertical, and make a spin test (see page 10).

Disassembly

In general, the disassembly of small Price current meters offers no difficulties and hence it will not be described in detail. The following precautions, however, should be observed.

1. Removal of the contact chamber from the yoke should be done carefully and without exerting appreciable force, so that the penta gear and shaft will not be damaged.

2. The contact-chamber cap should never be unscrewed when the upper end of the shaft bears forcibly against its underside, a condition which exists if the bucket-wheel raising nut has been previously tightened, and if the pivot adjustment has been made so tight that there is no play between the end of the shaft and the underside of the cap.

When the bucket-raising nut has been tightened, the upper end of the shaft bears against the underside of the cap at a point that is about three-sixteenths of an inch "off center" with respect to the center of the cap. If those two parts are in contact with each other when the cap is being either tightened or loosened, a severe bending force occurs at the point where the upper end of the shaft emerges from the upper bearing. Lack of attention to this subject is a common cause for "bent shafts" on Price-type current meters.

When the bucket-wheel-and-hub assembly is raised from the pivot by means of the raising nut, the bucket wheel should always be held stationary and the raising nut should be turned by hand. The bucket wheel should never be spun with the raising nut held stationary, as this method may cause several excess turns which may result in the shaft becoming bent or the yoke becoming sprung.

Inspection and Repair of Current Meters

To make sure that the current meter is in good condition and is properly lubricated, the operator should examine it, both before and after each discharge measurement, with regard to the details under the heading immediately following. Because all meter parts are manufactured to be interchangeable without affecting the calibration of the meter, replacement of any of the component parts can be made in the field.

Rotor and shaft alinement

By spinning the bucket wheel slowly and then watching the metal frame to which the cups are fastened, eccentricity in the bucket-wheel-and-hub assembly may be readily detected. If eccentricity is observed while making this test, either the wheel or shaft is bent, and further tests should be made to find the source of the eccentricity. The cap should be removed and the movement of the shaft inside the contact chamber should be observed. If, while the bucket wheel is rotating, any eccentricity in the movement of the top of the shaft is observed, the shaft should be removed from the assembly and should be further tested by observing its performance while rolling it on a clean flat surface. Any meter found to have a bent shaft should be repaired by replacing that shaft with a new one. If eccentricity is not found in the shaft, it may be present in the bucket wheel. Should the fault lie there, the rotor should be replaced with a new one.

Sprung yoke

The yoke may become sprung so that the distance between the upper and lower arms is too small or too great to permit proper adjustment of the rotor assembly within this space. It may also be distorted so that the coaxial holes will no longer properly aline the rotor assembly and the pivot. If either of these conditions is suspected, the alinement and spacing should be checked with a special yoke alinement gage that is available from the Property Maintenance Section, Silver Spring, Md.

In addition to the above, the stem of the yoke (that part from the slot for the hanger to the end onto which the tailpiece fits) occasionally becomes bent. A bent stem causes the bucket wheel to assume a position that is out of proper alinement with the flow lines of the water. If the amount of distortion in the yoke is minor and can be properly straightened, this should be done; if not, the yoke should be replaced with a new one.

Damaged cups

The bucket wheel and cups on it have more influence on the meter rating than has any other component. Cups should therefore be examined closely as any small distortion will cause a change in rating. Only for the most minor dents where the cups can be straightened to "like new" condition should repairs be attempted; otherwise the bucket wheel should be replaced with a new one.

Damaged tailpiece

The tailpiece should be examined for damage. It may be straightened if the damage is not too serious; otherwise it should be replaced with a new one.

Contact chamber

The contact chamber should be examined for proper meshing of the penta gear with the acme thread on the shaft and for proper adjustment of the contact wires. Proper adjustment of these parts should be maintained at all times. It should also be inspected for excessive wear of the upper bearing. Any missing or damaged parts such as screws, chamber caps, or binding posts should be replaced. Should the need arise, the entire contact chamber may be replaced with a new one.

Pivot and bearings

The pivot should be examined with a magnifying glass to see whether the point is fractured, rough, or warn flat at the apex. The point of a new pivot is rounded to a radius of approximately 0.005 inch; wear resulting in a radius greater than 0.010 inch is excessive. If any of these conditions exist, the pivot should be replaced with a new one.

To examine the pivot bearing conveniently, the contact chamber should be removed carefully and the bucket–wheel–and–hub assembly should be tilted to one side so that the lower arm of the yoke will not obstruct examination. The pivot bearing should then be examined for possible fracture, pits, or roughness. If any of the above are found, the entire hub assembly should be replaced with one containing a new pivot bearing.

No current meter should be packed or transported with the pivot bearing resting on the pivot. The pivot and pivot bearing should always be separated by the raising nut.

Lubrication

All bearing surfaces should be inspected to see that they have a thin coating of instrument oil. The small Price current meter has bearing surfaces above the bucket wheel in addition to the pivot bearing. These consist of (1) the bearing surfaces between the penta gear and the acme threads on the shaft, (2) the cylindrical bearing of the small shaft of the penta gear, (3) the cylindrial bearing of the shaft within the bearing lug, and (4) the thrust bearing between the shaft and the cap.

Spin tests

The spin test is an easy method of determining the condition of the bearings of a current meter. In making this test, the meter should be placed so that the shaft is in a vertical position and the bucket wheel is protected from air currents. The bucket wheel is then given a quick turn by hand to start it spinning, the duration of which is timed with a stopwatch. As the rotating bucket nears the stopping point, its motion should be carefully observed to see whether the stop is abrupt or gradual. Regardless of the duration of the spin, if the bucket wheel comes to an abrupt stop, the cause of such behavior should be found and corrected before the meter is used. In such instances, a lack of oil, the maladjustment of the penta gear, and a misalinement of the yoke are possible sources of trouble that should receive early attention.

The normal spin for a small type–AA Price should be approximately 4 minutes and should under no circumstances be less than 1½ minutes. Large variations in the duration of the spin test will be introduced by slight varations from the vertical position of the shaft. Some operators accordingly provide themselves with a small cir-

cular level vial that can be placed on the cap of the meter to help them make such a test with the shaft alined in a truly vertical position.

Another common test to determine the condition of the bearing of a current meter is to hold the meter so that the shaft is in a vertical position and while keeping the shaft in as nearly a fixed position as possible, to revolve the yoke and tailpiece in a horizontal plane around it. If the bucket wheel remains in a fixed position, it is an indication that the bearings are satisfactory, whereas if the bucket wheel tends to revolve with the yoke and tailpiece, it is an indication that the meter requires attention.

Routine Cleaning and Oiling of Current Meters

At the end of each day's use, the current meter should be thoroughly cleaned and oiled. The pivot and pivot bearing need special attention; unlike all other parts of the meter they are subject to rusting and, therefore, it is desirable that they be dried before they are oiled.

The outline below gives a step-by-step procedure for the cleaning and oiling of current meters.

Equipment:

1. Screwdrivers of proper size for use on set screws in the yoke and on the pivot-adjusting nut.
2. Large soft cloth that will readily absorb water for wiping the outer surfaces of the meter.
3. Cotton-tipped swabs for cleaning the bearing surfaces.
4. Supply of oil (instrument oil that is available from the Property Maintenance Section is recommended) in a container with facilities that permit a drop of oil to be applied in places that otherwise are difficult to reach.

Dismantle the current meter as follows:

1. Release the raising nut.
2. Release the two set screws in the yoke, holding the contact chamber and the pivot in place with forefinger and thumb.
3. Remove the contact chamber from the yoke slowly and carefully. Do not remove the cap at this time.
4. Remove the pivot from the yoke.

Clean the parts as follows:

1. Pivot bearing.
   a. Clean and dry the air pocket and the pivot bearing, using a cotton-tipped swab.
   b. Inspect the pivot bearing.
2. Pivot hole in the yoke.
   Swab the pivot hole in the yoke with a cotton-tipped swab.
3. Shaft.
   Clean and dry the shaft—particularly the acme threads.
4. Pivot.
   Wipe the pivot until it is thoroughly dry.
5. Contact chamber.

a. Remove the cap and shake out any water that may be trapped within the contact chamber. Occasionally, clean the chamber thoroughly by allowing hot water to flow into it under pressure. A jet of water such as that issuing from a hot-water tap is recommended. Hoppe's powder solvent has been used successfully to remove gummed oil if cleaning with hot water is not successful.

b. Wipe the interior of the stem of the contact chamber.

c. Swab the hole in the bearing lug by means of a cotton-tipped swab inserted through the stem of the contact chamber. Cleaning the hole in the bearing lug **from the top** frequently causes the contact wires to bend and eventually break, whereas cleaning it **from the bottom** neither bends the wires nor affects their adjustment.

Oil as follows:

1. Shaft.
   Apply a film of oil to (a) the acme threads (liberally, so that the excess oil will later spread over the penta gear and the penta shaft), (b) the area that enters the bearing lug, and (c) the uppermost end of the shaft.
2. Pivot bearing.
   Apply a thin film of oil over all exposed parts of the pivot bearing.
3. Pivot hole in yoke.
   Apply a drop of oil to the sides of the hole through which the pivot passes.
4. Pivot.
   Apply a thin film of oil to the pivot.

Reassemble as follows:

1. Replace the pivot and tighten the set screw that holds it in place. Make sure that the pivot lock nut bears against the yoke, and that the set screw bears against the flattened part of the pivot.

2. Fit the contact chamber over the end of the shaft and into its hole in the upper arm of the yoke. Do this slowly and carefully without applying much force, otherwise the penta gear or shaft may become damaged.

3. Match the marks on the contact chamber and yoke, and tighten the set screw holding the contact chamber in place.

4. Check the contact wires. The adjustment of both the single- and penta-contact wires should be examined to be sure that the adjustments are as light as possible without impairing the electrical contact.

5. Replace the cap on contact chamber.

6. Move the bucket-wheel-and-hub assembly up and down to determine whether the pivot adjustment is correct.

7. Check the operation of the current meter with a spin test.

8. Unless the current meter is to be used immediately, raise the pivot bearing off the pivot by means of the bucket-raising nut.

Low-Velocity Price Meter

The low-velocity meter differs from the general purpose Price meter in that the penta gear is removed and the single eccentric is replaced by a double eccentric which makes two electrical contacts for each revolution of the bucket wheel.

These meters are produced by the same dies and fixtures used in the manufacture of the general purpose meter. Consequently, they also have a single standard rating, and any parts may be replaced without the necessity of calibration. The duration of the normal spin should be 4½–5 minutes, and it should never be less than 2½ minutes.

In all respects other than those pointed out above the two types of meters are identical and all of the preceding paragraphs apply to the low-velocity meter.

Pygmy Current Meters

The Geological Survey designed the first of its pygmy current meters (see fig. 1) in 1936. The pygmy current meter is of the Price type in that it contains a cup-type bucket wheel mounted on a vertical shaft having bearings that operate in air pockets. The bucket wheel is 2 inches in diameter (two–fifths the size of that in the small Price current meter). The pygmy meter is designed particularly for the measurement of discharges of those streams that are so shallow that the small Price current meter fails to perform accurately, but which have too great a flow to be measured conveniently by either volumetric means or with small weirs.

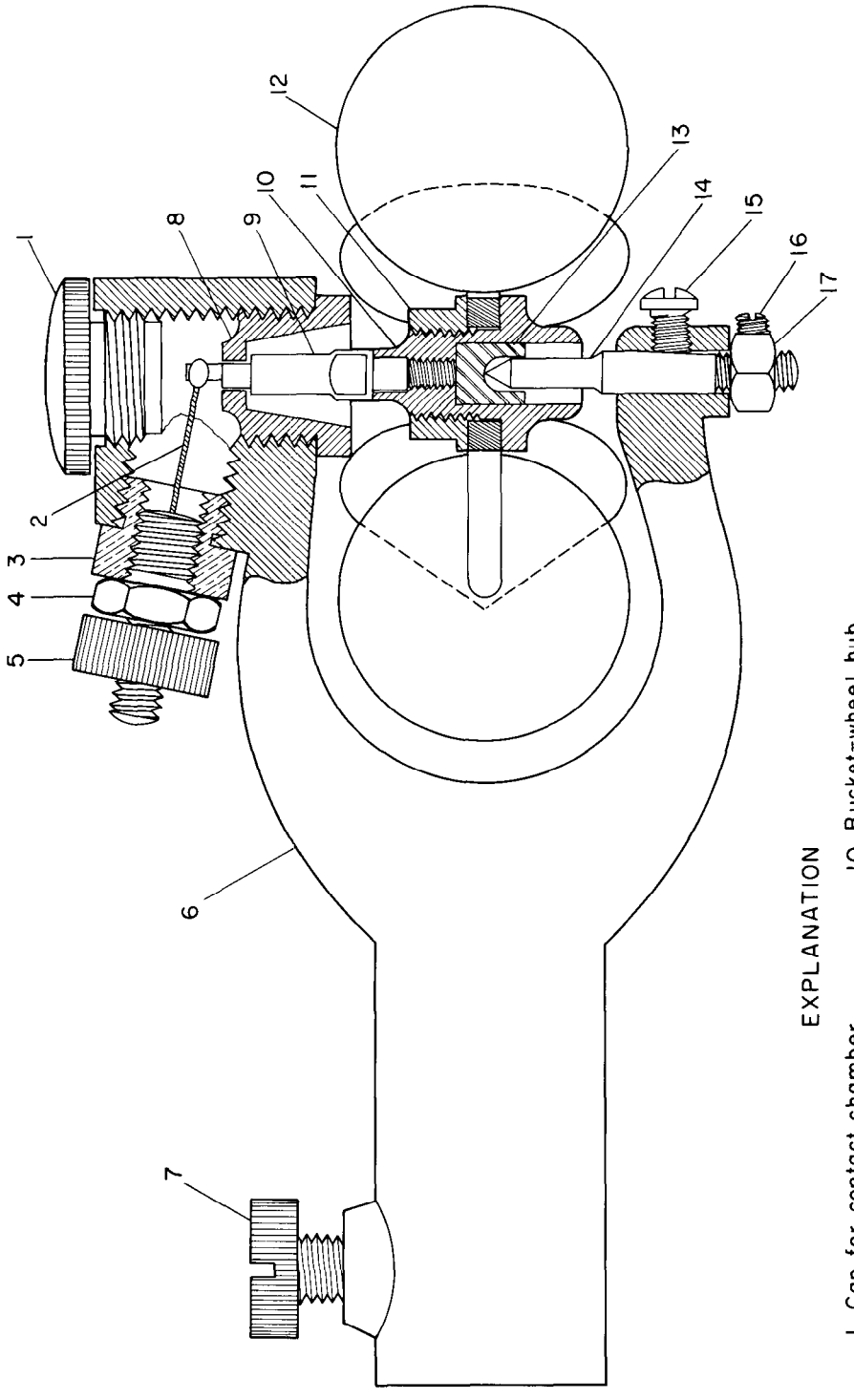
The pygmy meter differs from the type-AA small Price current meter in respects other than size (see fig. 4). The contact chamber is an integral part of the yoke and contains a single-revolution contact only. The meter has no tailpiece nor has it any provision for suspension from a cable. There is no bucket-wheel raising nut on the pygmy meter, but a small brass plug is provided to replace the pivot when the meter is stored or transported.

The bucket wheel revolves about 2¼ times as fast as that of the small Price current meter. This relatively high speed, combined with the fact that no multiple-contact arrangement is provided, limits its use to conditions where the revolutions are counted aurally to velocities not exceeding 3 feet per second.

The Survey's pygmy current meters are constructed so that the bucket-wheel-and-hub assembly may be removed from the yoke as a unit for convenience in cleaning and oiling. Instructions for removing and replacing such assemblies follow:

To remove the bucket-wheel-and-hub assembly from the yoke:

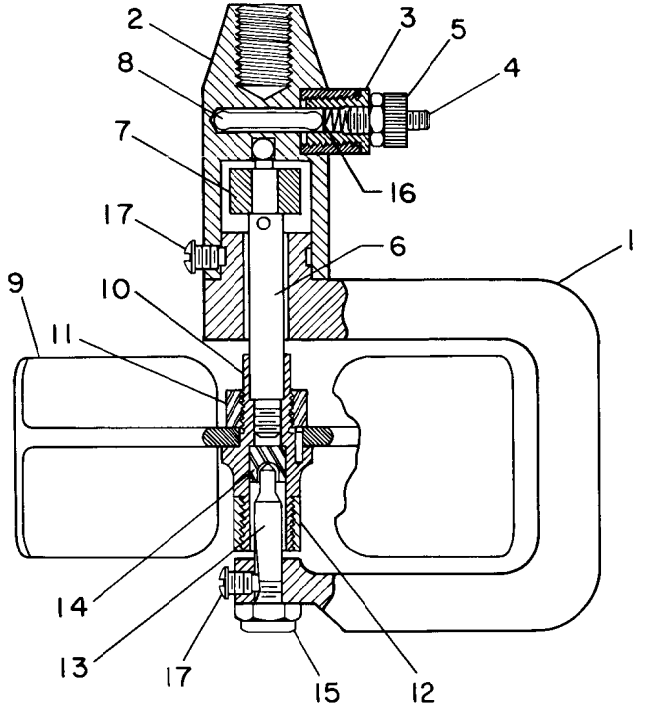
1. Remove the cap.
2. Release the set screw holding the pivot in the yoke.
3. Remove the pivot.
4. Tighten the set screw into the yoke (otherwise, it may offer difficulties in removing the bucket wheel).
5. Lower the bucket wheel to the lowest position in the yoke and carefully slide it forward and outward. If it is found that the bucket-wheel-and-hub assembly does not come out freely, return it to its original position and rotate it one-sixth of a turn. Repeat this operation until successful. **Never apply force in removing the bucket-wheel-and hub assembly** because the shaft and eccentric may become bent.



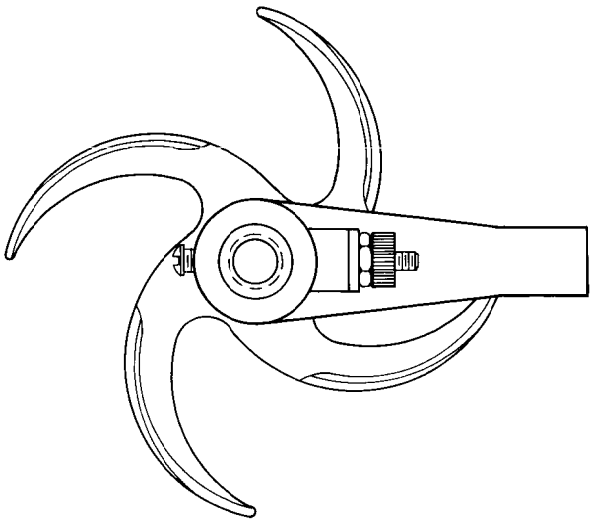
EXPLANATION

1. Cap for contact chamber
2. Binding-post beaded wire
3. Binding-post insulating bushing
4. Binding-post body
5. Binding-post nut
6. Yoke
7. Yoke set screw
8. Upper bearing
9. Shaft
10. Bucket-wheel hub
11. Bucket-wheel hub nut
12. Bucket wheel
13. Pivot bearing
14. Pivot
15. Pivot set screw
16. Pivot-adjusting nut
keeper screw
17. Pivot-adjusting nut

Figure 4.—Assembly diagram of pygmy current meter.



SIDE VIEW



TOP VIEW

EXPLANATION

1. Yoke
2. Contact chamber
3. Binding-post insulating bushing
4. Binding post
5. Binding-post nut
6. Shaft
7. Magnet
8. Glass switch
9. Vane
10. Vane hub
11. Vane hub nut
12. Raising nut
13. Pivot
14. Pivot bearing
15. Pivot-adjusting nut
16. Compression-spring assembly
17. Set screw

Figure 5.—Assembly diagram of ice meter.

To insert the bucket-wheel-and-hub assembly into the yoke:

1. With the pivot removed, set screw tightened, cap removed, and yoke and shaft held upside down, direct the upper end of the shaft into the hole of the upper bearing, and carefully adjust the bucket wheel into position within the arms of the yoke. **Do not apply force.** If the bucket wheel cannot be placed within the yoke without forcing, remove it, turn it one-sixth of a revolution, and repeat until successful.
2. Unscrew the set screw to a position that will permit the pivot to be inserted.
3. Insert the pivot.
4. Tighten the set screw and turn the yoke right side up.
5. Replace the cap.

Investigations have shown that there are very slight differences in the rotors of pygmy meters that prevent a standardized rating. Because the rotors are not identical, they cannot be replaced in the field. Meters are calibrated individually and each is supplied with its own rating table. A pygmy current meter which has been damaged should be returned to the Property Maintenance Section for repair and recalibration. The duration of the normal spin should be approximately 1½ minutes and should never be less than half a minute.

Ice Meters

Ice meters (see fig. 1) are also the vertical-axis type but differ from the Price in that the rotor used consists of four curved vanes. Other differences may also be seen in figure 5, which illustrates the assembly diagram of the ice meter. They are:

1. There is no rear extension of the yoke. The meter is supported by a section of special wading rod that screws into the top of the contact chamber. The object of this arrangement is to reduce the size of the ice hole required for inserting the meter.
2. The upper bearing is a small sphere instead of a sleeve.
3. The electrical contact is a magnetically actuated glass-sealed switch. There are two contact closures for each revolution of the rotor, one each time the poles of the magnet are alined with the leaves of the switch.

Assembly or disassembly of the ice meter offers no special problems except that the magnet is very brittle and must be handled with care, as all parts should be. Care and lubrication should be of the same type described for the Price meter.

Investigations have shown that there are very slight differences in the rotors of ice meters that prevent a standardized rating. Because the rotors are not identical, they cannot be replaced in the field. Meters are calibrated individually and each is supplied with its own rating table. An ice meter which has been damaged should be returned to the Property Maintenance Section for repair and recalibration. The duration of the normal spin should be approximately 5 minutes and should never be less than 2 minutes.

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10. Appendix E – Project Health and Safety Plan

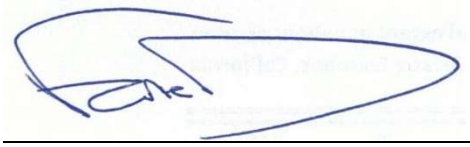
June 12, 2024

A WATCHING OUR WATERSHEDS RECEIVING WATER TRASH MONITORING HEALTH AND SAFETY PLAN

Prepared on behalf of:

Alameda Countywide Clean Water Program
Contra Costa Clean Water Program
San Mateo Countywide Water Pollution Prevention Program
Santa Clara Valley Urban Runoff Pollution Prevention Program
Solano Stormwater Alliance

by



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APPENDICES

1 INTRODUCTION

Since its inception in 1988, Balance Hydrologics (Balance) has provided high-quality scientific support and project management to myriad clients including state and federal agencies, municipalities, and planning firms. Balance has developed and implemented this water quality monitoring-specific Health and Safety Plan (HSP) as part of its overall health and safety program related to activities laid out in the Regional Trash Monitoring Plan for the Receiving Water Monitoring in compliance with the San Francisco Bay Municipal Regional Stormwater National Pollutant Discharge Elimination System (NPDES) Permit, Order No. R2-2022-0018, Provision C.8.e. It is the responsibility of all Balance employees and subcontractors to follow the requirements set forth in this HSP in accordance with Balance's Safety & Occupational Health Policy. When engaged in Balance-led sampling efforts, all participating field personnel are expected to abide by the procedures and requirements set forth in this HSP, as well as the safety and health polices of their employer or institution.

The goals of the program are:

- To promote and maintain the well-being of sampling personnel by the prevention of occupational injury and illness
- To identify and eliminate hazards that endanger the health and safety of sampling personnel
- To reduce work interruptions and delays caused by accidents
- To develop safety consciousness in sampling personnel.

An effective health and safety program is directly related to the dedication with which it is implemented by both management and employees. Every person is expected, as an individual, to comply in all respects with the goals and requirements in the HSP to maximize safety for themselves and for their fellow workers.

The purpose of this sampling-specific HSP is to assign responsibilities, establish personnel protection standards, specify safe operating procedures, and to provide for contingencies that may arise during field survey operations, especially those which involve environmental sampling and processing.

The Field Team Lead (FTL) has responsibility for implementing and enforcing this HSP. The FTL will continue to evaluate the HSP for adequacy throughout the field operations, and

will request changes as may be required by changes in site activities. All field personnel involved in sampling will be briefed on the contents of this HSP and given the opportunity to question any procedures.

1.1 Acknowledgements

This HSP is based on the Project HSP template established for the outfall monitoring portion of the Regional Trash Monitoring Plan which was prepared by Paul Salop at Applied Marine Sciences for their review of this HSP.

1.2 Project Area and Emergency Medical Centers

Sampling activities will be conducted at the general locations shown in **Table 1. Table 1** also provides information on the nearest emergency medical facility to target sampling locations. In the event of a medical emergency, field personnel should contact 911. When convenient, field personnel should then contact the Balance Health and Safety Officer (HSO) and Project Manager (PM) to inform them of the situation.

Table 1 Balance Project Team Sampling Locations

Location	Emergency Center
Dublin	**Stanford Health Care – ValleyCare** 5555 W Las Positas Blvd, Pleasanton 925-416-3418
Rodeo	**Contra Costa Regional Medical Center** 2500 Alhambra Ave, Martinez, CA 94553 925-370-5000
Fremont	**Kaiser Permanente** 39400 Paseo Padre Pkwy Hospital Building, 1st Floor, 39400 Paseo Padre Pkwy, Fremont, CA 94538 510-248-3000
Palo Alto	**Stanford Hospital Marc and Laura Andreessen Adult Emergency Department** 1199 Welch Rd, Palo Alto, CA 94304 650-723-5111
Milpitas	**Regional Medical Center Emergency Room** 225 N Jackson Ave, San Jose, CA 95116 408-259-5000
South San Francisco	**Kaiser Permanente Emergency Services** 1200 El Camino Real Hospital Tower, 1st Floor, South San Francisco, CA 94080 650-742-2511

1.3 Responsibilities

The following persons will have authority and responsibility for the program's implementation and continuance:

- Balance HSO
- Balance PM
- FTL

Certain duties may be conducted by other field personnel under the direction and supervision of one or more of the above-listed persons. In addition, the following individuals or groups will have specific duties.

2 PROJECT TEAM

2.1 Supervisory Personnel

The acting FTL is responsible for informing Balance employees, collaborators, and subcontractors regarding proper health and safety procedures. Additional responsibilities include:

- Directing employees under their supervision to learn and follow safe practices
- Setting a good example by following all safety rules
- Keeping informed of existing health and safety standards and effective safe work practices
- Encouraging employees to suggest improvements
- Working with the team so that no employee is assigned a task without appropriate safety training
- Recommending appropriate action when personal safeguards and safety equipment are not used in accordance with established procedures.

2.2 Field Staff - Individual Accountability

Balance Staff are responsible for following Balance's field safety protocols and procedures. Sub-consultants should follow their employers safety protocols and procedures.

Ultimately, the safety and well-being of each field staff member are paramount. While the company provides training, resources, and guidelines, it is imperative for every individual to take ownership of their safety in the field. This includes adhering to safety protocols, assessing risks, and making informed decisions to mitigate potential hazards.

As you embark on your fieldwork adventures, remember that safety is not just a priority—it is a mindset. By familiarizing yourself with the contents of this guidebook and adopting a proactive approach to safety, you contribute to the overall success of our field operations while ensuring your own well-being and that of your team members. Stay vigilant, stay informed, and stay safe out there.

Individual field staff are responsible for:

- Understanding and complying with all safety rules and regulations
- Keeping physically fit and mentally alert to accomplish work without injury
- Becoming familiar with safety practices and potential hazards associated with their job assignments
- Watching for and recognizing potential safety hazards and correcting them when possible. If unable to correct the hazard, report it immediately to the Field Team Lead and PM.
- Keeping supervisors apprised of any limitations that interfere with safe performance of their assigned job task
- Reporting all injuries and illnesses to supervisors immediately.

2.3 Training

Training is essential to maximize the skills and knowledge of all sampling personnel. All employees shall receive training and instruction in the following areas:

2.3.1 General Safety and Health Work Practices

Personnel directly involved in the field activities will be fully trained in the safe use of field equipment they will be engaged in operating and technical procedures. All sampling personnel will receive the daily safety briefings. Annual safety trainings that include job-specific safety training will be conducted prior to each sampling season.

2.3.2 Handling of Potentially Hazardous Materials

In the course of Project implementation, there is the potential for hazardous materials to form part of the waste stream that is captured through monitoring efforts. All Project personnel potentially coming into contact with trash collected as part of this effort will be trained in the identification and appropriate handling of hazardous waste materials.

2.3.3 Tailgate Safety Training

Associated with monitoring efforts, FTLs will hold "tailgate" safety briefings daily prior to onset of field operations. At the conclusion of each sampling event, FTLs will be

responsible for submitting copies of tailgate checklists and, as appropriate, a brief post-sampling report that assesses performance and any safety-related issues that bear additional attention.

2.4 Project Safety Analysis

A Jobs Hazard Analysis (JHA) will be completed prior to starting any on-site activities and will become part of this HSP (Appendix A).

3 HAZARD IDENTIFICATION

3.1 Travel

Field crews will be required to drive to and from each monitoring site, often in stormy conditions and sometimes at night.

3.2 Vehicle Traffic at Monitoring Site

Vehicle hazards are greatest during times of reduced visibility, such as during storm events and at night. The primary threats associated with working in or alongside roadways are workers being struck by passing vehicles or being involved in a vehicular collision. Traffic passing close to sampling areas may also splash water on sampling personnel, adding to risk posed by biological and exposure hazards. The risk associated with these threats is severe bodily injury or death.

3.3 Physical Hazards

Cuts, contusions, tripping hazards, and inclement weather are all possible physical hazards that may be confronted. Other hazards can include hypothermia, sunburn and exposure, heat stress, and overheating. Sampling in or near swift water also presents safety hazards.

3.4 Chemical Hazards

There is potential for hazardous gaseous and/or liquid contaminants to be present as the result of industrial runoff, illicit sanitary sewer connections, and illegal dumping of wastes. The presence of chemicals and/or chemical vapors may result in one or more of the following threats: toxic conditions, oxygen displacement, explosion, and fire. The risks associated with these threats include poisoning (acute and chronic), asphyxiation, and bodily injury.

3.5 Biological Hazards

Rodents and pathogenic microorganisms (including viruses) are potential biological hazards of concern. The primary threats associated with these hazards are injury from bites and the contraction of diseases.

4 HEALTH AND SAFETY PRACTICES

4.1 Personal Protection

Personal protective equipment (PPE) such as gloves and foul weather gear should be worn when exposed to chemical or environmental hazards. Closed toed shoes and long pants are also required. Sunscreen and thermal protection should also be used when appropriate. A minimum list of PPE should include:

- Hard hat
- Gloves, nitrile
- Glove, leather or other heavy duty
- Reflective traffic vest
- Steel-toed boots
- Eye protection
- Rain gear
- Personal floatation device

This list represents the minimum level of protective equipment. Additional equipment may be warranted for some sites or efforts. In additional, Project-related staff should observe the following general guidelines to protect against typical hazards associated with waste handling:

- When picking up uncontaminated sharp objects, such as glass or metal, staff should wear puncture resistant gloves.
- Sharps should be stored in an approved sharps disposal container
- Proper lifting techniques should be used for bulky items (e.g., full trash net). If nets are too heavy to lift manually, other means of deployment / retrieval should be employed (e.g., boom truck).
- Trash objects that are obviously hazardous, such as feces and hypodermic needles, should only be removed by trained personnel. If an object poses a substantial health risk and it can be removed safely, the objects should

be picked up using an appropriate tool and placed into a hazardous waste disposal container.

- If crystalline material is noted on or in any container, the contents shall be considered to be shock-sensitive waste and the container shall not be moved.
- Staff should report any suspicious, inappropriate, or potentially hazardous waste dumping to appropriate authorities, whether this material is collected as part of monitoring-related activities or not.

4.2 Traffic

It is anticipated that all sampling sites will be accessed by vehicle. As such, field personnel should abide by all traffic rules in conducting sampling activities. In addition, field personnel should be aware of nearby traffic, and potential hazards posed by it, during sampling and sample processing operations. Vests, traffic cones, and signage will be provided and should be used as site-specific conditions dictate.

4.3 Decontamination

Not applicable to field operations.

4.4 Waste Disposal

All waste from sampling activities should be collected and disposed of properly per the Project Monitoring Plan (MP). Related equipment that should be brought into the field associated with monitoring and characterization efforts includes:

- Heavy duty trash bags
- Hazardous waste disposal container
- Sharps storage container

4.5 Biological Hazards

To protect against bacterial and viral hazards, crews should avoid contact with stormwater samples. The use of powder-free nitrile gloves when handling samples is recommended. Crews should wash hands with soap and water before handling any food or drink. All potable food and water taken into the field must be kept separate from

all samples and chemicals in a dedicated cooler. Any animals encountered during sampling should be avoided.

Personnel participating in trash handling and characterization should have current vaccinations for tetanus and hepatitis A and B.

Puncture wounds as the result of discarded sharps must wash puncture site in warm soapy water for 15-minutes, do not limit blood flow if any, allow wound to bleed.

4.6 Thunderstorms

If a thunderstorm approaches, move inside a building or vehicle. If you find yourself caught outside during a thunderstorm, there may be nothing you can do to prevent being struck by lightning. There simply is no safe place outside in a thunderstorm. This is why it is very important to get to a safe place at the first signs of a thunderstorm. If you are caught outside, follow NOAA's recommendations to decrease the risk of being struck:

- Avoid open fields, the top of a hill or a ridge top.
- Stay away from tall, isolated trees or other tall objects. If you are in a forest, stay near a lower stand of trees.
- If you are in a group, spread out to avoid the current traveling between group members.
- If you are camping in an open area, set up camp in a valley, ravine or other low area. Remember, a tent offers NO protection from lighting.
- Stay away from water, wet items, such as ropes, and metal objects, such as fences and poles. Water and metal do not attract lightning, but they are excellent conductors of electricity. The current from a lightning flash will easily travel for long distances.

4.7 Swift Flowing Water

By implementing these preventative safety measures and following an effective emergency response plan, you can help mitigate the risks associated with working in or near swift moving water and ensure the safety and well-being of your employees.

4.7.1 Preventative Safety Measures

- Risk Assessment: Before working near or in swift water, conduct a thorough risk assessment to identify potential hazards and implement appropriate safety measures.
- Training: Ensure that all employees receive adequate training in swift water safety, including recognizing hazards, using personal protective equipment (PPE), and self-rescue techniques.
- Personal Protective Equipment (PPE): Provide employees with appropriate PPE such as a personal flotation device (PFD), helmet, wetsuit, and sturdy footwear to protect against hazards and aid in flotation.
- Buddy System: Implement a buddy system where employees work in pairs or small groups and keep visual contact with each other at all times. This enables prompt assistance in case of an emergency.
- Communication: Establish clear communication protocols, including hand signals or verbal cues, to communicate effectively while working in or near swift water.
- Awareness of Environment: Stay vigilant and aware of changing water conditions, including water levels, currents, and obstacles. Avoid working in areas with fast-moving or turbulent water.

4.7.2 Wading

Wading measurements represent one of the greatest potential sources of accidents during stream sampling. The wide range of conditions, combined with the relatively large number of measurements made by wading, creates the high potential for accidents. Constant awareness of wading dangers and weather conditions needs to be maintained to avoid accidents and potential injury. Listed below are some safety guidelines that need to be observed:

- Assess whether the river stage is rising or falling. Beware of rapid rises in river stage when wading and anticipate and allow for changes in flow conditions at the end of the measurement. It is a good idea to select an object (rock, stump, mark along bank, etc.) that is just above water surface and keep watching it to determine if the river stage is rising or falling.

- Always probe the stream bed ahead with a rod when moving from bank to bank. Keep your feet spread apart and alignment of legs parallel to the flow for better stability.
- If the velocity becomes too great for safe wading do not turn around, because when the greater area of the front or back of the body is exposed to the current, you may be swept downstream. Back out carefully, bracing yourself with the wading rod.
- Don't try to break the station discharge record for the maximum wading measurement.
- Wear a PFD when wading and conducting discharge measurements. Tie the tagline securely so that you may pull yourself out, if necessary.
- Don't wear boots or waders that are too tight or too loose.
- Beware of sand channels where pot- holes, quicksand, and scour can be hazardous.
- Beware of slick, steep banks, and swampy areas.
- Watch for debris

4.7.3 BRIDGE WORK, INCLUDING USE OF BRIDGE CRANES

Equipment needed to sample from bridges differs from that used in wading measurements in that a portable metal crane will be used to mount a reel and suspend the meter, sounding weights, and cable over the bridge. Some bridges are not adaptable for cranes, and bridge boards must be used, however for the bridges used in this project the bridge railings have been evaluated for compatibility.

Bridges are inherently dangerous because of vehicular traffic. The following safety procedures are recommended when making discharge measurements from a bridge:

- Know how to use the equipment. Make a dry run with new equipment or unfamiliar equipment at the office with someone who knows how it operates.
- Check the operation of the equipment before leaving the office to make sure that cranes, meters and reels are in good operating condition.

- Park the vehicle on the shoulder and use colored, revolving beams and emergency flashers on vehicle to warn oncoming traffic, as stated in the TCP.
- Set "caution" signs and/or plastic cones around work area and assign a person, when necessary, to watch for traffic and debris in the river and shout warnings as appropriate.
- Wear a PFD and work gloves.
- Using a reel and crane can be dangerous because of the possibility of getting fingers caught under the cable or having the cable break and fly wildly. If at any time you lose your grip on the hand crank, make no attempt to grab the handle. Let it go! The flying handle can severely bruise an arm or even break a bone.
- When sampling at night, use adequate lights, especially if drift is running.
- Keep a sharp look-out for drift when measuring. Have a pair of heavy-duty wire cutters handy to cut loose if drift is snagged.
- When working from a bridge that has hazardous power lines, provide a permanent warning sign on some part of the bridge directly above or below the hazard to alert the field person of the danger.

4.7.4 Emergency Response if Employee Falls into Swift Moving Water

- Stay Calm: If an employee falls into swift moving water, it's crucial for them to stay calm and avoid panicking. Panic can lead to poor decision-making and increase the risk of injury.
- Self-Rescue Techniques: Encourage employees to use self-rescue techniques if possible, such as swimming to the nearest bank, grabbing onto a stationary object, or floating on their back with feet downstream.
- Throw Rope or Reach Assist: If available, throw a rescue rope or extend a reach assist tool, such as a pole or branch, to the employee in the water. Instruct them to grab onto the rope or object while maintaining a firm grip.
- Emergency Communication: Immediately initiate emergency communication procedures to alert designated responders and

emergency services. Provide detailed information about the location of the incident and the employee's condition.

- Rescue by Trained Personnel: If the employee is unable to self-rescue, trained personnel equipped with appropriate rescue gear should perform a swift water rescue using specialized techniques and equipment.
- Medical Evaluation: After the employee has been rescued from the water, ensure they receive prompt medical evaluation and treatment, even if they appear uninjured. Swift water incidents can result in injuries or medical conditions that may not be immediately apparent.

4.8 Heat / Cold Stress Management

4.8.1 Cold Stress

Some of the anticipated Project-related activities may pose cold stress risk due to need to conduct Project activities in inclement weather. As with heat stress risk, task-specific SAPs/APPs will address control of temperature-related stress hazards, as appropriate for the season, activity, and work location.

For relevant efforts, documentation and training should cover the following topics relative to the activities and conditions expected:

- Training on the signs, symptoms, and first aid for hypothermia and frostbite;
- Control and prevention measures to include PPE, engineering and administrative controls, eating, drinking, and safe work practices;
- Conditions and limitations in which bare hand work can be performed;
- Training specific to water-related activities, which is covered in more detail in other sections of this manual.

The following general guidelines shall be followed to prevent cold-related injury and documented within APPs and JHAs.

- Warming areas should be available as required;
- A change of clothing shall be available if there is an opportunity for a worker to become wet;

- Workers shall use the buddy system to watch for signs and symptoms of cold related injuries or illnesses;
- If any extremity or body part is immersed in water where the air temperature is below 40°F (4°C), the employee shall be required to change any clothing that became wet and to dry off in a warm area.

4.8.2 Heat Stress

It is not anticipated that monitoring-related activities will place Balance employees and sub-consultants in locations with inherent heat stress concerns due to arid/high heat environments. However, task-specific activities (e.g. installation, maintenance, deconstruction) may generate heat stress and therefore training should incorporate elements of monitoring for heat stress. For relevant efforts, documentation and training should cover the following topics relative to the activities and conditions expected:

- Training on heat-related illnesses, how they can be prevented, and the control measures to be taken;
- Methods used to monitor for heat stress, including standards being utilized and the responsible party for monitoring heat stress;
- Signs and symptoms of heat-related illnesses and first aid procedures for each condition;
- Exacerbation of heat related injury and illness based on various types of clothing, including general work clothing, semi-permeable and non-permeable clothing, arc flash clothing, and other protective clothing which reduces the evaporation rate.

4.9 Branches and poking hazards

Encountering injuries from branches while in the field, such as cuts, scrapes, or even puncture wounds, can happen unexpectedly.

4.9.1 Preventative Measures:

- Stay Alert: Pay attention to your surroundings, especially when walking through dense foliage or wooded areas. Watch out for low-hanging branches or protruding branches that may pose a risk.

- Wear Protective Gear: Consider wearing long sleeves, pants, gloves, and safety glasses to provide some level of protection against scratches and cuts from branches.
- Use a Walking Stick or Trekking Pole: A walking stick or trekking pole can help you navigate uneven terrain and push branches aside to clear a path, reducing the risk of injury.
- Stay on Designated Trails: Stick to established trails whenever possible to minimize the likelihood of encountering overgrown vegetation or branches.
- Check Branches Before Grabbing: If you need to hold onto branches for support while navigating steep terrain, check them first to ensure they are sturdy and won't break or snap under your weight.
- Tuck shoelaces into shoes to prevent them from being caught on tree roots.
- Make a go/no-go decision during heavy winds, if sampling location is under heavy tree cover.

4.9.2 First Aid Response:

- Assess the Injury: Determine the extent of the injury and assess whether it requires immediate medical attention. Minor cuts and scrapes can typically be treated with basic first aid, while deeper wounds or punctures may require more intensive care.
- Clean the Wound: If the injury is minor, clean the wound with clean water and mild soap to remove dirt and debris. Avoid scrubbing the wound too vigorously, as this can cause further irritation.
- Apply Pressure: For cuts that are bleeding, apply gentle pressure with a clean cloth or bandage to help control the bleeding. Elevate the injured area, if possible, to further reduce blood flow.
- Dress the Wound: Once the wound is clean, apply an appropriate dressing, such as a sterile bandage or adhesive strip, to protect it from further contamination and promote healing.

- Monitor for Signs of Infection: Keep an eye on the wound over the next few days for any signs of infection, such as increased redness, swelling, warmth, or drainage. Seek medical attention if you notice any concerning symptoms.
- Seek Professional Help if Needed: If the injury is severe or you're unsure how to properly treat it, seek medical help as soon as possible. In remote backcountry locations, this may involve activating emergency services or seeking assistance from nearby hikers or park rangers.

4.10 Poison Oak

You can spot the plant all year long, though it changes color from green to crimson red in the fall.

- It's typically green in the spring and changes to crimson red in the fall.
- It grows into groups of three leaflets with the center leaflet typically growing longer than the other two.
- It grows into a dense and leafy shrub, ranging from one to six feet high.
- It has a vine-like appearance.
- It has either glossy or dull leaves.

4.10.1 Preventative

- Poison Oak pre-treatment – all offices should have pretreatment lotion. Be sure you have it in your field kit before you leave.
- Long-sleeve shirts / pants.
- Hat and gloves.
- Closed-toe boots/shoes.
- Never burn poison oak branches, smoke can cause irritation.
- Where safety glasses or prescription or sunglasses.

4.10.2 Self-Treatment

- Do not scratch

- Thoroughly wash exposed skin with cool water and/or poison oak post-exposure treatment or rubbing alcohol
- Wash under nails
- Take Benadryl if you have a negative reaction.
- Cortisone cream

4.10.3 When to seek medical attention

- If the rash covers much of your body
- If you have many blisters or swelling–especially on your eyelids, face, or genitals
- If you have trouble breathing or swallowing

4.11 Ticks

4.11.1 Personal Protection

- Wearing light-colored clothing (to more easily see ticks).
- Wearing long-sleeved shirts, tucking pant legs into socks or boots (delays ticks from reaching skin so they can be more easily found before attaching).
- Wearing high boots or closed shoes covering entire foot.
- Wearing a hat.
- Using appropriate insect repellants on non-facial skin and permethrin on clothes (kills ticks) in accordance with Environmental Protection Agency guidelines.
- Showering and washing/drying clothes at high temperature after outdoor exposure.
- Doing a careful body check for ticks, prompt removal with tweezers and skin cleansing with antiseptic.

4.11.2 Tick First Aid

- Remove the tick promptly and carefully. Use fine-tipped forceps or tweezers to grasp the tick as close to the skin as possible. Gently pull out the tick using a slow and steady upward motion. Avoid twisting or squeezing the tick. Do not handle the tick with bare hands. Do not use petroleum jelly, fingernail polish or a hot match to remove a tick.
- Secure the tick and take a picture. A picture of the tick can help you and your health care provider identify what type it is and whether you are at risk of a transmitted disease. You can trap the tick in a piece of tape for disposal in the garbage. Your provider may want to see the tick or a photo if you develop new symptoms.
- Wash your hands and the bite site. Use warm water and soap, rubbing alcohol, or an iodine scrub.

4.11.3 When to call your doctor

Contact your healthcare professional if:

- You aren't able to completely remove the tick. The longer the tick remains attached to the skin, the greater the risk of getting a disease from it. Your skin may also get irritated.
- The rash gets bigger. A small bump may appear at the site of the tick bite. This is typical. If it develops into a larger rash or you develop a rash anywhere, possibly with a bull's-eye pattern, it may be a sign of Lyme disease. The rash usually appears within 3 to 14 days.
- Consult your provider even if the rash disappears because you may still be at risk of having the disease. Your risk of contracting a disease from a tick bite depends on where you live or travel to, how much time you spend outside in woody and grassy areas, and how well you protect yourself.
- You develop flu-like signs and symptoms. Fever, chills, fatigue, muscle and joint pain, and a headache may accompany the rash.
- You think the bite site is infected. Signs and symptoms include pain, change in skin color or oozing from the site.
- You think you were bitten by a deer tick. You may need antibiotics.

4.12 Insect Stings - Bee and Wasps

The following are important for prevention of insect stings:

- Wear light-colored, smooth-finished clothing covering as much of the body as possible.
- Clothing that seals at the wrists and ankles prevents insects from entering under clothing.
- Avoid colognes, perfumes, and scented soaps, shampoos, and deodorants.
- Wear clean clothing and bathe daily since sweat may anger bees.
- Avoid flowering plants and discarded food.
- Remain calm and still if a single stinging insect is flying around.
- Swatting at an insect may cause it to sting or release a chemical (pheromone) that attracts more insects. Crushing a bee may also result in pheromone release.
- If you are attacked by several stinging insects at once, run to get away from them. (They may release pheromones while attacking).
    - Go indoors (not likely an option)
    - A shaded area is better than an open area to get away from the insects.
- If a bee comes inside your vehicle, stop the car slowly, and open all the windows.
- Workers with a history of severe allergic reactions to insect bites or stings should consider carrying an epinephrine auto injector (e.g. Epi-Pen™) and should wear a medical identification bracelet or necklace stating their allergy.

4.12.1 Insect Sting First Aid

- Remove the stinger using gauze wiped over the area or by scraping with a fingernail or other straight-edged object such as a credit card. Do not squeeze the stinger or use tweezers as this may release more venom.

- Wash the site with soap and water or antiseptic towelettes.
- Remove rings and other tight-fitting jewelry.
- Elevate the affected body area and apply ice or a cold compress to reduce swelling.
- Do not scratch the sting as this may increase swelling, itching, and risk of infection.
- Have someone stay with the worker to assist if they have an allergic reaction.
- Treatment for localized swelling and itching may include over-the-counter pain relievers, steroid creams, anesthetic sprays and/or oral antihistamines, if the individual is not allergic to these. However, antihistamines may cause drowsiness, which could create a safety concern for employees returning to work that day.

The website of the American Academy of Allergy, Asthma and Immunology (a professional organization for physicians and other healthcare providers who treat patients with allergies including from stinging insects) notes that most people develop pain, redness and swelling at the site of an insect sting. Much less commonly, some people experience anaphylaxis, which is a severe allergic reaction. According to the Mayo Clinic, people who have a severe allergic reaction to a bee sting have a 25% to 65% chance of anaphylaxis the next time they are stung. Symptoms and signs of anaphylaxis can include:

- Swelling of the face, throat or tongue
- Difficulty breathing
- Dizziness or fainting
- Stomach cramps
- Nausea or diarrhea
- Itchiness and hives over large areas of the body

Treatment for anaphylaxis involves properly administered epinephrine. Patients with a known history of this type of allergy carry auto-injectors with them for use if needed before

they can get to an emergency room. Several states have passed laws allowing entities rather than individuals to have auto-injectable epinephrine in their first aid kits.

4.13 Rattle Snakes

Most bites occur between the months of April and October when snakes and humans are most active outdoors. About 25 percent of the bites are "dry," meaning no venom was injected, but the bites still require medical treatment. Depending on weather and threatening conditions such wildfires; rattlesnakes may roam at any time of the day or night. If walking at night, be sure to use a flashlight. To avoid rattlesnake bites some safety precautions will help:

- Wear appropriate over-the-ankle hiking boots, thick socks, and loose-fitting long pants. Never go barefoot or wear sandals when walking through wild areas.
- When hiking, stick to well-used trails if possible.
- Avoid tall grass, weeds and heavy underbrush where snakes may hide during the day.
- Look at your feet to watch where you step and do not put your foot in or near a crevice where you cannot see.
- Do not step or put your hands where you cannot see and avoid wandering around in the dark.
- If a fallen tree or large rock is in your path, step up on to it instead of over it, as there might be a snake on the other side.
- Be especially careful when climbing rocks or gathering firewood.
- Check out stumps or logs before sitting down and shake out sleeping bags before use.
- Do not turn over rocks or logs. If you must move a rock or log, use gloves and roll it toward you, giving anything beneath it the opportunity to escape in the opposite direction.
- Never grab "sticks" or "branches" while swimming in lakes and rivers. Rattlesnakes can swim.

- Avoid approaching any snake you cannot positively identify as a safe species.
- If you hear the warning rattle, move away from the area and do not make sudden or threatening movements in the direction of the snake.
- Remember rattlesnakes do not always rattle before they strike!
- Do not handle a freshly killed snake - it can still inject venom.

4.13.1 Rattlesnake Bite First Aid

DON'T:

If bitten by a rattlesnake DO NOT:

- Do not make incisions over the bite wound.
- Do not restrict blood flow by applying a tourniquet.
- Do not ice the wound.
- Do not suck the poison out with your mouth.

These methods can very well cause additional harm and most amputations or other serious results of a rattlesnake bite are a result of icing or applying a tourniquet.

DO:

- Stay calm
- Call Dispatch via radio or 911
- Wash the bite area gently with soap and water if available
- Remove watches, rings, etc., which may constrict swelling
- Immobilize the affected area
- Keep the bite below the heart if possible
- Transport safely to the nearest medical facility immediately.

In remote areas, carry a rattlesnake snakebit kit. Most modern over-the-counter snakebite kits consist of a suction device for drawing out venom from the bite wound. This can be helpful in the interim of getting to a hospital or poison center if a kit is handy. Using your mouth is not advisable as the poison can enter the bloodstream through cuts or sores and might be swallowed.

5 EMERGENCY INFORMATION AND CONTACTS

Contact	Name	Organization	Phone Contact	Cell Number
Balance HSO	Eric Donaldson	Balance	510-704-1000 x210	510-517-7806
Balance PM	Eric Donaldson	Balance	510-704-1000 x210	510-517-7806
Balance COO	Colleen Haraden	Balance	510-704-1000 x212	510-520-5417
Total Flow PM	Jeff Blum	Total Flow	510-774-9223	510-774-9223
Blaine Tech PM	Bart Gebbie	Blaine Tech	310-628-1116	310-628-1116
Emergency Response		Fire Department	911	911

6 EMERGENCY FACILITIES

The information in the following table is repeated from **Table 1.**

Location	Emergency Center
Dublin	**Stanford Health Care – ValleyCare** 5555 W Las Positas Blvd, Pleasanton 925-416-3418
Rodeo	**Contra Costa Regional Medical Center** 2500 Alhambra Ave, Martinez, CA 94553 925-370-5000
Fremont	**Kaiser Permanente** 39400 Paseo Padre Pkwy Hospital Building, 1st Floor, 39400 Paseo Padre Pkwy, Fremont, CA 94538 510-248-3000
Palo Alto	**Stanford Hospital Marc and Laura Andreessen Adult Emergency Department** 1199 Welch Rd, Palo Alto, CA 94304 650-723-5111
Milpitas	**Regional Medical Center Emergency Room** 225 N Jackson Ave, San Jose, CA 95116 408-259-5000
South San Francisco	**Kaiser Permanente Emergency Services** 1200 El Camino Real Hospital Tower, 1st Floor, South San Francisco, CA 94080 650-742-2511

Appendix A – Jobs Hazard Analysis

Jobs Hazard Analysis (JHA)

Date Prepared: 4/22/2024
Project: WOW Trash Sampling Project
Activity: Receiving Water Sampling
Location: Contra Costa, Alameda, San Mateo and Santa Clara Counties, California
Prepared by: Eric Donaldson, Balance Hydrologics

Platform	Activity	Hazard	Action to Eliminate Hazard
All	General operations	Cold Exposure	Field personal will bring extra clothing and have a place to warm up, if needed.
All	General operations	Floating Debris	Have a spotter on duty looking for floating debris coming down the channel; move or retreve bridge board, if needed. If trawl is tangled with large debris that may pull the bridge crane into the flow, cut the cable to the trawl.
All	General operations	Overhead hazards (branches, powerlines, etc.)	Avoid areas where overhead obstacles may potentially interfere with operations, especially related to bridge crane operations.
All	General operations	Hyperthermia / hypothermia	Field personnel will wear clothing appropriate to work efforts and environmental conditions. Field personnel will have sunscreen and hats, and will bring lunch and drinks. Field personnel will work in pairs, at a minimum, and be observant of others present.
All	General operations	Ingestion of polluted water	a) Field personnel should assume the water being sampled is polluted and should take steps to minimize risk of ingestion. b) Field personnel should use proper PPE and ensure they are current on relevant immunizations. Field personnel should have access to drinking water, wash water, soap, and disinfectant. As applicable, field personnel should protect any existing wounds on hands with rubber or plastic gloves.
All	General operations	Noise exposure	Field personnel should use ear protection when intense noise or long-term exposure is anticipated.

Platform	Activity	Hazard	Action to Eliminate Hazard
All	General operations	Lifting/heavy loads	a) Personnel will wear sturdy non-skid soled shoes while working. b) Personnel will wear PPE (gloves, coveralls, bibs, etc.) as needed and observe proper lifting techniques and use the “buddy-system" for personal hazards.
All	General operations	Sun exposure	Field personnel should wear sunscreen when intense or long exposure to sunlight is a possibility. When contaminant monitoring is being conducted, the appropriate type of sunscreen should be selected in consultation with the project manager.
All	General operations	Slips, trips, falls	Field personnel should: be aware of potentially slippery surfaces and tripping hazards; wear footwear that has sufficient traction to reduce risk of slipping; wear steel-toed boots; keep all areas clean and free of debris; clean up all spills immediately; notify the Field Team Lead of any unsafe conditions
All	General operations	Lifting / heavy loads	Personnel will wear sturdy non-skid soled shoes while working. Wear PPE (gloves, coveralls, bibs, etc.) as needed and observe proper lifting techniques and the “buddy-system" for material / equipment handling.
All	General operations	Contact with person infected with COVID-19, potential spread to others	a) Personnel with active symptoms of COVID-19 will not be assigned to sampling operations b) Personnel with recent COVID-19 diagnosis will be allowed to return to active participation following current Centers for Disease Control guidance.

Appendix B – Tailgate Meeting Form

Balance Tailgate Safety Meeting Form
CC-ROD Station, Rodeo

Date_____ Time_____

Task Name_____

Site Location_____

Safety Topics **(add additional comments on other side / additional pages)**

Traffic Safety and Control: Traffic, splashing, cones / signage, safe parking	Protective Clothing/Equipment: Hard hat, steel-toed, foulies, gloves
Chemical/Biological Hazards: Calibration standards, rodents	Physical Hazards: Slips, trips (vault, sampling eqpt)
Water Hazards: Viruses, FIB	Emergency Response Procedures: Notifications, first aid kit, 911 / emergency rooms
Heat Illness/Cold Exposure Prevention: Buddy system, vehicles, clothing / layers	Other Site-Specific Issues: Be aware of surroundings, low pedestrian usage areas

Emergency Information

Nearest Hospital **Contra Costa Regional Medical Center**	Hospital Address and Route: **2500 Alhambra Ave, Martinez, CA 94553**
Hospital Phone Number **(925-370-5000**	

Project Contact Info

Project Health and Safety Officer Name **Eric Donaldson**	Project Health and Safety Officer Phone Number **510-517-7806 (m)**
Project Manager Name **Eric Donaldson**	Project Manager Phone Number **510-517-7806 (m)**

Field Team Lead _____

Printed Name Signature

Balance Tailgate Safety Meeting Form
AC-CRA Station, Fremont

Date_____ Time_____

Task Name_____

Site Location_____

Safety Topics **(add additional comments on other side / additional pages)**

Traffic Safety and Control: Traffic, splashing, cones / signage, safe parking	Protective Clothing/Equipment: Hard hat, steel-toed, foulies, gloves
Chemical/Biological Hazards: Calibration standards, rodents	Physical Hazards: Slips, trips (vault, sampling eqpt)
Water Hazards: Viruses, FIB	Emergency Response Procedures: Notifications, first aid kit, 911 / emergency rooms
Heat Illness/Cold Exposure Prevention: Buddy system, vehicles, clothing / layers	Other Site-Specific Issues: Be aware of surroundings, low pedestrian usage areas

Emergency Information

Nearest Hospital **Kaiser Permanente** **39400 Paseo Padre Pkwy Hospital Building, 1st Floor**	Hospital Address and Route:
Hospital Phone Number **(510-248-3000**	**1st Floor, 39400 Paseo Padre Pkwy, Fremont, CA 94538**

Project Contact Info

Project Health and Safety Officer Name **Eric Donaldson**	Project Health and Safety Officer Phone Number **510-517-7806 (m)**
Project Manager Name **Eric Donaldson**	Project Manager Phone Number **510-517-7806 (m)**

Field Team Lead _____

Printed Name Signature

Balance Tailgate Safety Meeting Form
AC-ALM Station, Dublin

Date_____ Time_____

Task Name_____

Site Location_____

Safety Topics **(add additional comments on other side / additional pages)**

Traffic Safety and Control: Traffic, splashing, cones / signage, safe parking	Protective Clothing/Equipment: Hard hat, steel-toed, foulies, gloves
Chemical/Biological Hazards: Calibration standards, rodents	Physical Hazards: Slips, trips (vault, sampling eqpt)
Water Hazards: Viruses, FIB	Emergency Response Procedures: Notifications, first aid kit, 911 / emergency rooms
Heat Illness/Cold Exposure Prevention: Buddy system, vehicles, clothing / layers	Other Site-Specific Issues: Be aware of surroundings, low pedestrian usage areas

Emergency Information

Nearest Hospital **Stanford Health Care – ValleyCare**	Hospital Address and Route:
Hospital Phone Number **925-416-3418**	**5555 W Las Positas Blvd, Pleasanton**

Project Contact Info

Project Health and Safety Officer Name **Eric Donaldson**	Project Health and Safety Officer Phone Number **510-517-7806 (m)**
Project Manager Name **Eric Donaldson**	Project Manager Phone Number **510-517-7806 (m)**

Field Team Lead _____

Printed Name Signature

Balance Tailgate Safety Meeting Form
SC-LPA Station, Milpitas

Date_____ Time_____

Task Name_____

Site Location_____

Safety Topics **(add additional comments on other side / additional pages)**

Traffic Safety and Control: Traffic, splashing, cones / signage, safe parking	Protective Clothing/Equipment: Hard hat, steel-toed, foulies, gloves
Chemical/Biological Hazards: Calibration standards, rodents	Physical Hazards: Slips, trips (vault, sampling eqpt)
Water Hazards: Viruses, FIB	Emergency Response Procedures: Notifications, first aid kit, 911 / emergency rooms
Heat Illness/Cold Exposure Prevention: Buddy system, vehicles, clothing / layers	Other Site-Specific Issues: Be aware of surroundings, low pedestrian usage areas

Emergency Information

Nearest Hospital **Regional Medical Center Emergency Room**	Hospital Address and Route:
Hospital Phone Number **408-259-5000**	**225 N Jackson Ave, San Jose, CA 95116**

Project Contact Info

Project Health and Safety Officer Name **Eric Donaldson**	Project Health and Safety Officer Phone Number **510-517-7806 (m)**
Project Manager Name **Eric Donaldson**	Project Manager Phone Number **510-517-7806 (m)**

Field Team Lead _____

Printed Name Signature

Balance Tailgate Safety Meeting Form
SC-ADO Station, Palo Alto

Date_____ Time_____

Task Name_____

Site Location_____

Safety Topics **(add additional comments on other side / additional pages)**

Traffic Safety and Control: Traffic, splashing, cones / signage, safe parking	Protective Clothing/Equipment: Hard hat, steel-toed, foulies, gloves
Chemical/Biological Hazards: Calibration standards, rodents	Physical Hazards: Slips, trips (vault, sampling eqpt)
Water Hazards: Viruses, FIB	Emergency Response Procedures: Notifications, first aid kit, 911 / emergency rooms
Heat Illness/Cold Exposure Prevention: Buddy system, vehicles, clothing / layers	Other Site-Specific Issues: Be aware of surroundings, low pedestrian usage areas

Emergency Information

Nearest Hospital **Stanford Hospital Marc and Laura Andreessen Adult Emergency Department**	Hospital Address and Route:
Hospital Phone Number **650-723-5111**	**1199 Welch Rd, Palo Alto, CA 94304**

Project Contact Info

Project Health and Safety Officer Name **Eric Donaldson**	Project Health and Safety Officer Phone Number **510-517-7806 (m)**
Project Manager Name **Eric Donaldson**	Project Manager Phone Number **510-517-7806 (m)**

Field Team Lead _____

Printed Name Signature

Balance Tailgate Safety Meeting Form
SM-COL Station, South San Francisco

Date_____ Time_____

Task Name_____

Site Location_____

Safety Topics **(add additional comments on other side / additional pages)**

Traffic Safety and Control: Traffic, splashing, cones / signage, safe parking	Protective Clothing/Equipment: Hard hat, steel-toed, foulies, gloves
Chemical/Biological Hazards: Calibration standards, rodents	Physical Hazards: Slips, trips (vault, sampling eqpt)
Water Hazards: Viruses, FIB	Emergency Response Procedures: Notifications, first aid kit, 911 / emergency rooms
Heat Illness/Cold Exposure Prevention: Buddy system, vehicles, clothing / layers	Other Site-Specific Issues: Be aware of surroundings, low pedestrian usage areas

Emergency Information

Nearest Hospital **Kaiser Permanente Emergency Services**	Hospital Address and Route: **1200 El Camino Real Hospital Tower, 1st Floor, South San Francisco, CA 94080**
Hospital Phone Number **650-742-2511**	

Project Contact Info

Project Health and Safety Officer Name **Eric Donaldson**	Project Health and Safety Officer Phone Number **510-517-7806 (m)**
Project Manager Name **Eric Donaldson**	Project Manager Phone Number **510-517-7806 (m)**

Field Team Lead _____

Printed Name Signature

Tailgate Safety Meeting Form

Date_____ Time_____

Task Name_____

Site Location_____

Participant (Name/Affiliation)

Affiliation	Name	Comment

11. Appendix F - Trash Characterization Photo Library

BAY AREA MUNICIPAL
STORMWATER COLLABORATIVE (BAMSC)

BAMSC REGIONAL TRASH MONITORING PROJECT

OUTFALL AND RECEIVING WATER MONITORING TRASH CHARACTERIZATION PHOTO LIBRARY VERSION 1.1

Submitted in compliance with the San Francisco Bay Municipal Regional Stormwater National Pollutant Discharge Elimination System (NPDES) Permit, Order No. R2-2022-0018, Provision C.8.e and EPA Water Quality Improvement Fund Grant 98T61401

Prepared on behalf of:

Alameda Countywide Clean Water Program
Contra Costa Clean Water Program
San Mateo Countywide Water Pollution Prevention Program
Santa Clara Valley Urban Runoff Pollution Prevention Program
Solano Stormwater Alliance

July 31, 2024 Draft

Item Type:
Single-Use Carryout Plastic Bags

Description:
Single-use carryout grocery-type bags (or pieces of bags)

Note: Bags with handles that are marked as “re-useable” or plastic bags with no handles are classified as “plastic, other”

Item Type:
Expanded Polystyrene (EPS) Foam

Description:
EPS foam (e.g., Styrofoam) limited to food and beverage related items.

Item Type: EPS foam/other (i.e., not related to food service) **Description:** EPS foam pieces related to packing materials, cooler pieces	
	

Item Type:
Single Use Plastic Food / Drink Ware

Description:
Any items made of plastic, including non-EPS plastic and compostable plastic, associated with food service or designed for one-time use for prepared food and beverage. This includes plastic cups (e.g., fast food, coffee etc) lids (non-EPS), straws, stirrers, cup spill plugs, cutlery, all containers, bowls, plates, trays, boxes, and other items designed for one-time use for prepared food.

Note: Does not include "Food Service Ware Accessories" such as straws, stirrers, cup spill plugs, cup sleeves, condiment packets, utensils (including chopsticks), cocktail sticks/picks, toothpicks, napkins, and other similar accessories. These get categorized as plastic other.

Plastic bottles associated with liquor or grocery stores (soda, wine, liquor) are also considered plastic, other.

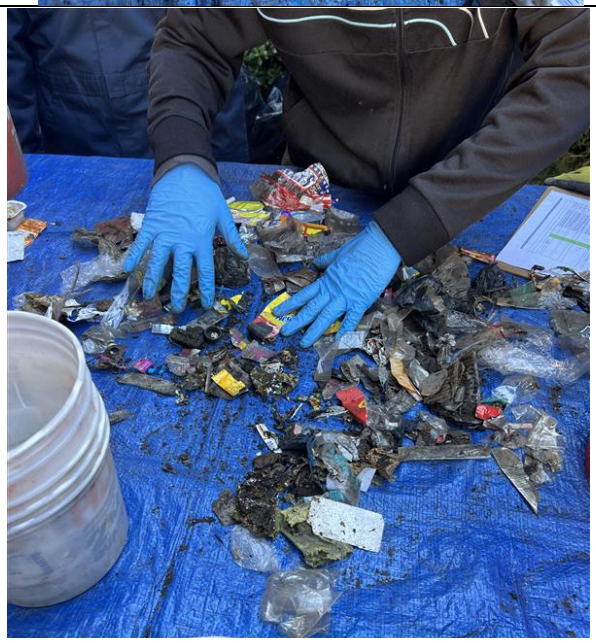
Item Type: Smoking Products, Traditional **Description:** Includes cigarette and cigar butts related to traditional smoking products.	

Item Type:
Smoking Products, Other.

Description:
Excluding cigarette / cigar butts, all remaining materials related to traditional smoking products. Includes plastic tips, matches, and packaging associated with each. Also includes components of electronic cigarette or cannabis smoking products, including refill containers. Lighters are excluded here and included in category of other plastic items.

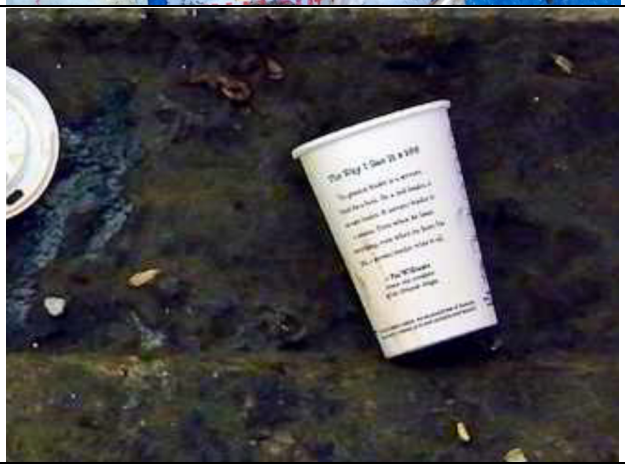
Item Type:
Other Plastic Items / Pieces

Description:
All other types of plastic items (or pieces of items), including but not limited to soft plastic pieces, hard plastic pieces, all rubber, all vinyl, and all other plastic fragments and pieces, mylar (non-recyclable) film food wrappers, food packaging, pre-packaged condiment packets, bottle caps, paper wrappers coated with plastic, six pack rings, plastic lids (non-EPS), pull tabs, plastic film, and all other plastic.



Item Type:
Organic / paper

Description:
Items (or pieces of items) solely made of paper, including, but not limited to, paper beverage containers (including coffee cups and aseptic containers), newspapers / magazines, lottery tickets/ parking tickets / receipts, books, cardboard, paper towels, envelopes, paper food containers (both clean and soiled) and labels, food packaging, wooden utensils (toothpicks, stirrers, chopsticks), bulk paper, food scraps, and hair. Yard waste is not included.

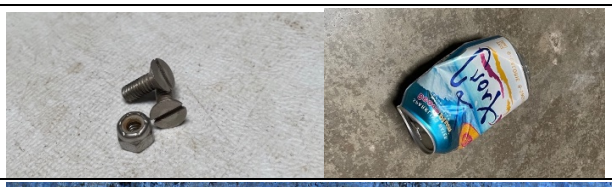


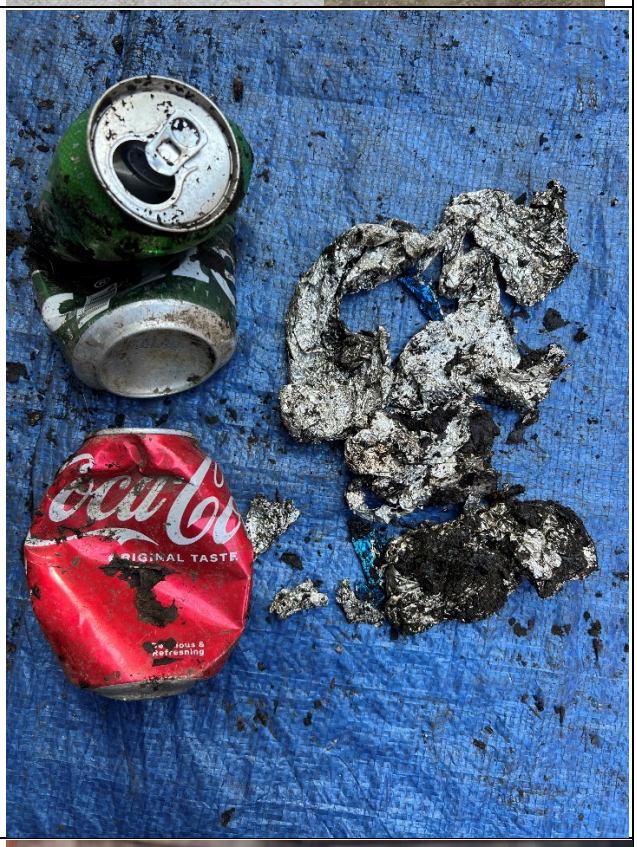
Item Type:
Fabric

Description:
Items (or pieces of items) made of organic or synthetic materials and produced by weaving or knitting fibers.

Item Type:
Metal

Description:
Items (or pieces of items) made of metal, including aluminum, copper, zinc, lead, etc. Includes, but not limited to, metallic food and beverage containers, aerosol cans, paint cans, aluminum food containers, and foil.

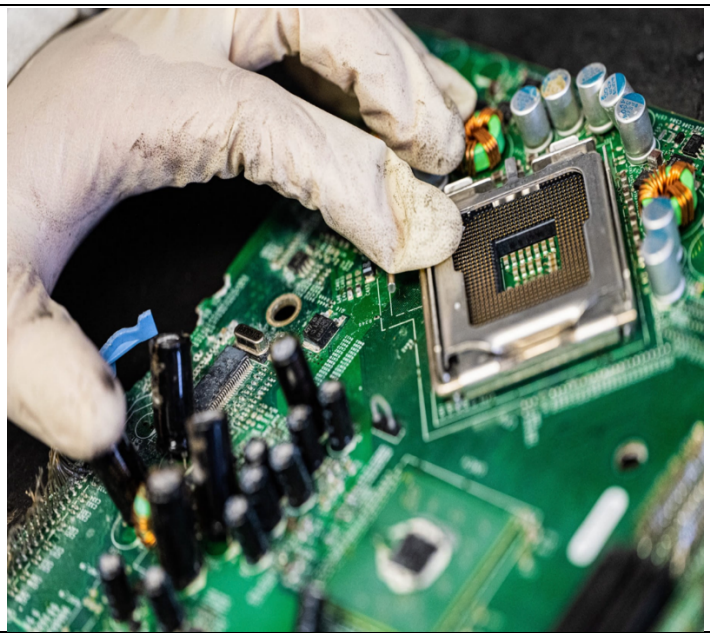




Item Type: Glass **Description:** Items (or pieces of items) made of glass.	
	
	

Item Type:
Mixed Materials

Description:
All items that contain more than one type of material described previously or don't otherwise fit in other categories. Examples may include foil-backed fiberglass, demolition debris, and circuit boards.



Above Photo Credit: Jeff Fitlow, Rice University

Item Type:
Biohazard

Description:
Items (or pieces of items) that may have the potential for presence of dangerous bacteria or viruses, including those associated with medical waste or human/dog waste.