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Technical Report

River Water Quality Monitoring Manual: Pre-Sampling Quality Assurance and Quality Control

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Front cover photo: Upstream of the Kebena tributary of Akaki river in December 2022 (photo by Abel Zewengel).
Back cover photo: Participants in the workshop to decide the scope of the manual (photo by IWMI).

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List of Acronyms

AMR	Antimicrobial resistance
ARB	Antibiotic-resistant bacteria
APHA	American Public Health Association
BRLi	BRL ingénierie
CoC	Chain of Custody
DO	Dissolved oxygen
DQO	Data quality objective
ESBL	Extended-spectrum β-lactamase
GPS	Global Positioning System
HDPE	High-density polyethylene
PPE	Personal protective equipment
QAP	Quality Assurance Plan
QA	Quality assurance
QA/QC	Quality assurance and quality control
QC	Quality control
SOP	Standard operating procedure
SDS	Safety data sheet
UNEP	United Nations Environment Programme
WHO	World Health Organization
IWMI	International Water Management Institute
AAWSA	Addis Ababa Water and Sewerage Authority
ARG	Antibiotic resistance gene
BOD	Biochemical oxygen demand
CFU	Colony-forming unit
CGIAR	Consultative Group on International Agricultural Research
SMART	Specific, measurable, achievable, relevant, and time-bound
TKN	Total Kjeldahl nitrogen
TSS	Total suspended solids

Summary

Water quality information plays a crucial role in determining the causes of pollution, environmental and public health hazards, and management of water. Variations in monitoring, sampling, analysis, and data-handling procedures could affect the reliability and consistency of results; thus, there is a need for standardised monitoring and quality assurance and quality control (QA/QC) to ensure evidence-based prevention and control of pollution. This manual titled "River Water Quality Monitoring Manual: Pre-Sampling Quality Assurance and Quality Control" provides guidelines on how to prepare the team, equipment, instruments, sampling materials, documentation, laboratory, transportation, and safety before sampling.

This manual outlines the key activities that need to be done before field activities, including: (i) the definition of sampling and data quality objectives; (ii) the preparation of field teams and task assignment; (iii) equipment and materials inspection; (iv) instrument calibration and verification; (v) verification of monitoring sites and sampling procedures; (vi) selecting containers, labelling, preserving, and storing samples within holding times; (vii) sample transportation and laboratory receiving; (viii) documentation and chain of custody; (ix) health, safety, and biosafety preparation; and (x) final readiness review and deployment authorisation.

Pre-sampling QA/QC focuses mainly on preventing contamination, sample degradation, equipment malfunction, and recording errors. Field blanks, duplicates, and other types of quality assurance samples help assess the chances of contamination and the repeatability of the sampling process, whereas instrument calibration, equipment checklists, sampling records, and chain-of-custody (CoC) documentation help identify weaknesses in preparation.

This manual is meant for water quality professionals, field workers, laboratory technicians, inspectors, scientists, and other entities involved in environmental monitoring and pollution control. The manual is general and can be adapted to any river catchments, taking account of local seasons and laboratory capacity. It was primarily developed and applied based on experiences in the Akaki Catchment, Ethiopia, and it may be useful for coordinating efforts on pollution source investigations, assessment of microbial pollution, and antimicrobial resistance (AMR) monitoring from the One Health viewpoint.

Effective use requires trained personnel, the right equipment, enough materials, defined roles, standard operating procedures, interaction between field and laboratory staff, and a pre-sampling readiness review. Sampling must not begin if any of these is lacking, because the safety of the work and the accuracy of the samples and data depend on them. Better QA/QC preparation helps generate good-quality data.

Introduction

Overview

Pre-sampling preparation is everything a field team does before leaving for a sampling site. It ensures that people, equipment, instruments, sampling materials, paperwork, laboratories, transport, safety measures, and quality checks are ready. Good preparation means samples are collected, preserved, transported, and recorded consistently, so the results are reliable and scientifically sound. This manual gives step-by-step guidance on the quality assurance and quality control (QA/QC) needed before sampling river water. It draws on lessons from water quality work by IWMI and its partners in Ethiopia's Akaki catchment, so it reflects the needs of the institutions and experts working there. However, the manual is general and can be applied to any river catchment in Ethiopia and elsewhere.

The manual outlines common steps for preparing before sampling: checking equipment and instruments, reviewing the sampling plan, labelling samples, preserving them, transporting them, keeping records, and carrying out quality checks (QA/QC).

When every team prepares the same way, results from different teams, sites, and dates can be compared and trusted. This helps institutions work together and supports decisions on managing the catchment, setting regulations, and tracking changes in water quality over time (UNEP, 2023; Kibret et al., 2025).

Following the steps exactly is especially important when sampling for bacteria and AMR. Small differences in how samples are handled, kept clean, preserved, transported, or timed can change the results. Using the same procedures every time keeps results accurate and reliable (Liguori et al., 2022; Coque et al., 2023).

Consistent handling also allows teams to produce comparable data on antibiotic-resistant bacteria (ARB) and the water conditions that help them spread. That data supports joint efforts to prevent and control river pollution under the One Health approach, which links the health of people, animals, and the environment.

Key QA/QC activities before sampling

Table 1 lists the quality checks (QA/QC) that must be completed before the team goes to the field, covering planning, logistics, technical checks, paperwork, safety, biosafety, and final approval. These activities are grouped into nine areas: team organization and communication; equipment, instruments, and supplies; calibration, checks, and records; sampling plan and site readiness; containers, labels, preservation, and holding times; logistics, transport, and laboratory

coordination; field records and chain of custody; health, safety, biosafety, environment, and emergency preparedness; and final QA/QC approval. For each activity, the table shows what needs to be done, which quality checks apply, who is responsible, and which records must be kept, so it is clear who did what and every step can be traced later. Figure 1 shows how these areas fit together in one workflow, from planning to deployment authorisation.

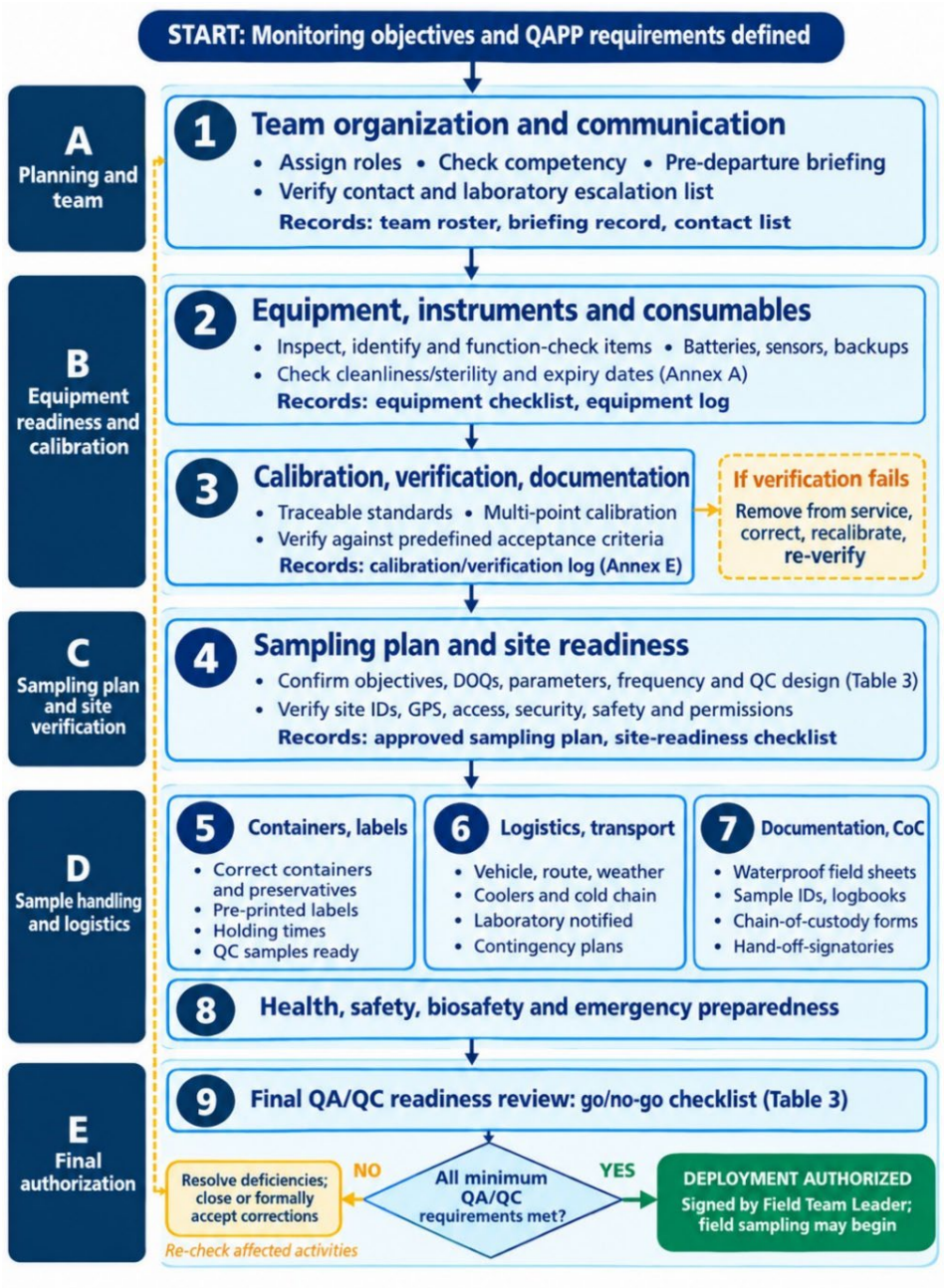


Figure 1. Pre-sampling QA/QC workflow for water quality monitoring and field deployment authorisation (Adapted from APHA, 2017 and UNEP, 2023)

Table 1. Major pre-sampling preparation activities, required tasks, associated QA/QC measures, and required documentation

No.	Preparation activity	Key tasks before deployment	Specific QA/QC measures	Lead responsibility	Required records
1	Team organization and communication	Confirm team composition; assign field, safety, equipment, documentation and sample-transport roles; conduct briefing; confirm laboratory contacts and escalation arrangements	Roles documented; competency/training status checked; briefing completed; contact list verified; changes communicated and recorded	Field Team Leader	Team roster; briefing record; contact list
2	Equipment, instruments and consumables checklist	Inspect equipment and instruments, verify functionality and measurement range, check batteries, sensors and accessories, confirm cleanliness/sterility, confirm equipment identification, confirm critical backups are available	Functional checks completed; verification tests for measurement range confirmed for field instruments (and detection/quantification limits for laboratory instruments); equipment ID recorded; sterile/clean materials verified; expiry dates checked; deficiencies corrected or documented; backups available for critical items	Field Team Leader / Sampling & Equipment Officer	Equipment checklist; equipment log
3	Instrument calibration, verification and documentation	Prepare traceable standards; perform multi-point calibrations on field probes using fresh calibration standards according to SOP/manufacturer requirements; verify performance and document results	Verification of calibration performed using certified reference materials and standards of known concentration; acceptance criteria predefined; calibration and verification results recorded; failed instruments removed from service until corrective action is completed	Sampling & Equipment Officer	Calibration and verification logs
4	Sampling plan preparation and site readiness	Confirm objectives, identify hotspots, sites, parameters, sample types, frequency, timing, review SOPs for parameter-specific collection methods, laboratory requirements and contingency arrangements; confirm site access and safety	Approved plan available to all team members; site IDs/GPS verified; site access and security reviewed; sampling design selected based on site heterogeneity and objectives; QC sample types and frequency predefined; deviations documented	Project Coordinator / Field Team Leader	Approved sampling plan; site-readiness checklist
5	Sample containers, labels, preservation, storage and holding times	Prepare correct container type and volume; label in advance; prepare preservatives where required; confirm storage temperature and method-specific holding times	Container suitability and material compatibility verified against target analytes (e.g., sterile polypropylene or borosilicate glass for coliforms; acid-washed HDPE for metals); equipment blanks, and trip blanks used to detect cross-contamination; sterile containers used for microbiology; labels match sample IDs; preservatives	Sampling & Equipment Officer / Documentation, Custody & Laboratory Liaison Officer	Container checklist; preservation/holding-time schedule

No.	Preparation activity	Key tasks before deployment	Specific QA/QC measures	Lead responsibility	Required records
			correct and within expiry; temperature and holding-time requirements documented		
6	Logistics, transport, and laboratory coordination	Confirm vehicle, route, site access, weather, coolers, ice/cooling materials, communication, laboratory receipt and transfer arrangements	Transport timing verified to support required holding times (e.g., 6–24 hours for coliforms/*E. coli*, cooled to <10 °C, 48 hours for unpreserved nitrate/nitrite, cooled to ≤6 °C); cold-chain arrangements checked, maintaining target temperatures using wet ice or conditioned gel packs in insulated transport coolers; laboratory notified; chain-of-custody forms prepared; contingency arrangements confirmed	Safety & Logistics Officer / Documentation, Custody & Laboratory Liaison Officer	Logistics checklist; transport plan; laboratory notification
7	Field documentation and chain of custody	Prepare waterproof field sheets, site forms, sample labels, field logbooks and custody forms; assign handoff responsibilities	Forms pre-labelled where practical; unique sample IDs checked; custody fields and signatures defined for field→transport→laboratory transfers	Documentation, Custody & Laboratory Liaison Officer / Field Team Leader	Field forms; chain-of-custody records
8	Health, safety, biosafety, environmental and emergency preparedness	Complete risk assessment; prepare PPE, first aid, communication and emergency supplies; review biosafety, chemical and waste management	Risk controls verified; PPE serviceable; emergency contacts functional; waste/disinfection materials available; Safety Data Sheets maintained as an accessible, up-to-date inventory for every chemical on site; briefing completed	Safety & Logistics Officer / Field Team Leader	Risk assessment; safety checklist; briefing record
9	Final QA/QC Readiness Review and deployment authorisation	Complete a final QA/QC review of all preparation records before deployment. Document minor deviations and resolve all critical deficiencies. Field deployment is authorised only when critical deficiencies are resolved, minor deviations are closed or formally accepted, and minimum QA/QC requirements are met	Go/no-go checklist completed; corrective actions closed or formally accepted; Field Team Leader and QA Officer sign deployment authorisation	Field Team Leader / QA Officer	Pre-deployment authorisation record

(Adapted from APHA, 2017; UNEP, 2023)

Team Organization and Communication

The field team is set up according to the monitoring goals, the number and type of sites, the tests required, and the safety conditions on the ground, with the following five factors considered.

- The team should be large enough to cover sample collection, quality checks, record-keeping, and safety, while still fitting in the available vehicles, and it should be designed around the hazards expected at each site, such as traffic, deep or fast water, and contact with harmful bacteria or chemicals.
- Every member should be trained to collect samples, use and care for the instruments, and follow the QA/QC and record-keeping steps.
- Team size and roles should match the vehicle space, the order of sites, and the time needed to finish all sites in one day.
- At least one member should know the catchment well, including how to reach the sites and how to talk with local communities.
- The team must stay in contact with the laboratory, the Safety and Logistics Officer, and the project coordinator throughout the sampling campaign.

Figure 2 summarizes the four-person field-team structure and reporting lines. Experience in the Akaki catchment indicates that a core field team of four people can usually travel together in one 4WD vehicle: a Field Team Leader, a Sampling and Equipment Officer, a Documentation, Custody and Laboratory Liaison Officer, and a Safety and Logistics Officer (Table 2). The Project Coordinator and the QA Officer oversee the work and are not counted among the four team members; the QA Officer must be independent of the Field Team Leader. The driver is not counted among the four unless also assigned one of these roles. The Field Team Leader coordinates field tasks and confirms readiness; the Sampling and Equipment Officer reports site access, sample-condition, and equipment problems; the Documentation, Custody and Laboratory Liaison Officer confirms laboratory requirements and sample receipt; and the Safety and Logistics Officer briefs the team on hazards, biosafety, and emergency procedures. Before departure, the Field Team Leader verifies that forms, labels, chain-of-custody documents, calibrated instruments, preservation materials, QC containers, coolers, and laboratory submission requirements are ready. The briefing covers objectives, site order, QC samples, laboratory delivery time, safety risks, weather and road conditions, and contingency plans. Any change from the approved sampling plan must be entered in the deviation and change log, including the reason, date, responsible person, and corrective action.

Table 2. Pre-sampling roles, responsibilities, and communication protocols

Role	Preparation responsibilities	Communication responsibilities	Key records
Field Team Leader	Confirms team composition; approves equipment and readiness checks; reviews sampling plan; ensures risk assessment and briefing; co-signs the deployment authorisation with the QA Officer	Coordinates the team; communicates changes, delays and unresolved risks to the Project Coordinator/QA Officer; confirms laboratory readiness and QA/QC pre-departure readiness before authorising departure	Team roster; readiness checklist; briefing; deployment authorisation
Sampling and Equipment Officer	Reviews site procedures, sample types, container requirements, QC samples, labelling and sample handling requirements and checks equipment condition, IDs, batteries, sensors, calibration status, standards and backups before departure	Reports site access, safety, sampling or sample-integrity problems immediately to the Field Team Leader. Also reports equipment deficiencies and corrective actions and confirms equipment readiness before departure	Training/competency record; field checklist; equipment and calibration logs
Documentation, Custody & Laboratory Liaison Officer	Prepares field sheets, sample IDs, labels, logbooks and chain-of-custody forms; checks completeness, confirms analytical requirements, container/preservation needs, holding times and laboratory sample-receipt arrangements	Coordinates sample identification and custody information with the field sampler, transport/courier and laboratory, confirms expected laboratory delivery time, receipt conditions, rejection criteria and any change in analytical arrangements	Field forms; chain-of-custody forms; laboratory notification; sample-receipt requirements
Safety and Logistics Officer	Completes/updates risk assessment; checks PPE, first aid, disinfectants, waste materials and emergency contacts; confirms vehicle, route, site access, weather, coolers and transport/logistics arrangements	Communicates hazards, control measures and emergency procedures during briefing and throughout deployment, and communicates logistics and transport constraints and contingency arrangements	Risk assessment; safety checklist; briefing record

(Adapted from BRLi, 2009; UNEP, 2023)

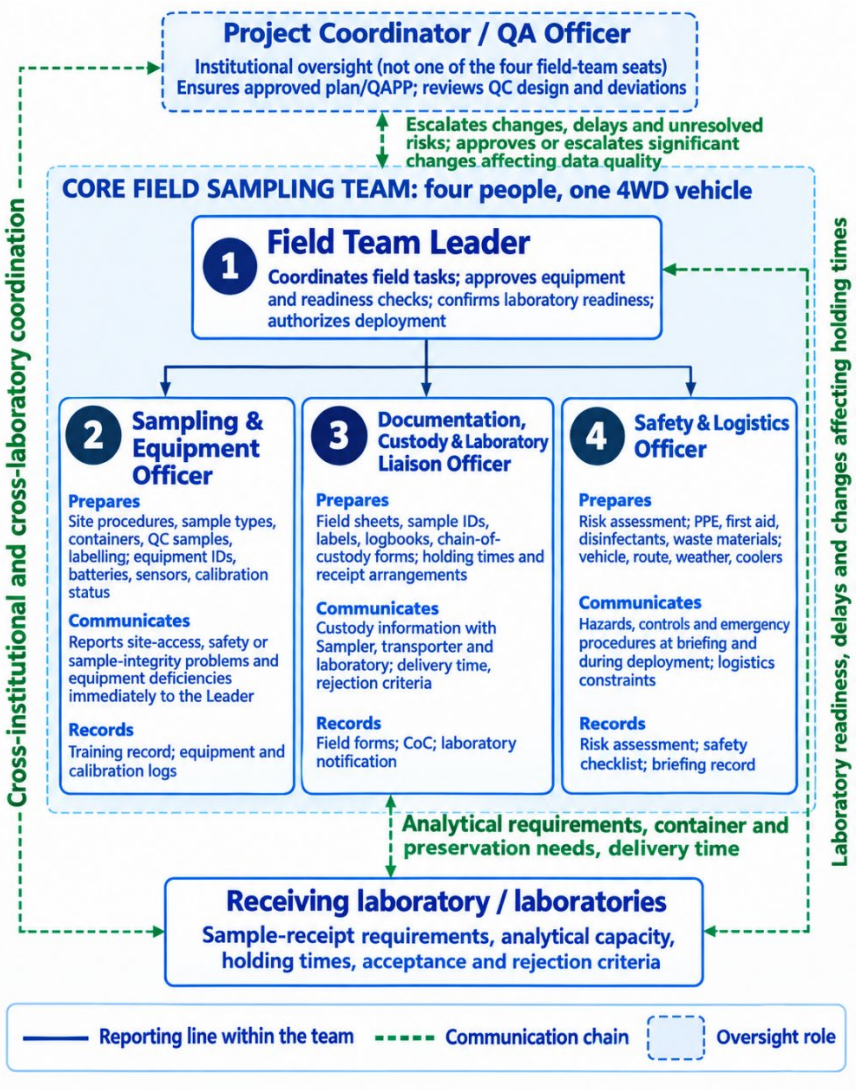


Figure 2. Field team organization chart for the four-person sampling team, showing reporting lines and the communication chain to the laboratory and Project Coordinator/QA Officer (Adapted from BRLi, 2009; UNEP, 2023)

Equipment, Instruments, and Consumables Checklist

Use the equipment inspection checklist in Annex A before departure to confirm that all required equipment and instruments are available, functional, clean, correctly identified, and suitable for the planned measurements. This check reduces the risk of equipment failure, poor calibration, contamination, and data loss. Equipment selection should be based on the monitoring objectives and parameter-specific methods, and should be consistent with relevant guidance, including the Guideline for Developing a Water Pollution Prevention and Control Plan for the Akaki Catchment (Kibret et al., 2025), the Awash Basin Water Quality Strategic Plan (Awash Basin Authority, 2017), and the National Integrated Water Resources Management Program (Alamirew & Kahsay, 2018). Before each campaign, the Field Team Leader confirms that coolers, ice packs, spare batteries, and chargers are ready, and that damaged equipment has been replaced. Consumables

must be available in sufficient quantities, within expiry dates, clean or sterile as required, correctly labelled, and suitable for the planned physical, chemical, microbiological, and AMR analyses.

Before every field trip, use the pre-sampling QA/QC checklist in Annex B to verify that sample containers are suitable and ready. Use the separate pre-sampling checklist in Annex C to check preservatives, gloves, labels, field blanks and other QA/QC samples, and cleaning materials. Use Annex D to verify parameter-specific container and preservation requirements. Complete the applicable checklists for each sampling campaign and, where appropriate, for each cooler or sample batch. Record each item as Yes, No, or Not applicable, and document any deficiency and corrective action in the corrective action column. Sampling must not begin until critical deficiencies have been corrected and recorded and the Field Team Leader has signed the checklist; minor deviations must be documented and may be formally accepted by the Field Team Leader and QA Officer.

Instrument Calibration, Verification, Documentation and Traceability

Calibration and verification are the key quality checks that show field and laboratory instruments are ready to use before sampling. Calibration means adjusting the instrument against a certified reference standard. Verification means confirming, with an independent check standard, that the readings fall within the approved limits. Together, these checks make measurements more accurate, catch instruments that drift over time, make results comparable across teams, and ensure the data can stand up to scientific scrutiny (APHA, 2017; UNEP, 2023). Every field instrument must be calibrated before the team leaves, following the approved SOPs, the manufacturer's instructions, and the Quality Assurance Plan (QAP), using the pre-departure steps as shown in Figure 3.

Step 1. Inspect instruments. Check each instrument for damage, make sure its ID number is visible, and confirm all accessories, cables, and spare parts are there.

Step 2. Clean probes and sensors. Clean and prepare probes and sensors as the manufacturer recommends, then rinse them with deionized water.

Step 3. Check batteries. Make sure batteries are fully charged, and spare batteries are packed.

Step 4. Prepare standards. Use fresh, certified standards that have not expired and, where required, are at the temperature the manufacturer recommends.

Step 5. Calibrate. Calibrate each instrument following the approved SOPs and the manufacturer's instructions, using multi-point calibration for field probes where applicable.

Step 6. Check the results. Measure a check standard and confirm the reading falls within the limits set in the QAP.

Step 7. Record the results. Record all calibration and verification details promptly in Part A of the Calibration, Verification and Traceability Record (Annex E), and log each event in Part B.

Step 8. Set aside failed instruments. Label any instrument that fails calibration or checking as "out of service" and do not use it until it has been fixed, recalibrated, and checked again. Use a backup instrument in the meantime.

Calibration and verification use materials such as pH buffer solutions (for example, pH 4, 7, and 10), conductivity standards, turbidity standards, dissolved oxygen calibration accessories (such as water-saturated air or zero-oxygen solution, as the manufacturer specifies), a calibrated reference thermometer for temperature, and deionized water for zero-point checks. All standards must be certified, stored as the supplier instructs, used before their expiry date, and never reused unless the manufacturer allows it. Every instrument must have its own ID number linked to its full calibration, maintenance, and verification history (BRLi, 2009). Instruments must be checked right after calibration, at the start of each sampling day, after transport, after large temperature changes, and whenever readings look wrong, and, where possible, at least once during the day and again at the end of the day to catch any drift. Checks can be done by measuring a check standard, comparing readings with a reference instrument, taking repeat measurements, or running a zero-point check. The pass or fail limits, such as the largest acceptable difference from the check standard, must be set in the QAP (or in an SOP the QAP refers to) before calibration starts, so the decision is clear and not left to judgment.

Documentation and traceability

All calibration and verification records must be complete, legible, and traceable to the reference standards used. Each record must include the instrument ID, manufacturer, model and serial number (if available); calibration date and time; operator; standards and their lot numbers and expiry dates; readings before and after adjustment; acceptance limits and pass/fail outcome; corrective action; next calibration date; and record location. Enter the information in Part A of the Calibration, Verification and Traceability Record (Annex E). The Sampling and Equipment Officer or QA Officer reviews the record, which is retained with the equipment log in the campaign file.

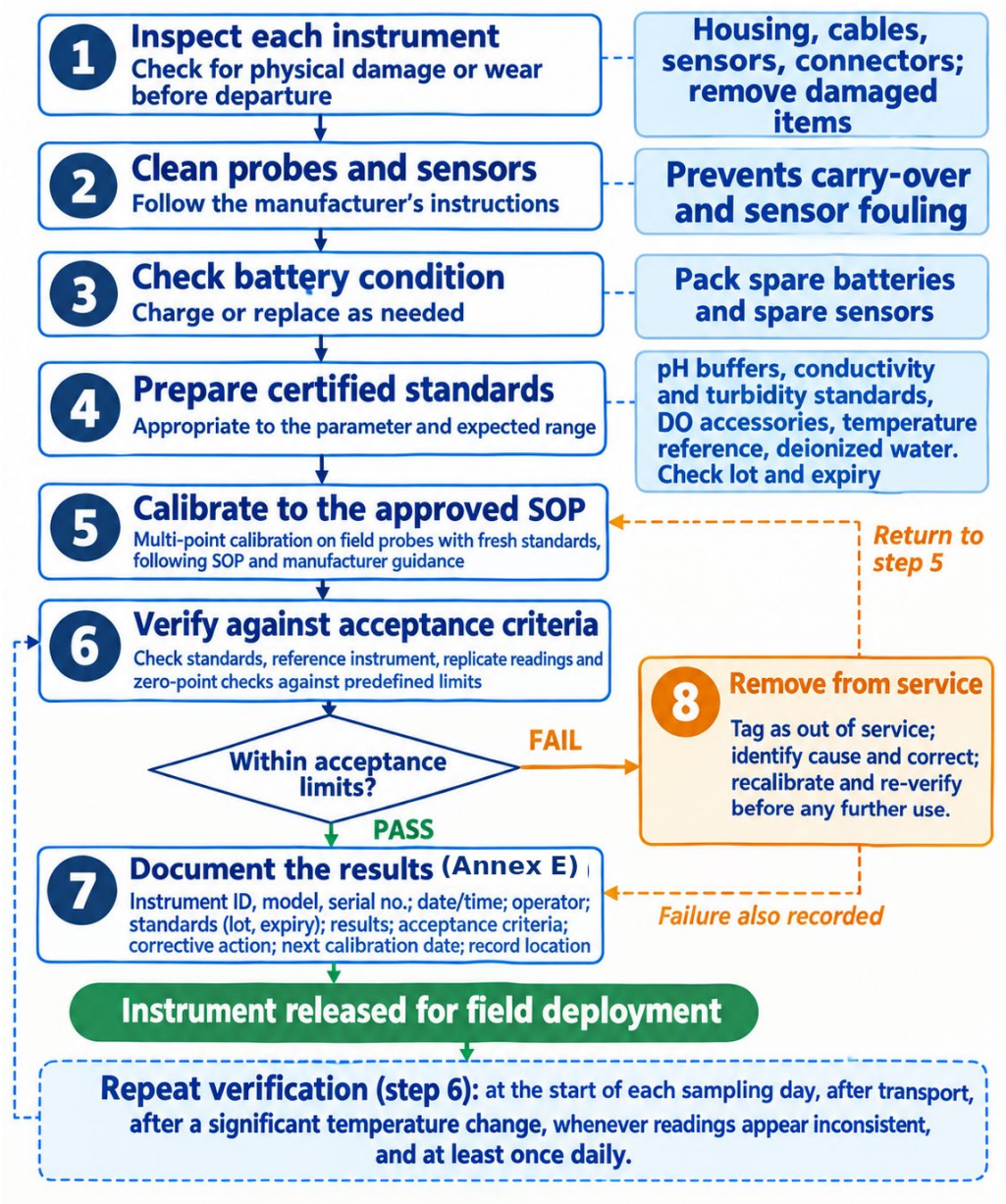


Figure 3. Pre-Deployment Instrument Calibration and Verification Workflow (Adapted from APHA, 2017; Alamirew & Kahsay, 2018; BRLi, 2009).

Preparation of the Sampling Plan and Site Readiness

Preparation of Sampling Plan

The sampling plan turns the monitoring goals and Data Quality Objectives (DQOs) into a practical field programme. It sets out what will be sampled, where, when, how, and by whom, which methods and equipment will be used, and how samples and data will be tracked and recorded (APHA, 2017; UNEP, 2023). A clear sampling plan makes data collection fair, efficient, and comparable, so the results meet the monitoring goals and support water resource management.

QA/QC before sampling

The sampling plan is the main document that sets the quality requirements and is used to check them before the team leaves for the field. It does this in six ways: it states the monitoring goals and DQOs so the required data quality is known in advance; it fixes the sites, parameters, frequency, timing, and methods so results are unbiased and campaigns can be repeated; it sets out the QC samples (blanks, duplicates, splits, and check standards), how often they are taken, and their pass or fail limits; it specifies containers, preservatives, holding times, and transport conditions so samples can be checked before departure; it assigns roles and responsibilities and makes sure any changes are reviewed, approved, and recorded; and it includes backup plans for equipment failure, bad weather, unreachable sites, and delays. In this manual, pass or fail limits are defined in the QAP and applied through the sampling plan and SOPs; the sampling plan is therefore also the reference for the final readiness review.

Monitoring objectives

A monitoring objective explains why data are being collected, what decision they will support, and who will use them. Objectives must be set before choosing sites, parameters, or methods, because everything else in the sampling plan follows from them. An objective is developed in seven steps: identify the question and who will use the data; describe the problem and the likely pollution sources; choose an indicator that answers the question; write a SMART objective (specific, measurable, achievable, relevant, and time-bound) stating what will be measured, where, how often, and why; set the DQOs; design the sampling (sites, frequency, methods, and QC) based on the objective; and review the objective with stakeholders and record it in the sampling plan.

The Akaki rivers receive domestic and hospital wastewater, industrial wastewater, and agricultural runoff in Addis Ababa, and downstream the water is used for irrigation and by local communities, including for drinking. This scenario provides an excellent illustration of the One Health concept, which suggests that there are close connections among the health of humans, animals, and the environment. Yet comparable information on where and when antibiotic resistance is introduced and transmitted through the river is still lacking. Collection of data on the presence of ESBL-producing *E. coli* from all stations and throughout different seasons using standard methods would establish a basis for action (Text Box 1).

Text Box 1: Akaki case example: objectives of water quality monitoring in the Akaki catchment to inform One Health

Overall objective

The Akaki catchment receives city wastewater, factory waste, discharges from health facilities, and farm runoff, and downstream users rely on the river for irrigation and drinking water. These sources may release antibiotic-resistant bacteria and resistance genes into the rivers, but institutions have not yet recorded where and when this happens comparably (Kibret et al., 2025; Liguori et al., 2022). The overall objective is therefore to measure the amount and share of ESBL-producing *E. coli* in surface water at stations along the Little and Great Akaki rivers. Stations cover an upstream reference site, urban and industrial discharge points, a wastewater treatment plant outfall, a health facility discharge, an irrigation intake, and downstream sites where flows combine. Sampling is done once in each season (Kiremt, Belg, and dry) to find AMR hotspots and provide a baseline for the Akaki Water Pollution Prevention and Control Plan.

Specific objectives

This overall objective is broken into five specific objectives. O1 sets a baseline of AMR levels along the catchment by measuring ESBL-producing *E. coli* (CFU/100 mL and as a share of total *E. coli*) from the upstream reference site to the downstream sites. O2 tracks seasonal change by measuring the same indicator in the main rainy season (Kiremt), the short rainy season (Belg), and the dry season (Bega), at the same stations and at about the same time of day. O3 identifies the impact of specific sources by comparing stations just upstream and downstream of a treatment plant outfall, health facility discharge, or factory discharge, with field duplicates taken at these sites. O4 assesses risk to people by sampling irrigation intakes and community water-use points and comparing them with the reference site. O5 ensures data can be compared across institutions by having all teams and laboratories use the same SOPs, QC samples, and records.

Data Quality Objectives

Data Quality Objectives (DQOs) are measurable targets that define how good the data must be to meet the monitoring objectives. They are derived from the monitoring objectives, recorded in the QAP before sampling, and defined for each parameter using six criteria. Accuracy is how close a reading is to the true value, checked through calibration, check standards, and certified reference materials. Precision is how closely repeated measurements agree, checked using field duplicates or replicates. Representativeness is how well a sample reflects the river at that place and time, ensured by careful site choice, sampling depth, well-mixed water, and a consistent time of day. Comparability is the ability to compare results across sites, seasons, and institutions, ensured by using the same methods, units, SOPs, and reporting formats. Completeness is the share of planned samples that are collected and valid, for example, at least 90%, with the exact value set in the QAP. Sensitivity is whether the method can detect and measure the parameter at the level needed, shown by comparing the detection or reporting limit with the decision threshold.

DQOs guide every stage of the work. In sampling design, they decide the number of sites, how often to sample, and how many QC samples to take. In the field, they set the rules for calibration,

blanks, duplicates, and sample handling. In the laboratory, they decide the methods, detection limits, and lab QC. In record-keeping, they set what must be recorded so each result can be traced. They also set the pass or fail limits for blanks, duplicates, check standards, and holding times, which decide whether data are accepted, flagged, or rejected, and when corrective action is needed.

In the Akaki AMR monitoring case, example targets are no bacterial growth in the sterile-water field blank; field duplicates for about 5 to 10% of samples, agreeing within 0.5 log10; samples kept cool and processed within the holding time set in the QAP (target 6 hours, maximum 24 hours); at least 90% of planned samples collected and valid; and the same stations sampled at about the same time of day every season.

Contents of the sampling plan

The sampling plan must include, at a minimum, the 15 components listed in Table 3.

Table 3. Minimum contents of the sampling plan

No.	Component	Description
1	Monitoring objectives and DQOs	Purpose of programme and required data quality/performance criteria
2	Monitoring parameters	Physical, chemical, biological, microbiological and hydrological parameters
3	Sampling locations and rationale	Sites and justification based on objectives, pollution sources and environmental characteristics
4	Frequency and timing	Schedule, seasonality and sampling timing
5	Sampling methods and sample types	Grab, composite, integrated, depth and other approved approaches
6	Collection and handling procedures	Standardised collection, labelling, preservation and documentation
7	Field measurements	In-situ measurements, instruments and procedures
8	QA/QC procedures	Calibration, blanks, duplicates, equipment blanks, split samples, acceptance criteria and corrective actions
9	Preservation and transport	Containers, preservatives, holding times, storage temperatures and chain of custody
10	Laboratory methods	Methods, detection limits, laboratory QC and competence/accreditation requirements
11	Health, safety and biosafety	Hazards, controls, PPE, emergency and biosafety procedures
12	Roles and responsibilities	Field, laboratory, QA/QC, safety, transport and coordination roles
13	Logistics and equipment	Equipment, supplies, transport, communication and support resources
14	Contingency plans	Equipment failure, weather, inaccessible sites, safety incidents and transport/laboratory delays
15	Data management and reporting	Recording, validation, storage, analysis, reporting, archiving and dissemination

(Adapted from Alamirew & Kahsay, 2018; APHA, 2017; UNEP, 2023)

Approval and change control

Before fieldwork starts, the Field Team Leader must review the sampling plan, the Project Coordinator must approve it and add it to the QAP, and it must be shared with every team member. If sites, methods, parameters, schedules, or responsibilities change, the plan must be updated through a recorded process: the change, the reason, who approved it, and the date are entered in

the deviation and change log, the plan's version number is updated, and the revised plan is shared with the team before it is used.

Selection of Monitoring Sites and Site Readiness

Monitoring sites must be chosen using set, recorded quality criteria, not simply because they are easy to reach. A good site represents the river or pollution source being studied, fits the monitoring objectives, can be reached, is safe and secure for the team, has stable water flow, can be sampled at the same spot each time, and is suitable for long-term monitoring (UNEP, 2023).

Avoiding bias

Choosing sites for convenience, such as sampling only at bridges or roadside points, can give misleading results. The set of sites should instead include places that show clean reference conditions, pollution sources, mixing zones, points where people use the water, and downstream conditions, and the reason for choosing each site should be written down. Priority goes to sites that serve the monitoring objective and to sources that may add harmful bacteria or AMR to the river, such as city wastewater, factory waste, and discharges from health facilities.

Types of monitoring sites

In the Akaki catchment, sites fall into six types: reference sites upstream of major pollution; pollution-source sites, such as urban and industrial discharge areas, treatment plant outfalls, health facility discharges, and farm runoff points; mixing zones where tributaries join; water-use points, such as irrigation intakes and recreation areas; ecologically sensitive areas; and downstream sites that show the combined effect of everything upstream (Haile et al., 2025; Kibret et al., 2025).

Recording site details

Each site must have its own site code, GPS coordinates, a written description, notes on how to get there, photographs, a map reference, nearby landmarks, and a written reason for choosing it, so the team can find and sample the same spot in every campaign (APHA, 2017). The step-by-step site screening process used for sampling-site selection in the Akaki catchment is summarised in Text Box 2.

Site readiness: Before the team goes out, each site must be confirmed as ready. Check the site ID, coordinates, route, security and safety, any permissions needed, expected river conditions, whether the required sample can be taken safely, and whether the site can be visited again in

future. Keep GPS coordinates, site descriptions, photographs, and maps up to date so the team can return to the exact same spot every time (APHA, 2017; UNEP, 2023).

Text Box 2. Akaki case example: site-screening funnel

The monitoring network was narrowed in stages, each with a different purpose. The final network had to be affordable to sample repeatedly (Haile et al., 2025).

Starting point: 48 sites from the literature

Earlier studies sampled 48 sites along the Akaki River and its tributaries, about 35 of them in the Great Akaki. Each study used its own sites, lasted at most two years, and sampled twice a year. With no agreed network, results could not be compared, and trends could not be followed.

Stage 1: 40 candidate sites (one-time screening)

- **Consolidation and gaps:** Earlier sites were consolidated into at least 35 candidates, five of which coincided with citizen-science flow-monitoring sites. A reference site was added at the head of the Kebena River, and new sites on the middle Bulbula River captured livestock and hospital effects.
- **Stakeholder input and cost:** A workshop agreed on 40 sites, with some placed just downstream of major pollution sources. This was also the number the project could afford to sample once.
- **Screening:** All 40 sites were sampled on 18 December 2022 (dry season) for dissolved oxygen, chemical oxygen demand, ammonia, and ESBL-producing *E. coli*, *Salmonella*/*Shigella* and *Klebsiella pneumoniae*. Results identified pollution and AMR hotspots. Cluster analysis grouped the sites into three clusters of 10, 2 and 28 sites.

Stage 2: 20 sites for regular monitoring to inform research

Regular sampling of all 40 sites was too costly technically and financially. The 20 sites were chosen to include hotspots accessible in all seasons; five sites with river-discharge data; the outlet of a major tributary and a site capturing irrigation-related pollution; three clean reference sites (S20, S26, S40); a spread of pollution sources and AMR exposure routes; and all three clusters. Sampling is proposed three times a year (dry (Bega), Belg and main rainy (Kiremt) seasons).

Stage 3: 7 sites for long-term monitoring to inform pollution control authorities

If resources are limited and the aim is to sustain long-term monitoring, the core set is two reference sites (S20, S40), the Kebena River outlet (S67), the Kebena–Bulbula confluence (S68), two AMR hotspot sites (S31, S50) and one downstream site at the main bridge.

Checking sites before approval: Before sampling sites are finally approved, they must be checked using maps, past monitoring records, recent field information, input from local authorities, facility managers, and communities, and a safety check. If a site turns out to be unreachable, unsafe, or no longer representative, it is replaced or moved through the change-control procedure.

When and how often to sample: How often and when to sample depends on the monitoring objectives and how much water quality changes over time (Table 3). Routine monitoring is usually done monthly or every three months, but extra sampling may be needed to investigate pollution or to capture events such as heavy rain, spills, or high river flows (Merid, 2005; UNEP, 2023). In Ethiopian catchments such as the Akaki, sampling should cover the country's three seasons, namely the main rainy season (Kiremt), the short rainy season (Belg), and the dry season (Bega), to see how pollution and water quality change through the year (Awash Basin Authority, 2017;

Kibret et al., 2025). Where possible, take samples at about the same time of day on each visit, because temperature, dissolved oxygen, pH, and living organisms in the water change during the day (APHA, 2017).

QA/QC Sample Design and Field-Team Competency

Before going to the field, the team must prepare all the materials needed for quality control samples. These may include field blanks, trip blanks, equipment blanks, bottles for duplicate samples, containers for split samples, sterile water, field check standards, and matrix-spike materials (Table 4). How many QC samples to take depends on the monitoring objective, the test method, the risk of contamination, the total number of samples, and the QAP. The numbers given in Table 4 are practical examples, not fixed rules for every situation. Field-team competency to collect and handle these QC samples is confirmed before departure through the training and competency records described under Team Organization and Communication and in the Competency of personnel paragraph of the health and safety section.

Table 4. Preparation of Quality Control samples before sampling

No	QC sample/type	Typical application	Preparation/collection requirement
1	Field blank	Detect contamination introduced during field handling and exposure	Prepare using appropriate blank water/materials; typically, one per sampling event or a predefined number of samples (e.g., per 10 samples), subject to the QAP and analytical method
2	Field duplicate/replicate	Assess field and sampling precision	Collect a second sample from the same sampling point using the approved procedure; typically, about 5–10% of samples where appropriate, subject to the QAP
3	Trip blank	Assess contamination during transport, particularly for analytes susceptible to transport contamination	Prepare and handle as specified by the analytical method; typically, one per cooler/shipment when required
4	Equipment blank	Assess contamination from reusable sampling equipment	Collect after equipment cleaning/decontamination according to the approved procedure where applicable
5	Split sample	Compare results between laboratories or methods	Divide a well-mixed sample using an approved procedure and maintain identical sample identification/custody information
6	Field check standard	Verify field instrument performance	Measure a suitable check standard at the predefined frequency and record the result against acceptance criteria
7	Matrix spike	Evaluate analyte recovery and matrix effects	Coordinate with the receiving laboratory; prepare/submit according to the analytical method and laboratory QC plan
8	Sterile-water blank	Microbiological form of the field blank (row 1), used when samples are for microbiological analysis	Use sterile water and appropriate sterile handling procedures for microbiological field blanks

(Adapted from APHA, 2017; Awash Basin Authority, 2017)

Sample Containers, Labels, Preservation, Storage, and Holding Times

Preparing sample containers properly is a key part of getting ready, because even a correctly collected sample becomes useless if it is put in the wrong container, left unlabelled, given the wrong preservative, stored incorrectly, or kept too long before testing. The requirements for each parameter come from the approved test method and standards. Table 5 lists the general preparation requirements, and Annex D gives the parameter-specific container and preservation requirements. The sampling plan should include a schedule, agreed with the receiving laboratory, showing how each parameter must be preserved and how long it can be held before testing. When samples are shared between the programme's own laboratory and outside laboratories, the same rules for sample IDs, preservation, chain of custody, and delivery apply to all of them. Outside laboratories must receive full paperwork and, where required, proof that they are qualified or accredited to do the tests.

Table 5. Requirements for sample containers, preservation, labelling, storage and transport before field sampling

No	Preparation requirement	Key procedure/requirement
1	Container selection	Select the correct container material, size, volume and closure for each analyte or sample type
2	Sterile containers	Use sterile containers for microbiological analyses and maintain sterility until the point of sampling
3	Container inspection	Inspect containers for damage, contamination, leakage and correct preparation status; confirm expiry dates where applicable
4	Labelling	Prepare waterproof labels in advance where practical. Include the project/programme, site ID, sample ID, date and other information required by the sampling plan
5	Preservatives	Prepare preservatives according to the analytical method. Confirm identity, concentration/preparation status, storage conditions and expiry
6	Sample preservation	Where preservation is required, apply it immediately after collection or according to the approved method
7	Storage and transport conditions	Define the required storage temperature and transport conditions for each parameter before field deployment. Use appropriate cooling materials and protect light-sensitive samples as required
8	Holding times	Document method-specific holding times and design transport schedules to ensure samples reach the laboratory within the required period
9	Microbiological samples	Keep microbiological samples under the required cold-chain conditions and transfer them to the laboratory as quickly as practicable
10	Transport and cross-contamination control	Separate samples from chemicals/reagents during transport and prevent cross-contamination between sample types

(Adapted from APHA, 2017; BRLi, 2009).

Logistics, Transport, Field Documentation, Chain of Custody, and Laboratory Coordination

Logistics planning makes sure that all equipment, containers, preservatives, paperwork, staff, vehicles, communication tools, and laboratory arrangements are ready before the team leaves. The transport plan should be worked out backwards from the holding times and the laboratory's

receiving conditions, meaning the team first confirms when samples must reach the laboratory and then plans the route and schedule to meet that deadline. Table 6 lists the key logistics, transport, and laboratory arrangements that must be completed before fieldwork, covering site access, sample transport, temperature control, paperwork, and chain of custody. Agreeing arrangements with the laboratory in advance and having backup plans in place help avoid delays that could damage samples or push them past their holding time. Figure 4 depicts the physical flow of samples (collection in the field, cold chain transportation, receipt in laboratory) together with their associated CoC documentation, whereby signed transfers of custody connect each phase. Accepted samples are released for testing; rejected or qualified samples are reported to the Field Team Leader and QA Officer.

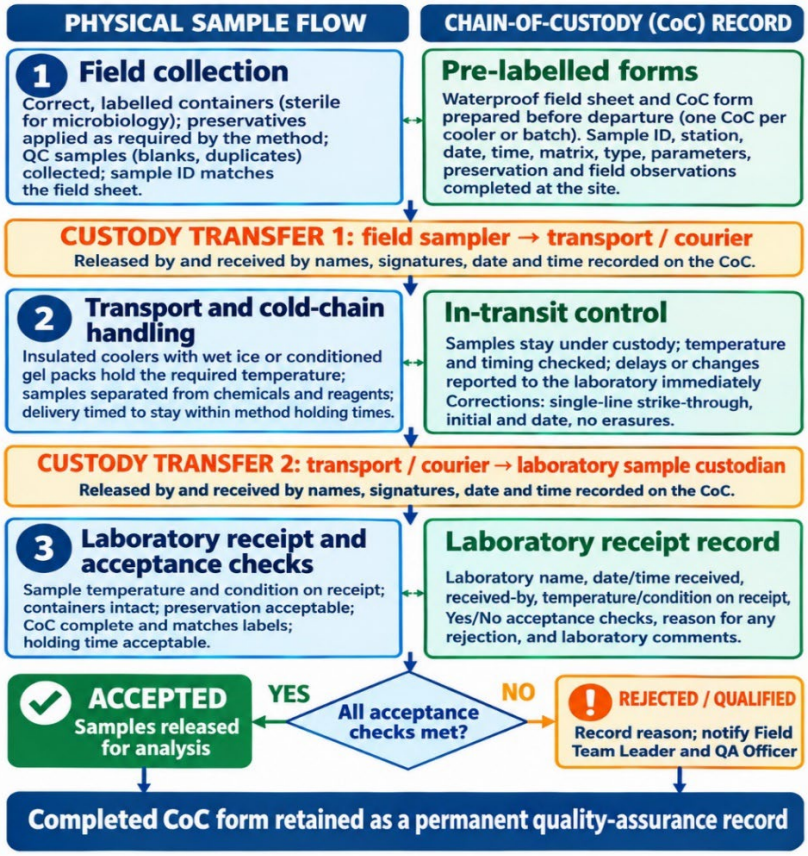


Figure 4. Sample Flow and Chain of Custody from Field Collection to Laboratory Acceptance (Adapted from APHA, 2017)

Table 6 Field logistics, sample transport and laboratory coordination requirements before sampling

No	Logistics and coordination requirement	Key actions
1	Route and site access	Confirm the sampling route, site sequence, vehicle, driver, access permissions, expected travel time and alternative routes where relevant

2	Weather and field conditions	Check weather forecasts, river conditions and other factors that may affect safe access or sample integrity
3	Laboratory coordination	Confirm laboratory operating hours, receiving personnel, analytical capacity, sample acceptance criteria and expected delivery time
4	External laboratory arrangements	For samples sent to external laboratories, confirm shipping/transport requirements, required documentation, custody arrangements and receiving-laboratory contacts in advance
5	Coolers and temperature control	Prepare clean coolers and appropriate cooling materials and verify that transport conditions can maintain the required sample temperature
6	Field documentation	Prepare waterproof data sheets labelled with the project and site ID, field logbooks, sample labels and chain-of-custody forms
7	Chain of custody	Prepare the chain-of-custody form in advance and define who signs each handoff from field sampler to transport/courier and from transport to laboratory sample custodian
8	Supplies and contingency materials	Ensure enough consumables, spare batteries, backup equipment and contingency materials are available for the planned campaign
9	Communication and delay management	Notify laboratory personnel of the sampling schedule and immediately communicate delays or changes that could affect holding times

(Adapted from APHA, 2017; UNEP, 2023; Alamirew & Kahsay, 2018).

Chain of custody is the written record tracking each sample from collection through transport to laboratory analysis. Each sample ID must match the field sheet. Every transfer must record the names and signatures of the person releasing the sample and the person receiving it, together with the date and time. The field form should record the sampling team, site details, sample IDs and types, requested analyses, preservation, and relevant field notes. Use the Chain-of-Custody Form in Annex F.

Before deployment, the field team should review the Field Sampling Checklist in Annex G, which is completed at each site during sampling, to ensure that site identification, access, safety, equipment readiness and documentation requirements are understood.

Health, Safety, Biosafety, Environmental, and Emergency Preparedness

Water sampling can expose the team to physical, chemical, biological, and environmental hazards, so these must be dealt with before the team goes to the field. A risk assessment for each site should be completed and discussed during the pre-departure briefing. Possible hazards include fast-flowing or deep water, slippery riverbanks, bad weather, polluted water, disease-causing and antibiotic-resistant bacteria, harmful chemicals, wild animals and livestock, road traffic, electrical hazards, and remote or hard-to-reach sites. Taking the right health, safety, and biosafety precautions protects the team, limits harm to the environment, and keeps sampling safe. All

fieldwork must follow the institution's safety rules, national workplace safety regulations, and the approved SOPs. Table 7 is a short checklist for the pre-departure briefing; the full checklist, with an acceptance-evidence column, is Annex I, which is the record to complete and file before deployment.

Table 7. Health, Safety, Biosafety and Environmental Checklist

No.	Item	Verification
1	Site-specific risk assessment completed	☐ Verified
2	PPE available and serviceable	☐ Verified
3	First-aid kit stocked	☐ Verified
4	Emergency contacts available	☐ Verified
5	Communication devices functional	☐ Verified
6	Emergency supplies/GPS available	☐ Verified
7	Disinfectants available	☐ Verified
8	Biohazard/waste bags available	☐ Verified
9	Chemical handling and SDS arrangements confirmed	☐ Verified
10	Safety and biosafety briefing completed	☐ Verified
11	Personnel training/competency confirmed	☐ Verified
12	Environmental precautions reviewed	☐ Verified
13	Waste-disposal arrangements confirmed	☐ Verified

(Liguori et al., 2022; Coque et al., 2023; WHO, 2022**).**

Risk assessment: Before every field trip, a risk assessment must be done for each site to identify possible hazards and how to reduce them. All the hazards listed at the start of this section should be checked at every site, and if any hazard is found, it must be dealt with before sampling begins.

Personal protective equipment (PPE): Field staff must wear the right protective gear for the work being done. This includes safety boots, gloves, safety glasses, a reflective vest, a lab coat or waterproof overall, a face mask when needed, a life jacket when working near deep or fast-flowing water, and a hat for sun protection (sunscreen is also advisable but is not PPE). Any damaged or contaminated gear must be replaced.

Biosafety: River water can carry disease-causing bacteria, so extra care is needed when sampling for microbes and AMR. Use sterile sample bottles, never touch the sample directly, change gloves at every new site, and disinfect reusable equipment after each site. Clean or sanitise hands after sampling and before eating, and keep staff vaccinations (for example, tetanus and hepatitis B) up to date as advised by the institution's occupational health service. Keep microbiological samples

away from chemicals, pack biohazardous materials properly, and transport microbiological samples at the correct temperature.

Chemical safety: Chemicals such as preservatives must be handled with care. Carry them in labelled containers, bring the Safety Data Sheet (SDS) for every chemical, wear PPE when handling them, avoid spills, keep chemicals separate from samples during transport, and dispose of chemical waste according to institutional rules.

Emergency preparedness: Every team must carry a first aid kit, a list of emergency contacts, communication tools, vehicle emergency supplies, drinking water, emergency lights if needed, and maps or GPS locations. Where needed, staff work in pairs (buddy system) near water, any team member may stop work if conditions become unsafe, and incidents must be reported to the Field Team Leader. Emergency procedures must be reviewed before departure.

Waste management: All waste from fieldwork must be handled so it does not pollute the environment. Collect all solid waste, keep biological and chemical waste separate, disinfect equipment that will be reused, dispose of sharp items and contaminated materials safely, and take hazardous waste to approved disposal sites. Nothing should be left behind at sampling sites.

Competency of personnel: Everyone involved in water quality monitoring must be trained in sampling, using instruments, QA/QC procedures, biosafety, handling chemicals, emergency response, and chain-of-custody procedures. Training records must be kept, and staff skills must be checked regularly.

Annex I provides a checklist for verifying that the necessary health, safety, biosafety, and environmental protection measures are in place before field teams depart and when they arrive at sampling sites. It covers site-specific risk assessment, personal protective equipment (PPE), first aid, emergency preparedness, hygiene and disinfection supplies, biohazard management, chemical safety, microbiological sampling procedures, staff competency, safe working arrangements, and waste disposal.

Final QA/QC readiness review and deployment authorisation

Table 8 lists the final items to check before departure, the minimum standard each must meet, and the proof required. The Field Team Leader carries out this final check before the team travels, and the QA Officer reviews it. Before deployment, the Field Team Leader and QA Officer should complete the Pre-Deployment Readiness Checklist (Go/No-Go) in Annex H. Sampling must not

proceed while critical deficiencies remain unresolved. A critical deficiency is one that affects safety, sample integrity or data quality; any other deficiency is a minor deviation.

Table 8. Final go/no-go readiness and authorisation

No	Final readiness item	Minimum acceptance condition	Evidence
1	Approved sampling plan	Current approved plan available; team briefed on objectives, sites, methods, schedule, and QC design	Approved plan/briefing record
2	Team and competency	Roles assigned; required training and competency confirmed	Team roster/training records
3	Equipment	Critical equipment inspected, functional, identified, and backed up where needed	Equipment checklist
4	Calibration and verification	All required instruments have valid calibration or verification status	Calibration/verification records
5	Containers and preservation	Correct containers, preservatives, labels, and storage arrangements available	Container/preservation checklist
6	QC samples	Required blanks, duplicates or triplicates, and other QC materials prepared	QC preparation record
7	Logistics and transport	Vehicle, route, site access, coolers, and cooling materials confirmed	Logistics checklist
8	Laboratory coordination	Receiving laboratories notified and ready to accept samples within holding times	Laboratory notification
9	Chain of custody	Chain-of-custody forms prepared, and handover responsibilities assigned	Chain-of-custody forms
10	Safety and environment	Risk assessment, PPE, emergency supplies, disinfection, and waste controls complete	Safety checklist
11	Go/no-go decision	No unresolved critical deficiencies affecting safety, sample integrity, or data quality	Deployment authorisation signed by the Field Team Leader and QA Officer

(Adapted from APHA, 2017; UNEP, 2023)

References

Alamirew, T.; Kahsay, T.N. 2018. National integrated water resources management program: Draft report. Addis Ababa, Ethiopia: National Integrated Water Resources Management Program; USAID.

APHA (American Public Health Association). 2017. Standard methods for the examination of water and wastewater. 23rd ed. Washington, DC, USA: American Public Health Association; American Water Works Association; Water Environment Federation.

Awash Basin Authority. 2017. Awash basin water quality strategic plan. Adama, Ethiopia: Awash Basin Authority.

BRLi. 2009. Water information and knowledge management system project, component 2: Strengthening of water quality data generation and management. Addis Ababa, Ethiopia: Ministry of Water Resources.

Coque, T.; Graham, D.W.; Pruden, A.; So, A.; Topp, E. 2023. Bracing for superbugs: Strengthening environmental action in the One Health response to antimicrobial resistance. Nairobi, Kenya: United Nations Environment Programme (UNEP).

Haile, A. T., Kibret, M., Haileselassie, M. M., Anley, K. A., Bekele, T. W., Mohammed Kassa, J., Mateo-Sagasta, J. 2025. Designing a monitoring plan for microbial water quality and waterborne antimicrobial resistance in the Akaki catchment, Ethiopia. Environmental Monitoring and Assessment 197(3): 317. https://doi.org/10.1007/s10661-025-13748-6

Kibret, M.; Haile, A. T.; Gebre, E. S.; Terfie, T. A.; Hiruy, A. M.; Yibel, B.; Mateo-Sagasta, J. 2025. Guideline for developing a water pollution prevention and control plan for the Akaki Catchment, Ethiopia. Colombo, Sri Lanka: International Water Management Institute (IWMI). CGIAR Sustainable Animal and Aquatic Foods Program. 45p. https://hdl.handle.net/10568/179606

Liguori, K.; Keenum, I.; Davis, B.C.; Calarco, J.; Milligan, E.; Harwood, V.J.; Pruden, A. 2022. Antimicrobial resistance monitoring of water environments: A framework for standardised methods and quality control. Environmental Science & Technology 56(13): 9149–9160. https://doi.org/10.1021/acs.est.1c08918

Merid, F. 2005. National Nile basin water quality monitoring baseline report for Ethiopia. Addis Ababa, Ethiopia: Nile Basin Initiative, Transboundary Environmental Action Project. Available at https://nilebasin.org/sites/default/files/2023-09/WQM_Baseline%20report-Ethiopia.pdf (accessed on September 2026).

UNEP (United Nations Environment Programme). 2023. Water quality monitoring and assessment in rivers, lakes and reservoirs. Nairobi, Kenya: United Nations Environment Programme. https://doi.org/10.59117/20.500.11822/4300

WHO (World Health Organization). 2022. Guidelines for drinking-water quality: Fourth edition incorporating the first and second addenda. Geneva, Switzerland: World Health Organization. Available at https://www.who.int/publications/i/item/9789240045064 (accessed on September 2026).

Annexes: Checklist and Templates

Annex A. Equipment Inspection Checklist

Instrument name:		**Instrument ID:**	
Manufacturer/model :		**Serial number:**	
Sampling campaign:		**Inspection date and time:**	

No.	Check	What to confirm	Yes	No	N/A	Corrective action
A	**Condition**					
1	**No physical damage**	Body, screen, probes, and cables are free of cracks, leaks, or loose parts	☐	☐	☐	
2	**Clean**	Probes, sensors, and housing are clean and rinsed with deionized water	☐	☐	☐	
3	**Working properly**	Instrument switches on, shows no error messages, and gives stable readings	☐	☐	☐	
4	**Accessories complete**	All cables, probe guards, caps, and storage solutions are present	☐	☐	☐	
B	**Calibration and verification**					
5	**Calibrated**	Calibration done and still valid; date recorded in the Calibration, Verification and Traceability Record (Annex E)	☐	☐	☐	
6	**Verified**	Check standard reading is within the QAP limits	☐	☐	☐	
7	**Standards available**	Calibration standards for field checks are packed, labelled, and not expired	☐	☐	☐	
C	**Power and spares**					
8	**Batteries charged**	Batteries fully charged	☐	☐	☐	
9	**Spare batteries packed**	Charged spare batteries or charger packed	☐	☐	☐	
10	**Spare parts packed**	Spare sensors, membranes, or other critical parts packed	☐	☐	☐	
11	**Backup instrument**	Backup instrument available if this one fails	☐	☐	☐	
D	**Records and identification**					
12	**ID visible**	Instrument ID number is clearly marked and readable	☐	☐	☐	
13	**Maintenance up to date**	Required maintenance done and recorded in the equipment log	☐	☐	☐	
14	**Records complete**	Calibration, verification, and maintenance records filled in and filed	☐	☐	☐	
E	**Ready for transport**					
15	**Packed safely**	Instrument packed in its protective case, secured against knocks and water	☐	☐	☐	

Result: ☐ Ready for field use ☐ Not ready – out of service (tag instrument and use backup)

	Name	Signature	Date
Inspected by			
Approved by (Field Team Leader)			
Reviewed by (QA Officer)			

If any item is marked "No," write the problem and the action taken in the corrective action column. The instrument must not be used in the field until the problem is fixed and the item is rechecked.

Annex B. Sample Container Checklist

Complete before every field trip. Tick one box for each check.

No.	Check	Pass if	Yes	No	N/A	Remarks / corrective action
A	**Sample bottles**					
A1	**Right container for each test**	Bottle material, size, and cap match Annex D, the approved sampling plan, and the receiving laboratory's requirements	☐	☐	☐	
A2	**Bottles clean**	No dirt, residue, smell, or particles; any dirty bottle is removed	☐	☐	☐	
A3	**Bottles undamaged and sealed**	Caps close tightly, no leaks or cracks; damaged or worn bottles are thrown away	☐	☐	☐	
A4	**Enough bottles**	Bottles counted for all routine samples, duplicates, blanks, and spares, and the count matches the sampling plan	☐	☐	☐	
A5	**Metals bottles acid-washed**	Acid-washing recorded in the container preparation record	☐	☐	☐	
A6	**Amber glass where needed**	Bottles for organics, oil and grease, and antibiotic residues are amber glass, with Teflon-lined caps where specified, as recorded in the container preparation record	☐	☐	☐	
A7	**Batch number recorded**	Bottle lot or batch number written down, so the source can be traced if a blank shows contamination	☐	☐	☐	
A8	**Bottles kept clean until use**	Bottles are capped, bagged or boxed, and packed away from chemicals, fuel, and dust	☐	☐	☐	
A9	**Bottles sorted by site**	Bottles grouped by site and test, so the right set is ready at each stop	☐	☐	☐	

If any item is marked "No," write the problem and the action taken in the corrective action column. Sampling must not start until the problem is fixed.

Monitoring institution		**Sampling campaign/date**	
Field Team Leader		**Documentation, Custody & Laboratory Liaison Officer**	

Annex C. Pre-Sampling Checklist for Preservatives, Gloves, Labels, Field Blanks QA/QC and Cleaning Materials

Use separate checklist for each material category. Mark Yes, No or N/A and record any corrective action.

Checklist 1. Preservatives

Monitoring institution		**Sampling campaign/date**	
Field Team Leader		**Completed by / date & time**	

No.	QA/QC check	Acceptance criterion	Result Y / N / N/A	Remarks / corrective action
P1	Correct preservative available for each target parameter (refer to preservation schedule	Identity matches the approved preservation schedule	☐ Yes ☐ No ☐ N/A	
P2	Preservatives are analytical grade and labelled with contents and concentration	Label is complete and legible	☐ Yes ☐ No ☐ N/A	
P3	Expiry date is valid, and lot/batch number is recorded	Expired preservatives are discarded; lot number is recorded	☐ Yes ☐ No ☐ N/A	
P4	Timing and volume of preservative addition are specified and recorded.	Added before departure or immediately after collection as instructed by the laboratory; volume recorded	☐ Yes ☐ No ☐ N/A	
P5	Preservatives are stored and handled safely; spill kit and PPE are available	Stored away from sunlight and heat and apart from samples; no leakage; PPE used	☐ Yes ☐ No ☐ N/A	
P6	Pre-preserved bottles are clearly marked	Mark is visible, so bottles are not rinsed or overfilled	☐ Yes ☐ No ☐ N/A	

Pre-departure review: ☐ All checks satisfactory ☐ Deficiencies corrected / formally accepted

Reviewed by: _____ Signature: _____ Date/time: _____

Checklist 2. Gloves

Monitoring institution		Sampling campaign/date	
Field Team Leader		Completed by / date & time	

No.	QA/QC check	Acceptance criterion	Result Y / N / N/A	Remarks / corrective action
G1	Sterile gloves available for microbiological and AMR sampling	Packs are sealed and within expiry date	☐ Yes ☐ No ☐ N/A	
G2	Chemical-resistant gloves available for handling preservatives	Gloves are intact and of the correct type	☐ Yes ☐ No ☐ N/A	
G3	Sufficient pairs available to change gloves between sites and after contamination	Spare pairs counted; powder-free gloves and correct sizes available	☐ Yes ☐ No ☐ N/A	
G4	Damaged or contaminated personal protective equipment (PPE) replaced	No damaged or contaminated PPE is in use	☐ Yes ☐ No ☐ N/A	
G5	Glove expiry dates checked	Gloves are within expiry date; expired items removed from the field kit	☐ Yes ☐ No ☐ N/A	

Pre-departure review: ☐ All checks satisfactory ☐ Deficiencies corrected / formally accepted

Reviewed by: _____ Signature: _____ Date/time: _____

Checklist 3. Labels

Monitoring institution		Sampling campaign/date	
Field Team Leader		Completed by / date & time	

No.	QA/QC check	Acceptance criterion	Result Y / N / N/A	Remarks / corrective action
L1	Waterproof and durable labels available	Moisture- and chemical-resistant; adhesion tested on a wet bottle	☐ Yes ☐ No ☐ N/A	
L2	Labels contain required pre-filled fields: sample ID, station ID, sample type, parameters, date, preservation method, sampler initials and programme ID	All required fields are present and legible.	☐ Yes ☐ No ☐ N/A	
L3	Space provided to record collection time	Blank field is present	☐ Yes ☐ No ☐ N/A	
L4	Label IDs match the chain-of-custody form and field sheet; no duplicate IDs	Cross-checked by a second person	☐ Yes ☐ No ☐ N/A	
L5	Labels prepared for blanks and duplicates, with spare labels	Required labels counted; spares available	☐ Yes ☐ No ☐ N/A	
L6	Waterproof markers or barcodes available	Available and ready for use	☐ Yes ☐ No ☐ N/A	

Pre-departure review: ☐ All checks satisfactory ☐ Deficiencies corrected / formally accepted

Reviewed by: _____ Signature: _____ Date/time: _____

Checklist 4. Field Blanks and Other QA/QC Samples

Monitoring institution		Sampling campaign/date	
Field Team Leader		Completed by / date & time	

No.	QA/QC check	Acceptance criterion	Result Y / N / N/A	Remarks / corrective action
B1	Field blanks prepared using certified deionized water; sterile water used for microbiological blanks where required	Water source and lot/batch recorded	☐ Yes ☐ No ☐ N/A	
B2	Blanks handled and labelled like routine samples and analysed for the same parameters.	Blank frequency specified in the Quality Assurance Plan (QAP)	☐ Yes ☐ No ☐ N/A	
B3	Trip blanks prepared where required and kept sealed	Trip blanks are not opened in the field	☐ Yes ☐ No ☐ N/A	
B4	Equipment blank can be prepared where reusable equipment is used	Deionized water and cleaned equipment available	☐ Yes ☐ No ☐ N/A	
B5	Duplicate and split-sample containers prepared and labelled	Frequency and identification rules set in the QAP	☐ Yes ☐ No ☐ N/A	
B6	Blank acceptance limits and corrective actions defined	Limits documented in the QAP (e.g., below reporting limit; no growth for microbiology)	☐ Yes ☐ No ☐ N/A	
B7	Sufficient containers available for routine samples, duplicates, blanks and contingency samples	Counts recorded against the sampling plan	☐ Yes ☐ No ☐ N/A	

Pre-departure review: ☐ All checks satisfactory ☐ Deficiencies corrected / formally accepted

Reviewed by: _____ Signature: _____ Date/time: _____

Checklist 5. Cleaning Materials and Equipment Decontamination

Monitoring institution		Sampling campaign/date	
Field Team Leader		Completed by / date & time	

No.	QA/QC check	Acceptance criterion	Result Y / N / N/A	Remarks / corrective action
C1	Cleaning materials available: laboratory-grade detergent, deionized water, dilute nitric acid for metals, and solvent for organics, as required	Materials are present, labelled and within date	☐ Yes ☐ No ☐ N/A	
C2	Cleaning sequence followed: detergent wash, tap-water rinse, repeated deionized-water rinses, acid or solvent step if required, final deionized-water rinse, and drying under clean conditions	Each step is recorded in the preparation record	☐ Yes ☐ No ☐ N/A	
C3	Detergent suitable for nutrient bottles is phosphate-free and fully rinsed off	No foaming or residue after final rinse	☐ Yes ☐ No ☐ N/A	
C4	Sampling equipment is decontaminated between sites; disinfectant and 70% alcohol spray available	Equipment blank is within acceptance limits where applicable	☐ Yes ☐ No ☐ N/A	
C5	Disposable containers are not reused	Only validated multi-use containers are reused	☐ Yes ☐ No ☐ N/A	
C6	Cleaning and container preparation records are completed	Type, volume, target parameters, cleaning, sterilisation (where applicable), date, preparer, inspection and storage recorded	☐ Yes ☐ No ☐ N/A	

Pre-departure review: ☐ All checks satisfactory ☐ Deficiencies corrected / formally accepted

Reviewed by: _____ Signature: _____ Date/time: _____

Checklist 6. Coolers and Cold Chain

Monitoring institution		Sampling campaign/date	
Field Team Leader		Completed by / date & time	

No.	QA/QC check	Acceptance criterion	Result Y / N / N/A	Remarks / corrective action
T1	Coolers of suitable size and number are available for all routine samples, QC samples and spares	Cooler count and capacity recorded against the sampling plan; samples can be packed upright without overcrowding	☐ Yes ☐ No ☐ N/A	
T2	Coolers are clean, intact, dry and disinfected	No cracks, leaks, odour or residue; lid seals tightly; cleaned/disinfected as per SOP; dry before loading	☐ Yes ☐ No ☐ N/A	
T3	Each cooler has a unique ID, and one COC form is assigned	Cooler ID is marked on the cooler and entered on the CoC form (Annex F)	☐ Yes ☐ No ☐ N/A	
T4	Cooling materials are available in sufficient quantity, including spares for the longest expected transit time	Gel packs are frozen solid; ice is in sealed bags to prevent meltwater contact with sample bottles; quantity recorded	☐ Yes ☐ No ☐ N/A	
T5	Required temperature range for each sample group is defined in the sampling plan and agreed with the receiving laboratory	Microbiology/AMR samples below 10 °C and not frozen; chemical samples at or below 6 °C unless the method specifies otherwise (see Annex D)	☐ Yes ☐ No ☐ N/A	
T6	A calibrated thermometer or temperature data logger is available for each cooler, and a temperature blank is prepared where required	Instrument ID and calibration status recorded (Annex E); batteries charged; logger start time set; temperature blank labelled	☐ Yes ☐ No ☐ N/A	
T7	Coolers and cooling materials are pre-conditioned before loading	Cooler interior pre-chilled; gel packs frozen for the period required by the SOP; starting temperature recorded	☐ Yes ☐ No ☐ N/A	
T8	Packing arrangement prevents cross-contamination and freezing	Bottles upright and capped, in leak-proof bags; separated from preservatives, chemicals and fuel; no direct contact with frozen packs; light-sensitive samples shaded; trip blank included where required	☐ Yes ☐ No ☐ N/A	
T9	Transport schedule keeps the time from sampling to laboratory receipt within the holding time	Target and maximum delivery times documented (e.g., microbiology target 6 h, maximum 24 h); route and driver confirmed; contingency for delay	☐ Yes ☐ No ☐ N/A	
T10	Receiving laboratory is notified of the expected arrival time and confirms cold storage and receipt arrangements	Laboratory contact, receiving hours, cold-storage capacity and temperature acceptance criteria confirmed and recorded	☐ Yes ☐ No ☐ N/A	

Pre-departure review: ☐ All checks satisfactory ☐ Deficiencies corrected / formally accepted

Reviewed by: _____ Signature: _____ Date/time: _____

Annex D. Container and Preservation Checklist by Parameter

Tick "Ready" for each parameter planned for this campaign. Values shown are typical figures and must be confirmed with the receiving laboratory and the QAP.

Parameter	Container	Preservation and handling	Storage and holding time (APHA, 2017)	Check before departure	Ready
General physicochemical (e.g., TSS, BOD, alkalinity)	Clean HDPE bottle	No chemical added; fill to the top; keep cool	≤6 °C; shortest holding time in this group sets the deadline (e.g., BOD 6 h)	Bottles clean and labelled; lab confirmed it can start short-holding tests on arrival	☐
Nutrients, acid-preserved (e.g., ammonia, TKN, total phosphorus)	Clean HDPE bottle	Sulfuric acid to pH below 2; keep cool	≤6 °C, 28 days	Acid correct and in date; dropper or pre-dosed bottles ready; pH strips packed	☐
Nutrients, unpreserved (e.g., nitrate, nitrite, orthophosphate)	Clean HDPE bottle	No acid; filter orthophosphate on site if the method requires	≤6 °C, 48 h	Separate bottles from acid-preserved nutrients; filters and syringes packed if needed	☐
Heavy metals	Acid-washed HDPE bottle	Nitric acid to pH below 2, as set by the lab; filter first if testing dissolved metals	6 months (28 days for mercury)	Acid-wash record checked; acid in date; pH strips and filters packed if needed	☐
Organic contaminants	Amber glass, Teflon-lined cap	Keep cool and dark; do not rinse the bottle	≤6 °C, 7 days to extraction	Amber glass only; no plastic in contact with the sample; caps have Teflon liners	☐
Oil and grease	Wide-mouth amber glass bottle	Acid as set by the lab method; do not rinse or overfill, since the whole bottle is tested	≤6 °C, 28 days	Amber glass; clean; acid ready if required	☐
Antibiotic residues	Amber glass bottle	Keep cool and dark; add any stabiliser the lab method requires	Cool; deliver as fast as possible, as set by the lab	Amber glass; clean; lab-confirmed any stabiliser and the holding time	☐
E. coli, total coliforms, enterococci	Sterile polypropylene or borosilicate glass	Do not rinse; leave 2–3 cm air space; cool straight away	Below 10 °C, not frozen; target 6 h, maximum 24 h	Sterile and sealed; sodium thiosulfate in bottles for chlorinated discharges only	☐
ARB and ARGs (AMR tests)	Sterile polypropylene bottle	Do not rinse; cool straight away; keep apart from chemicals	Below 10 °C, not frozen; same holding time as above; ARG samples filtered or frozen within the time the lab sets	Sterile and sealed; cooler, ice packs, and temperature logger ready	☐

If any item is not ready, record the problem and the action taken. Do not leave for the field until all bottles, preservatives, and cooling for the planned parameters are ready.

Remarks / corrective action:

	Name	Signature	Date
Checked by			

	Name	Signature	Date
Approved by (Field Team Leader)			

Annex E. Calibration, Verification and Traceability Record

Purpose: to bring together the documentation needed to show that every field and laboratory instrument was fit for use before sampling, and that each measurement can be traced to a named instrument, operator, reference standard and record. Complete a Calibration and Verification Record (Part A) for each instrument at every calibration and enter it in the Calibration Log (Part B). Part C lists all pre-sampling records that must be in the campaign file.

Traceability chain

Reference standard (lot, certificate, expiry) → calibration record → instrument ID → field measurement on the field sheet → sample ID on the label → chain-of-custody form → laboratory receipt → reported result.

A break at any link (for example an unidentified instrument, an unrecorded standard lot, or a sample ID missing from the custody form) means the affected data cannot be shown to be reliable and shall be flagged or rejected.

General rules for all records

- Each record carries a unique ID or a clear link to the instrument, sample or campaign it covers, plus the date, time and name of the person completing it.
- Entries are made in permanent ink or an approved electronic system with version control and an audit trail. Pencil is not permitted.
- Corrections: strike through the original entry with a single line, enter the correct information, and initial and date the correction. Erasures and correction fluid are not permitted.
- Records are completed at the time of the activity, not afterwards, and are legible.
- Each record states where the original and any electronic copy are stored, and the Field Team Leader checks completeness before filing.
- The retention period is set in the Quality Assurance Plan (QAP) in line with institutional and regulatory requirements.
- An instrument that fails calibration or verification is tagged "OUT OF SERVICE" and is not used until corrective action is completed and re-verification passes.

Part A. Calibration and Verification Record (one per instrument per calibration)

1. Instrument and event details

Instrument ID		**Manufacturer and model**	
Serial number ("none" if absent)		**Parameter(s) and range**	
Calibration location		**Operator (name and signature)**	
Date and time calibration started		**Date and time calibration ended**	
Calibration procedure / SOP no.		**Reason (routine / after maintenance / after failed check)**	

2. Reference standards and reagents used

Standard / reagent	Nominal value	Supplier	Lot / batch no.	Certificate no.	Date opened	Expiry date

3. Calibration results

Calibration point / standard	Reading before	Reading after	Slope / offset (if available)	Acceptance criterion (set in QAP / SOP)	Pass / Fail	Initials

4. Performance verification

Date / time	Check standard (name, lot, expiry)	Check value	Observed value	Deviation	Acceptance limit	Pass / Fail	Initials

5. Outcome, corrective action and filing

Overall outcome (Pass / Fail)			
Corrective action taken (e.g. recalibrated, sensor or membrane replaced, serviced, backup instrument used)			
Corrective action by (name)		**Date of corrective action**	
Result of re-verification (Pass / Fail, value)			
Next calibration date or trigger		**Instrument status (In service / Out of service)**	
Record storage location (original: cabinet / file code; electronic: folder path)			
Reviewed by Sampling & Equipment Officer / QA Officer (signature)		**Review date**	

Part B. Calibration Log (register of all instruments)

Enter one row per instrument per calibration event. The full details remain in the Part A record, whose reference number should be entered in the last column.

No.	Instrument ID / model / serial	Parameter	Date and time	Operator	Reference standard (lot / expiry)	Observed result	Acceptance criterion	Pass / Fail	Corrective action	Next calibration	Storage location	Part A ref.

Part C. Consolidated Documentation Requirements Before Sampling

Table C.1. Records to be completed and filed before field deployment

Record	Minimum content	Completed by	Stored in
Team roster and competency record	Names, roles, training and competency status, contact details	Field Team Leader	Campaign file
Equipment inspection checklist (Annex A)	Instrument ID, condition, battery, spares, calibration status, inspector, date	Sampling & Equipment Officer	Equipment log
Calibration and verification record and log (this annex)	All fields in Parts A and B	Sampling & Equipment Officer	Campaign file
Standards and reagent register	Item, supplier, lot, certificate, date received, date opened, expiry date, storage conditions	Sampling & Equipment Officer	Reagent file
Container and preservative preparation record	Container type and volume, parameters, cleaning, sterilisation, preservative and lot, expiry, preparer, date, inspection	Sampling & Equipment Officer / Documentation, Custody & Laboratory Liaison Officer	Campaign file
QC materials record	Type, preparation, batch, storage, expiry, planned frequency	Documentation, Custody & Laboratory Liaison Officer	Campaign file
Approved sampling plan and QAP	Version number, approval signature and date, distribution list	Project Coordinator	Programme archive
Deviation and change log	Change, reason, date, person responsible, corrective action	Field Team Leader	Campaign file
Site-readiness checklist	Site ID, GPS coordinates, access, safety, permissions	Field Team Leader	Campaign file
Field sheets and logbooks	Waterproof; pre-labelled with project and site ID	Documentation, Custody & Laboratory Liaison Officer	Campaign file
Sample labels	Sample ID, station ID, sample type, parameters, date, preservation, sampler initials, programme ID	Sampling team	On the bottle
Chain-of-custody form (Annex F)	Sample IDs, handoff signatures, dates and times, laboratory receipt	Documentation, Custody & Laboratory Liaison Officer	Campaign file and laboratory
Risk assessment and briefing record	Hazards, controls, attendees, date	Safety & Logistics Officer	Campaign file
Laboratory notification	Expected delivery time, analyses requested, holding times	Documentation, Custody & Laboratory Liaison Officer	Campaign file
Pre-deployment authorisation	Go/no-go checklist, closed deficiencies, signatures	Field Team Leader and QA Officer	Programme archive

Annex F. Chain-of-Custody Form for Water Quality Monitoring for the Akaki Catchment

Field	Information to be completed
Monitoring institution	
Sampling campaign	Routine / Baseline / Compliance / Pollution Investigation / Other
Field Team Leader	
Field team members	
Date of sampling	
Weather conditions	
River/system	Little Akaki / Great Akaki / Tributary / Other
Sampling station ID	
Station name/location	
GPS coordinates	
Sample identification number(s)	
Sample matrix	Surface water / Wastewater / Sediment / Other
Sample type	Grab / Composite / Duplicate / Blank / Split
Sampling depth, if applicable	
Parameters requested	Physicochemical / Nutrients / Metals / Microbiology / Organic / Emerging contaminants / Other
Number and type of containers	
Preservation method	As specified by analytical method
Time sampling completed	
Field observations	Colour, odour, turbidity, weather, nearby pollution sources, unusual observations

Chain-of-custody transfer record

Transfer stage	Released by / signature	Date & time	Received by / signature	Date & time
Field sampler → Transport/courier				
Transport/courier → Laboratory sample custodian				
Other transfer, if applicable				

Laboratory receipt

Item	Information
Laboratory name	
Date/time received	
Received by	
Sample temperature/condition upon receipt	
Containers intact	Yes / No
Preservation acceptable	Yes / No
Chain-of-custody complete	Yes / No
Holding time acceptable	Yes / No
Samples accepted for analysis	Yes / No
Reason for rejection, if applicable	
Laboratory comments	

Notes: A separate chain-of-custody form should accompany each cooler or sample batch submitted to the laboratory. All custody transfers should be documented with names/signatures, dates and times. Corrections should be made by striking through the original entry with a single line, entering the correct information, and initialling and dating the correction. Erasures and correction fluid should not be used. The completed form should be retained as part of the permanent quality-assurance records.

Annex G. Field Sampling Checklist

Use at each site. Follow the approved SOP and parameter-specific instructions; record deviations in the field log.

Campaign ID/date	_____	Site ID/name	_____
GPS coordinates	_____	Sampler(s)	_____
Arrival time	_____	Weather / river conditions	_____

No.	Field check / action	Yes	No	N/A	Observation result or corrective action
1	Site ID and coordinates match the approved sampling plan	☐	☐	☐	
2	Site access and conditions are safe; risk controls remain adequate	☐	☐	☐	
3	Required PPE worn; clean gloves available and changed between sites	☐	☐	☐	
4	Instrument IDs and calibration/verification status checked	☐	☐	☐	
5	Field measurements taken and recorded with units and time	☐	☐	☐	
6	Correct sample containers and labels confirmed before collection	☐	☐	☐	
7	Samples collected using the approved method without cross-contamination	☐	☐	☐	
8	Required blanks, duplicates and other QC samples collected	☐	☐	☐	
9	Preservation and cooling applied as specified in the sampling plan	☐	☐	☐	
10	Sample IDs match field sheets and chain-of-custody forms	☐	☐	☐	
11	Cooler condition / temperature checked and recorded where required	☐	☐	☐	
12	Site waste collected; reusable equipment cleaned/decontaminated	☐	☐	☐	

Sample ID	Parameter/sample type	Collection time	Field result/units	Preservation/cooler	Notes/deviation

Site completed by: _____ Signature: _____ Time: _____

Deviation / incident reference (if any): _____

Annex H. Pre-Deployment Readiness Checklist (Go/No-Go)

Complete jointly by the Field Team Leader and relevant team officers; refer to the approved sampling plan and QAP.

Campaign/date		Field Team Leader	
Sampling area/sites		Checklist completed by	

No.	Readiness item	Minimum acceptance condition/evidence	Yes	No	N/A	Issue / corrective action / owner
1	Approved sampling plan	Current approved version available; sites, parameters, methods, schedule and QC design confirmed	☐	☐	☐	
2	Team and competency	Roster complete; roles assigned; required training/competency verified	☐	☐	☐	
3	Briefing	Objectives, site sequence, QC samples, safety, communication and contingencies discussed	☐	☐	☐	
4	Equipment and supplies	Critical equipment functional; IDs recorded; consumables and backups available	☐	☐	☐	
5	Calibration/verification	Required instruments pass approved calibration/verification criteria; logs completed	☐	☐	☐	
6	Containers and labels	Correct containers, labels, preservatives, sterility and quantities checked	☐	☐	☐	
7	QC materials	Required blanks, duplicates, check standards and other QC materials prepared	☐	☐	☐	
8	Logistics and transport	Vehicle, route, access permissions, coolers and cooling materials confirmed	☐	☐	☐	
9	Laboratory coordination	Laboratory notified; receipt arrangements, acceptance criteria and holding times confirmed	☐	☐	☐	
10	Documentation/custody	Field forms and chain-of-custody forms prepared; handoffs assigned	☐	☐	☐	
11	Safety and environment	Risk assessment complete; PPE, first aid, emergency contacts, disinfection and waste controls ready	☐	☐	☐	

Open issue/deficiency	Risk level (critical/minor)	Corrective action	Responsible person	Due / closed date	Verified by

Decision: ☐ GO ☐ NO-GO Critical deficiencies resolved? ☐ Yes ☐ No
Field Team Leader name/signature: _____ Date/time: _____
QA Officer/reviewer name/signature: _____ Date/time: _____

Annex I. Health, Safety, Biosafety and Environmental Checklist

Complete before departure and verify again at the site. Mark Yes/No/N/A and document corrective action.

Campaign/date			
Sites covered			

No.	Checklist item	Acceptance evidence / requirement	Yes	No	N/A	Corrective action / remarks
1	Site-specific risk assessment completed and communicated	Signed risk assessment; briefing record	☐	☐	☐	
2	Required PPE available, serviceable and appropriate to hazards	PPE checked against the risk assessment; damaged items replaced	☐	☐	☐	
3	First-aid kit stocked and accessible	Contents checked against kit list; items in date	☐	☐	☐	
4	Emergency contacts, evacuation arrangements and communication devices verified	Contact list verified; phones or radios tested	☐	☐	☐	
5	GPS/maps and vehicle emergency supplies available	GPS/maps loaded; vehicle emergency supplies checked	☐	☐	☐	
6	Disinfectant and hand-hygiene supplies available	Disinfectant, hand sanitiser and clean water counted	☐	☐	☐	
7	Biohazard bags and waste containers available	Bags and rigid waste containers counted	☐	☐	☐	
8	Chemical containers labelled; relevant Safety Data Sheets accessible	Containers labelled; SDS inventory carried	☐	☐	☐	
9	Sterile containers and procedures for microbiological sampling confirmed	Sterile containers sealed and in date; Annex B completed	☐	☐	☐	
10	Staff competency and task-specific training verified	Training and competency records on file	☐	☐	☐	

No.	Checklist item	Acceptance evidence / requirement	Yes	No	N/A	Corrective action / remarks
11	Safe working distance / buddy arrangements established where needed	Pairs assigned; safe distance from water briefed	☐	☐	☐	
12	Environmental protection and waste-disposal arrangements confirmed	Waste route and approved disposal site confirmed	☐	☐	☐	
13	Stop-work authority and incident-reporting procedure understood	Stop-work authority and incident reporting covered in briefing record	☐	☐	☐	

Safety briefing completed by: _____ Signature: _____ Date/time: _____

Outstanding issues and resolution: _____

Safety and Logistics Officer / Field Team Leader approval: _____ Date: _____



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