Quality Assurance Project Plan

For Nutrient Reduction Bioassay Experiments

Under The

Sacramento-San Joaquin Delta Regional Monitoring Program

(Version 1.1)

Submitted On

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GROUP A. PROJECT MANAGEMENT AND INFORMATION/DATA QUALITY OBJECTIVES

A.1 TITLE AND APPROVAL PAGE

This Quality Assurance Project Plan (QAPP) describes the procedures, objectives, and responsible personnel for ensuring the quality of data generated by the Nutrient Reduction Bioassay (NRB) experiments under the Delta Regional Monitoring Program (DRMP).

A.2 APPROVAL SIGNATURES

This is a contractual document. The signature dates indicate the earliest date when the project can start. Signatures will be obtained once the Central Valley Regional Water Quality Control Board and State Water Resources Control Board Quality Assurance (QA) Officer have indicated the QAPP is ready for approval.

Delta Regional Monitoring Program

Program Role	Name	Affiliation	Signature	Date
Board of Directors President	Debbie Mackey	DRMP	Signed by: Debbie Mackay	9/5/2025
Program Manager	Melissa Turner	MLJ Environmental	DocuSigned by: Melissa Turner	9/3/2025
Quality Assurance Officer	Will Hagan	MPSL-MLML	DocuSigned by: Will Hagan	9/3/2025
Data Manager	Cassandra Lamerdin	MLJ Environmental	Signed by: Cassandra Lamerdin	9/3/2025

Central Valley Regional Water Quality Control Board

Program Role	Name	Affiliation	Signature	Date
Environmental Program Manager	Meredith Howard	CVRWQCB	DocuSigned by: Meredith Howard	9/9/2025
Quality Assurance Representative	Vacant	CVRWQCB	NA	NA

State Water Resources Control Board

Program Role	Name	Affiliation	Signature	Date
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Project Personnel

Project Role	Name	Affiliation	Signature	Date
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Project Role	Name	Affiliation	Signature	Date
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A.3 TABLE OF CONTENTS

A.3.1 LIST OF APPENDICES

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A.3.4 LIST OF ACRONYMS

BOD	Board of Directors
CEDEN	California Environmental Data Exchange Network
CHAB	Cyanobacterial Harmful Algal Bloom
Chl	Chlorophyll-a
CCR	Coastal Conservation and Research
COC	Chain of Custody
CRM	Certified Reference Material
CV RDC	Central Valley Regional Data Center

CVRWQCB	Central Valley Regional Water Quality Control Board
DRMP	Delta Regional Monitoring Program
DMT	Data Management Team
DO	Dissolved Oxygen
DQI	Data Quality Indicator
DQO	Data Quality Objective
DWR	Department of Water Resources
E	Environmental Sample
EC	Electrical Conductivity
EDD	Electronic Data Deliverable
ELAP	Environmental Laboratory Accreditation Program
EPA	Environmental Protection Agency
FD	Field Duplicate
HAB	Harmful Algal Bloom
LCS	Lab Control Sample
LCSD	Lab Control Sample Duplicate
MLML	Moss Landing Marine Laboratories
MPSL	Marine Pollution Studies Laboratory
MQO	Measurement Quality Objective
MS	Matrix Spike
MSD	Matrix Spike Duplicate
MS4	Municipal Separate Stormwater Sewer System
MVI	*Microcystis* Visual Index
N	Nitrogen
NOAA	National Oceanic and Atmospheric Administration
NRB	Nutrient Reduction Bioassay
P	Phosphorous
PDF	Portable Document Format
POTW	Publicly Owned Treatment Works
PM	Project Manager
PR	Percent Recovery
QA	Quality Assurance
QAM	Quality Assurance Manual
QAPP	Quality Assurance Project Plan
QAPrP	Quality Assurance Program Plan
QC	Quality Control
QMP	Quality Management Plan
RL	Reporting Limit
RPD	Relative Percent Difference
SOP	Standard Operating Procedure
SRM	Standard Reference Material
SWAMP	Surface Water Ambient Monitoring Program
SWRCB	State Water Resources Control Board
TAC	Technical Advisory Committee

A.3.5 LIST OF UNITS

°C	degrees Celsius
cm	centimeter
g	gram
kg	kilogram
L	liter
mg	milligram
mL	milliliter
mol	mole
ng	nanogram
µg	microgram
µmol	micromole
µS	Microsiemen
W/m2	Watts per square meter

A.3.6 DOCUMENT CONTROL

A.3.6.1 Current Version

Title: DRMP Nutrient Reduction Bioassay Experiments Quality Assurance Project Plan

Version: 1.1

Document Code: DRMP NRB Experiment QAPP v1.1

CEDEN Protocol Code: CEDEN Database Code

Approval Date: August 26, 2025

Effective Date: August 26, 2025

A.3.6.2 Revision History

Table 1. Document revision history.

VERSION	DATE	REVISION DESCRIPTION
1.0	May 1, 2025	Original submittal to the CVRWQCB
1.1	August 26, 2025	Resubmittal incorporating comments from CVRWQCB and SWRCB.

A.4 PROJECT PURPOSE, PROBLEM DEFINITION, AND BACKGROUND

A.4.1 QUALITY ASSURANCE PLANNING DOCUMENTS

The DRMP has developed a Data Management Plan which outlines the policies and procedures enacted by the DRMP to manage the availability, usability, integrity, and security of the data generated under the projects and studies funded by the Program. This Data Management Plan is the umbrella document outlining the data governance policies of the DRMP. The Data Management Plan outlines the overall strategy and policies for data quality management and establishes the criteria by which data acceptability under the DRMP can be determined. All project documents defining data management procedures and data quality reviews shall be in accordance with the procedures established in this document (unless otherwise approved prior to project implementation) to be acceptable under the DRMP.

The hierarchy of DRMP and its implementation in program documents can be compared to the three levels of the State Water Resources Control Board (SWRCB) documents, namely, the State's Quality Management Plan (QMP, SWRCB 2017), Quality Assurance Program Plans (QAPrPs), and project specific QAPPs. The planning documents of the DRMP should be in accordance with the policies outlined in the Water Boards planning documents.

The SWRCB QMP outlines the pathway to integrate quality assurance principles into all data collection, assessment, and analytical work of the SWRCB and Regional Water Quality Control Boards (collectively referred to as Water Boards).

The Surface Water Ambient Monitoring Program (SWAMP) QAPrP establishes the requirements for collecting data that are scientifically valid and defensible, and of known and documented quality. The DRMP looks for guidance from SWAMP and their associated data management documentation including the QAPrP.

A.4.2 PROJECT PURPOSE AND PROBLEM DEFINITION

The Sacramento-San Joaquin Delta (Delta) is an important water supply for municipal, industrial, and agricultural use for much of the state and is a critical ecosystem for fish and wildlife, including many rare and endangered species. The native fishes of the Sacramento–San Joaquin Delta have been declining at an increasingly rapid rate for more than two decades. This decline has significant consequences for water resource management in the Delta. There is no single cause for the decline of these fishes. All facets of the Delta ecosystem have changed dramatically in the past two decades and most changes have been detrimental to native fishes. Climate change, recent droughts, and increasing wildfires are a few of these changes. Another factor that can cause harm to native species are point- or nonpoint-source discharges that alter water quality (through land and water use activities). Upstream water diversions also affect contaminant concentrations and water temperatures through changes in flows, and current export pumping practices can exacerbate poor water quality conditions in altered habitats. Contaminants have been documented in all major aquatic habitats in the Delta and Suisun Marsh. Discharges that alter water quality can affect both individual and populations of native species. The magnitude of cumulative effects of multiple contaminants that alter water quality is not well documented in the Delta. However, cumulative effects of harmful contaminants may also affect native species through direct toxicity or disruption of food webs.

The DRMP was initiated under the encouragement of the Central Valley Regional Water Quality Control Board (CVRWQCB) with the primary goal of tracking and documenting the effectiveness of beneficial use protection and restoration efforts through comprehensive monitoring of water quality constituents and their effects in the Delta. Understanding the current water quality conditions within the Delta and the potential impacts to water quality conditions is important to preserve and enhance the Delta and inform corresponding regulatory and management decisions, which should be based upon sound science.

CVRWQCB Delta Nutrient Research Plan identified research recommendations for further research to better address nutrient management questions in the Delta (Cooke et al. 2018). The top-ranking special study recommendation was to determine the roles of nutrients and other drivers (e.g. light limitation, mixing, grazing, and presence of macrophytes) in controlling the growth rate, maximum biomass, and toxin production of harmful algal blooms (HABs). The CVRWQCB noted that they anticipate the possible development of nutrient benchmarks and/or reduction goals during the Delta Nutrient Research Plan implementation.

Accordingly, the DRMP developed a Nutrient Multi-Year Study Plan (DRMP Study Plan) to guide long-term studies of the effects of nutrients on the ecology of the Delta. Three

primary questions (also referred to as focus areas) guided the development of the DRMP Study Plan.

1. Following a reduction in nutrient loading from different point and nonpoint sources, what ranges of nutrient concentrations are expected to occur throughout the Delta, and how might they be affected by climate change, wetland restorations, and water management and routing?
2. What are the thresholds for nutrients (nitrogen (N) and phosphorus (P) and their ratios) that can limit HAB biomass and cyanotoxin accumulation to safe levels, limit the abundance and distribution of nuisance macrophytes, and support robust growth of desirable phytoplankton and macrophytes throughout the Delta?
3. How are the characteristics of harmful cyanobacteria blooms and cyanotoxins in the Delta changing (e.g., species, magnitude, geographic extent, and timing) and what factors contribute to these changes?

The DRMP Study Plan addresses these three focus areas using a combination of modeling, field/experimental studies, and monitoring. It is not the objective of the DRMP Study Plan to completely address all three focus area questions. The intent of the DRMP Study Plan is to begin a multi-year process that begins to address these questions with a hypothesis driven approach and prioritizing data gaps identified by the Steering Committee and DRMP Nutrient Technical Advisory Committee (Nutrient TAC).

To assist with understanding the ecological effects of nutrient reductions, the Nutrient Reduction Bioassay Experiments aim to answer focus area number two of the Study Plan:

- What are the thresholds for nutrients (N and P and their ratios) that can limit HAB biomass and cyanotoxin accumulation to safe levels, limit the abundance and distribution of nuisance macrophytes, and support robust growth of desirable phytoplankton and macrophytes throughout the Delta?

This experimental study will use controlled and replicated bioassay experiments to investigate the role of nutrient (N and P) reductions, and other drivers, in controlling the growth rate, biomass accumulation, and toxin production of cyanobacterial harmful algal bloom (CHAB) species versus other beneficial phytoplankton species in the Delta.

HABs, particularly those caused by CHABs like *Microcystis* sp. (*Microcystis*), have increased in coverage, duration, and severity since their first occurrence in the Delta in 1999 (Lehman et al. 2005). Promoted by drought, warming temperatures, decreased turbidity, and decreased inflows, blooms are occurring sooner in the summer season and persisting longer into the fall (Lehman et al. 2008, 2013, 2017). However, CHABs do not occur uniformly across the Delta which consists of a complex network of over 700 miles of rivers, sloughs, and dead-end channels (Jassby et al. 2002). Variations in environmental parameters such as salinity, water temperature, turbidity, nutrient

concentrations, rate of mixing, and water residence time are factors that contribute to differences in biomass levels of phytoplankton in general and CHABs in particular (Downing et al. 2016, Berg et al. 2022, Preece et al. 2024a). For example, specific regions of the Delta have been characterized as “hot spots” of CHAB, especially *Microcystis*, occurrences. These hot spots are characterized by greater residence times and a higher degree of nutrient depletion than other regions of the Delta (Preece et al. 2024b). It is of great interest to investigate whether reductions in nutrient loadings to such hot spot regions would decrease biomass accumulation (typically measured as chlorophyll-a (Chl) concentration, of CHAB species such as the colonial *Microcystis*.
To investigate the efficacy of nutrient reductions on growth and biomass accumulation of CHABs, focus will be put on hotspot regions which reliably develop *Microcystis* blooms annually to answer the three broad questions with associated hypotheses listed in **Table 2**. The intended outcomes of the NRB experiments are to:

- Characterize the concentration of N (and P) that is limiting for the production of *Microcystis* colony biomass, i.e. determine the concentration of N (or P) that results in no change in biomass in a treatment with a certain starting biomass level. In treatments where growth does occur, characterize the Chl production to nitrogen uptake ratio (Chl:N ratio, g:mol) according to Gowen et al. (1992), and cyanotoxin concentrations.
- Characterize what phytoplankton species will be reduced and what species will dominate in mixed phytoplankton communities, that include *Microcystis* sp., under nutrient-limiting conditions in the NRBs.
- Characterize how a second environmental factor (i.e. change in irradiance, variation in mixing, presence of macrophytes, or clam grazing) would potentially alter the impact of variation in the concentration of nutrients on accumulation of *Microcystis* biomass as well as other parameters such as Chl:N ratio (g:mol) and cyanotoxin production.
- Describe how phytoplankton physiology develops (and potentially differs) in the NRBs compared with that of the source water location over a short-term (i.e. 2-4 day) incubation period.

Table 2. NRB Experiment Questions and Hypotheses

Question	Hypothesis	
Would N and P reductions decrease *Microcystis* growth, biomass accumulation, and toxin production? If so, what level of N and P reduction relative to starting phytoplankton biomass is needed to significantly reduce CHAB growth, biomass, and cyanotoxin concentrations?	1	Growth of *Microcystis* will cease (i.e. become zero or negative) and biomass accumulation will cease when the ratio of *Microcystis* Chl concentration (µg/L) to N concentration (µmol/L) in the growth medium (i.e. Chl:N ratio g:mol) is above or equal to 1 in the Nutrient Reduction Bioassays (NRBs).
	2	The P concentration will modulate *Microcystis* growth rate at a Chl:N ratio (g:mol) above 1 but not at a ratio below 1 in the NRBs.
	3	Cyanotoxin production will cease when growth rate of *Microcystis* is no longer positive (i.e. zero or negative).
Would N and P reductions decrease accumulation of biomass of desirable phytoplankton in the Delta? If so, what is the interaction between N and P reduction and decrease in biomass of *Microcystis* species. versus other phytoplankton species?	1	Growth of all phytoplankton, including *Microcystis*, will cease (i.e. become zero or negative) and biomass accumulation will cease when the community Chl:N ratio (g:mol) is above or equal to 1 in the NRBs.
How would other environmental factors, such as change in irradiance, mixing, aquatic plant growth, and clam grazing, alter the effects of N and P reductions on *Microcystis* sp. and/or phytoplankton populations?	1	Effects of N and P reductions would impact all phytoplankton, including *Microcystis*, equally and not be altered by a secondary environmental factor because nutrient limitation takes precedence over other physiological impacts.

A.4.2.1 Decisions and Information

The NRB experiments are designed to partially inform one of the management questions identified as a high priority by the DRMP Steering Committee. “What are the thresholds for nutrients (N and P and their ratios) that can limit CHAB biomass and cyanotoxin accumulation to safe levels, limit the abundance and distribution of nuisance macrophytes, and support robust growth of desirable phytoplankton and macrophytes throughout the Delta?” It also follows a research recommendation in the Delta Nutrient

Research Plan (Cooke et al. 2018), to perform a “Study of potential for changes in nutrients or physical drivers to reduce frequency and magnitude of harmful cyanobacteria blooms and toxins”.

Reduced nutrient concentrations in the Delta might help control the occurrence and severity of CHABs, such as *Microcystis* sp., *Aphanizomenon* sp., and *Dolichospermum* sp. and reduce cyanotoxin concentrations, such as microcystin, anatoxin, saxitoxins, and cylindrospermopsin. However, nutrient reduction also has the potential to reduce the growth of desirable phytoplankton species, such as diatoms, which provide an important base for the Delta’s pelagic food web.

The NRB study addresses an important question for N management; which phytoplankton species and how much phytoplankton biomass are likely to grow in the Delta at low N and P concentrations under ideal growing conditions? Phytoplankton (and CHAB) management strategies also need to identify expected nutrient concentrations throughout the Delta under reduced nutrient loading (investigated by Focus Area 1) and how other factors known to reduce phytoplankton growth might interact with low dissolved inorganic nitrogen (DIN) to affect phytoplankton species biomass and occurrence.

Other important factors that should be studied in combination with nutrient limitation include light or silica limitation, reduced growth periods due to increased flows, temperature effects, herbicide effects, salinity effects, stratification, competition with macrophytes, grazing by herbivores, and mortality from disease and parasites. If a model can combine all the known outcomes of these interacting factors on phytoplankton growth, and estimate the biogeochemical nitrogen cycle, it should provide reasonable predictions for how phytoplankton would respond to nutrient loading reductions in the Delta.

This NRB study provides a useful first step by identifying the upper limit of phytoplankton biomass that might occur in the Delta at different low DIN and P concentrations in the absence of these other regulating factors. The study will also help evaluate if light limitation, competition with a submerged macrophyte, or grazing by clams might have substantial impacts on phytoplankton growth at low nutrient concentrations.

The findings from this study will help California State regulators and stakeholders estimate the upper limit of cyanobacteria biomass and cyanotoxins that can be produced at low N or P concentrations, under conditions promoting phytoplankton growth. This information will help California State regulators and stakeholders evaluate the level of nutrient reduction that might result in material reductions in CHAB populations. The findings will also help determine if low N or P concentrations might limit the biomass of beneficial phytoplankton produced in the Delta where Chl concentrations above 10 µg/L have been shown to support maximal zooplankton growth rates (Müller-Solger et al.

2002). The study also provides an initial investigation into potential interactions between low DIN concentrations and other factors known to affect phytoplankton biomass in the Delta, including light limitation, nutrient competition with macrophytes, and grazing losses to clams, to assess the importance of combined effects.

There are limitations to bioassay experiments focused on phytoplankton communities, including unintended impacts of the study design such as: impacts of the container on physiological performance of phytoplankton, potential changes in species composition, and the potential of inducing limitation of a secondary nutrient when adding the primary macronutrient to the container (Beardall et al 2001). Therefore, results of these types of studies should be used in context of the limitations of the study design recognizing that they will not be a perfect representation of the Delta.

The findings from this study should be interpreted cautiously as many environmental conditions in containers are different from those present in the Delta waterways. Experimental containers are beneficial for isolating and evaluating mechanistic effects of environmental factors, but they may not accurately represent phytoplankton growth under natural conditions in the Delta. Additionally, phytoplankton responses to N and P reductions are likely to differ due to interactions with other organisms and environmental variables.

A.4.2.2 Regulatory Criteria

A variety of permittees throughout the Central Valley regulated by the CVRWQCB contribute and participate in the DRMP. In 2013, the CVRWQCB passed R5-2013-0130 allowing permittees with sufficient participation in the DRMP to modify or reduce some of the requirements of their own permits in exchange for their contribution to the Program. As such, the close collaboration with the CVRWQCB is essential to ensure the continued value and effectiveness of regional monitoring in lieu of individual monitoring and special studies that otherwise might be required by CVRWQCB for participating permittees.

In October 2021, the CVRWQCB passed Resolution R5-2021-0054 approving the updated DRMP governance structure as a vehicle for this modified monitoring to occur. Attachment A of Resolution R5-2021-0054 outlines the reporting requirements of the DRMP to the CVRWQCB in order to ensure added value of the coordinated efforts under the Program are adequate to investigate water quality issues in lieu of individual monitoring and special studies.

The requirements in Resolution R5-2021-0054 relevant to the QAPP include:

- Developing QAPPs that meet the requirements of the Water Boards and US Environmental Protection Agency (EPA).
- A documentation process for deviations and an assessment and corrective action process.

- Approval by the SWRCB QA Officer prior to implementation of monitoring.
- Deviations to the QAPP must be approved by the CVRWQCB QA Representative or the SWRCB QA Officer.
    - When prior approval is not possible for QAPP deviations, they must be reported to the CVRWQCB QA Representative within 7 Calendar Days of the Board of Directors or contractors becoming aware of the deviation.

A.4.2.3 Possible Actions

Any results reported above the associated Water Quality Metrics must be reported to the CVRWQCB within 60 calendar days of the sample analysis, per R5-2021-0054. The Water Quality Metrics constitute the project action limits for samples collected under this QAPP and are defined by the CVRWQCB by July 1 of each year, also per R5-2021-0054. The current action limits for this project are defined in **Table 20**, which also includes the laboratory analysis limits (Reporting and Method Detection Limits).

A.4.3 PROJECT BACKGROUND

This study will use controlled and replicated bioassay experiments to investigate how phytoplankton sourced from the Delta responds to limited N or P availability. Bioassay experiments simplify complex natural processes by controlling specific factors and can be used to test a hypothesis in a similar but controlled environment.

An initial set of pilot studies (Phase 1) testing different variables of the project design, such as sampling locations, water volumes, incubation duration, dilution water chemistry, N and P concentrations, salinities, light levels, clam biomass, and macrophyte biomass, will be performed prior to running the fully replicated study (Phase 2).

As a bioassay study, this is a hypothesis-driven experimental design with the goal of understanding CHAB management when nutrients are reduced. Specifically, this study aims to characterize interactions and change-points between CHAB and non-CHAB species relative to current conditions and as nutrients are reduced. For this reason, this specific experiment aims to test both the naturally occurring, eukaryotic phytoplankton community (i.e. diatoms and chlorophytes) and prokaryotic CHAB species such as *Microcystis*.

In order to increase the likelihood of being able to sample a mixed phytoplankton community that includes a CHAB species like *Microcystis*, this project will include the collection of samples from one or more of three hot spot locations in the Delta. These include Big Break, Discovery Bay, and the Stockton Waterfront (see **Figure 1**, section **A.5.4**). Sample collections will be predicated on the presence of CHAB species as well as a relatively moderate to low ambient nutrient concentration in the water. During the pilot phase of the project, these three locations will be monitored throughout the summer growing season in order to characterize phytoplankton community biomass

accumulation as well as nutrient reductions as blooms progress over the growing season. Based on the data gathered, a decision will be made regarding what location to collect samples from for the full-scale NRB experiments in the following year.

This special study focuses on hotspot regions that reliably develop *Microcystis* sp. blooms during the summer growth season to answer the questions listed in **Table 2**. An additional question that we will explore is how phytoplankton physiology and water quality conditions in the NRBs develop compared with that of the source water location over the incubation period.

Nutrient addition bioassays are commonly used to test phytoplankton nutrient limitation in aquatic systems (e.g. Fisher and Gustafson 1999, Beardall et al. 2001, Arrigo 2005, Elser et al. 2007, Moore et al. 2013). The premise behind nutrient addition bioassays is that in environments with low nutrient concentrations it is difficult to discover which nutrient is limiting growth of phytoplankton at a physiological level (Geider and LaRoche 2002, Turner Rabalais 2013). By adding nutrients to separate treatments containing natural phytoplankton communities and measuring growth, the nutrient that produces the greatest growth in a short time span is the proximal limiting nutrient of the community (e.g. Browning and Moore 2023). A principal distinguishing factor of nutrient addition bioassays is that all variables other than the nutrient being tested are held constant, including starting biomass of phytoplankton, phytoplankton community composition, irradiance, and temperature, such that only the impact of nutrients is tested. Artifacts associated with bioassay experiments, commonly known as “bottle effects”, such as small sample volume, lack of water exchange, lack of mixing, and a large wall-area-to-water-volume ratio impact how readily results from bioassay experiments can be extrapolated to a natural system (e.g. Marasee and Caron 1992, Oviatt 1994, Berg et al. 1999). One way to limit the impacts from artifacts on measurement end points and results is to use a larger volume (i.e. for plankton assays greater than 500 ml; Marasee and Caron 1992) and keep the incubation duration to a minimum (e.g. 1-2 days; Fisher and Gustafson 1992).

Compared with the nutrient addition bioassay, a more challenging assay to perform is a nutrient reduction bioassay (NRB). This type of bioassay has become more widely employed in recent years to test the efficacy of reduction of nutrients from a specific aquatic environment that produces HABs to gauge whether the nutrient reduction would lead to a decrease in the growth of the HAB species (e.g. Barnard et al. 2021). This type of assay can be performed in two ways. Either the test water containing the natural phytoplankton community can be diluted with non-nutrient containing water to achieve a lower nutrient (and other constituents) test water, or the phytoplankton community can be concentrated and added to treatments with varying concentrations of different nutrients. The former approach minimizes manipulations of the natural phytoplankton community, but it does not keep the starting phytoplankton biomass or the test medium constant. It could also alter the starting phytoplankton community

composition depending on the test volume and impact of dilution. The latter approach includes manipulation of the community which could potentially impact the physiology of the phytoplankton, but it would allow starting phytoplankton biomass and community composition to remain consistent among treatments. It could also allow test medium to remain consistent depending on how lowering the nutrient concentration is achieved. However, both these approaches could lead to results being deemed the consequence of manipulation rather than treatment.

For this project, a hybrid approach will be employed that will allow the "background" phytoplankton community to remain undisturbed, the test medium to remain consistent among treatments, and the phytoplankton to be assayed to be minimally manipulated. This can be achieved by focusing on *Microcystis* as the test organisms.

Microcystis sp. is a colonial cyanobacterial species that traps air bubbles in their cells that allow them to float at the surface in calm water. In a well-mixed water column, *Microcystis* sp. will be distributed evenly from top to bottom. But when mixing is "arrested," colonies will float to the surface and form a "scum" layer (Visser et al. 2015). For communities specific to the Delta, this feature can be taken advantage of and used to isolate colonies and add them to treatments containing a natural phytoplankton community. In addition, the natural community can be sampled from a location where nutrients have been reduced from the water due to growth of a CHAB species thereby already furnishing a reduced nutrient treatment. In order to compare with low concentrations, nutrients can be added to the "control" treatment. In this manner, an NRB with consistent treatment medium, phytoplankton composition and biomass, can be obtained.

To facilitate an understanding of the applicability of the results of the NRBs to the natural system, this project will characterize the physical, water quality, and biological conditions of the source water location. This will include vertical profiles of temperature, specific conductivity (SC), pH, dissolved oxygen (DO), turbidity, and irradiance. In addition, water column mixing and nutrient concentrations will also be characterized. Biological characterization will include active Chl fluorescence (i.e. fluorescence when excited by a bright light relative to background fluorescence), Chl concentration, and phytoplankton species enumeration.

A.5 PROJECT TASK DESCRIPTION

This project will be divided into three experimental tasks in addition to a project management task for a total of four tasks as described below.

A.5.1 WORK STATEMENT AND DELIVERABLES

As part of project management, the Project Manager (PM) will attend meetings with the DRMP Nutrient TAC. Over two years of the project, attendance at 24 Nutrient TAC meetings will be assumed. Upon completion of analysis of results from a particular phase of the project, these will be presented by the PM at an appropriate Nutrient TAC meeting. From the first phase of the project (Phase 1) during year one, two presentations will be prepared. One presentation will summarize field monitoring results, and a second will summarize results of the pilot studies. In the second year of the project (Phase 2), between one and three full-scale NRB experiments will be completed, and results from these experiments will be summarized in two separate presentations. Additionally, monthly progress reports will be submitted with monthly invoices, for a total of 24 progress reports over the course of two years.

Phase 1: Source Water Monitoring and Pilot Studies

Phase 1 monitoring and pilot studies will occur during the summer of 2025. Monitoring of the three field sites, Stockton Waterfront, Big Break, and Discovery Bay (**Table 12**) will be divided among three groups. Coastal Conservation and Research (CCR) and its collaborating partner Moss Landing Marine Laboratories (MLML) will sample Big Break, Discovery Bay, and the Stockton Waterfront. The Stockton Waterfront will also be sampled by the Department of Water Resources (DWR) who already has a project at that site as their schedule allows. Field monitoring of source water will occur two times per month from July through September. If DWR staff are unable to sample Stockton Waterfront according to the schedule, project personnel will complete the sampling. Monitoring will include the field measurements and analysis of grab samples for the constituents listed in **Table 3**. Grab samples will be analyzed for the constituents indicated in **Table 3**, which also specifies the agencies responsible for analyzing each sample. Timing of sample collections at each site will be coordinated such that samples collected by various project personnel will be transported together to the assigned laboratories for analysis.

For the NRBs, very low nutrient concentrations (i.e. ~0.5 µmol/L for nitrate) will need to be accurately measured in the experimental containers. Additionally, a guaranteed

analysis turnaround time of one day will be necessary at the start of the experiment. Both these conditions can be met by the MLML Nutrient Laboratory.

For the pilot experiments, it will be key to select a location with a relatively strong *Microcystis* presence. The *Microcystis* Visual Index (MVI) is a method developed by DWR to visually observe and rank the relative density of *Microcystis* colonies in the water (Flynn et al. 2022). It is routinely used to describe relative colony densities of *Microcystis* in Delta waterways (Preece et al. 2024b). Project personnel will be trained to ensure MVI ranking is standardized across sampling teams. Project personnel training is further discussed in **Element A.11**.

The site with a strong and healthy *Microcystis* sp. population (i.e. a relatively high MVI ranking coupled with a high active fluorescence yield, measured as variable (F_v) over maximum (F_m) fluorescence, indicating a physiologically healthy population, will be used for the pilot NRB experiments. The pilot experiments will include a number of different tests in replicate containers suspended *in situ* at the location where the samples are collected. Tests include 1) determining the best container to use (i.e. material, size, and shape), 2) optimal incubation duration, 3) how to add/equalize a consistent amount of *Microcystis* biomass (i.e. colonies) across treatments and replicates, 4) differences in starting *Microcystis* biomass on *Microcystis* growth, 5) optimization of concentration of nutrients (N and P) to be added daily to the low nutrient treatments, 6) evaluating methods of mixing the container, 7) evaluating light intensities for an irradiance treatment, and lastly how to add macrophytes and clams as treatments.

Additional tests and monitoring may be required if significant problems are encountered with the experimental design during the pilot testing. Significant problems will be brought to the Nutrient TAC and options to test additional components of the bioassay design will be discussed. Additional tests will not be performed without agreement by the Nutrient TAC and approval of the DRMP BOD. A technical memo will be provided describing the additional test(s) that will occur. If the approved additional test(s) deviations from this QAPP, a QAPP amendment will be submitted to the CVRWQC and SWRCB with additional information.

Method performance validation will begin concurrently with the start of Phase 1, with the intent of completing validation prior to the analysis of project samples. Any project data generated prior to completion of method validation will be considered preliminary and will undergo evaluation for confidence, validity, and usability, with appropriate qualifiers assigned to indicate its status. All data deficiencies will be assessed by the experts of the TAC in coordination with the Program Manager, Program QA Officer, and CVRWQCB QA Representative, as prescribed in the Data Management Plan. Deficient or rejected data generated during Phase 1 may still be utilized by the project team to help inform the design and planning of Phase 2. Any data generated after the completion

of method validation will be processed, finalized, and made publicly available in accordance with this QAPP. As part of the validation process, laboratory-specific SOP(s) will be developed to standardize calibration and low-level nutrient analysis, supplementing the reference methods currently in use as SOPs.**Phase 2: Full-Scale Nutrient Reduction Bioassays**

The full-scale NRB (Phase 2) will be performed during the summer of 2026. The design of the NRBs will reflect lessons learned from the 2025 pilot experiments.

1. The location and timing of collection of phytoplankton and performance of the NRBs will be based on the previous summer's field monitoring results. To ensure adequate bloom conditions and starting biomass at the chosen location, one field observation trip in the month prior to experiment start will be performed. In addition, two days prior to experimental start, the chosen experimental location will be visited for collection of samples for analyses of nutrient concentrations and Chl concentration to get an idea for starting concentrations for the experiment in order to calculate appropriate "low" and "medium" N and P additions. The goal is for source water used for the NRBs to meet the constituent target concentrations listed in **Table 11;** if necessary, adjustments in source water location or dilutions of the source water can be made as described in **Element B.1.1.1**. in order to meet target concentrations.
2. The first full-scale NRB experiment comprising testing of N- and P-limited conditions will be performed over the optimal incubation period (to be determined during pilot studies) with an additional day to prepare the experiment and an additional day to break it down. The optimal incubation period will be determined as described **Element B.1.1.1**. Each NRB will consist of five treatments, each in triplicate, and require three staff to sample daily. Over the course of each NRB, source water monitoring will occur at the location where the source water was collected over the same days the experiment is sampled. Both grab samples and vertical sonde profiles will be collected from the source water location. Up to three full-scale NRBs will be performed over the course of the summer of 2026. Each NRB will constitute a sub-task under the NRB task.

A.5.1.1 Deliverables

Phase 1 will produce two main data sets, one from field monitoring and one from the pilot experiments. The measurements to be made during the field monitoring are described below in **Table 3**. These two Phase 1 dataset deliverables will be deposited with the DRMP. The field-specific dataset will also be entered into the California Environmental Data Exchange Network (CEDEN) database by the DRMP. From Phase 1,

there will be two reports completed and submitted to the DRMP, one for each type of dataset, for a total of four deliverables under this phase (**Table 4**).

Phase 2 will include full-scale NRB experiments, each experiment constituting its own task. The constituents to be measured are listed in **Table 3** below and will be the same for each experiment. From each NRB, a complete dataset containing measurement results from all the constituents will be produced. When all the NRBs are completed, each dataset will be verified and delivered to the DRMP. When the datasets have all been analyzed, they will be summarized in a final report. The deliverables under Phase 2 include one dataset for each NRB and one draft and final report for all the NRBs (**Table 4**).

A.5.2 CONSTITUENTS TO BE MONITORED

Table 3. Constituents to be measured in the field (in situ) or in the NRBs.

Constituent	Agency	Matrix	Method	Technology	Fractions/ Endpoints	Reporting Units
Photo Documentation[1]	CCR	--	Digital Capture	Phone/ digital camera	--	--
Microcystis Visual Index[1]	CCR	Water	Visual Assessment	--	--	Scale Scoring (1-5)
Temperature[1]	CCR	Water	EPA 170.1	AquaTroll Sonde	--	°C
Dissolved Oxygen[1]	CCR	Water	SM 4500-O H	AquaTroll Sonde	--	mg/L
Dissolved Oxygen[1]	CCR	Water	SM 4500-O H	AquaTroll Sonde	--	% saturation
pH[1]	CCR	Water	EPA 150.1	AquaTroll Sonde	--	pH units
Specific Conductivity[1]	CCR	Water	EPA 120.1	AquaTroll Sonde	--	µS/cm
Turbidity[1]	CCR	Water	EPA 180.1	AquaTroll Sonde	--	NTU
Irradiance[2,3]	CCR	Water	SM 10200 H	LI-COR quantum sensor	--	W/m2
Active Fluorescence[1,2]	CCR	Water	Berg et al. 2017	Phytoflash	Total	RFU
Temperature[2]	CCR	Water	EPA 170.1	Probe	Total	°C
Dissolved Oxygen[2]	CCR	Water	SM 4500-O G	Extech DO600 Electrode	Total	mg/L
Dissolved Oxygen[2]	CCR	Water	SM 4500-O G	Extech DO600 Electrode	Total	% saturation
pH[2]	CCR	Water	EPA 150.1	Extech pH100 Electrode	Total	pH units
Turbidity[1,2]	CCR	Water	EPA 180.1	Portable Turbidity Meter	Total	NTU
Ammonia as N	MLML Nutrient Lab	Water	EPA 350.1	Flow Injection Analysis	Dissolved	mg/L

Constituent	Agency	Matrix	Method	Technology	Fractions/ Endpoints	Reporting Units
Nitrate as N	MLML Nutrient Lab	Water	EPA 353.4	Flow Injection Analysis	Dissolved	mg/L
Nitrite as N	MLML Nutrient Lab	Water	EPA 353.4	Flow Injection Analysis	Dissolved	mg/L
Nitrogen, Total	MLML Nutrient Lab	Water	Valderrama 1981/ EPA 353.4	Persulfate digestion followed by flow injection analysis	Dissolved	mg/L
Nitrogen, Organic	MLML Nutrient Lab	Water	EPA 440.0	Elemental Analysis	Particulate	mg
Nitrogen, Organic[4]	MLML Nutrient Lab	Water	NA	Calculation	Dissolved	mg/L
Particulate Organic Carbon	MLML Nutrient Lab	Water	EPA 440.0	Elemental Analysis	Particulate	mg
OrthoPhosphate as P	MLML Nutrient Lab	Water	EPA 365.5	Flow Injection Analysis	Dissolved	mg/L
Phosphorus as P	MLML Nutrient Lab	Water	Valderrama 1981/ EPA 365.5	Persulfate digestion followed by flow injection analysis	Dissolved	mg/L
Phosphorus as P, Organic[5]	MLML Nutrient Lab	Water	NA	Calculation	Dissolved	mg/L
Silicate as Si	MLML Nutrient Lab	Water	EPA 366	Flow Injection Analysis	Dissolved	mg/L
Chlorophyll-a	MLML Nutrient Lab	Water	EPA 445.0	Turner Fluorometer	Particulate	µg/L
Phytoplankton Abundance	BSA Environmental	Water	Beaver et al. 2013	Inverted Microscope	Total	Cells/L

Constituent	Agency	Matrix	Method	Technology	Fractions/ Endpoints	Reporting Units
Phytoplankton Biovolume	BSA Environmental	Water	Beaver et al. 2013	Inverted Microscope	Total	$\mu m^3/L$
Microcystis Colony Geometry	MLML EBL	Water	Görögcs et al. 2018	Aqusens Imaging Flow Cytometry	Total	µm
Microcystis Colony Enumeration	MLML EBL	Water	Görögcs et al. 2018	Aqusens Imaging Flow Cytometry	Total	Colonies/L
Microcystis Chlorophyll-a[6]	MLML Nutrient Lab	Water	EPA 445.0	Turner Fluorometer	Total	µg/L
Microcystins, Total	MLML EBL	Water	ELISA Abraxis 520011	Enzyme-Linked Immunosorbent Assay (ELISA)	Total	µg/L

[1]Field measurement of ambient water
[2]Field measurement taken from experimental container
[3]Field measurement of ambient water measured concurrently with NRB experimental container measurements to determine the difference. The reported value will represent the irradiance inside the experimental container.
[4]Organic Nitrogen = Total Nitrogen – Ammonia – Nitrate – Nitrite
[5]Organic Phosphorus = Total phosphorous - orthophosphate
[6]Measured only if visually present in the collected *Microcystis* sample

A.5.3 HABITAT OBSERVATIONS (IF APPLICABLE)

In addition to the samples and measurements collected in the field, sampling crews shall record habitat parameters documenting the qualitative site condition information at the time that samples were collected. The required habitat observations are consistent with SWAMP surface water sample collection protocols and are defined on the SWAMP field sheets used for this project. The field sheet will be tailored specific to the needs of the NRB Experiments project, an example of a SWAMP field sheet is provided in **Figure 4**. In addition to field site observations listed on SWAMP field sheets (in bullet form below), digital photographs will be taken of the water and the level of *Microcystis* colony density will be ranked/scored according to the MVI scale from 1-5 (Flynn 2022). This will enable scoring of the CHAB bloom level/intensity at the time of sampling.

Field site observations to be recorded in accordance with SWAMP protocol:

- Site odor
- Sky code
- Other presence
- Dominant substrate
- Water clarity
- Water odor
- Water color
- Overland runoff (last 24 hours)
- Observed flow
- Wadeability
- Wind speed (Beaufort scale)
- Wind direction
- Precipitation (at time of sampling)
- Precipitation (last 24 hours)
- Occupation Method
- Starting bank (facing downstream)
- Distance from bank (m)
- Stream width (m)
- Water depth (m)
- Location
- Hydromodification

A.5.4 PROJECT SCHEDULE

The project schedule is determined based on the study design, which may vary in duration and timing. Monitoring priorities and designs are assessed on an annual basis based on recommendations from the Steering Committee as part of developing annual Workplans and associated budgets which are developed on a fiscal year basis (July 1 through June 30). Workplans outlining the study goals, designs, and budgets for all projects in the upcoming fiscal year are provided to the CVRWQCB by May 1 annually and must be approved by the CVRWQCB prior to implementation. In addition to the annual workplan process, the DRMP may develop and approve multi-year study designs and QAPPs that include deliverables extending across several years. Anticipated project activities for the entirety of the project are outlined below. Individual QAPPs will be reviewed annually to determine if a revision is necessary; however, a QAPP must be revised every three years at a minimum. Ongoing project updates are documented through QAPP amendments and reviewed and revised as outlined in Section 4.4 of the DRMP Data Management Plan.

All deliverable dates will, at a minimum, meet the reporting requirements outlined in Resolution R5-2021-0054. Preliminary data must be reported to the CVRWQCB within 60 calendar days of the sample analysis and Annual Reports are due on February 1 each year for the previous fiscal year.

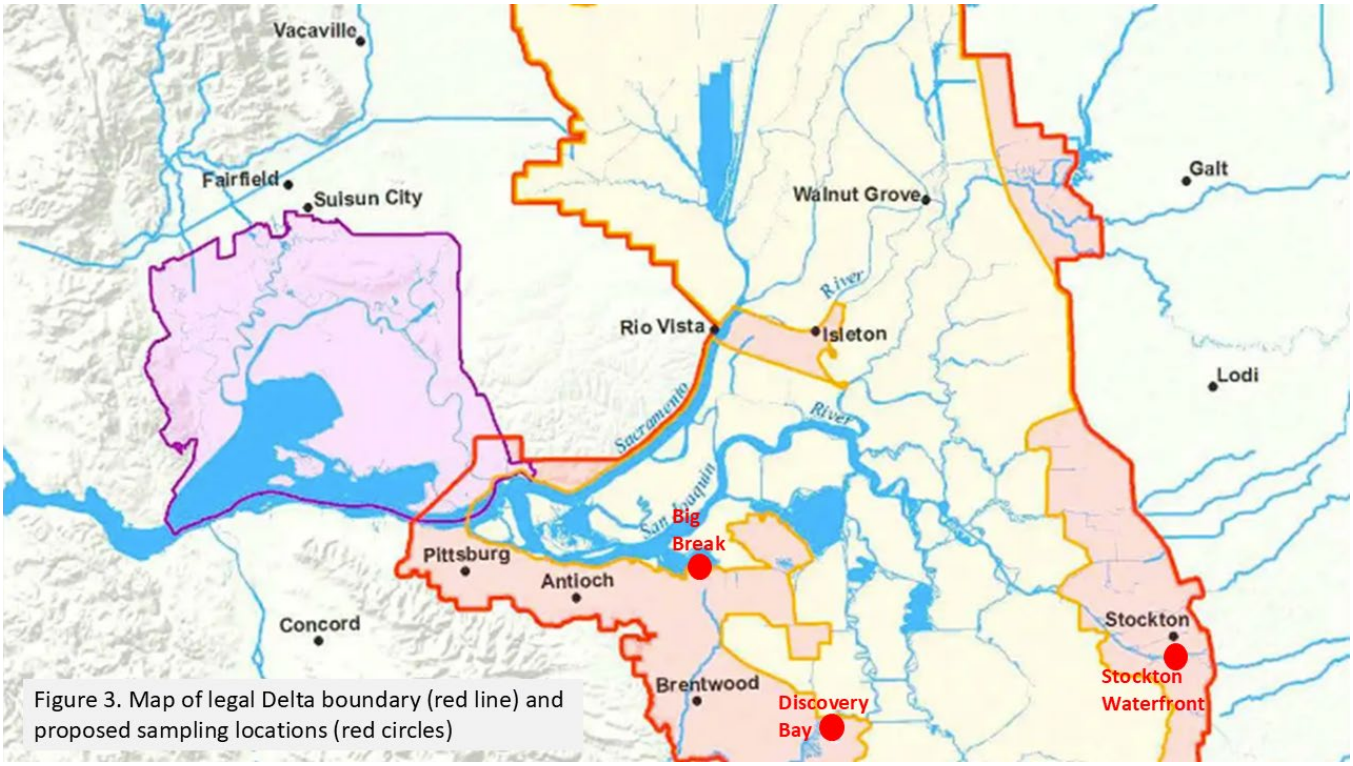
Table 4 summarizes the schedule of work to be performed under Phase 1 and 2, and deliverables to be submitted.

Table 4. Project deliverable schedule timeline.

Deliverable	Deliverable Due Date	Activity Period or Trigger	Frequency	Description
Resolution Deliverables				
Preliminary Data (Phase 1 and Phase 2)	60 calendar days	Sample analysis	Per sample event	Preliminary data collected during Phase 1 and 2 delivered within 60 calendar days of the sample analysis date.
Final Data: CHAB Hot Spot Field Data (Phase 1)	6 months / October 2025	Sample analysis / July-September 2025	Per event	Spreadsheet containing nutrient, Chl, MVI ranking, phytoplankton, and basic water quality data, collected from the 3 CHAB hot spot locations in the Delta

Deliverable	Deliverable Due Date	Activity Period or Trigger	Frequency	Description
Final Data: Pilot NRB (Phase 1)	6 months / November 2025	Sample analysis / July – September 2025	Per event (experiment)	Spreadsheet containing results of NRB pilot tests and analyses of various test parameters
Final Data: NRB Experiment 1 Data (Phase 2)	6 months/ October 2026	Sample analysis / August 2026	Per event (experiment)	Spreadsheet containing all data collected from first NRB experiment
Final Data: NRB Experiment 2 & 3 Data (Phase 2)	6 months / November 2026	Sample analysis / September 2026	Per event (experiment)	Spreadsheet containing all data collected from second and potentially third NRB experiments
DRMP FY 25-26 Annual Report	February 1, 2026	July 1, 2025 – June 30, 2026	Annually	Annual Report for FY 25-26 (Phase 1 efforts)
DRMP FY 26-27 Annual Report	February 1, 2027	July 1, 2026 – June 30, 2027	Annually	Annual Report for FY 26-27 (Phase 2 efforts)
Additional Study Deliverables				
Technical Memo	October 2025	October 2025	Once	Report on Phytoplankton Community Parameters at 3 CHAB Hot Spot Locations in the Delta
Phase 1 Data Report and QA Assessment	December 2025	November-December 2025	Once	Draft and final report on Pilot Experiment Results including Phytoplankton Community Parameters at 3 CHAB Hot Spot Locations in the Delta
Phase 2 Data Report and QA Assessment	April 2027	October 2026-April 2027	Once	Draft and final report on NRB experiment results

Figure 1. Map of the Delta highlighting potential CHAB hot spots with markers at Big Break, Discovery Bay, and the Stockton waterfront.



A.6 QUALITY OBJECTIVES AND CRITERIA

A.6.1 DATA QUALITY OBJECTIVES

In order to account for the inherent level of uncertainty that can occur from the study design process, it is important for the project to identify limits of acceptable error that define data quality and useability.

Data quality objectives (DQOs) are the qualitative and quantitative statements that define the appropriate metrics that will be used to establish the level of quality for a project (EPA 2006). The DQO Process is a tool developed by EPA that can be used by project managers to determine the type, quantity, and quality of data needed. During the development of the study design, DQOs should be clearly defined and considered when determining metrics for assessing the quality and useability of the data for decision making. Data will be considered valid if DQOs for each of the data quality indicators outline below are achieved. The effectiveness of the QA/QC program will be assessed by the quality of the data generated by the analytical laboratory and determination of field parameters.

A.6.2 DATA QUALITY INDICATORS

Data Quality Indicators (DQIs) are the quantitative statistics and qualitative descriptors used to interpret the degree of acceptability or utility of data to the user (US EPA QA/G-5, 2002). The principal data quality indicators are precision, accuracy (bias), representativeness, comparability, completeness, and sensitivity.

Limits for error must be established for all applicable DQIs for every measurement conducted under the DRMP. Program definitions for each DQI are provided below. Minimum targets associated with each of the following DQIs are outlined below in **Element A.6.3.**

A.6.2.1 Precision and Accuracy (Bias)

Precision measures the agreement among repeated measurements of the same property under identical, or substantially similar, conditions. The closer two values that result from the same measurement under the same conditions are, the higher the degree of precision. The degree of precision can be a result of error and/or the limits of the measurement system. A measurement quality objective (MQO) can be set for the allowable amount of variation between multiple measurements to account for limits of the measurement system and the inherent amount of user error associated with the measurement system. Program precision is monitored using duplicate quality control samples, including but not limited to field duplicates (or replicates), laboratory duplicates, and matrix spike duplicates.

Accuracy is a measure of the overall agreement of a measurement to a known value. Accuracy includes a combination of random error (precision) and systematic error (bias) components that are due to sampling and analytical operations.

MQOs can be set to limit bias and to set an amount of error as compared to a true value achieved for a measurement. Contamination, measurement error, and matrix interference are all examples of causes of reduction in accuracy of a measurement.

Contamination that may be introduced during sample handling, preparation, or analysis can be monitored with the use of field blanks and laboratory blanks. If contamination is introduced, blank sample results can provide the degree of bias resulting from the error or analytical bias.

Measurement errors can be monitored through the analysis of a known concentration range and compared to measured results. This can be done using certified reference materials and laboratory control spike samples.

Bias introduced through interfering conditions present in the sample matrix can be monitored by duplicate environmental samples with a known concentration of target analytes prior to analytical process, known as matrix spike samples.

Data quality will be attained by maximizing the accuracy and precision of the methods used. Any changes in procedures due to equipment changes or to improved precision and accuracy will be documented. All analyses and determinations must be performed by qualified personnel in conformance with all current EPA standards and procedures. All laboratories will employ only methods and techniques which have been determined to produce measurement data of a known and verifiable quality and which are of quality sufficient to meet the overall objectives of the project.

A.6.2.2 Representativeness

Representativeness is the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition. Representativeness for the DRMP can be defined as the degree to which the environmental data generated by the monitoring program accurately and precisely represents actual environmental conditions. For this project, this objective is addressed by the overall study design, adherence with sampling Standard Operating Procedures (SOPs), and meeting holding times. Assuring that the data are representative of the program objectives is addressed primarily by selecting appropriate locations, methods, times, and frequencies of sampling for each environmental parameter, and by maintaining the integrity of the sample after collection. The overall study design and rationale is provided in the workplan and is summarized in **Element B.1**.

A.6.2.3 Comparability

Comparability is a measure of the confidence with which one data set or method can be compared to another. Project data are comparable when evaluated against similar quality objectives and when utilizing similar methodology and reporting requirements. All projects contributing to the DRMP must maintain comparability by following the provisions outlined in the DRMP Data Management Plan.

A.6.2.4 Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system. This assessment is typically expressed as a percentage of measurements reported within the prescribed limits associated with the respective DQOs, compared to those initially planned. Completeness evaluations ensure program requirements for data generation and reporting are met by contributing projects. Program completeness is

assessed on three levels: field and transport, analytical, and batch completeness. Field completeness requires that sampling crews successfully visit each site, document the visit, and collect the field information and samples as outlined in **Elements B.1**. Transport completeness requires that the samples collected by field crews are successfully transported to the laboratories within hold-times and meeting sample storage requirements (e.g., appropriate temperature and accompanied by a completed chain of custody form). Analytical completeness is based on the number of samples successfully analyzed by the laboratory and for which valid results are generated. Batch completeness is based on whether batches were processed with the appropriate quality control (QC) samples, as prescribed by the method or defined by the laboratory. Minimum QC sample frequency requirements can be found in **Element B.4**.

A.6.2.5 Sensitivity and Resolution

Analytical sensitivity is commonly defined as the lowest value an instrument or method can measure with a reasonable degree of certainty. Resolution is the capability of a method or instrument to discriminate between measurement responses representing different levels of a variable of interest. These limits are important to know when evaluating the appropriateness of a method or instrument for the requirements of a given study.

Reporting Limits (RLs) represent the level at which a method or instrument can accurately measure a target compound. Wherever analytically feasible, reporting limits should be lower than the required project action limit to be appropriate for the project. Project RLs are defined in **Table 18**; project laboratories will verify their ability to achieve these RLs through an applicable accreditation or assessment of performance as described in **Element B.2.2**. Wherever analytically feasible, reporting limits should be lower than the required project action limit to be appropriate for the project.

A.6.3 PERFORMANCE CRITERIA

Performance criteria address the adequacy of information that is to be collected for a project. For this project, the MQOs defined below are the specific criteria to which environmental or quality control measures are compared to determine adequacy and acceptability. Measurement quality objectives for accuracy, precision, completeness, recovery, and contamination are assessed through a combination of instrument calibration and the analysis of duplicates, blanks, and spikes. Completeness is assessed based on the number of samples successfully obtained and validated for use and the proportion of quality control samples that are within acceptance criteria. Measurement quality objectives are listed below in **Table 5** and in **Table 6** are the performance criteria utilized to evaluate whether the data quality objectives were met.

Field measurements are taken with multi-parameter systems; accuracy and precision are measured during calibration (if applicable), taking into account the manufacturer's specifications. For all other types of samples (e.g. grabs), analyses, accuracy, precision, and recovery are assessed through the use of QC samples, including laboratory spikes and matrix spikes to assess accuracy and recovery, and laboratory and field duplicates to assess precision.

Table 5 summarizes measurement quality objectives in measurements of accuracy, precision, and completeness; testing/calibration frequency is per event for all multiparameter systems.

Table 5. Measurement quality objectives for field accuracy, precision, and completeness measurements.

CONSTITUENT	ACCURACY/PRECISION	COMPLETENESS
Temperature	±0.1 °C/0.01°C	90%
pH	±0.1 pH units/0.01 pH	90%
Specific Conductivity	±0.5 µS/cm/0.1 µS/cm	90%
Dissolved Oxygen	± 0.1 mg/L/0.01 mg/L	90%
Turbidity	±0.5 NTU/0.01 NTU	90%
Active Fluorescence	±1%/0.025 ug/L	90%
Irradiance	±5%/4 uA	90%

Table 6. Measurement quality objectives for laboratory batch[1] accuracy, precision, and completeness measurements

Constituent	Matrix	Method	Matrix Spike Accuracy	Laboratory Control Spike[2] Accuracy	Precision[3]	Laboratory Blank	Completeness
Ammonia as N	Water	EPA 350.1	PR 80-120%	PR 90-110%	RPD ≤10%	<RL	90%
Nitrate as N	Water	EPA 353.4	PR 80-120%	PR 90-110%	RPD ≤10%	<RL	90%
Nitrite as N	Water	EPA 353.4	PR 80-120%	PR 90-110%	RPD ≤10%	<RL	90%
Nitrogen, Total	Water	Valderrama 1981	PR 80-120%	PR 90-110%	RPD ≤10%	<RL	90%
Nitrogen, Organic[4]	Water	Calculation	NA	NA	NA	NA	NA
Nitrogen, Organic	Water	EPA 440.0	PR 80-120%	PR 90-110%	RPD ≤10%	<RL	90%
Particulate Organic Carbon	Water	EPA 440.0	PR 80-120%	PR 90-110%	RPD ≤10%	<RL	90%
Orthophosphate as P	Water	EPA 365.5	PR 80-120%	PR 90-110%	RPD ≤10%	<RL	90%
Phosphorus, as P	Water	Valderrama 1981 / EPA 365.5	PR 80-120%	PR 90-110%	RPD ≤10%	<RL	90%
Phosphorus as P, Organic[5]	Water	Calculation	NA	NA	NA	NA	NA
Silicate as Si	Water	EPA 366	PR 80-120%	PR 90-110%	RPD ≤10%	<RL	90%
Chlorophyll-a	Water	EPA 445.0	NA	NA	RPD ≤20%	<RL	90%
Phytoplankton Abundance	Water	Beaver et al. 2013	NA	NA	NA	NA	NA
Phytoplankton Biovolume	Water	Beaver et al. 2013	NA	NA	NA	NA	NA
Microcystis Colony Geometry	Water	Göröcs et al. 2018	NA	NA	NA	NA	NA
Microcystis Colony Enumeration	Water	Göröcs et al. 2018	NA	NA	NA	NA	NA

Constituent	Matrix	Method	Matrix Spike Accuracy	Laboratory Control Spike[2] Accuracy	Precision[3]	Laboratory Blank	Completeness
Microcystis Chlorophyll-a[6]	Water	EPA 445.0	NA	NA	RPD ≤20%	<RL	90%
Microcystins, Total	Water	ELISA Abraxis 520011	PR 77-133%	PR 77-133%	RPD ≤33%	<RL	90%

[1]A batch must not exceed 20 environmental samples. At minimum, a lab blank, LCS, MS, and one duplicate[2] must be included in each batch.
[2]Certified reference material may be used in place of a laboratory control spike.
[3]A matrix spike duplicate or a laboratory control spike duplicate, or sample duplicate may be used for demonstration of precision.
[4]Ammonia, nitrate, nitrate, nitrite, and total nitrogen analyses are used to calculate Organic Nitrogen in mg/L.
[5]Phosphorus and orthophosphate are used to calculate organic phosphorus in mg/L.
[6]Measured only if visually present in the collected *Microcystis* sample

A.6.4 ACCEPTANCE CRITERIA

Acceptance criteria address the adequacy of existing information proposed for inclusion in the project. These criteria often apply to information drawn from existing sources outside of the DRMP. Previously collected information (not generated under this QAPP) or data collected by other monitoring entities will undergo a more general QA/QC review to identify potentially erroneous data. **Element A.4.2.1** identifies any existing information that may be used for this project and provides general guidance for evaluating the data quality. Non-direct measurements must meet the minimum requirements outlined within **Element A.6** before being accepted for use. The necessity and means by which external data are used and evaluated will be specified in the relevant data reports.

A.7 DISTRIBUTION LIST

The individuals and groups listed in **Table 7**. QAPP distribution list. will receive a final, executed copy of this document and any subsequent revisions. Copies of this document will be made available to the public via the DRMP website, https://DeltaRMP.org/.

Table 7. QAPP distribution list.

TITLE	NAME	ORGANIZATION
DRMP Steering Committee	Distribution List	NA
Nutrient Technical Advisory Committee	Distribution List	NA
DRMP Board of Directors President	Debbie Mackey	DRMP
DRMP Program Manager	Melissa Turner	MLJ Environmental
DRMP Quality Assurance Officer	Will Hagan	MPSL-MLML
DRMP Data Manager	Cassandra Lamerdin	MLJ Environmental
CVRWQCB Environmental Program Manager	Meredith Howard	CVRWQCB
CVRWQCB Quality Assurance Representative	Vacant[1]	CVRWQCB
SWRCB Quality Assurance Officer	Ranita Prasad	SWRCB
Nutrient Laboratory Manager	Steven Cunningham	MLML
Environmental Biotechnology Laboratory Manager	Holly Bowers	MLML
Director	John Beaver	BSA Environmental Services

[1]At the time of this QAPP, the CVRWQCB does not have a Quality Assurance Representative.

A.7.1 QAPP DISTRIBUTION

The Program Manager will ensure that copies of this QAPP will be distributed to all parties involved with the project. Electronic copies will be sent to all labs for review and reference. Final, approved copies will also be published on the DRMP website (DeltaRMP.org). Any future amended QAPPs will be held and distributed in the same fashion. All original and subsequent amended QAPPs will also be held at the CVRWQCB.

A.8 PROJECT ORGANIZATION

A.8.1 DELTA REGIONAL MONITORING PROGRAM STRUCTURE

The purpose of the DRMP is to educate and inform decisions on how to protect, and where necessary, restore beneficial uses of water in the Sacramento-San Joaquin River Delta area of California, by producing objective and cost-effective scientific information critical to understanding regional water quality conditions and trends. The Implementing Entity for the DRMP is a nonprofit public benefit corporation under which the Board of Directors (BOD) oversee operations of the program.

The DRMP pursues the following objectives:

a) Improve the efficiency of water quality data collection and management in the Delta.

b) Generate information that informs and educates the public, agencies, and decision makers.

c) Raise awareness of Delta water quality conditions and how they impact beneficial uses.

d) Foster independent science, objective peer review, and a transparent review process.

The DRMP is implemented with stakeholder participation of various coordinated monitoring, resource, regulatory and regulated entities. These groups give technical and policy recommendations to the BOD through participation in the Steering Committee and various project-specific technical advisory committees (TACs). The Program structure is illustrated below in **Figure 2**.

The implementation of the Program is done in close coordination with the CVRWQCB. The expectations of these requirements are outlined in Resolution R5-2021-0054, Approval of Delta Regional Monitoring Program Governance Structure and Implementing Entity, which provides the general approval of the DRMP Implementing Entity and governance structure (see **Regulatory Criteria**). All monitoring and data generation occurring under this QAPP must be in accordance with the submission requirements and due dates defined in the Resolution Attachment A.

A.8.2 GOVERNING BOARDS AND ADVISORY COMMITTEES

A.8.2.1 Board of Directors

The BOD consists of directors dedicated to the purposes of the DRMP and appointed by their sector's appointing agency(ies). The BOD makes all binding decisions for the DRMP. The BOD will appoint both standing committees of the Board and advisory committees to the BOD. The BOD also appoints four Board Officers from among the existing members including a President, Vice President, Secretary, and Treasurer.

On a two-year rotation, agencies will put forth a nominee for their respective seat(s) to represent them on the BOD. Currently, the Bylaws provide for 11 director seats as follows:

- Agricultural interest (2 seats).
- Publicly Owned Treatment Works (POTW– 3 seats).
- Storm Water Agencies (MS4s – 3 seats).
- Water Supply Agencies (1 seat).
- Habitat Restoration/Flood Management (1 seat).
- 'At large' seat appointed by the Board of Directors (1 seat).

The responsibilities of the Board include (also See Article V, Section 1 of the Bylaws):

- Adopt policies, rules and procedures for the management and operation of the DRMP.
- Develop the financial operations of the nonprofit.
    - Create and approve budgets and expenditures.
    - Receive and accept contributions, grants, etc.
- Hire leadership staff, as necessary, to run the nonprofit and implement the DRMP program.
- Enter into contracts with entities and individuals as necessary to operate and implement the DRMP.
- Appoint and/or form Committees of the Board or Advisory Committees (technical and administrative) (See Section VI).
    - Under nonprofit law, committees of the Board must be comprised of only Board members. Advisory Committees can be made up of both Board members and non-Board members.

    - The Bylaws currently identify two Standing committees, the Executive Committee and the Steering Committee. All other committees (i.e., those that are not Standing Committees, either of the Board or Advisory) are formed by resolution of the Board.
- Establish and oversee the implementation of policies and priorities of the DRMP.

A.8.2.2 Executive Committee

The Executive Committee is a standing Committee of the Board and has the authority between Board meetings to make decisions and take action relative to the operation of the nonprofit organization on behalf of the Board following developed policies and procedures of the Board. The Executive Committee consists of the four Board officers. The Executive Committee is responsible for authorizing the daily management of the Corporation including setting agendas for Board meetings, making/approving authorized limit expenditures, and similar. The Executive Committee may develop policies for Board approval and may review and recommend to the Board changes to the bylaws and to other operating policies.

The Executive Committee consists of the following Board officers which are selected from existing members of the Board: President, Vice President, Secretary, and Treasurer.

A.8.2.3 Steering Committee

The Steering Committee is a standing Advisory Committee to the BOD as described in the Bylaws and consists of representatives of the same categories as those defined for the members of the BOD, and with the same number of seats per category, plus representatives of regulatory agencies. These representative categories are listed below, specifically:

- Agricultural interest - 2 seats.
- POTWs – 3 seats.
- Storm Water Agencies (MS4s) – 3 seats.
- Water Supply Agencies – 1 seat.
- Habitat Restoration/Flood Management – 1 seat.
- Dredgers – 1 seat.
- Coordinated monitoring (Interagency Ecological Program/California Department of Fish and Wildlife) - 1 seat.
- Resource Agencies (NOAA Fisheries) - 1 seat.

- Regulatory Agencies (US EPA, SWRCB, and CVRWQCB-Management level staff) - 3 seats.
- Tribal representative – 1 seat.

The Steering Committee is charged with the authority and responsibility to:

- Serve as an advisory body to the BOD;
- Advise on strategic direction and the policies and procedures to implement the DRMP in a manner consistent with regulatory conditions and priorities;
- Recommend direction for technical committees on priorities, constraints, and management questions to develop technical recommendations and products within the resource allocations determined by the BOD;
- Recommend DRMP work products and any other plans or products.

All decisions by the Steering Committee will be in the form of advice/recommendations to the Board. The Steering Committee will have no binding authority on DRMP implementation. The Board will consider all recommendations by the Steering Committee in a timely manner.

All decisions by the Steering Committee are subject to subsequent timely consideration by the Board including but not limited to pursuit of opinions by others (e.g., the Executive Director, the Program Manager and other technical specialists (as warranted)).

Some decisions by the Steering Committee that are time-sensitive or less significant can be made via e-mail or telephone conference, but only if these items have previously been discussed in a Steering Committee meeting.

A.8.2.4 Nutrient Technical Advisory Committee

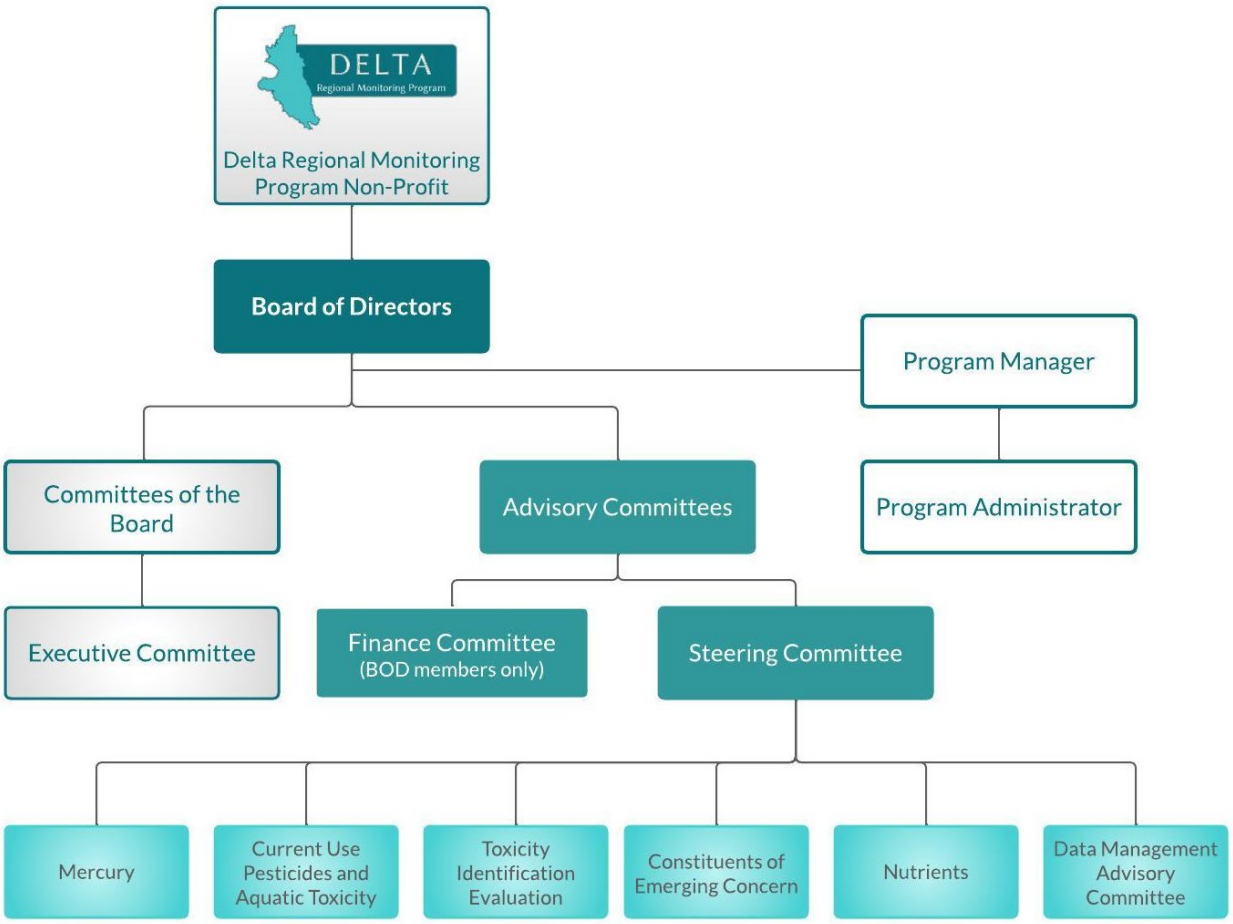
For this project, the Nutrient TAC has been established to provide recommendations to the Steering Committee and the BOD regarding technical recommendations for the implementation of this project. The TAC has been provided specific responsibilities associated with expected deliverables by the Board (e.g., the “Charge”) as also informed by Steering Committee recommendations. The TAC members serving as technical advisors for this project are identified in **Table 8**.

The Nutrient TAC will provide direction during Phase 1 regarding additional treatments to be conducted as part of the Pilot Studies if issues arise that require additional investigation. The Nutrient TAC will also provide direction on whether additional treatments (treatment 3 and 4) of the NRB experiments should be conducted. Any additional analysis and/or methods not currently in the QAPP will require an amendment to be approved.

Table 8. Nutrient Technical Advisory Committee members.

TITLE	NAME	ORGANIZATION
TAC Member	Tim Mussen	SacSewer
TAC Member	Janis Cooke	CVRWQB
TAC Member	Stephen Metzger	MLJ Environmental

Figure 2. DRMP Non-Profit Structure (as of August 2024).



A.8.3 PROGRAM MANAGEMENT

A.8.3.1 DRMP Program Manager Role

The BOD has hired Melissa Turner of MLJ Environmental as the Program Manager. The Program Manager oversees all technical programs and associated leadership and staff for each technical area of the DRMP. The Program Manager will be responsible for planning and overseeing DRMP projects to ensure that they are completed within a timely

manner and within budget. It is the Program Manager's responsibility to plan projects, prepare budgets, monitor progress, and keep stakeholders informed.

The Program Manager is responsible for the implementation of the project in accordance with Resolution R5-2021-0054, the approved fiscal year Workplan, the DRMP Data Management Plan, and the QAPP. The Program Manager ensures the communication of direction, decisions, and challenges to implementation between technical staff and committees, the CVRWQCB, the Steering Committee, and the BOD.

A.8.4 QUALITY ASSURANCE OVERSIGHT

A.8.4.1 Program Quality Assurance Officer Role

The DRMP Program QA Officer is Will Hagan of the Marine Pollution Studies Laboratory (MPSL) at MLML. The Program QA Officer provides ultimate quality assurance oversight for field and laboratory procedures, and final data review and assessment of completeness, accuracy, and precision of data generated by this project. The DRMP QA Officer is independent of any direct data generation, such as sample collection, field parameter recording, or laboratory analysis.

In addition to procedural QA/QC, the Program QA Officer, in coordination with the Program Manager, is responsible for reviewing laboratory protocols to confirm laboratory compliance with the overall requirements of the DRMP and is ultimately responsible for reviewing project data both for accuracy and comparability with the SWRCB SWAMP. The Program QA Officer may stop all actions, including those conducted by the laboratories, if there are significant deviations from required QAPP practices or if there is evidence of a systematic failure.

Quality assurance oversight for the implementation of DRMP projects and studies is conducted in coordination with the CVRWQCB QA Representative. The SWRCB QA Officer will also be consulted to ensure consistency with SWRCB data management policies; the SWRCB QA Officer is a signatory of the QAPP, and their approval is required prior to the implementation of this project.

Deviations to this QAPP will be reviewed by the Program QA Officer, the Program Manager, and the CVRWQCB QA Representative to assess impacts on data quality and project objectives. All deviations must be approved by the CVRWQCB QA Representative or the SWRCB QA Officer prior to implementation. When prior approval is not possible, the deviations must be reported to the CVRWQCB QA Representative within seven (7) calendar days per Resolution R5-2021-0054. Deviations to this QAPP are documented according to the procedures outlined in **Element C.1**.

A.8.4.2 Data Manager Role

The Central Valley Regional Data Center (CV RDC) Manager (Victoria Bowles) coordinates the Data Management Team, which performs data review and verification to ensure that data submitted by subcontractor laboratories are timely, complete, and properly incorporated into the Regional Data Center database. Cassandra Lamerdin (MLJ Environmental) will be the project Data Manager leading the Data Management Team (DMT) under the direction of the CV RDC Manager. Ms. Lamerdin is responsible for data processing, QA/QC review, and data upload to the California Environmental Data Exchange Network (CEDEN). Once the data have been reviewed and processed, they will undergo a final review and qualification by Will Hagan, the Program QA Officer and/or a delegate of the QA Officer. In the event there are changes to the data after it has been published, they will be communicated to data users in a timely manner.

A.8.5 NRB PROJECT PERSONNEL

A.8.5.1 Field, Laboratory, and Technical Services

The Project Manager for the NRB Project is Mine Berg, Senior Environmental Scientist with CCR. The DRMP defines the Project Lead as the person responsible for ensuring the project is completed according to the planning documentation. The Project Manager facilitates the implementation of the project under the guidance of the Delta RMP Program Manager. The Project Manager is responsible for the coordination of sampling, laboratory analysis, and data reporting as prescribed in the study design. Prior to monitoring (if applicable), the Project Manager is responsible for ensuring that all parties involved in collecting and analyzing samples are aware of both field and laboratory roles and responsibilities. The Project Manager is responsible for ensuring communication between all parties and the Delta RMP regarding the status of the project and any deviations from the Monitoring Workplan, QAPP, or appropriate project planning document. For this project (both Phase 1 and 2), the Project Manager is responsible for ensuring the training of field staff and ensuring all sampling personnel are qualified to perform monitoring according to the procedures outlined in this QAPP. The Project Manager will provide sampling support, including measurements with the Phytoflash and imaging with the Aqusens Imager. The Project Manager will communicate to the DRMP Program QA Officer any deviations from the procedures outlined in the QAPP.

Samples will be analyzed for nutrient concentrations and Chl concentrations by the Nutrient Laboratory at MLML. Each laboratory has an appointed Laboratory Project Manager who is responsible for ensuring that all activities are completed following the procedures established in this QAPP. The Laboratory Project Manager, Steven Cunningham, the Nutrient Laboratory Manager at MLML, is responsible for project

management of nutrient and Chl analyses. The Laboratory Project Manager, Dr. John Beaver of BSA Environmental, is responsible for the project management of identification, enumeration and biovolume determination of phytoplankton from preserved whole-water samples. The Laboratory Project Managers will communicate to the Project Manager any deviations from the procedures outlined in the QAPP.

Per the DRMP Data Management Plan, all commercial contract laboratories must maintain the appropriate accreditation with the California Environmental Laboratory Accreditation Program (ELAP). Wherever possible, the laboratories must be accredited in the specific analytical methods used for performing analysis under this QAPP or provide the appropriate performance verification information as outlined in **Element B.2.2**.

Due to this study being an experiment bioassay, the laboratories utilized are not commercial laboratories and do not have ELAP accreditations.

A.8.6 PERSONS RESPONSIBLE FOR QAPP MAINTENANCE

The DRMP Program Manager and Program QA Officer are responsible for creating, maintaining, and updating this QAPP, including the submission of amendments to reflect updates to the project implementation. This QAPP must be reviewed and approved by the CVRWQCB QA Representative and SWRCB QA Officer. Project implementation cannot occur until the QAPP is approved.

Amendments to this document should be made in concurrence with the associated TAC and must be approved by either the SWRCB QA Officer or the CVRWQCB QA Representative prior to implementation. The DRMP Program Manager is responsible for documenting changes, submitting these changes for review and approval by Waterboards staff, and obtaining final signatures for all revisions and amendments to the QAPP.

A.8.7 PRINCIPAL DATA USERS

Data collected by the DRMP has a primary goal of informing management decisions of DRMP participants such as POTWs, small and large municipal separate storm sewer system (MS4) agencies, irrigated agriculture coalitions, Native American tribal entities, Interagency Ecological Program (Department of Fish and Wildlife, Department of Water Resources, Bureau of Reclamation), water suppliers (including exporters), resource agencies (National Marine Fisheries Service), and regulatory agencies (USEPA, SWRCB, and CVRWQCB).

A.9 QUALITY ASSURANCE OFFICER INDEPENDENCE

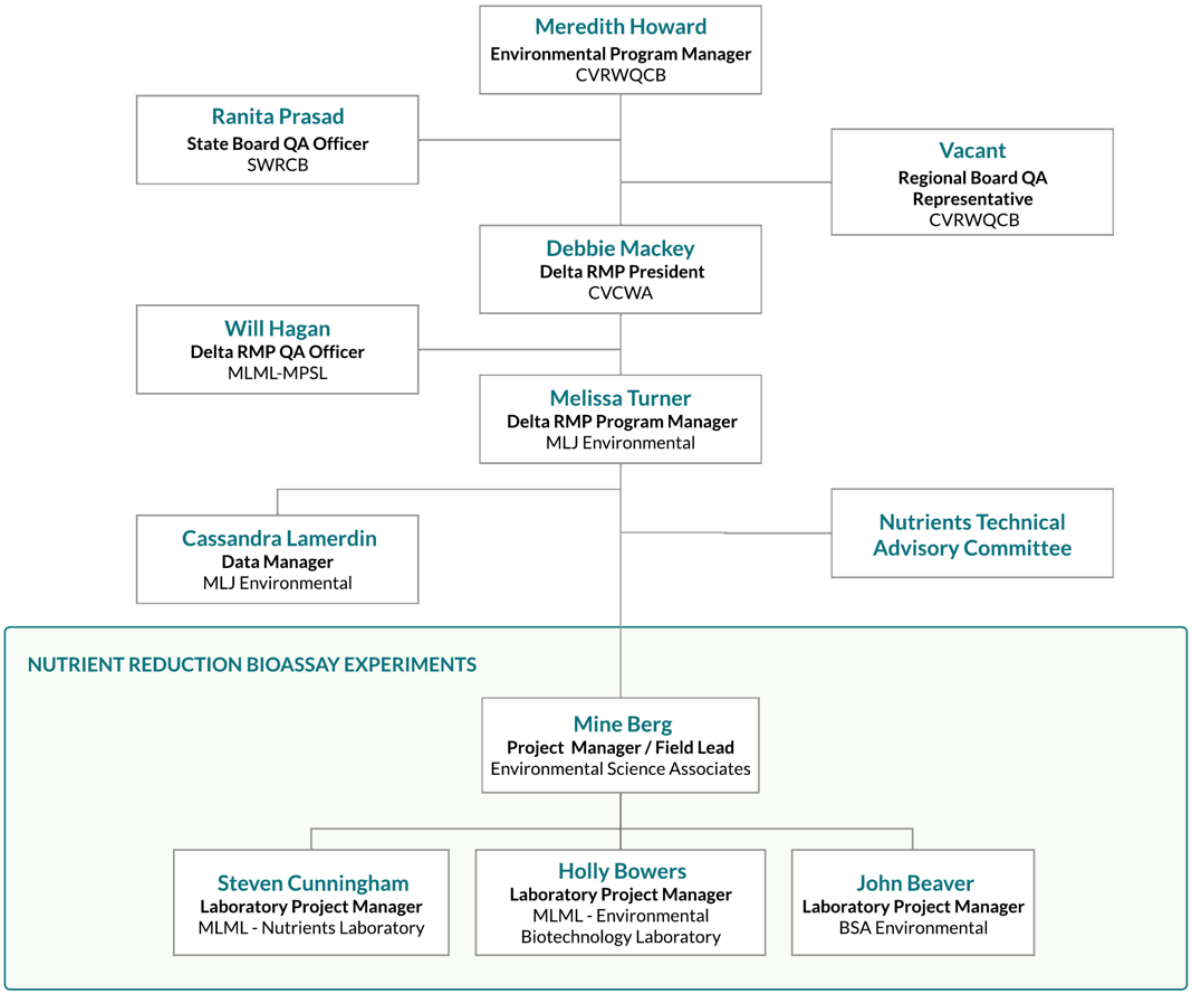
The DRMP QA Officer shall be independent of environmental information operations. This independence is ensured by the DRMP QA Officer remaining independent of any direct data generation, such as sample collection, field parameter recording, or laboratory analysis. The DRMP QA Officer is not required to be independent of senior officials, such as the DRMP BOD and DRMP administrators, who are nominally, but not functionally, involved in environmental information operations. The DRMP Program Manager or designee does not have authority to sign QAPPs for the DRMP QA Officer or designee, nor will the DRMP QA Officer or designee have authority to sign QAPPs for the DRMP Program Manager or designee. The two functions, QA and operations, shall remain independent.

A.10 ORGANIZATION CHART AND COMMUNICATIONS

The generation of data under the NRB project is conducted under the operations of the DRMP. The DRMP, regulatory oversight staff, and project-specific personnel, including contractors, subcontractors, and sub-grantees are identified in **Figure 3** with their associated reporting relationships. Communication procedures should adhere to the DRMP Data Management Plan, and the project structure outlined in **Project Organization.** The process for addressing deviations is detailed under the **.** The process for identifying, communicating, and documenting data rejection decisions is outlined in **Figure 7.**

Figure 3. Project organizational chart for oversight of project data generation.

Changes to personnel listed in the organization chart must be communicated to the DRMP Program Manager and documented with a QAPP amendment.



A.11 PERSONNEL TRAINING/CERTIFICATIONS

Personnel responsible for conducting the tasks identified in this QAPP shall have appropriate qualifications, education, training, experience, and knowledge of the requirements of the work activities to be performed.

A.11.1 SPECIALIZED TRAINING OR CERTIFICATIONS

All personnel performing sampling are trained in proper sampling techniques. Training includes a review of all SOPs and detailed information on filling sample bottles for the various types of analysis and proper procedures for filling field QC samples. Other topics covered are sample transport, calibration, use and maintenance of meters, and sample site confirmation. To further safeguard against sampling error, all sampling by personnel undergoing training is done under the supervision of more experienced personnel who accompany sampling crews each time they go in the field until training is completed. In addition to sampling training all sampling staff attend a field safety course. The Project Manager will oversee training and document when training has been completed.

Laboratory personnel must be trained in proper laboratory safety and general laboratory protocols before following the procedures for analyzing samples. Trainers must be trained in proper laboratory safety and must demonstrate adequate performance following the methods described by the SOPs. If performance is less than adequate, re-training by laboratory management must occur. Laboratory training takes place at the appropriate laboratory. Laboratory training procedures are outlined in the respective laboratory Quality Assurance Manual (QAM).

A.11.2 TRAINING OF PERSONNEL

The Field Lead is responsible for training all sampling personnel in field sampling and safety (**Table 9**).

The Laboratory Project Manager and Laboratory Quality Assurance Manager are responsible for ensuring that all laboratory staff are qualified and authorized to perform sample analysis according to the laboratory Quality Manual (QM) and Standard Operating Procedures (SOPs).

Table 9. Specialized personnel training and certification.

Specialized Training Course Title or Description	Training Provider	Personnel Receiving Training/ Organizational Affiliation	Location of Records & Certificates
Field Sampling	Project Manager	All Sampling Personnel	CCR Office
Field Safety	Project Manager	All Sampling Personnel	CCR Office
Laboratory Procedures	Lead Chemist	All Analysts	MLML Nutrient Lab
Laboratory Safety	Lead Chemist	All Analysts	MLML Nutrient Lab
Laboratory Procedures	Quality Assurance Manager	All Analysts	MLML Nutrient Lab

A.11.3 TRAINING AND CERTIFICATION DOCUMENTATION

Field training documentation that records the types of training provided in preparation for sampling activities that includes name of trainer, name of trainee, dates on which training occurred will be maintained at the respective field office. Laboratory training records and documentation of demonstrations of capability are maintained by the respective Laboratory QA Officer.

A.11.4 TRAINING AND CERTIFICATION OVERSIGHT

It is the responsibility of the QA officers for contracted laboratories, and the responsibility of the Project Manager for the samplers, to ensure that all employees achieve satisfactory training, including any necessary certifications. Signatures of participants are collected as evidence of attendance and this documentation is kept at the respective laboratory or field office.

A.12 DOCUMENTATION AND RECORDS

A.12.1 REPORT FORMAT

Preliminary raw data and monitoring results shall be provided to the CVRWQCB within 60 calendar days from the date of sample analysis. Final sampling and monitoring results shall be submitted to the CVRWQCB within 6 months from the date of sample analysis and the data must go through primary quality verification and corrective actions completed, if applicable.

A.12.2 ADDITIONAL DOCUMENTS AND RECORDS

Additional documents may include photographic documentation, summary reports, meeting notes, presentations, and reports. All forms of documentation must be held on file where they are readily available if requested.

Reporting of results that exceed any Water Quality Metrics provided in **Table 19** will occur within 60 calendar days of the sample analysis, per R5-2021-0054. Exceedance reports will be submitted electronically to the CVRWQCB by the Program Manager or a delegate. Copies of exceedance reports will be retained and maintained by the Program Manager.

A.12.3 RETENTION OF DOCUMENTS AND RECORDS

All data and/or other products created by the program will be retained by the participating entities and contract laboratories for a minimum of 10 years. The documents may be held for 10 years as electronic copies. Servers where the files reside will be backed up nightly.

Table 10. Document and record retention, archival, and disposition information.

Record Type	Record Needed	Retention	Archival	Disposition
Sample Collection Records	Field Sheets	MLJ Environmental	MLJ Environmental	Stored at CWSC or in MLJ office for at least 10 years
Sample Transfer Records	COC/Analytical Request Forms	MLJ Environmental	MLJ Environmental	Stored at lab or in MLJ office for at least 10 years
Analytical Records	Laboratory Reports and Electronic Data Deliverables	MLJ Environmental	MLJ Environmental	Stored at lab or in MLJ office for at least 10 years
Data Records	CV RDC	Remote Server, Moss Landing	Remote Server, Moss Landing	Permanent Storage on Remote Server
Assessment Records	NRB Data Reports	MLJ Environmental	MLJ Environmental	Permanent Storage on DRMP Website

A.12.4 MANAGEMENT OF DOCUMENTS AND RECORDS

The management of project information is described in **Element B.7**. The DRMP Program Manager is responsible for maintaining a document control system through which products and information generated under the DRMP are managed, distributed for review and approval, and archived. Documents and records generated by projects under the DRMP are made available to the public on the DRMP website (DeltaRMP.org).

A.12.4.1 Electronic Record Backups

All electronic copies of files maintained by MLJ Environmental are stored on a third-party cloud server. Records maintained on this server are backed up every 12 hours to a remote data center and backups are retained for 14 hours.

Files stored by MLJ Environmental on a web-based sharing platform to provide access to Delta RMP stakeholders are housed on a third-party cloud server with nightly backups replicated to at least one independent server to create redundancy and allow for instant replication if a failure occurs.

The Delta RMP Program Manager in coordination with the Data Manager will maintain the records in the CV RDC database; data management procedures including back-up plans for data stored in the CV RDC are outlined in **Element B.7**of this QAPP.

GROUP B. IMPLEMENTING ENVIRONMENTAL INFORMATION OPERATIONS

B.1 IDENTIFICATION OF PROJECT ENVIRONMENTAL INFORMATION OPERATIONS

Any deviations from the design outlined in the approved Monitoring Workplan and in this QAPP must be approved by the CVRWQCB prior to implementation. When prior approval is not possible, deviations must be reported to the CVRWQCB QA Representative within seven (7) calendar days of the BOD or contractors becoming aware of the deviation.

B.1.1 MONITORING AND EXPERIMENTAL DESIGN

An initial set of pilot studies testing different variables of the project design, such as source water location, optimal length of incubation duration, how to attain nutrient limited conditions in the treatments and not in the control, how to add a consistent amount of *Microcystis* biomass across treatments and controls, how to best provide mixing of the vessels for a mixing treatment, how to provide different light intensities for an irradiance treatment, type of macrophyte species and biomass to include, and others , will be performed in summer of 2025, prior to running the fully replicated study in the summer of 2026.

Phase 1: Source Water Monitoring and Pilot Studies

Phase 1 monitoring of the sites listed in **Table 12** will be used to determine a suitable source water location for the Phase 2 NRB Experiments. The locations of source water sites to be monitored for the presence of *Microcystis* in the Delta are shown in **Figure 1** and **Table 12**.

Each source water site will be sampled every 2 weeks over the course of 3 months, from July through September, providing a total of 6 sampling events. Although every effort will be made to sample all three sites every 2 weeks, source water monitoring can be delayed for equipment failure, excessive heat, or other reasons. The total number of samples anticipated to be collected for source water monitoring, and analyte counts are outlined in **Table 12.** During each sampling event, vertical sonde profiles of basic water quality parameters will be recorded, and grab samples will be collected for the

constituents list in **Table 3**. The replicates to be collected for each constituent are included in **Table 21.** The MVI ranking of the water will be performed visually giving a ranking of 1 (*Microcystis* absent) to 5 (contiguous *Microcystis* colonies) of the source water in accordance with Flynn et al. (2022). Photos (digital images) will also be taken of the water and the MVI rank will be associated with the digital image.

The prime determinant of the suitability of the location to be used as source water for the NRB experiments will be the consistency of occurrence of a relatively high MVI ranking of the water coupled with a relatively high fluorescence yield, i.e. F_v/F_m, indicating a physiologically healthy *Microcystis* population. A ranking between 3-5 will be considered adequate for using the location for collection of source water for the experiments. In addition to MVI ranking and F_v/F_m, the concentrations of Chl and N (as nitrate) will be determined. A location with relatively high Chl concentration and low N concentration will be preferred. The target concentration of Chl will be above 10 ug/L and the target nitrate concentration will be below 0.1 mg/L. The NRB source water constituents must meet the target concentrations listed in **Table 11**. If the nitrate concentration is above 0.1 mg/L, it may be necessary to dilute the source water with N and P-free water to achieve the target starting nitrate concentration. In that case, the background phytoplankton community biomass will also be diluted together with the N and P concentrations (and all other macro- and micro-nutrients). However, for the NRB experiments, a target Chl concentration will still be achieved through addition/equalization of *Microcystis* colonies across treatments (see NRB experiment description below for Phase 2).

If *Microcystis* is absent during the source water monitoring at all three sampling locations during the summer of 2025, then monitoring of all three sites during July of 2026 will also be performed to check whether *Microcystis* is present in order to determine if the full NRB experiments can be performed in the summer of 2026. If *Microcystis* is absent at the three source water locations in the summer of 2026, then the Phase 2 NRB experiments may have to be delayed until appropriate conditions are present. If *Microcystis* is not observed at the three field sites in the summer of 2025, the QAPP may be amended to include monitoring of additional or alternate sites in the summer of 2026, such as Willow Berm, Korth's Pirates Lair Marina, and Tiki Lagoon Marina.

The site with the highest MVI score and Fv/Fm (indicating a healthy community) will be used for the pilot NRB experiments. The pilot experiments include a number of different tests to be performed in replicate containers suspended *in situ* at the location where the samples are collected. Tests that may include 1) examining differences in container type (i.e. material, size, and shape), 2) optimal incubation duration, 3) how to add a consistent amount of *Microcystis* biomass across treatments, 4) differences in starting *Microcystis* concentration on growth, 5) optimal additions of daily nutrient stocks, 6) best method for

mixing containers and optimal light intensities for irradiance treatments, and 7) how to best add clams and macrophytes as treatments.

During pilot tests, daily samples will be taken for Chl and nutrient concentrations and the time series will be examined for length of lag and exponential growth phases, and maximum biomass accumulation. Based on the time series data, optimal containers type, incubation duration, starting biomass concentrations, nutrient additions, methods of mixing, exposure to light, and best way to add macrophytes and clams will be determined.

Samples from the Phase 1 NRB containers will be collected for each treatment following the timing and constituent requirements outlined **Table 11**. The projected analyte counts for the bioassay monitoring are listed in **Table 13** to reflect a maximum of three NRBs that are up to a four-days in length, however, the optimal incubation period will be determined during the Phase 1 pilot studies and is therefore subject to change. Samples will be collected from the Phase 1 NRB containers during each day of the study for each treatment as outlined in **Table 14**.

Phase 2: Full-Scale NRB Experiments

One location will be chosen as source water for the NRB experiments based on results obtained during the Phase I source water monitoring effort.

To ensure adequate bloom conditions and starting biomass at the chosen location, one field observation trip in the month prior to experiment start will be performed. Additionally, two days prior to the scheduled start of each NRB experiment sampling will occur to ensure that *Microcystis* is present and that the NRB experiment can proceed as planned. The samples will be analyzed for the same constituents as the source water monitoring performed in Phase 1. The NRB source water constituents must meet the target concentrations listed in **Table 11**. The MVI score, Fv/Fm, and nitrate concentration will be determined and evaluated to confirm previous results; if necessary, adjustments in source water location or dilutions of the source water can be made prior to location being chosen for collection of water for NRB experiments. See **Table 11** for source water constituent target concentrations and **Table 12** for source water monitoring locations.

The experimental design is guided by three principles:

1) starting phytoplankton biomass is the same across control and treatments,

2) starting phytoplankton composition is the same, and

3) the ratio of starting Chl concentration to N (and P) concentration varies with each treatment and differs from the control.

Different aspects of the experimental design are described below and summarized in **Table 14** through **Table 16.**

Experiment 1: N- and P-limited growth

NRB Experiment 1 will consist of 1 control and 4 treatments conducted in triplicate, requiring 15 experimental containers in total**.** NRB experiment 1 includes the following treatments:

- Seeding Phytoplankton: Whole water containing a mixed background phytoplankton population will be collected into a large pre-cleaned barrel. The experimental containers will be filled from the barrel by siphoning, while the barrel is continuously mixed. Separately, whole surface water containing *Microcystis* colonies will be filled into several 5-gallon buckets. *Microcystis* colonies visible to the eye (i.e. lettuce flakes) will float to the surface of the bucket from where they will be skimmed into wide mouth transfer containers. As far as possible, equal number of colonies/biomass will be added to each experimental container to provide close-to equal concentrations of *Microcystis* colonies or biomass in each experimental container.
- Nutrient Additions: Based on region in the Delta, mean summertime phytoplankton biomass typically varies from 2-4 µg Chl L^{-1} in the central Delta, and 6-26 µg Chl L^{-1} in the South Delta (Preece et al. 2024b). Mean summertime dissolved inorganic nitrogen (sum of nitrate, nitrite, and ammonium) concentration typically varies from 8-20 µmol L^{-1} (0.11-0.28 mg L^{-1}) in the central Delta and 27-63 µmol L^{-1} (0.38-0.88 mg L^{-1}) in the south Delta. This allows for three or more doublings of phytoplankton biomass and demonstrates that typical conditions in the Delta are non-nutrient limited for phytoplankton growth and biomass accumulation. This project aims to preserve this non-limiting nutrient condition for the control treatment. Because the starting Chl concentration at the location where the phytoplankton seed population to be used for the experiments is not known, the nutrient concentration in the control treatment will be set to give a Chl:N (g:mol) starting ratio of 0.1. The concentration of P in the control will be set so that the N:P ratio (mol:mol) is ~16 in accordance with the canonical Redfield N:P ratio of 16 which is optimal for phytoplankton growth (e.g. Redfield 1958, Ryther and Dunstan 1974). This will constitute the control.

  A moderate N-limited treatment would have N and P added to give a starting concentration Chl:N (g:mol) ratio of approximately 0.5 and a P concentration similar to the positive control. A more strongly N-limited treatment would have a Chl:N (g:mol) starting ratio of approximately one or greater and a P concentration similar to the positive control. The exact ratios will be determined during the pilot

experiments. As an example, for a starting Chl concentration of 5 µg L^{-1}, N concentration in the control would be 50 µ mol L^{-1} (0.70 mg L-1), in the low N treatment N would be 5 µ mol L^{-1} (0.07 mg/L), and in the medium N treatment N would be 10 µmol L^{-1} (0.14 mg/L). The N concentrations for the low and medium N reduction treatments are close to target N concentrations of 0.05 mg/L and 0.1 mg/L described in the work plan. A moderate P-limited treatment will have a Chl:P (g:mol) ratio of 8 and a N concentration equivalent to the positive control. A more strongly P-limited treatment would have a Chl:P (g:mol) ratio of 16 or greater and a N concentration similar to the positive control. The initial addition of N and P to the treatments and positive control will be repeated daily with stock solutions. No fresh medium will be added so that cultures will be maintained in batch mode.

- Incubations: Experimental containers will be placed into floating mesh-walled enclosures tied off to a dock allowing the containers to remain at ambient water temperatures and receive mild agitation from surface waves. Neutral density screening will be attached across the top of the enclosures to provide shading.

Experiment 2: N-limited growth, irradiance, and mixing treatment

NRB experiment 2 will consist of 1 control and 5 treatments conducted in triplicate, requiring 18 experimental containers in total. NRB experiment 2 includes the following treatments:

- Seeding Phytoplankton: Mixed background phytoplankton community and *Microcystis* colonies will be added as above.
- Nutrient Additions: One nutrient treatment will be used which will be the strongly N-limited treatment.
- Mixing: There will be three mixing treatments, no mixing, moderate mixing, and high mixing. Each mixing level will be divided into 2 different irradiance levels, high and low. The high irradiance, no mixing treatment will be equivalent to the strongly N-limited treatment from NRB 1 and serve as control.
- Incubations: In enclosures exposed to ambient water temperature.

Experiment 3: N-limited growth, macrophyte, and clam

NRB experiment 3 will consist of 1 control and 5 treatments conducted in triplicate, requiring 18 experimental containers in total. NRB experiment 3 includes the following treatments:

- Seeding Phytoplankton: Mixed background phytoplankton community and *Microcystis* colonies will be added as above.

- Nutrient Additions: One nutrient treatment will be used which will be the strongly N-limited treatment.
- Macrophyte: There will be three macrophyte treatments, no macrophyte added, species 1 macrophyte, and species 2 macrophyte. Each macrophyte treatment will be divided into 2 different clam additions, no clam added, and one clam added. The no macrophyte, no clam treatment will be equivalent to the strongly N-limited treatment from NRB 1 and will serve as the control.
- Incubations: In enclosures exposed to ambient water temperatures and receive mild agitation from surface waves. Neutral density screening will be attached across the top.

The constituents to be monitored for the NRBs are listed in **Table 3**. Samples will be taken from the containers during each day of the study according to **Table 15**. The projected analyte counts for the bioassay monitoring are listed in **Table 13** to reflect up to a four-day NRB, however, the optimal incubation period will be determined during the Phase 1 pilot studies and is therefore subject to change. Over the course of each NRB, source water monitoring will occur at the location where the source water was collected over the same days the experiment is sampled. Both grab samples and vertical sonde profiles will be collected from the source water location. Up to three full-scale NRBs may be performed over the course of the summer of 2026.

Table 11. Source Water Constituent Target Concentrations

CONSTITUENT	TARGET SCORE/CONCENTRATION
Microcystis density / MVI ranking score	3-5 MVI score
Chl concentration at bloom peak	10-30 µg/L
Nitrate concentration	0.05-0.1 mg/L
Phosphate concentration	0.005-0.02 mg/L

Table 12. Source Water Monitoring Locations and Number of Ambient Water Grab Sample Laboratory Analyte Counts

Analyte counts represent counts for samples collected for laboratory analyses.

Station Name	CEDEN Station Code	Station Type	Latitude	Longitude	Datum	Matrix	Number of Events	Analyte Count Per Event	Analyte Count Total
Big Break 1-544ST0125	544ST0125	Marina	38.0141	-121.72971	NR	Water	6	29[1]	174
Yacht Club in Discovery Bay	544CCC005	Marina	37.90287	-121.58801	NAD83	Water	6	29[1]	174
McLeod Lake at Stockton Downtown Marina	544SJC531	Marina	37.95335	-121.29919	NAD83	Water	6	29[1]	174
TBD (selected Phase 2 NRB source water location) [1]	TBD	TBD	TBD	TBD	TBD	Water	15	29[1]	261
Totals								**116**	**783**

[1]Phytoplankton abundance and biovolume taxonomy data each count as one analyte count.

[2]*Microcystis* chlorophyll (analyte count of three) will only be measured if visually present in the *Microcystis* sample

Table 13. NRB Experimental Container Monitoring Samples and Laboratory Analyte Counts.

Project Phase	Number of NRB Experiments	Days Per NRB Experiment	Total Number of NRB Containers[3]	Analyte Count
Phase 1[1]	3	4	45	1281
Phase 2[2]	3	4	51	1644
Total				**2925**

[1]The number of NRBs and the optimal incubation period (days per NRB) will be determined during the study. The values presented represent the maximum projected estimates for this pilot phase and are subject to change.
[2]The optimal incubation period (days per NRB) will be determined during Phase 1 of the project. The values presented represent the maximum projected estimates for this pilot phase and are subject to change. Changes will be approved and documented through a QAPP amendment.
[3]Phase 1 NRB experiment counts are calculated with 15 containers per experiment (total of 45 containers). Phase 2 NRB experiment counts are calculated with 15 containers for experiment one, and 18 containers each for experiment two and three (total of 51 containers).

Table 14. Phase 1 NRB pilot experiment sample collection days for each test constituent.

Constituent	Source Water[1]	Pilot Experimental Container Measurements				
	Day 0 - Initial	Day 0	Day 1	Day 2	Day 3	Day 4
Irradiance[2]	--	X	--	--	--	--
Active Fluorescence[2]	X	--	X	X	X	X
Temperature[2]	X	--	--	--	--	--
Dissolved Oxygen[2]	X	--	--	--	--	--
pH[2]	X	--	--	--	--	--
Specific Conductivity[2]	X	--	--	--	--	--
Turbidity[2]	X	--	--	--	--	--
Ammonia as N	X	--	X	X	X	X
Nitrate as N	X	--	X	X	X	X
Nitrite as N	X	--	X	X	X	X
Nitrogen, Total	--	--	--	--	--	--
Nitrogen, Organic (particulate)	--	--	--	--	--	--
Nitrogen, Organic (dissolved)	--	--	--	--	--	--
Particulate Organic Carbon	--	--	--	--	--	--
OrthoPhosphate as P	X	--	X	X	X	X
Phosphorus as P	--	--	--	--	--	--
Phosphorus as P, Organic	--	--	--	--	--	--
Silicate as Si	X	--	X	X	X	X
Chlorophyll-a	X	--	X	X	X	X
Phytoplankton Abundance	--	--	--	--	--	--
Phytoplankton Biovolume	--	--	--	--	--	--
Microcystis Colony Geometry	--	--	--	--	--	--
Microcystis Colony Enumeration	--	--	--	--	--	--
Microcystis Chlorophyll-a	--	--	--	--	--	--
Microcystins, Total	--	--	--	--	--	--

[1]Measurements taken from barrel prior to mixing.

Constituent	Source Water[1]	Pilot Experimental Container Measurements				
	Day 0 - Initial	Day 0	Day 1	Day 2	Day 3	Day 4

[2]Field measurement

Table 15. Phase 2 NRB experiment sample collection days for each test constituent.

Constituent	Source Water[1]		Experimental Container Measurements			
	Day 0 - Initial	Day 0 - Mixed	Day 1	Day 2	Day 3	Day 4
Irradiance[2]	--	--	--	--	--	--
Active Fluorescence[2]	X	X	X	X	X	X
Temperature[2]	X	X	X	X	X	X
Dissolved Oxygen[2]	X	X	X	X	X	X
pH[2]	X	X	X	X	X	X
Specific Conductivity[2]	X	X	--	--	--	--
Turbidity[2]	X	X	--	--	--	X
Ammonia as N	X	X	--	X	--	X
Nitrate as N	X	X	--	X	--	X
Nitrite as N	X	X	--	X	--	X
Nitrogen, Total	X	X	--	--	--	X
Nitrogen, Organic (Particulate)	X	X	--	--	--	X
Nitrogen, Organic (Dissolved)	X	X	--	--	--	X
Phosphorus as P, Organic (Dissolved)	X	X	--	--	--	X
Particulate Organic Carbon	X	X	--	--	--	X
OrthoPhosphate as P	X	X	--	X	--	X
Phosphorus as P	X	X	--	--	--	X
Silicate as Si	X	X	--	X	--	X
Chlorophyll-a	X	X	X	X	X	X
Phytoplankton Abundance	X	X	--	--	--	X
Phytoplankton Biovolume	X	X	--	--	--	X
Microcystis Colony Geometry	X	X	--	--	--	X

Constituent	Source Water[1]		Experimental Container Measurements			
	Day 0 - Initial	Day 0 - Mixed	Day 1	Day 2	Day 3	Day 4
Microcystis Colony Enumeration	X	X	--	--	--	X
Microcystis Chlorophyll-a	X	X	--	--	--	X
Microcystins, Total	X	X	--	--	--	X

[1]Measurements taken from barrel prior to mixing (initial) and after mixing.
[2]Field measurement

Table 16. NRB Experiment 1: N- and P-limited growth

Parameter	Control (high N, high P)	Low N	Medium N	Low P	Medium P
Chl:N Target Ratio (g:mol)	0.1	1	0.5	--	--
Chl:P Target Ratio (g:mol)	1.6	--	--	16	8
Starting Chlorophyll (µg/L)	5	5	5	5	5
Starting Nitrogen (µmol/L)	50	5	10	50	50
Starting Nitrogen (mg/L)	0.70	0.07	0.14	0.70	0.70
Starting Phosphorus (µmol/L)	3.13	3.13	3.13	0.31	0.63
Starting Phosphorus (mg/L)	0.10	0.10	0.10	0.01	0.02

Table 17. NRB Experiment 2: N-limited growth, irradiance, and mixing

Irradiance	Parameter	Low N	Low N + Low Mixing	Low N + High Mixing
High	Chl:N Target Ratio (g:mol)	1	1	1
High	Starting Chlorophyll (µg/L)	5	5	5
High	Starting Nitrogen (µmol/L)	5	5	5
High	Starting Nitrogen (mg/L)	0.07	0.07	0.07
High	Starting Phosphorus (µmol/L)	3.13	3.13	3.13
High	Starting Phosphorus (mg/L)	0.1	0.1	0.1
Low	Chl:N Target Ratio (g:mol)	1	1	1
Low	Starting Chlorophyll (µg/L)	5	5	5
Low	Starting Nitrogen (µmol/L)	5	5	5
Low	Starting Nitrogen (mg/L)	0.07	0.07	0.07
Low	Starting Phosphorus (µmol/L)	3.13	3.13	3.13
Low	Starting Phosphorus (mg/L)	0.1	0.1	0.1

Table 18. NRB Experiment 3: N-limited growth, macrophytes, and clam

Clam	Parameter	Low N	Low N + Macrophyte A	Low N + Macrophyte B
Absent	Chl:N Target Ratio (g:mol)	1	1	1
Absent	Starting Chlorophyll (µg/L)	5	5	5
Absent	Starting Nitrogen (µmol/L)	5	5	5
Absent	Starting Nitrogen (mg/L)	0.07	0.07	0.07
Absent	Starting Phosphorus (µmol/L)	3.13	3.13	3.13
Absent	Starting Phosphorus (mg/L)	0.1	0.1	0.1
Present	Chl:N Target Ratio (g:mol)	1	1	1
Present	Starting Chlorophyll (µg/L)	5	5	5
Present	Starting Nitrogen (µmol/L)	5	5	5
Present	Starting Nitrogen (mg/L)	0.07	0.07	0.07
Present	Starting Phosphorus (µmol/L)	3.13	3.13	3.13
Present	Starting Phosphorus (mg/L)	0.1	0.1	0.1

B.2 METHODS FOR ENVIRONMENTAL INFORMATION ACQUISITION

The methods and procedures for acquiring environmental information throughout the project are described below. The acquisition of environmental information includes collection, production, evaluation and/or use as well as design, construction, operation, or application of environmental technology.

B.2.1 FIELD AND EXPERIMENTAL MEASUREMENTS

All samples are collected according to detailed SOPs for collection of samples (**Appendix I**). The SOPs contain instructions for collecting and preserving samples and cleaning equipment between samples. These methods are summarized below. Any deviation to the procedures outlined in this QAPP must be either approved prior to implementation (if anticipated) or reported to the CVRWQCB within 7 days (if unanticipated).

Field measurements will be performed according to the standard procedures outlined in **Appendix I**. Field technicians will be properly trained in how to deploy, operate, and maintain field instruments according to the requirements outlined in **Element A.7**. Field measurements will be performed according to the methods and SOPs outlined in **Table 20.**

Table 19. Sampling, handling and custody.

Analytical Parameter	Method	Matrix/ Fraction	Sample Container Material and Volume	Initial Preservation/ Holding Requirements	Extraction/ Preparation Holding Time	Analysis Holding Time
Ammonia as N	EPA 350.1	Water/ Dissolved	2 x 50 mL polypropylene tube	Field-filter and Store at ≤ -20 °C	NA	1 year
				Field-filter and Store at ≤ 6 °C		48 hours
Nitrate as N	EPA 353.4	Water/ Dissolved	2 x 50 mL polypropylene tube	Field-filter and Store at ≤ -20 °C	NA	1 year
				Field-filter and Store at ≤ 6 °C		48 hours
Nitrite as N	EPA 353.4	Water/ Dissolved	2 x 50 mL polypropylene tube	Field-filter and Store at ≤ -20 °C	NA	1 year

Analytical Parameter	Method	Matrix/ Fraction	Sample Container Material and Volume	Initial Preservation/ Holding Requirements	Extraction/ Preparation Holding Time	Analysis Holding Time
				Field-filter and Store at ≤ 6 °C		48 hours
Nitrogen, Total	Valderrama 1981/ EPA 353.4	Water/ Dissolved	2 x 50 mL polypropylene tube	Field-filter and Store at ≤ -20 °C	NA	1 year
				Field-filter and Store at ≤ 6 °C		48 hours
Orthophosphate as P	EPA 365.5	Water/ Dissolved	2 x 50 mL polypropylene tube	Field-filter within 15 minutes and Store at ≤ -20 °C	NA	1 year
				Field-filter and Store at ≤ 6 °C		48 hours
Phosphorus as P	Valderrama 1981/ EPA 365.5	Water/ Dissolved	2 x 50 mL polypropylene tube	Field-filter within 15 minutes and Store at ≤ -20 °C	NA	1 year
				Field-filter and Store at ≤ 6 °C		48 hours
Silicate as Si	EPA 366	Water/ Dissolved	2 x 50 mL polypropylene tube	Field-filter and Store at ≤ -20 °C	NA	1 year
				Field-filter and Store at ≤ 6 °C		48 hours
Nitrogen, Organic	EPA 440.0	Water/ Particulate	60 mL volume through a GF/F filter in field; transport in sterile single use petri dish	Store filter in desiccator after drying at 103-105°C for 24hrs	NA	100 days
Particulate Organic Carbon	EPA 440.0	Water/ Particulate	60 mL volume through a GF/F filter in field; transport in sterile single use petri dish	Store filter in desiccator after drying at 103-105°C for 24hrs	NA	100 days
Chlorophyll a	EPA 445.0	Water / Particulate	Place filter into 3 mL	Field-filter and Store filter in dark at	Store frozen in dark at	6 months

Analytical Parameter	Method	Matrix/ Fraction	Sample Container Material and Volume	Initial Preservation/ Holding Requirements	Extraction/ Preparation Holding Time	Analysis Holding Time
			plastic cryovial in foil	≤ -80 °C	≤ -80 °C; store extraction for up to 6 months	
Phytoplankton Abundance	Beaver et al. 2013	Water/ Total	250 ml amber glass or dark brown HDPE	Lugol's Iodine, store refrigerated at 2-6°C in the dark	NA	6 months
Phytoplankton Biovolume	Beaver et al. 2013	Water/ Total	250 ml amber glass or dark brown HDPE	Lugol's Iodine, store refrigerated at 2-6°C in the dark	NA	6 months
Microcystis Colony Geometry	Göröcs et al. 2018	Water/ Total	250 ml amber glass with Teflon-lined cap	Lugol's Iodine	Refrigeration 2-6°C	3-6 months
				None		1 hour
Microcystis Colony Enumeration	Göröcs et al. 2018	Water/ Total	250 ml amber glass with Teflon-lined cap	Lugol's Iodine	Refrigeration 2-6°C	3-6 months
				None		1 hour
Microcystins, Total	ELISA Abraxis 520011	Water/ Total	250 ml amber glass with Teflon-lined cap	Store at ≤ -20 °C within 48 hours	Store at ≤ -20 °C	6 months

B.2.2 LABORATORY ANALYSES

Laboratory analyses will be performed according to the methods and SOPs outlined in **Table 18**. Analytical results will be evaluated according to the detection and reporting limits outlined in **Table 18**. Commercial laboratories will be accredited by ELAP to perform all analyses according to the methods listed below, wherever possible. In the event that ELAP accreditation is not available or applicable due to the use of non-standard methods or alternate test procedures, the laboratory shall demonstrate their performance and ability to achieve RLs by submitting the performance study information outlined in Section 5.2 of the DRMP Data Management Plan.

Due to this study being an experimental bioassay, the laboratories utilized are not commercial laboratories and do not have ELAP accreditations.

Laboratory analyses will require the equipment listed in **Table 18**. In the event of equipment failure or deviation, the Laboratory QA Officer or Project Manager should notify the Program Manager and the Program QA Officer as soon as possible and provide the appropriate documentation including whether corrective actions were initiated. Specifics regarding the type of failure or deviation, reasons, and any laboratory corrective actions that were already initiated will be provided to the CVRWQCB QA Representative within seven calendar days of notification. Any additional corrective actions required by the CVRWQCB QA Representative or requested by TAC members will then be communicated back to the laboratory by the DRMP Program Manager.

Corrective actions must be implemented by the laboratory on a case-by-case basis to address the root cause of analysis failure or deviation from the QAPP. Once corrective actions are implemented, re-extraction, re-analysis, resampling can be requested if the sample data cannot be salvaged (**Table 19**). If the failure necessitates a qualifier or flag in the database, it is the Program QA Officer's responsibility to ensure that the correct qualifier or flag is applied. Once the appropriate corrective actions have been implemented, the failure and the associated corrective actions will be documented on a QAPP Deviation Form and submitted to the CVRWQCB for approval.

Laboratory reporting turnaround times (beginning at the time of sample receipt) may vary according to the specific analytical method, sample preparation, and sample holding time requirements. Regardless of turnaround times specified in individual laboratory contracts, the reporting of preliminary data to the DRMP is not to exceed 60 calendar days from the time of sample analysis by the laboratory, per R5-2021-0054.

A laboratory must store surplus volume for 6 months for re-extraction or reanalysis, if necessary. The laboratory shall dispose of all samples in accordance with state and federal regulations.

Table 20. Field and laboratory analytical methods.

Field SOPs are included in **Appendix I**; Laboratory SOPs are included in **Appendix III**

Constituent	Matrix	Laboratory	Preparation Method	Analytical Method/ Equivalency	Fraction	Units	MDL	RL	Water Quality Metric[6]
Temperature[1]	Water	CCR	--	EPA 170.1	None	°C	NA	0.1	NA
Dissolved Oxygen[1]	Water	CCR	--	SM 4500-O H	Total	mg/L	NA	0.1	NA
Dissolved Oxygen[1]	Water	CCR	--	SM 4500-O H	Total	% saturation	NA	0.1	NA
pH[1]	Water	CCR	--	EPA 150.1	None	pH units	NA	0.1	NA
Specific Conductivity[1]	Water	CCR	--	EPA 120.1	Total	µS/cm	NA	100	NA
Irradiance[2,3]	Water	CCR	--	SM 10200 H	None	W/m^2	NA	NA	NA
Active Fluorescence[1,2]	Water	CCR	--	Berg et al. 2017	Total	RFU	NA	NA	NA
Temperature[2]	Water	CCR	--	EPA 170.1	Total	°C	NA	0.1	NA
Dissolved Oxygen[2]	Water	CCR	--	SM 4500-O G	Total	mg/L	NA	0.1	NA
Dissolved Oxygen[2]	Water	CCR	--	SM 4500-O G	Total	% saturation	NA	0.1	NA
Turbidity[1,2]	Water	CCR	--	SM 2130 B	Total	NTU	NA	0.7	NA
Ammonia as N	Water	MLML – Nutrient Lab	--	QuikChem 31-107-06-1-B / EPA 350.1	Dissolved	mg/L	0.000346	0.005	NA
Nitrate as N	Water	MLML– Nutrient Lab	--	QuikChem 31-107-04-1-E / EPA 353.4	Dissolved	mg/L	0.000323	0.017	NA
Nitrite as N	Water	MLML– Nutrient Lab	--	QuikChem 31-107-05-1-A / EPA 353.4	Dissolved	mg/L	0.000361	0.007	NA

Constituent	Matrix	Laboratory	Preparation Method	Analytical Method/ Equivalency	Fraction	Units	MDL	RL	Water Quality Metric[6]
Nitrogen, Total	Water	MLML–Nutrient Lab	Valderrama 1981	QuikChem 31-107-04-1-E / EPA353.4	Dissolved	mg/L	0.000323	0.017	NA
Nitrogen, Total	Water	MLML–Nutrient Lab	--	EPA 440.0	Particulate	mg	0.00114	0.05	NA
Nitrogen, Organic	Water	MLML–Nutrient Lab	--	Calculated	Dissolved	mg/L	NA	0.017	NA
Particulate Organic Carbon	Water	MLML-Nutrient Lab	--	EPA 440.0	Particulate	mg	0.000685	0.05	NA
OrthoPhosphate as P	Water	MLML–Nutrient Lab	--	QuikChem 31-115-01-1-I / EPA 365.5	Dissolved	mg/L	0.0000102	0.001	NA
Phosphorus as P	Water	MLML–Nutrient Lab	Valderrama 1981	QuikChem 31-115-01-1-I / EPA 365.5	Dissolved	mg/L	0.0000102	0.001	NA
Phosphorus as P, Organic	Water	MLML – Nutrient Lab	NA	Calculated	Dissolved	mg/L	NA	0.001	NA
Silicate as Si	Water	MLML–Nutrient Lab	--	QuikChem 31-114-27-1-D / EPA366	Dissolved	mg/L	0.000155	0.010	NA
Chlorophyll a	Water	MLML–Nutrient Lab	--	EPA 445.0	Particulate	µg/L	0.5	0.5	NA
Phytoplankton Abundance	Water	BSA	--	Beaver et al. 2013	Total	Cells/L	NA	NA	NA

Constituent	Matrix	Laboratory	Preparation Method	Analytical Method/ Equivalency	Fraction	Units	MDL	RL	Water Quality Metric[6]
Phytoplankton Biovolume	Water	BSA	--	Beaver et al. 2013	Total	$\mu m^3/L$	NA	NA	NA
Microcystis Colony Geometry	Water	MLML EBL	--	Göröcs et al. 2018	Total	µm	NA	NA	NA
Microcystis Colony Enumeration	Water	MLML EBL	--	Göröcs et al. 2018	Total	Colonies/L	NA	NA	NA
Microcystis Chlorophyll-a[4]	Water	MLML Nutrients Lab	--	EPA 445.0	Particulate	µg/L	0.5	0.5	NA
Microcystins, Total	Water	MLML EBL	--	ELISA Abraxis 520011	Total	µg/L	NA	0.1	NA

[1]Field measurement of ambient water
[2]Field measurement taken from experimental container
[3]Field measurement of ambient water measured concurrently with NRB experimental container measurements to determine the difference. The reported value will represent the irradiance inside the experimental container.
[4]Organic Nitrogen = TN – Ammonia – Nitrate – Nitrite
[5]Measured only if visually present in the collected *Microcystis* sample
[6]Due to this study design being an experimental bioassay, no water quality metrics are applicable.

B.2.3 EXISTING INFORMATION

This project will not use existing information; all information used for analysis and conclusions will be collected according to this QAPP.

B.2.4 ENVIRONMENTAL TECHNOLOGY

Environmental technology is an all-inclusive term used to describe pollution control devices and systems, waste treatment processes and storage facilities, and site remediation technologies and their components that may be utilized to remove pollutants or contaminants from or prevent them from entering the environment. The purpose of this project is to investigate the efficacy of nutrient reductions on the growth and biomass accumulation of CHABs. Therefore, the project does not involve the use of environmental technology.

B.3 INTEGRITY OF ENVIRONMENTAL INFORMATION

B.3.1 SAMPLE HANDLING AND CUSTODY

All sample bottles are labeled with indelible marker clearly stating sample ID, collection date and time, and collector. Immediately after collection, sample containers are checked for integrity (e.g., bottle caps are tightened, no leakage is occurring) and preserved according to the requirements provided in **Table 17.**
Field crews are required to fill out standardized field sheets for each sampling event. A standardized field sheet is provided as **Figure 4.**

Custody of all samples is documented and traceable from collection time to submittal for analysis on a chain of custody (COC) form. An example COC form is provided as **Figure 5**. The COC accompanies the samples at all times. Samples are considered under custody if:

- they are in actual possession;
- they are in view after being in physical possession;
- they are placed in a secure area (accessible by or under the scrutiny of authorized personnel only after in possession).

Custody forms are completed by samplers and must be signed by the sampler in charge to relinquish samples into the custody of the laboratory and/or intermediate couriers. Individuals relinquishing custody must provide their name, the date, and the time at

which custody was transferred. Individuals taking custody of samples must also sign and date the forms to indicate the time at which the samples were received. Errors or amendments to COC forms should be clearly documented (i.e., changes initialed and dated) in order to maintain a clear record of sample possession from collection to analysis.

It is the responsibility of the field crews, laboratory personnel, and any intermediate sample custodians to maintain proper documentation of sample custody from sample collection through transit to and receipt by the laboratory. The individuals in custody of samples are responsible for handling, transferring, securing, and processing samples in a timely manner such that the required holding times and preservation requirements identified in **Table 17** are met.

Once in the laboratory's possession, it is the responsibility of the analyzing laboratory to maintain custody logs sufficient to track each sample submitted and to analyze or preserve each sample within specified holding times. The contract laboratory follows sample custody procedures outlined in their QAM; contract laboratory QAMs are on file with the respective laboratories. It is the responsibility of the personnel of each analytical laboratory to ensure that all applicable regulations are followed in the disposal of samples or related chemicals remaining after successful completion of analyses.

Figure 4. Field Sheet

Field Data Sheet (Water Chemistry & Discrete Probe) - EventType=BA

Entered in d-base (initial/date) | Pg of Pg

*StationID: | *Date (mm/dd/yyyy): / / | *Group: | *Agency:

Event: 1 2 3 4 5 6 | ArrivalTime: | DepartureTime: | *SampleTime (1st sample): | *Protocol:DRMP_NRB_F

*ProjectCode: 25DRMP5NRB | *Personnel: | *Purpose (circle): WaterChem, Habitat, FieldMeas, TimeSeries, Algae | *PurposeFailure:

*Location: Bank OpenWater | *GPS/DGPS | Lat (dd.ddddd) | Long (ddd.ddddd) | OCCUPATION METHOD: Walk-in, From Pier, Dock

GPS Device: | Target | 37.953408 | -121.298137 | STARTING BANK (facing downstream): LB / RB / NA

Datum: NAD83 | Accuracy (ft / m): | *Actual: | – | Point of Sample (if Integrated, then -88 in dbase)

Habitat Observations (CollectionMethod = Habitat_generic)

SITE ODOR: None, Sulfides, Sewage, Petroleum, Smoke, Other_____

SKY CODE: Clear, Partly Cloudy, Overcast, Fog, Smoky, Hazy

OTHER PRESENCE: Vascular, Nonvascular, OilySheen, Foam, Trash, Other_____

DOMINANT SUBSTRATE Bedrock, Concrete, Cobble, Boulder, Gravel, Sand, Mud, Unk, Other_____

WATERCLARITY: Clear (see bottom), Cloudy (>4" vis), Murky (<4" vis

WATERODOR: None, Sulfides, Sewage, Petroleum, Mixed, Other_

PHOTOS (RB & LB assigned when facing downstream; RENAME to StationCode_yyyy_mm_dd_uniquecode):

1: (RB / LB / BB / US / DS / ##)

2: (RB / LB / BB / US / DS / ##)

3: (RB / LB / BB / US / DS / ##)

Field Measurements (SampleType = FieldMeasure; Method = Field)

	Depth Collected (m; 1.0 m)	MVI (1-5)	Active Fluor (RFU)	Active Fluor (RFU) Rep2	Turbidity (NTU)	Turbidity (NTU) Rep2	Turbidity (NTU) Rep3		Sonde Measurements taken				
Subsurface													
Instrument:													
Calib. Date:													

Samples Taken (# of containers filled) - Method=Water_G | Field Dup YES / NO; Field Blank YES / NO;

SAMPLE TYPE: Grab | COLLECTION DEVICE (circle): Indiv bottle (by hand, by pole, by bucket); Van Dorn

	Depth Collected (m)	Nutrients (2 reps)	Chl a (3 reps)	Phyto Abund & Biovol	Microcystis Enum & Geom	Microcystis Chl a (3 reps)	Microcystis						
# bottles		4* x 50 m	3 vials	1- 250 ml	1-250 ml	3 vials	1-250 ml						
Volume filtered													

COMMENTS: * 2 are backup

Figure 5. Chain of custody form.

Project ID: Nutrient Reduction Bioassays				Client Contact: [Name]							
PO #:				Address: [Laboratory address]							
Results to: ☐ ESA ☐ Client											
ESA Contact: Mine Berg				Phone: [phone number]							
Email: mberg@esassoc.com				Email: [email]							
Sample ID / Site Name	Sample Matrix	Date	Time	Analyses						Comments	
				Nutrient Panel	Chlorophyl						
[Name Loc 1]	[Whole freshwater]	[date]			X						
[Name Loc 2]	[Filtered freshwater]	[date]		X							
Relinquished by:		Date:	Time:	Shipping: ☐ Delivered by ESA							
Received by:		Date:	Time:	☐ Picked up by lab							
# coolers:				☐ Fedex / Other Tracking # _____							

B.3.2 PROJECT LABORATORIES

All samples collected will be transferred to and analyzed by the laboratories identified in **Table 18**. These agencies will perform the analyses identified in **Table 18**.

All commercial contract laboratories will maintain current accreditation for the specific analyses identified in **Table 18** while performing project analyses. In the event that a laboratory's accreditation status changes, the laboratory should, in consultation with the Program Manager, subcontract to another laboratory with applicable ELAP accreditations or provide performance-based validation information for approval as described in the DRMP Data Management Plan. If laboratories must be changed or added for any reason, the new laboratory must meet the requirements as identified in **Table 18** as well as all requirements outlined in the QAPP, such as MQOs (**Table 5** and **Table 6**), trainings (**Personnel Training/Certifications**), and calibration requirements (**Instruments/Equipment Calibration, Testing, Inspection, and Maintenance**). Additionally, an amendment to the QAPP documenting the change is required for any laboratory not identified in this QAPP.

Due to this study being an experimental bioassay, the laboratories utilized are not commercial laboratories and do not have ELAP accreditations.

B.4 QUALITY CONTROL

This project will comply with the QC guidelines and corrective actions listed in **Table 21** (field sampling QC) and **Table 22** (analytical QC). Field QC frequencies (field blanks) are calculated to ensure that a minimum of 5% of all analyses are for QC purposes. The percent total is calculated as follows:

$$\%\,Total = \left(\frac{N_{FB}\ or\ N_{FD}}{N_E}\right) \times 100$$

N_{FB} = The number of field blanks

N_{FD} = The number of field duplicates

N_E = The number of environmental samples

All analytical QC samples must be analyzed at a frequency of 1 per analytical batch; an analytical batch is not to exceed 20 environmental samples. Quality Control activities for this project are listed in **Table 19** and **Table 20**. Measurement quality objectives for each QC parameter are included in **Table 6**.

Precision is assessed through laboratory duplicate samples. Precision of a pair of samples is measured as the relative percent difference (RPD) between a sample and its duplicate—a laboratory control sample (LCS) and its duplicate (LCSD), a matrix spike (MS) and matrix spike duplicate (MSD), , or an environmental sample and its associated laboratory generated duplicate. It is calculated as follows:

$$RPD\,(\%) = \left|\frac{2(V_i - V_D)}{V_i + V_D}\right| \times 100$$

V_i = The measured concentration of the initial sample
V_D = The measured concentration of the sample duplicate

For precision assessment purposes any laboratory duplicate, including a matrix spike duplicate, an un-spiked environmental laboratory duplicate, or a lab control spike duplicate, may function as the lab duplicate in any batch.

Accuracy is assessed using either an LCS or MS. For an LCS, lab water is spiked with a known concentration of a target analyte and the percent recovery (PR) is reported. The PR in an LCS is calculated as follows:

$$\%\ Recovery\ =\ \left(\frac{V_{LCS}}{V_{Spike}}\right)\ \times 100$$

V_{LCS} = The measured concentration of the spiked control sample
V_{Spike} = The expected spike concentration

An MS can also be used to assess accuracy. For an MS, environmental water is spiked with a known concentration of a target analyte and the PR is reported. The PR in an MS is calculated as follows:

$$\%\ Recovery\ =\ \left(\frac{V_{MS}\ -\ V_{E}}{V_{Spike}}\right)\ \times 100$$

V_{MS} = The measured concentration of the spiked matrix sample
V_{Spike} = The concentration of the spike added
V_{E} = The measured concentration of the original (unspiked) matrix sample

The MS should not be used solely to assess accuracy due to the likelihood of matrix interference. However, if an LCS does not fall within acceptance criteria, an MS may be used to validate a batch if the MS is within acceptance criteria. Some constituents are difficult to spike and therefore a laboratory may choose to analyze a certified/standard reference material (CRM or SRM). A CRM or SRM analysis may be used in place of an LCS analysis.

When quality control sample results do not meet the data quality objectives provided in this QAPP the laboratory must implement corrective measures as outlined in **Table 22**. Detections in blanks must be sourced and field, analytical, or cleaning practices must be modified to reduce the risk of further contamination. Excessive RPD values or percent recoveries outside of criteria may also require a change of field or laboratory practices. Exceedances of analytical control limits must be reported in the appropriate lab report and qualified in the electronic data deliverable (EDD) according to the procedures outlined in the Data Management SOP.

If corrective measures require reanalysis of the sample, and the results repeatedly fail to meet the objectives, then the lab is obligated to halt the analysis of samples, identify the source of the imprecision, and make corrections where appropriate before proceeding. In scenarios where the actions outlined below cannot be completed and/or results cannot be brought within control limits the laboratory must notify the Program Manager and the Program QA Officer as soon as possible and provide the appropriate documentation and details of corrective actions taken. Specifics regarding the type of failure, reasons for failure, and any laboratory corrective actions that were already initiated will be provided to the CVRWQCB QA Representative, and the TAC within

seven calendar days of notification. Any additional corrective actions required by the CVRWQCB QA Representative or requested by TAC members will then be communicated back to the laboratory by the Program Manager.

Control failures that cannot be rectified are documented with a QAPP Deviation Form (**Figure 6**) and submitted to the CVRWQCB for approval.

If results for any field duplicates and associated environmental samples do not meet the data quality objectives listed in the above tables then the samplers must assess sampling practices and make corrections to their field procedures which will ensure homogeneity in the samples before proceeding. Any deviation from the sampling procedures outlined in this QAPP must be approved by the CVRWQCB QA Representative prior to implementation (if anticipated) or be reported to within seven calendar days (if unanticipated).

Analytical QC results must adhere to the minimum limits of error and frequency requirements detailed in **Table 20.**

For this project, all ambient water samples will be collected in duplicate or triplicate to enhance data reliability and account for sampling variability. The average of the replicate samples will be used for project data reporting and interpretation, incorporating the inherent variability. Variability in sample results is expected from multiple sources, including but not limited to, environmental heterogeneity, field sampling procedures, and matrix effects. By averaging replicate samples, variability from these sources is incorporated into reported values, reducing the impact of outliers and improving representativeness. **Table 23** summarizes how many replicates will be collected for each constituent. Replicates are counted in the analyte counts included in **Table 12** and **Table 13** and will not be counted separately as field QC. The NRB experimental container measurements will not be taken in replicate except for chlorophyll – a which will be duplicated, as shown in **Table 23.**

While averaged values will be used for project reporting, each individual replicate result will be submitted to CEDEN to ensure transparency and maintain consistency with database reporting requirements.

Table 21. Field sampling QC.

Sample Type	Frequency	Acceptable Limits	Corrective Action	Sampling SOP
Field Blank	5% annual total	<RL	Investigate and remove sources of contamination	Appendix I

Table 22. Analytical QC.

Measurement quality objectives for each QC sample type are included in **Table 6.**

SAMPLE TYPE	CORRECTIVE ACTION	ANALYTICAL SOP
Nutrients		
Laboratory Blank	Determine cause of problem, remove sources of contamination, reanalyze suspect sample or flag all suspect data	Appendix III
Laboratory Control Sample[1]	Determine the cause, take appropriate corrective action. Recalibrate and reanalyze all suspect samples or flag all suspect data.	Appendix III
Matrix Spike	Determine the cause, take appropriate corrective action. Recalibrate and reanalyze all suspect samples or flag all suspect data.	Appendix III
Matrix Spike Duplicate or Laboratory Control Sample Duplicate	Determine the cause, take appropriate corrective action. Recalibrate and reanalyze all suspect samples or flag all suspect data.	Appendix III
Sample Duplicate[2]	Visually inspect the samples to determine if a high RPD could be contributed to sample heterogeneity. Reanalyze suspect samples or qualify the results and document the heterogeneity.	Appendix III
Chlorophyll		
Laboratory Blank	Determine cause of problem, remove sources of contamination, reanalyze suspect sample or flag all suspect data	Appendix III
Microcystins, Total		
Laboratory Blank	Determine cause of problem, remove sources of contamination, reanalyze suspect sample or flag all suspect data	Appendix III
Laboratory Duplicate[2]	Visually inspect the samples to determine if a high RPD could be contributed to sample heterogeneity. Reanalyze suspect	Appendix III

Sample Type	Corrective Action	Analytical SOP
	samples or qualify the results and document the heterogeneity.	
Laboratory Control Sample[1]	Determine the cause, take appropriate corrective action. Recalibrate and reanalyze all suspect samples or flag all suspect data.	Appendix III
Matrix Spike	Determine the cause, take appropriate corrective action. Recalibrate and reanalyze all suspect samples or flag all suspect data.	Appendix III
Matrix Spike Duplicate or Laboratory Control Sample Duplicate	Determine the cause, take appropriate corrective action. Recalibrate and reanalyze all suspect samples or flag all suspect data.	Appendix III
Sample Duplicate[2]	Visually inspect the samples to determine if a high RPD could be contributed to sample heterogeneity. Reanalyze suspect samples or qualify the results and document the heterogeneity.	Appendix III

[1]Certified reference material may be used in place of a laboratory control spike.
[2]For the purposes of this project it is acceptable for the matrix spike duplicate or the laboratory control duplicate to stand in for the lab duplicate as a measure of the precision of the analytical method.

Table 23. Summary of replicates collected per constituent

Constituent	Method	Fractions/ Endpoints	Replicates Phase 1 Source Water Monitoring	Replicates Phase 2 Source Water Monitoring	Replicates Phase 1 NRB Exp Container Monitoring	Replicates Phase 2 NRB Exp Container Monitoring
Photo Documentation[1]	Digital Capture	--	3	3	--	--
Microcystis Visual Index[1]	Visual Assessment	--	1	1	--	--
Temperature[1]	EPA 170.1	--	--	--	--	--
Dissolved Oxygen[1]	SM 4500-O G	--	--	--	--	--
pH[1]	EPA 150.1	--	--	--	--	--
Specific Conductivity[1]	EPA 120.1	--	--	--	--	--
Turbidity[1]	EPA 180.1 (Sonde)	--	--	--	--	--
Irradiance[2]	SM 10200 H	--	--	--	1	--
Active Fluorescence[1,2]	Berg et al. 2017	Total	2	2	1	1
Temperature[2]	EPA 170.1	Total	--	--	1	1
Dissolved Oxygen[2]	SM 4500-O G	Total	--	--	1	1
pH[2]	EPA 150.1	Total	--	--	1	1
Specific Conductivity[2]	EPA 120.1	Total	--	--	1	1
Turbidity[1,2]	EPA 180.1 (portable meter)	Total	3	3	1	1
Ammonia as N	EPA 350.1	Dissolved	2	2	1	1
Nitrate as N	EPA 353.4	Dissolved	2	2	1	1
Nitrite as N	EPA 353.4	Dissolved	2	2	1	1
Nitrogen, Total	Valderrama 1981 / EPA 353.4	Dissolved	2	2	--	1
Nitrogen, Organic	EPA 440.0	Particulate	--	--	--	1
Nitrogen, Organic	Calculation	Dissolved	2	2	1	1

Constituent	Method	Fractions/ Endpoints	Replicates Phase 1 Source Water Monitoring	Replicates Phase 2 Source Water Monitoring	Replicates Phase 1 NRB Exp Container Monitoring	Replicates Phase 2 NRB Exp Container Monitoring
Particulate Organic Carbon	EPA 440.0	Particulate	--	--	--	1
OrthoPhosphate as P	EPA 365.5	Dissolved	2	2	1	1
Phosphorus as P	Valderrama 1981 / EPA 365.5	Dissolved	2	2	--	1
Phosphorus as P, Organic	Calculation	Dissolved	2	2	1	1
Silicate as Si	EPA 366	Dissolved	2	2	1	1
Chlorophyll-a	EPA 445.0	Particulate	3	3	2	2
Phytoplankton Abundance	Beaver et al. 2013	Total	1	1	--	1
Phytoplankton Biovolume	Beaver et al. 2013	Total	1	1	--	1
Microcystis Colony Geometry	Görögcs et al. 2018	Total	1	1	--	1
Microcystis Colony Enumeration	Görögcs et al. 2018	Total	1	1	--	1
Microcystis Chlorophyll-a	EPA 445.0	Particulate	3	3	--	1
Microcystins, Total	ELISA Abraxis 520011	Total	1	1	--	1

[1]Field Measurement of ambient water
[2]Field Measurement taken from experimental container
[3]Field Measurement of ambient water measured concurrently with NRB experimental container measurements to determine the difference. The reported value will represent the irradiance inside the experimental container.
[4]Measured only if visually present in the collected *Microcystis* sample

B.5 INSTRUMENTS/EQUIPMENT CALIBRATION, TESTING, INSPECTION, AND MAINTENANCE

Laboratory equipment is maintained by a qualified technician at the frequency listed in **Table 21**. Field equipment and meters are maintained according to standard procedures and at the frequency listed in **Table 21.** Laboratories are responsible for maintaining all laboratory equipment according to manufacturer specifications. Frequency and procedures for maintenance of analytical equipment used by each laboratory are documented in the Quality Assurance Manual for each laboratory, which is available from the laboratory on request. Laboratories are responsible for testing, inspecting, and maintaining all analytical equipment. In the event of equipment failure, the source of the failure must be identified and rectified, the equipment must be recalibrated, and any samples analyzed outside of calibration limits must be reanalyzed. The Program Manager, DRMP QA Officer, and CVRWQCB QA Representative will then work with the laboratory to identify the causes and address deficiencies in the SOPs that resulted in failures. If the problem is serious and cannot be corrected by the laboratory, the Program Manager, DRMP QA Officer, and CVRWQCB QA Representative will discuss and identify alternatives, including changing the sampling materials and methods, the extraction and analytical methods, the laboratory, or any combination of these. Any changes to the Monitoring Workplan must be approved by the EO prior to implementation. Amendments to the QAPP must be approved by the SWRCB QA Officer and/or the CVRWQCB QA Representative.

Field equipment and meters are calibrated according to standard procedures and at the frequency listed in **Table 21**. Laboratories are responsible for calibrating all laboratory equipment according to manufacturer specifications. Frequency and procedures for calibration of analytical equipment used by each laboratory are documented in the Quality Assurance Manual for each laboratory, which is available from the laboratory on request. A record of pre- and post-calibration results are logged and maintained for calibration records. All equipment capable of being calibrated must be successfully calibrated before analysis. If calibration fails, all affected samples must be re-analyzed, or the data flagged, and the equipment must be repaired before further analysis.

Table 24. Calibration, testing, inspection, maintenance of field and analytical instruments.

Due to the complexity and sensitivity of most laboratory instruments the testing, inspection, and maintenance procedures are difficult to summarize. A brief and general summary for each instrument follows; however, this table is not intended to describe all testing, inspection, and maintenance procedures for all tests, nor will this QAPP attempt to report SOPs for all such procedures. It is expected that laboratories will employ knowledgeable staff capable of testing, inspecting, and maintaining analytical instruments to ensure a level of data quality that matches or exceeds that demanded in this QAPP.

Analysis	Equipment / Instrument	Maintenance, Testing, or Inspection Activity	Frequency of Activity	Calibration Description and Criteria	Frequency of Calibration
Water quality	AquaTroll Sonde	Calibration of probes	Every use	Use of calibration solutions	Every use
Nutrients	Lachet Flow Injection Analyzer	CRM calibration	Once per month	Use of CRM	Every use

B.6 INSPECTION/ACCEPTANCE OF SUPPLIES AND SERVICES

Project consumables and services are listed in **Table 22**. Consumables are rejected for use if obvious signs of contamination or tampering exist. All laboratories are responsible for inspecting and testing all consumables against laboratory-specific acceptance criteria and maintaining adequate records.

Table 25. Inspection/acceptance testing requirements for supplies and services.

Project-Related Supplies or Services	Inspection / Testing Specifications	Acceptance Criteria	Frequency	Responsible Individual
Sample Bottles	Bottles are inspected for physical integrity	Bottles and caps intact	At receipt data of shipment	Field Lead
Calibration Standards	Solution bottles are inspected to verify factory seal and expiration date; initial measurements are compared to prior standard measurements.	Manufacturer's seal intact, measurements within MQOs	Upon opening a fresh stand solution	Field Lead
Nitrile Gloves	Carton seal is visually inspected for damage or tampering	Carton is intact and gloves within are clean and intact	At receipt data of shipment	Field Lead

B.7 ENVIRONMENTAL INFORMATION MANAGEMENT

Two types of data will be collected under the current project, field monitoring data (including data sheets and results in EDD format) and NRB data (pilot and full-scale). Both types of data will be delivered to the DRMP after being reviewed by CCR.

As established in **Element A.12** above, the Project Manager will maintain an inventory of data and will periodically check the inventory against the records in their possession.

The Project Manager will scan and send an electronic copy of field sheets and COCs to the Program Manager. All scanned copies will be stored on the Droplet which is a shared file system that is accessible to TAC members and the CVRWQCB. All field data are entered into the CV RDC database after being reviewed and qualified. All data transcribed or transformed, electronically and otherwise, are double checked for accuracy by MLJ Environmental staff and records of this double-checking are maintained at the MLJ Environmental office.

The process for receiving and finalizing data is detailed below and will occur according to the following general steps:

1. Receive EDD within 60 days of sample analysis (shared with Regional Board and TAC).
2. Verify data per the Data Management SOP.
3. Communicate with laboratory regarding any questions/concerns regarding data received; receive updated data, if necessary.
4. Stage 1 verified data are loaded into the CV RDC (shared with Regional Board and TAC).
5. Second verification of the data.

Stage 2 final data are ready for TAC review and discussion (shared with Regional Board and TAC). Transfer of data from laboratories to MLJ Environmental is accomplished by electronic submittal. Lab reports are received as electronic Portable Document Formats (PDFs) and in CEDEN templates, both of which are filed on the Droplet. The EDDs are uploaded to the CV RDC according to the procedures outlined in the **Appendix II – Data Management Procedures.**

According to the requirements outlined in Resolution R5-2021-0054, preliminary data in the form of unverified/raw results provided by the project laboratories will be submitted within 60 days of the sample analysis date for each sampling event. Raw data and laboratory reports (where applicable) are provided to the Nutrient TAC and CVRWQCB staff via upload to a shared file storage site. Preliminary data on the file storage site

(DRMP Droplet) are stored in a specific file under the Nutrient TAC primary folder; these files are considered static and are only updated if the laboratory resubmits new files. An associated Excel tracker (also stored on the Droplet) tracks the date the files were received, the project they are associated with, the file name, and the file location.

The DRMP will also email the following CVRWQCB staff with the preliminary data attached to the email when the files are uploaded to the file storage site: Executive Officer, Program Manager, and any other specified staff.

The DMT consists of Cassandra Lamerdin, who is the Data Manager for DRMP data, and Data Specialists at MLJ Environmental. The DMT is responsible for reviewing reports and EDDs to ensure completeness, assessing whether project MQOs were met, and ensuring CEDEN/SWAMP comparability. The DMT is responsible for uploading data to the CV RDC, performing final checks, and transferring data to CEDEN annually within 6 months of the last sampling date per Resolution R5-2021-0054. The CV RDC will track completion of monitoring events and data received; this information will be used to complete the QA Report at the end of the monitoring year.

Stage 1 data are reviewed by DMT staff during the data loading process for each individual EDD received. Data verification by the CV RDC DMT according to the approved Data Management SOP (**Appendix II)** occurs as close to receipt of the EDD as possible to ensure that any analytical issues identified during review can be communicated with laboratories and resolved in a timely manner. Once loaded into the CV RDC, an additional data verification is conducted by the Program QA Officer (or a delegate) on a result and batch level for individual results sets. The Program QA Officer (or a delegate) applies the appropriate compliance codes to each reviewed record, indicating the data are finalized on the result and batch level. These Stage 2 data are considered final data and are then exported and provided to the Nutrient TAC, stakeholders, and CVRWQCB staff. Per Resolution R5-2021-0054, this is done within six months of sample analysis.

Per the Resolution R5-2021-0054 requirement, a quality assurance assessment for samples collected in the previous fiscal year must be included in the DRMP Annual Report. This assessment will include all of the quality assurance section elements identified in R5-2021-0054 and is considered an intermediate QA Assessment since not all samples will have been received, verified, and finalized for the WY. The Program QA Officer (or a delegate) will conduct a final review and assessment of the data prior to transfer to CEDEN including a QA Report for data collected during the WY.

All data residing on the Droplet is housed on a third-party cloud server with nightly backups replicated to at least one independent server to create redundancy and allow for instant replication if a failure occurs.

The CV RDC database resides on a server housed at MLML main laboratory server room. Server RDC-Gamma hosts both the CV RDC and MLML RDC database and connects to a second server (MLML RDC) which hosts the Central Valley Checker System. Servers are monitored daily with weekly software maintenance and backed up nightly. Hardware maintenance occurs on an as needed basis. The most recent month of database backups are available for retrieval if needed; older backups are archived.

Monitoring reports which summarize the monitoring data are submitted to the DRMP and the CVRWQCB following the schedule outlined in **Element A.5.4**.

GROUP C. ASSESSMENT, RESPONSE ACTIONS, AND OVERSIGHT

C.1 ASSESSMENTS AND RESPONSE ACTIONS

C.1.1 ASSESSMENTS

Quality assurance reviews of data generated under the project will be made by the Program QA Officer according to this QAPP, and may include the Program Manager and CVRWQCB QA Representative, if necessary. Contract laboratories are responsible for self-assessment and oversight of finalized data submitted in laboratory reports and electronic deliverables, by the data managers, and/or the laboratory QA Officer. Once data are received, they will be reviewed and flagged according to the procedures outlined in **Appendix II**. The Program QA Officer and Program Manager are responsible for ensuring the proper flagging of all data that do not meet established QA/QC criteria.

The quality of data are routinely reviewed as a whole and assessed to determine if procedural (field and analytical) changes are necessary for improved data quality. The Program QA Officer (or designee) may request to visit the laboratory to discuss the review and data quality. Laboratory visits may occur as frequently as once a year or less depending on the need. In addition to laboratory visits by the DRMP staff, laboratories maintaining ELAP accreditations are subject to periodic assessments required for the maintenance of that status (see **Element B.3.2**). Other assessments that occur periodically will be oral or electronic via email correspondence; if no discrepancies are noted and corrective action is not required, additional records are neither maintained nor reported. If discrepancies are observed, the details of the discrepancy and any corrective action will be reported in the quarterly and final monitoring report. Due to the experimental nature of this study the Project Manager will be reviewing data as soon as it's available from the laboratory and communicating any proposed design changes to the Nutrient TAC.

C.1.2 RESPONSE ACTIONS

If a discrepancy is discovered during an assessment, the Program Manager and Program QA Officer will discuss the discrepancy with the personnel responsible for the activity. The discussion will include the accuracy of the information, potential cause(s) leading to the deviation, how the deviation might impact data quality and the corrective actions that might be considered. Deviations from the QAPP that can prevent project and data quality objectives from being met shall be described in the QAPP and must be approved

by the CVRWQCB QA Representative prior to implementation. When prior approval is not possible, deviations must be reported to the CVRWQCB QA Representative within seven calendar days, per R5-2021-0054. The Program Manager is responsible for documenting and communicating all deviations from this QAPP to the TAC and appropriate stakeholder groups. For immediate deviation notification, communication will include the following information: the applicable Workplan and/or QAPP, constituents and/or locations affected, sampling dates, whether the deviation is affecting one or multiple events, description of the concern, the proposed solution and rationale, and a place for a final decision to be communicated.

Once QAPP deviations are identified and a resolution determined, the process is documented on a DRMP QAPP Deviation Form (**Figure 6**). Deviation forms shall be completed and included in the Quarterly Reports submitted to the CVRWQCB. At a minimum, deviation forms must document:

- A description of the deviation that occurred
- Reason for the deviation
- Impact on the present and completed work
- Corrective actions taken as a result, by when and by whom

Once completed, deviation forms are reviewed and approved by the CVRWQCB QA Representative. The Program Manager will follow up with the party responsible tasked with implementing the corrective actions and track when they are performed. Deviations and corrective actions are reported for the previous fiscal year in the DRMP Annual Report that is submitted annually to the CVRWQCB on February 1.

The Program Manager and the Program QA Officer have the power to halt all sampling and analytical work by both the field crews and contracted laboratory if the deviation(s) noted are considered detrimental to data quality.

Figure 6. Deviation form template.

DELTA
Regional Monitoring Program

Deviation Report / Corrective Action Form

Title:	
Deviation Number:	
Prepared By:	
Included:	

Applicable Reference(s):

Complete the following table regarding the major milestones for the relevant deviation. Add additional rows as needed.

	Date	Notes/Description (optional)
Date Deviation Occurred:		
Date DRMP Program Manager was notified:		
Date CVRWQCB QA Representative Notified:		
Date Non -Conformance Report sent:		
Deviation Form sent for Review:		
Deviation Form sent for Review:		
Deviation Form Sent for Signatures:		

Deviation Report / Corrective Action Form, page 1 of 2

Description of Deviation/Change:

Reason for Deviation/Change

Impact on Present and Completed Work (discuss potential magnitude of impact and bias of deviation/change, if this can be anticipated, if no impact is expected please indicate this)

Corrective Action	By Date	By Whom

ACKNOWLEDGED BY:

Task/Lab Manager:		Date:	
Regional Board Representative:		Date:	
Program Manager:		Date:	
	Melissa Turner		
DRMP QA Officer:		Date:	
	Will Hagan		

C.2 OVERSIGHT AND REPORTS TO MANAGEMENT

Quality assurance assessments are provided in individual project data reports, which are drafted upon the completion of a study or monitoring cycle, as needed. Data reports are reviewed by the appropriate TAC, recommended for approval by the Steering Committee, and approved for publication by the BOD. Quality assurance assessments are also provided in the DRMP Annual Report according to the requirements outlined in Resolution R5-2021-0054.

The Data Manager is responsible for summarizing QA issues with reported data and communicating those issues to the DRMP Program Manager and the Program QA Officer. The DRMP Program Manager is responsible for communicating delays in data deliverables and/or QA issues to the CVRWQCB QA Representative and the appropriate stakeholders and committees.

Deviation Forms (**Figure 6**) are generated on an ad hoc basis to document any significant changes to the implementation of this QAPP, the impacts on project data, and the corrective actions that should be taken as a result. A record of all deviations that occur, including copies of completed Deviation Forms that occurred within a given reporting period, is provided in the DRMP Quarterly Reports, submitted November 1, February 1, May 1, and August 1, annually, and in the DRMP Annual Report, submitted on February 1 of each year.

GROUP D. ENVIRONMENTAL INFORMATION REVIEW AND USEABILITY DETERMINATION

D.1 ENVIRONMENTAL INFORMATION REVIEW

Data generated by this project will be reviewed against the measurement quality objectives cited in **Element A.6** and QA/QC practices outlined in **Elements B.4 – B.6**. Data will be qualified according to the methods outlined in **Element B.7.** The Program QA Officer will complete a secondary review to ensure that all data are properly qualified according to the project requirements. Data collected by other agencies, projects, or studies that are to be used in conjunction with the data generated under this QAPP will undergo the review requirements outlined in **Element D.1**. The DRMP has developed a Data Management Plan which will be updated at a minimum every three years. This section should be consistent with the most recent version of the approved Data Management Plan.

D.1.1 DATA VERIFICATION

The DMT will perform all data verification according to the methods outlined in **Appendix II**. These minimum requirements for data verification procedures are summarized below; however, the detailed procedures defined in the Data Management SOP must conform to the data management principles of the Water Boards and the DRMP Data Management Plan. Conformity to these principles ensures that the data generated by this project are comparable and properly verified according to both the DRMP and Water Board's needs. The attached SOP has been reviewed by the SWRCB to ensure agreement with data processing procedures and SWRCB requirements.

All field collection records are entered either directly into the database or into a CEDEN comparable EDD format. Field data should be verified against the original collection records before finalized and, if necessary, exported to provide field collection details to laboratories.

The contract laboratories are responsible for the reduction of the raw data generated by the methods used to a data deliverable format determined by agreement between the laboratory and the Program Manager. Each contract laboratory's QA Officer will perform checks of all of its records at a frequency that the laboratory determines sufficient. The analytical process includes verification or a quality assurance review of the data, which includes:

- Verifying the calibration samples for compliance with the laboratory and project criteria;
- Verifying that the batch QC samples were analyzed at a proper frequency and the results were within specifications;
- Comparing the raw data (e.g., chromatogram) with reported concentration for accuracy and consistency;
- Verifying that the holding times were met and that the reporting units and quantitation limits are correct;
- Determining whether a corrective action was performed, and control was re-established and documented prior to reanalysis of QC or project samples;
- Verifying that all project and QC sample results were properly reported and flagged; and
- Preparing batch narratives that adequately identify and discuss any problems encountered.

Data verification for the DRMP this project will take place on two levels: initial verification (Stage 1) and secondary verification (Stage 2).

D.1.1.1 Stage 1 – Reviewed Data

The purpose of the initial verification is to ensure that the original data provided by the laboratory includes the required data fields, formatted correctly, and flagged according to the QAPP requirements. Initial verifications are completed by the DMT, who communicate with the laboratory regarding any missing values or inconsistent reporting of data.

Once results are received from laboratories, the DMT reviews 100% of the reports and deliverables generated. Data verification procedures should at a minimum include:

- Verification of the results against the original sample collection records to ensure all expected results are received.
    - This may include the removal of superfluous results (such as non-project QC data) that should not be included in the final dataset.
- Verification of electronic data against lab reports or additional analysis records received to ensure consistent results between formats.
- Verification of sample processing and analysis information against the requirements outlined in this QAPP; this should include checks for
    - Expected analytes,
    - Expected methods,
    - Reporting limits and minimum detection limits
    - Batch definition, and
    - Reporting units.

- Verification that fields not controlled by lookup lists (e.g., comment fields) are formatted in a way that is consistent with the project requirements and the business rules of database into which the dataset will be loaded.
- Verification that all quality control evaluation calculations are complete (e.g., RPDs)
- Verification of all environmental and QC sample results against the MQOs outlined in this QAPP, and, where results do not meet the MQOs, verification that the proper data qualifier is applied to the record. Checks against MQOs should include an evaluation of:
    - Holding time compliance,
    - QC sample frequency,
    - Detections in blank samples,
    - Recoveries of spiked samples and surrogates, and
    - Precision metrics of duplicate samples.
- Verification that all records are unique, and no duplicated data exist in the dataset.
- Verification that all required fields are completed.

Once all data verification steps are completed, DMT staff apply the appropriate CEDEN comparable Lab Submission Code and Batch Verification Code according to the project requirements, the results of the data review, and data verification steps that were completed. The list of acceptable codes can be found in the documentation of CEDEN lookup lists (http://ceden.org/CEDEN_Checker/Checker/LookUpLists.php). In addition, data processors may add to comment fields of the final data records any pertinent information from the laboratory report case narrative to further qualify data, as needed. If available for the data deliverable template that was provided, the finalized results should be run through an appropriate data checker once verification is complete to ensure that the final data meet the minimum requirements of the database into which they will eventually be loaded.

Data having completed initial verification are loaded into the CV RDC. At a minimum, data used for the intermediate QA Assessment conducted as a part of the February 1 Annual Report must have undergone this initial verification and be loaded into the CV RDC database.

D.1.1.2 Stage 2 – Verified Data

Once data are loaded into the CV RDC, they can undergo the secondary verification. The purpose of the secondary verification is to perform a second check of the data against the MQOs in the QAPP to ensure that all qualifying codes are applied consistently throughout the dataset on both a result and batch level. Once secondary verification is

completed, the appropriate CEDEN compliance codes are applied to each data record. The secondary verification is completed by the Program QA Officer or a delegate independent of data generation. Data that have undergone secondary verification and have the appropriate compliance codes applied are considered “final” on a results level and on a batch level. These data are then exported and provided to the Nutrient TAC, stakeholders, and CVRWQCB staff. Per Resolution R5-2021-0054, this is done within six months of sample analysis. Data used in the final Data Reports generated at the end of a WY must have undergone initial and secondary verification. All QA issues will be noted, and the associated results qualified with the appropriate data flag.

When QA issues affect the useability of the associated results, reconciliation and correction of these issues will be done by a committee composed of the Program Manager, the Program QA Officer, the CVRWQC QA Representative, and the appropriate field and/or laboratory staff. Any resulting corrective actions will be documented with a Deviation Form (**Figure 6**) according to the procedures outlined in **Element C.1**. The Program Manager is responsible for distributing results to the appropriate committees, stakeholders, and data users, and for ensuring data are submitted to the CVRWQCB within the timelines outlined in R5-2021-0054.

D.1.2 DATA VALIDATION

Data validation steps provide a broader assessment of data compliance with project requirements, useability, and suitability for their intended use. Such assessments may be conducted in long-term interpretive reports, trend analyses, or ad hoc quality assessments as requested by the Steering Committee or BOD; however, at this time there are no data validation requirements for the data generated under this QAPP.

D.1.3 REJECTION OF DATA

The decision to accept or reject data will be made jointly by the Program QA Officer, the Program Manager, the CVRWQCB QA Representative, and if necessary, SWRCB QA staff. Data rejections will be documented with a deviation form or QAPP amendment and require the approval of the QA Representative and/or the SWRCB QA Officer. Decisions regarding accepting and rejecting data should also be informed by input from the TAC.

There are three time-steps where data may be identified for rejection: 1) identified by the laboratory prior to reporting to the DRMP, 2) during data verification (either Stage 1 or Stage 2), and 3) during the finalization of the data through the TAC process (Stage 3). These data rejection pathways are described in **Figure 7**. Missing analytical records will

be discussed in the DRMP Annual Report and Data Reports; rejection decisions may also lead to amendments to the Data Management SOP and/or the QAPP.

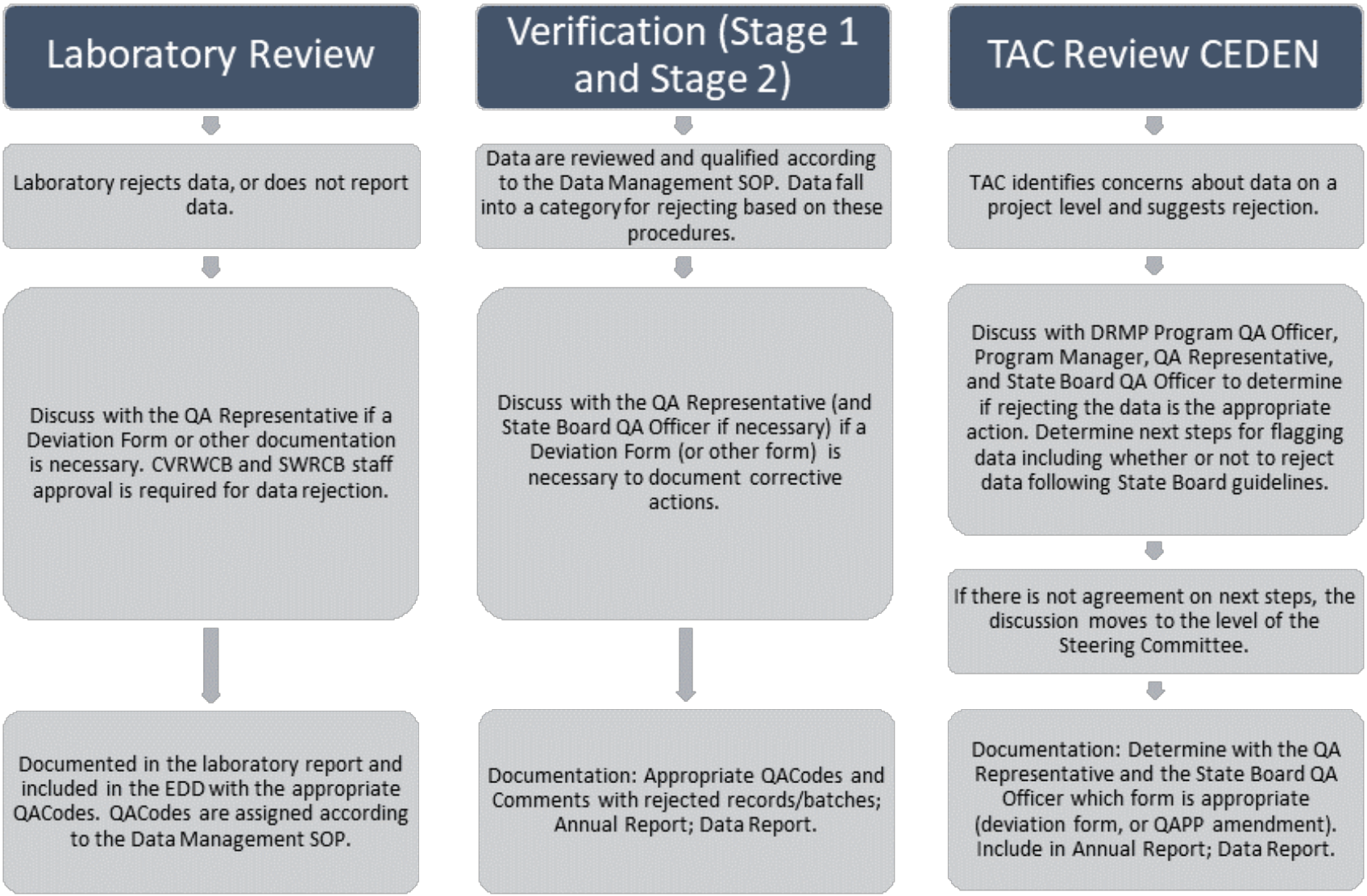
- Laboratory Review: The following situations will be communicated to the Program QA Officer, the Program Manager, the QA Representative, and, if necessary, the SWRCB QA Officer and documented in the laboratory report. The QA Representative or the SWRCB QA Officer will determine if a deviation form or other documentation is necessary.
    - The laboratory identifies that the analysis did not meet performance standards (e.g., instrument failure) or a quality control failure that results in the inability to accurately quantify the analyte.
    - When the QAPP does not clearly identify the performance standard not being met or quality control failure, the laboratory will provide a justification for the recommendation to omit the results from the EDDs.
- Data Management Verification: data verification occurs when the data are reviewed and flagged by the Data Manager (Stage 1) and again when the Program QA Officer reviews and verifies that data are flagged according to this QAPP (Stage 2).
    - Stage 1 – the Data Manager identifies egregious or numerous failures of MQOs during data review and notifies Program QA Officer, the Program Manager, the QA Representative, and, if necessary, the SWRCB QA Officer about the concern and potential for data rejection.
    - Stage 2 – the Program QA Officer identifies a situation during the secondary verification procedures where rejection of data is recommended.
    - In both cases, the Program QA Officer, the Program Manager, the QA Representative, and, if necessary, the SWRCB QA Officer will determine if the data should be rejected. The QA Representative or the SWRCB QA Officer will determine if a deviation form or QAPP amendment is necessary.
- TAC Review: the TAC will review the finalized dataset (Stage 3) and associated Data Report to assess the quality of the data relative to the project goals. During this review, TAC members may identify project-level data quality concerns that were not previously identified by the laboratory, Data Manager, or Program QA Officer. These situations will be communicated to the Program QA Officer, the Program Manager, the QA Representative, and the SWRCB QA Officer to determine if the results should be rejected. The QA Representative or the SWRCB QA Officer will determine if a deviation form or QAPP amendment is necessary.

If the Program QA Officer, Program Manager, CVRWQCB QA Representative, and SWRCB QA Officer agree to reject, qualify, or not publish data, the agreed upon next steps will be documented, implemented, and communicated to the [insert associated TAC] and Steering Committee. If the Program QA Officer, Program Manager, CVRWQCB QA Representative, and SWRCB QA Officer cannot agree on whether to reject, qualify, or not publish data, the discussion will be elevated to the Steering Committee for a recommendation, and then on to the CVRWQCB Executive Officer and DRMP Executive Committee for discussion prior to a final decision by the CVRWQCB Executive Officer.

In the case where the Program QA Officer, Program Manager, CVRWQCB QA Representative, and SWRCB QA Officer cannot agree on whether to reject, qualify, or not publish data, two short memos, each authored by the proponents of the solution and describing the issue and proposed resolution, will be provided to the Steering Committee Co-Chairs for dissemination to the Steering Committee and discussion at the next Steering Committee meeting. The Steering Committee will be asked to provide advice and/or make a recommendation to the Board of Directors/Executive Committee concerning the data. As described in the Steering Committee Responsibilities and Voting language, consensus on a recommendation may come from an informal vote or simple question such as “Is any Steering Committee member opposed to a recommendation?”. If there is a clear consensus, the recommendation will be included in the meeting summary as being reached by consensus and that no vote was needed. If the Steering Committee members cannot come to consensus on a recommendation, the Steering Committee member(s) that are not in agreement should put forth a workable compromise to see if consensus can be gained. After discussion, if consensus cannot be gained informally, the Steering Committee Chairs should ask for a recommendation to vote on (i.e., moved and seconded by Steering Committee members). Voting should be recorded as green (in favor), white (abstain), yellow (stand aside), and red (opposed/block). A single block means that consensus has not been achieved. Majority and minority opinions, reservations, and oppositions will be noted verbally at the meeting, including the member who has made such recommendations, and documented in the meeting summary.

Following the Steering Committee meeting, the Steering Committee Co-Chairs will provide the two memos and communicate the Steering Committee’s recommendation (either consensus or non-consensus) to the CVRWQCB Executive Officer. The CVRWQCB Executive Officer will consult with the DRMP Executive Committee prior to making a final decision.

Figure 7. Process for identifying, communicating, and documenting data rejection decisions.
See **Element A.10** for additional details regarding communication processes.



D.2DATA USEABILITY DETERMINATION

Procedures to review, verify, and validate data generated under this QAPP are outlined in **Element D.1.1** and included as a part of **Appendix II**. These procedures ensure that all data uploaded into the database have been qualified on a result, batch, and project level with each deviation being coded and comments provided.

Data are reported to the CVRWQCB and TAC in a variety of formats including CEDEN templates, narrative data summaries (including data compiled into tables and charts), and laboratory reports. Limitations in data use will be reported to the CVRWQCB in the Annual Report and will be summarized in the monitoring year QA Report. The DRMP has developed a Data Management Plan, and this section should be consistent with the requirements in the most recent version of the approved Data Management Plan.

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APPENDIX I – FIELD SAMPLING PROCEDURES

Standard Operating Procedures for Monitoring

Standard Operating Procedure (SOP) For Plankton and Water Sample Collections from Source Waters and Bioassay Experiments in the Sacramento-San Joaquin Delta (Delta)

Purpose: To sample phytoplankton, including cyanobacterial harmful algal bloom species, and ancillary measurements in Delta source waters and in nutrient reduction bioassay experiments.

Source Water Sample Collections

Table 1. Types of sampling parameters and equipment

Parameters	Collection method	Equipment
Temperature, DO, pH, conductivity, turbidity	Sonde	Aqua TROLL multiparameter Sonde; laptop
Chlorophyll-a	Discrete grab	Irradiance
Nutrient Panel	Discrete grab	Van Dorn Sampler, sterile filter tower with 0.2 um membrane, 50 ml falcon tubes, hand pump
Active fluorescence	Discrete grab	Van Dorn Sampler, 30 ml opaque HDPE wide mouth or amber glass bottle, glass cuvette, Turner Phytoflash
Phytoplankton enumeration	Concentrator	Plankton concentrator with cod end, Lugol's preservative, 250 ml opaque HDPE wide mouth or amber glass bottle
Microcystis colonies	Discrete grab	Bucket, opaque 250 ml HDPE wide mouth or amber glass bottle, Aqusens imager
Microcystis Visual Index	Photo / visual observation	Phone, field sheet
		Cooler with ice, cooler with dry ice, deionized (DI) water, squirt bottles, nitrile gloves, pens, labels, forceps

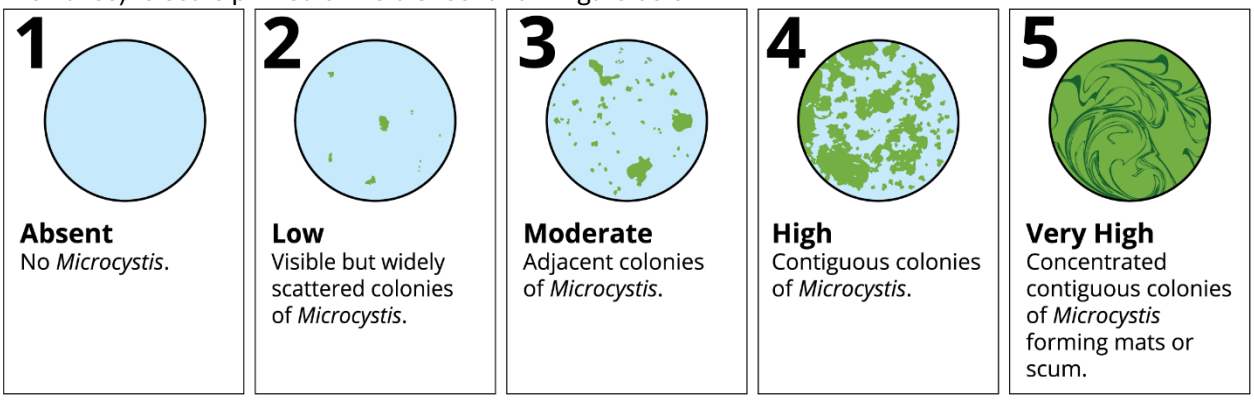
Prior to sampling:

1. Purchase Lugol's preservative, Whatman filters, labels, sterile filter towers, pre-cleaned sample bottles, tubes, vials and transfer containers according to Table 1. A transfer container is a larger container that can be used to collect enough water to be partitioned/aliquoted into several sample containers for different types of analyses.
2. Inquire with analytical laboratories if they provide sample containers or recommend that samples are preserved. Alert laboratories when samples will be delivered.

On the day of sampling:

1. Label all sample containers with date, water body (Location) name, station ID, sample type, and organization. Leave time of sampling blank and add when sample is filled. Prepare chain of custody (COC) forms ahead of sampling. Bring gloves, distilled water, pens, field sheets, and coolers with dry ice and wet ice.

2. Fill out field sheet, take photos of the water, note time photos were taken, and perform Microcystis Visual Index (MVI) ranking by comparing density of Microcystis colonies (visible as small lettuce-like flakes) to scale printed on field sheet and in figure below:



3. Vertical profiling of water column with sonde: Turn instrument on according to manufacturer's directions. Lower sonde into water by its cord just below the surface so that it is covered by water. Hold instrument at surface for 1 minute (min) to equilibrate instrument before lowering slowly to the bottom and back up to the top. Download data to laptop according to manufacturer's instructions.
4. Collection of discrete surface grab samples with Van Dorn sampler or similar device: if sampling from a pier or bridge, a sampling device such as a Van Dorn sampler can be lowered into the water to collect the water sample.
    a. Collect two samples of natural water into the sampler that has been pre-cleaned with deionized water. Pour the samples out as these two samples are to rinse the sampler. Collect a third water sample and note depth at which sample was collected (aim for 1 m below the surface). Use this water to fill the sample containers as soon as the sample has been collected.
    b. Phytoplankton enumeration sample: Pour water from the Van Dorn sampler into the water concentrator device with cod end. Note volume of water poured. Fill water from the cod end into the 250 ml phytoplankton enumeration sample bottle such that it is ¾ full, add 5 ml Lugol's preservative, cap tightly, and invert gently 3 times to distribute preservative evenly in sample before placing on ice.
    c. Field filtration of chlorophyll (Chl) sample: Fill water from Van Dorn sampler into transfer container. Draw 60 ml water from transfer container into disposable syringe, attach swinex pre-charged with GF/F filter, filter 60 ml sample through, fold and remove filter from swinex with forceps and place into cryovial that is covered with foil. Place cryovial on dry ice. Collect triplicate Chl samples. Collect one field blank sample for every sampling event randomly from one of the three sampling locations.
    d. Field filtration of nutrient panel sample: Pour water from Van Dorn sampler or transfer container into 2 separate sterile filter towers that are connected to hand pumps. Pump water through devices. Unscrew filter top and aliquot water from each filter tower into separate 50 ml falcon tubes and place on ice in cooler. Collect one field blank sample for every sampling event randomly from one of the three sampling locations.
    e. Active fluorescence sample: Pour water from transfer container into two separate opaque 30 ml bottles. Store bottles for active fluorescence measurement in a dark, cool place for 10 min before transferring water sample into cuvette and into Phytoflash in the dark to take the reading. Note readings on field sheet. Take one blank measurement for every sampling event randomly from one of the three sampling locations.

5. Microcystis colony sample collection and analyses: Collect water from pier into 5 gallon bucket, let stand on pier until visible Microcystis colonies accumulate at the surface (ca. 10 min). Skim colonies into wide mouth bottle and run through Aqusens imager. Collect second sample of water that does not contain visible colonies and run sample through imager for background community and picoplankton analysis. Skim colonies into wide mouth bottle and process for Chl concentration. Briefly, transfer into syringe, filter and preserve as described above for Chl analysis. Collect triplicate filters with Microcystis colonies for Chl analysis. Note estimated number of colonies per filter.
6. Cleaning Equipment: Clean Van Dorn sampling device with multiple rinses of deionized water following sampling, and with native water before next sample is collected at the next station/location. At the end of the day, clean Van Dorn sampler by scrubbing with a dilute 2% Liquinox (or other phosphate free) detergent solution, followed by rinsing with deionized water multiple times (five times or more). Air dry and close end caps before storing.
7. Transporting or shipping samples to laboratory: Fill out chain of custody (COC) form for each laboratory and place into cooler(s) with samples. Transport field-filtered samples for nutrient panel analysis and Chl determination to laboratory and place in -20°C freezer. Preserved samples for phytoplankton enumeration have longer hold times and can be refrigerated for up to 3 months before being shipped to BSA Environmental for enumeration. should be transported or shipped same-day to the analytical laboratory. When shipping or handing samples to laboratory for analysis, include all COC forms. Ship samples overnight with carrier.
8. Analytical Laboratories:
    a. BSA Environmental Services (https://www.bsaenv.com/)
    b. Moss Landing Nutrient Laboratory (https://www.mlml.sjsu.edu/)

Nutrient Reduction Bioassay (NRB) Sample Collections

Table 2. Types of sampling parameters and equipment for NRB experiments

Parameters	Collection method	Equipment
Temperature	Probe	Hand-held probe
DO, pH, conductivity	Probe	Hand-held probe
Turbidity	Probe	Hand-held probe
Chlorophyll-a	Discrete grab	Transfer container, filter rig, 25mm Whatman GF/F filters, cryovials, dry ice
Nutrient Panel	Discrete grab	Transfer container, sterile filter tower with 0.2 um membrane, 50 ml falcon tubes, hand pump
Active fluorescence	Discrete grab	Transfer container, 30 ml opaque HDPE wide mouth or amber glass bottle, glass cuvette, Turner Phytoflash
Phytoplankton enumeration and biovolume	Discrete grab	Transfer container, Lugol's preservative, 250 ml opaque HDPE wide mouth or amber glass bottle
Microcystis colonies	Discrete grab	Transfer container, Lugol's preservative, 250 ml opaque HDPE wide mouth or amber glass bottle
		Cooler with ice, cooler with dry ice, deionized (DI) water, squirt bottles, nitrile gloves, pens, labels, forceps

Prior to sampling:

1. Purchase Lugol's preservative, Whatman GF/F filters, labels, sterile filter towers, sterile disposable 60 ml syringes, pre-cleaned sample bottles, tubes, vials and transfer containers according to Table 2. A transfer container is a larger container that can be used to collect enough water to be partitioned/aliquoted into several sample containers for different types of analyses.
2. Inquire with analytical laboratories if they provide sample containers or recommend that samples are preserved. Alert laboratories when samples will be delivered.
3. Prepare five nutrient stock solutions (one control and 4 treatments) to be added daily to experimental containers to give final treatment nutrient concentration with addition of specific stock volume.

Daily Nutrient Additions, including after containers are filled on Day 0:

1. Unscrew cap on container, add nutrient stock solution with pipette, close container cap tightly, gently invert container 3 times to distribute nutrients evenly.

Day 0 sampling to be performed on water collected into barrel before water is distributed into containers:

1. Label sample containers with date, Day zero, and sample type. Leave time of sampling blank and add when sample is filled. Prepare chain of custody (COC) forms ahead of sampling. Bring gloves, distilled water, kim wipes, pens, field sheets, coolers with wet ice and sample bottles, and cooler with dry ice.

2. Sampling of water from barrel: Mix water in barrel well and siphon water into transfer container. From first transfer container: Aliquot water from transfer container for the various samples. Field-filter one sample for the nutrient panel through a sterile filter tower and collect samples into 50 ml falcon tube. Filter triplicate Chl filters as described above for the source water. Place cryovials with Chl filters on dry ice in cooler and falcon tubes with nutrient samples on wet ice in cooler. Pour water from transfer container for phytoplankton enumeration into 250 ml amber bottle and add 5 ml Lugol's preservative. Cap and invert bottle gently 3 times to distribute preservative and place in cooler on ice. Pour water from transfer container into 2 opaque 30 ml bottles; use one for active fluorescence reading and incubate in a cool, dark place for 10 min. Transfer sample into cuvette in the dark and read on Phytoflash. Use water in second 30 ml bottle for Aqusens reading. Empty water from transfer container and pour second aliquot from barrel after mixing barrel.
3. From second transfer container: Take second replicate samples for nutrient panel, for triplicate Chl filters, and for phytoplankton enumeration. Take probe readings (turbidity, dissolved oxygen, pH, and temperature) on water in transfer container. Turn probes on according to manufacturer's directions. Unscrew cap and place first probe into container water and take reading. Note reading on field sheet. Place second probe into container water and take reading and note on field sheet. Place third probe in container and take reading and note on field sheet. Run triplicate readings on turbidity meter. Note each reading on field sheet.
4. Filling from barrel: Commence with filling experimental containers with water from barrel after mixing barrel again.
5. After all containers have been filled, add nutrients into containers separately from stock solutions, mix container by inverting, and secure in corral/enclosure in water.

Middle of experiment sampling: Sampling of basic water quality parameters (temperature, DO, pH), Chl, nutrient panel, and active fluorescence:

1. Label all sample containers with date, NRB Container ID, and sample type. Leave time of sampling blank and add when sample is filled. Prepare chain of custody (COC) forms ahead of sampling. Bring gloves, distilled water, kim wipes, pens, field sheets, coolers with wet ice and sample bottles, and cooler with dry ice.
2. Collection of data with hand-held probes (temperature, DO, pH): Gently invert bioassay container 2 times. Turn probes on according to manufacturer's directions. Unscrew cap and place first probe into container water and take reading. Note reading on field sheet. Place second probe into container water and take reading and note on field sheet. Rinse probes after each container with DI water applied with squirt bottle.
3. Collection of grab samples using transfer container: invert experimental container gently 2 times, set container on firm surface, unscrew cap and withdraw water from container with siphon from bottom of container (taking care not to draw up Microcystis colonies) into transfer container. Pour water from transfer container into filter rig for Chl filtration (60 ml into each tower) and into sterile filter tower for nutrient panel filtration. Filter duplicate samples for Chl from each container. Collect field blanks for Chl and nutrient panel analyses every 20 samples. Filter samples and preserve as above for source water monitoring. Withdraw water into 30 ml opaque bottle for active fluorescence reading; incubate bottle in dark for 10 min and read on Phytoflash. Collect and read field blank and duplicate sample on Phytoflash every 20 samples. Note Phytoflash readings on field sheet.

Last day sampling:

1. Label all sample containers with date, NRB Container ID, and sample type. Leave time of sampling blank and add when sample is filled. Prepare chain of custody (COC) forms ahead of sampling. Bring gloves, distilled water, kimwipes, pens, field sheets, coolers with wet ice and sample bottles, and cooler with dry ice.
2. Collection of data with hand-held probes (temperature, DO, pH): Gently invert bioassay container 2 times. Turn probes on according to manufacturer's directions. Unscrew cap and place first probe into container water and take reading. Note reading on field sheet. Place second probe into container water and take reading and note on field sheet. Rinse probes after each container with DI water applied with squirt bottle.
3. Collection of grab samples using transfer container: invert experimental container gently 2 times, set container on firm surface, unscrew cap and withdraw water from container with siphon from bottom of container (taking care not to draw up Microcystis colonies) into transfer container. Pour water from transfer container into filter rig for Chl filtration and filter tower for nutrient panel filtration. Filter duplicate samples for Chl from each container. Collect field blanks for Chl and nutrient panel analyses every 20 samples. Filter samples and preserve as above for source water monitoring. Pour water from transfer container into two 30 ml opaque bottles; use one for active fluorescence reading after incubating bottle in dark for 10 min, read on Phytoflash. Collect and read field blank and duplicate sample on Phytoflash every 20 samples. Use second bottle for Aqusens reading. Pour water into 250 ml opaque bottle for phytoplankton enumeration via microscopy, add 5 ml Lugol's preservative, cap tightly, invert bottle gently 3 times and place on ice in cooler.
4. Microcystis colony samples: use rest of water from NRB experimental container for enumeration and sizing of visible Microcystis colonies. Count/estimate number of colonies visible to the eye and note estimate on field sheet. Pour aliquots of water with colonies into 250 ml opaque bottle for analysis via microscopy, add 5 ml Lugol's preservative, cap tightly, invert bottle gently 3 times and place on ice in cooler. Pour water with colonies into 30 ml opaque container; keep on ice until sample can be processed with Aqusens imager. Pour water with colonies into 60 ml syringe fitted with swinex pre-charged with GF/F filter. Filter water and preserve triplicate filters for Chl determination as described above for source water monitoring. Estime number of colonies filtered for each filter and note on field sheet.

APPENDIX II – DATA MANAGEMENT PROCEDURES

Standard Operating Procedures for Data Management

Standard Operating Procedures for Surface Water Data Management

For Data Generated under the Delta Regional Monitoring Program

Version 2.5

February 2, 2024

Prepared by:

MLJ ENVIRONMENTAL

SOP for Surface Water Data Management revision history.

Revision No.	Revision Date	Person Responsible	Revision Description	Section(s) Affected
2.0	09/01/2021	L. McCrink	Update to MLJ Data Management Procedures to include updated checklists and tissue; addition of MIS procedures.	All
2.1	11/22/2021	L. McCrink	Updates regarding data Quality Assurance flagging rules when blank contamination is observed.	VII.E.7, Table 7, Attachment B
2.2	05/18/2022	L. McCrink	Updates regarding QA Codes and business rules added to chemistry and toxicity verification sections. Toxicity water quality parameter requirements checks added as Section VII.F.4 and Table 8. Clarified CEDEN upload timeline requirements to be in agreement with R5-2021-0054.	Table 7, Table 8, Table 9, VII.F.4, IX.C
2.3	10/20/2022	L. McCrink	Additional information regarding secondary verification procedures.	VIII
2.4	12/21/2022	L. McCrink	Updates to clarify the field data processing and verification procedures. Clarification of Secondary Results Verification procedures and Data Publication procedures based on comments received from CVRWQCB and SWRCB staff. Field result checklist added as Attachment A.	VI.A.2, VI.B, VIII, IX, Attachment A
2.5	02/02/2024	L. McCrink	Updates to clarify procedures and parameters associated with use of high-salinity controls and alternate species for toxicity tests. Add flowchart for high salinity control. Update toxicity results flagging business rules for high-salinity controls. Clarified wording of blank flagging rules for chemistry results.	Table 7, Table 8, Table 9. Attachment C (Item 10), Table 12.

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ATTACHMENTS

LIST OF ACRONYMS

CEDEN	California Environmental Data Exchange Network
CV RDC	Central Valley Regional Data Center
COC	Chain of Custody
EDD	Electronic Data Deliverable
eDERs	Environmental Data Entry and Reporting System
eQAPP	Electronic Quality Assurance Project Plan
LCS	Laboratory Control Spike
LCSD	Laboratory Control Spike Duplicate
LIMS	Laboratory Information Management System
MDL	Minimum Detection Limit
MLJ DMT	Michael L Johnson Data Management Team
MLML-MPSL	Moss Landing Marine Laboratories Marine Pollution Studies Laboratory
MQO	Measurement Quality Objective
MIS	Management Information System
MS SQL	Microsoft SQL Server
MS	Matrix Spike
MSD	Matrix Spike Duplicate
PR	Percent Recovery
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RL	Reporting Limit
RPD	Relative Percent Difference
SOP	Standard Operating Procedures
SWAMP	Surface Water Ambient Monitoring Program
TAC	Technical Advisory Committee
TAccC	Test Acceptability Criteria
TIE	Toxicity Evaluation Identification
WQM	Water Quality Metrics
WY	Water Year

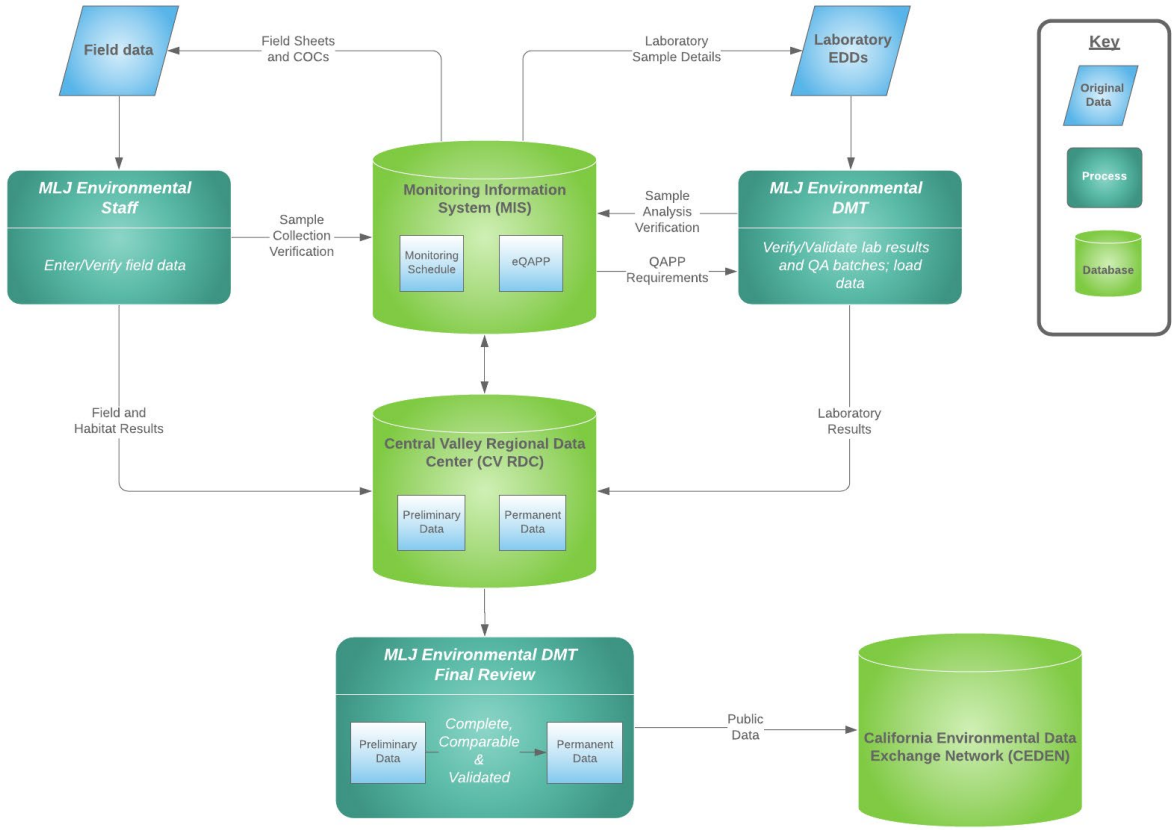
I. INTRODUCTION

The MLJ Environmental (MLJ) Standard Operating Procedures (SOPs) for Surface Water and Sediment Data Management describes the preparation, verification, quality control (QC), and processing of surface water, sediment, and tissue data completed by MLJ staff. Procedures outlined in this SOP apply to both chemistry and toxicity data.

A. PURPOSE

The following SOP outlines the procedures for the management of environmental quality data by MLJ Environmental. This document describes the general processes, minimum information requirements, and data verification procedures for field measurements and laboratory results, and the storage and management of those results in the Central Valley Regional Data Center (CV RDC) database. **Figure 1** is an illustration of the data flow from the receipt of data, through verification and quality control checks and finally uploaded and stored in relational databases managed by MLJ. Finalized data are transferred to the State Water Resources Control Board's (State Water Board) California Environmental Data Exchange Network (CEDEN) database when approved by the data provider.

Figure 1. Data flow diagram for water quality data (including sediment and tissue) managed in the CV RDC database and migrated to CEDEN.



B. DATABASES

There are three primary databases which are used throughout the data management process:

- ***Monitoring Information System (MIS Database).*** The MIS Database is an internal data management system managed and maintained by MLJ staff. The primary function of the MIS Database is to store and maintain programmatic information needed to manage and complete monitoring for various projects. Where necessary, data in the MIS are maintained in a format that is comparable to the CV RDC, allowing for monitoring data to be queried across both database systems for reporting purposes. There are two main elements of the MIS database that are used in different capacities throughout the data review and management process:
    - *Monitoring Schedule Database*: This element of the database stores scheduled sampling event details by project. The monitoring schedule is used to track samples collected and results received. Reports generated from this system are used to communicate the number of samples planned to be collected based on method and analyte to the laboratories and create field sampling materials including field sheets and chains of custody (COCs). It also stores information regarding the status and completion of

specific milestones for the processes outlined in this SOP such as completion dates for field data entry, laboratory deliverable receipt, and results loading into the CV RDC.
    - *eQAPP Database*: This element of the database stores Measurement Quality Objectives (MQOs) and quality assurance requirements for each project. The term "eQAPP" refers to an electronic Quality Assurance Project Plan (QAPP). This part of the database serves as the official repository for current QAPP requirements by project.
- ***Central Valley Regional Data Center Database (CV RDC).*** The CV RDC is one of three Regional Data Centers in California that can migrate data to CEDEN which is managed by the State Water Board. The relational design of the CV RDC was developed with the intent to ensure that data submitted through this process are CEDEN comparable and meet CEDEN minimum requirements and business rules. The CV RDC is synced with CEDEN weekly to ensure comparability of lookup lists. Data within the CV RDC are not publicly available through CEDEN until they are verified and marked as public.
- ***California Environmental Data Exchange Network (CEDEN).*** This statewide water quality database is the repository for the public results of most surface water monitoring occurring in the State of California. It is maintained and managed by State Water Board staff; data in it are publicly available through http://ceden.org.

C. PERMISSIONS AND SECURITY

The MIS is a MS SQL database that is hosted on Amazon Web Services (AWS). Permissions to the MIS occur at the project level for specific clients upon request as well as to MLJ staff, as necessary.

The CV RDC database is a Microsoft (MS) SQL database which can be accessed online by using the Environmental Data Entry and Reporting System (eDERS) hosted by Moss Landing Marine Laboratories (MLML) or internally by MLJ Data Management Team (DMT) staff using MS SQL Management Studio or MS Access interfaces. All users are assigned a username and password for access to data. Permissions are unique to individual staff logins and are granted on the individual result record level (Row Level Security or RLS) based on RowSecurityIDs applied to every table and record in the database. Permissions are assigned by MLJ DMT staff when new projects or user logins are created in the database.

The CV RDC database is hosted on the MLML server, along with the MLML RDC; both databases are maintained as separate environments by the respective data management staff and do not share data or permissions. MLML staff cannot assign permissions to data within the CV RDC and cannot access CV RDC data unless permissions are assigned to them for specific results by MLJ DMT staff as needed for various projects (e.g. Delta RMP data review).

II. PROJECT DEFINITION

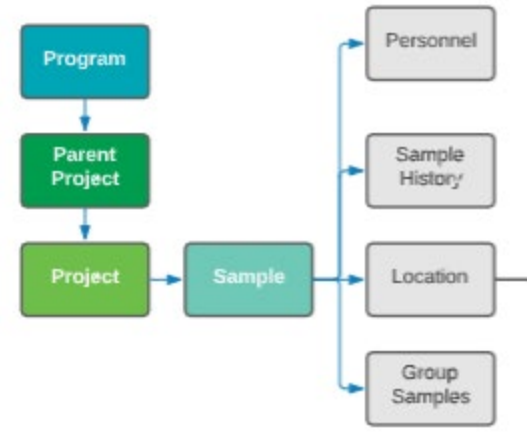
Certain elements of a monitoring project must be defined in the CV RDC Database before any results can be loaded or stored. High-level information associated with the project (Program Code, Parent Project Code, Project Code) and the sampling locations (Station Code, Target Latitude, Longitude, and datum) are required to be associated with any monitoring data in the CV RDC Database. Likewise, if elements of the monitoring program are managed by MLJ staff in the MIS Database, the same high-level project information stored in the CV RDC Database must also be within the MIS. Project definition information are stored in a comparable format between the MIS and the CV RDC such that data can easily be moved and queried between the two systems.

Data that are only being loaded directly to the CV RDC do not need to be defined in the MIS; however, at a minimum, the following fields must be populated in at least the CV RDC Database prior to loading any field or laboratory results.

- *Program Code.* The Program Code is the top tier of project definition information that can capture the requirements for initiating the project in the broadest sense, such as the regulatory program under which the project is required (e.g., Irrigated Lands Regulatory Program/ILRP).
- *Parent Project Code.* The Parent Project Code is the second tier of project definition information, further identifying the specific projects that operate within the defined program (e.g., specific coalitions under the ILRP, such as ILRP East San Joaquin Water Quality Coalition). For long term monitoring programs, the Parent Project Code should remain static as long as the monitoring is being conducted.
- *Project Code:* The Project Code associates surface water results with a higher-level Parent Project and Program Code. Project Codes can be used at the discretion of the Project Manager to logically combine samples in spatial or temporal groupings to meet programmatic needs. The Project Code also connects the station information and associated sampling results to the original workplan and monitoring schedules. When creating a Project Code, it is important to keep in mind that all data for a specific project code will be transferred at one time; therefore, Project Codes for long term projects often capture a specific time period that will be transferred in a single effort, such a quarter or a year.
- *Station Code*: The Station Code must be unique and reflects the station name; station codes can be no more than 25 characters. Whenever possible, station codes associated with data managed by the MLJ DMT should start with the 3-digit hydrologic unit code followed by six characters representing the station location e.g., 541MER520; this format is consistent with SWAMP station code formatting.
- *Target Latitude and Longitude*: Target latitude and longitude is used to positively identify the Station Code location during sampling and reporting.

The hierarchical groupings of Program, Parent Project, and Project Codes are outlined in **Figure 2**. This hierarchy allows managers the ability to group Project Codes into logical temporal time frames like water (WY) or calendar year focused on time frames for loading data to CEDEN.

Figure 2. Relationship of Program, Parent Project, and Project Codes to Sample Table in CV RDC Database.



Project data submitted to the CV RDC must meet minimum reporting requirements for the data to be made public via CEDEN when applicable; not all data submitted to the CV RDC are transferred to CEDEN based on client needs. These specific requirements are described in the CV RDC Entry Manuals on the MLJ Environmental website.

III. MANAGEMENT INFORMATION SYSTEM (MIS)

The MIS Database is an internal data management tool to help facilitate reporting of monitoring requirements for various projects managed by MLJ staff. Depending on the needs of each individual project, elements of the MIS may or may not need to be populated. The sections below describe the general design elements and their intended use. The overall design of the database is purposefully flexible to allow the data management in the MIS to be tailored to specific client and/or project needs.

A. MONITORING SCHEDULE

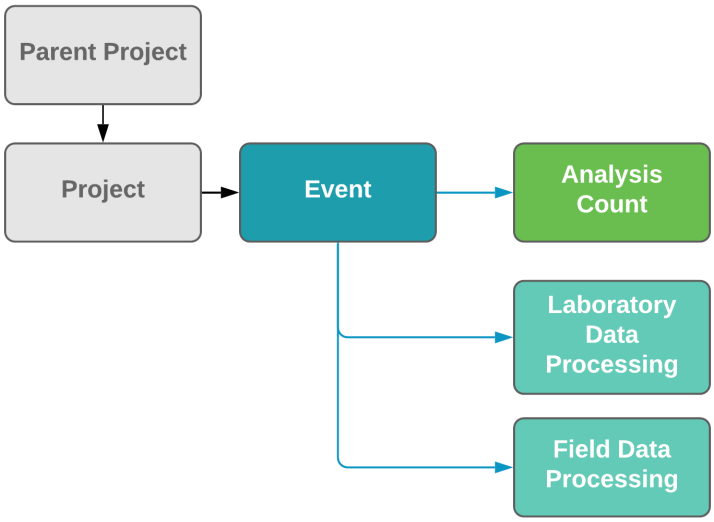
The monitoring schedule tables within the MIS Database are comprised of data necessary for developing monitoring schedules including where samples will be collected and what analytes will be measured. This monitoring schedule tables are used for the organization, planning, tracking and management of sample collection and analysis completion for each individual project.

Monitoring schedules are stored on two different levels: the sample event level and the individual analysis level (**Figure 3**).

Sample event data are associated with the Project Code defined in the MIS and the CV RDC. Each event is assigned an anticipated sampling date. Depending on the needs of the project, events can be assigned season codes and/or Event IDs which help categorize or qualify the sampling events as needed. Season codes are maintained in the MIS and are created based on project specifications (e.g., “Storm” event code for events triggered by rainfall in the area).

Individual samples are defined on the Analysis Count table and must be assigned to a sampling event. The locations (station codes) and constituents to be monitored for each sampling event are defined on this table. Sample replicates and additional quality control samples requiring additional volume are defined as individual records. Station Codes and constituents (defined by the analyte name, analytical method, matrix, fraction, and reporting units) must be comparable to lookup lists in the CV RDC. Monitoring scheduling information is captured on the individual sample level using the Monitoring Type Code on the Analysis Count table. Monitoring type codes describe how individual samples meet the requirements of the individual monitoring program requirements (e.g., an ILRP Management Plan Monitoring constituent would be coded “MPM”).

Figure 3. Relationship of monitoring schedule tables in the MIS Database.



B. POPULATING THE MONITORING SCHEDULE IN THE MIS

1. Load Monitoring Schedule into the MIS Database

Data management staff work with the Project Manager to finalize and upload a complete monitoring schedule for each project. Monitoring schedules are exported directly from the MIS and can be used as part of regulatory compliance; any changes to the schedule must be updated within the database to allow for correct assessment of completion, cost estimates, and creation of field sheets and chain of custody forms.

The monitoring schedule tables (**Table 1**) include specific details necessary to achieve each project's specific data management and data usability goals; at a minimum this must include:

- Project information; comparable with the CV RDC
- Expected sample dates
- Sample event information
- Sample stations/locations; comparable with the CV RDC
- Sample type codes; comparable with the CV RDC
- Analysis information, including analyte, analytical method, matrix, fraction, and reporting units; comparable with the CV RDC
- Monitoring requirement type codes
- Sample qualifier codes

The monitoring schedule is then formatted for uploading and imported into the MIS for the tracking and reporting of completeness as monitoring occurs; this process is outlined in the SOP for Monitoring Schedule Updates and Loading into the MIS. All project, site location, and analytical

information associated with results that will be stored in the CV RDC will be maintained as comparable to the CV RDC lookup lists and codes. This ensures that data stored in the MIS Database can be linked to analytical results in the CV RDC allowing for completeness assessment and status updates during the data receipt, review and loading process.

Table 1. Monitoring schedule tables in the MIS Database.

Only the primary columns used by most projects are defined below. Ancillary fields are not included in this table; these fields can be used to manage data or further qualify project requirements where necessary.

TABLE NAME	FIELD NAME	FIELD DESCRIPTION	CV RDC COMPARABLE
Event	ParentProjectCode	High-level project definition code.	Yes
	ProjectCode	Project definition code, often specific to a designated time period in which sample collection occurs.	Yes
	ScheduledSampleDate	Anticipated date on which the sampling event will occur.	--
	SampleDate_Beginning	Actual date on which sampling began.	--
	SampleDate_End	Actual date on which sampling ended; this is the same as the beginning date if the sampling event was completed in one day.	--
	Season	Description of sampling periods, variable by to project.	--
Analysis Count	StationCode	Station at which sample is collected.	Yes
	SampleTypeCode	Code describing the type of sample to be collected (e.g., Grab, FieldBlank, etc.)	Yes
	Replicate	Sample replicate number.	Yes
	Constituent ID	Unique identifier that defines the specific constituent being sampled by analyte (or organism) name, matrix, method, fraction, and reporting units.	No[1]
	SampleCount	Number of samples associated with each record.	--
	MonitoringType	Code describing the monitoring requirements for the specific sample.	--
	SampleQualifierCode	Code describing if and by whom the sample is intended to be collected.	--
	SampleFailureCode	Code describing the reason why a sample was not collected or analyzed by the laboratory.	No
	SampleComplete	True/false field indicating whether a scheduled sample was collected; to be completed by staff during **Sample Collection Verification** outlined below.	--
	AnalysisComplete	True/false field indicating whether results were received for a collected sample; to be completed by staff during Verify **Sample Analysis** steps outlined below.	--

[1]Constituent IDs are managed separately by MLJ in both the MIS and the CV RDC. Constituent IDs in the MIS do not always directly compare to the CV RDC; however, each of the individual elements of a constituent code (analyte, matrix, method, fraction, and units) must be comparable to the CV RDC.

2. Monitoring Schedule Verification

Once the final monitoring schedule is imported into the MIS Database, the monitoring schedule is then exported and verified by the DMT, Project QA Officer, and Project Manager prior to being submitted for finalization and/or approval by a regulatory entity. This review, at a minimum, includes specific sample requirements (e.g., ensuring all dissolved metals samples are associated

with an analysis for hardness at the same site), database business rules (e.g., the correct application of data codes), and CV RDC data comparability (e.g., lookup lists). Project Managers are responsible for reviewing exported monitoring schedules for accuracy and project requirements. The Project QA Officer is responsible for reviewing this schedule to ensure all QAPP requirements (e.g., quality control sample frequency) are met. Any errors or changes found in the export are made in the database and the schedule is re-exported.

3. Analysis Count Reports for Laboratories

Finalized sample schedules are exported as reports and sent to the appropriate analytical laboratories. Laboratories can use the schedule to determine which analyses will be requested for how many samples prior to each sampling event. The Field Sampling Coordinator or Project Manager is responsible for providing these reports to laboratories when monitoring schedules are finalized in addition to coordinating with laboratory staff regarding updates to the monitoring schedule and sample bottle shipments prior to events.

C. POST-SAMPLING UPDATES TO MONITORING SCHEDULE

1. Tracking of Samples Collected

Once the sampling events scheduled in the database have occurred, MLJ staff update the MIS with specific information regarding what samples were collected during the event; this information is then compared to what was expected. These steps are discussed in the **Sample Collection Verification** section below.

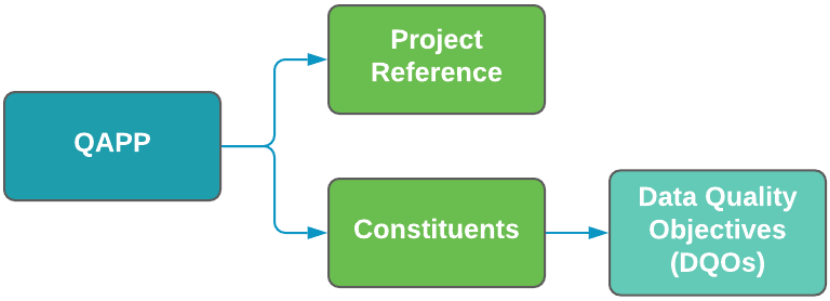
2. Informing Laboratories of Sample Details

For each event in which samples are submitted to a laboratory for analysis, specific reports (Laboratory Sample Details) are exported and sent to the analytical laboratories. These Laboratory Sample Details files provide the laboratories with the data that are required for generating CV RDC/CEDEN comparable electronic data deliverables (EDDs). The Laboratory Sample Details export process is outlined below in the **Laboratory Sample Details** section.

IV. ELECTRONIC QAPP (EQAPP) DATABASE

The electronic QAPP (eQAPP) is a relational database that stores quality assurance requirements and data quality objectives (DQOs) for each project and analyte, as defined by the project's QAPP, as shown in **Figure 4**. The eQAPP Database is the internal repository for all up-to-date quality assurance requirements for projects in which data are managed by MLJ staff. The eQAPP Database is updated when amendments to QAPPs are approved. Data exported from the eQAPP Database can be used to ensure document submittals match the most up to date quality assurance requirements stored in the database. The Project QA Officer is responsible for ensuring the eQAPP Database reflects current quality assurance requirements of each project.

Figure 4. Relationship of eQAPP tables in the MIS Database.



The MLJ DMT uses the data stored in the eQAPP Database to process EDDs received from laboratories and verify that the data reported in the EDDs meet the project requirements and associated measurement quality objects (MQOs). The eQAPP compiles quality assurance requirements in a format comparable to the CV RDC to ensure efficiency and accuracy when processing laboratory EDDs. A description of the specific fields which can be populated in the eQAPP Database are outlined in **Table 2**. Though specific requirements may vary by project, the eQAPP should include the following information to assess laboratory results:

- Original QAPP document reference and submittal information;
- Constituent information such as analyte name, matrix, method, fraction and unit, comparable with CV RDC/CEDEN;
- Preparation and digest extract methods, comparable with CV RDC/CEDEN;
- Expected MDL and RL values (not accounting for adjustments made when dilutions are performed);
- Required measurement quality objects (e.g., LCS percent recovery control limits);
- Batch completeness requirements.

Each of these elements must be defined in the database and verified by the Project QA Officer prior to the MLJ DMT processing any EDDs received for a project. Data are uploaded to and managed in the eQAPP according to the SOP, Procedures for eQAPP SQL Data Management.

Table 2. eQAPP tables in the MIS Database.

Only the primary columns used by most projects are defined below. Ancillary fields are not included in this table; these fields can be used to manage data or further qualify project requirements where necessary.

Table Name	Field Name	Field Description	CV RDC Comparable
QAPP	QAPPCode	A code representing the QAPP under which monitoring is being conducted.	--
	QAPPName	Title of the QAPP.	--
	QAPPDescription	Narrative description of the project defined by the QAPP.	--
	QAPPStartDate	Project start date.	--
	QAPPEndDate	Project end date.	--
Project Reference	ParentProjectCode	Parent Project Code associated with data generated under the QAPP.	Yes
Constituent	Laboratory	Laboratory contracted to analyze the constituent.	No
	Constituent ID	Unique identifier that defines the specific constituent being sampled by analyte (or organism) name, matrix, method, fraction, and reporting units.	No[1]
	PrepPreservationName	Preservative or sample preparation associated with the constituent (if applicable).	Yes
	DigestExtractMethod	Digestion or extraction methods used by the laboratory (if applicable).	Yes
	MDL	Constituent detection limit.	Yes
	RL	Constituent reporting limit.	Yes
	ConstituentStatus	Indicates whether the consituent definition is active or inactive	--
	Constituent AmendmentCode	Indicates the version of the QAPP in which the constituent information was approved.	--
	Constituent StartDate	Date on which the constituent information was approved.	--
	Constituent EndDate	Date on which the constituent information was removed from the QAPP or replace by more accurate information.	--
DQOs	DQOParameter	Specific data parameter being evaluated, e.g., field duplicate RPD, matrix spike percent recovery.	--
	DQOType	Reference to the specific data quality element being assessed (e.g., "PR" for percent recovery, "RefTox" for toxicity accuracy evaluation).	--
	DQOCriterion	Assessment criteria (e.g., less than a specific value)	--
	DQOValue	The specific value or threshold used for the assessment (e.g., a maximum RPD threshold of 25)	--
	DQOCriterion Second	Any secondary criteria that should also be considered when evaluating against the primary.	--
	DQOStatus	Indicates whether the specific objective is active or inactive.	--
	DQO AmendmentCode	Indicates the version of the QAPP in which the objective was approved.	--

[1]Constituent IDs are managed separately by MLJ in both the MIS and the CV RDC. Constituent IDs in the MIS do not always directly compare to the CV RDC; however, each of the individual elements of a constituent code (analyte, matrix, method, fraction, and units) must be comparable to the CV RDC.

V. PRE- AND POST-SAMPLING DATA MANAGEMENT

For projects in which MLJ is responsible for collecting samples and submitting them to laboratories, the monitoring schedule defined in the MIS Database is used to generate sampling materials and track the status of the samples required to be monitored. The following steps can be completed for projects for which MLJ staff are responsible for all components of the monitoring completion. Each step may or may not be necessary for all projects, depending on the level of participation of MLJ staff in the sample collection process and/or specific client needs.

A. SAMPLE PREPARATION FOR MLJ MANAGED PROJECTS

The MIS can be used to prepare field sheets, sample labels and COCs. This step occurs for projects with a sampling component managed by MLJ and is not required for other projects. MLJ Sampling Staff use the MIS to prepare for an upcoming sample collection event to confirm bottle counts and additional checks of sampling materials against the MIS sampling schedule information.

1. Bottle Counts

Prior to a sampling event, MLJ field crews assess the amount of sample containers required for the event. Bottle count reports are exported using sample collection requirements stored in the MIS Database. Counts of the required containers are used to submit bottle requests to laboratories and/or order containers directly from suppliers ahead of a sampling event to ensure the required sampling materials are in house prior to the event. Bottle count reports are also used to pack coolers and allocate materials to sampling teams in preparation for sampling events. The Field Sampling Coordinator is responsible for ensuring timely requests for sample bottles from laboratories and ensuring that all supplies are obtained prior to sampling.

2. Field Sheets, Sample Labels, and COCs

Field sheets and sample bottle labels are exported directly from the database using reports designed to pull formatted information from the MIS Database. Field sheets and labels are populated with as much information as possible prior to the event to streamline tasks in the field as well as avoid erroneous sample records or analysis requests. Chain of Custody forms, which must accompany all samples once they are collected, are generated in Excel using information from the MIS sampling schedule to ensure minimal manual updates to sample event information.

Sample collection contingency plans are also generated to account for in-field changes to the sampling schedule (such as sites that may not be able to be sampled) given future monitoring events and annual analyte counts. The Field Sampling Coordinator is responsible for ensuring all sample materials are verified against the original sample schedule in the MIS Database prior to the field sampling event.

B. SAMPLE EFFORT

Samples should be collected according to the sampling SOPs included in the associated project's QAPP to ensure the collection of field data are performed in a scientifically sound and repeatable manner. Many pre- and post-sampling details not directly replate to data management are detailed in the associate Sampling SOP and are not discussed in this document.

C. POST SAMPLING PROCESSES

1. Electronic Filing of Field Documentation

For projects managed by MLJ, field sheets, COCs, and sampling photos are stored electronically on a secure server which is backed up nightly. All hard copies are physically filed where they can be accessed by MLJ staff and the Project QA Officer if needed. Electronic documents must be retained for a minimum of 10 years.

2. Sampling Summary Report

For all projects in which monitoring was completed by MLJ field crews, a Sampling Summary Report is typed up after each sampling event which includes a short narrative of all stations that were sampled, sample failures, and any remarkable or anomalous events or observations made by field crews. The summary is distributed to the Project Managers and the DMT and is used to communicate the status of the sampling event including any anomalies encountered. The Field Sampling Coordinator is responsible for ensuring the Sample Summary Reports are complete and are distributed to appropriate staff.

3. Sample Collection Verification

Sample collection information is verified against the MIS schedule for each sampling event. After each sampling event, the MIS Database is updated to reflect which samples were collected based on the completed field sheets and COCs. At a minimum, the following items should be verified or updated once sampling is complete:

- **Sample Date**. The MIS Database is populated with expected sample dates when the initial monitoring schedule is loaded. These dates need to be verified or updated to the day or range of days on which the sampling event occurred.
- **Sample Complete**. Each sample that was scheduled should be marked as true/false for sample completed. All samples and analytes planned to be collected must be accounted for in the monitoring schedule in the MIS Database (**Table 1**). If a scheduled sample was not collected, the record in the database should be flagged with the correct failure code to qualify why the sample is missing. The acceptable failure codes currently listed in the database are provided in **Table 3**.

Table 3. Acceptable sample failure codes to be used in the MIS database.

Where possible, failure codes are similar to those defined in CEDEN; however, not all failure codes stored in the MIS Database are CEDEN comparable, some have been added for internal tracking.

SAMPLE FAILURE CODE	SAMPLE FAILURE	DESCRIPTION
BRK	Sample bottle broken	Sample bottle broken.
CMIS	Collection Missed	Sample failed to be collected due to oversite on COC/fieldsheet.
DIS	Discontinued	Sample was originally scheduled to be sample but was then discontinued. No sample was collected because it was no longer required.
DRY	Dry	Dry (No water)
FLD	Flooded	Flooded
HAB	Hard Bottom	Hard Bottom (no sediment)
INF	Instrument Failure	Instrument failure
ISP	Isolated Pool	Isolated pool not connected to moving water source, no flow.
LMIS	Laboratory Missed. Did Not Analyze	Sample was not analyzed by the lab due to lab error.
None	None	No failure, sample was collected.
TEMPLAB	Sample stored at improper temperature by Lab.	Sample stored at improper temperature by Lab. Not storing or utilizing results.
TOS	Too Shallow	Too shallow to collect water samples.

4. QC Sample Verification and Assessment

If there is a situation where a site is scheduled for QC sample collection and the samples could not be collected, the QC samples will need to be collected at a different site. The determination of the back-up site at which the QC samples are collected is usually made in the field based on sample collection contingency plans established prior to sampling. Wherever this occurs, the sample schedule in the MIS must be updated after the sampling event to include the field QC samples that were actually collected. In addition, field QC sample frequency requirements must be reassessed after every sampling event to ensure any changes in the field do not reduce the total amount of QC samples required for the project. The QC frequency percentages are recalculated following each event to ensure the minimum requirements for each analyte are still met. Any field QC that could not be collected during the event must be rescheduled for future events to ensure that QC frequency requirements are met. The Field Sampling Coordinator should notify the Project QA Officer if there are no future events in which the analyte(s) in question are scheduled and the QC frequency requirements required by the QAPP will not be met.

D. EXPECTED SAMPLE RESULTS TRACKING

The sample tracking component of the MIS Database is used to ensure that requirements are met for each sample from the beginning of the process (sample collection) to end (finalized results loaded in the CV RDC). Once a sample has been collected and verified against the monitoring schedule, a record must be created to track all future expected reporting deliverables. Reporting

deliverables will be project specific and may include preliminary laboratory results, laboratory reports, EDDs, and laboratory invoices.

Field result process and deliverables are tracked on the Field Data Processing table in the MIS Database (**Figure 3**). A record must be created on this table to track each of the steps outlined below for the **Field Data Processing** requirements. The specific fields on this table are outlined in **Table 4**.

Table 4. Field data processing steps tracked in the MIS Database.

TABLE NAME	FIELD NAME	FIELD DESCRIPTION	REFERENCE
Field Data Processing	FieldEntryCompleteDate	Date on which field data entry was completed.	**Field Data Entry**
	FieldEntryPerformedBy	Staff who completed field data entry	
	FieldVerificationCompleteDate	Date on which field data verification was completed.	**Field Result Quality Assurance**
	FieldVerificationPerformedBy	Staff who completed field data verification.	
	FieldEntryVerificationComments	Details regarding field data verification.	
	SampleDetailsSentDate	Date on which the sample details file was sent to the laboratory.	**Laboratory Sample Details**
	SampleDetailsSentBy	Staff who sent the sample details file to the laboratory.	
	SampleDetailComments	Details regarding sample details communications with laboratories.	
	FieldExceedanceReportRequired	Indication of additional project action requirements triggered by the field results.	--

In the Laboratory Data Processing table (**Figure 3**), a separate record needs to be created for each laboratory and report type combination that is expected to be received given what was collected and submitted for analysis. These records will be used for tracking expected reports from laboratories and paying laboratory invoices once all deliverables have been received, as outlined in **Table 5**.

The sample completion counts and expected report records are used by MLJ DMT staff in charge of receiving laboratory results to track timely receipt of deliverables from laboratories and to verify the completeness of the results received. Accurate sample counts are crucial to the analytical data verification steps outlined below (see **Laboratory Data Processing**). Sample collection verification activities are overseen by the Project QA Officer.

Table 5. Laboratory data processing steps tracked in the MIS Database.

TABLE NAME	FIELD NAME	FIELD DESCRIPTION	REFERENCE
Laboratory Data Processing	Laboratory	Analyzing laboratory form which a report is expected.	--
	ReportType	Description of expected report.	--
	ReportNumber	Report identifier provided by the laboratory.	--
	PrelimLabReportReceivedDate	Date on which preliminary results were received by the laboratory.	**Receipt and Filing of Laboratory Results**
	LabReportReceivedDate	Date on which the PDF report was received by the laboratory.	
	EDDReceivedDate	Date on which electronic data were received by the laboratory.	
	LabReportEDDReceivedComments	Details regarding the receipt of laboratory deliverables.	
	LabReportReviewedDate	Date on which the PDF report was reviewed by MLJ staff.	**Initial Laboratory PDF Review**
	LabReportReviewedBy	Staff who completed the report review.	
	LabReportReviewComments	Details regarding the review of the report.	
	LabExceedanceReportRequired	Indication of additional project action requirements triggered by the results.	
	EDDReviewedDate	Date on which the electronic data were reviewed by MLJ DMT.	**Processing of Chemistry EDDs, Processing of Toxicity EDDs, Processing of Tissue EDDs**
	EDDReviewedBy	Staff who completed the electronic data review.	
	EDDDoubleCheck	Staff who verified the electronic data processing.	**Loading Laboratory Results into CV RDC Database**
	EDDReadyToLoad	A true/false field indicating if an EDD is in the queue for loading to the CV RDC.	
	EDDLoadedDate	Date on which a processed EDD was loaded to the CV RDC.	
	EDDLoadedBy	Staff who loaded the data to the CV RDC.	
	EDDComments	Details regarding the processing and loading of the EDD.	
	InvoiceNumber	Identifier of the invoice for the analyses completed and data received.	--
	InvoiceDate	Date on which the invoice was received.	
	InvoiceComments	Details regarding the invoicing process.	

VI. FIELD DATA PROCESSING

A. FIELD DATA ENTRY

Field data must be entered into the CV RDC database after each sampling event is complete using information recorded on the field sheets. There are two options for field data entry into the CV RDC: 1) direct field data entry using the Environmental Data Entry and Reporting System (eDERS) hosted by MLML, or 2) upload of field results using the CEDEN Field Template.

1. Option 1 – Field Data Entry via eDERS

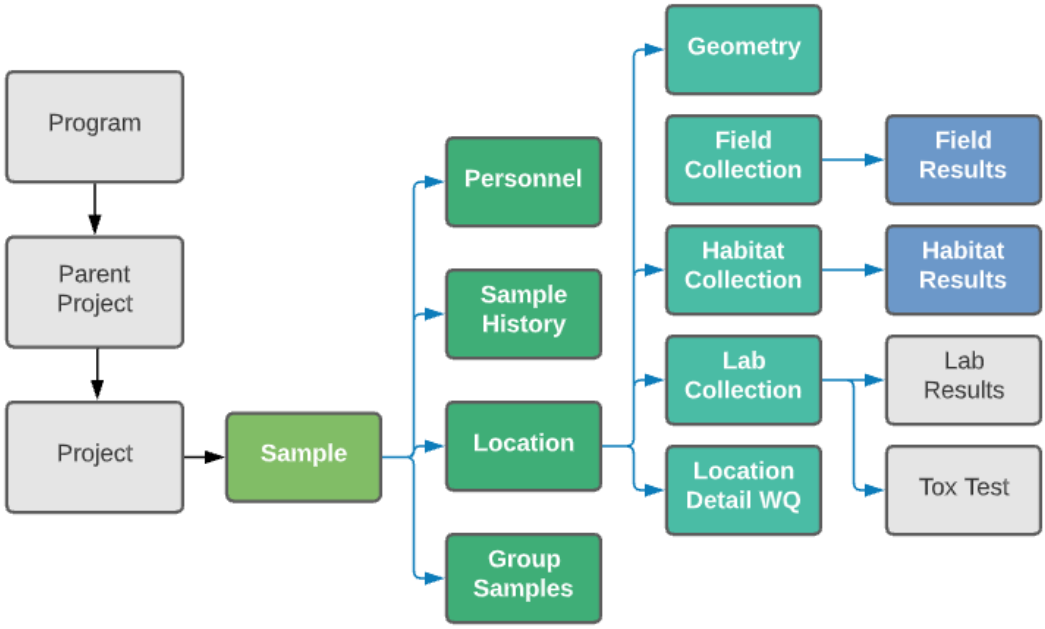
Data are entered directly into the CV RDC using the eDERS online webforms. Field data are entered according to the Field Data Entry SOP. The eDERS field data entry forms were developed based on SWAMP field sheets and include drop down lists from the valid lookup list tables to ensure CEDEN comparability.

2. Option 2 – Field Data Entry via CEDEN Field Template

If data are formatted in the Field Template, then MLJ DMT staff can load them directly into the CV RDC as a single file, rather than entering results by hand. Field EDDs are processed according to the detailed checklist provided in **Attachment A**. Data are loaded using a series of queries to add the results to the CV RDC relational database design. Automated checks are performed on the data during the loading process to ensure that results are unique, assigned to the correct project and site information, formatted correctly, contain the correct valid values, and that all required fields are populated. Result table counts are tracked prior to loading and compared to counts after loading to ensure all intended results were uploaded. After the Field Template is loaded, specific verification steps are performed to ensure the correct results have been added into the CV RDC database.

The conceptual relational table design in the CV RDC storing field data is shown in **Figure 5;** the CV RDC design matches the design in CEDEN to ensure comparability and ability to transfer data directly to CEDEN.

Figure 5. Sample through Field and Habitat Result tables the CV RDC Database.



The field data that are usually entered into the CV RDC by MLJ staff are listed in **Table 6**. Fields listed as "required" in **Table 6** must be entered into the database for each sample collected.

Table 6. Field and habitat result tables in the CV RDC.

Only primary fields are included; ancillary fields for each table referenced are not included but can be found in CV RDC documentation available online. All columns described below are preferred to be populated to best describe the project data; however, not all columns are required (are nullable) in the CV RDC database. Fields required to be populated are indicated with a "Yes" in the CV RDC Required column. In some cases, default values may be added by MLJ staff when information is not available from the data submitter.

TABLE NAME	FIELD NAME	FIELD DESCRIPTION	CV RDC REQUIRED
Sample	EventCode	Represents the primary reason for the sampling event at a particular station and date, e.g., water quality, tissue or bioassessment.	Yes
	ProjectCode	References the project that originated the sample.	Yes
	StationCode	A 9-digit assigned code that uniquely identifies the monitoring location within the CV RDC database.	Yes
	SampleDate	The date the sample was collected in the field, expressed as dd/mmm/yyyy.	Yes
	AgencyCode	The acronym for the agency that collected/created the sample.	Yes
	ProtocolCode	A code representing the sampling protocols and methods used during the sampling event.	Yes

TABLE NAME	FIELD NAME	FIELD DESCRIPTION	CV RDC REQUIRED
	SampleComments	The comments field should be used for any notes or comments specifically related to the sample collection.	
Sample History	SamplePurposeCode	A code representing the reason samples were collected from a specific station on a specific date to collect (e.g., habitat, water chemistry).	Yes
	PurposeFailureName	A code used to identify if there were any issues with collecting any of the intended samples/information at a site, (e.g., dry site).	Yes
Personnel	PersonnelCode	A code representing the personnel collecting the sample.	Yes
Group Sample	Group Code	Allows programs to group samples together to meet individual program needs, such as by Season.	Yes
Geometry	Latitude	Latitude from which sample was taken in decimal degrees with 5 decimal places.	Yes
	Longitude	Longitude from which sample was taken in decimal degrees with 5 decimal places.	Yes
	GPSDevice	A code identifying the GPS device used to collect the GPS measurements.	Yes
	Datum	The Datum field records the datum that was used on the GPSDevice to record the GPS measurements.	
	GPSAccuracy	The accuracy of the GPS device used to collect the GPS measurements.	
Location Detail	OccupationMethod	Method of station occupation for sample collection (e.g. "Walk In", "From Bridge", or report research vessel name).	
	Starting Bank	Bank where distances are measured from; left or right bank (when looking downstream).	
	Stream Width	Stream Width at the station where sample was taken.	
	Unit Stream Width	Units in which the stream width is measured.	
	Station Water Depth	The average of the water depth measurements when taking discharge.	
	Unit Station Water Depth	Unit in which Station Water Depth was measured.	

TABLE NAME	FIELD NAME	FIELD DESCRIPTION	CV RDC REQUIRED
	Hydromodification	Any hydromodification at sample site (e.g., Bridge, ConcreteChannel, Pipes).	
	Hydromodification Loc	Location of hydromodification relative to sample – upstream, downstream, not applicable, or not recorded	
	Location Detail WQ Comments	The comments field should be used for any notes or comments specifically related to location details. Put additional hydromodifications here.	
Lab Collection	Collection Method	The general method of collection (e.g., "Water_Grab", "Sed_Grab", "Autosampler24h")	Yes
	Sample Type	The type of sample collected or analyzed (e.g., "Grab", "Fieldblank", "LCS")	Yes
	Collection Time	The time when the first sample was collected at that site in the field, expressed as hh:mm. (24 hour clock).	Yes
	Replicate	A number that identifies replicates created in the field.	Yes
	Collection Device	The specific device used to collect samples.	Yes
	Position in Water Column	Position in water column where sample was taken.	
	Collection Depth	The depth at which the sample was collected.	Yes
	Unit Collection Depth	The units associated with the above "CollectionDepth" value.	Yes
Habitat Collection	CollectionMethodCode	A code referring to the general method of collection. Default for habitat is "Not Applicable".	Yes
	Collection Time	The time when the first sample was collected at that site in the field, expressed as hh:mm. (24 hour clock).	Yes
Habitat Result	Constituent	A combination of the analyte, matrix, method, fraction, and unit being collected.	Yes
	Variable Result	Non numerical or qualitative result collected as field observations.	
	ResQualCode	A code that qualifies the result for the sample, if necessary. The Default value is "=" for Habitat.	Yes
	QACode	A code that describes any special conditions, situations or outliers that occurred during or prior to the observation to achieve the result.	Yes

TABLE NAME	FIELD NAME	FIELD DESCRIPTION	CV RDC REQUIRED
	Collection Device	The specific device used to collect sample.	Yes
	Habitat Result Comments	The comments field should be used for any notes or comments specifically related to the habitat result. Put additional variable results here if needed.	
Field Collection	Collection Method	Refers to the general method of collection. Default value is "Field".	Yes
	Collection Time	The time when the first sample was collected at that site in the field, expressed as hh:mm. (24 hour clock).	Yes
	Collection Depth	The depth at which the sample was collected.	Yes
	Unit Collection Depth	The units associated with the "CollectionDepth" value. The default values should be "m" (meters) for water samples or "cm" (centimeters) for sediment samples.	Yes
	Position Water Column	The position in the water column where the sample was taken.	
Field Results	Constituent	A combination of the analyte, matrix, method, fraction, and unit being collected.	Yes
	Result	The result of the field measurement.	
	ResQualCode	Qualifies the result for the sample, if necessary. The Default value is "=".	Yes
	QACode	A code that describes any special conditions, situations or outliers that occurred during or prior to the observation to achieve the result.	Yes
	Collection Device	A code that refers to the refers to the specific device used in the collection of the sample.	Yes
	Calibration Date	Date on which the field collection device was calibrated.	Yes
	Field Result Comments	The comments field should be used for any notes or comments specifically related to the field result. If any failures or issues occurred put explanation here.	

For all samples collected by MLJ sampling staff, a combination of qualitative habitat results and quantitative field measurements are taken whenever a site is visited.

The habitat observations that are usually collected by MLJ sampling staff and entered into the CV RDC include:

- Color (specific to either the sediment or water being collected),
- Composition (specific to sediment),
- Dominant substrate,

- Observed flow,
- Odor (of the overall site and the water and/or sediment)
- Other presence,
- Precipitation,
- Precipitation in the last 24 hours,
- Sky code (clear, cloudy, etc.),
- Wadeability of the waterbody,
- Water clarity,
- Wind direction,
- Wind speed.

In addition, MLJ staff take photos of site conditions when visiting a sample location; codes referencing the photo documentation taken by sampling staff are stored in the CV RDC database with habitat parameters.

Quantitative measurements are taken in the field by MLJ staff whenever site conditions allow. Field measurements are taken using multiparameter meters and flow meters according to the Sample Collection SOPs followed by sampling staff. Specific field measurements may vary according to individual project requirements; however, in most cases MLJ staff collect the following measurements that are recorded in the CV RDC during field data entry:

- Air temperature in °C,
- Discharge in cfs,
- Dissolved oxygen in mg/L,
- Specific conductivity in uS/cm,
- pH,
- Water temperature in °C

Once complete, data entry should be tracked by adding the data entry staff name (formatted as last name and first initial) and date of entry in the Field Data Processing table in the MIS Database (**Table 4**).

B. FIELD RESULT QUALITY ASSURANCE

Once field data are entered into the CV RDC database, all electronic field data should be double checked against the original field collection records. Depending on the project this may be all records.

1. Direct Data Entry Verification

For field results entered directly into the CV RDC through the eDERs portal, the final field data are exported and copied into an Excel workbook to review for accuracy using the following steps.

a) EXPORT FIELD DATA FROM EDERS

Each of the following items should be exported into a single Excel sheet for the sampling event using the queries provided:

- Sample, Personnel, Group, Purpose, Location, Geometry, and Location Detail information

- Field Results
- Habitat Results
- Lab Collection

b) Compare the Electronic Field Data to the Field Sheets

Each Excel spreadsheet is verified against the field sheets from the sampling event. Data entry QC is completed by a staff member who did not complete the data entry. The Excel files and field sheets should be reviewed for both completeness and accuracy of entry. All sample failures (such as dry sites or sites to which sampling crews could not gain access) should be noted on the field sheets and recorded in the CV RDC and MIS Databases to account for any deviations from the planned monitoring schedule.

2. Field Result Verification

Field EDDs received in the CEDEN format are verified for formatting, CV RDC business rules, completeness, and accuracy according to the steps provided in **Attachment A**.

In addition, all field parameter measurements (either entered directly into the CV RDC or loaded with a field EDD) are verified against ranges of expected values to ensure the values recorded are reasonable given the environmental conditions of ambient surface water:

- Query field parameter measurements against the upper and lower thresholds identified in the field data review checklist (**Attachment A**, Section 5.1) to determine if they are outside of the range of reasonable values expected for the measurement.
    - If a field result is outside the specified limits, verify the value against the original fieldsheet to ensure it is not the result of a transcription error.
    - Any results identified as unlikely based on the specified limits and verified with the field sheet should be discussed with the Project Manager and QA Officer to determine if the result suspect.
        - It may be the case that the result is determined to be legitimately outside of the normal range based on further site-specific information or anomalous sampling conditions. If the result is determined to be useable, no further data qualifiers are required, though a note should be added to the comment field specifying that the result is anomalous but was verified after further review.
        - Values determined to be suspect should be updated to a null value with a ResQualCode of "NR", a QA code of “FIF” for Instrument Failure, and a specific comment including the original suspect result that was removed (e.g., "Value recorded as 45mg/L, suspected instrument failure").
        - Suspect measurements that are removed from the results field will be determined according to the data rejection procedures identified in the Delta RMP Data Management Plan and/or the associated project QAPP.

Once complete, field result verification should be tracked by adding the data entry staff name (formatted as last name and first initial) and date of verification in the Field Data Processing table in the MIS Database (**Table 4**).

Once field results are entered into the database and verification is complete, MLJ staff will compare the collection information to field QC requirements outlined in the QAPP to ensure that all required QC samples were collected (see **QC Sample Verification and Assessment**). Failure to meet minimum field QC sample requirements during a sampling event must be reported to the Project QA Officer and Project Manager.

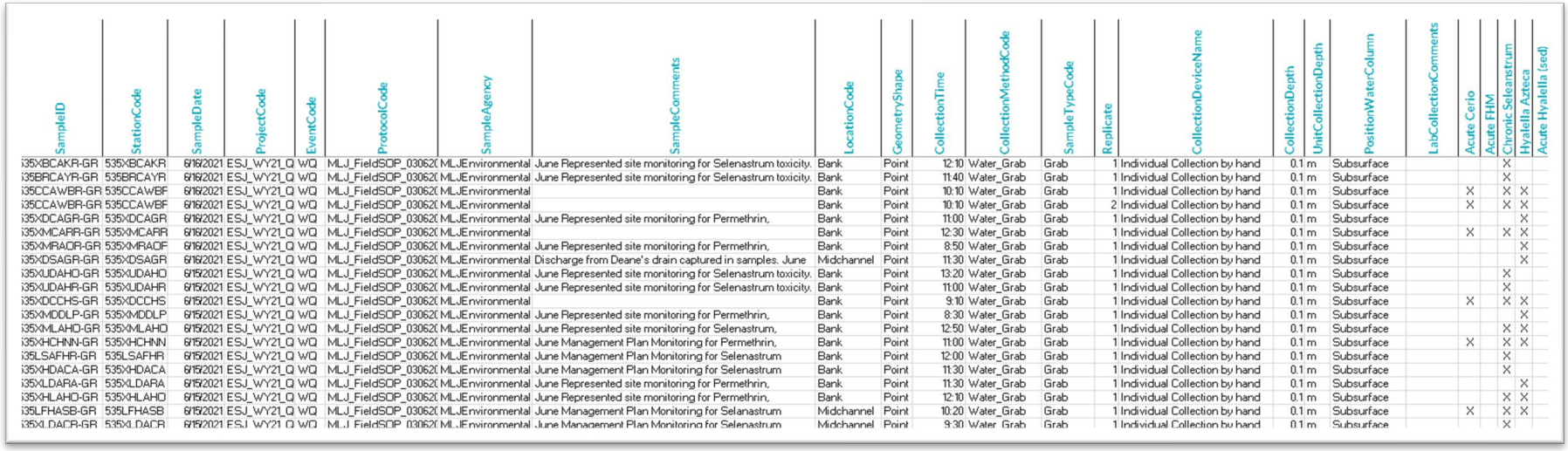
C. LABORATORY SAMPLE DETAILS

Once field data are entered into the CV RDC, the laboratory sample detail information is exported and submitted to the laboratories in an Excel file referred to as Sample Details. The laboratories use the Sample Details file to populate the sample collection information required in the CEDEN comparable EDD. The Sample Details includes the CEDEN analyte names of the constituents associated with samples submitted for analysis. Sample Details should be sent to the laboratory as soon as possible after the event is completed and field data are verified. The following information should be queried from the CV RDC to create Sample Details for each sampling event:

- Sample ID (generally a combination of the Station Code and the sample type information)
- Station Code
- Sample Date
- Project Code
- Event Code
- Protocol Code
- Agency Code
- Sample Comments
- Location Code
- Geometry Shape
- Collection Time
- Collection Method Code
- Sample Type Code
- Replicate
- Collection Device Name
- Collection Depth
- Unit Collection Depth
- Position Water Column
- Lab Collection Comments

Once submitted to the laboratory, the sample details should be tracked by adding the staff name (formatted as last name and first initial) and date on which the file was sent in the Field Data Processing table in the MIS Database (**Table 4**). An example of a final laboratory Sample Details report is shown in **Figure 6**.

Figure 6. Example sample details sent to a laboratory to assist in completing and formatting EDDs.



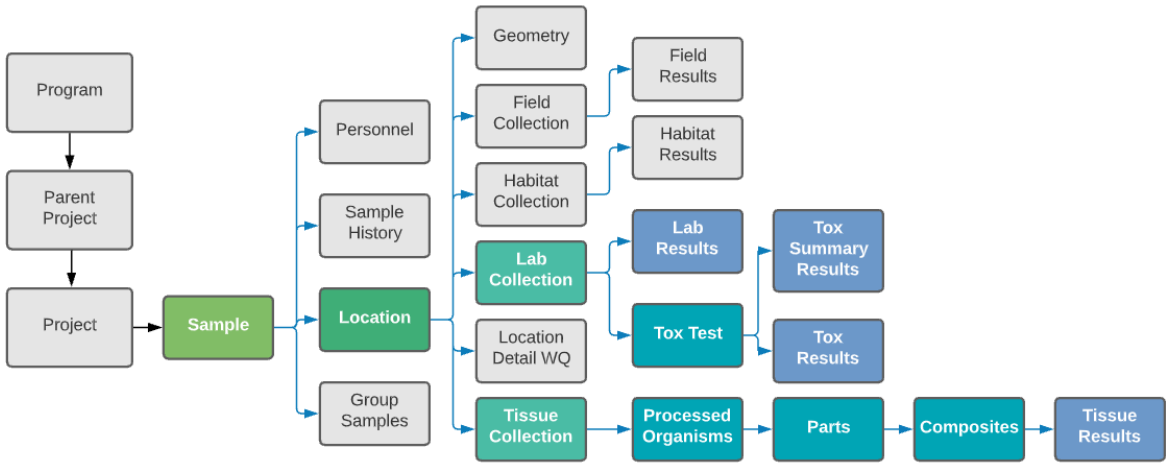
SampleID	StationCode	SampleDate	ProjectCode	EventCode	ProtocolCode	SampleAgency	SampleComments	LocationCode	GeometryShape	CollectionTime	CollectionMethodCode	SampleTypeCode	Replicate	CollectionDeviceName	CollectionDepth	UnitCollectionDepth	PositionWaterColumn	LabCollectionComments	Acute Cerio	Acute FHM	Chronic Selenastrum	Hyalella Azteca	Acute Hyalella (sed)
535XBCAKR-GR	535XBCAKR	6/16/2021	ESJ_WY21_Q	WQ	MLJ_FieldSOP_03062(	MLJEnvironmental	June Represented site monitoring for Selenastrum toxicity.	Bank	Point	12:10	Water_Grab	Grab	1	Individual Collection by hand	0.1	m	Subsurface				X		
535BRCAYR-GR	535BRCAYR	6/16/2021	ESJ_WY21_Q	WQ	MLJ_FieldSOP_03062(	MLJEnvironmental	June Represented site monitoring for Selenastrum toxicity.	Bank	Point	11:40	Water_Grab	Grab	1	Individual Collection by hand	0.1	m	Subsurface				X		
535CCAWBR-GR	535CCAWBF	6/16/2021	ESJ_WY21_Q	WQ	MLJ_FieldSOP_03062(	MLJEnvironmental		Bank	Point	10:10	Water_Grab	Grab	1	Individual Collection by hand	0.1	m	Subsurface		X		X	X	
535CCAWBR-GR	535CCAWBF	6/16/2021	ESJ_WY21_Q	WQ	MLJ_FieldSOP_03062(	MLJEnvironmental		Bank	Point	10:10	Water_Grab	Grab	2	Individual Collection by hand	0.1	m	Subsurface		X		X	X	
535XDCAGR-GR	535XDCAGR	6/16/2021	ESJ_WY21_Q	WQ	MLJ_FieldSOP_03062(	MLJEnvironmental	June Represented site monitoring for Permethrin,	Bank	Point	11:00	Water_Grab	Grab	1	Individual Collection by hand	0.1	m	Subsurface						X
535XMCARR-GR	535XMCARR	6/16/2021	ESJ_WY21_Q	WQ	MLJ_FieldSOP_03062(	MLJEnvironmental		Bank	Point	12:30	Water_Grab	Grab	1	Individual Collection by hand	0.1	m	Subsurface		X		X	X	
535XMRAOR-GR	535XMRAOF	6/16/2021	ESJ_WY21_Q	WQ	MLJ_FieldSOP_03062(	MLJEnvironmental	June Represented site monitoring for Permethrin,	Bank	Point	8:50	Water_Grab	Grab	1	Individual Collection by hand	0.1	m	Subsurface						X
535XDSAGR-GR	535XDSAGR	6/16/2021	ESJ_WY21_Q	WQ	MLJ_FieldSOP_03062(	MLJEnvironmental	Discharge from Deane's drain captured in samples. June	Midchannel	Point	11:30	Water_Grab	Grab	1	Individual Collection by hand	0.1	m	Subsurface						X
535XUDAHO-GR	535XUDAHO	6/15/2021	ESJ_WY21_Q	WQ	MLJ_FieldSOP_03062(	MLJEnvironmental	June Represented site monitoring for Selenastrum toxicity.	Bank	Point	13:20	Water_Grab	Grab	1	Individual Collection by hand	0.1	m	Subsurface				X		
535XUDAHR-GR	535XUDAHR	6/15/2021	ESJ_WY21_Q	WQ	MLJ_FieldSOP_03062(	MLJEnvironmental	June Represented site monitoring for Selenastrum toxicity.	Bank	Point	11:00	Water_Grab	Grab	1	Individual Collection by hand	0.1	m	Subsurface				X		
535XDCCHS-GR	535XDCCHS	6/15/2021	ESJ_WY21_Q	WQ	MLJ_FieldSOP_03062(	MLJEnvironmental		Bank	Point	9:10	Water_Grab	Grab	1	Individual Collection by hand	0.1	m	Subsurface		X		X	X	
535XMDDLP-GR	535XMDDLP	6/15/2021	ESJ_WY21_Q	WQ	MLJ_FieldSOP_03062(	MLJEnvironmental	June Represented site monitoring for Permethrin,	Bank	Point	8:30	Water_Grab	Grab	1	Individual Collection by hand	0.1	m	Subsurface						X
535XMLAHO-GR	535XMLAHO	6/15/2021	ESJ_WY21_Q	WQ	MLJ_FieldSOP_03062(	MLJEnvironmental	June Represented site monitoring for Selenastrum,	Bank	Point	12:50	Water_Grab	Grab	1	Individual Collection by hand	0.1	m	Subsurface				X	X	
535XHCHNN-GR	535XHCHNN	6/15/2021	ESJ_WY21_Q	WQ	MLJ_FieldSOP_03062(	MLJEnvironmental	June Management Plan Monitoring for Permethrin,	Bank	Point	11:00	Water_Grab	Grab	1	Individual Collection by hand	0.1	m	Subsurface		X		X	X	
535LSAFHR-GR	535LSAFHR	6/15/2021	ESJ_WY21_Q	WQ	MLJ_FieldSOP_03062(	MLJEnvironmental	June Management Plan Monitoring for Selenastrum	Bank	Point	12:00	Water_Grab	Grab	1	Individual Collection by hand	0.1	m	Subsurface				X		
535XHDACA-GR	535XHDACA	6/15/2021	ESJ_WY21_Q	WQ	MLJ_FieldSOP_03062(	MLJEnvironmental	June Management Plan Monitoring for Selenastrum	Bank	Point	11:30	Water_Grab	Grab	1	Individual Collection by hand	0.1	m	Subsurface				X		
535XLDARA-GR	535XLDARA	6/15/2021	ESJ_WY21_Q	WQ	MLJ_FieldSOP_03062(	MLJEnvironmental	June Represented site monitoring for Permethrin,	Bank	Point	11:30	Water_Grab	Grab	1	Individual Collection by hand	0.1	m	Subsurface					X	
535XHLAHO-GR	535XHLAHO	6/15/2021	ESJ_WY21_Q	WQ	MLJ_FieldSOP_03062(	MLJEnvironmental	June Represented site monitoring for Permethrin,	Bank	Point	12:10	Water_Grab	Grab	1	Individual Collection by hand	0.1	m	Subsurface				X	X	
535LFHASB-GR	535LFHASB	6/15/2021	ESJ_WY21_Q	WQ	MLJ_FieldSOP_03062(	MLJEnvironmental	June Management Plan Monitoring for Selanastrum	Midchannel	Point	10:20	Water_Grab	Grab	1	Individual Collection by hand	0.1	m	Subsurface		X		X	X	
535XLDACR-GR	535XLDACR	6/15/2021	ESJ_WY21_Q	WQ	MLJ_FieldSOP_03062(	MLJEnvironmental	June Management Plan Monitoring for Selenastrum	Midchannel	Point	9:30	Water_Grab	Grab	1	Individual Collection by hand	0.1	m	Subsurface				X		

VII. LABORATORY DATA PROCESSING (STAGE 1 DATA)

A. LABORATORY DATA TABLES AND STRUCTURE

Laboratory data are submitted to the MLJ DMT using a CEDEN comparable EDD template. Data are reviewed and loaded into the CV RDC Database through data loading tools that are maintained by the MLJ DMT staff (**Figure 1**). The relational table design in which laboratory data are stored in the CV RDC Database is shown in **Figure 7**.

Figure 7. Sample through Laboratory and Toxicity Result tables within the CV RDC database.



B. MINMUM REQUIREMENTS FOR DATA FORMATTING AND SUBMISSION

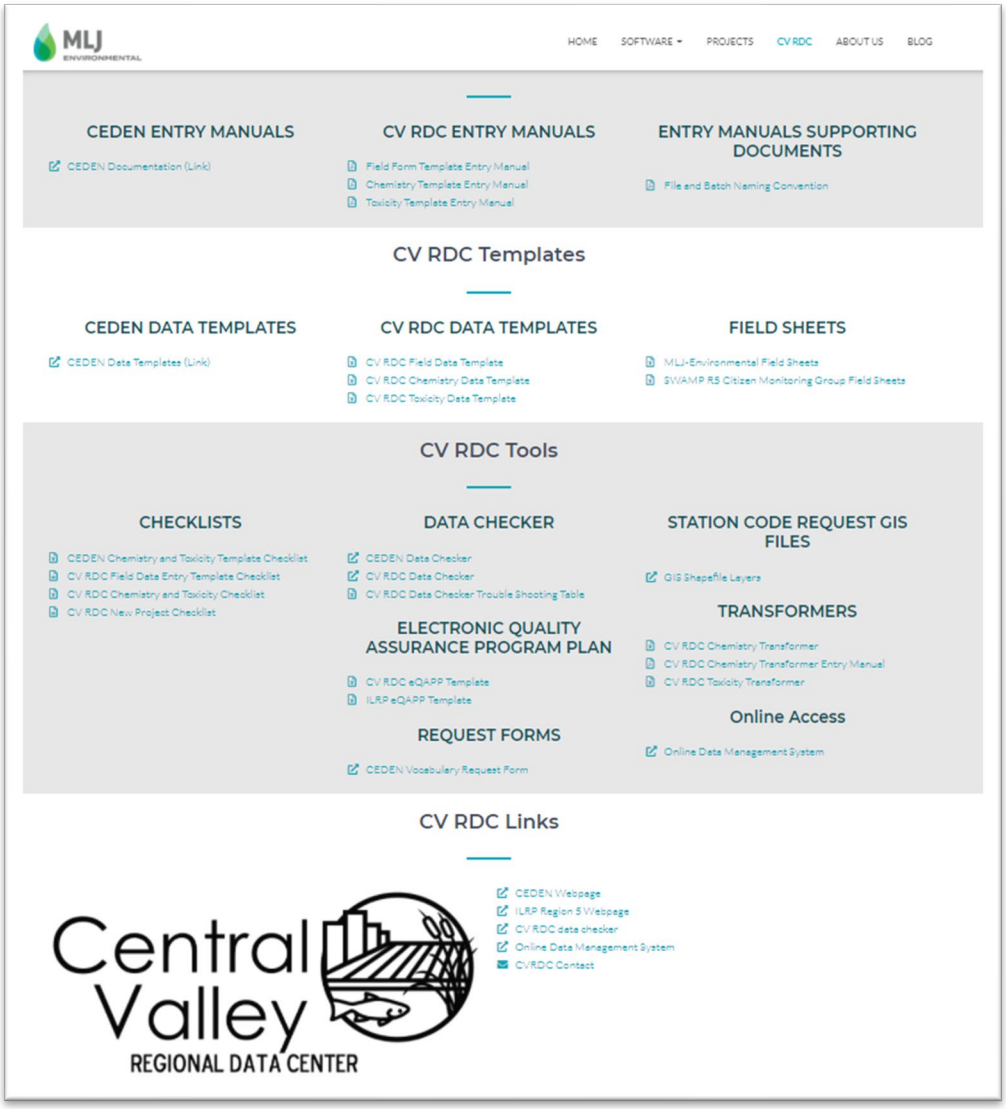
Reporting laboratories follow the CV RDC data submission steps can be found on the MLJ website. MLJ DMT staff are available to assist with questions about the processes outlined on the website. Data submission steps are as follows:

- Step 1: Review of required data elements,
- Step 2: Determine comparability and register project (see **Project Definition**),
- Step 3: Entry into appropriate templates,
- Step 4: Verification that data are correct and comparable,
- Step 5; Submission of data to CV RDC,
- Step 6: Coordination (if appropriate) whether data should be exported to CEDEN.

MLJ works in partnership with laboratories to assist with data reporting. MLJ staff generate **Laboratory Sample Details** for the laboratories to ensure the correct sample collection information is included in the EDD. MLJ ensures all necessary reporting templates and documentation are available online, including online data checkers to facilitate data submission

(**Figure 8**). These checkers allow the submitting agencies to double check the EDDs they have generated against common CV RDC/CEDEN business rules and lookup list values.

Figure 8. Online resources for data submissions available on the MLJ website.



C. RECEIPT AND FILING OF LABORATORY RESULTS

Laboratory results are typically received in two formats: a PDF report in the laboratory's standard output format and an EDD in CV RDC/CEDEN template formats. Once received, both the PDF and the original EDD are electronically filed on secure servers and marked as received by MLJ DMT staff in the Laboratory Data Processing table in the MIS Database (**Table 5**). All documents must be retained for a minimum of 10 years.

Laboratory reports and EDD files are received by email from the individual project and/or data managers for each laboratory. Results should be received according to the schedule as outlined in

individual laboratory contracts and the QAPP. Though turnaround times may vary, laboratories are generally expected to provide the PDF report within 30 days of sample submission and the EDD within 45 days; preliminary results from toxicity testing are generally expected within two weeks. Occasionally, unforeseen delays can occur for receiving laboratory information (such as re-analyses due to QC failure). When laboratory deliverables are not received within the specified timeframe, MLJ staff will follow up with laboratory staff and request an estimated date for the deliverable. Deliverables that are excessively late must be discussed with the Project QA Officer.

Laboratory deliverables must be entered in the MIS Database with a receipt date that reflects the business day on which the laboratory submitted them to MLJ. Any deliverables received before 4 PM on a business day should be recorded with that received date; any deliverables received on a weekend, holiday, or after 4 PM on a business day should be marked as received on the next business day.

D. INITIAL LABORATORY PDF REVIEW

Laboratory results are usually provided in the PDF report prior to receiving the EDDs. Results received in the PDF should be reviewed for completeness and high-level QC concerns immediately upon receiving the report from the laboratory. This initial review allows the opportunity to resolve questions or concerns with the laboratory before the results are provided in the EDD. Furthermore, for some projects, results exceeding thresholds or trigger limits are assessed and reported within a specific time frame according to their program requirements. Trigger limit assessments are completed during this review to ensure program deadlines are met.

Review of the laboratory report is only an initial review; the same checks are repeated during the more in-depth EDD review outlined below. At a minimum, the initial checks of the PDF report should include:

- **Initial sample completeness.** Ensure all analytes requested are reported.
- **Initial blank sample assessment.** Ensure there are no detections above the allowable limit in laboratory and field blanks.
- **Initial positive control sample assessment.** Check the recoveries reported for MS and LCS samples. For projects where the QAPP states that all MS samples with zero percent recovery are reanalyzed, MLJ DMT staff will ensure reanalysis did occur. Reports with multiple positive control failures should be reviewed by the Project QA Officer.
- **Case narrative review.** Any anomalous or concerning issues identified in the report case narrative should be communicated to and reviewed by the QA Officer.

Any reporting discrepancies should be communicated back to the laboratory for clarification and/or a revised report. Significant QC issues noted by MLJ DMT staff during the initial review should be further reviewed by the Project QA Officer to ensure the project requirements are met and determine whether corrective actions need to be taken by the laboratory or MLJ staff. Communications with the laboratory or the QA Officer should occur as soon as possible to ensure project timeline requirements (such as trigger limit exceedance reporting deadlines) are met.

E. PROCESSING OF CHEMISTRY EDDS

Prior to loading an EDD into the CV RDC database, each EDD is reviewed following a checklist that has been customized for the specific reporting laboratory, data type, and project (when applicable). The fundamental checklist items are described below; the detailed checklist used to process chemistry EDDs is provided in **Attachment B**.

EDD reviews require three items: the EDD, the accompanying PDF laboratory report, and eQAPP information.

1. Verify Sample Analysis

All laboratory results should be verified against the sample collection records and COCs upon receipt from the laboratory. Each record in the original monitoring schedule in the MIS that was marked as sampled should now be marked as completed for the analysis. Any missing or mis-reported analyses must be communicated back to the laboratory. Expected analyses that were not completed must be marked as incomplete and qualified with the correct Sample Failure Code on the Analysis Count table in the MIS Database (**Table 3**).

The Project QA Officer is responsible for overseeing laboratory result verification and ensuring that revised reports and data deliverables are received, as necessary. The Project QA Officer may delegate some of this work including communication with the laboratory, follow ups regarding revised report and tracking of QC anomalies.

Any re-analyses should be reviewed by the Project QA Officer for proper reporting procedures. The Project QA Officer or their delegate should communicate with the laboratory to decide which data are acceptable and ensure they are properly flagged and qualified. Only one set of results for any analysis will be loaded into the CV RDC Database (reanalysis results can be referenced in result comments).

2. Remove Extra Non-Project QC Data

Analytical batches processed in the laboratory often contain samples from multiple projects; when laboratories provide all QC results associated with a batch, they may include matrix spike results performed on samples from a different project. At the discretion of the QA Officer, MLJ DMT staff will remove any extra non-project or non-direct data that is not needed to qualify results. Occasionally non-project data are needed to fulfill batch QC requirements; when this occurs, data are assessed against the same QAPP requirements used for project-generated samples (see **Verify Laboratory Data Quality Control**).

3. Verify Results

Electronic data deliverables should be verified against the PDF reports to ensure reporting consistency between report formats. When laboratories generate EDDs directly from their Laboratory Information Management System (LIMS), a minimum of 10% of the data must be verified against the PDF report. When EDDs are hand entered by the laboratory, 100% of the results provided must be checked against the report.

If discrepancies are found during the 10% data verification, additional verification is needed to ensure the laboratory export is correct and matches the PDF laboratory report. Issues are communicated back to the laboratory and, if needed, a new export will be requested.

4. Verify Processing and Analysis Information

All analytical sample processing and analysis information should be verified against the project-specific requirements outlined in the eQAPP and against the business rules of the CV RDC (e.g., correct formatting of the LabBatch identifier). Any discrepancies between the processing and analysis information and the expected requirements in the project eQAPP should be communicated back to the contract laboratory and the report amended if applicable. At a minimum, results will be checked for:

- Expected LabBatch formatting utilizing CV RDC batch naming conventions.
- Expected batch grouping – ensure that the LabBatch is grouped by method.
- Expected batch completion times – ensure the analysis dates and digest/extract dates (where applicable) in a batch are within 24 hours of each other.
- Expected analyte/calculation reporting.
- Expected preparation or digest methods.
- Expected minimum detection limits (MDLs) and reporting limits (RLs) - ensure detection and reporting limits match those specified in the eQAPP. Diluted samples are reported with elevated detection and reporting limits, so only results with a dilution factor of 1 would be expected to match the QAPP.
- Expected reporting units.

5. Verify Formatting

Fields that are not controlled by valid values (e.g., comment fields) need to be reviewed to ensure consistency and usability. According to CV RDC business rules and the original SWAMP formatting, the Lab Result Comments field is used to capture percent recovery (PR) and relative percent difference (RPD) values for accuracy and precision control samples. The laboratory result comment field should be formatted as follows for all MS, LCS, laboratory duplicate, or field duplicate samples:

1. Indicate PR or RPD, followed by the calculated value: PR XX or RPD XX. (e.g, PR 99)
    - When in combination, separate the two values with a comma: PR XX, RPD XX (e.g. PR 99, RPD 5).
    - Some programs indicate FD RPD XX for field duplicates.

Any non-detect results should be blank and coded “ND” for the result qualifier code. Results below the MDL are considered non-detect.

6. Calculating Field Duplicate Precision

Field duplicate RPD (or applicable precision evaluation) calculations are not normally provided by the laboratory; these values must be calculated according to requirements outlined in the QAPP and added to the Lab Result Comments of the EDD for evaluating field duplicate acceptability.

When a field duplicate or parent sample result is non-detect the RPD cannot be calculated and the RPD is indicated as "RPD NA" in the Lab Result Comments field.

7. Verify Laboratory Data Quality Control

All laboratory analysis results will be verified against the current MQOs stored in the eQAPP Database. Any data that do not meet the project acceptability criteria must be flagged with an approved quality assurance flag defined in the CV RDC/CEDEN QACode LookUp lists. Common quality assurance flags are listed in **Table 7** as well as business rules for how the codes are applied for most projects in which data are processed by MLJ staff. All acceptable, unflagged data are assigned a QACode of None to indicate there were no anomalies for which a QACode is required. No records with an unpopulated QACode field can be loaded to the database.

If necessary, MLJ DMT staff will update QACodes applied by the laboratory to match the project QA requirements. Any updates will be highlighted and provided to the laboratory to ensure the correct QACode is applied in future EDDs.

Any quality assurance concerns that require an additional code not yet approved for use in a specific project must be reviewed by the project QA Officer. All approved codes are reviewed for CV RDC/CEDEN comparability and for consistency of QA failure classification by the Project QA Officer. Qualified data are still considered useable as multiple factors are considered when determining usability; refer to specific QAPPs for information regarding the determination of useable data.

At a minimum, the following QC checks must be performed prior to loading analytical data into the database:

- **Hold time compliance.** Samples are evaluated to ensure they were performed within the designated hold time outlined within the eQAPP.
- **QC sample frequency evaluation.** Depending on the specific requirements outlined in the QAPP, most batches should be analyzed with the following QC samples:
  - Laboratory blank,
  - Laboratory control spike (LCS),
  - Matrix spike (MS), and
  - Laboratory duplicate.

  When sample frequency requirements are not met, the LabSubmissionCode is updated to "QI" to indicate incomplete QC; otherwise, the LabSubmissionCode is populated according to the **LabBatch Information Updates** conventions. A Lab Batch Comment is always required to indicate why batch QC frequency was not met.
- **Field QC sample evaluation.** All applicable field QC should be evaluated according to the requirements in the eQAPP. This usually includes (but is not limited to):
  - Field blank detections – any field blank detections should be below the acceptable limit outlined in the eQAPP.
  - Field duplicate acceptability – field duplicate RPDs must be below the acceptable limit outlined in the eQAPP.

- **Laboratory QC sample evaluation.** All applicable Laboratory QC should be evaluated according to the requirements in the eQAPP. This usually includes (but is not limited to):
  - Laboratory blank detections – any laboratory blank detections should be below the acceptable limit outlined in the eQAPP.
    - When laboratory blank results do not meet MQOs, any associated environmental samples with detectable results (> MDL) should also be flagged as "FI" indicating the analyte was present in both the environmental sample and its associated blank.
  - Laboratory control spike (LCS) recoveries – PR values for LCS samples should be within the acceptable limits outlined in the eQAPP.
  - Matrix spike recoveries – PR values for MS samples should be within the acceptable limits outlined in the eQAPP.
  - Laboratory replicate acceptability – laboratory replicate RPDs must be below the acceptable limit outlined in the eQAPP.
  - Surrogate recoveries - PR values for surrogate samples should be within the acceptable limits outlined in the eQAPP.

Table 7. Common quality assurance codes and flagging rules for chemistry data.

Sample Type		QA Code	Code Description	Flagging Business Rules
Environmental Samples	Holding Time	H	A holding time violation has occurred	Apply to each result with the holding time exceeded. Apply to matrix spikes with parent environmental samples. Do not apply to LABQA.
	Dilutions performed	D	EPA Flag - Analytes analyzed at a secondary dilution	Apply to results with a dilution factor greater than 1.
	Blank Contamination	FI	Analyte in field sample and associated blank	Apply to environmental results with detections that are associated with a laboratory blank result that was above the acceptable limit. LabBlank is flagged with "IP"; LabBlank and environmental results are given a compliance code of QUAL.
Field QC Samples	Field Blanks	IP/IP5 [1]	Analyte detected in method, trip, or equipment blank	Apply to field blank results with a detection above the acceptable limit (project MQO).
	Field Duplicates	FDP	Field duplicate RPD outside of established limits	Apply to results for both replicates with an RPD above the acceptable limit.
Laboratory QC Samples	LabBlank	IP	Analyte detected in method, trip, or equipment blank	Apply to lab blank result with a detection above the acceptable limit (project MQO).

Sample Type		QA Code	Code Description	Flagging Business Rules
	MS/MSD	GB	Matrix spike recovery not within control limits	Apply to MS or MSD result with a percent recovery outside of project QC limits.
	MS/MSD	BB	Sample > 4x spike concentration	Apply to MS and MSD results associated with high native concentrations; both RPD and PR should be recorded as "Not Calculable"
	MS/MSD	BBM	Sample > 2x but less than 4x spike concentration	Apply to MS and MSD results associated with high native concentrations; both RPD and PR should be recorded as "Not Calculable"
	LCS	EUM	LCS recovery is outside of control limits.	Apply to LCS results with a percent recovery outside of project QC limits.
	CRM	GBC	CRM analyte recovery is outside of control limits.	Apply to CRM results with a percent recovery outside of project QC limits.
	Laboratory Dup/MSD	IL	Duplicate analysis not within control limits.	Apply to results for both replicates with an RPD above the acceptable limit.
	000NONPJ samples	QAX	When the native sample for the MS/MSD or DUP is not included in the batch reported	Apply to 000NONPJ samples when the native sample is not included in the batch reported.
Surrogates		GN	Surrogate recovery is outside of control limits	Apply to both the surrogate that did not meet QC limits and to the analytes/sample associated to that surrogate. If there are two surrogates performed for a sample and one is outside project QC limits and one is inside QC limits, GN is applied to all analytes for that sample except the surrogate that was inside QC limits.
Isotope Dilution Analogues		GIDA	Isotope Dilution Analogue recovery not within control limits	Apply to both the labeled IDA that did not meet QC limits and to the environmental result(s) associated/ quantified with that IDA.
		IDA	Isotope Dilution Analogue corrected	Apply to applicable environmental result but not the IDA itself.

SAMPLE TYPE	QA CODE	CODE DESCRIPTION	FLAGGING BUSINESS RULES
Rejecting Batches	R	Data rejected - EPA Flag	Apply to all samples within a rejected batch (environmental and QC) that are outside project QC limits and the program QA officer determines to be rejected. (See **Rejected Chemistry Results** section for details)

[1]The use of the specific "IP" code may vary by project according to the FB evaluation requirements outlined in the QAPP; the determination of the correct code to use is at the discretion of the Project QA Officer.

8. LabBatch Information Updates

The CV RDC business rules applied to most projects when reviewing and updating the LabBatch worksheet within the CEDEN template are as follows:

- **LabSubmissionCode updates**. For data processed by MLJ DMT staff, the Lab Submission Code is updated anytime a QACode other than None is used in a batch. Batches where all results have a QACode of "None" have a LabSubmissionCode of "A" for acceptable. If the batch has any QACode other than "None", "A,MD" is applied indicating acceptable with minor deviations .
- **BatchVerificationCode updates.** Unless otherwise specified, all data processed by MLJ staff according to the steps outlined in this SOP are given a batch verification code of "VAC" indicating a cursory verification was completed.

9. Unique Row Verification

Unique records are verified by completing two checks:

- Ensure that there is only one analyte and fraction for each station, sample date, and sample type for environmental samples, and
- Ensure all required CV RDC fields are unique in the EDD.

10. Chemistry Data Checker

Once the EDD review is complete, the processed EDD is uploaded into a CV RDC/CEDEN online data checker for a verification of business rules and valid values by the MLJ DMT. A data checker is an online tool into which a data provider can upload a populated template to run the data set through a series of automated checks. The data checker provides a report to the data provider via email identifying errors that need to be resolved and issues that need to be reviewed in the submitted EDD. In most cases, errors identified by the data checker are database requirements and must be resolved for the data to be uploaded into the CV RDC database. Other items identified as potential issues with the EDD are warnings which may be project specific or not applicable to the data set. All potential issues identified by the data checker are evaluated and addressed, when applicable, by the MLJ DMT in coordination with the data provider and/or laboratory (as needed) prior to finalizing the EDD and loading it into the CV RDC database (see **Loading Laboratory Results into CV RDC Database**). Processed EDDs may be uploaded to the data checker more than once to ensure all applicable errors and warnings have been successfully corrected. Links to data checkers used for CV RDC data can be found on the MLJ Environmental

website; the specific data checker that should be used for an EDD is dependent on the project and the CEDEN template being submitted.

11. Rejected Chemistry Results

Results that do not meet project acceptance criteria must be assessed through the corrective action process (see Corrective Action/Resolution). When corrective actions are assessed and no resolution can be reached the rejection of results that do not meet QC requirements as outlined by the QAPP are left to the discretion of the Project QA Officer. The Project QA Officer works in coordination with data users and any project-specific authorities or regulators to assess the QC failures according to project goals and determine whether results should be rejected.

Results that are rejected by the QA Officer, and are therefore considered unusable for the project goals, are processed and flagged with a QACode of "R" for rejected. Individual rejected results should be formatted as follows:

- The result is removed from the Result column (cell is null) and the ResQualCode updated to "NR".
- The Lab Result Comments are updated to indicate the original result of the failed sample,
  - Example: "Original result 0.02 ug/L. Batch rejected. See batch comments."
- An applicable Lab Batch Comment is applied to indicate why the batch and/or result was rejected.
- Appropriate QACode flags, indicating that QC limits that were not met, are applied in addition to the rejected QACode.

If the whole batch is rejected, the following updates are made to the batch-level information:

- The Lab Submission Code is updated with an "R,QC" indicating that the batch is rejected;
- The batch verification code is updated to "VR"; and
- The compliance code is also updated to "Rej" to indicate that the data are rejected and unusable for intended purposes.

12. Chemistry EDD Review MIS Tracking

Once complete, the EDD review should be tracked by adding the staff name (formatted as last name and first initial) and date on which the review was completed in the Laboratory Data Processing table in the MIS Database (**Table 5**).

F. PROCESSING OF TOXICITY EDDS

Like the chemistry EDDs, MLJ DMT staff process individual toxicity EDDs prior to loading them into the CV RDC Database. Each EDD is reviewed following a checklist that has been customized for the specific reporting laboratory, data type, and project when applicable. The fundamental checklist items are described below; a detailed checklist used to process toxicity EDDs is provided in **Attachment C**.

EDD reviews require three items: the EDD, the accompanying PDF laboratory report, and the eQAPP project information.

1. Verify Sample Analysis

Toxicity results should be verified against the sample collection records and the MIS Database according to the same steps outlined above for chemistry results (**Verify Sample Analysis**).

2. Verify Results

Toxicity results should be verified against the final laboratory PDF report according to the same steps outlined above for chemistry results (**Verify Results**).

3. Verify Processing and Analysis Information

All toxicity sample processing and analysis information should be verified against the project-specific requirements outlined in the eQAPP and against the business rules of the CV RDC Database (e.g., correct formatting of the LabBatch identifier**)**. Any discrepancies between the processing and analysis information and the expected requirements in the project eQAPP should be communicated back to the contract laboratory; if applicable, the report should be amended by the laboratory and resubmitted. At a minimum, toxicity results will be checked for:

- Expected ToxBatch formatting utilizing CV RDC batch naming conventions.
- Expected batch grouping – ensure that the ToxBatch is grouped by method and organism.
- Expected test and method information.
- Expected statistical information.
- Expected organisms and endpoints.

4. Verify Water Quality Information

The water quality parameter results reported by the laboratory along with the toxicity test results should be verified according to the requirements and frequency outlined in **Table 8**. Results associated with water quality measurements outside of the acceptable range are flagged accordingly.

Table 8. Water quality parameter requirements for toxicity samples analyzed by Pacific EcoRisk (PER).

Test	Parameter	Review Procedure	Min	Max	Max (Upper Threshold)	Max difference [a]	WQ Measurement Time Points
7-Day Chronic Freshwater *Pimephales promelas* Survival and Growth Toxicity Test	pH	Verify collection time points.	--	--	--	--	initial, final, renewal (daily)
	Specific Conductivity (µS/cm)	Verify collection time points, compare values to range.	100 [b]	1,900 [b]	6,000 [b]	--	initial, final
	Temperature (°C)	Verify collection time points, compare values to range (25 ±1).	24	26	--	3	initial, final, renewal (daily); lab must report minimum and maximum measurement values
	Dissolved Oxygen (mg/L)	Verify collection time points, check initial value.	4.0 [e]	--	--	--	initial, final, renewal (daily, 1 in old solution and 1 in new solution)
	Ammonia	Verify collection time points.	--	--	--	--	initial, final
	Hardness	Verify collection time points.	--	--	--	--	initial
	Alkalinity	Verify collection time points.	--	--	--	--	initial
	Toxicity Testing Field Duplicates	Statistical agreement between duplicates (RPD <25%)	--	--	--	--	N/A
6-8-Day Chronic Freshwater *Ceriodaphnia dubia* Survival and Reproduction Toxicity Test	pH	Verify collection time points.	--	--	--	--	initial, final, renewal (daily)
	Specific Conductivity (µS/cm)	Verify collection time points, compare values to range.	130 [c]	1,900 [c]	2,500 [c]	--	initial, final
	Temperature (°C)	Verify collection time points, compare values to range (25 ±1).	24	26	--	3	initial, final, renewal (daily); lab must report minimum and maximum measurement values
	Dissolved Oxygen (mg/L)	Verify collection time points, check initial value.	4.0 [e]	--	--	--	initial, final, renewal (daily, 1 in old solution and 1 in new solution)
	Ammonia	Verify collection time points.	--	--	--	--	initial, final
	Hardness	Verify collection time points.	--	--	--	--	initial
	Alkalinity	Verify collection time points.	--	--	--	--	initial
	Toxicity Testing Field Duplicates	Statistical agreement between duplicates (RPD <25%)	--	--	--	--	N/A

Test	Parameter	Review Procedure	Min	Max	Max (Upper Threshold)	Max difference [a]	WQ Measurement Time Points
96-Hour Chronic Freshwater *Selenastrum capricornutum* Growth Toxicity Test	pH	Verify collection time points.	--	--	--	--	initial, final, renewal (daily)
	Specific Conductivity (µS/cm)	Verify collection time points, compare values to range.	--	1,500 [d]	3,000 [d]	--	initial, final
	Temperature (°C)	Verify collection time points, compare values to range(25 ±1).	24	26	--	3	initial, final, renewal (daily); lab must report minimum and maximum measurement values
	Dissolved Oxygen (mg/L)	Verify collection time points, check initial value.	4.0 [e]	--	--	--	initial, final, renewal (daily, 1 in old solution and 1 in new solution)
	Ammonia	Verify collection time points.	--	--	--	--	initial, final
	Hardness	Verify collection time points.	--	--	--	--	initial
	Alkalinity	Verify collection time points.	--	--	--	--	initial
	Toxicity Testing Field Duplicates	Statistical agreement between duplicates (RPD <25%)	--	--	--	--	N/A
10-Day Chronic Freshwater *Chironomus dilutus* Survival and Growth Toxicity Test	pH	Verify collection time points.	--	--	--	--	initial, final, renewal (daily)
	Specific Conductivity (µS/cm)	Verify collection time points. SWAMP recommends <12‰ salinity.	--	--	--	--	initial, final
	Temperature (°C)	Verify collection time points, compare values to range (23 ±1).	24	26	--	3	initial, final, renewal (daily); lab must report minimum and maximum measurement values
	Dissolved Oxygen (mg/L)	Verify collection time points, check initial value.	2.5 [e]	--	--	--	initial, final, renewal (daily, 1 in old solution and 1 in new solution)
	Ammonia	Verify collection time points.	--	--	--	--	initial, final
	Hardness	Verify collection time points.	--	--	--	--	initial
	Alkalinity	Verify collection time points.	--	--	--	--	initial
	Toxicity Testing Field Duplicates	Statistical agreement between duplicates (RPD <25%)	--	--	--	--	N/A

Test	Parameter	Review Procedure	Min	Max	Max (Upper Threshold)	Max difference [a]	WQ Measurement Time Points
96-Hour Acute Freshwater *Hyalella azteca* Survival Toxicity Test	pH	Verify collection time points.	--	--	--	--	initial, final, renewal (daily)
	Specific Conductivity (µS/cm)	Verify collection time points. SWAMP recommends <15‰ salinity.	--	--	--	--	initial, final, renewal (daily)
	Temperature (°C)	Verify collection time points, compare values to range (20 ±1).	19	21	--	3	initial, final, renewal (daily); lab must report minimum and maximum measurement values
	Dissolved Oxygen (mg/L)	Verify collection time points, check initial value.	2.5 [e]	--	--	--	initial, final, renewal (daily, 1 in old solution and 1 in new solution)
	Ammonia	Verify collection time points.	--	--	--	--	initial, final
	Hardness	Verify collection time points.	--	--	--	--	initial
	Alkalinity	Verify collection time points.	--	--	--	--	initial
	Toxicity Testing Field Duplicates	Statistical agreement between duplicates (RPD <25%)	--	--	--	--	N/A

[a] Maximum temperature must not deviate from the minimum temperature by more than 3 °C.
[b] *P. promelas*: add high conductivity control when sample conductivity exceeds 1,900 µS/cm; when sample conductivity exceeds 6,000 µS/cm, test with alternate species *Menidia beryllina*.
[c] *C. dubia*: add high conductivity control when sample conductivity exceeds 1,900 µS/cm; when sample conductivity exceeds 2,500 µS/cm, test with alternate species *H. azteca* (CUP monitoring already includes testing for *H. azteca*).
[d] *S. capricornutum*: add high conductivity control when sample conductivity exceeds 1,500 µS/cm; when sample conductivity exceeds 3,000 µS/cm, test with alternate *Thalassiosira* species.
[e] Initial dissolved oxygen levels should range from 4.0 mg/L (*C. dubia*, *P. promelas*, and *S. capricornutum*) or 2.5 mg/L (*C. dilutus* and *H. azteca*) to 100% saturation.

5. Calculating Field Duplicate Precision

Field duplicate RPD (or applicable precision evaluation) calculations are not normally provided by the laboratory; these values must be calculated according to the requirements outlined in the QAPP and added to the ToxPointSummaryComments field of the EDD for evaluating field duplicate acceptability. According to CV RDC business rules, the RPD calculation in the ToxPointSummaryComments field should be formatted as "RPD XX" or, for some projects, as "FD RPD XX" for field duplicates.

6. Verify Laboratory Data Quality Control

Toxicity results should be verified against the current MQOs stored in the eQAPP Database. Like chemistry data, any data that do not meet the project acceptability criteria must be flagged with an approved quality assurance flag defined on the CV RDC/CEDEN QA Code LookUp lists. Common quality assurance flags are listed in **Table 9**. All acceptable, unflagged data are assigned a QACode of None to indicate there were no anomalies for which a QACode is required. All records must have QACode field in order to be loaded to the database.

At a minimum, the following QC checks must be performed prior to toxicity data being loaded into the database:

- **Hold time compliance.** Samples are evaluated to ensure they were performed within the designated hold time outlined within the eQAPP.
- **QC sample frequency evaluation.** Depending on the specific requirements outlined in the eQAPP, toxicity batches should be analyzed with at least one negative control (CNEG) sample.
  When QC sample frequency requirements are not met, the LabSubmissionCode is updated to "QI" to indicate incomplete QC. A ToxBatchComments is required to indicate why batch QC frequency was not met.
- **Field QC sample evaluation.** All applicable field QC should be evaluated according to the frequency requirements in the eQAPP. This usually includes (but is not limited to):
  - Field duplicate acceptability – field duplicate RPDs must be below the acceptable limit outlined in the eQAPP.

Table 9. Common quality assurance codes and flagging rules for toxicity data.

Sample Type		QA Code	Code Description	Flagging Business Rules for ToxSummary TestQACode
Environmental Samples	Holding Time	H	A holding time violation has occurred	Apply to each result with the holding time exceeded. Do not apply to LABQA.
	Dilutions performed	D	EPA Flag - Analytes analyzed at a secondary dilution	Apply to results with a dilution other than 100.

Sample Type		QA Code	Code Description	Flagging Business Rules for ToxSummary TestQACode
Field QC Samples	Field Duplicates	FDP	Field duplicate RPD outside of established limits	Apply to results for both replicates with an RPD above the acceptable limit.
Laboratory Control Samples	CNEG	TAC	Alternative control used in toxicity statistical analysis	Apply to CNEG that was not utilized in statistical analysis
	CNSL/ CNpH[1]	TCF	Alternative control does not meet test acceptability criteria	Apply to alternative control result that is outside of TAccC limits.
Samples with Water Quality Parameter Issues		TCI	Conductivity insufficient for test species	Apply to applicable sample only
		TCT	Conductivity tolerance exceeded for test species	Apply to applicable sample only
		TR	Test conditions not acceptable (temp, light)	Apply to applicable sample only
		TW	Water quality parameters outside recommended test method ranges	Apply to applicable sample only
		TWN	Required water quality parameters not measured	Apply to applicable sample only
		TA	Ammonia precision or accuracy exceeds laboratory control limit	Apply to applicable sample only
Sample with Organism or Survival Issues		PRM	Low survival in toxicity test resulted from test interference due to pathogen-related mortality	Apply to applicable sample only
		TAD	Additional metamorphosized or pupated organism accidently included in statistical analysis	Apply to applicable sample only
		TAF	Test organisms exceeds maximum weight requirement at test initiation	Apply to applicable sample only
		TMM	Male replicate excluded from test analysis	Apply to applicable sample only

SAMPLE TYPE	QA CODE	CODE DESCRIPTION	FLAGGING BUSINESS RULES FOR TOXSUMMARY TESTQACODE
	TMO	Test organisms escaped or are otherwise missing	Apply to applicable sample only; In replicate tab result comments add how many organisms were excluded and how many organisms were included in the statistics (e.g. 1 organism pupated, 9 organisms used in the calculation).
	TOQ	Number of organisms in a toxicity test do not meet the minimum quantity per replicate at test initiation or an unequal quantity of organisms per replicate is used	Apply to applicable sample only. Ensure OrganismPerRep is correct.
	TMSD	Endpoint considered not toxic; per EPA method, when both the relative difference from control and the test percent minimum significant difference (PMSD) are less than EPA lower PMSD bound (10th percentile)	Apply to applicable samples that are tested for *C. dubia*, *P. promelas* or *S. capricornutum*. For survival endpoint comment add: TMSD not applied to survival endpoint only appliable to [insert reproduction or growth endpoint]. For comment on reproduction or growth endpoint record add: TMSD applied to endpoint
	TAE	Organism exceeds age limit	Apply to applicable sample only
	TAS	Alternate species tested	Apply when upper threshold for intended species is exceeded and an alternate species is used
Replicate Issues	RLST	Replicate lost or destroyed	Apply to applicable sample only. Ensure RepCount is adjusted accordingly.
Rejecting Batches	R	Data rejected - EPA Flag	Apply to all samples within a rejected batch (environmental and QC) that are outside project QC limits and the program QA officer determines to be rejected. (See **Rejected Toxicity Results** section for details)

7. ToxBatch Information Updates

ToxBatch information should be populated according to CV RDC business rules as outlined in the chemistry section; see **LabBatch Information Updates** section above.

8. Toxicity Unique Row Verification

Unique records are verified by completing two checks:

- Ensure that there is only one organism and endpoint for each station, sample date and sample type for environmental samples, and
- Ensure all required CV RDC fields are unique in the EDD.

9. Toxicity Data Checker

Once the EDD review is complete, toxicity results should be uploaded to the CV RDC/CEDEN data checkers according to the same steps outlined for chemistry data above (**Chemistry Data Checker**).

10. Rejected Toxicity Results

Results that do not meet project acceptance criteria must be assessed through the corrective action process (see Corrective Action/Resolution). When corrective actions are assessed and no resolution can be reached the rejection of results that do not meet QC requirements as outlined by the QAPP are left to the discretion of the Project QA Officer. The Project QA Officer works in coordination with data users and any project-specific authorities or regulators to assess the QC failures according to project goals and determine whether results should be rejected.

Results that are rejected by the QA Officer are considered unusable for the project goals and are processed with other results and flagged with a QACode of "R" for rejected. Individual rejected toxicity results should be formatted as follows:

- PercentEffect is removed (cell is null),
- SigEffect updated to "NA"
- TestQACode updated to "R"
- ComplianceCode as "REJ"
- The mean is left as is with the mean populated
- The tox point summary comments are updated to indicate why the samples were rejected
  - Example: "Control did not meet test acceptability criteria. Rejected data."
- An applicable tox batch comment is applied to indicate why the batch or sample was rejected.
- Appropriate QACode flags, indicating that QC limits that were not met, are applied in addition to the rejected QACode.

If the whole batch is rejected, the following updates are made to the batch-level information:

- The LabSubmissionCode is updated with an "R,QC" indicating that the batch is rejected,
- The BatchVerificationCode is updated to "VAC,VCN" (Cursory Verification, Tox Control Failure, Flagged by QAO),
- The ComplianceCode is updated to "Rej" to indicate that the data is rejected and unusable for all intended purposes.

11. Toxicity EDD Review MIS Tracking

Once complete, the EDD review should be tracked by adding the staff name (formatted as last name and first initial) and date on which the review was completed in the Laboratory Data Processing table in the MIS Database (**Table 5**).

G. PROCESSING OF TISSUE EDDS

Prior to loading a tissue EDD into the CV RDC database, each EDD is reviewed following a checklist that has been customized for the specific reporting laboratory, data type, and project (when applicable). The fundamental checklist items are described below; the detailed checklist used to process chemistry EDDs is provided in **Attachment D**.

EDD reviews require three items: the EDD, the accompanying PDF laboratory report and eQAPP project information.

Tissue EDD processing follows the same steps outlined above in the **Processing of Chemistry EDDs** section; the major exception is the review of the sample composite information outlined below. The composite review steps are completed first, then the steps for chemistry EDDs can be followed to compete the process.

1. Fish Composite

For fish tissue samples the below items on the tissue template fish composite worksheet must be reviewed for accuracy, consistency and adherence to CV RDC business rules:

- Ensure sample and collection information matches field data entry (Columns A -N).
- Ensure TisSource is “NA”.
- Ensure Organism IDs follow a recognizable, consistent convention for the program.
- If fork and total length are recorded, ensure the total length is larger than fork length.
- If the project is a human health study, ensure that the smallest fish total length is no more than 20% difference compared to the largest fish total length (if applicable according to the QAPP).
- Review for extreme or erroneous values for fork length, total length, and weight of fish.
- Ensure TissueIDs follow a recognizable, consistent convention for the program.
- Ensure TissueName and PartsPrepPreservationName matches tissue processing procedures in QAPP.
- Review the tissue weight against the weight of fish to ensure the tissue weights are lower (or similar where the whole fish was used).
- Ensure CompositeIDs follow a recognizable, consistent convention for the program. Often CompositeIDs should include the StationCode, sample date, and organism reference. If the program has individual vs composite samples typically “I” or “C” are referenced in the CompositeID.
- Ensure that the CompositeWeight, CompositeType, CompositeReplicate, UnitCompositeWeight, HomogDate, OrganismGroup, ComAgencyCode are the same for each CompositeID.

- Review the individual organism weights against the CompositeWeights and ensure there are no extreme or erroneous values.

2. Bivalve Composite

For bivalve tissue samples the below items on the tissue template bivalve composite worksheet must be reviewed for accuracy, consistency, and adherence to business rules:

- Ensure sample and collection information matches field data entry (Columns A -N).
- Ensure TisSource is "Resident" or "Transplant".
- Ensure OrganismIDs follow a recognizable, consistent convention for the program.
- Ensure ShellLength, ShellWidth and LengthWidthType are consistent; check for extreme or erroneous values.
- Ensure individual bivalve measurements are provided. If the program is not reporting individual bivalve measurements, ensure QAPP allows for averaging measurements.
- Ensure TissueIDs follow a recognizable, consistent convention for the program.
- Ensure TissueName and PartsPrepPreservationName match tissue processing procedures in QAPP.
- Review for erroneous values for tissue weight compared to organism weight (if reported).
- Ensure the CompositeIDs follow a recognizable, consistent convention for the program. CompositeIDs should include StationCode, sample date, and organism reference. If the program has individual vs composite samples typically "I" or "C" are referenced in the CompositeID.
- Ensure that the CompositeWeight, CompositeType, CompositeReplicate, UnitCompositeWeight, HomogDate, OrganismGroup, ComAgencyCode are the same for each CompositeID.
- Review the individual organism weights against the CompositeWeights and ensure there are no extreme or erroneous values.

3. Super Composite

For super composite samples the below items on the tissue template super composite worksheet must be reviewed for ensure accuracy, consistency, and adherence to business rules:

- Ensure CompositeSourceID matches ID from original composite worksheet.
- Ensure CompositeType, CompositeReplicate, CompositeWeight and UnitCompositeWeight are the same for each SuperCompositeID.
- Ensure SuperCompositeIDs follow a recognizable, consistent convention for the program.
- Ensure CompositeType equals "super".

4. Verify Tissue Result

When verifying tissue chemistry results follow the steps outlined in the **Verify Results** section above for processing chemistry EDDs. In addition to those steps, tissue results must also be checked for the following:

- Ensure SampleTypeCode equals "Composite".

- Ensure the CompositeID matches between results worksheet and corresponding composite worksheet.
- Ensure OrganismGroup is applicable to the corresponding type of composite.

5. Verify Processing and Analysis Information

Processing and analysis information should be verified according to the **Verify Processing and Analysis Information** steps outlined for chemistry EDDs.

6. Verify Formatting

Formatting should be verified according to the **Verify Formatting** steps outlined for chemistry EDDs.

7. Verify Laboratory Data Quality Control

Laboratory data quality control samples are verified according to the **Verify Laboratory Data Quality Control** steps outlined for chemistry EDDs.

8. LabBatch Information Updates

Laboratory batch information should be process according to the **LabBatch Information Updates** steps outlined for chemistry EDDs.

9. Unique Row Verification

Unique row checks for tissue data are run according to the **Unique Row Verification** steps outlined for chemistry EDDs.

10. Tissue Chemistry Data Checker

Tissue data are run through data checkers according to the **Chemistry Data Checker** steps outlined for chemistry EDDs.

11. Rejected Tissue Chemistry Results

Results that do not meet project acceptance criteria must be assessed through the corrective action process (see Corrective Action/Resolution). When corrective actions are assessed and no resolution can be reached the rejection of results that do not meet QC requirements as outlined by the QAPP are left to the discretion of the Project QA Officer. The Project QA Officer works in coordination with data users and any project-specific authorities or regulators to assess the QC failures according to project goals and determine whether results should be rejected.

Tissue chemistry data are rejected and coded according to the **Rejected Chemistry Results** steps outlined for chemistry EDDs.

12. Chemistry EDD Review MIS Tracking

Once complete, the EDD review should be tracked by adding the staff name (formatted as last name and first initial) and date on which the review was completed in the Laboratory Data Processing table in the MIS Database (**Table 5**).

H. CORRECTIVE ACTION/RESOLUTION

Results that fail to meet project acceptance criteria due to errors in the field or lab trigger the initiation of the corrective action process. While the specific process may vary by project, there are four general steps that should be followed to complete this process:

1. Identification of the error or deviation,
2. Documentation and tracking,
3. Investigation of the root cause, and
4. Review/follow up to assess if the error has been successfully corrected.

As the MLJ DMT staff are the first reviewers of data received from laboratories, they are primarily involved in the identification and documentation of errors and deviations.

When errors are found in either the PDF report or the EDD file which prevent the data from being processed and/or loaded into the database, the following actions should be performed:

- The appropriate laboratory will be contacted regarding the issue(s) requiring resolution and sent a copy of the data file to use as a reference if needed.
- If the issue requires a resubmission, a revised data file and/or hardcopy report will be requested from the laboratory.

All minor issues will be revised by the MLJ DMT staff in the EDD file; the laboratory must be notified of any changes to the final data file prior to loading.

Similarly, for field deviations/errors identified during the data review process, the field crew and project manager will be notified, and any additional actions discussed for correcting the data and preventing similar issues in the future.

Any laboratory errors that cannot be resolved by an updated report or data file must be reviewed by the QA Officer and assessed for the necessity of further investigation or resolution. The QA Officer works with the labs to establish proper documentation and corrective actions for laboratory errors.

For most projects, follow up reviews of implemented corrective actions occur on two levels:

1. Summaries and reviews of corrective actions are provided to data users and regulators through annual QA assessment reports, and
2. Reviews with laboratory staff occur through annual meetings conducted by the QA Officer and data managers assessing performance and data needs.

The associated QAPP provides additional guidance regarding project-specific corrective actions and should be referenced when determining the level to which step 3 and 4 should be implemented.

I. PROVIDING CHEMISTRY RESULTS FOR TOXIC TOXICITY RESULTS (PHASE III TIE)

For certain projects, toxicity samples in which the organisms exhibit a certain amount of toxic effect may require further investigation as to the source of the toxicity in the samples. Toxicity Identification Evaluations (TIEs) may be performed and, as part of a Phase III TIE, chemistry results can be used to evaluate the toxic effect of specific analytes detected in the sample. When a TIE is triggered (according to limits defined by the program requirements), MLJ DMT staff provide relevant chemistry data associated with the sample that is determined to be toxic to one or more organisms, back to the toxicity laboratory so that a Phase III TIE can be completed.

If there are relevant chemistry results available to send back to the laboratory, MLJ DMT staff export these results into a Phase III TIE chemistry data template once the originally reported results have been verified and loaded into the database. The Laboratory Data Processing table in the MIS Database is updated to reflect that chemistry results were sent to the laboratory. The laboratory uses the data provided to calculate the toxic units of any detected analytes for the TIE investigation summary in the final laboratory report.

J. LOADING LABORATORY RESULTS INTO CV RDC DATABASE

Once an EDD is processed and verified (the checklist is completed and any remaining laboratory questions are answered and updated), the EDD is placed in a queue for loading into the CV RDC Database. Prior to loading, EDDs should be double-check by one additional staff member to ensure the data processing steps have been completed as outlined above. MLJ DMT staff follow internal SOPs specific to loading chemistry, toxicity, and tissue EDDs into the CV RDC database. Completion of each of these steps are tracked in the Laboratory Data Processing table of the MIS Database.

Data are loaded using a series of queries to add the results to the CV RDC relational database design. Automated checks are performed on the data prior to loading to ensure that results are unique, assigned to the correct sample collection information, formatted correctly, contain the correct valid values, and that all required fields are populated. Result table counts are tracked prior to loading and compared to counts after loading to ensure all intended results were uploaded. After the EDD is loaded, specific verification steps are performed to ensure the correct results have been added into the CV RDC database. Basic data queries are run after all results are loaded to verify the correct permissions and usability codes are on the results.

Any discrepancies will be noted and communicated back to the Project Manager and Project QA Officer to be reconciled. The loaded EDD is filed in the appropriate internal system as described above (**Receipt and Filing of Laboratory Results**); loaded copies of EDDs containing any updates

that occurred during data processing are saved with the end of the file name updated to indicate it was loaded and the date it was uploaded (e.g., "_LOADED_071821").

Once complete, the loaded EDD should be tracked by adding the staff name (formatted as last name and first initial) and date on which loading was completed in the Laboratory Data Processing table in the MIS Database (**Table 5**).

All final data loaded into the CV RDC and given the CEDEN Compliance Code of "Pend" to indicate they are pending the further QA review described below in Section **VIII. Secondary Results Verification (Stage 2 Data)**.

VIII. SECONDARY RESULTS VERIFICATION (STAGE 2 DATA)

Secondary verification is performed by the Marine Pollution Studies Laboratory (MPSL) on laboratory-submitted data that have undergone an initial verification by CV RDC staff during upload to the CV RDC. The intent of the secondary verification is to provide an independent data review against the applicable Delta RMP QAPP, and to confirm proper documentation of non-conformances. As part of the secondary verification, all verified data are assigned a classification and the corresponding CEDEN compliance code described below in **Table 10**.

Table 10. CEDEN Compliance Codes applied during secondary result verification.

CEDEN Compliance Code	Definition	Description
Com	Compliant	Data meet all requirements specified in the applicable DRMP QAPP.
Est	Estimated	Data (i.e., EPA "J" flag) are assigned to data batches and sample results that are not considered quantifiable.
Pend	Pending	Data are pending QA review (have not yet undergone Secondary Verification)
Qual	Qualified	Data do not meet one or more of the requirements specified in the applicable DRMP QAPP. These data are considered usable for their intended purpose following an additional assessment to determine the scope and impact of the deficiency.
Scr	Screening	Data are for information purposes only and are considered to be non-quantifiable.
Rej	Rejected	Data do not meet the minimum requirements specified in the applicable DRMP QAPP. These data are not considered usable for their intended purpose.
NA	Not Applicable	Data were not verified since there were no DRMP QAPP requirements for the specific parameter (e.g., oxygen saturation) or a failure (e.g., zero flow, probe malfunction) was reported that prevented data collection.

Secondary verification can begin once data have been processed according to the procedures listed in **Section VII** and loaded into the CV RDC by the DMT. Secondary verification is performed on field measurement, chemistry (water quality, sediment, and tissue), and toxicity data. Quality control samples without specific MQO defined in the applicable QAPP are verified against SWAMP MQOs, laboratory statistical limits, or method control limits. Results for QC samples not required by the applicable Delta RMP QAPP and/or method may not be evaluated; records that are not evaluated are given the compliance code of "NA" during the secondary verification process.

1. Secondary Verification of Field Results

All field measurements are verified against the requirements defined in the applicable QAPP. Field measurement results, including associated frequencies and collection devices are verified according to the following steps.

- Field measurement frequency: verify the number of results according to the frequency requirements outlined in the applicable QAPP (e.g., one measurement per water quality sample collection).
- Collection device calibration: Field probe calibration frequency is verified against the applicable QAPP requirements (e.g., within 24 hours prior to measurement collection).
    - All *QACodes* for collection or calibration failures are checked to confirm that they are present and applied correctly. When missing data flags are identified, the CEDEN codes applied by MPSL QA staff during secondary verification will be preceded by a "V", indicating the records were "flagged by QAO". The outlier is documented on the *Data Verification Comment* (DVC) Microsoft Excel Spreadsheet. In cases where there are systematic errors in the application of QACodes, these are discussed with the CV RDC DMT and the submitting laboratory.

2. Secondary Verification of Chemistry and Toxicity Results

All chemistry results for water quality, sediment, and tissue samples are reviewed following the SWAMP SOPs for chemistry data verification and according to the requirements of the Delta RMP Data Management Plan. All toxicity results are reviewed following the SWAMP SOPs for toxicity data verification and according to the requirements of the Delta RMP Data Management Plan. All results are verified against the requirements outlined in the applicable Delta RMP QAPP (including any amendments) and are reviewed for the following general steps.

- *QACodes* for preservation, holding times, and blank contamination (field and laboratory), as well as QC frequency, accuracy, and precision are checked to ensure that they have been applied correctly by the laboratory and/or CV RDC DMT.
- Missing *QACodes* are applied to the data as appropriate. *QACodes* that were applied incorrectly are either updated or removed following discussion with the CV RDC DMT. All instances of missing or incorrectly applied *QACodes* are recorded in the DVC Microsoft Excel spreadsheet.
    - When missing data flags are identified, the CEDEN codes applied by MPSL QA staff during secondary verification will be preceded by a "V", indicating the records were "flagged by QAO". The outlier is documented on the DVC Microsoft Excel Spreadsheet. In cases where there are systematic errors in the application of QACodes, these are discussed with the CV RDC DMT and the submitting laboratory.
- It is then confirmed that project method detection limits (MDLs) and reporting limits (RLs) are reported as required by the applicable Delta RMP QAPP and are adjusted correctly for any dilutions. Updates to MDLs or RLs are first discussed with the CV RDC DMT. Any outliers are recorded in the DVC spreadsheet.
- Percent recoveries and relative percent differences (RPDs) are recalculated at a rate of one analyte per reported QC type. If there are non-rounding discrepancies between the reported and calculated values, the CV RDC DMT is notified before involving the laboratory as necessary. Any outliers are recorded in the DVC spreadsheet.
- Data issues (e.g., calibration range exceedances) that do not fall under the typical accuracy and precision categories are also evaluated and applicable *QACodes* are assigned. If

appropriate, the laboratory is contacted by the CV DMT on behalf of the independent verifier. These issues are recorded in the DVC spreadsheet.

Once the data have been verified, results are assigned the appropriate compliance code (**Table 10**) and the data are marked as finalized for export to CEDEN as described below in Section **IX. Data Finalization and Publication**.

IX. DATA FINALIZATION AND PUBLICATION

A. INTERNAL DATA REVIEW

Prior to project deliverables and reporting of the project data set, the data in the CV RDC database is compared to information in the MIS to check for completeness, ensure specific business rules are applied, verify any Water Quality Metrics exceedances reported for applicable projects, and ensure data output for Project Managers and reports are exporting correctly. The main checks include:

- Ensure Analysis Count table in the MIS Database is marked correctly for sample collection and analysis completion (**Table 1**).
- Ensure completeness assessments in the MIS Database agree with the data loaded into the CV RDC.
- Ensure exceedances identified during the **Initial Laboratory PDF Review** section match the final results in the CV RDC.
- Verify that all field results are within the expected range (see **Field Result Verification** above).
- Ensure business rules for field entry have been correctly applied such as ResQualCodes and QACodes.

B. UPDATE CV RDC DATA FROM PRELIMINARY TO PERMANENT

Every result table in the CV RDC Database has a status column that indicates if the record is preliminary or permanent data. Permanent data have been fully reviewed and finalized; in most cases the finalization of the data is associated with the completion of an associated data report. Permanent data are ready to be transferred to CEDEN. Some data may not be included in the weekly synchronization between the CV RDC and CEDEN (e.g., they are already published on CEDEN through another program or are being published through NWIS or another publicly accessible database approved by the Central Valley Regional Water Board Executive Officer); these data are qualified with an appropriate status as outlined in **Table 11**.

Preliminary data are working data that have not been fully reviewed and/or finalized. Preliminary data must undergo a final review and be approved for finalization before being considered permanent. The specific valid values used to indicate these statuses are outlined in **Table 11**.

Each data set that is ready to be finalized will undergo a series of global query checks which ensure that the data submitted follow the documented CV RDC business rules. If any discrepancy is found during a review, MLJ DMT staff will discuss the discrepancy with the appropriate person. Discussion will cover whether the information collected is accurate, what the cause(s) leading to the deviation may be, how the deviation might impact data quality, and what corrective actions might be considered.

Once all the global query checks have been performed and documented, MLJ DMT staff will update the status of each record to indicate it is permanent data and notify the Project Manager.

Table 11. Status field valid values used in the CV RDC.

STATUS VALID VALUE	TRANSFER TO CEDEN	STATUS DESCRIPTION
CEDEN_Entry_CVRDC	No	Used for preliminary CV RDC data to be eventually exported to CEDEN, transfer to CEDEN cannot occur until the data are updated to permanent.
CEDEN_Perm_CVRDC	Yes	Used for permanent CV RDC data to be exported to CEDEN.
CVRDC_Entry	No	Used for internal preliminary CV RDC data not to be exported.
CVRDC_Perm	No	Used for internal permanent CV RDC data not to be exported.

C. TRANSFER DATA FROM THE CV RDC TO CEDEN

Data cannot be transferred to CEDEN until the status is marked as permanent, indicating it has undergone global query checks, and that it is intended to be published in CEDEN (**Table 11**). When data are finalized and ready for transfer, the MLJ DMT will receive final approval from the Project Manager. The Project Manager will receive an Excel file that summarizes the data to be transferred and provides result counts. All data transfers to CEDEN will be recorded and documented. Once the transfer is complete, the Project Managers will be notified.

Data should be transferred to CEDEN once any final reports including an assessment and interpretation of the associated results have been submitted to regulators and/or data users (unless specified otherwise by the project requirements). All data in a single dataset must be uploaded to CEDEN within 6 months of the last sampling event date for the applicable project code to be in compliance with Resolution R5-2021-0054. This occurs on an annual basis. The MLJ DMT generally publish finalized data to CEDEN within 1-2 months of report submittal. Excessive delays are generally not expected seeing as finalized, permanent data in the CV RDC do not need to undergo further data checks or verification steps prior to being transferred to CEDEN. If delays past this time period are to be expected, the reasons for the delay along with an expected timeline for publication should be provided to the data users; deviations from 6-month requirement for data publication to CEDEN require prior approval by the Central Valley Regional Water Board.

In addition to updating the status of each record to "CEDEN_Perm_CVRDC", several other fields in the CV RDC must be updated for any data that are data intended for CEDEN to ultimately be transferred. The following fields must be updated appropriately for the final CEDEN transfer to occur:

- Status,
- DataToBeExported,
- CollectionComplete, and
- Public.

Once datasets are appropriately updated in the CV RDC Database, the data will automatically be uploaded to CEDEN during the weekly synchronization that occurs every Saturday morning. This process is performed using automated run statements managed by MLML-MPSL.

In addition to the correct data coding in the CV RDC, MLJ DMT staff must also notify the CEDEN DMT to update the project lookup list to indicate the project is public; this step allows the data to be visible on any CEDEN export tool.

Any updates to CV RDC data that have already been transferred to CEDEN are synchronized with CEDEN on a weekly basis. Any significant changes to data in the CV RDC that affect results or the interpretation of results (e.g., sample location) are communicated to CEDEN staff and the agency associated with the project through the use of the CEDEN Data Modification Request Form (http://ceden.org/procedures.shtml). The Request Form serves as official notification to CEDEN staff that the change will occur; the changes will be implemented during the database synchronization unless concerns are raised during the notification process. Minor changes (e.g., spelling or formatting changes to comment fields) do not require that CEDEN be notified. All changes to data that have already been published, both significant and insignificant, are reviewed by the Project QA Officer and documented internally by the MLJ DMT.

ATTACHMENT A. MLJ ENVIRONMENTAL FIELD RESULTS REVIEW CHECKLIST

MLJ Field Results Checklist

Item No.		Component Name	Verified (No Verified Fixes Needed	Not Applicable	Comments
1		**Results Check**			
1.1		Verify Results with the Fieldsheet			
	1.1.1	Check 10% of the results. Filter on the sample information to ensure that the sample information lines up with the results. If the 10% check is all correct, then proceed with processing the results. If errors are found, check all results against the field sheets.			
2		**Field Sample Information**			
2.1		Field Samples			
	2.1.1	Station Code is correct format and within Stationlookup lists.			
	2.1.2	SampleDate is formatted as dd/mmm/yyyy (Note: in text box looks like mm/dd/yyyy).			
	2.1.3	ProjectCode is within the ProjectCodeLookup list (see eQAPP or ProjectLookUp).			
	2.1.4	EventCode = "WQ".			
	2.1.5	ProtocolCode is in Protocollookup list.			
	2.1.6	AgencyCode is within the AgencyCodeLookup list and is the Agency that collected the sample.			
	2.1.7	LocationCode = "Bank", "MidChannel", or "Thalweg".			
	2.1.8	Collection time is formatted as xx:xx (24 hour) (Note: text box looks like xx:xx:xx PM or AM).			
	2.1.9	CollectionMethodCode = "Field"			
	2.1.10	Replicate = "1"			
	2.1.11	CollectionDeviceName is within lookup list and associated with the project.			
	2.1.12	CollectionDepth matches Chain of Custody or Default of "0.1" for Environmental Samples, and "-88" for Field blanks DRMP Project Specific: airtemp colleciton depth =-88			
	2.1.13	UnitCollectionDepth = "m" or "cm" (for sediment).			
	2.1.14	PositioninWaterColumn = "Subsurface"; "Not Applicable" for air temp			
3		**Field Analysis Information**			
3.1		Field Constituents			
	3.1.1	Verify Constituent with P_Constituent pivot table. (DRMP Project Specific: Extra constituents are ok; verify against ConstituentLookUp)			
	3.1.2	FieldReplicate = "1"			
4		**Field Results and Coding for Special Conditions**			
4.1		Successful Chemistry and Discharge Measurements			
	4.1.1	Result is a numeric value with no symbols or text attached to the value.			
	4.1.2	ResQualCode = "=".			
	4.1.3	QACode = "None"			
	4.1.4	CalibrationDate is included and formatted as dd/mmm/yyyy (Note: in text box looks like mm/dd/yyyy).			
	4.1.5	ComplianceCode =Pend (or NR) and BatchVerificationCode=NA			

Item No.		Component Name	Verified (No Verified Fixes Needed	Not Applicable	Comments
4.2		Chemistry - Special Conditions			
	4.2.1	**Instrument Failure:** Result= blank, ResultQualCode = "NR", QACode = "FIF", Comments = "Instrument Failure"			
	4.2.2	**Cannot Deploy Instrument:** Result = blank, ResQualCode = "NR", QACode = "FUD", Comments = "Unable to deploy instrument for measurement"			
4.3		Discharge – Special Conditions			
	4.3.1	**Instrument Failure:** Result= blank, ResultQualCode = "NR", QACode = "FIF", Comments = "Instrument Failure"			
	4.3.2	**Water Present, but Cannot Deploy Instrument:** Result = blank, ResQualCode = "NR", QACode = "FUD", Comments = "Unable to deploy instrument, but flow is estimated to be XX CFS based on surface debris movement.			
	4.3.3	**Water Present, but Too Deep to Wade:** Result = blank, ResQualCode = "NR", QACode = "FUD", Comments = "Too deep to take discharge measurements".			
	4.3.4	**Water Present, but no Measurable Flow:** Result = "0", ResQualCode = "=", QACode = "FLV", Comments = "No Measurable Flow".			
	4.3.5	**Water Present, but Too Shallow to Take Discharge:** Result = blank, ResQualCode = "NR", QACode = "FS", Comments = " Too Shallow to take discharge measurement".			
	4.3.6	**Non-Contiguous/ Isolated Pool:** Result = "0", ResQualCode = "=", QACode = "FLV", Comments = "Non-Contiguous water body". (No field results should be taken now with isolated pools.)			
5		Field Result Accuracy and Quality Assurance/Control Review			
5.1		Expected/Realistic Ranges for Field Measurement Values			
	5.1.1	**Dissolved Oxygen values should fall between 0 mg/L and 20mg/L.** • Make sure measurements are not recorded in % saturation. • If outside of this range double check the fieldsheet to verify the result. • If value matches fieldsheet leave as question for field crews/client. • If client feels result is suspect and directs to remove, update to: Result = blank, ResQualCode = "NR", appropriate QA code (e.g., "FIF" for Instrument Failure), Comments must contain original value and reason for failure, e.g.: "Value recorded as 45mg/L, suspected instrument failure".			
	5.1.2	**pH values should fall between 2 and 11 units.** • If outside of this range double check the fieldsheet to verify the result. • If value matches fieldsheet leave as question for field crews/client. • If client feels result is suspect and directs to remove, update to: Result = blank, ResQualCode = "NR", appropriate QA code (e.g., "FIF" for Instrument Failure), Comments must contain original value and reason for failure, e.g.: "Value recorded as 1 pH unit, suspected instrument failure".			

ITEM NO.			COMPONENT NAME	VERIFIED (NO VERIFIED	FIXES NEEDED	NOT APPLICABLE	COMMENTS
		5.1.3	**Specific Conductivity values should fall between 50 µS and 10,000 µS.** • If outside of this range double check the fieldsheet to verify the result. • If value matches fieldsheet leave as question for field crews/client. • If client feels result is suspect and directs to remove, update to: Result = blank, ResQualCode = "NR", appropriate QA code (e.g., "FIF" for Instrument Failure), Comments must contain original value and reason for failure, e.g.: "Value recorded as 10 µS, suspected instrument failure".				
		5.1.4	**Turbidity values should fall between 0 NTU and 1,000 NTU.** • If outside of this range double check the fieldsheet to verify the result. • If value matches fieldsheet leave as question for field crews/client. • If client feels result is suspect and directs to remove, update to: Result = blank, ResQualCode = "NR", appropriate QA code (e.g., "FIF" for Instrument Failure), Comments must contain original value and reason for failure, e.g.: "Value recorded as 1600 NTU, suspected instrument failure".				
		5.1.5	**Water Temperature values should fall between 0 °C and 45 °C.** • If outside of this range double check the fieldsheet to verify the result. • If value matches fieldsheet leave as question for field crews/client. • If client feels result is suspect and directs to remove, update to: Result = blank, ResQualCode = "NR", appropriate QA code (e.g., "FIF" for Instrument Failure), Comments must contain original value and reason for failure, e.g.: "Value recorded as 60 deg C, suspected instrument failure".				
6			Habitat Results				
	6.1		Habitat Sample Information				
		6.1.1	Station Code is correct format and within StationLookup lists.				
		6.1.2	SampleDate is formatted as dd/mmm/yyyy (Note: in text box looks like mm/dd/yyyy).				
		6.1.3	ProjectCode is within the ProjectCodeLookup list (see eQAPP or ProjectLookUp).				
		6.1.4	EventCode = "WQ".				
		6.1.5	ProtocolCode is in Protocollookup list.				
		6.1.6	AgencyCode is within the AgencyCodeLookup list and is the Agency that collected the sample.				
		6.1.7	LocationCode = "Bank", "MidChannel", or "Thalweg".				
		6.1.8	Collection time is formatted as xx:xx (24 hour) (Note: text box looks like xx:xx:xx PM or AM).				
		6.1.9	CollectionMethodCode = "Habitat_Generic"				
		6.1.10	Replicate = "1"				
		6.1.11	CollectionDeviceName = "None"				

Item No.			Component Name	Verified (No Verified Fixes Needed	Not Applicable	Comments
	6.2		Habitat Observation Information			
		6.2.1	Matrix Name = "habitat", "samplewater", "sediment"			
		6.2.2	Method Name = "FieldObservation"			
		6.2.3	Analyte Name within AnalyteLookUp.			
		6.2.4	Fractions = "None"			
		6.2.5	UnitName = "None"			
		6.2.6	VariableResult is within LookupList			
		6.2.7	Result = blank			
		6.2.8	ResQualCode = "="			
		6.2.9	QACode = "None"			
		6.2.10	ComplianceCode =NA and BatchVerificationCode=NA			
7			Sample Information Consistency			
	7.1		Check Field/Habitat Sample Information Matches			
		7.1.1	Copy field and habitat sample information to the FieldHabitatSampleDetails. Populate source and run P_SampleDetailCheck. Check to ensure that field and habitat matches.			
8			Sample Purpose			
	8.1		Populate SamplePurpose			
		8.1.1	Create SamplePurpose tab: Take sample information from habitat tab and remove duplicates. Make a set for FieldMeasure, Habitat, and any lab parameters collected by site (e.g., WaterChem, WaterTox, SedChem, Sed Tox, Tissue).			
		8.1.2	Use a pivot table to ensure all SamplePurpose combinations are correct and line up by project, e.g., for every WaterTox record there should be a WaterChem record (see P_SamplePurpose).			
		8.1.3	Verify all SamplePurpose failures are documented with the appropriate Sample Purpose Failure Code. Comments should contain description of all sample purpose failures.			
9			Sample Locations			
	9.1		Check Sample Location Information			
		9.1.1	**There should be no stations without coordinates:** ensure all coordinates and the associated datum are populated.			
		9.1.2	Review actual lat/longs to make sure GIS coordinates look reasonable (values should be relatively similar based on location).			
		9.1.3	**Coordinate Source is a required field:** ensure all Coordinate Sources are populated; add "NR" if blank.			
		9.1.4	Confirm tab headers are correct			
	9.2		Check Location Distance from Target Location			
		9.2.1	Run the Distance Query in DMT file to check distance of the actual sample lat/longs from the target lat/longs. DRMP Project Specific: if distance is greater than allowed in QAPP, notify Program Manager and initiate deviation process.			

Item No.			Component Name	Verified (No Verified Fixes Needed	Not Applicable	Comments
10			Final Checks			
	10.1		Check Result Completeness			
		10.1.1	Use pivot table to ensure all stations and dates have every required analyte (use P_FieldResultAmountCheck).			
	10.2		Check Uniqueness			
		10.2.1	Use pivot tables to ensure that field results and habitat results are unique			
11			Data Checker			
	11.1		Data Checker: Run file through data checker and resolve any issues. When errors are found run through data checker again until all applicable items are resolved. Field templates are the CEDEN template, use the CEDEN data checker: http://ceden.org/CEDEN_checker/Checker/CEDENUpload.php.			
12			Tracking			
	12.1		MIS Database Tracking			
		12.1.1	Update MIS, FieldResultDataProcessing tracking information with the date completed and your name.			
		12.1.2	DRMP Project Specific: after the file has been posted to the Droplet, update the file sharing tracking information with the date and your name.			
	12.2		CV RDC Metadata			
		12.2.1	After the processed file is loaded to the CV RDC, add in personnel and sample locations through EDERs portal.			

ATTACHMENT B. MLJ ENVIRONMENTAL CHEMISTRY ANALYSIS REVIEW CHECKLIST

MLJ Water Chemistry Analysis Checklist

Item No.			Component Name	Verified (No Verified Fixes Needed	Verified	Not Applicable	Comments
1			**Results Check**				
	1.1		Verify Results with the PDF				
		1.1.1	Check 10% of the results. Filter on the sample information to ensure that the sample information lines up with the results. If the 10% check is all correct, then proceed with processing the EDD. If errors are found, check all results against the PDF.				
		1.1.2	Check the case narrative in each PDF for important information about reanalysis, hold time violations, or anything that appears out of the ordinary that could affect specific samples or the entire batch. Paste snips of pertinent information into the LaboratoryQuestions tab, and update LabResultsComments if necessary.				
2			Sample Information				
	2.1		Samples (Grab, field duplicates, field blanks, matrix spikes)				
		2.1.1	Lab Sample Details: Compare sample collection information from the database to the EDD to verify they are the same.				
3			Processing and Analysis Information				
	3.1		Lab Batches				
		3.1.1	Batch names should conform to the CV RDC batch naming guidelines, stored here: X:\P_CV_RDC\Management_Documentation\2_Documentation_EntryManuals \File-BatchName (or online at CV RDC batch naming conventions).				
		3.1.2	Batches are defined by Method. Each batch should have same Units (excluding surrogates) and Analysis Date. Analysis Dates in a batch should be within 24 hours of each other; if there is a Digest Date then digests/extractions should all be within 24 hours.				
	3.2		Matrix Name				
		3.2.1	When an MS is performed off blankwater, add the following comment to the CollectionComments. Include the period: "MS performed on FieldBlank."				
	3.3		Method Name, Analyte Name, Fraction Name, Unit, MDL and RL				
		3.3.1	Each method, analyte, fraction and unit should have the correct Preparation & Digestion methods reported. Review the eQAPP to verify.				
	3.5		ExpectedValue				
		3.5.1	All MS, LCS, CRM or Surrogate samples should have an expected value.				
	3.6		LabSampleComments				
		3.6.1	LabReplicates of 2 should have an RPD (Relative Percent Difference) recorded (excluding surrogate samples).				
		3.6.2	All LCS and MS samples should have a PR (Percent Recovery) recorded.				
		3.6.3	Check the correct format for PR and RPD was applied: use "PR XX" or "RPD XX"; when in combination (such as for an MSD), use "PR XX, RPD XX" (e.g., PR 99, RPD 5)				

ITEM NO.			COMPONENT NAME	VERIFIED (NO VERIFIED	FIXES NEEDED	NOT APPLICABLE	COMMENTS
		3.6.4	Calculate Field Duplicate RPDs: Calculate RPD for FieldDup (replicate of 2) and its associated environmental sample: Round results to TWO sig figs (unless 3 digits: i.e., 24, 2.5 163). See QAPP for calculation; example ABS((X-Y)/(X+Y))*100 (where X = env sample result and Y = fielddup result). FD RPD calculations do NOT apply to surrogates (unit=%). For ND results, enter "FD RPD NA" (if either the environmental sample or the field duplicate is ND) If RPD values equal zero (both replicates have the same positive value), use "FD RPD 0" (Project Specific: label only FD sample with "FD RPD XX")					
		3.6.5	Flag FD RPD (If Applicable): If the calculated RPD is outside limits, flag the FieldDup AND environmental sample with a QACode of "FDP". See eQAPP for project specific limits.					
		3.6.6	If the EDD includes bacteria results (E. coli) Calculate Field Duplicate/LabRep Rlog: W:\P_ILRP\2.3_DataMgmt\6_ReviewEDDs\EDDChecking\Rlog_calcs\2018 WY. If one sample is ND then enter "Rlog NA". If one sample is >2419.6 enter "Rlog NA". Remove FD RPD that is calculated by the lab and replace with Rlog you calculated as per eQAPP.					
	3.7		Submitting Agency					
		3.7.1	Submitting Agency is MLJ Environmental					
	3.8		BatchVerificationCode					
		3.8.1	Populate BatchVerificationCode column with VAC if all checks within this checklist are performed.					
4			QA Checks					
	4.1		Batch Amount Check: Verify laboratory batches have the correct amount of QC required by the QAPP; if QC is missing batch is appropriately flagged with a LabSubmissionCode of QI and a lab batch comment is included. (Verify with lab first as to why it is missing)					
	4.2		Hold Time Check: Check extraction/analysis occurred within the appropriate holding times; if holding times were not met the batch is appropriately flagged and a lab batch comment is included.					

ITEM NO.			COMPONENT NAME	VERIFIED (NO VERIFIED	FIXES NEEDED	NOT APPLICABLE	COMMENTS
	4.3		FieldBlank Check: (or any project blank samples) If a field blank flag is required notify QA Officer. Potentially need to reanalyze samples. If lab reanalyzed samples to confirm ensure LabResultComments indicates so. Project Specific: 1) Check that FieldBlanks meet eQAPP limits 2) If equal to or >RL, check if FB results is <1/5 env sample 3) If <1/5 env sample, leave QACode as None and add LabResultComments "<1/5 env sample, env sample=XX" 4) If >1/5 env sample, change QACode to IP5 and add LabResultComments ">1/5 env sample, env sample=XX" 5) For flagged samples, add LabBatchComm "Analyte detected in fieldblank (">1/5 env sample, env sample=XX)."					
	4.4		Laboratory QC Check: Laboratory QC (MS, LCS, MSD, Lab Blank, Lab Duplicates) Verify samples are within the eQAPP requirements; if QC is outside of requirements the batch is appropriately flagged and a lab batch comment is included. Verify LabBlanks, Matrix Spikes, Lab duplicates and LCS's and any other specific MQO's according to eQAPP. Project Specific: Where there is an exceedance of the MQO in the Lab Blank, verify the QACode "FI" is applied to all associated environmental samples with detectable results (> MDL).					
	4.5		LabBatch Comments Check: Once all QACodes are applied use a pivot table to verify that LabBatch comments reflect all QACodes in the Results tab. (Make sure to refresh pivot table before check and use the Standardized LabBatchComments.) Check that all QC issues explained at beginning of report are recorded in EDD with either a QACode or in the batch comment. Standardized LabBatchComments excel file is located here: W:\P_ILRP\2.3_DataMgmt\6_ReviewEDDs\EDDChecking					
	4.6		Project Specific: Look at LabReplicates: similar to Field Duplicates, if either lab results are ND, the RPD values should be NA. Change the value the lab has calculated to RPD NA if either rep 1 or rep 2 has a result of ND.					
	4.7		LabSubmissionCode Check: If the batch has any QACode other than "None", labbatch CANNOT be "A"; should be "A,MD" with a batch comment explaining the code; note that there is NO space between the "A," and "MD".					
	4.8		Lab Report qualifiers: double the check PDF lab report and make sure any appropriate qualifiers are added to either the result or batch comments.					
5			Unique Row Check					
	5.1		Unique Row: Verify that each row is unique. Sample and database unique.					
6			Data Checker					
	6.1		Data Checker: Run file through data checker and resolve any issues. http://checker.cv.mpsl.mlml.calstate.edu/CVRDC/CVRDCUpload.php. When errors are found run through data checker again until all applicable items are resolved. For CEDEN template use: http://ceden.org/CEDEN_checker/Checker/CEDENUpload.php					
	6.2		LabBatch naming convention changed. Verify less than 50 characters (max for the database). The data checker will show an error for anything over 35 characters, which is ok. No action necessary to change if under 50 characters.					
7			Tracking					

Item No.			Component Name	Verified (No Verified	Fixes Needed	Not Applicable	Comments
	7.1		Counts: Refresh pivot table for counting analytes for each environmental sample. Update analysis count in MIS ensure all analytes expected were received.				
	7.2		Tracking: Update MIS, LaboratoryDataProcessing group, qry2_ReportEDDProcessing with date EDD is complete and your name.				

ATTACHMENT C. MLJ ENVIRONMENTAL TOXICITY ANALYSIS REVIEW CHECKLIST

MLJ Toxicity Analysis Checklist

Delta RMP Version 1.0, Last updated on September 1, 2021

Item No.		Component Name	Verified (No	Verified	Fixes Needed	Not- Applicable	Comments
1		Summary and Replicate Results Check					
	1.1	Verify Summary Results with the PDF					
	1.1.1	Check the Mean					
	1.1.2	Check the Percent Control					
	1.1.3	Check the SigEffect: The field cannot be empty- for LABQAs it is "NA" NSG= not significant, greater than threshold SG= significant, greater than threshold NSL=not significant, less than threshold SL= significant, less than threshold					
	1.1.4	For information about TIEs reference the report to correctly format the comment. Project Specific: TIENarrative: Any sample that is SL with a PctControl less then (<) 50% should have a TIE run (excluding not applicable Field duplicate samples see comment below for this situation). To check if chemistry has been done on our end, check: W:\2.3_DataMgmt\2.1_ResultDetails_PhaseIII_TIE. The comment should include any TIE comments/conclusions if a TIE was run: "A TIE was conducted on XX/XX/XX and it was concluded that X was the cause of toxicity." "No TIE was conducted due to…" (Do not apply this comment to samples with a percent effect greater than 50%) "No TIE was conducted on field duplicate due to the TIE being performed on environmental sample."					
	1.2	Verify WQ Replicate Results with pdf					
	1.2.1	Double Check WQ Results using the P_WQResults: 1) Check WQ Results against the PDF (Copy the P_WQResults into new Workbook) 2) Check high low results: Check the high/low values are correct. Use the formulas contained in the TOXEDD_WQMeasurement_HighLowCheck excel file (newer EDDs may have hi/low tab in EDD) located in the checklist folder: W:\2.3_DataMgmt\6_ReviewEDDs\EDDChecking\EDDChecklists (Notes for Sediment: Conductivity, DO, Temp and pH can be checked using the individual water quality measurement data sheets, and Ammonia is found on a separate sheet (Total Ammonia Analysis, check Day0 and Day10 ammonia values). Project Specific: 3) Check if applicable renewal WQ Results for DO, pH, conductivity, and temperature are included in bench sheet section within lab report for *Ceriodaphnia*, *Chironomus*, *Hyalella* and *Pimephales* tests.					

Item No.			Component Name	Verified (No	Verified	Fixes Needed	Not- Applicable	Comments
		1.2.2	ResQualCode: "=" (default); "ND" (non-detect); or "NR" for results that were not recorded (due to replicate loss; not required by the program; or by negligence). "NSI" (no surviving individuals) ResQualCode to be applied if a chronic endpoint could not be recorded due to 100% mortality in a replicate and the values should be added to the datasheet if they are missing.					
	1.3		Samples (Grab, field duplicates, field blanks)					
		1.3.1	Lab Sample Details: Compare sample collection information from the database to EDD to verify elements are the same.					
	1.4		Laboratory Quality Assurance Samples (Control Samples)					
		1.4.1	Check the AgencyCode is in the AgencyCodeLookup list and is the Laboratory that created the sample.					
		1.4.2	Project Specific: Check TAccC (Test Acceptibility Criteria) are met (see Section 9 of this checklist for DRMP specific TAccC criteria).					
		1.4.3	UnitCollectionDepth = m (for water) or cm (for sediment).					
2			Processing and Analysis Information (For Summary and Results Tab)					
	2.1		Collection Information					
		2.1.1	Project Specific: Check Protocol Code is correct for individual project.					
		2.1.2	Project Specific: Agency Code = Sampling Agency for environmental samples and Lab Agency for LABQA samples.					
		2.1.3	Check the GeometryShape = "Point" for env. samples or is left blank for LABQA samples					
		2.1.4	Project Specific: Check the CollectionDeviceName = “Individual bottle by hand” or "Individual bottle by USGS-PFRG weighted sampler"; or "None" for LABQA.					
		2.1.5	PositionWaterColumn = "Subsurface" (water) or "Not Applicable" (LABQA or Sediment)					
	2.2		Toxicity Batch					
		2.2.1	Batch names should conform to the CV RDC batch naming guidelines, stored here: X:\P_CV_RDC\Management_Documentation\2_Documentation_EntryManuals\File-BatchName (or online at CV RDC batch naming conventions).					
		2.2.2	Batches are grouped by OrganismName and Method; and include supporting QA samples.					
	2.3		MatrixName, Method Name, Test Duration, Organism Name, Test Exposure Type, QA Control ID, Treatment, Concentration, Unit Treatment, Analyte Name, Unit Analyte, QA Code, Compliance Code					
		2.3.1	Matrix Name: "samplewater" (env. Sample) or "labwater" (LABQA sample)					
		2.3.2	Check the MethodName matches the requirements for the specific organism in the QAPP.					
		2.3.3	TestDuration: Check test duration matches the requirements of the method used.					
		2.3.4	Check the OrganismName matches the lookup list					
		2.3.5	Project Specific: TestExposureType = Chronic or Acute. Check Test Exposure Type reported is appropriate for the method used per the QAPP.					

Item No.			Component Name	Verified (No	Verified	Fixes Needed	Not- Applicable	Comments
		2.3.6	QA Control ID = LabSampleID of Control used for statistical analysis. Use "Control" if left blank by laboratory.					
		2.3.7	Project Specific: Treatment = “None” if no Treatment is applied. Otherwise, check if Treatment reported is appropriate per the QAPP.					
		2.3.8	Project Specific: Concentration = “0” if no Treatment is reported. If a Treatment is applied, check that the Concentration is appropriate per the QAPP.					
		2.3.9	Project Specific: UnitTreatment = “None” if no Treatment is applied. Otherwise, check if TreatmentUnit reported is appropriate per the QAPP.					
		2.3.10	Dilution = 100					
		2.3.11	Project Specific: AnalyteName = Check Analyte Name matches desired endpoints per the QAPP.					
		2.3.12	Project Specific: UnitAnalyte = Check Unit of Analyte matches desired units for endpoints per the QAPP.					
		2.3.13	QACode = "None" unless there was a deviation from expected test parameters. Refer to CEDEN lookup lists to verify any QACodes reported by the lab other than "None".					
		2.3.14	Project Specific: Compliance code = COM or PEND, depending on chain of review for the individual project					
3			Processing and Analysis Information - Summary Worksheet Only					
	3.1		Analysis Check					
		3.1.1	WQSource = Not Applicable (default)					
		3.1.2	ToxPointMethod = None (default)					
		3.1.3	Project Specific: AnalyteName = Check Analyte Name matches desired endpoints per the QAPP.					
		3.1.4	Fraction = None (default)					
		3.1.5	Project Specific: UnitAnalyte = Check Unit of Analyte matches desired units for endpoints per the QAPP.					
		3.1.6	Project Specific: Time Point = Check Time Points required per QAPP					
		3.1.7	Project Specific: Replicate Count = Replicate Count required per QAPP					
		3.1.8	Statistical Method =T-test or Mann-U (when applicable) or Fisher (when applicable)					
		3.1.9	Percent of Control and Effect values are calculated for all environmental samples. Compare to those listed in Lab Report.					
		3.1.10	Sig Effect is found in the SigEffectLookup (NA = LABQA)					
	3.2		ToxPointSummaryComments					
		3.2.1	Calculate Field Duplicate Relative Percent Difference (RPD) for field duplicates (Grab rep 2) and its associate environmental sample: See QAPP for calculation; example ABS((X-Y)/(X+Y))*100 (where X = env sample result and Y = field dup result). If RPD values equal zero (both replicates have the same positive value), use “RPD 0”. (Project Specific: label only FD sample as "FD RPD XX"					

Item No.			Component Name	Verified (No	Verified	Fixes Needed	Not- Applicable	Comments
		3.2.2	Flag FD RPD (If Applicable): If the calculated FD RPD is outside limits, flag the FieldDup AND environmental sample with a QACode of "FDP". See eQAPP for project specific limits.					
4			QA Checks					
	4.1		Laboratory batches have the correct amount of QC required by the QAPP. Each batch must have a control with it.					
	4.2		Hold Time Check: Check that all analyses were run within the appropriate holding times. If holding times were not met a QA Code of "H" is to be entered in TestQACode field in SUMMARY TAB ONLY (not Replicate tab).					
5			Toxicity Batch Worksheet					
	5.1		Submitting Agency					
		5.1.1	Project Specific: Submitting Agency is "MLJ Environmental" unless specified otherwise by the project manager.					
	5.2		LabSubmissionCode					
		5.2.1	If batch has a QACode other than "None", lab batch CANNOT be "A"; should be "A,MD" with a batch comment explaining the code; note that there is NO space between the A, and MD.					
	5.3		ToxBatchComments					
		5.3.1	Include lab batch comment explaining any QACode associated with the batch. If no code, leave blank.					
		5.3.2	Project Specific: Depending on chain of review for individual projects, populate BatchVerificationCode column with "NR"; the final verification will be done by MLJ, who will apply "VAC" after their final review.					
6			Unique Row Check					
	6.1		Unique Row: Verify that each row is unique for the Summary tab.					
	6.2		Unique Row: Verify that each row is unique for the Results tab.					
7			Data Checker					
	7.1		Data Checker: Run file through data checker and resolve any issues. http://checker.cv.mpsl.mlml.calstate.edu/CVRDC/CVRDCUpload.php.					
8			Tracking					
	8.1		Counts: Compare counts in EDD to those in the MIS to ensure all organisms and endpoints are accounted for.					
	8.2		Tracking: Update MIS for count verification and review completion.					
9			Test Acceptability Criteria (TAccC) (DRMP Specific)					
	9.1		Check for TAccC					
		9.1.1	*H. azteca* (96 hr): ≥ 90% mean survival in controls					
		9.1.2	*H. azteca* (10 day): ≥ 80% mean survival in controls and measurable growth					
		9.1.3	*C. dilutes* (10 day): ≥ 80% mean survival in controls and an average of ≥ 0.60 mg ash-free dry weight for surviving individuals					

ITEM NO.			COMPONENT NAME	VERIFIED (NO	VERIFIED	FIXES NEEDED	NOT- APPLICABLE	COMMENTS
		9.1.4	*P. promelas* (7 day): ≥80% mean survival in controls and an average of ≥ 0.25 mg ash-free dry weight for surviving individuals					
		9.1.5	*C. dubia* (6-8 day): ≥80% control survival and 60% of the surviving control females must produce 3 broods with an average of 15 or more young per surviving female					
		9.1.6	*S. capricornutum* (96-hour): (without EDTA) mean cell density of at least $2x10^5$ cells/mL in controls and variability (CV%) among control replicates ≤20%					
10			Salinity (DRMP specific)					
	10.1		For *C. dubia*: if there is an environmental sample that has a conductivity of ≤ 130 µS/cm make sure that a low conductivity tolerance control is run (CNSL).					
	10.2	10.2.1	If a low conductivity tolerance control is run (CNSL), but it does not meet TAccC, the sample is compared to the regular CNEG and the following comment applied to the CEDEN database field **ToxTestComment**: "Tolerance control based on sample conductivity did not meet test acceptability criteria; percent effect based on comparison with standard control. Effects may include response to low EC in sample." ToxTestQACode: TW (Water quality parameters outside recommended test method ranges)					
		10.2.2	If a high conductivity tolerance control is run (CNSL), but it does not meet TAccC, the sample is compared to the regular CNEG and the following comment applied to the CEDEN database field **ToxTestComment**: "Tolerance control based on sample conductivity did not meet test acceptability criteria; percent effect based on comparison with standard control. Effects may include response to high-EC in sample." **ToxTestQACode** : TW (Water quality parameters outside recommended test method ranges)					
	10.3	10.3.1	If the specific conductivity is > 2,500 µS/cm, *C. dubia* should not be tested. *H. azteca* can be used instead if samples are not already being tested for *H. azteca* toxicity.					
		10.3.2	If the specific conductivity is > 3,000 µS/cm, *S. capricornutum* should not be tested. *Thalassiosira* can be used instead, Test QA code= TAS					
		10.3.3	If the specific conductivity is > 6,000 µS/cm, *P. promelas* should not be tested. *Menidia beryllina* can be used instead, Test QA code= TAS					

Salinity Controls

The Delta RMP performs toxicity testing and data management following SWAMP guidance and associated information. There are some specific situations when additional negative controls are performed, and associated data will need to be flagged either on the result and/or batch level.

CONTROL DECISION TREES

The following decision trees were developed by the Delta RMP Pesticide Subcommittee to provide guidance on when a tolerance control should be performed, what kind of tolerance control should be created, and which samples should be compared to which controls.

Figure 9. Flowchart illustrating procedure for preparing the appropriate low-conductivity controls for *C. dubia* toxicity testing.

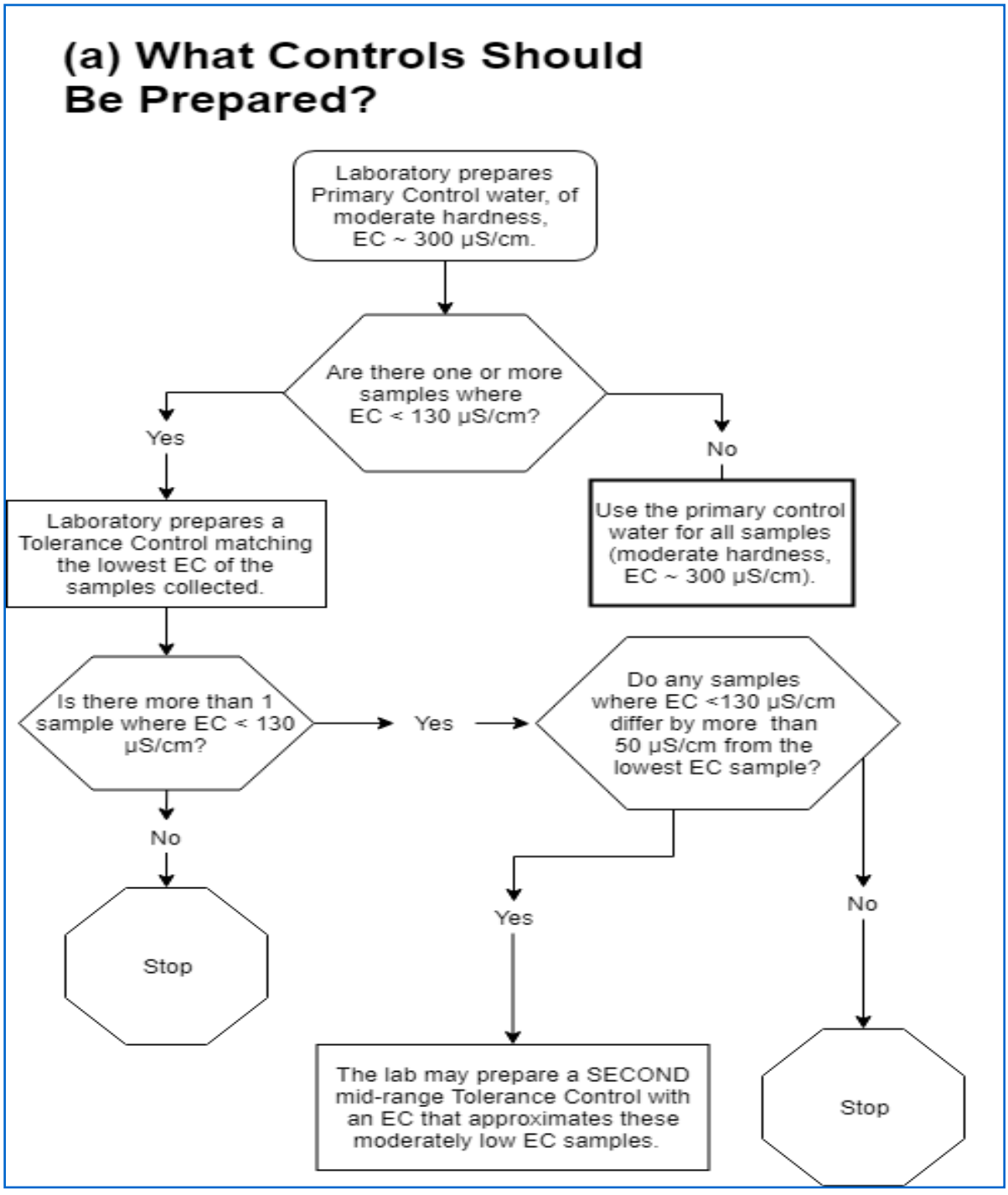


Figure 10. Flowchart illustrating procedure for selecting the appropriate low-conductivity controls for *C. dubia* toxicity testing.

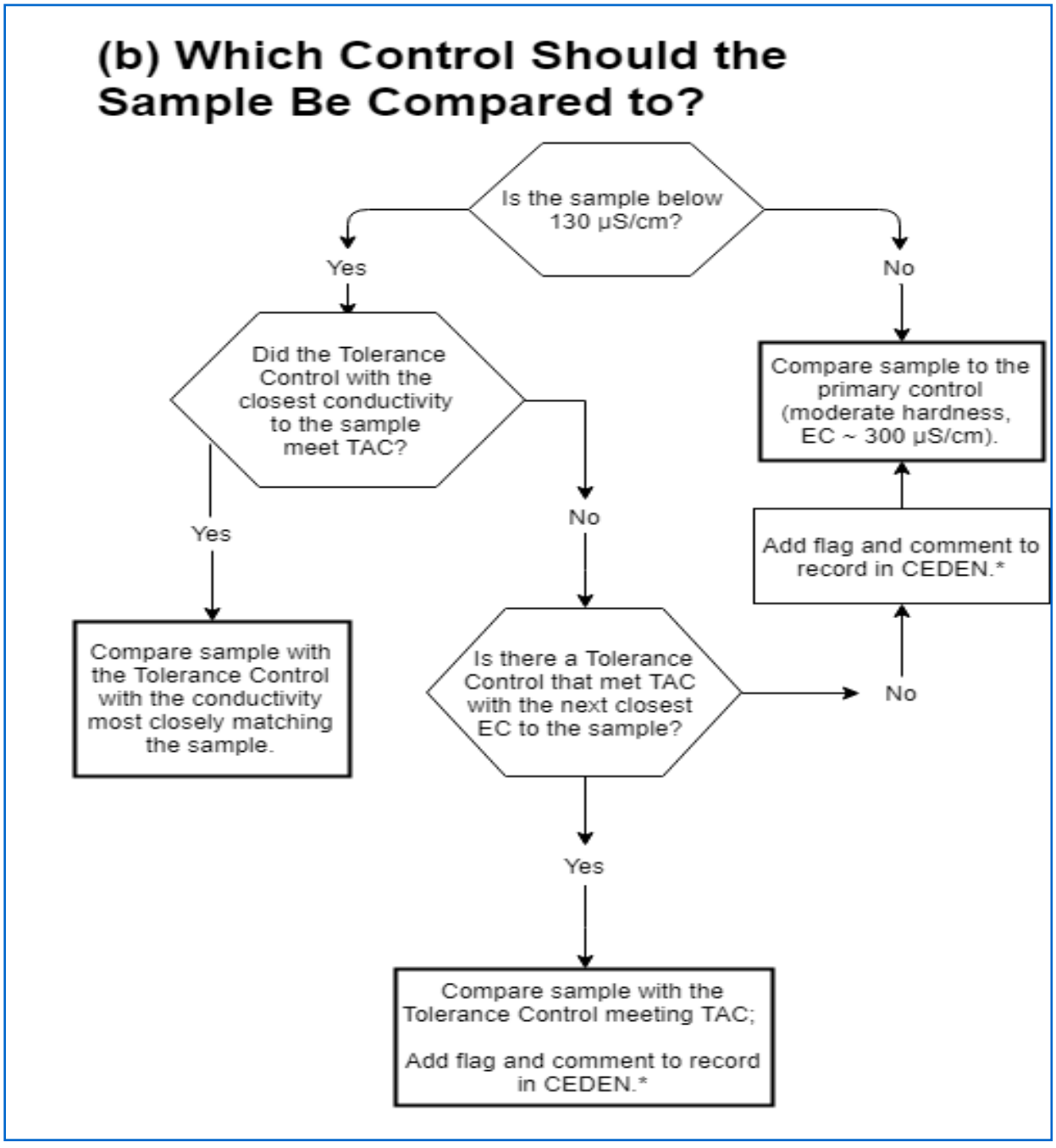
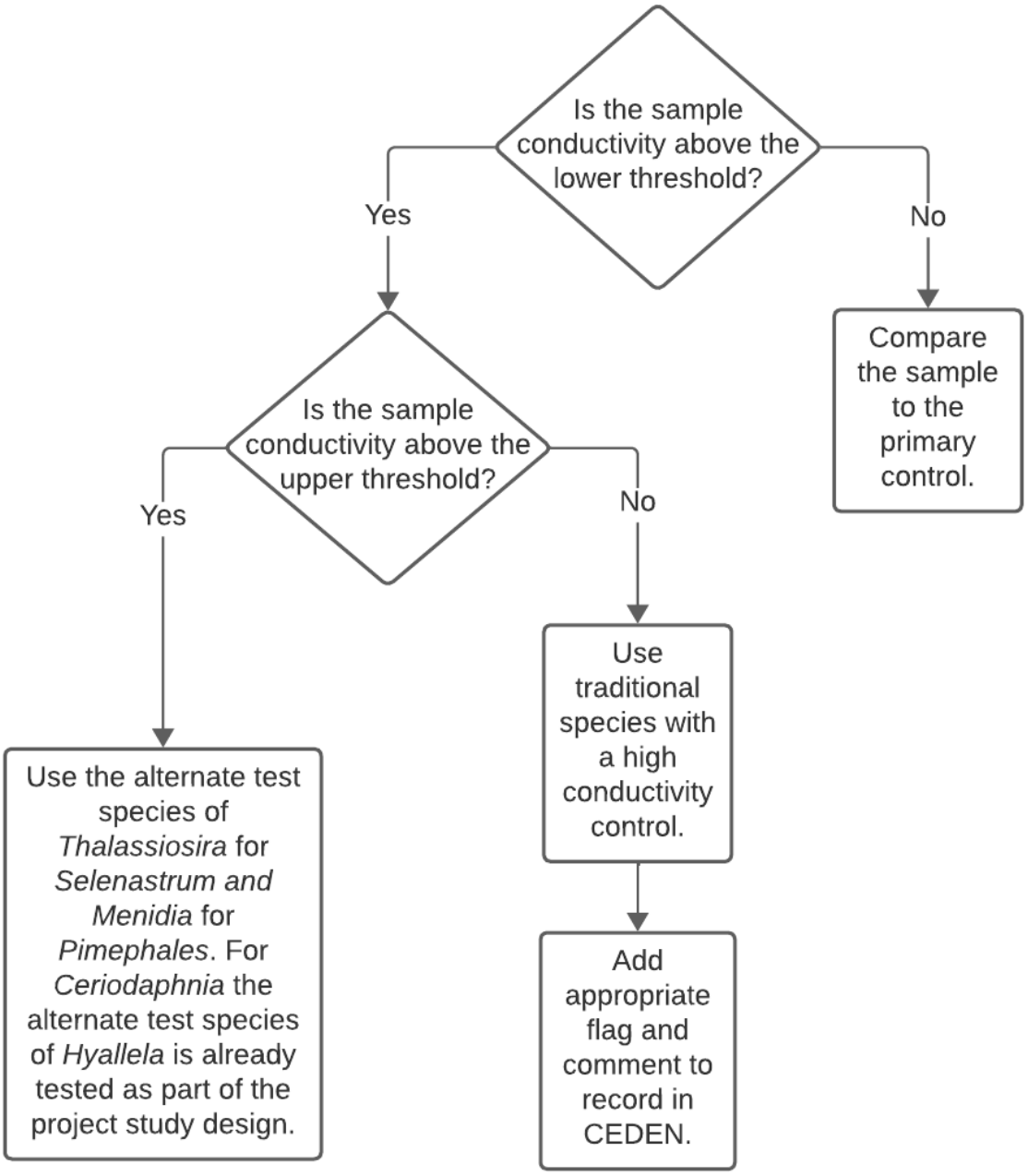


Figure 11. Flowchart illustrating procedure for selecting the appropriate high-conductivity controls for toxicity testing.



FLAGGING BUSINESS RULES

The following image reflects the scenarios and flagging combinations that have been discussed and agreed upon by the Delta RMP Pesticide Subcommittee; these rules will be followed to ensure consistency in flagging and comments across project years.

Table 12. QA Codes applied to control and test samples for possible CNEG and CNSL pass/fail combinations.

CASE	CNEG	CNSL LOW (ROWS 1-4)/ HIGH (ROWS 5-8)	BATCH VERIFICATION CODE[2]	BATCH COMPLIANCE CODE[3]	CONTROL USED FOR SAMPLES IN TOLERANCE RANGE	QACODE[4] ON CNEG	QACODE ON SAMPLES IN TOLERANCE RANGE	CONTROL USED FOR SAMPLES OUTSIDE TOLERANCE RANGE	QACODE[4] ON CNSL	QACODE[4] ON SAMPLES OUTSIDE TOLERANCE RANGE
1: CNEG(+) CNSL(+)	(+) pass TAccC	(+) pass TAccC	VAC	Com	CNEG	None	None	CNSL low	TAC	TAC,TCI
2: CNEG(-) CNSL(+)	(-) fail TAccC	(+) pass TAccC	VAC,VCN	Rej	N/A	R	R	NA	R,TCF	R,TCI
3: CNEG(+) CNSL(-)	(+) pass TAccC	(-)fail TAccC	VAC,VMD	Qual[4]	CNEG	None	None	CNEG	TCF	TCI
4: CNEG(-) CNSL(-)	(-) fail TAccC	(-)fail TAccC	VAC,VCN	Rej	N/A	R	R	NA	R,TCF	R,TCI
5: CNEG(+) CNSL(+)	(+) pass TAccC	(+) pass TAccC	VAC	Com	CNEG	None	None	CNSL high	TAC	TAC,TCT,TAS[5]
6: CNEG(-) CNSL(+)	(-) fail TAccC	(+) pass TAccC	VAC,VCN	Rej	N/A	R	R	NA	R,TCF	R,TCT
7: CNEG(+) CNSL(-)	(+) pass TAccC	(-) fail TAccC	VAC,VMD	Qual[1]	CNEG	None	None	CNEG	TCF	TCT
8: CNEG(-) CNSL(-)	(-) fail TAccC	(-) fail TAccC	VAC,VCN	Rej	N/A	R	R	NA	R,TCF	R,TCT

(+) Pass
(-) Fail
TAccC: Test Acceptability Criteria
N/A: Not applicable
CNEG: Laboratory Negative Control Sample
CNSL: Laboratory Conductivity/Salinity Control
Qual[1]: Only applied to low conductivity samples and CNSL
QACode[2]: Found in CEDEN BatchVerificationLookUp (http://ceden.org/CEDEN_Checker/Checker/DisplayCEDENLookUp.php?List=ComplianceLookUp)
QACode[3]: Found in CEDEN ComplianceLookUp (http://ceden.org/CEDEN_Checker/Checker/DisplayCEDENLookUp.php?List=BatchVerificationLookUp)
QACode[4]: Found in CEDEN QALookUp (http://ceden.org/CEDEN_Checker/Checker/DisplayCEDENLookUp.php?List=QALookUp)
TAS[5]: created new QA Code for when an alternate species is used

Batch Verification Code Scenarios

Toxicity batches are assigned batch verification codes based on the quality control of samples within the batch using CEDEN codes. There have been unique situations during the history of the Delta RMP where the batch verification code needs to reflect a minor deviation (VMD), a serious deviation (VSD), or rejection (VR). The following instances are example situations where these codes have been applied to date. The assignment of a batch verification code when deviations occur should be reported to the Delta RMP Technical Program Manager and the Pesticide Technical Advisory Committee (TAC). This table may be added to or revised over time based on guidance from the Pesticide TAC and State Board.

Table 13. Examples of instances where the batch verification code reflects data with minor deviations, serious deviations, or are rejected.

Instance: Samples outside of organism tolerance range, CNSL either not run or fails TAccC, statistical tests (for low or high conductivity samples) run against CNEG instead
BatchVerification Code: VSD (serious deviation)
Rationale: With the absence of a CNSL similar to low or high conductivity samples, whether any apparent toxic effect (for those samples out of tolerance range) is entirely or partly due to that parameter is unknown; for test batches where the CNSL is run but fails TAccC, the failure of the CNSL itself may indicate the influence of being outside of the tolerance range, and any apparent toxicity may include that confounding factor. VSD is to caveat potential data users that the deviations may not be "minor", which may be misinterpreted as equivalent to having "insignificant" effect.
Date added: 2021/03/09

Instance: Test condition "recommended" ranges deviations within 2x of the accepted range (e.g., for temperature outside of 25 ± 1°C recommendation, but still within 25 ± 2°C)
BatchVerification Code: VMD (minor deviation)
Rationale: Many method recommendations include a margin of safety, or show negligible or smaller degrees of effect where deviations are only slightly beyond target ranges. This table may be edited or refined for parameters with sharper cutoffs where notable effects are observed with smaller deviations outside of the range.
Date Added: 2021/03/09

Instance: Test condition "recommended" ranges deviations well outside of the accepted range (e.g., for 25 ± 1°C recommendation, may be outside of 25 ± 2°C)
BatchVerification Code: VSD (serious deviation)
Rationale: Deviations well outside of a recommended range have a higher probability of exceeding any margin of safety built into a method, and may show effects. VSD is to qualify data deviations may not be "minor", t. If there are parameters that are identified as being less sensitive to deviations, specific exceptions or handling rules for those may be added at a later date.
Date Added: 2021/03/09

Instance: Test condition "REQUIRED" are not met
BatchVerification Code: VR (rejected)
Rationale: Deviations outside of method "requirements" are presumed to be extremely serious, sufficient to warrant rejection of data in most cases. This table may be edited or refined for parameters where notable effects are not expected or observed, in cases rejection might be too extreme, and would otherwise remove data that might be useful for more limited purposes (e.g., if a VSD were applied instead).
Date Added: 2021/03/09

Instance:
BatchVerification Code:
Rationale:
Date Added:

ATTACHMENT D. MLJ ENVIRONMENTAL TISSUE ANALYSIS REVIEW CHECKLIST

MLJ Tissue Analysis Checklist

Item No.		Component Name	Verified (No	Verified	Fixes Needed	Not Applicable	Comments
1		Fish Composite Check (If applicable)					
1.1		Sample and Collection Verification					
	1.1.1	Lab Sample Details: Compare sample collection information from the database to the EDD to verify they are the same.					
1.2		Organism Checks					
	1.2.1	TisSource = NA					
	1.2.2	OrganismID is in a consistent format.					
	1.2.3	Fork Length < Total Length.					
	1.2.4	Project Specific: Check that the difference between the smallest fish length compared to the largest fish length is not more than 20%.					
	1.2.5	Review for outliers: fork length, total length and weight of fish.					
1.3		Tissue Checks					
	1.3.1	TissueID consistent format.					
	1.3.2	Project Specific: TissueName = fillet, PartsPrepPreservationName = Skin off					
	1.3.3	Review for outliers: tissue weight and weight of fish. Create a pivot table to review that the tissue weights are each less than the fish weights (or that they are similar values if using the whole fish).					
1.4		Composite Checks					
	1.4.1	Check the CompositeID is in a consistent format. CompositeIDs should usually include the StationCode, SampleDate and Organism reference. If program has individual vs composite samples typically "I" or "C" are referenced in the CompositeID.					
	1.4.2	Check that the CompositeType, CompositeReplicate, CompositeWeight, UnitCompositeWeight, HomogDate, OrganismGroup, ComAgencyCode are the same for each CompositeID.					
	1.4.3	Review for outliers: use the pivot table to check the individual organism weights against the CompositeWeight.					
2		Bivalve Composite Check (If applicable)					
2.1		Sample and Collection Verification					
	2.1.1	Lab Sample Details: Compare sample collection information from the database to the EDD to verify they are the same.					
2.2		Organism Checks					
	2.2.1	TisSource = "Resident" or "Transplant"					
	2.2.2	OrganismID is in a consistent format.					
	2.2.3	Check that individual bivalve measurements are provided (unless the QAPP specifically allows average measurements).					
	2.2.4	Review for outliers: use the pivot table to check for consistent values for ShellLength, ShellWidth and LengthWidthType					

Item No.		Component Name	Verified (No	Verified	Fixes Needed	Not Applicable	Comments
2.3		Tissue Checks					
	2.3.1	TissueIDs are in a consistent format.					
	2.3.2	Project Specific: TissueName = soft tissue without gonads, PartsPrepPreservationName = None					
	2.3.3	Review for outliers: use the pivot table to check tissue weight against organism weight (if reported).					
2.4		Composite Checks					
	2.4.1	Check the CompositeID is in a consistent format. CompositeIDs should usually include the StationCode, SampleDate and Organism reference. If program has individual vs composite samples typically "I" or "C" are referenced in the CompositeID.					
	2.4.2	Check the CompositeType, CompositeReplicate, CompositeWeight, UnitCompositeWeight, HomogDate, OrganismGroup, ComAgencyCode are the same for each CompositeID.					
	2.4.3	Review for outliers: use the pivot table to check the individual organism weights against the CompositeWeight.					
3		Super Composite Check (If applicable)					
3.1		Composite Checks					
	3.1.1	CompositeSourceID matches ID from original composite worksheet					
	3.1.2	SuperCompositeID is in a consistent format.					
	3.1.3	Check the CompositeType, CompositeReplicate, CompositeWeight and UnitCompositeWeight are the same for each SuperCompositeID					
	3.1.4	CompositeType = super					
4		Results Check					
4.1		Verify Results with the PDF					
	4.1.1	Check 10% of the results. Filter on the sample information to ensure that the sample information lines up with the results. If the 10% check is all correct, then proceed with processing the EDD. If errors are found, check all results against the PDF.					
	4.1.2	Check the case narrative in each PDF for important information about reanalysis, hold time violations, or anything that appears out of the ordinary that could affect specific samples or the entire batch. Paste snips of pertinent information into the LaboratoryQuestions tab, and update LabResultsComments if necessary.					
	4.1.3	Check the CompositeID matches corresponding composite worksheet CompositeID.					
	4.1.4	OrganismGroup = correct composite grouping.					
5		Sample Information					
5.1		Coalition Samples (Grab, field duplicates, field blanks, matrix spikes)					
	5.1.1	SampleTypeCode = Composite (for normal samples)					

Item No.		Component Name	Verified (No	Verified	Fixes Needed	Not Applicable	Comments
6		Processing and Analysis Information					
	6.1	Lab Batches					
	6.1.1	Batch names should conform to the CV RDC batch naming guidelines, stored here: X:\P_CV_RDC\Management_Documentation\2_Documentation_EntryManuals\File-BatchName (or online at CV RDC batch naming conventions).					
	6.1.2	Batches are defined by Method. Each batch should have same Units (excluding surrogates) and Analysis Date. Analysis Dates in a batch should be within 24 hours of each other; if there is a Digest Date then digests/extractions should all be within 24 hours.					
	6.2	Method Name, Analyte Name, Fraction Name, Unit, MDL and RL					
	6.2.1	Each method, analyte, fraction and unit has correct Preparation & Digestion. Review eQAPP to verify.					
	6.3	ExpectedValue					
	6.3.1	All MS, LCS, CRM or Surrogate samples have an expected value.					
	6.4	LabSampleComments					
	6.4.1	LabReplicates of 2 should have an RPD (Relative Percent Difference) recorded (excluding surrogate samples).					
	6.4.2	All LCS and MS have a PR (Percent Recovery) recorded					
	6.4.3	Check the correct format for PR and RPD was applied: use “PR XX” or “RPD XX”; when in combination (such as for an MSD), use “PR XX, RPD XX” (e.g., PR 99, RPD 5)					
	6.5	Submitting Agency					
	6.5.1	Submitting Agency is MLJ Environmental					
	6.6	BatchVerificationCode					
	6.6.1	Populate BatchVerificationCode column with VAC if all checks in this checklist are performed.					
7		QA Checks					
	7.1	Batch Amount Check: Verify laboratory batches have the correct amount of QC required by the QAPP; if QC is missing batch is appropriately flagged with a LabSubmissionCode of QI and a lab batch comment is included. (Verify with lab first as to why it is missing)					
	7.2	Hold Time Check: Check extraction/analysis occurred within the appropriate holding times; if holding times were not met the batch is appropriately flagged and a lab batch comment is included.					

Item No.			Component Name	Verified (No	Verified	Fixes Needed	Not Applicable	Comments
	7.3		Laboratory QC Check: Laboratory QC (MS, LCS, MSD, Lab Blank, Lab Duplicates) Verify samples are within the eQAPP requirements; if QC is outside of requirements the batch is appropriately flagged and a lab batch comment is included. Verify LabBlanks, Matrix Spikes, Lab duplicates and LCS's and any other specific MQO's according to eQAPP.					
	7.4		LabBatch Comments Check: Once all QACodes are applied use a pivot table to verify that LabBatch comments reflect all QACodes in the Results tab. (Make sure to refresh pivot table before check and use the Standardized LabBatchComments.) Check that all QC issues explained at beginning of report are recorded in EDD with either a QACode or in the batch comment. Standardized LabBatchComments excel file is located here: W:\P_ILRP\2.3_DataMgmt\6_ReviewEDDs\EDDChecking					
	7.5		Project Specific: Look at LabReplicates: if either lab results are ND, the RPD values should be NA. Change the value the lab has calculated to RPD NA if either rep 1 or rep 2 has a result of ND.					
	7.6		LabSubmissionCode Check: If the batch has any QACode other than "None", labbatch CANNOT be "A"; should be "A,MD" with a batch comment explaining the code; note that there is NO space between the "A," and "MD".					
	7.7		Lab Report qualifiers: double check PDF lab report and make sure any appropriate qualifiers are added to either the result or batch comments					
8			Unique Row Check					
	8.1		Unique Row: Verify that each row is unique. Sample and database unique.					
9			Data Checker					
	9.1		Data Checker: Run file through data checker and resolve any issues. http://checker.cv.mpsl.mlml.calstate.edu/CVRDC/CVRDCUpload.php. When errors are found run through data checker again until all applicable items are resolved. For CEDEN template use: http://ceden.org/CEDEN_checker/Checker/CEDENUpload.php					
	9.2		LabBatch naming convention changed. Verify less than 50 characters (max for the database). The data checker will show an error for anything over 35 characters, which is ok. No action necessary to change if under 50 characters.					
10			Tracking					
	10.1		Counts: Refresh pivot table for counting analytes for each environmental sample. Update analysis count in MIS ensure all analytes expected were received.					

Item No.			Component Name	Verified (No Verified	Fixes Needed	Not Applicable	Comments
	10.2		Tracking: Update MIS, LaboratoryDataProcessing group, qry2_ReportEDDProcessing with date EDD is complete and your name.					

APPENDIX III – LABORATORY SOPS

Proprietary – Do Not Distribute

The following SOPs are on kept file and only available for regulatory review and approval of this QAPP.

Section	Subsection	Reference	SOP	Title
III.A	III-A.1	EPA 350.1	QuikChem Method 31-107-06-1-B	Determination of Ammonia in Brackish or Seawater by Flow Injection Analysis
	III-A.2	EPA 353.4	QuikChem 31-107-04-1-E	Determination of Nitrate/Nitrite in Brackish or Seawater by Flow Injection Analysis Colorimetry
	III-A.3	EPA 353.4	QuikChem 31-107-05-1-A	Determination of Nitrite in Brackish or Seawater by Flow Injection Analysis
	III-A.4	EPA 365.5	QuikChem 31-115-01-1-I	Orthophosphate in Seawaters
	III-A.5	EPA 366	QuikChem 31-114-27-1-D	Determination of Silicate in Brackish or Seawater by Flow Injection Analysis
	III-A.6	Valderrama 1981	Valderrama 1981	The Simultaneous Analysis of Total Nitrogen and Total Phosphorus in Natural Waters
	III-A.7	EPA 440.0	EPA 440.0	Determination of Carbon and Nitrogen in Sediments and Particulates of Estuarine/Coastal Waters Using Elemental Analysis
	III-A.8	EPA 445.0	EPA 445.0	*In Vitro* Determination of Chlorophyll *a* and Pheophytin *a* in Marine and Freshwater Algae by Fluorescence
III.B	III-B.1	Beaver et al. 2013	Beaver et al. 2013	Response of phytoplankton and zooplankton communities in six reservoirs of the middle Missouri River (USA) to drought conditions and a major flood event

Section	Subsection	Reference	SOP	Title
	III-B.2	Göröcs et al. 2018	Göröcs et al. 2018	A deep learning-enabled portable imaging flow cytometer for cost-effective, high throughput, and label-free analysis of natural water samples
	III-B.3	ELISA Abraxis 520011	ELISA Abraxis 520011	ABRAXIS® Microcystins-ADDA OH ELISA Microtiter Plate