Mojave River Watershed Group

Small Municipal Separate Storm Sewer System General Permit

Receiving Water Monitoring Program Plan

Phase II Small Municipal Separate Storm Sewer System General Permit

Receiving Water Monitoring Program

Prepared for:

Mojave River Watershed Group

Town of Apple Valley
City of Hesperia
City of Victorville
County of San Bernardino

November 13, 2014

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Acronyms

ASBS	Area of Special Biological Significance
BMI	Benthic Macroinvertebrates
BMP	Best Management Practice
CEDEN	California Environmental Data Exchange Network
CWA	Clean Water Act
cfs	Cubic feet per second
DI	Deionized water
DO	Dissolved oxygen
GPS	Global Positioning System
LID	Low Impact Development
MS	Matrix Spike
MSD	Matrix Spike Duplicate
MQO	Measurement Quality Objective
m	Meter
MDL	Method Detection Limit
mL	Milliliter
MRWG	Mojave River Watershed Group
MS4	Municipal Separate Storm Sewer System
NPDES	National Pollutant Discharge Elimination System
NOI	Notice of Intent
PHAB	Physical Habitat
psi	Pound-force per square inch
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
RWB	Reach-wide benthos
RWMP	Receiving Water Monitoring Program
RWQCB	Regional Water Quality Control Board
RPD	Relative Percent Difference
RL	Reporting Limit
SOP	Standard Operating Procedure
SRM	Standard Reference Material
SWRCB	State Water Resources Control Board
SMARTS	Storm Water Multiple Application and Report Tracking System
SWAMP	Surface Water Ambient Monitoring Program
TMDL	Total Maximum Daily Load
USGS	United States Geological Survey
WDID	Waste Discharge Identification
WDR	Waste Discharge Requirement
WQM	Water Quality Monitoring

1. Introduction

On February 5, 2013 the State Water Resources Control Board (State Board or SWRCB) adopted Order No. 2013-0001-DWQ *Waste Discharge Requirements (WDRs) for Stormwater Discharges from Small Municipal Separate Storm Sewer Systems (MS4s)*, National Pollutant Discharge Elimination System (NPDES) Permit No. CAS000004. Superseding the 2003 permit, this statewide Phase II Small MS4 General Permit became effective on July 1, 2013. Each municipal Permittee will be responsible for its implementation, within their jurisdiction, under Regional Water Quality Control Board (Regional Board or RWQCB) oversight. The Mojave River Watershed Group (MRWG) agencies, shown in **Figure 1-1** and consisting of the Town of Apple Valley, Cities of Hesperia and Victorville, and County of San Bernardino, submitted individual Notices of Intent (NOIs) for coverage under the 2013 permit coverage, as Renewal Traditional Small MS4 Permittees, prior to July 1, 2013 with oversight by Lahontan RWQCB.

The Phase II Small MS4 General Permit is intended to minimize or eliminate adverse surface water quality impacts by establishing controls on MS4 stormwater and non-stormwater runoff discharges, which may contain pollutants such as trash, debris, sediments, fertilizers, oil, grease, metals, and pesticides, that have the potential to degrade receiving water beneficial uses. Permittees listed in Permit Attachment A are required to conduct Water Quality Monitoring (WQM) per Section E.13, which include the following programs:

- Area of Special Biological Significance (ASBS) Monitoring (Section E.13.a);
- Total Maximum Daily Load (TMDL) Monitoring (Section E.13.b);
- Clean Water Act (CWA) 303(d) list or State Integrated Report Monitoring (Section E.13.c);
- Receiving Water Monitoring (Section E.13.d.1); and
- Special Studies (Section E.13.d.2).

Permittees, such as the MRWG, that are not already conducting ASBS, TMDL, or 303(d) monitoring must participate in Receiving Water Monitoring or Special Studies in accordance with Permit Sections E.13.d.1 or E.13.d.2.

The MRWG Receiving Water Monitoring Program (RWMP) will be a collaborative regional effort to comprehensively evaluate water quality conditions within the Mojave River Watershed. The MRWG RWMP approach will:

1. Assess whether water quality standards are being met in the receiving water;
2. Assess the extent and magnitude of the current or potential receiving water problems;
3. Identify the relative urban runoff contribution to the receiving water problem(s);
4. Characterize the sources to urban runoff that contribute to the receiving water problem(s); and
5. Evaluate whether receiving water conditions are changing over time due to urban development.

1.1 Mojave River Watershed Background

Located within San Bernardino County, the Mojave River Watershed encompasses approximately 4,500 square miles, as shown in **Figure 1-2**. In 2010, the total population in the Mojave River Watershed was approximately 390,000 people with much of the population concentrated in the Victor Valley, which includes the communities of Adelanto, Apple Valley, Hesperia, Lucerne Valley, Oak Hills, Phelan, Victorville, and Wrightwood. Additional urban growth is expected throughout the watershed, with the population projected to reach nearly one-half million people by the year 2015.

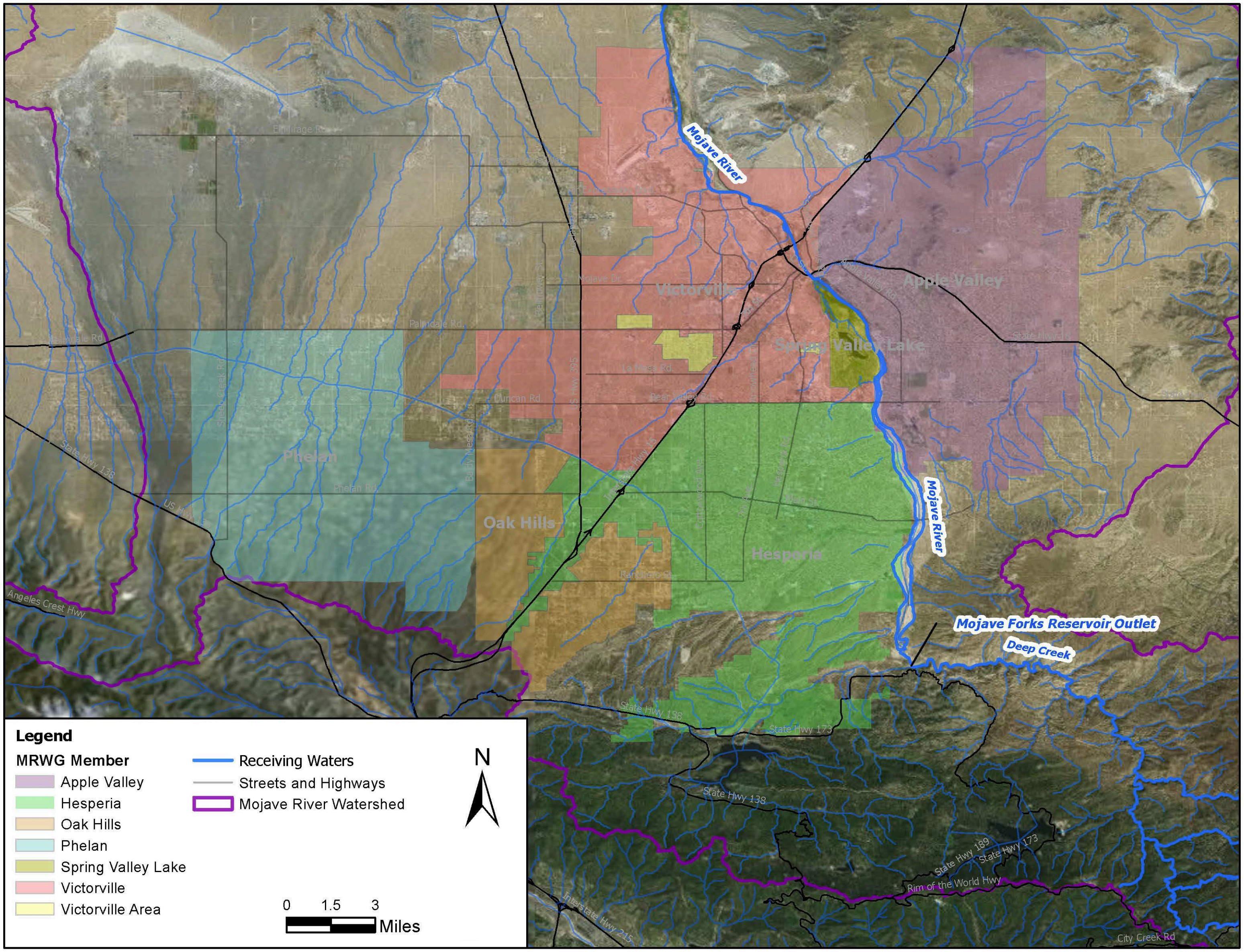

Figure 1-1 Mojave River Watershed Group and Adjacent Communities

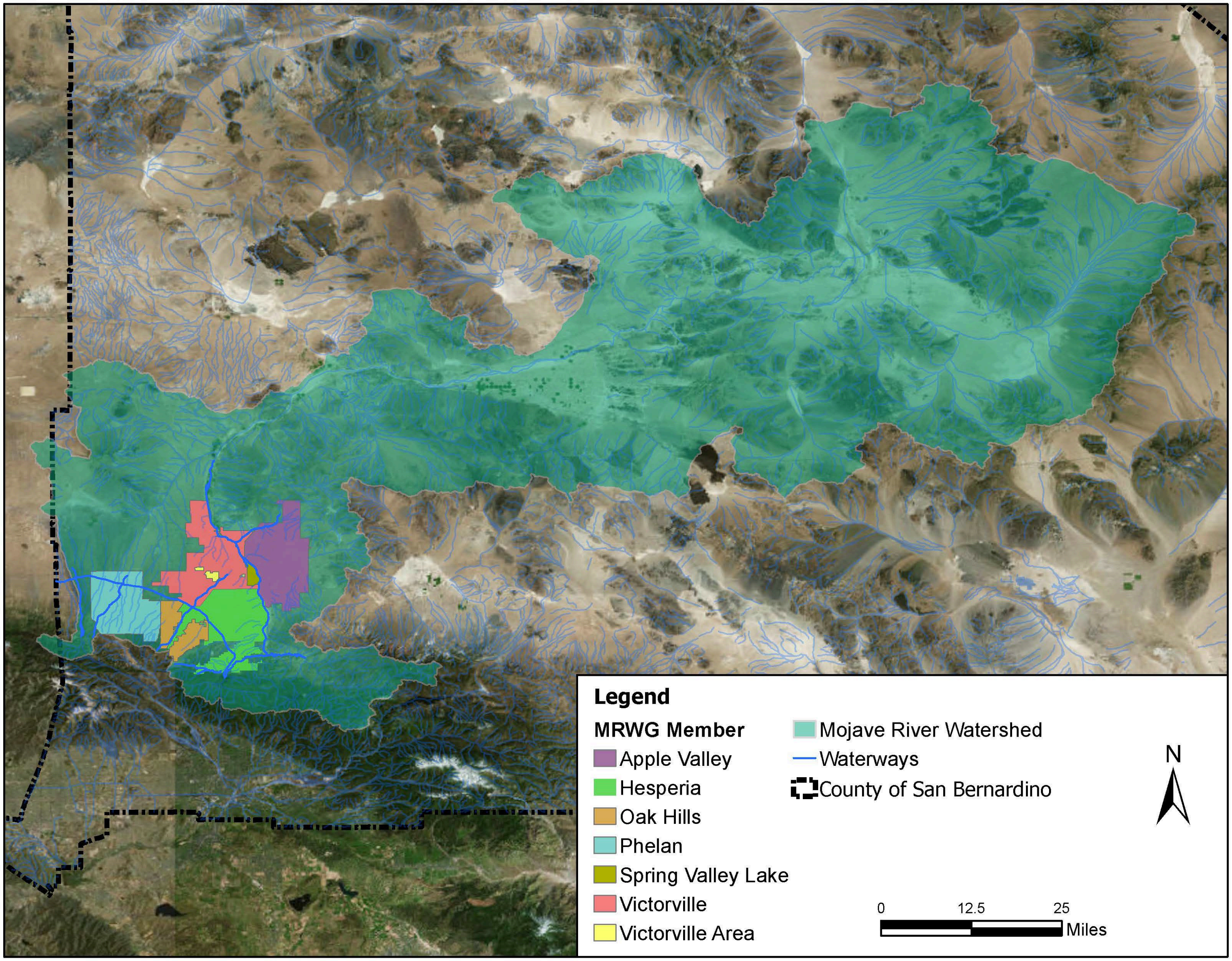

Figure 1-2 Mojave River Watershed Area

As indicted in **Figure 1-3**, the United States Geological Survey (USGS) Report 95-4189 has divided the Mojave River Watershed into five sections based on hydrologic features and identified as:

1. Headwaters Section – Tributaries above the Mojave Forks Dam;
2. Upper Main-Stem Section – Mojave Forks Dam to the Lower Narrows at Victorville;
3. Middle Main-Stem Section – Lower Narrows to the Waterman Fault at Barstow;
4. Lower Main-Stem Section – Waterman Fault to Afton Canyon; and
5. Tailwater Section – Afton Canyon to Silver Lake.

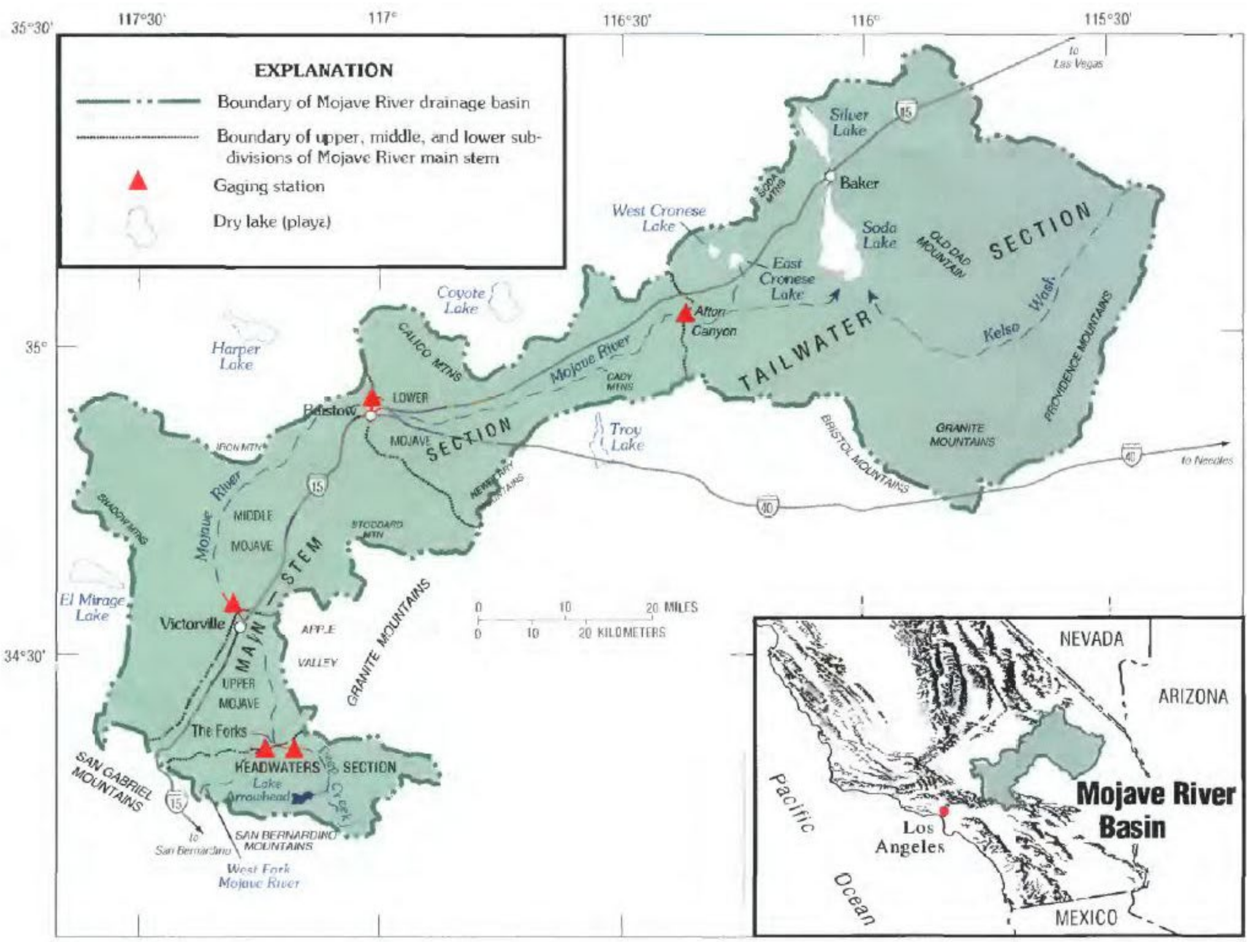

Figure 1-3 Mojave River Drainage Basin[1]

The MRWG area is located in the Upper, and Middle, Main-Stem Mojave River Watershed sections which, as typical of the arid southwest, receives limited and unpredictable rainfall. With San Bernardino Mountain elevations reaching 8,535 feet, the Mojave River headwaters receive an annual average precipitation of over 40 inches, much of which falls as snow that provides spring recharge which rapidly percolates into the porous Mojave River alluvium. The Mojave River Basin consists of interconnected floodplain and regional aquifers, composed of sand and gravel underlain by silts and clay, that are as much as 250 feet thick and generally conform to the surface expression of the Mojave River. Historically, Mojave River basin recharges are approximately 75,000 acre-feet per year and locally derived groundwater is a primary water supply source throughout the watershed.

[1] Modified from USGS Water-Investigation Report 95-4189, A Watershed Management Approach to Assessment of Water Quality and Development of Revised Water Quality Standards for Ground Waters of Mojave River Floodplain – Christopher R. Maxwell

The Mojave River Watershed has historically contained limited areas of agricultural, residential, industrial, and military land use. Over the last several decades, the Victor Valley has become significantly more urbanized and residential, which has resulted in stormwater and treated wastewater discharge management decisions that could potentially affect Mojave River Watershed water quality. Ongoing urbanization along with water quality issues associated with past and current agricultural, industrial, and military land uses will continue to be underlining challenges the watershed will have to manage.

1.1.1 The Mojave River

The primary geographic and hydrologic feature of the watershed is the Mojave River, which historically flowed perennially in most sections. By the mid 1900's, only the main-stem reaches maintained naturally occurring perennial flows. Since then, as pumping for agricultural and municipal purposes has continued to increase, even these reaches have ceased to flow for most of the year and the river is unreliable for most direct agricultural and municipal users. The only remaining perennial flows occur from immediately upstream of the Upper Narrows to a short distance downstream from the Lower Narrows, as depicted in **Figure 1-4**, where groundwater is forced to the surface by local geology and the remaining 100 miles of streambed are now normally dry, except during and immediately following storms. Only very significant winter storms, that produce runoff throughout the watershed, result in flows along the entire length of the Mojave River. Flows from ephemeral tributary streams has never been gauged or measured directly.

The genesis of the Mojave River results from the confluence of the West Fork Mojave River and Deep Creek at "The Forks," as shown in **Figure 1-4**, at an elevation of about 3,000 feet above sea level. The Mojave River then flows generally northward through Victorville, northeastward through Barstow, and eastward through Afton Canyon which is at an elevation of about 1,400 feet above sea level. After emerging from Afton Canyon, the Mojave River terminates at Soda and East Cronese Dry Lakes. Presently, stream flows along the West Fork Mojave River, Deep Creek, and Mojave River are monitored at six USGS gauging stations as summarized in **Table 1-1** and shown in **Figure 1-4**. Real-time stream flow data for these six USGS gauging stations can be accessed at the USGS website under the National Water Information System, Current Conditions for California: Streamflow[2].

Table 1-1 Retired and Current USGS Gauging Stations on the Mojave River

Gauging Station	Location	Identifier	GPS Coordinates
a	Deep Creek near Hesperia	10260500	34.343056°, -117.225556°
b	West Fork Mojave River near Hesperia	10260950	34.338889°, -117.256944°
c[1]	West Fork Mojave River near Hesperia (Deep Creek and West Fork)	10261100	34.34583°, -117.237222°
d	Mojave River at Lower Narrows near Victorville	10261500	34.573056°, -117.319723°
e	Mojave River at Barstow	10262500	34.906944°, -117.021944°
f	Mojave River at Afton	10263000	35.037222°, -116.383334°

[1] Retired Station

[2] USGS: National Water Information System: Current Conditions for California Streamflow: http://waterdata.usgs.gov/ca/nwis/current/?type=flow&group_key=county_cd

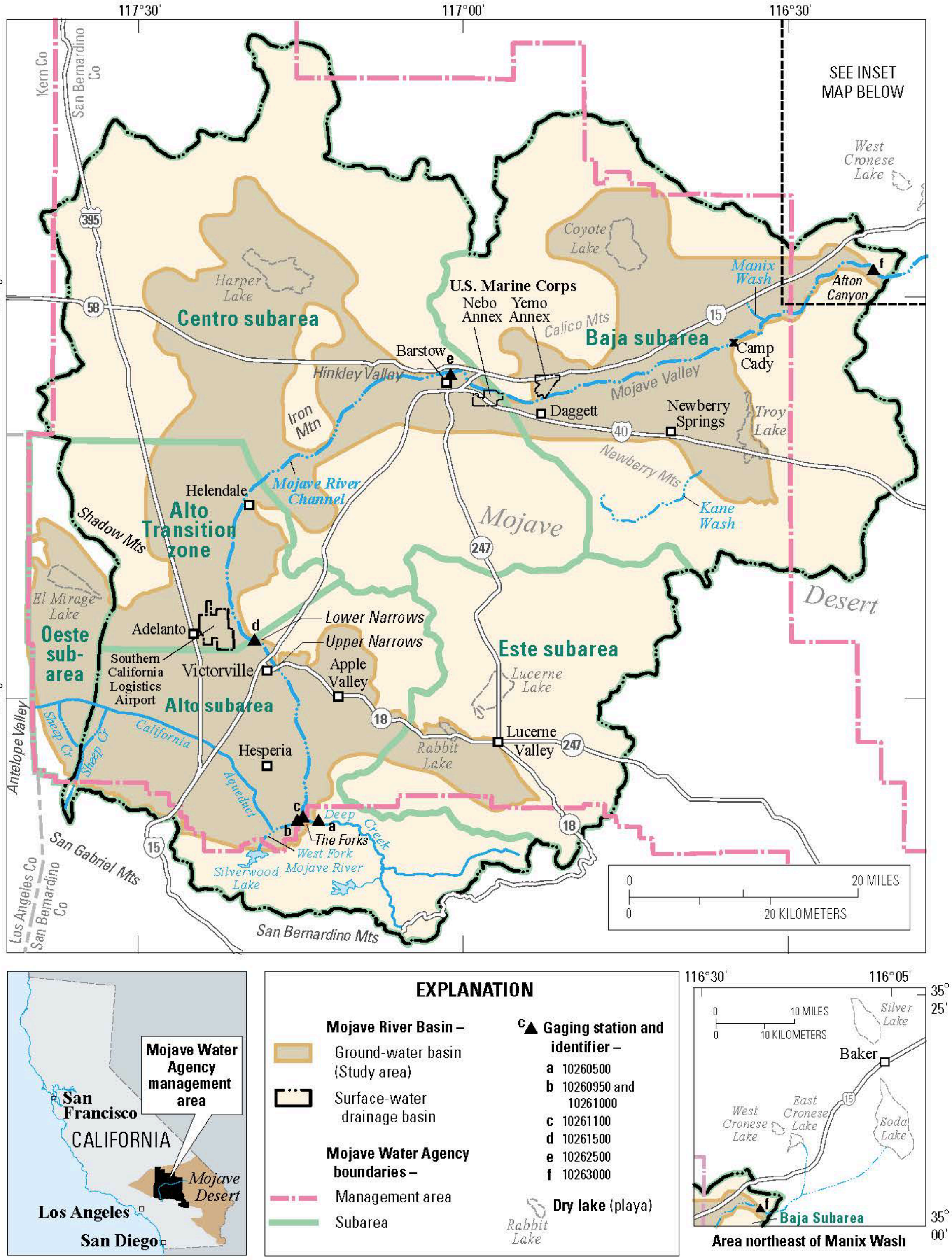

Figure 1-4 Location of USGS Gauging Stations[3]

[3]Retrieved from USGS, 2001. Water-Resources Investigations Report, *Simulation of Ground-Water Flow in the Mojave River Basin, California*

1.2 MRWG Receiving Water Monitoring Program Overview

The MRWG RWMP will provide the necessary data to demonstrate whether receiving water quality and beneficial uses are protected from the effects of urbanization and guide the MRWG in implementing future water quality management decisions. The MRWGs RWMP is composed of the following elements:

1. Receiving Water Monitoring Approach;
2. Sampling Frequency and Methods;
3. Sampling Protocol;
4. Quality Control;
5. Quality Assurance Project Plan (QAPP); and
6. Data Evaluation and Reporting.

Implementation of the MRWG RWMP will assess receiving water quality within the MRWG jurisdictional area and whether pollution source control efforts maintain and improve receiving water quality over time.

2. Receiving Water Monitoring

The MRWG RWMP objectives were identified in Permit Sections E.13.d.1.ii.a and E.13.d.1.ii.b as:

- To determine receiving water quality changes as Low Impact Development (LID) Best Management Practices (BMPs) are integrated into new development; and
- To assess whether receiving water quality improves as a result of efforts to control the sources of pollution and education to the public.

2.1 Monitoring Objectives and Approach

To satisfy Permit Section E.13.d.1.ii and group goals identified in the introduction, the 2014 MRWG Annual Report and MRWG RWMP proposes monitoring at the following two locations:

MR-URI is the Urban/Rural Interface location to monitor receiving water quality from an upstream location and evaluate changes in receiving water quality over time; and

MR-UD is the Urban Downstream location to monitor downstream of an urban area and evaluate changes in receiving water quality over time.

Figure 2-1 presents the approximate locations of the two receiving water monitoring locations.

2.1.1 Urban/Rural Interface (Upstream Location)

Permit Section E.13.d.1.ii.a characterizes the selection of the Urban/Rural Interface site as follows:

- *One characteristic waterway at the top, or upstream of a HUC 12 level watershed planned for development in the near future that traverses an urban/rural interface, using the 2010 Census Data and urban area maps, and establish a permanent monitoring location at the identified urban/rural interface*.

Based on the May 28, 2014 guidance letter provided by the Regional Board, the MRWG selected MR-URI, near the outlet of the Mojave Forks Dam, as the Urban/Rural Interface receiving water monitoring location. The Mojave Forks Dam, located just below the confluence of the West Fork Mojave River and Deep Creek, is unusual in having no discharge gates, functionally making it equivalent to a very large flood control detention structure with no long duration water impoundment capabilities. Ignoring debris blockages, flows of less than 7,300 cubic feet per second (cfs) are intended to pass unimpeded through the dam orifice. Flow rates above this value are dependent on water depth behind the dam, but limited by orifice flow hydraulics. The Mojave Forks Dam can detain approximately 179,400 acre-feet of water below the spill way elevation. USGS gauging station b (10260950), as shown in **Figure 2-1**, is essentially co-located with MR-URI and will provide the highest quality historic and current stream flow data to complement the MRWG RWMP water quality monitoring data for the location.

The MR-URI monitoring location will be established as a permanent monitoring location and assess changes in receiving water quality as LID BMPs are integrated into new development. The area upstream of the MR-URI monitoring location is relatively undeveloped and an ideal location to satisfy the Urban/Rural Interface requirements of the Phase II Small MS4 General Permit. The area surrounding the MR-URI receiving water monitoring location is part of the Mojave River Forks Regional Park and provides recreational, camping, and hiking facilities. The MR-URI monitoring location is an ideal location as it will establish baseline monitoring results to be used to indicate whether any changes in receiving water quality are occurring downstream. **Table 2-1** provides a summary of information for the MR-URI monitoring location.

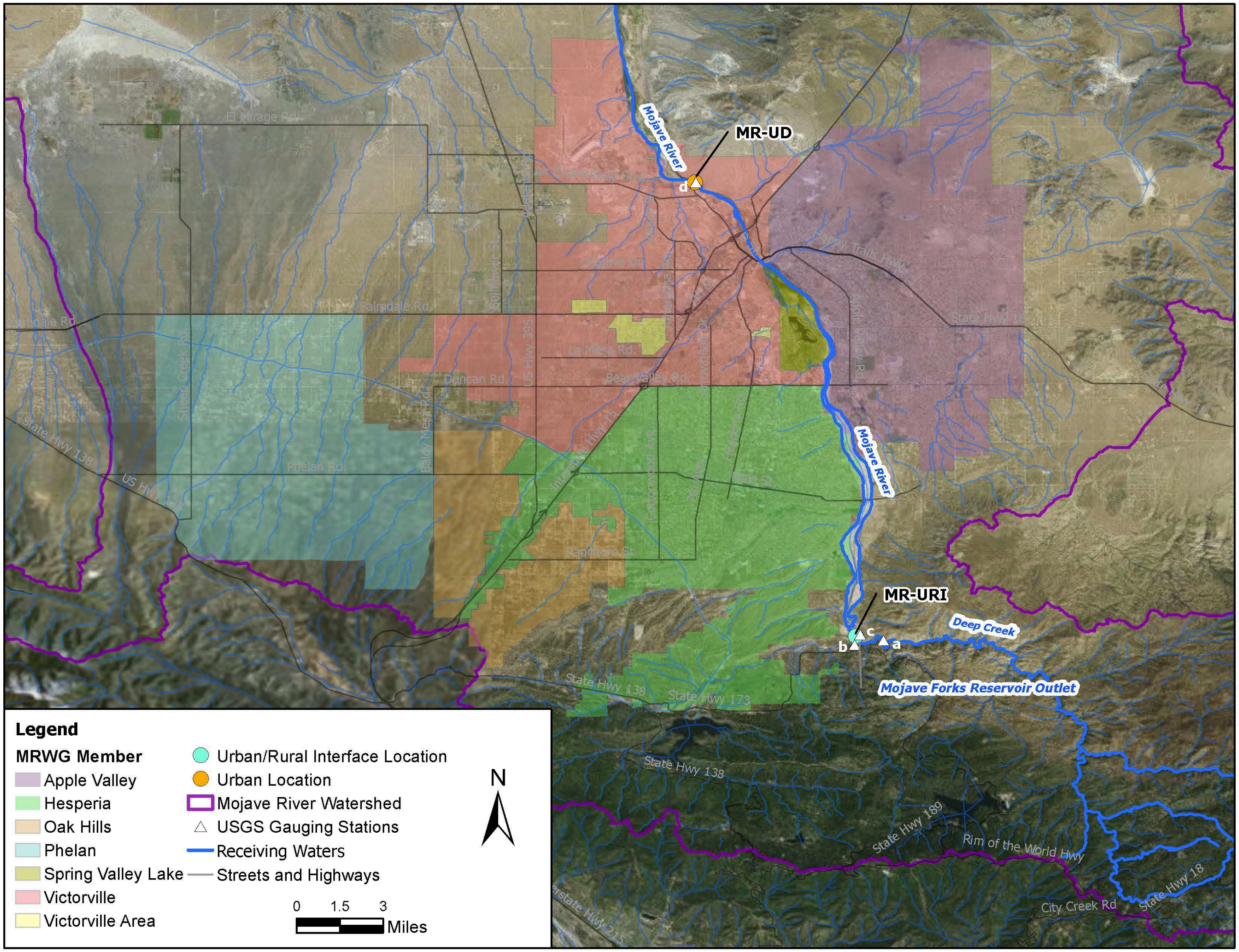

Figure 2-1 Receiving Water Monitoring Site Locations

<table>
<tr><th colspan="3">Table 2-1 MR-URI Urban/Rural Interface Receiving Water Monitoring Location</th></tr>
<tr><td>Site ID: MR-URI</td><td>Monitoring Type: Receiving Water</td><td>GPS Coordinates: 34.345149°, -117.239449°</td></tr>
<tr><td>Watershed: Mojave River</td><td colspan="2">Nearest Street Address: 5515 Arrowhead Lake Rd, Hesperia, CA 92345</td></tr>
<tr><td colspan="3">Aerial View:

</td></tr>
<tr><td colspan="3">Site View:

</td></tr>
</table>

2.2.2 Urban Downstream Location

Permit section E.13.d.1.ii.b characterizes the selection of the Urban Downstream site as follows:

- *One characteristic waterway at the bottom, or downstream, of the same HUC 12 watershed as the urban/rural interface monitoring location and within an urbanized area and establish a permanent monitoring location at the identified urbanized area waterway.*

Based on the May 28, 2014 guidance letter provided by the Regional Board, the MRWG located the Urban Downstream receiving water monitoring location, MR-UD, at the Mojave River Narrows, as shown in **Figure 2-1**. The MR-UD monitoring site is co-located with USGS gauging station D and can be expected to provide the highest quality historic and current stream flow data to complement the MRWG RWMP water quality monitoring data collected for the location. This location is within Rockview Nature Park, near the northern border of the City of Victorville, and is downstream of the MRWG member agencies. The site is located between the Upper and Lower Narrows where perennial flows historically occur as groundwater is forced to the surface by local geology; however, uprising groundwater may exhibit differing water quality characteristics than strictly surface flows. This source water characteristic may complicate the interpretation of receiving water quality data, but is unavoidable in this watershed.

MR-UD will be established as a permanent riparian monitoring location to evaluate water quality improvements as a result of pollution source control and public education efforts. The surrounding area consists predominately of industrial facilities with some residential and vacant land uses. The industrial facilities located near MR-UD consist of a gasoline service station, warehouse and storage facilities, substations, and concrete/cement batch plants. Although development in the surrounding area is expansive, the location for MR-UD is ultimately an ideal location to satisfy the requirements of the Phase II Small MS4 General Permit Urban Downstream monitoring location. **Table 2-2** provides additional information for the MR-UD monitoring location.

Table 2-2 MR-UD Urban Downstream Receiving Water Monitoring Location

Site ID: MR-UD	**Monitoring Type:** Receiving Water	**Latitude:** 34.572902°, -117.320138°
Watershed: Mojave River	**Nearest Street Address:** 17800 National Trails Hwy, Victorville, CA 92394	

Aerial View:

Site View:

3. Sampling Frequency and Methods

As outlined in Permit Section E.13.d.1, the MRWG RWMP will be implemented in accordance with Permit Table 3: Receiving Water Monitoring Parameters and Protocols. **Table 3-1** summarizes the monitoring frequency for each of the required parameters.

Table 3-1 Receiving Water Monitoring Parameters and Frequency

Endpoint	Frequency			
	Spring	**Summer**	**Fall**	**Winter**
Field Measurement				
Dissolved oxygen (DO)	Continuous[1] Sampling - 1 Week	Continuous[1] Sampling - 1 Week	Continuous[1] Sampling - 1 Week	
Temperature	Continuous[1] Sampling - 2 Weeks	Continuous[1] Sampling - 2 Weeks	Continuous[1] Sampling - 2 Weeks	
Flow[2]	Continuous[1] Sampling - 2 Weeks	Continuous[1] Sampling - 2 Weeks	Continuous[1] Sampling - 2 Weeks	
PHAB assessment: - pH - Specific Conductance - Alkalinity	1			
Channel cross sections	1			
Photo documentation	1			
Nutrients (Algae): - Total Chlorophyll[3]	1	1	1	
Laboratory Analysis				
Pyrethroids[4]* (sediment)	1			
Bacteria			Early Fall. Once weekly for 4 weeks	
Nutrients (Algae)	1	1	1	
Benthic Macroinvertebrate (BMI) Bioassessment	1			

[1] Continuous sampling is the preferred approach, but physical limitations that might force the collection of grab samples. When stream depths are < 1 foot, grab samples will be collected.

[2] Flow data will be derived from the co-located USGS Stream Gauging Stations.

[3] Water column only

[4] *Pyrethroid monitoring is required at the urban/rural interface site only.*

* *Currently, pyrethroids are the pesticide of greatest concern and abundance in urban/suburban waterways. However, new regulations enacted by the Dept. of Pesticide Regulation restrict how pyrethroids may be applied. Initial models by UC Davis researchers suggest that this could result in a runoff reduction of 80-90%, depending on the amount of impervious cover in the watershed. In the future, other pesticides may become more of a threat to aquatic life in urban waterways. One pesticide that is being used with greater frequency is fipronil, a phenylpyrazole insecticide, that is more water soluble than pyrethroids. In order to use the resources of the Permittees most efficiently, the State Water Resource Control Board reserves the right to modify the terms and conditions of the permit based on new information on pesticide use and toxicity. This could include substituting another pesticide for monitoring or eliminating this endpoint.*

3.1 Analytical Methods

Analytical methods are described in the Standard Methods for the Examination of Water and Wastewater and US Environmental Protection Agency (EPA) standard methods. The parameters, analytical methods, units of measure, method detection limits (MDLs), and reporting limits (RLs) are summarized in **Table 3-2**.

Table 3-2 Analytical Methods

Parameters	Matrix	Analytical Method	Units	MDL	RL
Pyrethroids					
Allethrin	Sediment	GCMS-NCI-SIM/8270M	ug/kg (ng/g)	0.05	0.33
Bifenthrin	Sediment	GCMS-NCI-SIM/8270M	ug/kg (ng/g)	0.1	0.33
Cyfluthrin	Sediment	GCMS-NCI-SIM/8270M	ug/kg (ng/g)	0.11	0.33
Lambda-Cyhalothrin	Sediment	GCMS-NCI-SIM/8270M	ug/kg (ng/g)	0.06	0.33
Cypermethrin	Sediment	GCMS-NCI-SIM/8270M	ug/kg (ng/g)	0.1	0.33
Deltamethrin:Tralomethrin	Sediment	GCMS-NCI-SIM/8270M	ug/kg (ng/g)	0.12	0.33
Esfenvalerate:Fenvalerate	Sediment	GCMS-NCI-SIM/8270M	ug/kg (ng/g)	0.13	0.33
Fenpropathrin	Sediment	GCMS-NCI-SIM/8270M	ug/kg (ng/g)	0.07	0.33
Tau-Fluvalinate	Sediment	GCMS-NCI-SIM/8270M	ug/kg (ng/g)	0.04	0.33
Permethrin	Sediment	GCMS-NCI-SIM/8270M	ug/kg (ng/g)	0.11	0.33
Tetramethrin	Sediment	GCMS-NCI-SIM/8270M	ug/kg (ng/g)	0.06	0.33
Bacteria					
E. coli	Water	SM 9223B	MPN/100mL	2	2
Nutrients					
Benthic Algal biomas and % cover	Sediment	SWAMP SOP	-	-	-
Bioassessment					
BMI field samples	Water	SWAMP physical habitat and BMI SOP (Ode et al. 2007, Appendix B)	-	-	-

4. Sampling Protocol

Sampling procedures will adhere to the guidelines found in the Surface Water Ambient Monitoring Program (SWAMP) water sample collection Standard Operating Procedure (SOP), "Field Collection Procedures for Water Samples" and included in Attachment 3 of **Appendix A** of the QAPP. This section details the monitoring event preparation, water sample collection procedures, and sample management procedures that will be followed.

4.1 Monitoring Event Preparation

The following sections refer to the specific monitoring event preparation protocols that will be followed by the sampling team.

4.1.1 Mobilization and Staffing

Receiving water monitoring requires considerable planning. It is critical to plan and prepare all possible aspects of the field efforts well in advance. A staffing plan of personnel and equipment required for each facet of monitoring will be established prior to the start of each monitoring event.

The field crew, during the receiving water monitoring event, is anticipated to consist of a two to three person team, as outline in the SWAMP sampling SOPs as well as a precaution given the number of samples that are to be collected. The staffing plan will include the following:

- Personnel assigned to each position;
- Necessary sampling, access and equipment mobilization and readiness; and
- Communication channels and alternate contacts.

4.1.2 Personnel

Water quality monitoring tasks require a variety of skills and positions. The required personnel include a:

- Sampling Manager;
- Field Coordinator; and
- Field Technicians.

Sampling Manager – The Sampling Manager is a technically-skilled, field experienced supervisor and is the most experienced member of the field team. This position requires a thorough understanding of the project requirements, sampling procedures, and equipment operations. The Sampling Manager will communicate frequently with the Field Coordinator and also monitor the ability of the field team to safely and effectively complete their shifts. The Sampling Manager will be available to troubleshoot the common problems that could be experienced by the field team.

Field Coordinator – The Field Coordinator is a person trained in field operations and procedures of dry- and wet-weather water quality monitoring. The Field Coordinator is responsible for directing the procedures at each site visit and ensuring that samples are collected and data is recorded properly. The Field Coordinator will communicate with the Sampling Manager to aid in the determination of task priorities and address any questions that may arise. The Field Coordinator will usually have one or two field technicians assisting them.

Field Technicians –Field technicians are trained in water sample collection and health and safety issues.

4.1.3 Field Equipment Preparation

Sampling personnel will provide all necessary equipment to be able to sample in anticipated environmental and physical conditions. The necessary equipment will be loaded into the appropriate vehicle before mobilizing to the monitoring site locations. A list of necessary equipment is presented below.

Table 4-1 Equipment and Mobilization List		
➢ Signed Access Authorization Letter ➢ Log books ➢ Job Site Health Analysis ➢ Tailgate Safety Meeting forms ➢ First aid kit ➢ Warning Lights and Signs ➢ Traffic cones ➢ Working Headlamp ➢ Personal Protective Equipment ➢ Waders ➢ Nitrile gloves ➢ Sample bottles	➢ Clean Sample Labels ➢ Coolers and Ice ➢ Sample control paperwork (e.g. COC) ➢ Field Meters ➢ Battery-Powered Peristaltic Pump ➢ Utility knife and diagonal cutters ➢ Assorted cable ties ➢ Ziploc baggies (assorted sizes) ➢ Pre-cleaned sample collection basins/buckets ➢ Shovel ➢ Deionized water squirt bottles ➢ Grab pole	➢ Sample scoops ➢ Cellular phone ➢ Camera ➢ Pencils ➢ Indelible Markers ➢ Duct and Electrical Tape ➢ Rope ➢ Straps ➢ Keys ➢ Clean Stir Rods ➢ Net ➢ Personal change of clothes

4.1.4 Bottle and Equipment Cleaning

Unfamiliar sampling equipment will go through a rigorous decontamination procedure prior to its use. The following procedures will be used:

1. Soak equipment (fully immersed) for three days in a 0.5% solution of Alconox™ detergent and deionized water; alternatively, Micro™ detergent may be used.
2. Rinse equipment three times with deionized water and let dry in a clean place.
3. Rinse equipment with 1.0% solution of hydrochloric acid, followed by a rinse with petroleum ether, followed by three rinses with deionized water. Allow the equipment to dry in a clean place.
4. Decontaminated equipment is stored in clean Ziploc™ bags until used in the field.

4.1.5 Communication Channels

Communication channels must be established for personnel to contact each other before and during the event. The project field notebook will include phone lists with home, work, and cellular numbers of the field team to aid in communication and work numbers for laboratory contacts. Cellular phones are essential for efficient monitoring, because the Project and Sampling Manager will need to track the location and workload of each field team and direct them to priority tasks.

4.1.6 Laboratory Coordination

The Field Coordinator will place a sample bottle order with the analytical laboratory before all monitoring activities. Immediately following each monitoring event, the bottle inventory will be checked and additional bottles ordered as needed. The bottles must be of the proper size and material, and contain preservatives as appropriate for the specified laboratory analytical methods. The laboratory order should also include blank water for the collection of required field blank samples.

4.1.7 Sample Container Preparation

The Sampling Manager and Field Coordinator will make sure that sufficient field supplies and sample containers are available prior to the start of sampling, using **Table 4-2** as a guide. All glassware, sample bottles, and collection equipment will be inspected prior to use. Sample bottles and caps will be obtained from the Certified Laboratory. All ordered supplies will be examined for damage as they are received. The laboratory maintains logbooks for consumables that are checked against all materials received. Bottles and caps will be inspected for damage prior to sampling, and only sound bottles with intact threads will be used. Container caps will be tested for tightness prior to sample collection.

Table 4-2 Inspection/Acceptance Testing Requirements for Consumables and Supplies

Project Related Supplies/Consumables	Inspection/Testing Specifications	Acceptance Criteria	Frequency
Pre-Cleaned Sample Bottles	Open bottle	Lids screwed on bottles	100%
Laboratory Glassware	Dirty	Clean	100%
Laboratory Solvents and Acids	Leaks	No cracks or chips	Prior to use
Plastic Containers	Laboratory sterilized	Lids screwed on containers	New bottles each monitoring event
Glass Containers	Laboratory cleaned and blanked	Lids screwed on containers	New bottles each monitoring event
Grab Bags	Dirty, open	Sealed bags	New bags each monitoring event
Plastic Tubing	Laboratory cleaned and blanked	Pass blanking analysis	New tubing at start of program
Gloves	New box	New box	Monthly

4.2 Sample Collection Methods

Water quality samples will be collected in laboratory supplied pre-cleaned containers with preservatives appropriate to the analytical methods presented in **Table 3-2**. All sampling procedures will adhere to the guidelines found in the SWAMP sampling SOPs, presented in Attachment 3 of the generic project QAPP, "Field measurement and field collection of water and bed sediment samples, water and bed sediment samples with associated field measurement and physical habitat, stream algae samples and associated physical habitat and chemical data, and benthic macroinvertebrates (BMI) samples and associated physical and chemical data." The QAPP will be revised upon determination of the sample collection team, agency or consultant, final field monitoring methods, and analytical laboratory.

A two- to three-person team will generally undertake the sampling event. The sampling team will have access to a cellular phone in order to alert rescue agencies should any accidents occur. Sampling will be postponed if the sampling team determines that the conditions are unsafe. Failure to collect a sample due to safety concerns or technical issues will be promptly reported to the Consultant Project Manager (PM) and Project Director, who will determine if any corrective action is needed and make arrangements to collect a replacement sample, if possible. The Consultant Quality Assurance/Quality Control Manager (QA/QCM) will document sampling failures and the effectiveness of corrective actions. The following subsections summarize the collection methods that the sampling team will be utilizing for the RWMP.

4.2.1 Direct Submersion: Grab Sample (Water and Sediment Sampling)

For the collection of water and sediment samples, the sampling team will adhere to the guidelines found in the SWAMP sampling SOP, "Collection of Water and Bed Sediment Samples with Associated Field Measurements and Physical Habitat." All sampling equipment will be properly cleaned prior to each sampling event. Samples will be collected by-hand, when possible. Where practical, grab samples will be collected by direct submersion at mid-stream, mid-depth using clean hand, dirty hand techniques and the following procedures:

1. Safely access the mid-stream area, allowing any disturbed sediments to move downstream. Remove the container lid then, being careful to retain any preservatives, submerge the container to mid-depth, and allow the container to fill, and then secure the lid.
2. Collect the remaining samples including quality control samples, if required, using the same protocols described above.
3. Promptly place the collected sample container(s) on ice.

A copy of the SWAMP sampling SOP can be found in Attachment 3 of the generic project QAPP.

4.2.2 Physical Habitat and Bioassessment

Physical Habitat (PHAB) assessment and collection of BMI samples will be conducted in accordance to the guidelines found in the SWAMP sampling SOP, "Benthic Macroinvertebrates Samples and Associated Physical and Chemical Data." An experienced two to three-person team will generally conduct the PHAB assessment and bioassessment sampling. The sampling team will have access to a cellular phone in order to alert rescue agencies should an accident occur. The following subsections present typical procedures for each method, although modifications may be necessary based on unique characteristics of the Mojave River Watershed and the proposed monitoring locations.

4.2.2.1 Physical Habitat Assessment

PHAB Assessment may be conducted as a stand-alone evaluation or in conjunction with other sampling activities. To conduct a PHAB assessment of the receiving water monitoring locations, a 150 meter (m) reach, or 250 m if the receiving water is wider than 10 m, will be measured at each monitoring location and divided into 11 equidistant transects arranged perpendicular to the direction of flow. The transects will be designated A through K and PHAB assessment will be conducted using the following procedures:

1. Fill out necessary field forms and determine the geographical coordinates in decimal degrees to at least four decimal places with a GPS receiver.
2. Once the site has been identified, make an initial survey of the reach from the stream banks, being sure to not disturb the instream habitat.
3. Determine if the average wetted width is greater or less than 10 m. If the average wetted width ≤ 10 m, use a 150 m reach length. If the average wetted width > 10 m, use a 250 m reach length.
4. Starting at one end of the reach, establish the position of the 11 transects (A through K, downstream to upstream) by measuring 15 m (25 m for streams > 10 m wetted width) along the bank from the previous transect. For easy setup and breakdown, mark the main transect with easily removable markers (e.g., survey flags). Since the data will be collected at the downstream end, it is often easiest to establish transects starting from the upstream end.
5. Measure and record common ambient field water quality characteristics (pH, DO, specific conductance, alkalinity, water temperature) starting at the downstream end of the reach, transect A. Any additional parameter should also be recorded for each transect such as channel cross section measurements.

6. Take a minimum of four photographs of the reach at the following locations:
    a. Transect A facing upstream;
    b. Transect F facing upstream;
    c. Transect F facing downstream;
    d. Transect K facing downstream; and
    e. Optional: Transect A facing downstream and Transect K facing upstream.
7. Record the dominant land use and land cover in the area surrounding the reach (evaluate land cover within 50 m of either side of the stream reach).
8. At the bottom of the form record evidence of recent flooding, fire, or other disturbances that might influence bioassessment samples. Especially note if flow conditions have been affected by recent rainfall, which can cause significant under-sampling of BMI diversity.

PHAB assessment should be conducted in association with bioassessment and nutrient (Algae) sampling. While conducting PHAB assessment, the sample team should take caution to not disturb the receiving water body, prior to bioassessment sampling.

4.2.2.2 Bioassessment

BMI samples will be collected by-hand, from nets to collection bucket, when possible utilizing the reach wide benthos (RWB) (multihabitat) procedure. The RWB procedure can be used to sample any wadeable stream reach since it does not target specific habitats. All sampling equipment will be properly cleaned prior to each sampling location and event. Where practical the composite sample from the 11 transects A through K will be collected by net placement within each transect. Sampling position within each transect will be alternated between the left, center and right position along the transaction (25%, 50%, and 75% of the wetted width respectively). Sampling will begin at the furthest downstream transect, using the following procedures:

1. Position a 500-μ D-net, with the net opening perpendicular to the flow and facing upstream, quickly and securely on the stream bottom to eliminate gaps under the frame.
2. Visually define a 1 square feet (ft^2) sample area and restrict sampling to that area.
3. Working backwards from the upstream edge of the sample area, look for heavy organisms such as mussels, snails, and stone-cased caddisflies. Remove these from the substrate by hand and place them into the net.
4. Collect remaining samples from the area by vigorously kicking the remaining finer substrate within the quadrat and move the net through the disturbed area to collect the organisms. Keep moving the net all the time so the organisms trapped in the net will not escape.
5. Let water run clear of any insect or organic material before carefully lifting the net. Immerse the net in the stream several times to remove fine sediments and to concentrate organisms at the end of the net. Continue kicking the substrate and moving the net for 30 seconds.
6. Repeat steps 1 to 5 at the next transect area until all 11 areas has been sampled.
7. Empty the contents of the net into a large plastic bucket (10-20 liter (L)). If any organisms are clinging to the net, remove them and place them into the bucket. Add stream water to the bucket, making sure to not introduce entrained organisms from the source water. Gently swirl the contents of the bucket to suspend and remove the organic material from the bucket. Repeat process until only inorganic material is left in the net.
8. Prepare BMI sample jar and place collected samples from the 11 transect areas into the sample jar ensuring all organisms are collected and placed in the sample jar.

Sampling will be postponed if the sampling team determines that the conditions are unsafe. Failure to collect a sample due to safety concerns or technical issues will be promptly reported to the Consultant PM and Project Director, who will determine if any corrective action is needed and make arrangements to collect a replacement sample, if possible. The Consultant QA/QCM will document sampling failures and the effectiveness of corrective actions. A copy of the SOP can be found in Attachment 3 of the QAPP.

4.2.3 Nutrient (Algae)

Algae sample collection follows the RWB sampling method as specified in the SWAMP sampling SOP, located in Attachment 3 of the QAPP. Algae SWAMP SOP will be an add-on module to the SWAMP SOP for bioassessment. Algae sampling should be conducted in conjunction with BMI sampling, however BMI samples must be collected BEFORE algae at each of the transects, in order to minimize the chances of disturbing BMIs during algal collection. After the BMIs are collected, the algae sample should be taken ¼ m upstream from the center of the upper edge of the "scar" in the stream bottom left from the BMI sampling. It is important to make sure that the surface from which algae will be collected has not been disturbed (by BMI sampling, or otherwise) prior to sampling the algae. As per Permit Section 13.d.1 Table 3, benthic algae biomass will be collected from sediment using the following procedures:

1. Locate sampling area ¼ m upstream of the BMI sampling location.
2. Using a PVC delimiter, isolate a specific quantity of sand/silt/gravel. Centered on the sampling spot, by pressing on the top 1 cm of sediment with the PVC delimiter.
3. Gently slide a masonry or kitchen spatula beneath the PVC delimiter, being careful to keep the collected sediment contained within.
4. Pull the PVC delimiter out of the water, with the spatula in place and remove any extra sediment from the spatula around the outside of the PVC delimiter.
5. Transfer the contents held in the delimiter by the spatula to the dish tub.
6. Repeat steps 1 through 5 for transects A through K.
7. After the collection of sediments for transects A through K, massage all the sand and/or silt in the dish tub thoroughly between the fingers to dislodge any clinging algae. For pieces of gravel, use a toothbrush to remove algal material from surfaces.
8. Rinse the sediment thoroughly (but as sparingly as possible) with stream water so as to create a suspension of the dislodged microalgae sample. The sediment should be rinsed once or twice with stream water until it appears that little to no additional suspended materials are present.
9. Separate the sediment from the liquid sample.
10. Measure the final volume of the sample liquid in the dish tub with a CLEAN graduated cylinder before the samples preparation.
11. After the liquid sample has been retrieved and measured, stream sediment may be discarded.
12. Using CLEAN filter forceps to center a glass fiber filter onto the mesh platform of a CLEAN filtering tower apparatus. Rinse the filter a little with deionized (DI) water to seat it well onto the mesh before attaching the filter reservoir on top.
13. Agitate the composite sample to resuspend all the micro algal material and carefully measure 25 milliliter (mL) of the composite sample. Midway through the pour, swirl the composite sample again to ensure the material is still fully suspended.
14. Once the 25 mL has been measured, pour the measured sample into the filter reservoir. Once empty, rinse the graduated cylinder with a few mL of DI water and add to the reservoir.
15. Filter the sample, proceeding slowly, one pump stroke at a time, until all of the liquid in the sample is passed through the filter. Pressure should never exceed 7 pound-force per square inch (psi), as this could cause cells to burst and release contents into the filtrate and be lost.
16. Once the composite samples has gone through the filter, rinse the sides of the filter reservoir with a few mL of DI water and continue filtering until the water is drawn down.
17. Using forceps, remove the filter from the filtering device, fold the filter in half with the sample material on the inside and place it inside a clean, snap-top Petri dish.
18. Envelop the Petri dish completely within a small sheet of aluminum foil in order to prevent any light from reaching the filter.
19. Place the covered Petri dish within a Whirl-pak bag, expelling as much air as possible, then use the wire tabs to seal the bag so that cooler water will not enter the bag.

Samples should be placed on dry ice as soon as possible (and within four hours of collection) and kept frozen; the holding time for the samples is 28 days from collection when kept frozen.

4.3 Sample Collection Procedures

As summarized in **Section 4.2** above, all sampling procedures will adhere to the guidelines found in the SWAMP sampling SOP, presented in Attachment 3 of the QAPP. The SWAMP sampling SOP consists of the following:

- Field measurement and field collection of water and bed sediment samples;
- Water and Bed Sediment Samples with Associated Field Measurement and Physical Habitat;
- Stream Algae Samples and Associated Physical Habitat and Chemical Data; and
- Benthic Macroinvertebrates Samples and Associated Physical and Chemical Data.

Should field crews feel that it is unsafe to collect samples for any reason, the field crews **SHOULD NOT COLLECT** a sample and note on the field log that the sample was not collected, why the sample was not collected, and provide photo documentation, when feasible.

4.3.1 Field Conditions Data Log Sheet

When the sampling team first arrives at the receiving water monitoring site locations, site conditions and other general observations must be accurately recorded on the Field Conditions Data Log Sheet or Log Book. A sample of this form, also with other required field forms, is included in Attachment 3 of the QAPP. The following general information should be entered for each receiving water monitoring event:

- Sampling site ID;
- Date;
- Time;
- Monitoring Program;
- Field team;
- Conveyance type;
- Weather conditions and temperature;
- Runoff characteristics;
- Flow estimations;
- Equipment condition; and
- Miscellaneous comments.

4.3.2 Clean Sample and Handling Equipment

During sampling operations, extreme care must be taken to minimize exposure of the sample and sample collection equipment to external sources of contamination, which has no association with the sample. Clean sample and equipment handling procedures are used to prevent external sources of contamination, when samples are collected. Clean sampling techniques typically require a two-person sampling team. Upon arrival at the sampling site, sampler one is designated as "dirty hands" and sampler two is designated as "clean hands." Sampler one, "dirty hands," wearing clean, powder-free Nitrile gloves, is responsible for preparation of the sample collector, with the exception of the sample bottle, operation of any machinery, and for all other activities that do not involve handling items that have direct contact with the sample. Sampler two, "clean hands," includes operations involving contact with the sample bottle, sample bottle lid, sample suction tubing, and the transfer of the sample from the sample collection system, if the sample is not directly collected in the bottle, while wearing clean, powder-free Nitrile gloves. Sampler two, "clean hands" will change into clean gloves as frequently as required to ensure that the gloved hands contacting the sample container, container lid, and laboratory cleaned sampling equipment will not come in contacted with any external source of potential contamination.

Although the duties of "clean hands" and "dirty hands" would appear to be a logical separation of responsibilities, in fact, the completion of the entire protocol may require a good deal of coordination and practice. For example, "dirty hands" must open the box or ice chest containing the sample bottle and unzip the outer bag; "clean hands" must reach into the outer bag, open the inner bag, remove the bottle, collect the sample, replace the bottle lid, put the bottle back into the inner bag, and zip the inner bag. "Dirty hands" must close the outer bag and place the double-bagged sample in an ice-filled ice chest. It is recommended that a third sampling team member be available to direct the team, review the monitoring plan, and complete the necessary sample documentation (e.g., sample location, time, sample number, weather conditions, etc.). If a third sampling team member is not available, "dirty hands" must perform the sample documentation activities.

4.3.3 No Sample Taken Procedures

With any situation, there may be circumstances that would prevent samples from being collected at the receiving water monitoring locations. These circumstances include:

- Lack of influent or effluent (discharge) flow or insufficient flow to collect a representative sample; and/or
- Site inaccessibility or safety concerns.

4.3.3.1 Low Flow Conditions

Sampling will be attempted even in low flow conditions. If a sample cannot be taken due to insufficient, or a lack of flow, a separate log sheet will be completed to explain why no sample was taken.

4.3.3.2 Site Inaccessibility Due to Temporary Physical Obstruction or Condition

If the receiving water monitoring site locations are temporarily blocked by a physical obstruction, such as downed trees, or power lines, the sampling team will attempt to sample immediately upstream or downstream from the monitoring site. If there still is no suitable access, the sampling team will determine the possibility of sampling further away from the original monitoring site.

4.3.3.3 Site Inaccessible Due to Dangerous Site Conditions

If the receiving water monitoring site locations are inaccessible due to dangerous flow conditions or other circumstances that would be a safety concern, the sampling team will delay sampling for 24 to 48 hours until after the conditions are suitable for sampling. However, if an alternative receiving water monitoring site location is in close proximately and provides a sample which is representative of the original monitoring site, then sampling will occur on schedule at the alternative receiving water monitoring site location.

4.4 Sample Management

The following sections will present the sampling management protocols used to collect representative samples as well as minimize potential external sources of contamination.

4.4.1 Sampling Handling and Custody

The laboratory will provide appropriate sample containers according to **Table 4-3**. All samples will be pre-labeled with the project name, site ID, sample type, bottle number, sampler name, preservative, and analysis. All sample bottles will also be pre-labeled with a unique Sample ID to track the sample throughout its analyses. At the time of sample collection, the sample labels will be completed in the field with the date and time. The Sample IDs will also be entered directly onto the Field Conditions Data Log Sheets and chain-of-custody (COC) Forms. The COC forms will accompany the collection of all samples.

The following sample handling protocols will be followed when collecting samples to minimize the possibility of contamination:

- New unused sample bottles will be employed. Sample bottles and bottle caps will be protected from contact with solvents, dust, or other contaminants during storage and bottle handing.
- The sampler will attempt to prevent large gravel and floating debris from entering the sample containers. The sampler will also make an effort to not stir up sediments at the sample locations.
- The inside of the sampling container will not be touched to the maximum extent practicable during preparation and sampling activities.
- Vehicle engines will be turned off during sampling, to minimize sample exposure to fumes.
- All samples will be collected in accordance with the "clean sampling" techniques.
- Manual water grab samples will be collected by inserting the transfer container under or down current of the direction of flow, with the container opening facing upstream.
- Once sample containers are filled, they will be promptly placed on ice, in a clean cooler (target temperature 6 degrees Celsius), in the dark and transported to the laboratory for processing to meet holding times. All necessary pre-processing for analysis, such as filtration and acidification, will take place in the laboratory by certified personnel.
- After the field crew collects and delivers the samples to the laboratory, the laboratory will conduct the analysis within the holding times listed in **Table 4-3**. The field and laboratory activities will be coordinated to assure all samples are handled within the proper holding time.

After the laboratory receives the samples, the certified laboratory technicians will dispense the sample contents into containers that contain the required volume specified in **Table 4-3**. The laboratory will preserve the water samples using the appropriate preservative and the laboratory will conduct the analysis within the maximum holding time limits.

4.4.2 Sample Bottle Labeling

Field samples, field blanks, and field duplicate samples will be labeled, recorded on the COC form, and transported with the samples to the analytical laboratory. Water quality sample bottles will be pre-labeled, to the greatest extent possible, before each monitoring event. Pre-labeling bottles simplifies field activities and the following information should be considered for each sample bottle label:

- Project name
- Sample location/ID
- Event number
- Date and time
- Sample matrix (stormwater)
- Sample type (dry-weather, wet-weather, etc.)
- Bottle __ of __ (for multi-bottle samples)
- Collected by
- Preservative
- Analysis

Table 4-3 Sampling Handling and Custody

Parameters	Container Type	Min Sample Volume	Preservation	Maximum Holding Time
Pyrethroids* (sediment)				
Allethrin	Solids in PSJ	8oz	Solids to be Frozen	14 days
Bifenthrin	Solids in PSJ	8oz	Solids to be Frozen	14 days
Cyfluthrin	Solids in PSJ	8oz	Solids to be Frozen	14 days
Lambda-Cyhalothrin	Solids in PSJ	8oz	Solids to be Frozen	14 days
Cypermethrin	Solids in PSJ	8oz	Solids to be Frozen	14 days
Deltamethrin:Tralomethrin	Solids in PSJ	8oz	Solids to be Frozen	14 days
Esfenvalerate:Fenvalerate	Solids in PSJ	8oz	Solids to be Frozen	14 days
Fenpropathrin	Solids in PSJ	8oz	Solids to be Frozen	14 days
Tau-Fluvalinate	Solids in PSJ	8oz	Solids to be Frozen	14 days
Permethrin	Solids in PSJ	8oz	Solids to be Frozen	14 days
Tetramethrin	Solids in PSJ	8oz	Solids to be Frozen	14 days
Bacteria				
E. coli	Sterile Plastic	100 mL	Sodium thiosulfate; Cool to 4°C; dark	8 hours
Nutrients (Algae)				
Benthic Algal biomas and % cover	Plastic	200 mL	H_2SO_4; Cool to ≤6°C	28 days
Bioassessment				
Benthic macroinvertebrate field samples	Plastic	500 mL	95% Ethanol for ≤ I month, Transfer to 70% Ethanol	5 years
Sorted specimens	Glass	Variable	70% Ethanol	5 years
Sorted subsample residue	Plastic	Variable	70% Ethanol	1 year from date of sorting
Unsorted sample	Plastic	Variable	70% Ethanol	2 years

PSJ – Poly Sleeve Jacket

4.4.3 Chain-of-Custody Procedures

Either the laboratory will supply the COC forms, or the exampler form in Attachment 2 of the QAPP may be utilized by the sampling team. COC procedures will be used for all samples throughout the collection, transport, and analytical process to ensure accurate results. COCs will be pre-printed along with the bottle labels and contain the same data as the labels. The COCs will be completed in the field with dates, times, and sample team names, and will be cross-checked with the bottles to make sure proper samples have been collected. Documentation of sample handling and custody will include the following:

- Sample identification;
- Type of sample;
- Sample collection date and time;
- Any special notations on sample characteristics or analysis;
- Analyses to be performed;
- Initials of the sampling team member that collected the sample; and
- Date the sample was delivered to/sent to the laboratory.

The COC forms will be transported with the samples to the analytical laboratory. Sampled water will be properly chilled and transferred to an analytical laboratory within holding times. When custody of the samples is transferred to the laboratory, the COC will be signed and dated, and a PDF copy will be sent from the laboratory. The COCs will be reviewed by personnel at the receiving laboratory to make sure no samples have been lost in transport. The laboratory will also verify that each sample has been received within holding times. COC records will be included in the final reports prepared by the analytical laboratory and are considered an integral part of the report.

4.4.4 Corrective Action

Corrective actions are normally undertaken by the laboratory, when an analysis is deemed suspect. Reasons could include exceedances of the relative percent difference (RPD) ranges, spike recoveries, and blanks. Corrective action varies by analysis method and suspect result, but typically involves:

- Check of standard operating procedures and their considered utilization;
- Review of documents and calculations to identify possible errors;
- Error corrections of calculations, quality assurance samples, or analytical equipment;
- Reanalysis of the sample, or extract, if available, to see if results are duplicated or validated; and
- Complete reprocessing and reanalysis of additional sample material, if it is available.

Any failures (e.g., instrument failures) that occur during data collection and laboratory analyses will be the responsibility of the field crew or laboratory conducting the work, respectively. In the case of field instruments, problems will be addressed through instrument cleaning, repair, or replacement of parts or the entire instrument, as needed. Sampling teams will carry basic spare parts and consumables with them, and will have access to spare parts or alternative equipment at the office. Records of all repairs or replacements of field instruments will be maintained. The laboratory has procedures in place to follow when failures occur, and will identify individuals responsible for corrective action and develop appropriate documentation. The Quality Assurance (QA) Officer at the laboratory has procedures in place to follow when failures occur, and will identify individuals responsible for corrective action and develop appropriate documentation. Any corrective actions will be documented by the laboratory in a Corrective Action Plan.

5. Quality Control

This section addresses Quality Assurance/Quality Control (QA/QC) activities associated with both field sampling and laboratory analyses. The field QA/QC samples are used to evaluate potential contamination and sampling errors introduced prior to submittal of the samples to the analytical laboratory. Laboratory QA/QC samples provide information to assess potential laboratory contamination, analytical precision, and accuracy. If any QA/QC standards are not met, the appropriate corrective actions will be taken in accordance with **Section 4.4.4** of this document and the laboratory's QA manual.

5.1 Quality Assurance/Quality Control

The main QA/QC methods that will be utilized for this RWMP are described below and in **Table 5-1**.

1. **Field Blanks** – Field blanks verify that field conditions, sampling activities, and air deposition are non-contaminating. Field blanks are submitted blind to the laboratory. Sample bottles are filled with reagent-grade, analyte-free, deionized water in the field during a sampling event.

2. **Equipment Blanks** – Equipment blanks verify that the sampling containers, sampling equipment, and tubing are contaminant free prior to sampling. A representative number of bottles or sections of tubing from each lot is submitted to the laboratory. The laboratory will use reagent-grade, analyte-free deionized water to fill the bottles or rinse through the tubing and then analyze the water. Blank analysis results are evaluated by checking against the reporting limit for that analyte. Results obtained should be less than the reporting limit for each analyte. If results are above the reporting limits then the entire lot must be cleaned and re-analyzed.

3. **Field Duplicates** – Field duplicates evaluate sampling error introduced by both field sampling and laboratory analyses. Field duplicates are submitted blind to the laboratory. Procedures for collecting field duplicates should be the same as those used for collecting field samples. Duplicates of manual grab samples will be collected by filling two grab sample containers at the same time, or in rapid sequence.

The blank and duplicate samples need not come from the same monitoring location during a particular sampling event. However, each of these QA/QC analyses will be provided along with the standard analyses if enough sample volume has been collected. The field QA/QC samples for field blanks and field duplicates are generally submitted blind to the analytical laboratory.

Table 5-1 Sampling (Field) QC

QA/QC Sample Type	Minimum Sampling Frequency	Constituent Class	Acceptance Limits
Field Blank	Every 20 samples collected at a given site, per sampling event.	All	Field blanks shall find no detectable amounts or less than 1/5 of sample amounts. Accuracy at 1 per culture medium or reagent lot.
Equipment Blank	Bottles should be blanked at 10% frequency, or per lot.	All	Equipment blank shall be less than the analyte reporting limit.
Field Duplicate	Every 10 samples collected at a given site, or per sampling event.	All	The relative percent difference between the primary sample result and the duplicate sample result should meet the objective for precision.

5.2 Laboratory Quality Assurance/Quality Control

Internal laboratory quality control checks will include the use of laboratory replicate/split, method blanks, matrix spike and matrix spike duplicates (MS/MSDs), laboratory control samples, and standard reference materials (SRMs). These quality control samples are as follows:

1. **Laboratory Replicate/Split** – A sample is split by the laboratory into two portions and each sample is analyzed. Once the duplicate analyses have been analyzed, the results are evaluated by calculating the RPD between the two sets of results. This serves as a measure of the reproducibility, or precision, of the sample analysis. Typically, duplicate results should fall within an accepted RPD range, depending upon the analysis.

2. **Method Blanks** – A method blank is an analysis of a known clean sample matrix that has been subjected to the same complete analytical procedure as the field sample to determine if potential contamination has been introduced during processing. Blank analysis results are evaluated by checking against reporting limits for that analyte. Results obtained should be less than the reporting limits for each analysis.

3. **Matrix Spike and Matrix Spike Duplicates** – MS/MSDs involve adding a known amount of the chemical(s) of interest to one of the actual samples being analyzed. One sample is split into three separate portions. One portion is analyzed to determine the concentration of the analyte in question in an un-spiked state. The other two portions are spiked with a known concentration of the analytes of interest. The recovery of the spike, after accounting for the concentration of the analyte in the original sample, is a measure of the accuracy of the analysis. By determining spike duplicate recoveries, another measure of precision is accomplished. An additional precision measure is made by calculating the RPD of the duplicate spike recoveries. Both the RPD values and spike recoveries are compared against accepted and known method dependent acceptance limits. Analyses outside these limits are subject to corrective action.

4. **Laboratory Control Sample** – The laboratory control sample procedure involves spiking known amounts of the analyte of interest into a known, clean, sample matrix to assess the possible matrix effects on spike recoveries. High or low recoveries of the analytes in the matrix spikes may be caused by interferences in the sample. Laboratory control samples assess these possible matrix effects since the laboratory control sample is known to be free from interferences.

5. **Standard Reference Material** – SRMs may be used in lieu of laboratory control samples. An SRM is a sample containing a known and certified amount of the analyte of interest and is typically analyzed with the analyst not knowing the analyte concentration. SRMs are typically purchased from independent suppliers who prepare them and certify the analyte concentrations. Results are evaluated by comparing results obtained against the known quantity and the acceptable range of results supplied by the manufacturer.

Table 5-2 presents the frequency of analysis for each of the laboratory quality control samples.

Table 5-2 Laboratory Quality Control Sample Frequency

QA/QC Sample Type	Minimum Sampling Frequency	Acceptance Limits
Laboratory Replicate/Split	One per batch or per 20 samples (5%), per sampling event.	The relative percent difference between the primary sample result and duplicate sample result should meet the objective for precision.
Method Blank	One per batch or per 20 samples (5%).	Procedural blanks should be below 10x the MDL.
Matrix Spike/Matrix Spike Duplicate (MS/MSDs)	One per batch or per 20 samples (5%), per sampling event.	The percent recovery should be within the accuracy acceptance limits.
Laboratory Control Spike	One per batch or per 20 samples (5%).	The percent recovery should be within the accuracy acceptance limits.
Standard Reference Material (SRM)	One per batch or per 20 samples (5%).	The percent recovery should be within the accuracy acceptance limits.

5.3 Instrument/Equipment Calibration and Frequency

All field and laboratory equipment will be calibrated based on manufacturer recommendations and accepted laboratory protocol. All Managers will also maintain calibration practices and records as part of their method SOPs which can be provided upon request.

5.4 Data Management

All data collected for the RWMP will be uploaded to Storm Water Multiple Application and Report Tracking System (SMARTS) and conform to the California Environmental Data Exchange Network (CEDEN) minimum data templates format. Data management will be initiated with the use of field and laboratory data sheets. The data are generated by the sampling team and analytical laboratory. Each of the two categories of data management is summarized below.

5.4.1 Laboratory Data Management

The Project Manager is responsible for data management. Overall management of the data will be consistent with established procedures for monitoring projects. The Sampling Manager will be responsible for tracking the analytical process to assure that the laboratory is meeting the required turnaround times and providing a complete deliverable package. The laboratory will conduct the quality control checks prior to data submittal, for more details regarding laboratory quality assurance and record keeping protocols refer to the QA Manual. The Sampling Manager receives the original hard copy from the laboratory, verifies completeness, and logs the date of receipt. Analysis results will be electronically sent to the Sampling Manager following the completion of quality control checks by the laboratory. Data will be screened for the following major items:

- A 100% check between electronic data provided by the laboratory and the hard copy reports;
- Conformity check between the COC forms and laboratory reports;
- A check for laboratory data report completeness, errors or suspect analytical data; and
- A check for typographical errors on the laboratory reports.

The original reports are transferred to the Project Manager and filed with all other original project documentation in order to maintain complete project records. Following the initial screening, a more complete QA/QC review process will be performed, which will include an evaluation of holding times, method and equipment blank contamination, and analytical accuracy and precision. The laboratory may be requested to provide data in both hard copy and electronic formats. The form of electronic submittals will conform to reporting protocols that are compatible with the SWAMP. A relational database will not be developed or used for this project data. The laboratory data will be maintained and managed with Microsoft Excel and/or Microsoft Access by the Project Manager.

The Sampling Manager will control the access to the project's database. The laboratory electronic data deliverables (EDDs) will be maintained in a file separate to the cumulative database so the original is maintained and can be used as a reference. If data is reissued, the file name will include the date and the word 'revised.' To manage the revision and prevent duplicate entries, the erroneous data set will be removed from the database prior to uploading the revised data set.

The Laboratory Manager will maintain their respective analytical laboratory records. The Project Manager will oversee the actions of these persons and arbitrate any issues relative to records retention and any decisions to discard records. All original laboratory notebooks and data summaries will be maintained in secure areas and electronic databases will be maintained and backed up.

5.4.2 Field Data Management

The Field Coordinator will be responsible for the proper management of field measurement and observation data. The Field Coordinator will review all Field Conditions Data Log Sheets for completeness and maintain the original hardcopies in the project file. The Field Conditions Data Log Sheet responses will also be manually entered into an electronic version of the Field Conditions Data Log Sheet and these fields will be saved in the Microsoft Access database. The data will be manually entered by one individual and the entries will be checked against the hard copies for accuracy by a second individual. Photographs of the monitoring sites taken by field personnel will be uploaded into the project file within three days of taking the photograph. Field team members will name the photographs using the photograph naming convention developed specifically for this project.

6. Quality Assurance Project Plan (QAPP)

A comprehensive draft or generic QAPP consistent with the SWAMP QAPP is included in **Appendix A**. The QAPP includes sections on Project Management, Data Generation and Acquisition, Assessment and Oversight, and Data Validation and Usability. Finalization of the QAPP will be deferred until after the sampling team and analytical laboratory has been contractually retained and staffing assignments determined.

7. Data Evaluation and Reporting

Receiving water monitoring will be conducted in accordance with this RWMP plan. The following subsections will discuss the procedures for data results evaluations and reporting.

7.1 Data Evaluation

Following the completion of each monitoring event, data assessment and validation will be performed as appropriate for the data use. Field and analytical data will be evaluated for the following, but not limited to:

- Review any information collected for consistency, reasonableness, and accuracy to the extent practicable, prior to use;
- Identify potential errors or inconsistencies in data obtained from available resources that may require further evaluation, prior to use of the data;
- Review applicable field and laboratory documentation to ensure that the applicable SOPs were followed;
- Review field and laboratory QC reports to understand quality and usability of data including:
    - Results of QC samples that were collected and analyzed;
    - Overall Measurement Quality Objectives (MQO) performance for analytical laboratory data by reviewing precision, accuracy, and completeness, and evaluating representativeness, comparability, and sensitivity; and
    - Data qualifier flags assigned to analytical laboratory data to assess sample collection, handling, or laboratory QC issues.
- Calculation of basic quantitative characteristics of the data using common statistical parameters (e.g., range, mean, medium, frequency of detection);
- Graphing the data using appropriate methods to identify patterns or trends in the data. These patterns or trends may be used to describe the data, identify potential correlations or problems with the data set, and to convey information to others; and
- Any outliers or irregularities will be assessed and the value of their inclusion in the analysis determined.

Data analysis to achieve the identified objectives, and the proposed timeline at which they will occur, include:

- Reporting and determination of baseline analyte values (Second year of Permit);
- Comparison of baseline values to all monitoring events (Permit term);
- Calculations of geometric mean for bacteria concentration (Permit term);
- Trend analysis to evaluate changes in analyte concentrations over time (Permit term);
- Comparison of Urban/Rural Interface (upstream) and Urban (downstream) data to assess potential differences in analyte concentrations as associated development (Permit term);
- Evaluation of analyte concentrations relative to factors of the MS4 that may have influenced the receiving water (Permit term); and
- Evaluation of analyte concentrations related to actions taken to improve receiving water quality to evaluate the effectiveness of the implementation of BMPs (Permit term).

The data evaluation will be used to assess whether RWMP objectives are being met and develop recommendations for necessary adjustments to BMP, LIDs, and any other practices that can help improve receiving water quality.

7.2 Reporting

Analysis and reporting of data is an integral part of verifying whether the RWMP is meeting the primary monitoring objectives. As required by the Phase II Small MS4 General Permit, the MRWG will complete and submit two Monitoring Reports, (1) Baseline Monitoring Report and (2) Comparison Monitoring Report. The Baseline Monitoring Report will be submitted during the second year Annual Report and will include a summary of baseline data collections and discussion of monitoring program results. The Comparison Monitoring Report will be submitted during the fifth year Annual Report and will include a comparison of data collection to the baseline data, and discussion of the monitoring program results.

At a minimum, the Baseline and Comparison Monitoring Report will include the following information:

a. The purpose of the monitoring, brief contextual background and a brief description of the study design and rationale.
b. Sampling site(s) locations, including the latitude and longitude coordinates, water sampling protocols, time of year, sampling frequency and length of sampling.
c. Methods used for sample collection: list methods used for sample collection, sample or data collection identification, collection date, and media if applicable.
d. Results of data collection, including concentration detected, measurement units, and detection limits if applicable.
e. Quantifiable assessment, analysis and interpretation of data for each monitoring parameter.
f. Comparison to reference sites (if applicable), guidelines or targets.
g. Discussion of whether data collected addresses the objective(s) or questions(s) of study design.
h. Quantifiable discussion of program/study pollutant reduction effectiveness.

In addition to the Monitoring Report, and as discussed in **Section 5.4**, MRWG will submit water quality data to SMARTS in the CEDEN minimum data templates format, as stated in the Phase II Small MS4 General Permit.

8. References

California State Water Resource Control Board. 2013. "National Pollutant Elimination System (NPDES) General Permit for Waste Discharge Requirements (WDRs) for Storm Water Discharges from Small Municipal Separate Storm Sewer Systems (MS4s) Order No. 2013-0001-DWQ, NPDES No. CAS000004. 2013 February 5.

California State Water Resources Control Board. 2002. *Watershed Management Initiative*. Retrievedhttp://www.waterboards.ca.gov/lahontan/water_issues/programs/watershed_management/docs/final_02_mr25.pdf. August 2014.

California Regional Water Quality Control Board, Lahontan Region. 2014. *Letter: Response to Questions Raised during the Mojave Watershed Group April 23, 2014*. 2014 May 28.

Mojave River Watershed Group. 2003. *Storm Water Management Program (SWMP)*. 2003 August.

Mojave Water Agency. 2013. *Appendix B: Evaluation of Potential Impacts of Cedar Springs Dam (Silverwood Lake) and Mojave River Dam on Downstream Mojave River Flows and Groundwater Recharge* http://www.mojavewater.org/files/Appendix-B-Evaluation-of-Potential-Impacts-of-Dams-on-MR-Flows.pdf. August 2014

U.S. Geological Survey (USGS) Water-Resources Investigations Report, 1996, Gregory C. Lines, *Ground-Water and Surface-Water Relations along the Mojave River, Southern California*, 1996

U.S. Geological Survey (USGS) Water-Resources Investigations Report, 2001, Christina L. Stamos, Peter Martin, Tracy Nishikawa and Brett F. Cox, *Simulation of Ground-Water Flow in the Mojave River Basin, California*, 2001

Appendix A
Quality Assurance Project Plan (QAPP)