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# Ammonia Water Effects Ratio and Site-Specific Objective Workplan for Los Angeles County Waterbodies

Submitted to:

City of Los Angeles

County Sanitation Districts of Los Angeles County

City of Burbank

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# Section 1. Introduction and Background Information

## 1.1. STUDY OBJECTIVE

Ambient water quality criteria are set at the national level by the United States Environmental Protection Agency to be protective of conditions throughout the United States. Because of the variety of waterbodies and differing conditions throughout the country, the criteria developed on the national level might be over or under-protective for some waterbodies. Beyond the headwaters, the waterbodies in Los Angeles County are typically effluent-dependent waterbodies running through concrete-lined channels or significantly altered watercourses. Characteristics of these waterbodies, such as high hardness and ionic composition, vary from conditions in other more “natural” waterbodies which contain flow other than urban runoff and publicly owned treatment works (POTWs) discharges. The objective of this workplan is to develop a site-specific objective for ammonia in Los Angeles County waterbodies that is sufficiently protective of the aquatic habitat in these waterbodies. The remaining sections in the introduction to this workplan describe the regulatory and guidance requirements for developing a site specific objective (SSO) using a water effects ratio (WER), and a discussion of the currently available information used to fulfill State and Federal requirements. The remaining sections contain a public participation plan (Section 2), a monitoring plan (Section 3), a quality assurance/quality control plan (Section 4), and a data reporting and analysis procedure for the SSO (Section 5).

## 1.2. BASIN PLAN SSO REQUIREMENTS

In the Water Quality Control Plan for the Los Angeles Region (Basin Plan) adopted in 1994, the Regional Board outlines requirements for the development of SSOs. These requirements are addressed in this workplan.

The Basin Plan states that a Use Attainability Analysis (UAA) be conducted if "the attainment of designated aquatic life or recreational beneficial uses is in question." The proposed approach for developing an ammonia SSO is through the development of a WER. A WER adjusts the existing objective to account for site-specific conditions by measuring the actual toxicity of the site water to aquatic species in the waterbody as compared to laboratory dilution water. For this reason, the SSO does not alter the designation or ability of the water to meet water quality objectives. The SSO simply adjusts the Basin Plan objective to take into account the water quality conditions in the waterbody that may make ammonia less toxic than predicted based on laboratory studies. Because the uses of the waterbody are not in question, it may be argued that the development of an SSO for ammonia should not require a UAA. However, the need for a UAA will be reassessed throughout the process as data is obtained and the SSO developed.

Secondly, the Basin Plan outlines elements that should be addressed to justify the need for an SSO. The following are the requirements from the Basin Plan:

- *Demonstration that the site in question has different beneficial uses (e.g., more or less sensitive species) as demonstrated in a UAA or that the site has physical or chemical characteristics that may alter the biological availability or toxicity of the chemical.*
- *Provide a thorough review of current technology and technology-based limits which can be achieved at the facility(ies) on the study reach.*
- *Provide a thorough review of historical limits and compliance with these limits at all facilities in the study reach.*
- *Conduct a detailed economic analysis of compliance with existing, proposed objectives.*
- *Conduct an analysis of compliance and consistency with all federal, state, and regional plans and policies.*

A discussion of the justification for the development of an SSO based on the chemical characteristics of Los Angeles County waterbodies is included in Section 1.2.2. A review of the current technology and historical limits is provided in Section 1.4 along with a description of the current conditions in the waterbodies and discharge characteristics. An economic analysis will be developed if requested by the Regional Board and/or the Technical Advisory Committee. Basin Plan and WER guidance requirements have been included in this document and the requirements addressed to the extent possible in the workplan. Compliance and consistency with other plans and policies, including, but not limited to the Clean Water Act, the Porter Cologne Act, and the Anti-degradation policy will be examined and discussed with the appropriate regulatory agencies. Supporting documentation required by any plan or policy that is needed for the Basin Plan amendment adoption process will be provided with the final report and results from this study.

Finally, once the studies have been conducted, the Basin Plan has several requirements for issues that must be addressed in the proposal for the new objective. These requirements are listed below.

- *Assurance that aquatic life and terrestrial predators are not currently threatened or impaired from bioaccumulation of the specific pollutant and that the biota will not be threatened or impaired by the proposed site-specific level of this pollutant. Safe tissue concentrations will be determined from the literature and from consultation with the California Department of Fish and Game and the U.S. Fish and Wildlife Service. For terrestrial predators, the presence, absence, or threat of harmful bioaccumulated pollutants will be determined through consultation with the California Department of Fish and Game and the U.S. Fish and Wildlife Service.*

- *Assurance that human consumers of fish and shellfish are currently protected from bioaccumulation of the study pollutant, and will not be affected from bioaccumulation of this pollutant under the proposed site-specific objective.*
- *Assurance that aquatic life is currently, and will be protected from chronic toxicity from the proposed site-specific objective.*
- *Assurance that the integrity of the aquatic ecosystem will be protected under the proposed site-specific objective.*
- *Assurance that no other beneficial uses will be threatened or impaired by the proposed site-specific objective.*

Ammonia does not bioaccumulate in aquatic life (USEPA, 1984). Therefore, aquatic and terrestrial life is not currently impaired or likely to be threatened due to bioaccumulation in the future as a result of the development of a SSO for ammonia. Correspondingly, human consumers of fish and shellfish will not be threatened by bioaccumulation of ammonia in fish.

The development of a WER is intended to determine the toxicity of ammonia to species in the Los Angeles River, Burbank Western Wash, San Gabriel River, San Jose Creek, Rio Hondo, Coyote Creek, and Santa Clara River. The workplan developed for this SSO is designed to assess the chronic toxicity of ammonia and assure that sensitive aquatic life will be protected under the SSO.

Assurance that the integrity of the aquatic ecosystem will be protected will be assessed during this study. The national ammonia criteria is based on the assumption that protection of the most sensitive species will result in protection of the aquatic ecosystem. The purpose of developing a WER is to provide the same level of protection for species in the national data set based on the conditions in the local waterbodies. The WER guidance outlines a procedure that is designed to provide an acceptable level of protection if properly implemented. As a result, the proper design of the SSO study in accordance with USEPA guidelines and procedures should ensure that the calculated SSO is sufficiently protective of the species in the ecosystem. For the proposed work, the primary test species is the most sensitive species used in the development of the 1999 USEPA chronic criteria for ammonia (1999 Update of Ambient Water Quality Criteria for Ammonia).

### 1.2.1. Beneficial Uses

The following table summarizes the beneficial uses for each of the waterbodies in the study. A discussion follows describing the potential impacts of an ammonia SSO on these beneficial uses and mechanisms to identify and address beneficial use impacts.

Table 1. Beneficial Uses of Waterbodies in Study Area

| Waterbody | GWR | WARM | REC1 | REC2 | RARE | COLD | MUN | IND | PROC | AGR | MIGR | WET | WILD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Los Angeles River | E | E | E | E | | | P* | P | | | | | E |
| Burbank Western Wash | | P | P | I | | | P* | | | | | | P |
| San Gabriel River | I | I | E | E | E | | P* | P | P | | | | E |
| San Jose Creek | I | I | P | I | | | P* | | | | | | E |
| Coyote Creek | | P | P | I | E | | P* | P | P | | | | P |
| Rio Hondo | I | P | P | E | E | | P* | | | | | E | I |
| Santa Clara River | E | E | E | E | E | E | P* | E | E | E | E | E | E |

MUN Community, military, or individual water system use, including, but not limited to, drinking water supply.
AGR Uses of water for farming, horticulture, or ranching.
PROC Uses of water for industrial activities that depend primarily on water quality.
IND Uses of water for industrial activities that do not depend primarily on water quality.
GWR Natural or artificial recharge of groundwater for purposes of future extraction, maintenance of water quality or halting of saltwater intrusion into freshwater aquifers.
REC1 Recreational uses of water involving body contact with the water.
REC2 Non-contact recreational uses of water.
WARM Support of warm water ecosystems.
COLD Support of cold water ecosystems.
WILD Support of terrestrial ecosystems.
RARE Support of habitats necessary for the survival and maintenance of rare, threatened or endangered species.
MIGR Support for habitats necessary for migration, acclimatization between fresh and salt water, or other temporary activities by aquatic organisms.
WET Support for wetland ecosystems, including, but not limited to, preservation or enhancement of wetland habitats, vegetation, fish, shellfish, or wildlife, and other unique wetland functions which enhance water quality, such as providing flood and erosion control, stream bank stabilization, and filtration and purification of naturally occurring contaminants.
E Existing beneficial use.
I Intermittent beneficial use.
P Potential beneficial use.
P* P* waterbodies in the Basin Plan are no longer considered to be designated as MUN based on a recent court decision. No effluent limits can be imposed based on this designation until studies have been conducted to determine whether or not the MUN beneficial use exists on the waterbody.

Currently, the dischargers' effluent contains ammonia concentrations that are significantly higher than the existing Basin Plan criteria (1984 ammonia criteria values) and the 1999 Ammonia Criteria Update. Discharge concentrations of ammonia generally range from 6 to over 20 mg-N/L from POTWs. Under the Basin Plan requirements, the dischargers need to "*(i) make the necessary adjustments/improvements to meet these objectives or (ii) conduct studies leading to an approved site-specific objective for ammonia*" by July, 2002. The dischargers are currently working towards achieving this requirement by installing ammonia treatment and pursuing a site specific objective. The WER being developed as outlined in this workplan will likely result in a SSO that is lower than the current effluent ammonia concentrations (based on the initial results presented in Section 1.2.2.2). As a result, the ammonia concentrations in the effluent from the dischargers will decrease in the near future to meet the Basin Plan requirements and the developed SSO.

In the concentrations currently observed in receiving waters throughout the study area, ammonia is not a concern for MUN, IND, PROC, WILD, and AGR beneficial uses. There are no human health objectives for ammonia in the Basin Plan. Ammonia can indirectly impact the MUN use as it is converted to nitrate in the water column, however there are currently no waterbodies in the study that are legally designated as MUN and limits can not be imposed until studies are completed to determine whether or not the MUN use exists on the waterbody. Nitrate does impact human health if water containing high nitrates is consumed. Currently, nitrate concentrations in the waterbodies (2 to 5 mg-N/L on average) do not exceed the Basin Plan water quality objectives for nitrate (5-10 mg-N/L). Because ammonia concentrations will not increase as a result of this SSO, there is no indication that the ammonia concentration in the waterbodies after implementation of the SSO will result in an exceedance of the nitrate objective. However, monitoring under the NPDES permits for the various dischargers will help prevent any exceedances of nitrate in the receiving water. Like humans, terrestrial animals are not impacted by ammonia concentrations in the water column. Industrial activities would only be impacted by ammonia at high enough levels to corrode equipment and piping. Agricultural users often add nitrogen as ammonia to crops for fertilization. Therefore, ammonia in the water provided to agriculture would typically be seen as a benefit for that use.

Groundwater recharge (GWR) beneficial uses could theoretically be impacted by the conversion of ammonia to nitrate. However, groundwater quality does not appear to be adversely impacted at current levels of ammonia (4 to 13 mg-N/L on average downstream of the dischargers) in surface waters. For instance, water with the current level of ammonia is being reclaimed through the San Gabriel and Whittier Narrows spreading grounds. No evidence of impacts to the groundwater has been demonstrated in these areas. Because the SSO will not result in ammonia discharge levels higher than existing levels, groundwater recharge is unlikely to be impacted by the SSO. However, groundwater data will be reviewed during the development of the SSO to identify any areas of potential impact.

Aquatic life uses (WARM and COLD) may be impacted by ammonia in two ways, (1) by direct toxicity and (2) by a reduction in dissolved oxygen concentrations from oxidation of ammonia to nitrite and nitrate. Low dissolved oxygen has only been identified as a factor causing impairment in one reach of one of the waterbodies in the study area. Data on dissolved oxygen levels in the waterbodies are presented in Section 1.4, but all of the areas for which data are available have average dissolved oxygen concentrations greater than 6 mg/L and most are above 8 mg/L. Because the SSO will not result in increases in the existing ammonia concentrations, dissolved oxygen is not likely to be reduced in the future from existing levels. The development of an SSO using a WER is designed to provide the appropriate level of protection from toxicity for aquatic life. Therefore, these beneficial uses should be protected by the development and implementation of an appropriate SSO.

The rare, threatened, and/or endangered species (RARE) present in the waterbodies will be identified and reviewed for sensitivity to ammonia. Two species fitting this designation have been identified to date. The Santa Clara River is home to the endangered species, the unarmored three-spine stickleback (*Gasterosteus aculeatus williamsoni*). The Los Angeles River and

San Gabriel River are potential habitats for the threatened species, the Santa ana sucker (*Catostomus santaanae*). Neither of these species were included in the toxicity tests used to develop the ammonia criteria. However, other species in the genus *Catostomus* were used in the criteria development. The other members of this genus were the 20th most sensitive genus used in the development of the acute criteria (GMAV = 38.1 mg/L-N) and the 6th most sensitive used in the development of the chronic criteria (GMCV=>4.79 mg/L-N). These results will need to be compared to the SSO developed for the waterbodies in which the species are present to determine if any additional testing or criteria adjustment is necessary. In addition to these species, the Santa Clara River estuary (30 miles downstream of the dischargers) has been identified as habitat for steelhead, another RARE species. For species found to be more sensitive than the species being tested or for which no information is available about the toxicity of ammonia, additional monitoring will be considered to address toxicity concerns for the species of concern or the criteria will be appropriately adjusted as discussed in the Basin Plan objective for ammonia before the application of the WER to determine the final SSO.

Recreational uses (REC1, REC2) could potentially be impacted by ammonia levels if nitrogen is determined to be a controlling factor in algal growth in the water bodies in the study area. Algal growths could be deemed to have an adverse effect on the aesthetic values in these water bodies. Clean Water Act Section 303(d) listings for nutrients and algae in some of these waterbodies indicate that ammonia may potentially be impacting recreational beneficial uses. If ammonia is determined to be a limiting factor contributing to algal impairment in any of the waterbodies being studied, the SSO will need to take into account this impact. Initial investigations indicate that nitrogen compounds may not be the limiting nutrient in at least some Los Angeles County waterbodies. In the Los Angeles River, initial studies have determined that the limiting nutrient is phosphorus, not nitrogen (Collins, 2001). Because of 303(d) listings, TMDLs will be developed for ammonia, nutrients and/or algae for all of the waterbodies being studied. Ammonia SSO development needs to be coordinated with the development of these TMDLs to ensure that all of the regulatory requirements for both of the processes are met and the outcomes do not conflict with each other. For example, the Los Angeles River nutrient TMDL is scheduled to be adopted by the Regional Board in mid-2002. Because this is ahead of the schedule for the development of the WER and SSO for ammonia, the TMDL development should recognize the SSO work effort to make sure any SSO developed can be incorporated into the TMDL. Ideally, the TMDL should set the targets for ammonia to be the EPA criteria times a WER. If a WER study is not completed, then the WER would default to 1. If a study has been completed, then the SSO would be automatically incorporated into the TMDL once it is approved.

### 1.2.2. Basis for Development of SSO

In 1999, the USEPA issued an update to the 1984 Ambient Water Quality Criteria for Ammonia. In both of the criteria documents, the USEPA acknowledged that ammonia toxicity may be dependent on the ionic composition of the exposure water, but the effects and understanding of these effects were insufficient to allow inclusion of them in the national criteria derivation. The 1999 Ammonia Criteria update states that these effects will "have to be addressed using water-effect ratios or other site-specific approaches" (USEPA, 1999). Studies cited in the 1999 Ammonia Criteria update include several studies that have been done to investigate the impacts of the ionic composition of the exposure water on the toxicity of ammonia to a number of species, including Atlantic salmon, lake trout, rainbow trout, *Ceriodaphnia dubia*, and *Hyalella azteca*. The results of these studies indicate that the toxicity of ammonia may be reduced in waterbodies similar to those found in Southern California with high hardness and elevated concentrations of certain ions (calcium, sodium, and potassium). Because the waterbodies in Los Angeles County are primarily effluent-dominated, the hardness and ionic concentrations in these waterbodies are much higher than the concentrations found in the laboratory dilution water used in the studies that were the basis for the ammonia criteria. For this reason, there is a potential to develop a WER for ammonia in these waterbodies.

In the 1999 Ammonia Criteria update, the chronic criteria were developed based on a limited number of chronic toxicity studies. The most sensitive species used in the development of the criteria was *Hyalella azteca*. The chronic study used in the development of the criteria was conducted by Uwe Borgmann in 1994. Borgmann also conducted acute toxicity tests on *Hyalella* that indicate that hardness and concentrations of certain ions may have a significant impact on the toxicity of ammonia to *Hyalella*. Because *Hyalella* is the most sensitive species on which the chronic criteria is based, initial studies were conducted as part of this SSO workplan development to determine the difference in toxicity to this species that occur in site water versus laboratory dilution water and give an indication whether a WER significantly different from 1.0 could be developed for ammonia.

#### 1.2.2.1. Summary of Previous Hyalella Studies

The Borgmann study used in the development of the ammonia chronic criteria was published in 1994. Four sets of 2-3 experiments each were conducted to examine various aspects of chronic ammonia toxicity to *Hyalella*. Two of these sets of experiments were looking at ammonia effects on survival and reproduction on 0-1 week old young and the reproduction in 4-5 week old adults, respectively. The other two sets investigated the impact of pH and hardness on the ammonia toxicity.

The first set of experiments (with 0-1 week old young) were the only results used in the development of the criteria. Three separate experiments were run with the 0-1 week old young, one for 4 weeks and the other two for 10 weeks. The studies compared survival, growth and reproduction relative to the control. EPA took the data from the two ten week studies and combined them into one dataset from which they used a multiple regression analysis to determine an EC20 (toxic concentration where 20% of exposed organisms showed an effect) for the species. At the lowest tested concentration, survival was reduced by 25% and reproduction was reduced by 55%. The EC20 found from this dataset is lower than the lowest tested concentration so the EC20 was determined to be less than the lowest tested concentration or <1.45 mg N/L.

No acute studies for *Hyalella* were used in the development of the acute ammonia standards. There were studies done on the species that were considered acceptable, but they were conducted between the 1984 and 1999 criteria documents and were not considered to add any information that would affect the criteria (i.e. they did not impact the lowest five genera). However, the data were compared to the criteria to make sure the criteria were protective. In soft water at high pHs, *Hyalella* results were below the acute criteria suggesting that this species may be one of the more sensitive species under those conditions. However, in moderately hard water, *Hyalella* was not one of the five most sensitive species, based on the acute test endpoint. The acute tests conducted by Borgmann that demonstrated a reduction in toxicity due to ionic concentrations was included in this review, but was not included in the development of the acute criteria.

#### 1.2.2.2. Initial Study Results

To assess the impact of Los Angeles area waterbodies on the toxicity of ammonia to *Hyalella*, two initial studies were conducted. The first study looked at acute toxicity in the Los Angeles River and the San Gabriel River. The second evaluated chronic toxicity in the San Gabriel River. A summary of the studies and the results are presented below.

##### 1.2.2.2.1. Acute Results

In October 2000, acute *Hyalella* toxicity tests were run on six samples collected in the Los Angeles River and four samples collected in the San Gabriel River. The sampling plan for the tests is included in Appendix 1. The toxicity tests were run to determine the EC50 (toxic concentration where 50% of exposed organisms showed an effect) in each of the collected samples and in a concurrently run analysis in moderately hard laboratory water. The following table summarizes the monitoring locations for the acute toxicity monitoring.

Table 2. Sampling Locations for 10/4/00 Monitoring Event

| Site Name | Location | Location of Sample Collection |
|---|---|---|
| LA-R4 Side | Los Angeles River at Riverside Blvd. | Side of river approximately 1 foot from edge |
| LA-R4 Mid | Los Angeles River at Riverside Blvd. | Side of river approximately 1 foot from edge |
| LA-R7 Side | Los Angeles River at Los Feliz Blvd. | Side of river approximately 1 foot from edge |
| LA-R7 Mid | Los Angeles River at Los Feliz Blvd. | Mid-stream, mid-depth in western side channel (stream divided by brush in middle) |
| LA-R8A | Los Angeles River at Coldwater Canyon Blvd. | Mid-stream, mid-depth |
| LA-R8B | Los Angeles River at Coldwater Canyon Blvd. | Side of river approximately 1 foot from edge |
| SGR-R4A[1] | San Gabriel River downstream of Artesia Blvd. | Edge of low flow channel |
| SGR-R4B[1] | San Gabriel River downstream of Artesia Blvd. | Edge of low flow channel |
| SGR-9W Side | San Gabriel River downstream of Willow Rd. | Edge of low flow channel |
| SGR-9W Mid | San Gabriel River downstream of Willow Rd. | Edge of low flow channel |

1. Unable to collect samples upstream of Los Coyotes because SJC plant was not discharging so there was insufficient flow to collect samples.

For each sample collected, the acute toxicity of ammonia to *Hyalella* was determined by exposing the test organisms to several different ammonia concentrations. From this testing, an EC50 was determined by MEC Analytical Laboratory. These EC50s were compared to the EC50 determined in laboratory dilution water of medium hardness (88 mg/L). In order to estimate a WER that corresponds to the pH observed in the site water, the EC50 determined in the laboratory dilution water was adjusted to the same pH as the specific site water sample. This was accomplished using equation 8 in the 1999 Ammonia Criteria update. As discussed later, there are some concerns that this equation may not be appropriate for *Hyalella*, so a separate pH relationship for *Hyalella* is being developed for this study. However, this relationship has not yet been developed, so equation 8 was used as the adjustment factor because it is the best estimate available. The site water EC50 was then divided by the adjusted laboratory EC50 to determine the estimated WER. Because of the pH dependency of ammonia toxicity, this WER is only applicable to the criteria calculated at the pH of the site water. Table 3 summarizes the laboratory determined EC50s and EC20s, the ambient pH and temperature, the adjusted EC50s, and the resulting WERs.

Table 3. Initial *Hyalella* Acute Toxicity Results and Estimated WERs

| Site | EC50 (mg/L-N) | EC20 (mg/L-N) | pH [1] | pH Range | Temperature (C) [1] | Temperature Range | Adjusted Lab Water EC50 (mg/L-N) | Estimated WER[2] |
|---|---|---|---|---|---|---|---|---|
| Lab Water | 74 | 49 | 7.6 | 7.3-7.9 | 23.6 | 22.7-25.2 | | |
| SGR-R4A | 128 | 100 | 8.2 | 7.5-8.5 | 23.5 | 22.7-24.9 | 27 | 4.8 |
| SGR-R4B | 132 | 105 | 8.1 | 7.5-8.3 | 22.9 | 22.0-23.5 | 31 | 4.2 |
| SGR-R9W MID | 140 | 118 | 8.1 | 7.6-8.3 | 23.2 | 22.4-24.3 | 28 | 4.9 |
| SGR-R9W SIDE | 152 | 105 | 8.0 | 7.6-8.2 | 23.4 | 22.0-24.2 | 39 | 3.9 |
| LA-R8A | 196 | 146 | 7.6 | 6.7-8.1 | 23.3 | 22.3-24.2 | 78 | 2.5 |
| LA-R8B | 187 | 110 | 7.6 | 7.0-8.1 | 22.6 | 21.8-23.5 | 72 | 2.6 |
| LA-R7 MID | 165 | 128 | 7.7 | 7.4-8.1 | 22.4 | 21.8-23.2 | 65 | 2.6 |
| LA-R7 SIDE | 165 | 121 | 7.7 | 7.5-8.1 | 23.6 | 22.6-25.9 | 58 | 2.9 |
| LA-R4 MID | >200 | 141 | 7.6 | 7.3-8.0 | 23.3 | 22.0-24.9 | >70 | >2.9 |
| LA-R4 SIDE | 206 | 128 | 7.5 | 7.2-8.0 | 23.6 | 22.6-25.0 | 80 | 2.6 |

1. Temperature and pH are the arithmetic means of all of the measurements taken for each of the dilution levels for the site water.
2. Based on equations in the criteria document and may be adjusted based on pH relationships developed in this study.

The EC50 determined in moderately hard laboratory water (74 mg/L-N at pH 7.6) compares well with the results of acute *Hyalella* studies conducted by Ankley, et. al that were cited in the 1999 Ammonia Criteria update (56 mg/L-N at pH 7.6). Because the results of this test in laboratory water were within 1.5 times the results of an independent study result, the laboratory results are considered to be confirmed based on requirements in the WER guidance.

The results demonstrate that the site water was approximately 2.5 to 4.9 times less toxic than the laboratory water, depending on the pH at the site. This compares favorably with the potential WER of 2.5 to 3 that was estimated in a preliminary report based on Borgmann's work, the *Feasibility for Developing an Ammonia SSO in the Los Angeles River* (LWA, 1999). The results also indicate that although there appear to be variations between waterbodies, the variations within a waterbody appear to be minimal, probably because pH is relatively consistent throughout the waterbody. Additionally, there is not significant variation between different sampling locations on the same cross-section of the river. However, to establish site to site differences in the WERs, pH variability at each site needs to be characterized both daily and seasonally. Some work has been done to characterize the pH variability of the Los Angeles and San Gabriel Rivers and is discussed in Section 1.4.

The estimated WERs can be multiplied by the existing Basin Plan or 1999 ammonia criteria at the site water pH shown in Table 3 to estimate the site-specific objective (SSO) appropriate for the waterbody. Table 4 summarizes the existing Basin Plan criteria, 1999 updated criteria and preliminary WER-adjusted 1999 criteria at each site based on the initial laboratory results.

Table 4. Summary of Current and Potential Ammonia Objectives at the Monitored Sites Based on Adjustment of the USEPA National Criterion with Observed WER Values (Total Ammonia in mg/L-N)

| Site | pH | Basin Plan Acute Objective (1 hr average) | Basin Plan Chronic Objective (4-day average) | 1999 Acute Criteria (1 hr average) | 1999 Chronic Criteria (30-day average) | Adjusted1999 Acute X WER (preliminary estimate) | Adjusted1999 Chronic WER (preliminary estimate) |
|---|---|---|---|---|---|---|---|
| SGR-R4A | 8.2 | 4.04 | 0.78 | 6.31 | 1.09 | 30.3 | 5.21 |
| SGR-R4B | 8.1 | 4.83 | 0.93 | 7.41 | 1.29 | 31.2 | 5.42 |
| SGR-R9W MID | 8.1 | 4.34 | 0.83 | 6.73 | 1.17 | 33.1 | 5.73 |
| SGR-R9W SIDE | 8.0 | 6.24 | 1.20 | 9.23 | 1.47 | 35.9 | 5.73 |
| LA-R8A | 7.6 | 15.27 | 2.94 | 18.43 | 2.37 | 46.3 | 5.97 |
| LA-R8B | 7.6 | 13.65 | 2.63 | 17.03 | 2.36 | 44.2 | 6.13 |
| LA-R7 MID | 7.7 | 11.75 | 2.26 | 15.27 | 2.23 | 39.0 | 5.70 |
| LA-R7 SIDE | 7.7 | 10.10 | 1.94 | 13.64 | 1.91 | 39.0 | 5.47 |
| LA-R4 MID | 7.6 | 13.14 | 2.53 | 16.58 | 2.22 | 47.3 | 6.34 |
| LA-R4 SIDE | 7.5 | 15.85 | 3.05 | 18.91 | 2.36 | 48.7 | 6.08 |

Although the estimated WERs were applied to both the Basin Plan and the 1999 Ammonia Criteria Update for comparison, the Basin Plan is scheduled to be updated to include the 1999 criteria in April 2002. The estimated WERs in Table 4 result in acute objectives that exceed 30 mg/L-N at all sites and chronic objectives in the 5-6 mg/L-N range. The interesting thing to note about the estimated SSOs is that, regardless of pH in the site water, the acute and chronic objectives adjusted by the WER are similar across the sites.

An adjustment of this magnitude to the chronic criteria results in the chronic value being higher than Species Mean Chronic Value (SMCV), on which the criteria are based, for four species: *Musculium transversum* (Fingernail clam), *Pimephales promelas* (Fathead minnow), *Lepomis macrochirus*(Bluegill), and *Micropterus dolomieu* (Small Mouth Bass). If any of these species are determined to be ecologically or commercially important, the ultimate SSO calculation could be based on a recalculation of the criteria prior to the application of the WER.

##### 1.2.2.2.2. Chronic Results

To assess the differences between the acute and chronic toxicity results for *Hyalella* and the potential WER that could result from chronic toxicity tests, a 6 week chronic toxicity test was run in June and July 2001. Endpoints observed at 7-day, 14-day 28-day and 42-day intervals were recorded during the study. Samples were collected from Station R5 at Willow Street on the San Gabriel River.

Significant mortality was observed in the laboratory water and all of the organisms died before the completion of the test. For this reason, a 42-day WER could not be estimated. Higher than expected mortality was observed in the laboratory water control, however the control for the San Gabriel River water did not have any mortality. For this reason, the chosen laboratory water does not appear to be appropriate for long term *Hyalella* testing and the results of the toxicity tests presented below should take this into consideration. However, the results from the San Gabriel River water are acceptable based on the control and did not demonstrate any significant mortality under any of the concentrations tested during the duration of the test.

Table 5. Results of the Initial *Hyalella* Chronic Toxicity Tests

| | **Average pH** | **7-day** | **14-day** | **28-day** |
|---|---|---|---|---|
| EC50 Lab Water (mg/L-N) | 7.4 | 6 | 3.5 | 2.5 |
| EC50 Lab Water pH Adjusted (mg/L-N)[1] | 8.3 | 1.9 | 1.1 | 0.8 |
| EC50 Site Water (mg/L-N) | 8.3 | >25 | >25 | >25 |
| Estimated WER | | >13 | >23 | >31 |

1. Based on equations in the criteria document and may be adjusted based on pH relationships developed in this study.

The results of the initial chronic toxicity tests demonstrate that the conditions in the San Gabriel River appear to reduce the toxicity of ammonia to *Hyalella*. Combined with the acute toxicity tests for the Los Angeles and San Gabriel Rivers, these preliminary results indicate that the development of a SSO for ammonia appears to be warranted in these waterbodies.

## 1.3. INTERIM WER GUIDANCE REQUIREMENTS

In 1994, the USEPA issued the *Interim Guidance on Determination and Use of Water-Effect Ratios for Metals*. This document is referenced in the 1999 Ammonia Criteria update as the guidance to be used in developing WERs for ammonia because specific WER guidance for ammonia has not been developed. This section summarizes the requirements for background information and study design outlined in the 1994 USEPA WER guidance.

### 1.3.1. Required Background Information

The 1994 WER guidance outlines the following information that should be obtained to help in the design of the study plan for WER development:

- **Information about effluent quality, operations and discharge schedules of the discharger.** This information is summarized in Section 1.4.
- **Spatial extent of the site to which the WER and the SSO are intended to apply.** The WER and SSO will apply to the waterbodies from the discharge point to either (1) confluence with the ocean, (2) the point at which another POTW discharges to the waterbody, or (3) the confluence of the waterbody with another waterbody for which a WER and SSO are being developed. Figure 1 shows the sites for which WER and SSOs are being developed.
- **Information relevant to calculation of permit limits including: design flows, upstream flow (7Q10), any mixing zone information, dilution at edge of mixing zone, and pH, temperature, hardness, etc. on which permit limits are based.** The 7Q10 design flow for each of the waterbodies in question is zero (0). No dilution or mixing zones are provided for the discharges to these water bodies. Currently, the dischargers have no permit limits for ammonia and it has not been determined at what pH and temperature the limits will be calculated. In permits issued in 1998 for DC Tillman and LA-Glendale, ammonia limits were placed in the permit findings based on the results of modeling done for the development of a nutrient TMDL on the Los Angeles River. The effluent limits were determined by calculating the ammonia objective at the average pH of the river at a monitoring station and placing that value into the model to determine what the effluent limits could be to meet the objective in the river. The average pH downstream of DC Tillman and LA-Glendale were 7.8 and 7.5

respectively. However, these permits have been remanded to the Regional Board based on a recent court decision. Recent tentative permits for some of the CSDLAC POTWs have required compliance with the pH and temperature dependent criteria in the Basin Plan without specifying a set pH and temperature to be used for determining compliance. Finally, a draft nutrient TMDL being developed for the Los Angeles River has proposed the use of 50$^{th}$ percentile receiving water pH and temperature values for the development of chronic effluent limits and 90$^{th}$ percentile receiving water pH values for the calculation of acute effluent limits. The use of 50$^{th}$ and 90$^{th}$ percentiles has been chosen as the appropriate approach for addressing pH and temperature variations during the development of the WER for ammonia based on the TMDL approach. A discussion of the calculations and the basis for this choice is included in Section 1.4.5.


Figure 1. SSO Sites

### 1.3.2. Requirements for Development of Chronic (cccWER) and Acute (cmcWER) WERs

Prior to the development of a WER, the decision needs to be made as to whether an acute WER, a chronic WER, or both will be developed. This decision helps determine the toxicity tests to be conducted. In general, the choice of which WER to develop is dependent on which criteria controls permit limits. In the case of ammonia, the chronic criteria is most likely the value that will control the permit limits, unless extreme pH values will be applied to determine the acute effluent limits. It is possible to develop a separate acute WER and chronic WER using toxicity tests with appropriate sensitivities, and it may be possible to determine a WER that can be applied to both the acute and the chronic criteria. One WER can be determined for both the acute and chronic criteria if the acute criteria is never lower than the chronic criteria.

For this study, an acute WER will be determined using a combination of acute and chronic toxicity tests. The development of an acute WER will allow the adjustment of both the acute and chronic criteria. Because the acute criteria is always higher than the chronic criteria at a given pH and temperature, the development of an acute WER will provide an environmentally conservative estimate of the WER.

### 1.3.3. Primary and Secondary Test Selection

The magnitude of a WER is likely to depend on the sensitivity of the test organisms used to determine the WER. More sensitive tests are expected to result in higher WERs and less sensitive tests will result in WERs closer to 1 (USEPA, 1994). The WER guidance outlines the following requirements for the selection of the test species:

- The primary toxicity test should have an endpoint in the laboratory dilution water that is close to, but not lower than, the criteria to which the WER is going to be applied.
- The primary toxicity test should be confirmed with a secondary test. The secondary test species should be taxonomically different from the primary test species (at least an order apart).
- The endpoint of the secondary test should be as close as possible to the criteria, but may be higher or lower than the criteria or the endpoint of the primary test.
- At least one species must be an animal and when feasible one should be a vertebrate and the other should be an invertebrate. Use a test and species for which the rate of success is known to be high and for which the test organisms are readily available.
- At least two separate tests must be available on the species in laboratory dilution water from the same or another lab. The studies in the criteria document may be used to fulfill this requirement.

- If the tests are otherwise acceptable, both acute WERs and chronic WERs may be determined using acute and/or chronic tests and using lethal and/or sublethal endpoints. The important consideration is the sensitivity of the test, not the duration, species, life stage, or adverse effect used.
- There is no requirement to use species that occur at the site, but they may be used if desired.

The WER guidance states that there is no reason to believe that different species with equally sensitive endpoints will result in different WERs. It is possible that the mode of action might differ from species to species and therefore the magnitude of the WER may vary. However, there is no data that support any conclusions about the existence or magnitude of such differences (USEPA, 1994).

The primary species to be used for the development of a WER for the waterbodies in Los Angeles County is *Hyalella azteca*. As discussed previously, this species is the most sensitive aquatic species used in the development of the chronic criteria in the 1999 Ammonia Criteria update. The endpoint of the *Hyalella* chronic toxicity test is close to, but not lower than, the chronic criteria for these waterbodies at the pH values observed in the waterbodies. The *Hyalella* acute toxicity endpoint value is higher than the acute criteria for these waterbodies. Additionally, initial tests have demonstrated that the conditions in the Los Angeles and San Gabriel Rivers significantly affect the toxicity of ammonia to this species. For these reasons, *Hyalella* is an appropriate species to use in the development of a WER for these waterbodies.

The WER guidance requires that at least one test be conducted with a secondary species to confirm the results with the primary species. Based on a review of the 1999 criteria document and other studies that have been conducted, the recommended secondary species for waterbodies designated as WARM at the discharge is the Fathead minnow (*Pimephales promelas*). The fathead minnow is the $4^{th}$ most sensitive species used in the development of the chronic criteria in the 1999 Ammonia criteria update. It is also one of the species used by all of the dischargers participating in the study in their Whole Effluent Toxicity (WET) testing of effluent. As a result, determining the level of ammonia toxicity to this species in the rivers to which the POTWs discharge will correspond with the requirements to prevent chronic toxicity in effluent discharges to the river. Studies have not been conducted on this species to determine whether or not the conditions in the waterbodies in Los Angeles County have an impact on the toxicity of ammonia to this species.

The Santa Clara River is the only one of the rivers in this study designated as COLD downstream of the treatment plants' discharges. However, only the estuary and the first river reach (nearest the estuary) of the Santa Clara River are designated as COLD habitat in the Basin Plan. This area is over 35 miles downstream from the dischargers (Saugus and Valencia WRPs). Between these dischargers and the estuary, the Freeman Diversion diverts a large amount of the river water from the stream (35 to 65%) (Kennedy/Jenks, 1998). Additionally, a model developed by Kennedy/Jenks Consultants (1998) showed that during dry periods of the year, the Santa Clara River upstream of the Freeman Diversion has no surface flow; thus the discharges from Saugus and Valencia WRPs rarely reach the diversion or the estuary or the first reach of the river. In fact, a dry gap in the river normally exists upstream of Piru Creek all the way to the Los Angeles/Ventura County line. This dry gap would prevent steelhead trout from traveling to the river reaches where the Saugus and Valencia WRPs discharge for the majority of the year. Only in extreme storm conditions does the flow from the POTWs even reach as far downstream as the Freeman Diversion. During the average wet weather period, the discharge from Saugus and Valencia WRPs accounts for at most only 10% of the surface flow at the Freeman Diversion (Kennedy/Jenks, 1998). Coupled with the fact that the Freeman Diversion diverts a large portion of the flow from the river, the impact of the effluent from these plants on the estuary is extremely diluted by other flows. As a result, there is not an expectation that the discharges from the Saugus and Valencia WRPs on the Santa Clara River impact the COLD portion of the Santa Clara River. While the chronic fathead minnow tests will be used as the secondary species for the WER, toxicity testing on rainbow trout will be conducted if determined to be necessary based on a demonstrated impact of the effluent on the portion of the Santa Clara River designated as COLD. The results of any tests conducted will be compared to the results of the chronic fathead tests, but they will not be used in calculating the WER to be applied to the WARM habitat at these discharges.

Based on the results of the initial *Hyalella* acute studies and one chronic toxicity test, the chronic toxicity test may result in a higher WER than the acute toxicity study. This is plausible, based on the fact that the chronic toxicity test has a more sensitive endpoint than the acute toxicity test. More sensitive tests are expected to result in higher WERs (USEPA, 1994).

For the purposes of this study, it is recommended that acute *Hyalella* studies be the basis of the development of the chronic WER. As demonstrated in the initial studies, the acute toxicity tests are likely to result in a lower WER than the chronic studies. The resulting SSO will therefore likely be conservative. Additionally, the shorter and less costly acute studies will allow more studies to be conducted. Finally, the acute toxicity test for *Hyalella* is a more frequently used and established test than the chronic toxicity test so there is more data from other laboratories to compare to the monitoring results. The WER guidance specifically outlines that the endpoint of the test is the determining factor for selecting the test, not whether or not the test is chronic or acute. As a result, according to the guidance, a WER developed using acute toxicity tests may be applied to a chronic criteria and visa versa as long as the endpoint of the primary test is not lower than the criteria being adjusted.

A chronic toxicity test will be used for the fathead minnow testing. Because initial toxicity testing has not been conducted for this species, the sensitivity of the chronic toxicity test as compared to the acute toxicity tests cannot be determined. Although the chronic toxicity test is a more sensitive test and is therefore expected to result in a higher WER than an acute study, no data are available to confirm this. As a result, the chronic toxicity tests will be conducted to ensure that chronic toxicity does not exist in the site water for this species.

In addition to the acute *Hyalella* and chronic fathead minnow testing, a limited number of chronic *Hyalella* studies will be conducted. Chronic studies will be conducted to ensure that the development of the WER using acute toxicity tests is environmentally conservative. It is possible that additional testing will be conducted to ensure that other species (*Ceriodaphnia dubia* and acute fathead minnow tests) used in Whole Effluent Toxicity (WET) testing are protected by the developed WER. However, the testing is not planned at this time. The following table summarizes the POTWs and the tests that will be run for each discharger.

Table 6. Summary of Toxicity Tests for Each Discharger

| POTW | Wet Weather Toxicity Test | Dry Weather Toxicity Tests |
|---|---|---|
| DC Tillman | Acute *Hyalella* | Acute *Hyalella*, Chronic Fathead Minnow |
| Los Angeles-Glendale | Acute *Hyalella* | Acute *Hyalella*, Chronic Fathead Minnow, Chronic *Hyalella* |
| Burbank | Acute *Hyalella* | Acute *Hyalella*, Chronic Fathead Minnow, Chronic *Hyalella* |
| Valencia | Acute *Hyalella* | Acute *Hyalella*, Chronic Fathead Minnow, Chronic *Hyalella* |
| Saugus | Acute *Hyalella* | Acute *Hyalella*, Chronic Fathead Minnow |
| Pomona | Acute *Hyalella* | Acute *Hyalella*, Chronic Fathead Minnow |
| Whittier Narrows | Acute *Hyalella* | Acute *Hyalella*, Chronic Fathead Minnow, Chronic *Hyalella* |
| San Jose Creek | Acute *Hyalella* | Acute *Hyalella*, Chronic Fathead Minnow |
| Los Coyotes | Acute *Hyalella* | Acute *Hyalella*, Chronic Fathead Minnow, Chronic *Hyalella* |
| Long Beach | Acute *Hyalella* | Acute *Hyalella*, Chronic Fathead Minnow, Chronic *Hyalella* |

### 1.3.4. Site Water Requirements

The WER guidance discusses the use of upstream water, actual downstream water, and simulated downstream water as the site water to be used to develop the WER. It outlines two methods, one for use with actual downstream water (Method 2) and one for use with simulated downstream water (Method 1). The guidance provided for Method 2 is very qualitative and does not provide specific guidance for the development of a WER. Method 1 describes very specific requirements, but suggests the use of simulated downstream water. For waterbodies with no background flow, the WER is to be developed in 100% effluent under Method 1.

The use of simulated downstream water is inappropriate for many of the dischargers and waterbodies in this study. In many cases, there is little or no flow upstream of the POTW, preventing the combination of upstream water and effluent in a known ratio. Because of this and the fact that permit limits in these watersheds are based on the assumption of no dilution from upstream waters, the WERs could be developed in 100% effluent. However, the current ammonia concentrations in the POTW effluent are too high to allow the tests to be conducted in 100% effluent. As a result, the only available option for developing the WER in these waterbodies is actual downstream water. The concern about actual downstream water is that the proportion of effluent in the stream may be unknown. However, in these streams, during critical low flow periods, the majority of the flow is POTW effluent and the permit limits are based on the assumption that there is no other flow in the stream. As a result, the use of downstream water should be appropriate for development of a WER for ammonia.

### 1.3.5. Sampling Events, Schedule, and Required Measurements

The *Interim Guidance for the Development of Water Effects Ratios for Metals* (EPA, 1994) specifies the minimum number of samples and types of samples to be collected for the development of a WER. The guidance requires at least three samples, two of which should be collected within 1 to 2 times the design flow of the waterbody and one collected in flows 2 to 10 times the design flow. Additionally, the guidance requires that at least one of the tests be conducted with a species other than the primary test species *Hyalella*. However, in the San Francisco Bay, SSOs are currently being developed without the inclusion of a second species because the dataset for the chosen species was considered to be sufficiently large. These SSOs are still being developed and have not been approved by the EPA or respective RWQCB.

The guidance does not have specific requirements for the number of sampling locations that are required. The only requirement is that the number of sampling locations be "sufficient to characterize the site to which the SSO will apply." To avoid dilution of the site water samples during toxicity testing, the ammonia concentration in the site water needs to be as low as possible. This requirement limits the choice of sampling locations to sites with sufficiently low ammonia concentrations. Additionally, site access is a consideration, especially for wet weather sampling, further restricting the choices of sampling locations. For this reason, only one location is used for each discharger at a location downstream of the discharge. Based on the results of the initial toxicity testing, it appears that the impacts of the different receiving waters on the toxicity of ammonia to *Hyalella* is similar and primarily varies with the pH of the waterbody. At a minimum, the results from all of the tests can be compared for consistency to determine if there are any anomalies.

It is possible that all of the results from the waterbodies sampled under this study can be combined to develop an SSO applicable to all of the waterbodies sampled. Precedence has been set for this type of analysis in a WER study conducted in Pennsylvania for copper (Hall and Associates, 1998). In that study, a SSO was developed for 10 dischargers by collecting one sample at one site downstream of each of the dischargers and combining the results to develop a WER applicable to all of the dischargers. The analytical method assumed that the WER for each discharger was equal to either the average of all of the analyses or the actual WER determined in site water if it was lower than the average. Combining the results from all of the waterbodies to be sampled in this study would provide a much larger dataset for analysis. The potential for the use of all of the monitoring results in the determination of the WER justifies the use of only one sampling location downstream of each discharger. Additionally, the March 2001 Streamlined WER Guidance for Copper (EPA, 2001) only requires one sampling location per designated WER site for the development of a WER for copper. Although the guidance is specific to copper, the fact that it has been determined to be appropriate for one constituent means that it may be appropriate for others if enough data are collected. An additional option would be to develop one WER and SSO for each watershed (Los Angeles River, San Gabriel River, and Santa Clara River).

The following are specific requirements from the WER guidance for conducting the sampling:

- Samples need to be collected under representative conditions when the discharger is operating normally.
- At least three WERs must be determined with the primary species and at least one with the secondary species.
- Test description must specify the test species, duration of the test, life stage of species, and adverse effect on which results are based.
- Recommended that during the first sampling event both the primary and secondary test are run so that the two can be interchanged if desired or to adjust the test if the results are surprising.
- If there are no results already available for the test species from another laboratory, the first or second time a WER is determined, at least two additional tests must be conducted in the laboratory dilution water in addition to the tests that are conducted for the determination of the WERs.
- Data are not required for a reference toxicant test for either the primary or secondary test.
- There must be at least 3 weeks between sampling events for the primary test. Desirable to obtain samples in at least two different seasons and/or during times of probable differences in the characteristics of the site water and/or effluent.

- At time of sample collection, flow, pH, hardness, TSS, TOC, and ammonia measurements must be taken. Any other water quality characteristics (TDS, conductivity) that are monitored monthly or more often in effluent and reported must also be measured.

These requirements have been incorporated into the monitoring plan presented in Section 3.

## 1.4. DISCHARGE SUMMARY AND RECEIVING WATER CHARACTERISTICS

As described above, the WER guidance requires that the effluent from the dischargers and the waterbodies themselves be characterized to the extent possible before the study begins to assist in study design. This information is necessary to determine the extent of the site to which the criteria will apply, define appropriate sampling locations, identify typical characteristics of the waterbodies and effluent to compare to collected samples, and determine the variability of pH and temperature in the effluent and waterbodies. Additionally, information about the current technology, compliance with historical limits by the dischargers, and compliance and consistency with federal, state and regional plans and policies is required by the Basin Plan for the development of an SSO.

### 1.4.1. POTW Characteristics

A total of ten POTWs discharge to the waterbodies addressed in this workplan. Two of the dischargers are run by the City of Los Angeles, one is operated by the City of Burbank, and the remaining dischargers are operated by the County Sanitation Districts of Los Angeles County. The following table summarizes the characteristics of each of the dischargers.

Table 7. POTW Characteristics

| Name | Agency | Number of Discharge Points | Main Receiving Water | Ultimate Effluent Destination | Design / Permitted Flow (mgd) | Typical Effluent Flow (mgd) (year 2000) | Flow to River | Typical Dry Weather Upstream Flow[1](mgd) |
|---|---|---|---|---|---|---|---|---|
| DC Tillman | City of Los Angeles | 8 | Los Angeles River | Japanese Garden Lake, Lake Balboa, Wildlife Lake, landscape irrigation, street cleaning, graffiti removal, construction-related dust control, Hansen Spreading Grounds, ocean through LA River near Long Beach | 80 | 57.9 | 57.9 | NA |
| LA-Glendale | City of Los Angeles | 1 | Los Angeles River | Ocean near Long Beach and reclaimed for landscape irrigation | 20 | 11.0 | 11.0 | 51 [2] |
| Burbank WWTP | City of Burbank | 2 | Burbank Western Wash/Los Angeles River | Ocean near Long Beach and reclaimed for cooling water and landscape irrigation | 9 | 4.7 | 4.7 | NA |
| Saugus | CSDLAC | 1 | Santa Clara River | Natural groundwater recharge, reclamation for landscape irrigation | 6.5 | 5.5 | 5.5 | 0 |
| Valencia | CSDLAC | 1 | Santa Clara River | Natural groundwater recharge, reclamation for landscape irrigation | 12.6 | 11.2 | 11.2 | 5.4* |
| Whittier Narrows | CSDLAC | 4 | Rio Hondo/San Gabriel River | San Gabriel and Rio Hondo Spreading Grounds and irrigation of nursery | 15 | 7.6 | 7.5 | NA |
| Los Coyotes | CSDLAC | 1 | San Gabriel River | Ocean and reclamation for irrigation and street sweeping | 37.5 | 34.4 | 29.2 | 0 |
| Long Beach | CSDLAC | 1 | Coyote Creek | Ocean and reclamation for irrigation and street sweeping | 25 | 18.8 | 14.5 | 10.3 |
| San Jose Creek | CSDLAC | 3 | San Gabriel River/San Jose Creek | Spreading grounds, ocean, and reclamation irrigation and street sweeping | 100 | 87.5 | 86.4 | 0/13.5** |
| Pomona | CSDLAC | 1 | San Jose Creek | Natural groundwater recharge and reclamation for irrigation and street sweeping | 15 | 10.7 | 3.2 | 0 |

1 Upstream flow is taken from LACDPW gauge data. The typical flow is taken as the median flow between 10/1/98 and 9/30/99.
2 The typical upstream value was calculated from the Army Corp LART gauge on the Los Angeles River at Tujunga.
NA Upstream flow data are not available.
* 5.4 mgd is the median of dry weather flows between 10/69 and 9/00 (May to Oct of every year only) at station F-92C-R.
** 0 mgd is the median flow on SGR upstream of confluence with San Jose Creek, whereas 13.5 mgd is the median on San Jose Creek upstream of SJCWRP discharge.

All of the treatment plants listed in Table 7 are tertiary treatment plants with filtration, chlorination and dechlorination. As shown in the table, a portion of the effluent from most of the plants is reclaimed for reuse in some manner. As such, the effluents meet all of the requirements for reclamation for these purposes and are of generally high quality.

In the 1994 Basin Plan, the Los Angeles Regional Water Quality Control Board (Regional Board), provided dischargers with eight years to comply with the ammonia objectives in the Basin Plan (or until 2003 per the CSDLAC permits). As a result of this Basin Plan language, none of the treatment plants listed above has an ammonia limit in their current permit to determine historical compliance. However, none of the dischargers currently meet the Basin Plan objectives for ammonia in their effluent. The following table summarizes the typical quality of the effluent from these dischargers.

Table 8. Discharge Effluent Water Quality Characteristics

| Discharger | Average Ammonia Concentration (mg/L-N) | Average pH | Maximum pH | Average Temperature (F) | Average Hardness (mg/L) | Average Sodium (mg/L) | Average Potassium (mg/L) | Average Calcium (mg/L) | Average Alkalinity (mg/L) |
|---|---|---|---|---|---|---|---|---|---|
| DC Tillman [1] | 16.6 | 7.20 | 7.37 | 75.3 | 157 | 88 | 11.9 | 36.1 | N/A |
| LA-Glendale [1] | 11.1 | 7.17 | 7.54 | 75.3 | 247 | 110 | 14.0 | 50.1 | N/A |
| Burbank [2] | 17 | 7.3 | 7.5 | 79 | 227 | N/A | N/A | N/A | N/A |
| Long Beach WRP [3] | 10.4 | 7.3 | 7.8 | 77 | 208 | 151 | N/A | 55 | 234 |
| Los Coyotes WRP [3] | 13.1 | 7.2 | 7.7 | 77 | 258 | 187 | 15.8 | 72 | 244 |
| Pomona WRP [3] | 11.0 | 7.1 | 7.7 | 76 | 203 | 94 | 10.5 | 58 | 202 |
| San Jose Creek WRP [3] | 9.8 | 7.0 | 7.7 | 77 | 218 | 112 | 12.7 | 57 | 202 |
| Whittier Narrows WRP [3,4] | 5.2 | 7.1 | 7.7 | 76 | 196 | 101 | 11.0 | 50 | 172 |
| Saugus WRP [3] | 11.8 | 7.4 | 8.5 | 75 | 261 | 140 | 15.9 | 60 | 267 |
| Valencia WRP [3] | 17.6 | 7.1 | 7.7 | 75 | 257 | 151 | 18.7 | 67 | 250 |

1. Average and maximum concentrations calculated from data collected from 1996-2000.
2. Average and maximum concentrations calculated from data collected in 2000.
3. Average and maximum concentrations calculated from data collected from 1995-2000.
4. Whittier Narrows is currently operating with nitrification and denitrification.

N/A Data for this constituent were not collected.

### 1.4.2. Los Angeles River

The Los Angeles (LA) River watershed is one of the largest in the Region. It is also one of the most diverse in terms of land use patterns. Approximately 324 square miles of the watershed are covered by forest or open space land including the area near the headwaters which originate in the Santa Monica, Santa Susana, and San Gabriel Mountains. The rest of the watershed is highly developed. The river flows through the San Fernando Valley past heavily developed residential and commercial areas. From the Arroyo Seco, north of downtown Los Angeles, to the confluence with the Rio Hondo, the river flows through industrial and commercial areas and is bordered by railyards, freeways, and major commercial and government buildings. From the Rio Hondo to the Pacific Ocean, the river flows through industrial, residential, and commercial areas, including major refineries and petroleum products storage facilities, major freeways, rail lines, and rail yards serving the Ports of Los Angeles and Long Beach.

Major tributaries to the river in the San Fernando Valley are the Pacoima Wash, Tujunga Wash (both drain portions of the Angeles National Forest in the San Gabriel Mountains), Burbank Western Channel and Verdugo Wash (both drain the

Verdugo Mountains). Due to major flood events at the beginning of the century, by the 1950's most of the river was lined with concrete. In the San Fernando Valley, there is a section of the river with a soft bottom at the Sepulveda Flood Control Basin. The Basin is a 2,150-acre open space upstream of the Sepulveda Dam designed to collect flood waters during major storms. Because the area is periodically inundated, it remains in a semi-natural condition and supports a variety of low-intensity uses as well as supplying habitat. At the eastern end of the San Fernando Valley, the river bends around the Hollywood Hills and flows through Griffith and Elysian Parks, in an area known as the Glendale Narrows. Since the water table was too high to allow laying of concrete, the river in this area has a rocky, unlined bottom with concrete-lined or rip-rap sides. This stretch of the river is fed by natural springs and supports stands of willows, sycamores, and cottonwoods. The many trails and paths along the river in this area are heavily used by the public for hiking, horseback riding, and bird watching.

South of the Glendale Narrows, the river is contained in a concrete-lined channel down to Willow Street in Long Beach. The main tributaries to the river in this stretch are the Arroyo Seco (which drains areas of Pasadena and portions of the Angeles National Forest in the San Gabriel Mountains), the Rio Hondo, and Compton Creek. Compton Creek supports a wetland habitat just before its confluence with the Los Angeles River. The river is hydraulically connected to the San Gabriel River Watershed by the Rio Hondo through the Whittier Narrows Reservoir during high flow events.

The LA River tidal prism/estuary begins in Long Beach at Willow Street and runs approximately three miles before joining with Queensway Bay between the Port of Long Beach and the City of Long Beach. The channel has a soft bottom in this reach with concrete-lined sides.

Four basins in the San Fernando Valley area contain substantial deep groundwater reserves and are recharged mainly through runoff and infiltration although the increase in impermeable surfaces has decreased infiltration. Groundwater basins in the San Gabriel Valley are not separated into distinct aquifers other than near the Whittier Narrows. Active recharge occurs in some of these areas through facilities operated by Los Angeles County. Spreading grounds recharge two basins in the coastal plain of Los Angeles west of the downtown area.

The Los Angeles River is primarily composed of effluent from three wastewater treatment facilities. The Donald C. Tillman Water Reclamation Plant discharges 56 million gallons per day on average into the river. The flow from this plant accounts for approximately one third of the river's dry weather flow as it enters the ocean (Gumprecht, 1999). The Los Angeles-Glendale Water Reclamation Plant discharges approximately twelve million gallons per day to the river downstream of the Glendale Narrows. The Burbank Wastewater Treatment Facility discharges to the Burbank Western Channel just south of Lake Drive in the City of Burbank. The Burbank Western Channel then drains into the Los Angeles River upstream of Victory

Boulevard, at a point approximately 2.5 miles downstream of the Burbank WTF discharge. On average, the Burbank Wastewater Treatment Facility discharges between 2 and 4 million gallons of the over 70 million gallons per day of dry weather flow present in the river downstream of the confluence of the Burbank Western Channel and the Los Angeles River. During dry weather, wastewater discharges account for approximately 50% percent of the river's flow where it enters the ocean. An additional 30% of the flow comes from urban runoff and industrial discharges, indicating that the majority of the flow in the river results from urban discharges.

### 1.4.3. San Gabriel River

The San Gabriel River receives drainage from a large area of eastern Los Angeles County; its headwaters originate in the San Gabriel Mountains. The watershed consists of extensive areas of undisturbed riparian and woodland habitats in its upper reaches. Much of the watershed of the West Fork and East Fork of the river is set aside as a wilderness area; other areas in the upper watershed are subject to heavy recreational use. The upper watershed also contains a series of flood control dams. Further downstream, towards the middle of the watershed, large spreading grounds are utilized for groundwater recharge. The watershed is hydraulically connected to the Los Angeles River through the Whittier Narrows Reservoir (normally only during high storm flows). The lower part of the river from near Firestone Blvd. flows through a concrete-lined channel in a heavily urbanized portion of the county before becoming a soft bottom channel once again near the ocean in the City of Long Beach. Due to the presence of upstream dams and the Rio Hondo and San Gabriel Spreading Grounds, the lower San Gabriel River receives little if any flow from the upper watershed. Starting at Firestone Blvd., the river is concrete-lined and made up almost exclusively of flow from the San Jose Creek WRP. The San Jose Creek WRP outfall location at Firestone Blvd. is 8 miles south of the treatment plant. Downstream, another CSDLAC POTW, Los Coyotes Water Reclamation Plant, discharges into the San Gabriel River. During dry weather, approximately 85% of the flow in the San Gabriel River is POTW effluent. However, during storm events, the majority of flow (approximately 60%) in the river comes from stormwater runoff.

San Jose Creek, Coyote Creek, and Rio Hondo are all tributaries to the San Gabriel River that receive discharges from POTWs involved in this study. The South Fork of San Jose Creek originates with the discharge from the Pomona WRP in Pomona. The creek flows approximately fifteen miles to its confluence with the San Gabriel River near the San Gabriel Spreading Grounds. In this area, the creek receives some discharge from the San Jose Creek WRP. Coyote Creek originates in Orange County and runs south to its confluence with the San Gabriel River, near Atherton Street. One POTW, the Long Beach Water Reclamation Plant, discharges to the Creek at the lower end of the watershed. Upstream of the plant, urban runoff and nonpoint source flow is approximately equivalent to the average yearly NPDES flow from the Long Beach Plant (Conway, 1999). Rio Hondo runs to the west of the upper San Gabriel River. In high flow situations, the Rio Hondo can discharge to the Los Angeles River after passing through the Whittier Narrows Reservoir. Flows from the San Gabriel River and Rio Hondo merge at this reservoir during larger flood events and flow to the LA River. Most of the water in the Rio Hondo is used for groundwater recharge during dry seasons. The Whittier Narrows WRP discharges to the Rio Hondo about one mile upstream of the Whittier Narrows Dam. Whittier Narrows WRP also discharges to the San Gabriel River just upstream of the dam.

#### 1.4.4. Santa Clara River

The Santa Clara River is the largest river system in Southern California that remains in a relatively natural state. The river originates in the northern slope of the San Gabriel Mountains in Los Angeles County, traverses Ventura County, and flows into the Pacific Ocean halfway between the cities of San Buenaventura and Oxnard. Several small tributaries come together to form the headwaters of the river in the Angeles National Forest upstream of Soledad Canyon. Downstream of Soledad Canyon, near the City of Santa Clarita, the river has been channelized for flood control for 6 miles. Downstream of Santa Clarita, the river flows in an unlined, unmodified channel through primarily agricultural land and the cities of Piru, Fillmore, and Santa Paula to the ocean. Multiple tributaries enter the river providing significant flow, especially during wet weather. Portions of the river contain little or no flow during the dry season, but the river is perennial due to wastewater treatment flows and rising groundwater downstream of the Saugus WRP and Valencia WRP.

Extensive patches of high quality riparian habitat are present along the length of the river and its tributaries. The endangered fish, the unarmored stickleback, is resident in the river. One of the largest of the Santa Clara River's tributaries, Sespe Creek, is designated a wild trout stream by the state of California and supports significant spawning and rearing habitat. The Sespe Creek is also designated a wild and scenic river. Piru and Santa Paula Creeks, which are tributaries to the Santa Clara River, also support good habitats for steelhead. In addition, the river serves as an important wildlife corridor. A lagoon exists at the mouth of the river and supports a large variety of wildlife.

The river receives discharges from a number of wastewater treatment plants. However, only two of the dischargers have been included in this study. The Saugus WRP discharges to the Santa Clara River approximately 4 miles upstream of the Valencia WRP.

### 1.4.5. Receiving Water Characteristics

The POTWs described above monitor a number of stations on the receiving waters to which they discharge as part of their NPDES permits. Data from these monitoring locations and some other available data are summarized in this section to help characterize the water quality in the waterbodies that may impact the toxicity of ammonia in the waterbodies. Table 9 lists the POTW monitoring locations. A map of the dischargers and monitoring locations is included as Figure 2.

Table 9. POTW Monitoring Locations

| POTW | Station ID | Location | Estimated Miles Downstream of Discharge | Waterbody |
|---|---|---|---|---|
| Burbank | R1 | Confluence of Burbank Western Wash and Lockheed Channel, 300 ft. above discharge | | Burbank Western Wash |
| Burbank | R2 | Verdugo Ave. | 1.5 | Burbank Western Wash |
| Burbank | R5 | Just upstream of confluence with LA River | 3 | Burbank Western Wash |
| DC Tillman | R7 | 1800 ft. downstream of Discharge No. 008 | 0.34 | LA River |
| DC Tillman | R8 | Upstream of confluence of Tujunga Wash | 4.5 | LA River |
| DC Tillman | R9 | Upstream of discharge at Reseda Blvd. | | LA River |
| LA Glendale | R4 | 214 Ft. upstream from discharge point | | LA River |
| LA Glendale | R5 | 850 ft. downstream from discharge point | 0.16 | LA River |
| LA Glendale | R7 | Los Feliz Blvd., upstream from bridge | 1.1 | LA River |
| Long Beach | R9 E | Downstream end of the pavement lining (near Atherton St. in the Eastern low flow channel) | 1.25 | San Gabriel River |
| Long Beach | RA | Just downstream of discharge | 0.05 | Coyote Creek |
| Long Beach | RA-1 | Upstream of discharge from Long Beach Water Reclamation Plant | | Coyote Creek |
| Los Coyotes | R4 | Artesia Blvd. | 0.25 | San Gabriel River |
| Los Coyotes | R5 | Willow Street | 1.5 | San Gabriel River |
| Los Coyotes | R6 | Seventh St. | 7.7 | San Gabriel River |
| Los Coyotes | R7 | Westminster Ave. (Second St.) | 8.7 | San Gabriel River |
| Los Coyotes | R8 | Marina Ave. | 10.2 | San Gabriel River |
| Los Coyotes | R9 W | Downstream end of the pavement lining (near Atherton St. in the Western low flow channel) | 6.5 | San Gabriel River |
| Los Coyotes | RA-2 | Downstream of the confluence of the eastern and western low flow channels | 6.9 | San Gabriel River |
| Pomona | RA | San Jose St. | 1 | South San Jose Creek |
| Pomona | RC | Downstream side of Old Brea Canyon Rd. | 4.25 | San Jose Creek |
| Pomona | RD | 200 yards downstream from Third Ave., City of Industry | 14.5 | San Jose Creek |
| San Jose Creek | C1 | Upstream of discharge point 002 | | San Jose Creek |
| San Jose Creek | C2 | Downstream of discharge point 002 | 0.2 | San Jose Creek |
| San Jose Creek | R10 | Upstream of San Jose Creek confluence | | San Gabriel River |
| San Jose Creek | R2 | Firestone Blvd. | 0.4 | San Gabriel River |
| San Jose Creek | R3 | Alondra Blvd. | 3.5 | San Gabriel River |
| San Jose Creek | R3-1 | Above LCWRP discharge 001, below culvert | 4.0 | San Gabriel River |
| Saugus | RA | 300 ft. upstream from discharge point | | Santa Clara River |
| Saugus | RB | 25 ft. downstream of discharge point | 0.01 | Santa Clara River |
| Valencia | RC | 300 ft. upstream from discharge point | | Santa Clara River |
| Valencia | RD | 300 ft. downstream of discharge point | 0.06 | Santa Clara River |
| Valencia | RE | 1.6 miles upstream of Chiquita Canyon Rd. | 3 | Santa Clara River |
| Whittier Narrows | RA | 150 ft. upstream from Whittier Narrows Dam | 0.05 | San Gabriel River |
| Whittier Narrows | RD | 1000 ft. upstream from San Gabriel Blvd. | 0.05 | Rio Hondo |

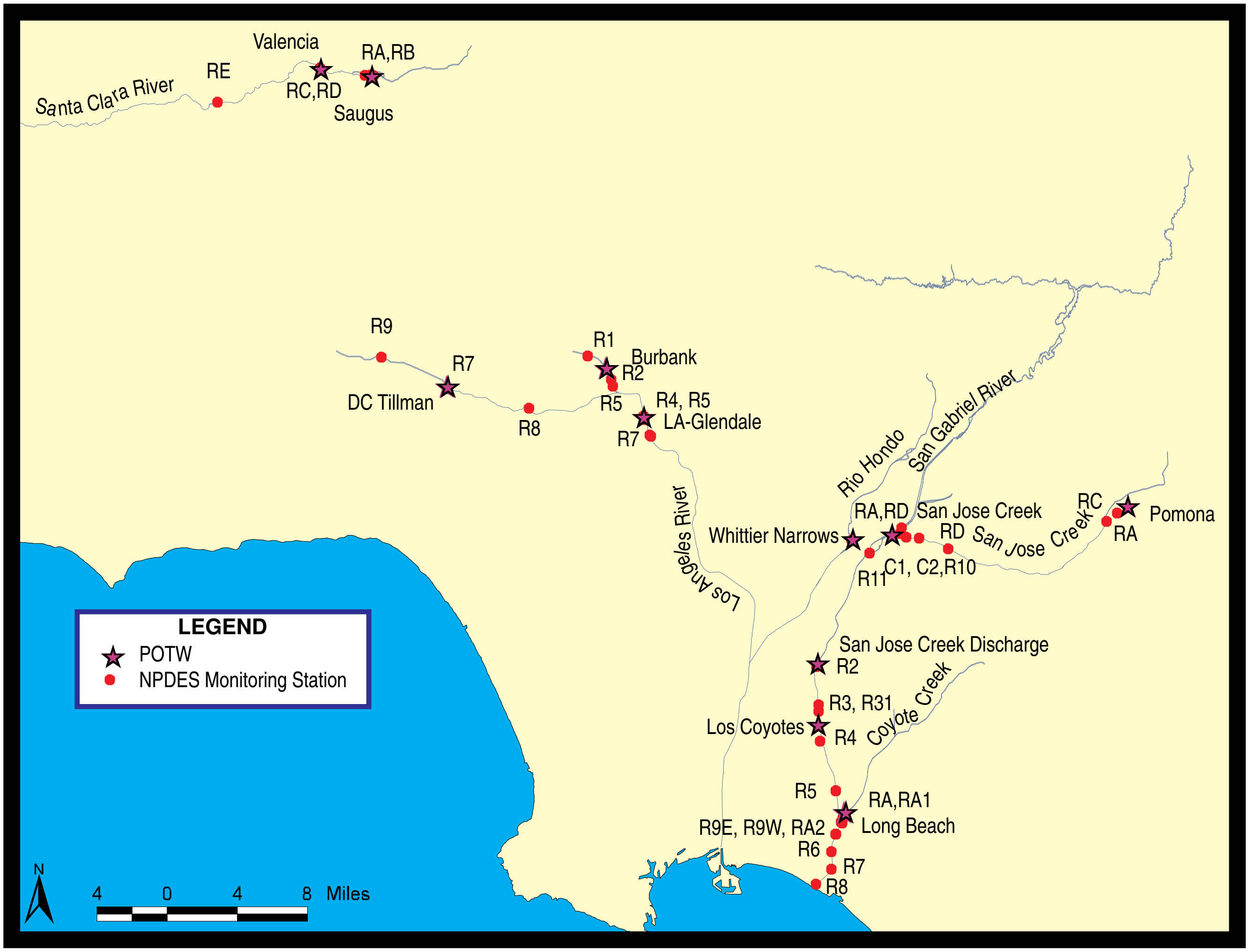


Figure 2. POTW Monitoring Locations

In addition to the POTW monitoring stations, some data were obtained from EPA's database STORET to help characterize the average concentrations of some additional constituents. Table 10 lists the STORET monitoring locations.

Table 10. STORET Monitoring Locations

| Waterbody | Location |
|---|---|
| Coyote Creek | Willow St. |
| Rio Hondo | San Gabriel Blvd. |
| Rio Hondo | Southern Ave. |
| Rio Hondo | At Spreading grounds |
| San Gabriel River | Above Spring St. |
| Los Angeles River | Tujunga |

Table 11 summarizes water quality characteristics of monitoring locations in the vicinity of each of the dischargers. In addition to the regular NPDES monitoring, samples for pH, temperature, and hardness were collected on the upper Los Angeles River and the lower San Gabriel River on a weekly basis to determine the variability of these measurements spatially and temporally. Figure 3 and Figure 4 show profiles of the measurements in the respective waterbodies.

Table 11. Receiving Water Monitoring Location Characteristics

| Discharger | Station ID | Average Ammonia (mg/L-N) | Average pH | Average Temperature (C) | Average Hardness (mg/L) | Average Alkalinity (mg/L) | Average DO (mg/L) | Average TDS (mg/L) | Average Chloride (mg/L) | Average Conductivity (mg/L) | Average Calcium (mg/L) | Average Sodium (mg/L) | Average Magnesium (mg/L) | Average Potassium (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Burbank | R1 | <5 | 8.5 | 15.0 | 388 | | 9.9 | 639 | 160 | 1045 | | | | |
| Burbank | R2 | 18 | 7.9 | 19.7 | 254 | | 8.6 | 596 | 123 | 1129 | | | | |
| Burbank | R5 | 16 | 8.1 | 17.2 | 207 | | 9.3 | 599 | 123 | 1166 | | | | |
| DC Tillman | R8 | 8.83 | 8.05 | 20.0 | 282 | | 11.01 | 689 | 109 | 1079 | | | | |
| DC Tillman | R9 | 0.42 | 8.18 | 15.6 | 708 | | 13.40 | 1273 | 125 | 1675 | | | | |
| DC Tillman | Tujunga | 12.3 | | | 329 | | 10.1 | | | | 84 | 95 | 29 | 10 |
| LA Glendale | R4 | 7.29 | 7.95 | 20.0 | 344 | | 10.95 | 620 | 99 | 963 | | | | |
| LA Glendale | R5 | 9.00 | 7.69 | 21.3 | 302 | | 9.66 | 636 | 119 | 1034 | | | | |
| LA Glendale | R7 | 6.50 | 7.61 | 20.0 | 328 | | 9.25 | 644 | 107 | 1034 | | | | |
| Long Beach | R9 E | 4.67 | 7.95 | 24.0 | 297 | 246 | 12.7 | 921 | 162 | 1506 | | | | |
| Long Beach | RA | 5.01 | 7.65 | 24.6 | 268 | 146 | 12.8 | 856 | 151 | 1497 | | | | |
| Long Beach | RA-1 | 0.41 | 8.47 | 20.9 | 428 | 334 | 15.8 | 1346 | 231 | 2059 | | | | |
| Los Coyotes | R4 | 7.46 | 7.44 | 25.3 | 230 | | 10.6 | 701 | 147 | 1208 | | | | |
| Los Coyotes | R5 | 5.62 | | | 224 | | | | | | | | | |
| Los Coyotes | R6 | 3.11 | 7.50 | 23.0 | 4824 | 135 | 8.05 | 8298 | 4611 | 15453 | | | | |
| Los Coyotes | R7 | 0.73 | 7.76 | 23.4 | | | 6.65 | 31530 | 16968 | 46054 | | | | |
| Los Coyotes | R8 | 0.64 | 7.81 | 23.0 | 5781 | 118 | 6.56 | 31521 | 16698 | 45862 | | | | |
| Los Coyotes | R9 W | 6.63 | 8.03 | 25.1 | 233 | | 14.0 | 721 | 148 | 1218 | | | | |
| Los Coyotes | RA-2 | 5.67 | 7.79 | 23.9 | | | 10.7 | 3081 | 1453 | 5224 | | | | |
| Pomona | RA | 4.98 | 7.38 | 22.2 | | | | 400 | 86 | | | | | |
| Pomona | RC | 0.72 | 8.30 | | 406 | 212 | | 726 | 89 | | | | | |
| Pomona | RD | 1.33 | 8.47 | | 483 | 297 | | 867 | 117 | | | | | |
| San Jose Creek | C1 | 1.96 | 8.09 | 17.1 | 469 | 298 | 7.74 | 962 | 134 | 1422 | | | | |
| San Jose Creek | C2 | 4.14 | 7.50 | 20.8 | 332 | 192 | 6.73 | 713 | 124 | 1182 | | | | |
| San Jose Creek | R10 | 0.46 | 6.08 | 12.5 | | | 7.92 | | 29.2 | 370 | | | | |
| San Jose Creek | R2 | 4.21 | 7.20 | 24.7 | 212 | | 6.27 | 598 | 113 | 1008 | | | | |
| San Jose Creek | R3 | | | | 200 | | | | | | | | | |
| Saugus | RA | 0.05 | | | | | | | | | | | | |
| Saugus | RB | 9.68 | 7.34 | 24.3 | 259 | 253 | | 712 | 125 | 1226 | | | | |
| Valencia | RC | 0.53 | 7.84 | 21.3 | 379 | 263 | | 812 | 88 | | | | | |
| Valencia | RD | 7.56 | 7.57 | 22.8 | 343 | 264 | | 803 | 109 | 1320 | | | | |
| Valencia | RE | 4.13 | | | 379 | 257 | | 775 | 96 | 1285 | | | | |
| Whittier Narrows | RA | 5.57 | 7.52 | 25.9 | 227 | 120 | | 469 | 79 | 997 | | | | |
| Whittier Narrows | RD | 3.69 | 7.30 | 22.3 | 216 | 161 | | 522 | 76 | 821 | | | | |
| DC Tillman | R7 | 5.30 | 8.07 | 19.4 | 363 | | 10.18 | 809 | 112 | 1191 | | | | |
| Coyote Creek | Willow St. | 13.0 | | | 251 | | 7.7 | | | | 65.8 | 163 | 21.3 | 12.1 |
| Rio Hondo | At Spreading grounds | 5.71 | | | 198 | | 7.4 | | | | 52.7 | 58.9 | 15.6 | 6.4 |
| Rio Hondo | San Gabriel Blvd. | 9.33 | | | 216 | | 5.6 | | | | 59.9 | 57.5 | 15.7 | 6.7 |
| Rio Hondo | Southern Ave. | 0.50 | | | 228 | | 11.0 | | | | 61.0 | 95.9 | 17.7 | 8.7 |
| San Gabriel River | Above Spring | | | | 168 | | 5.8 | | | | 44.8 | 103 | 12.5 | 10.7 |

Blank cells in the table above indicate that data are not available for that constituent.

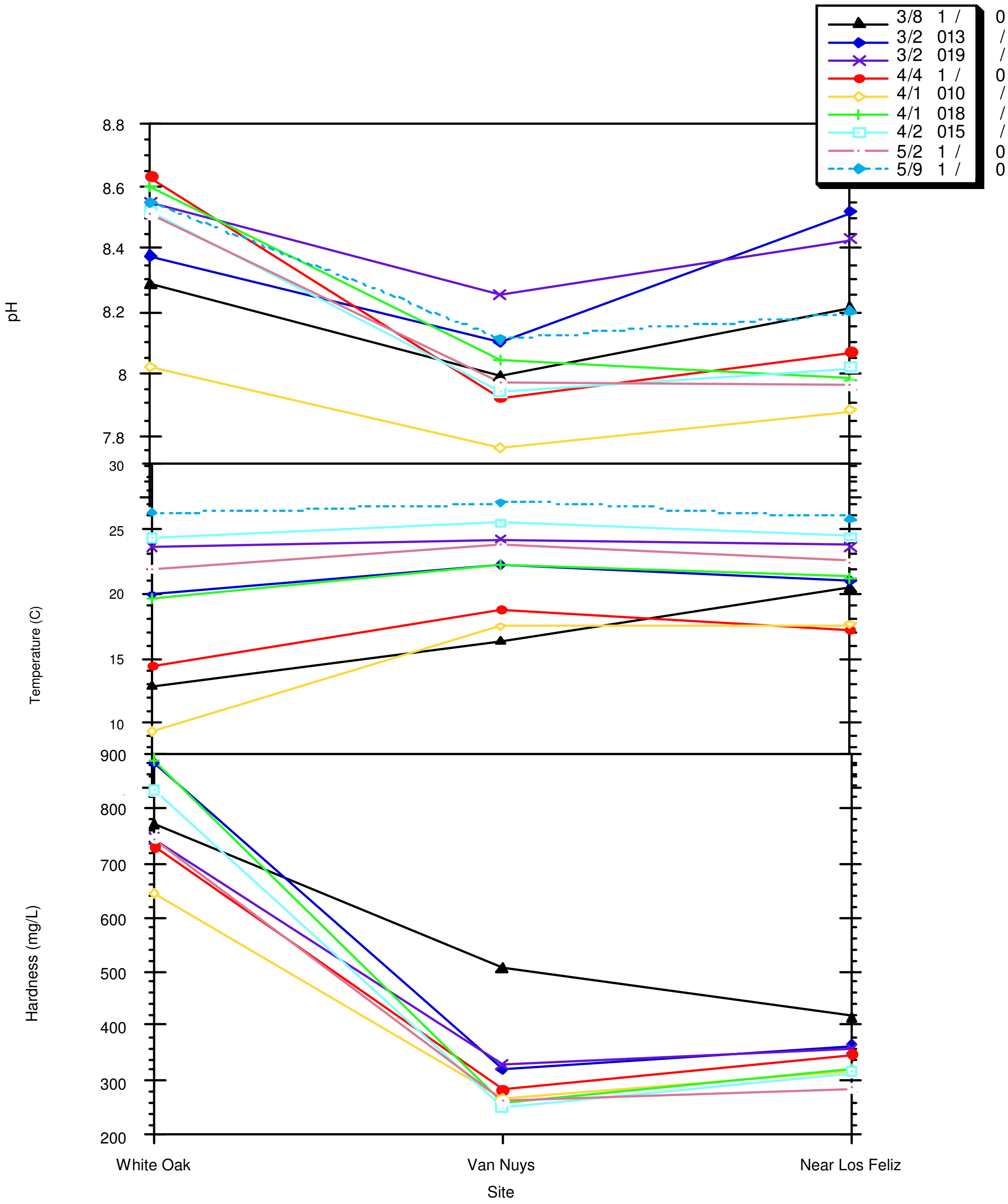


Figure 3. Los Angeles River pH, Temperature, and Hardness Profiles

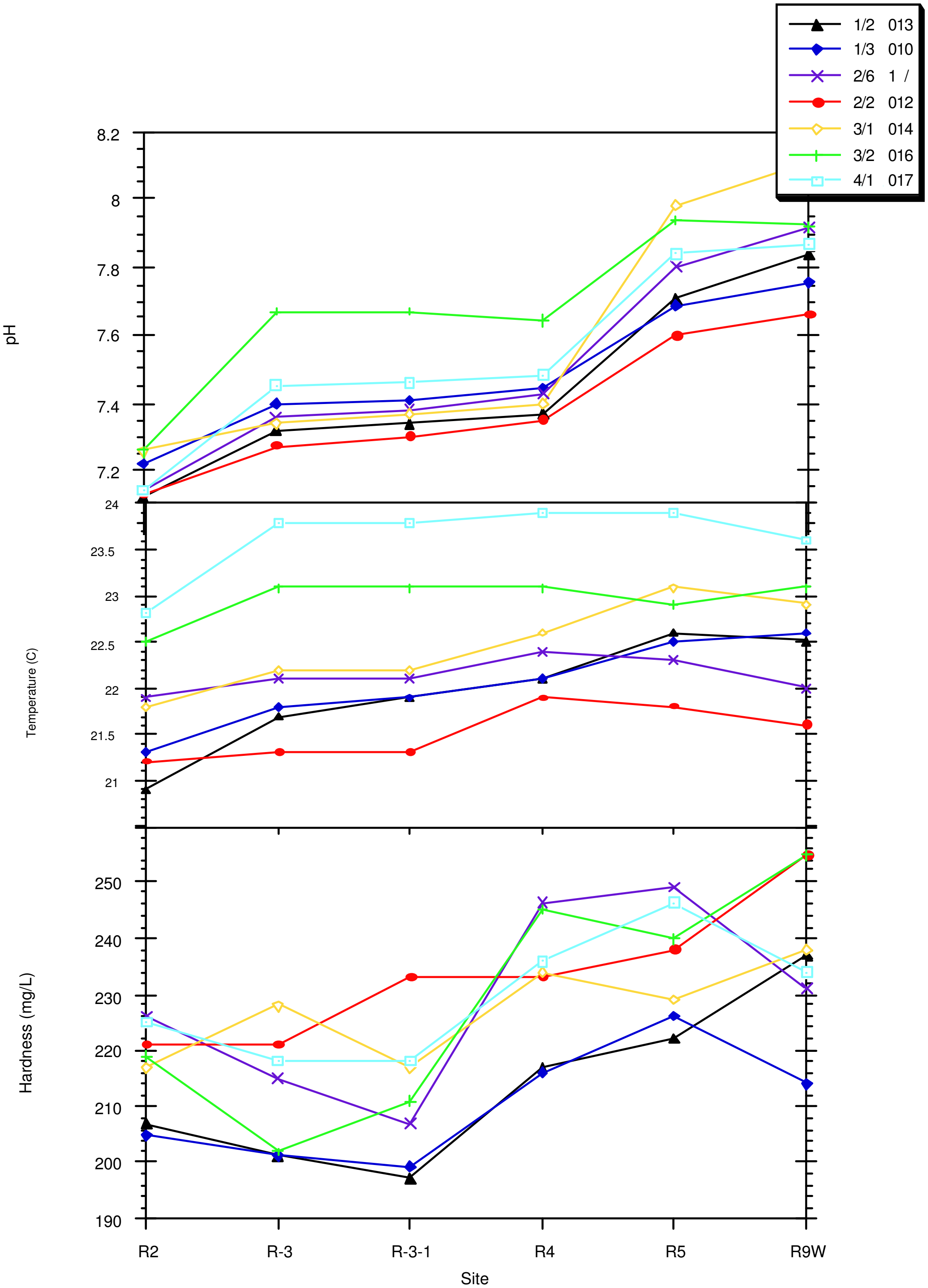


Figure 4. San Gabriel River pH, Temperature, and Hardness Profiles

#### 1.4.5.1. Receiving Water Target Monitoring Conditions

The toxicity of ammonia in the receiving waters is clearly dependent on the conditions present during the sampling events. For this reason, critical constituents that could impact the toxicity of ammonia were examined in more detail here to ensure the appropriate monitoring conditions are present during sampling. The critical conditions discussed here are pH, temperature, and hardness.

EPA has adopted and promulgated ammonia criteria that are dependent on pH and temperature conditions. For this reason, pH and temperature differences between the samples needs to be addressed. The proposed mechanism for addressing these issues is by following EPA guidance designed to address the hardness dependency of metals criteria in WER development. In 1997, an addendum to the 1994 WER guidance was developed to more clearly discuss how to take the hardness dependency of metals criteria into account when developing the WER (EPA, 1997). Additionally, the Streamlined WER Procedure for Copper further clarified the hardness calculations (EPA, 2001). For the purposes of developing a WER for ammonia, the hardness guidance from the three documents was assumed to be appropriate for pH and temperature dependency and the same approach was used. The basic procedure involves normalizing the hardness in the site water and the laboratory dilution water to the same concentration before calculating the WER. There is no requirement that the site water be collected at the design hardness or the hardness at which the criteria will be calculated for permit limits. WERs calculated from site waters of different hardness can be combined together to calculate the final WER.

The 1999 ammonia criteria document provides equations for pH and temperature adjustments similar to those found in the metals criteria documents that allow for the adjustment for hardness. However, the pH relationship for *Hyalella* may be different from the pH relationship in the 1999 Updated Ammonia Criteria that was based on the pooled data for all species for which data were available (see Figure 8, page 32 of the 1999 Updated Ammonia Criteria). As a result, a pH relationship for *Hyalella* will be developed through this study. Fathead minnows appear to have a pH relationship similar to the pooled dataset relationship so the equations in the criteria will be used to adjust the toxicity monitoring results for fathead minnow.

Using the developed pH relationship for *Hyalella* and the 1999 Updated Ammonia Criteria document equations, the pH and temperature at which the samples are collected can be adjusted through calculations after the analysis to apply to whatever criteria the Regional Board chooses to use in the calculation of permit limits. This means that the pH and temperature at which the sample is collected is not critical for the development of the WER. Although this is the case, the sampling plan has been designed to collect samples as close as possible to the pH and temperature at which the permit limits are likely to be applied to minimize the adjustments needed.

Although it is recognized that pH and temperature vary in effluent dependent waterbodies, the permit limits will likely be derived based on specific pH and temperature conditions in the site water determined from historical data. Thus, for the purposes of sampling, target pH and temperatures were defined. In the recently developed draft Los Angeles River Nutrient TMDL, the 50$^{th}$ percentiles of pH and temperature data were used to evaluate the appropriate chronic limit for ammonia. Using the 50$^{th}$ percentile as a basis for the evaluation of chronic effects is also supported by the State Implementation Plan for California, to appropriately estimate the chronic or long-term effects of exposure. The 90$^{th}$ percentile of pH was chosen as the basis for calculating the acute criteria. For the purposes of determining the target pH and temperature for sampling, the 50$^{th}$ and 90$^{th}$ percentiles from the first river monitoring station downstream of each discharger were calculated. The following table summarizes the pH and temperature data from these receiving water stations.

Table 12. pH and Temperature Variations and Percentiles at the Receiving Water Monitoring Stations

| | | **pH** | | | | | | | **Temperature ($^{o}$C)** | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Station | POTW | Min | Max | Average | 50$^{th}$ Percentile | 90$^{th}$ Percentile | Standard Deviation | Coefficient of Variation | Min | Max | Average | 50$^{th}$ Percentile | 90$^{th}$ Percentile | Standard Deviation | Coefficient of Variation |
| R2 | Burbank | 7.20 | 8.81 | 7.79 | 7.79 | 8.01 | 0.25 | 0.03 | 11.7 | 26.1 | 19.4 | 18.9 | 23.3 | 2.75 | 0.14 |
| R7 | DC Tillman | 7.50 | 8.97 | 8.07 | 8.04 | 8.34 | 0.26 | 0.03 | 11.7 | 27.2 | 19.7 | 19.7 | 25.1 | 4.33 | 0.22 |
| R5 | LA Glendale | 7.33 | 8.17 | 7.69 | 7.66 | 7.92 | 0.17 | 0.02 | 15.7 | 26.1 | 21.3 | 21.2 | 25.1 | 2.93 | 0.14 |
| RA | Long Beach | 6.69 | 8.77 | 7.65 | 7.6 | 8.1 | 0.37 | 0.05 | 14.4 | 31.1 | 24.58 | 24.4 | 28.3 | 2.92 | 0.12 |
| R4 | Los Coyotes | 6.7 | 8.2 | 7.44 | 7.43 | 7.69 | 0.25 | 0.03 | 18.9 | 30.4 | 25.27 | 25.4 | 27.89 | 2.35 | 0.09 |
| RA | Pomona | 5.8 | 9.5 | 7.38 | 7.3 | 8.0 | 0.62 | 0.08 | 13.3 | 30.6 | 22.15 | 21.7 | 26.7 | 3.25 | 0.15 |
| RB | Saugus | 6.43 | 8.13 | 7.34 | 7.37 | 7.55 | 0.24 | 0.03 | 17 | 28.8 | 24.29 | 24.5 | 27.3 | 2.37 | 0.10 |
| C2 | SJC | 6.68 | 8.82 | 7.50 | 7.16 | 7.59 | 0.42 | 0.06 | 7.39 | 28.2 | 20.75 | 24.75 | 27.53 | 4.77 | 0.23 |
| R2 | SJC | 6.38 | 8.34 | 7.20 | 7.46 | 8.12 | 0.29 | 0.04 | 19.2 | 29 | 24.71 | 21.4 | 26.64 | 2.42 | 0.10 |
| RD | Valencia | 6.48 | 8.87 | 7.57 | 7.57 | 7.93 | 0.30 | 0.04 | 13.6 | 32.5 | 22.80 | 23.2 | 26.44 | 3.08 | 0.13 |
| RA | Whittier Narrows | 6.7 | 8.6 | 7.52 | 7.45 | 8.2 | 0.45 | 0.06 | 20 | 30 | 25.91 | 26 | 28.66 | 2.17 | 0.08 |
| RD | Whittier Narrows | 6.7 | 8.6 | 7.30 | 7.21 | 7.6 | 0.27 | 0.04 | 11.1 | 28 | 22.25 | 22.2 | 26.7 | 3.09 | 0.14 |

During monitoring, sample pHs will be taken at the time of sample collection. Whenever possible, samples will be collected when the median pH is close to or equal to the 50$^{th}$ percentile pH shown in the table above. The temperature at which the test is run will be adjusted in the laboratory to be as close to the median temperature as feasible within the confines of the test requirements.

The toxicity of ammonia is dependent on the quantity of conservative constituents in the water column (hardness, sodium, potassium, and calcium). Because these constituents are conservative, the concentrations should not change significantly throughout the river. This is shown to be the case by the average concentrations summarized in Table 11. However, because the WER may be dependent on these constituents, the variability in the waterbodies was examined to ensure that the proposed sampling accounts for any significant variability. To examine this variability, hardness concentrations from monitoring locations downstream of dischargers were evaluated in detail. Hardness concentrations have a coefficient of variation between 0.01 and 0.27 downstream of the dischargers. The number of hardness samples collected from the monitoring sites varies significantly, but in general, very little variation in hardness is observed in the sites downstream of the dischargers. Variability of this magnitude observed in the hardness concentrations should be captured by the design of the monitoring program. Specifically, any wet weather variability should be captured during the wet weather monitoring included in the study plan. Additionally, monitoring during different times of the year should capture seasonal variations in hardness concentrations. To the extent possible, samples for acute *Hyalella* testing will be collected during different times of the day during the different sampling events. Because the final WER is calculated as a geometric mean of all of the WERs calculated from the individual monitoring events, the final WER will be an average of all of the conditions sampled. Finally, the results from the monitoring will be reviewed for relationships to hardness and equations developed to address this issue if significant relationships exist. If after two dry weather and one wet weather monitoring event, the hardness concentrations measured in the samples do not appear to cover the range of hardness expected from the monitoring shown in the following table, additional measures to address hardness variability will be considered before the remaining samples are collected.

Table 13. Hardness Variations and Percentiles at the Receiving Water Monitoring Stations

| | | Hardness (mg/L $CaCO_3$) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| POTW | Station | Min | Max | Average | 50th Percentile | 90th Percentile | Standard Deviation | Coefficient of Variation | Count |
| Burbank | R1 | 226 | 662 | 388 | 367 | 570 | 138 | 0.36 | 9 |
| Burbank | R2 | 191 | 323 | 254 | 256 | 291 | 39 | 0.15 | 9 |
| Burbank | R5 | 222 | 337 | 267 | 266 | 308 | 37 | 0.14 | 9 |
| DC Tillman | R7 | 290 | 504 | 363 | 348 | 450 | 74 | 0.20 | 9 |
| DC Tillman | R8 | 220 | 448 | 282 | 250 | 374 | 75 | 0.27 | 9 |
| DC Tillman | R9 | 531 | 818 | 708 | 686 | 813 | 102 | 0.14 | 9 |
| LA Glendale | R4 | 286 | 274 | 344 | 216 | 358 | 46 | 0.16 | 9 |
| LA Glendale | R5 | 269 | 266 | 302 | 232 | 324 | 30 | 0.11 | 9 |
| LA Glendale | R7 | 284 | 282 | 328 | 232 | 336 | 34 | 0.12 | 9 |
| Long Beach | RA | 245 | 291 | 268 | 268 | 286 | 33 | 0.12 | 2 |
| Los Coyotes | R4 | 216 | 256 | 230 | 217 | 248 | 23 | 0.10 | 3 |
| Los Coyotes | R5 | 222 | 226 | 224 | 224 | 226 | 3 | 0.01 | 2 |
| Los Coyotes | R9E | 178 | 479 | 297 | 282 | 384 | 62 | 0.21 | 85 |
| Los Coyotes | R9W | 214 | 242 | 233 | 237 | 241 | 13 | 0.05 | 4 |
| Los Coyotes | RA1 | 301 | 508 | 428 | 432 | 471 | 47 | 0.11 | 17 |
| San Jose Creek | C2 | 190 | 626 | 332 | 302 | 445 | 86 | 0.26 | 65 |
| San Jose Creek | R2 | 205 | 224 | 212 | 207 | 221 | 10 | 0.05 | 3 |
| San Jose Creek | R3 | 197 | 201 | 200 | 200 | 201 | 2 | 0.01 | 4 |
| Saugus | RB | 201 | 396 | 259 | 252 | 313 | 38 | 0.15 | 86 |
| Valencia | RD | 245 | 497 | 343 | 336 | 385 | 43 | 0.13 | 83 |
| Valencia | RE | 222 | 440 | 379 | 382 | 417 | 34 | 0.09 | 83 |
| Whittier Narrows | RA | 185 | 277 | 227 | 226 | 248 | 23 | 0.10 | 17 |
| Whittier Narrows | RD | 144 | 291 | 216 | 214 | 249 | 29 | 0.13 | 51 |

#### 1.4.5.2. Monitoring Location Selection

The water quality information presented in Table 11 was used in conjunction with the WER guidance requirements to select one monitoring location for each of the dischargers. The laboratory required samples to contain less than 10 mg/L of total ammonia as nitrogen and preferably less than 5 mg/L-N to avoid having to remove ammonia from the samples or dilute the samples with upstream water. Historical monitoring results were reviewed to assess appropriate monitoring locations based on this requirement.

Additionally, the selection of the monitoring locations was dictated in many cases by accessibility to the waterbody. The chosen locations had to be accessible during wet weather events (i.e. were near a bridge from which samples could be taken). To the extent possible, location of the monitoring locations was chosen to be approximately one to two miles downstream of each of the dischargers and upstream of any major tributaries and/or inputs to the waterbody. On the Santa Clara River downstream of Valencia, the only accessible monitoring location is located downstream of a major tributary. However, discharges from the tributary are controlled and sampling will only occur at times when discharges from the tributary are not occurring. The following table lists the selected monitoring stations.

Table 14. Sampling Locations

| Location ID | Relationship to Existing Monitoring Stations | Receiving Water | Description | Agency |
|---|---|---|---|---|
| LA-1 | Downstream 1.5 miles from DC Tillman R7 | Los Angeles River | Downstream of DC Tillman at Van Nuys Blvd. | City of LA |
| LA-2 | LA Glendale R7 | Los Angeles River | Downstream of LA Glendale at Los Feliz | City of LA |
| BW-1 | Just upstream of Burbank R5 | Burbank Western Wash | Downstream of Burbank at Riverside Dr. | City of Burbank |
| SGR-1 | San Jose Creek R3 | San Gabriel River | Downstream of San Jose Creek WRP at Alondra | CSDLAC |
| SGR-2 | Los Coyotes R5 | San Gabriel River | Downstream of Los Coyotes at Willow Rd. | CSDLAC |
| SJC-1 | Pomona RA | San Jose Creek | Downstream of Pomona WRP at San Jose St. | CSDLAC |
| CC-1 | Long Beach RA | Coyote Creek | Downstream of Long Beach at foot bridge 200 yards downstream of discharge | CSDLAC |
| RH-1 | Whittier Narrows RA | Rio Hondo | Downstream of Whittier Narrows WRP 150 feet upstream of the Whittier Narrows Dam | CSDLAC |
| SCR-1 | Saugus RB | South Fork Santa Clara River | Downstream of Saugus- 25 feet downstream of discharge | CSDLAC |
| SCR-2 | Valencia RE | Santa Clara River | Downstream of Valencia, 1.6 miles upstream of Chiquita Canyon Road. | CSDLAC |

## 1.5. APPROACH

The site-specific objective (SSO) for ammonia in the Los Angeles River will be determined through the development of a water effects ratio (WER) and implementation of USEPA guidance for SSO development. The proposed approach for developing the site-specific objective is outlined below and discussed in more detail in the following sections. The approach will consist of the following steps:

- Development of and consultation with a Technical Advisory Committee
- Input and guidance from a coordinating committee
- Toxicity monitoring as outlined in the included monitoring plan
- Data analysis and reporting
- Calculation of the appropriate site-specific objective for ammonia based on the analysis procedures

The steps outlined in the Basin Plan for the development of a SSO and the appropriate EPA guidance for WERs and aquatic life criteria will be followed.

# Section 2. Public Participation Plan

The technical review and public participation for the SSO development will consist of two components. The first will be the development of a technical advisory committee and a coordinating committee. The second component will be public participation and comment solicited through public workshops. The technical advisory committee will consist of outside experts that will conduct independent peer review of the workplans, data, and conclusions. A list of potential participants in the technical advisory committee is summarized in Table 15. A three to four person technical advisory committee with be determined from this list of mutually acceptable independent peer reviewers based on availability and desire of the experts to be involved in the process. The TAC will also be responsible for conducting the initial review of the workplan in Fall 2001.

Table 15. Proposed Technical Advisory Committee

| Member | Agency/Company | Expertise |
|---|---|---|
| Charles Delos | US EPA Headquarters | Developed Streamlined WER study, Worked on 1999 Ammonia criteria |
| Gary Chapman | Palladin Consulting | Water quality, WER and toxicity testing experience |
| Steve Bay | SCCWRP | Toxicologist |

In addition to the technical advisory committee, a coordinating committee will be developed. This coordinating committee will consist of a Regional Board staff member, a State Board staff member, an EPA Region 9 staff member and/or EPA headquarters staff member, a representative from the Department of Fish and Game, representatives from the dischargers, and environmental/public interest group representatives. Confirmed members are summarized in Table 16, but additional members may be added as the study progresses. The coordinating committee will serve as the primary body responsible for reviewing all of the workplans, analytical results, and for providing input into the study design and findings. The technical advisory committee will provide independent peer review of the decisions of the coordinating committee.

Table 16. Proposed Coordinating Committee

| Member | Agency/Company [1] |
|---|---|
| Robyn Stuber | US EPA Region 9 |
| Deb Smith | Los Angeles RWQCB |
| Mauricio Cardenas | Department of Fish and Game |
| Mark Gold | Heal the Bay |
| Jose Saez | CSDLAC |
| Shahrouzeh Saneie | City of Los Angeles |
| Rodney Anderson | City of Burbank |

1. A member from the State Water Resources Control Board may be added.

In addition to the technical advisory committee and the coordinating committee, public participation and comment will be solicited through public workshops designed to meet at least a portion of the Regional Board's participation requirements for Basin Plan amendments. As part of the Triennial Review of the Basin Plan, the Regional Board has identified the incorporation of the updated ammonia criteria into the Basin Plan as a top priority. The goal is to coordinate the development of the WER and SSO with the adoption of the 1999 ammonia criteria into the Basin Plan. Through this coordination, the public can be informed of the SSO development process and have opportunities to comment on the proposed objectives.

# Section 3. Monitoring Plan

This section discusses the monitoring activities from the steps required to prepare for sampling to the sample delivery procedure after completion of sample collection. All samples will be delivered to MEC Analytical Systems, Inc. in Carlsbad, CA for analysis.

## 3.1. SAMPLING LOCATIONS

One monitoring location was selected downstream of each of the POTWs for each of the receiving waters to which it discharges. As discussed in Section 1.4, these locations have been selected based on historical monitoring that demonstrated appropriate ammonia concentrations, and the requirements outlined in the WER guidance. The following table summarizes the monitoring locations.

Table 17. Sampling Locations

| Location ID | Receiving Water | Description | Agency | Access to Monitoring Location |
|---|---|---|---|---|
| LA-1 | Los Angeles River | Downstream of DC Tillman at Van Nuys Blvd. | City of LA | Bridge at Van Nuys or side of stream |
| LA-2 | Los Angeles River | Downstream of LA Glendale at Los Feliz | City of LA | Bridge at Los Feliz or side of stream |
| BW-1 | Burbank Western Wash | Downstream of Burbank at Riverside Dr. | City of Burbank | Bridge at Riverside Dr. |
| SGR-1 | San Gabriel River | Downstream of San Jose Creek WRP at Alondra | CSDLAC | Bridge at Alondra and/or the side of the stream |
| SGR-2 | San Gabriel River | Downstream of Los Coyotes at Willow | CSDLAC | Bridge at Willow and/or the side of the stream |
| SJC-1 | San Jose Creek | Downstream of Pomona WRP at San Jose St. | CSDLAC | Bridge at San Jose St. and/or the side of the stream |
| CC-1 | Coyote Creek | Downstream of Long Beach at foot bridge 200 yards downstream of discharge | CSDLAC | Foot bridge |
| RH-1 | Rio Hondo | Downstream of Whittier Narrows WRP 150 feet upstream of the Whittier Narrows Dam | CSDLAC | Bridge and/or the side of the stream |
| SCR-1 | South Fork Santa Clara River | Downstream of Saugus- 25 feet downstream of discharge | CSDLAC | Side of the stream [1] |
| SCR-2 | Santa Clara River | Downstream of Valencia, 1.6 miles upstream of Chiquita Canyon Road. | CSDLAC | Bridge |

1. Sample collection at these sites may not be possible during wet weather due to safety concerns.

Directions to the sampling locations are included in Appendix 3.

## 3.2. ANALYSES

The toxicity testing conducted for the development of a WER will include acute toxicity tests on *Hyalella* and chronic toxicity tests on fathead minnows (*P. promelas*). Chronic toxicity tests on *Hyalella* will be conducted at one station for each waterbody where suitable sampling locations are available. In addition to the toxicity testing, samples will be analyzed to determine the concentration of relevant constituents in the samples. The following constituents will be analyzed for each sample.

- Total Suspended Solids
- Total Dissolved Solids
- Total Organic Carbon
- Hardness
- Alkalinity
- Sodium
- Potassium
- Calcium
- Total residual chlorine
- Turbidity
- Settleable solids
- BOD
- Sulfate
- Chloride
- Conductivity

The following additional constituents are listed in the NPDES permits for some of the dischargers to be monitored at least once a month. As stated in the WER guidance, all constituents measured in the effluent at least once a month should be analyzed when the toxicity tests are conducted. The purpose of this requirement is to ensure that the water quality of the sample collected is "typical" of the discharge conditions. However, the following constituents are unlikely to have an impact on the toxicity of ammonia to the listed species. The constituents listed above adequately characterize the sample and provide information on constituents that may be impacting ammonia toxicity. As a result, the following constituents will not be analyzed during the toxicity sampling even though they are listed in at least one permit as a monthly monitoring requirement.

- Oil and grease
- Nitrate
- Nitrite
- Organic nitrogen
- Total nitrogen
- Phosphate
- Fluoride
- MBAS
- Iron
- Arsenic
- Cadmium
- Chromium VI
- Copper
- Lead
- Mercury
- Nickel
- Selenium
- Silver
- Zinc

- Cyanide
- Boron

Ammonia, temperature, pH, and dissolved oxygen measurements will be taken prior to initiation of the toxicity tests and throughout the toxicity test period by the laboratory to ensure that appropriate conditions are maintained in the sample. Sample water from the toxicity testing containers will be removed before the toxicity sampling is started and analyzed for the constituents listed above. This ensures that the water quality reported is the same as the quality of the water being used for the toxicity testing.

The following table summarizes the analytical requirements for each of the analyses.

Table 18. Analytical Requirements for Proposed Toxicity Tests

| **Analysis/ Constituent** | **Method** | **Detection Limit (mg/L)** | **Holding Time** | **Volume Water Needed (gal)** | Bottles | **Renewal Collection Schedule** |
|---|---|---|---|---|---|---|
| Acute *Hyalella azteca* 4-day test | EPA 600/4-91-002 | N/A | 36 hours | 7.5 | 3 - 2.5 gal glass pickle jars | None |
| Chronic *Pimephales promelas* (Fathead Minnow) 28-Day ELS test | EPA 600/4-91-002 | N/A | 36 hours | 40 | 8 - 5 gal glass jars | Once per week for 3-4 weeks [1] |
| Chronic *Hyalella* 21-Day test | EPA 600/4-91-002 | N/A | 36 hours | 40 | 8 - 5 gal glass jars | Once per week for 2-3 weeks[1] |
| Water Quality Constituents | | | | 2 L for all of the constituents listed below | From jars | |
| TSS | SM 2540C | 10 | 7 days | | | |
| TDS | SM 2540C | 20 | 28 days | | | |
| Sodium | EPA 3010 | 5.0 | 6 months | | | |
| Potassium | EPA 3010 | 5.0 | 6 months | | | |
| Calcium | EPA 200.7 | 1.0 | 6 months | | | |
| Hardness | SM 2340B | 2.0 | 6 months | | | |
| Alkalinity | SM 2320 | 1.0 | 28 days | | | |
| Ammonia | EPA 350.2 | 0.05 | 28 days | | | |
| Total Residual Chlorine | EPA 330.2 | 0.01 | | | | |
| Settleable Solids | SM 208F | 0.2 | 7 days | | | |
| Sulfate | SM 4110B | 1.0 | 6 months | | | |
| Chloride | SM 4110B | 1.0 | 6 months | | | |
| Turbidity | EPA 180.1 | 0.2 (NTU) | 48 hours | | | |
| BOD | EPA 405.1 | 1 | 48 hours | | | |
| TOC | SM 5310B | 1 | 28 days | | | |
| pH | Meter | | | | | |
| Temperature | Meter | | | | | |
| Dissolved Oxygen | Meter | | | | | |
| Conductivity | Meter | | | | | |

1. During each weekly sample collection, double the required volume is collected to account for any problems that may occur (such as rain) during the chronic testing period. If the sample collected during the second to the last week of the testing (week 3 for fathead and week 2 for *Hyalella*) is sufficient and no extra water is needed, renewal samples will not need to be collected during the last week of testing.

### 3.2.1. Laboratory Dilution Water

For each sampling event, a concurrent toxicity test in laboratory dilution water must be conducted side-by-side with the toxicity tests being conducted in site water. The laboratory dilution water toxicity test must not vary in any way from the site water toxicity tests except for the composition of the water and the ammonia concentrations. The WER guidance requires that the dilution water be groundwater, surface water, reconstituted water, diluted mineral water, or dechlorinated tap water with TOC and TSS concentrations less than 5 mg/L. Additionally, the hardness of the dilution water is recommended to be between 50 and 150 mg/L, and must be between 40 and 220 mg/L, and should not be higher than the site water. Alkalinity and pH of the dilution water must be appropriate for the hardness.

For this study, the laboratory dilution water will be moderately hard (80-100 mg/L as $CaCO_3$) laboratory water.

## 3.3. SAMPLING SCHEDULE

For each monitoring location, four samples will be collected during dry weather and one sample will be collected during wet weather. One of the dry weather samples will be collected during the wet season (November-March) and the remaining dry weather samples will be collected during the dry season (April-October). The sample collection events will be staggered so that at least one sample will be collected from at least one of the nine sites listed in the following tables every month during the dry weather and at least two wet weather events will be captured. Additionally, per the guidance, samples will be collected at least three weeks apart at every sample location. Samples for the two chronic toxicity tests will be collected in the afternoon to minimize the amount of ammonia in the ambient water. The samples previously collected on the Los Angeles and San Gabriel Rivers will be counted as one of the dry events for those sites. The following two tables summarize the sampling schedule and samples that will be collected during each monitoring event.

Table 19. Sample Schedule

| Date of Sample Collection | Sampling Locations | Tests run on sample |
|---|---|---|
| January 31, 2002 (Dry) | SCR1-Downstream Saugus | *Hyalella* acute |
| | SCR2-Downstream Valencia | *Hyalella* acute |
| | LA1-Downstream DC Tillman | *Hyalella* acute |
| | LA2-Downstream LA Glendale | *Hyalella* acute |
| March 4th, 2002 (Dry) | SGR1-Downstream San Jose Creek | *Hyalella* acute |
| | SGR2-Downstream Los Coyotes | *Hyalella* acute |
| | CC1-Downstream Long Beach | *Hyalella* acute |
| | SJC1-Downstream Pomona | *Hyalella* acute |
| | BW1-Downstream Burbank | *Hyalella* acute |
| April 1, 2001 | LA2-Downstream LA Glendale | *Hyalella* chronic |
| | SCR2-Downstream Valencia | *Hyalella* acute |
| | RH1-Downstream Whittier Narrows | *Hyalella* acute |
| April 16, 2002 | SGR2-Downstream Los Coyotes | *Hyalella* acute |
| | CC1-Downstream Long Beach | *Hyalella* acute |
| May 15, 2002 | LA1-Downstream DC Tillman | *Hyalella* acute |
| | LA2-Downstream LA Glendale | *Hyalella* acute |
| | BW1-Downstream Burbank | *Hyalella* acute |
| May 28, 2002 | LA1-Downstream DC Tillman | Fathead chronic (with renewals for next 3 weeks) |
| | LA2-Downstream LA Glendale | Fathead chronic (with renewals for next 3 weeks) |
| June 3, 2002 | SCR2-Downstream Valencia | *Hyalella* acute |
| | RH1-Downstream Whittier Narrows | *Hyalella* acute |
| | SCR1-Downstream Saugus | *Hyalella* acute |
| June 10, 2002 | SGR1-Downstream San Jose Creek | *Hyalella* acute |
| | SGR2-Downstream Los Coyotes | Fathead chronic (with renewals for next 3 weeks) |
| | SJC1-Downstream Pomona | *Hyalella* acute |
| | CC1-Downstream Long Beach | Fathead chronic (with renewals for next 3 weeks) |
| June 24, 2002 | BW1-Downstream Burbank | *Hyalella* chronic (with renewals for next 2 weeks) |
| | RH1-Downstream Whittier Narrows | *Hyalella* chronic (with renewals for next 2 weeks) |
| | SCR2-Downstream Valencia | *Hyalella* chronic (with renewals for next 2 weeks) |
| July 8, 2002 | SGR1-Downstream San Jose Creek | *Hyalella* acute |
| | SJC1-Downstream Pomona | *Hyalella* acute |
| July 15, 2002 | LA1-Downstream DC Tillman | *Hyalella* acute |
| | LA2-Downstream LA Glendale | *Hyalella* acute |
| | BW1-Downstream Burbank | *Hyalella* acute |
| | RH1-Downstream Whittier Narrows | Fathead chronic (with renewals for next 3 weeks) |
| | SCR1-Downstream Saugus | Fathead chronic (with renewals for next 3 weeks) |
| | SCR2-Downstream Valencia | Fathead chronic (with renewals for next 3 weeks) |
| July 29, 2002 | SGR2-Downstream Los Coyotes | *Hyalella* acute |
| | CC1-Downstream Long Beach | *Hyalella* acute |
| August 5, 2002 | BW1-Downstream Burbank | Fathead chronic (with renewals for next 3 weeks) |
| | SGR1-Downstream San Jose Creek | Fathead chronic (with renewals for next 3 weeks) |
| | SJC1-Downstream Pomona | Fathead chronic (with renewals for next 3 weeks) |
| August 19, 2002 | SGR2-Downstream Los Coyotes | *Hyalella* chronic (with renewals for next 2 weeks) |
| | CC1-Downstream Long Beach | *Hyalella* chronic (with renewals for next 2 weeks) |
| September 3, 2002 | SCR1-Downstream Saugus | *Hyalella* acute |
| | RH1-Downstream Whittier Narrows | *Hyalella* acute |
| 2002 Wet Event #1 | SCR1-Downstream Saugus | *Hyalella* acute |
| | SCR2-Downstream Valencia | *Hyalella* acute |
| | LA1-Downstream DC Tillman | *Hyalella* acute |
| | LA2-Downstream LA Glendale | *Hyalella* acute |
| | BW1-Downstream Burbank | *Hyalella* acute |
| 2002 Wet Event #2 | SGR1-Downstream San Jose Creek | *Hyalella* acute |
| | SGR2-Downstream Los Coyotes | *Hyalella* acute |
| | CC1-Downstream Long Beach | *Hyalella* acute |
| | SJC1-Downstream Pomona | *Hyalella* acute |
| | RH1-Downstream Whittier Narrows | *Hyalella* acute |

Table 20. Monthly Monitoring Schedule

| | LA1 | | LA2 | | | BW1 | | | SGR1 | | SGR2 | | | SJC1 | | RH1 | | | CC1 | | | SCR1 | | SCR2 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | H | F | H | Hc | F | H | Hc | F | H | F | H | Hc | F | H | F | H | Hc | F | H | Hc | F | H | F | H | Hc | F |
| Jan. 31, 2002 | X | | X | | | | | | | | | | | | | | | | | | | X | | X | | |
| March 4, 2002 | | | | | | X | | | X | | X | | | X | | | | | X | | | | | | | |
| April 1, 2002 | | | | X | | | | | | | | | | | | X | | | | | | | | X | | |
| April 8, 2002 | | | | R | | | | | | | | | | | | | | | | | | | | | | |
| April 16, 2002 | | | | R | | | | | | | X | | | | | | | | X | | | | | | | |
| May 15, 2002 | X | | X | | | X | | | | | | | | | | | | | | | | | | | | |
| May 28, 2002 [2] | | X | | | X | | | | | | | | | | | | | | | | | | | | | |
| June 3, 2002 | | R | | | R | | | | | | | | | | | X | | | | | | X | | X | | |
| June 10, 2002 | | R | | | R | | | | X | | | | X | X | | | | | | | X | | | | | |
| June 19, 2002 | | R | | | R | | | | | | | | R | | | | | | | | R | | | | | |
| June 24, 2002 | | | | | | | X | | | | | | R | | | | X | | | | R | | | | X | |
| July 1, 2002 | | | | | | | R | | | | | | R | | | | R | | | | R | | | | R | |
| July 8, 2002 | | | | | | | R | | X | | | | | X | | | R | | | | | | | | R | |
| July 15, 2002 | X | | X | | | X | | | | | | | | | | | | X | | | | | X | | | X |
| July 22, 2002 | | | | | | | | | | | | | | | | | | R | | | | | R | | | R |
| July 29, 2002 | | | | | | | | | | | X | | | | | | | R | X | | | | R | | | R |
| August 5, 2002 | | | | | | | | X | | X | | | | | X | | | R | | | | | R | | | R |
| August 12, 2002 | | | | | | | | R | | R | | | | | R | | | | | | | | | | | |
| August 19, 2002 | | | | | | | | R | | R | | X | | | R | | | | | X | | | | | | |
| August 26, 2002 | | | | | | | | R | | R | | R | | | R | | | | | R | | | | | | |
| September 3, 2002[3] | | | | | | | | | | | | R | | | | X | | | | R | | X | | | | |
| 2002 Wet Event #1 [1] | X | | X | | | X | | | | | | | | | | | | | | | | X | | X | | |
| 2002 Wet Event #2[1] | | | | | | | | | X | | X | | | X | | X | | | X | | | | | | | |

1 Wet weather event monitoring will occur when suitable storms produce sufficient rainfall for monitoring. The wet weather monitoring will occur during the first rain events in the fall of 2002. In all cases, the monitoring will be conducted at least three weeks apart for a given monitoring location.
2 Samples will be collected on a Tuesday this week because of the Memorial Day Holiday.
3 Samples will be collected on a Tuesday this week because of the Labor Day Holiday.
H *Hyalella azteca* acute toxicity test will be conducted.
F Fathead minnow (*Pimephales promelas*) chronic toxicity test will be conducted.
Hc *Hyalella azteca* chronic toxicity test will be conducted.
R Renewal sample will be collected.

The following table summarizes the QA/QC schedule for collecting duplicates for the additional constituents analyzed during the study.

Table 21. QA/QC Duplicate Schedule

| Date of Sample Collection | Lab Duplicate Station | Field Duplicate Station |
|---|---|---|
| 1/31/02 | LA2-Downstream LA Glendale | |
| 3/4/02 | | CC1-Downstream Long Beach |
| 4/1/02 | SCR2-Downstream Valencia | |
| 4/16/02 | | SGR2-Downstream Los Coyotes |
| 6/3/02 | RH1-Downstream Whittier Narrows | |
| 6/10/02 | | SGR1-Downstream San Jose Creek |
| 7/8/02 | SJC1-Downstream Pomona | |
| 7/15/02 | | LA1-Downstream DC Tillman |
| 7/29/02 | SGR2-Downstream Los Coyotes | |
| 9/3/02 | | SCR1-Downstream Saugus |
| 2002 Wet Event #1 | BW1-Downstream Burbank | |
| 2002 Wet Event #2 | | RH1-Downstream Whittier Narrows |

### 3.3.1. Definition of Wet Weather and Dry Weather Events

Dry weather monitoring will occur on the dates presented in Table 19 and Table 20 unless measurable precipitation occurs in the seven days prior to the monitoring event. Should rain occur, the dry weather monitoring event will be postponed until at least seven days without measurable rain has occurred and flows have returned to pre-precipitation levels.

Wet weather monitoring is defined as a flow between two and ten times the design flow in the river. Because of the safety concerns with monitoring during wet weather, wet weather monitoring may not occur during the peak of the storm event. Monitoring will occur when safe during a period of time during or after the rain event in which flows are at least two times the design flow of the river. River flows will be determined using Los Angeles Department of Public Works and U.S. Army Corps of Engineers' gauging stations. The following table summarizes the gauging station that will be used for determining wet weather events for each monitoring location and the relationship to the monitoring location. Additionally, the table lists the design flows on which permits are based (i.e. the maximum permitted discharge from the facility), the median flow at each gauging station, and the flows that will be considered to define a wet weather event. For POTWs with no dischargers upstream, the design flow was set equal to the maximum permitted discharge. For treatment plants with upstream POTW discharges (LA Glendale, Los Coyotes, and Valencia), the design flow was set equal to the maximum permitted discharge from the plant plus the lowest seven day average flow from 1996-2001 (7Q5 flow) from gauging stations upstream of the discharger. The required wet weather flow at the gauging station is equal to between 2 and 10 times the design flow. When the flow gauging station is upstream of the discharge, the required wet weather flow corresponds to the flow needed at the upstream station that when added to the discharge from the treatment plant will equal a downstream flow at the monitoring station that is between 2 and 10 times the design flow.

Table 22. Flow Gauging Stations and Required Flows for Wet Weather Monitoring

| Monitoring Location | Flow Gauge | Relationship of Flow Gauge to Monitoring Location | Design Flow at Monitoring Location (mgd) | Median Dry Weather Flow at Gauging Station (mgd) | Required Flow for Wet Weather Monitoring at Gauging Station (mgd) |
|---|---|---|---|---|---|
| LA-1 Downstream of DC Tillman at Van Nuys Blvd. | LARS-Los Angeles River below Sepulveda Dam | Downstream of DC Tillman discharge and upstream of monitoring location | 80 | 120 | 160-800 |
| LA-2 Downstream of LA Glendale at Los Feliz | LARA-Los Angeles River above Arroyo Seco Channel | Downstream of LA Glendale discharge and monitoring location | 43 | 117 | 86-430 |
| BW-1 Downstream of Burbank at Riverside Dr. [1] | LART-Los Angeles River above Tujunga Wash | Downstream of Burbank Western Wash at confluence of LA River and Tujunga Wash. | N/A | 51 | 100-510 |
| SGR-1 Downstream of San Jose Creek WRP at Alondra | SGRF-San Gabriel River above Florence Ave. | Upstream of SJC discharge point to lower San Gabriel River | 100 | 0.45 | 100-900 |
| SGR-2 Downstream of Los Coyotes WRP at Willow | SGRS-San Gabriel River at Spring Street | Downstream of Los Coyotes discharge and monitoring location | 45 | 100 | 90-450 |
| SJC-1 Downstream of 50 feet downstream of Pomona WRP discharge | F312B-R-San Jose Channel below Seventh Ave. | Downstream of Pomona discharge and monitoring locations | 15 | | 30-150 |
| CC-1 Downstream of Long Beach WRP at foot bridge 200 yards downstream of discharge | CCKS-Coyote Creek below Spring St. | Upstream of Long Beach discharge | 25 | 16 | 25-225 |
| RH-1 Downstream of Whittier Narrows WRP 150 feet upstream of the Whittier Narrows Dam | RHDG-Rio Hondo below Garvey Ave. | Upstream of Whittier Narrows discharge | 15 | 4.5 | 15-135 |
| SCR-1 Downstream of Saugus WRP- 25 feet downstream of discharge | F92CR-Santa Clara River at Old Road Bridge | Downstream of Saugus discharge and monitoring stations | 6.5 | 5.8 | 13-65 |
| SCR-2 Downstream of Valencia WRP, 1.6 miles upstream of Chiquita Canyon Road. | F92CR-Santa Clara River at Old Road Bridge | Upstream of Valencia discharge and monitoring stations | 15 | 5.8 | 15-135 |

1. No gauging stations are available on Burbank Western Wash. Therefore, if sufficient flow is available downstream of the confluence of the Burbank Western Wash and the Los Angeles River, it is assumed that there will be sufficient flow at the monitoring station.

Because of upstream flow controls, flows equal to 2 to 10 times the design flow may not occur in the lower San Gabriel River or may occur at times that do not correspond with the actual rain event. For this reason, the flow in the river will be the primary determining factor for sampling the lower San Gabriel River during a "wet" weather event. If the required flows are not achieved in the lower San Gabriel River because of the upstream flow control, an additional dry weather monitoring event will be collected and the appropriate method for calculating the final WER will be used (as described in the WER guidance).

Additionally, at SCR-1 and SJC-1, monitoring accessibility may not be possible during wet weather events. Because these sites are at locations with soft-sides on the river and no bridges, safety concerns during wet weather monitoring may prevent the collection of samples. Samples will be collected as soon as safe following a wet weather event which will hopefully be during a period of required flows. However, if samples cannot be collected during periods of sufficient flow to be considered a wet weather event, the calculation of the final WER for these sites will need to be based on alternative methods as outlined in the WER guidance.

### 3.3.2. pH Relationship Study

In addition to the samples collected above, a study will be conducted using acute *Hyalella* toxicity tests in laboratory dilution water to determine a relationship between pH and toxicity for this species. During each acute *Hyalella* monitoring event, a laboratory dilution water sample will be run to determine the WER for that group of samples. Each of these dilution water tests will be run at a pH similar to the pH of the site waters collected during that event. Additional samples will be run in a separate pH study to fill in any gaps in pH testing not found during the regular sample collection. Because the testing presented above is designed to be analyzed at the median to 90$^{th}$ percentile pH in the streams, lower pH testing will probably be required. Overall, the pH relationship will be developed based on a pH range of 7.0 to 9.0 (values typically observed in Los Angeles Region waterbodies). The special study will include a maximum of four acute *Hyalella* tests and include any necessary pH values to ensure that at least one test was run in each 0.5 pH unit interval (i.e. one test in each of the ranges 7.0-7.5, 7.5-8.0, 8.0-8.5, 8.5-9.0). A determination of the need for additional testing will be made in June 2002 and the special testing conducted in July 2002 if necessary.

## 3.4. SAMPLING PREPARATION

Prior to each sampling event, event summaries will be developed, sample bottles will be ordered and equipment maintenance performed as follows. Figure 5 provides a field equipment checklist.

Figure 5. Field Equipment Checklist

- Sampling Plan
- Event Summary Sheet
- Sample Bottles w/ labels
- Coolers w/ice
- Bubble wrap
- New powder-free gloves
- Chain of Custody forms
- Field Log Forms
- Pens
- Watch
- Camera
- Tape measure
- Hip waders
- First Aid Kit
- Cellular Phone
- Keys for gates
- Field meters
- Safety Equipment

### 3.4.1. Sampling Event Summary

Prior to each monitoring event, a sampling summary will be produced that outlines the sites to be monitored during that event, samples to be collected, and time of sample collection. An example sampling event summary for the first monitoring event is included in Appendix 2.

### 3.4.2. Bottle Order/Preparation

Prior to the beginning of the study, bottles will be purchased for the analyses. After each monitoring event, the bottles will be cleaned by the laboratory and either picked up when the next set of samples are delivered to the laboratory or shipped to the sampling crews. One week prior to each monitoring event, the sampling crews will inventory the number of clean bottles and obtain any additional bottles needed from the laboratory.

### 3.4.3. Sample Bottle Labeling

All samples will be pre-labeled, to the extent possible, before each sampling event. Pre-labeling sample bottles simplifies field activities, leaving only sample collection time, sample number, and sampling personnel names to be filled out in the field. Custom bottle labels will be produced using blank water-proof labels and labeling software provided by LWA. Using this approach will allow the sites and analytical constituent information to be entered into the computer program in advance, and printed as needed prior to each monitoring event.

Labels should be placed on the appropriate bottles in a dry environment; attempting to apply labels to sample bottles after filling will cause problems, as labels usually do not adhere to wet bottles. The labels should be applied to the bottles rather than to the caps.

Field labels should contain the following information:

- program name
- site ID/code (see next section)
- event number
- date
- time
- collected by_________

### 3.4.4. Sample ID Conventions

Sample bottles submitted to laboratories for analysis shall be labeled with the sampling site name, the date and time of sample collection, and a sample ID devised as follows:

*SITE*–Event #*XX*

| | | | |
|---|---|---|---|
| Where: | *SITE* | = | Site ID |
| | *XX* | = | Event number (i.e., 01, 02, or 03) |

The site ID will consist of the ID number listed in Table 17.

## 3.5. FIELD ACTIVITIES

### 3.5.1. Sample Collection

All samples will be collected as grab samples. To the extent possible, grab samples will be collected by directly submerging sample bottles at mid-stream and mid-depth. This is the preferred method for grab sample collection, however, due to the difficulty of reaching mid-stream in many of the waterbodies and safety concerns, direct filling of sample bottles is not always feasible. Monitoring site configuration and the type of grab sample will dictate grab sample collection technique. In general, grab samples will be taken at approximately mid-stream, mid-depth at the location of greatest flow (where feasible). Samples will be collected by wading to mid-stream and filling bottles by direct submersion of the sample bottle to approximately mid-depth. Clean powder-free nitrile gloves will be worn for collection of all grab samples. Grab samples will be collected directly into the appropriate sample bottles.

The grab sample techniques that may be employed are described below.

*Direct Submersion: Hand Technique*

Where practical, all grab samples may be collected by direct submersion to mid-stream, mid-depth using the following procedures.

- Wear clean gloves when handling bottles and caps;
- Pre-label sample containers (site code, location, date, time, analysis);
- Submerge bottle to mid-stream/mid-depth, remove lid, let bottle fill, and replace lid;
- Place sample on ice, fill out COC form, and deliver to MEC Analytical Systems, Inc.

*Intermediate Container Technique*

Samples for which the introduction of a secondary container is acceptable, and which will be collected from an open channel, may be collected with the use of a specially cleaned intermediate container following the steps listed below.

- Wear clean gloves when handling bottles and caps;
- Pre-label sample containers (site code, location, date, time, analysis);
- Submerge specially cleaned intermediate container to mid-stream/mid-depth, let container fill, and pour off into individual sample bottles;
- Place sample on ice, fill out COC form, and deliver to MEC Analytical Systems, Inc.

If at any time the collection of samples by wading appears unsafe, do not attempt to collect mid-stream, mid-depth measurements. If in-stream sampling is not safe, collect samples from a stable, unobstructed area at the river's edge. Attach the bottle to an expandable pole to reach out into the creek to collect samples and record the position of sample collection on the field log.

*Pumping*

At some sample locations, the use of a pump is required to obtain subsurface samples. The following technique will be used if a pump is used to collect samples.

- Insert pre-cleaned tubing into the pump using clean techniques. New clean tubing must be used at each sample location for which the pump is used.
- Place one end of the tubing below the surface of the water. To the extent possible, avoid placing the tubing near the bottom of the channel so that settled solids are not pumped into the sample.
- Place the other end of the tubing in the sample container. Be careful not to touch the tubing to the sample container.
- Pump the necessary sample volume into the sample container.

Record the information regarding the location of sample collection and the use of a pump on the field log.

#### 3.5.1.1. Clean Sampling Techniques

Samples will be collected using "clean sampling techniques" to minimize the possibility of sample contamination. Sampling methods will generally conform to EPA "clean sampling" methodology (USEPA 1995a). Although these methods are specific to metals, the techniques may be applied to collection of other water quality samples.

Clean sampling techniques are summarized below:

- Samples are collected only into rigorously pre-cleaned sample bottles.
- At least two persons, wearing clean powder-free nitrile gloves at all times, are required on a sampling crew.
- One person ("dirty hands") touches and opens only the outer bag of all double bagged items, avoiding touching the inside of the bag.
- The other person ("clean hands") reaches into the outer bag, opens the inner bag, and removes the clean item.
- After a grab sample is collected, or when a clean item must be re-bagged, it is done in the opposite order from which it was removed.
- Clean, powder-free nitrile gloves are changed whenever something not known to be clean has been touched.

To reduce potential contamination, sample collection personnel must adhere to the following rules while collecting samples:

- No smoking.
- Never sample near a running vehicle. Do not park vehicles in immediate sample collection area (even non-running vehicles).
- During wet weather events avoid allowing rain water to drip from rain gear or any other surface into sample bottles.

- Do not eat or drink during sample collection.
- Do not breathe, sneeze or cough in the direction of an open sample bottle.

### 3.5.2. Field Observations

Standard receiving water observations including odor, color, floating material, etc., together with observations of aquatic life will be recorded on the field log shown in Appendix 2. Photographs will be taken to supplement observations recorded on the field log and to provide evidence of observations.

### 3.5.3. Flow Measurement

Flow measurement will be recorded or estimated at each sampling collection point during each monitoring event. Where flow measurement equipment is not available, depth, width, and velocity measurements will be made to provide an estimate of flow rate. Depth will be estimated by using the average of several depth measurements taken along the channel. Width will be measured by extending a tape measure from one side of the bank to the other. If a velocity probe is not available, velocity will be estimated by measuring the time it takes a floating object to travel a known distance and applying a factor to translate from surface velocity to average cross-sectional velocity. Where flow gauging stations are available near the monitoring location, the estimated flows will be compared to records from the gauging station. The discharge flow from the POTW at the time of sample collection will also be recorded.

## 3.6. POST-SAMPLING ACTIVITIES

### 3.6.1. Chain-of-Custody

Chain-of-custody (COC) forms will be filled out for all samples submitted to each laboratory. Sample date, sample location, sample collection person(s), and analysis requested shall be noted on each COC.

### 3.6.2. Transport to Lab

Samples will be stored in coolers with ice and delivered to MEC Analytical Systems, Inc. as soon as possible after collection. Samples may be hand delivered to the laboratory or sent by courier. Samples should be delivered as soon as possible following sample collection and no later than the day following sample collection. Following are directions to the laboratory and contact information for the lab.

Mary Ann Irwin
MEC Analytical Systems, Inc.
2433 Impala Dr.
Carlsbad, CA 92008
760-931-8081
760-931-1580-fax

Directions to MEC Analytical Systems, Inc.:

- Take I-5 South to the TAMARACK AVENUE exit in Carlsbad.
- Turn LEFT onto TAMARACK AVE.
- Turn RIGHT onto EL CAMINO REAL.
- Turn LEFT onto FARADAY AVE.
- Turn LEFT onto PALMER WAY.
- Turn RIGHT onto IMPALA DR.

# Section 4. Quality Assurance/Quality Control Plan

Quality assurance/quality control procedures are outlined in the WER guidance and the analytical method for each analysis. Additionally, duplicate analyses will be collected for the additional constituents as outlined in the QA/QC schedule in the monitoring plan. This QA/QC Plan outlines the requirements presented in the WER guidance for preparing the test, conducting the test, determining acceptability of the tests, and reviewing the test results.

## 4.1. TESTING SET-UP REQUIREMENTS

- The facilities and test chambers for conducting the toxicity tests must be selected, cleaned, and set up as recommended by USEPA (1993 a, b, c) and/or ASTM (1993 a,b,c,d,e).
- The stock solution must be prepared with an inorganic salt that is highly soluble in water. The same salt will be used throughout the toxicity testing and the same stock solution used for all tests conducted at the same time. The salt will meet A.C.S. specifications for reagent-grade.
- Six or seven concentrations are recommended in the laboratory dilution water, and eight or nine in the site water.
- The number of organisms exposed to each treatment, including controls, must be at least 20 and preferably distributed between at least two test chambers per treatment. The organisms will be assigned impartially/randomly to each test chamber. The test chambers should be assigned to location in a totally random arrangement or in a randomized block design.
- For the laboratory dilution water, prepare the dilution series by either placing the same known volume of dilution water in each test chamber, adding the necessary amount of ammonia, mixing thoroughly and letting stand or 1 to 3 hours or prepare a large volume of the highest test concentration and perform serial dilution using a graduated cylinder and the well-mixed spiked and unspiked samples of the dilution water before letting stand for 1 to 3 hours.

### 4.1.1. Acquiring and Acclimating Test Organisms

The test organisms should be obtained, cultured, held, acclimated, fed, and handled as recommended by the USEPA (1993 a, b, c) and/or ASTM (1993 a,b,c,d,e). All test organisms must be acceptably acclimated to a laboratory dilution water. An appropriate number of the organisms may be randomly or impartially removed from the laboratory dilution water and placed in the site water when it becomes available in order to acclimate the organisms to the site water for a while just before the tests are begun. The organisms used in a pair of side-by-side tests must be drawn from the same population and tested under identical conditions.

## 4.2. CONDUCTING THE TESTS

- The test organism must be added to the test chambers for the side-by-side tests at the same time. The time at which the test organisms are placed in the test chambers is defined as the beginning of the tests, which must be within 36 hours of the collection of the samples.
- Recommendations concerning temperature, loading, feeding, dissolved oxygen, aeration, disturbance, and controls given by USEPA (1993 a, b, c) and/or ASTM (1993 a,b,c,d,e) must be followed.
- Each test must include a dilution-water control.
- No difference between side-by-side tests except the composition of the dilution water, concentrations of constituents tested, and possibly the water in which test organism are acclimated prior to beginning of tests may exist.
- More than one site water test may be conducted with one laboratory dilution test.

### 4.2.1. Test Renewal Requirements

- The renewal technique must be used for the tests that last more than 48 hours.
- If the concentration of ammonia decreases by more than 50% in 48 hours in static or renewal tests, the test solutions must be renewed every 24 hours. If the concentration of dissolved oxygen becomes too low, the test solutions must be renewed every 24 hours. If one test in a pair of tests is a renewal test, both tests must be renewal tests.
- When test solutions are to be renewed, the new test solutions must be prepared from the original unspiked water samples that have been stored at 0 to 4 C in the dark with no air space in the sample container.
- Whenever solutions are renewed, sufficient solution should be prepared for chemical analyses.

### 4.2.2. Measurements and Observations

- Thermometers and probes for measuring pH and dissolved oxygen must not be placed in test chambers. Measurements must be performed on either chemistry controls that contain test organisms that are fed the same as the other test chambers or on aliquots that are removed from the test chambers. The other measurements may be performed on the actual test solutions at the beginning and/or end of the test or the renewal.

- Dissolved oxygen, pH and temperature must be measured during the test at the times specified by USEPA (1993 a, b, c) and/or ASTM (1993 a,b,c,d,e). The measurements must be performed on the same schedule for both of the side-by-side tests. Measurements must be performed on both the chemistry controls and the actual test solutions at the end of the test.
- Ammonia must be measured in the site water and the appropriate test solutions for each test. Samples must be taken at the beginning and end of a static test and for each renewal test after the organisms have been transferred to the new test solutions.
- Observe the test organisms and record the effects and symptoms as specified by the USEPA (1993 a, b, c) and/or ASTM (1993 a,b,c,d,e). Especially note whether the effects, symptoms, and time course of toxicity are the same in the side-by-side tests.

#### 4.2.2.1. Additional pH QA/QC Requirements

- Calibration of pH meters will be conducted at least once a day.
- Routine maintenance and checks by the QA manager will be conducted on the meters at least once per month.
- Measurements of pH will be collected at least once per day. Duplicate measurements with a separate meter or two separate electrodes on the same meter will be collected at least once per week and preferably once per day on all samples. If the duplicate measurements are found to deviate by more than 0.2 pH units, the meters will be recalibrated, any sources of discrepancies identified, and the pH measurements collected again.
- Any anomalies or significant pH changes that occur during the testing will be noted on the laboratory reports of the results of the testing.

### 4.3. TEST ACCEPTABILITY

Acceptability of the tests will be determined based on the following criteria:

- The acceptability of each toxicity test will be evaluated individually.
- If the procedures used deviated from those specified in this section and the monitoring plan, particularly in terms of acclimation, randomization, temperature control, measurement of ammonia, and/or disease or disease-treatment, the test should be rejected; if deviations were numerous and/or substantial, the test must be rejected.
- The tests are unacceptable if more than 10% of the organisms in the controls were adversely affected.
- If an LC50 or EC50 is to be calculated: The percent of the organisms that were adversely affected must have been less than 50% and should have been less than 37% in at least one treatment other than the control. In laboratory dilution water,

the percent of the organisms that were adversely affected must have been greater than 50% and should have been greater than 63% in at least one treatment. In site water the percent of the organisms that were adversely affected should have been greater than 63% in at least one treatment. The LC50 may be a greater than or less than value in site water, but not in laboratory dilution water. If there was an inversion in the data it must not have involved more than two concentrations that killed or affected between 20 and 80 percent of the test organisms.

- Review the tests to determine whether there was anything unusual about the test results that would make them questionable.
- If solutions were not renewed every 24 hours, the concentration of ammonia must not have decreased by more than 50% from the beginning to the end of the static test or from the beginning to the end of a renewal in a renewal test in test concentrations that were used in the calculation of the results of the test.
- Evaluate whether the effects, symptoms, and time course of toxicity was the same in the side-by-side tests in the site water and the laboratory water . For example, did mortality occur in one acute test, but immobilization in the other? Did most deaths occur before 24 hours in one test, but after 24 hours in the other? In sublethal tests, was the most sensitive effect the same in both tests? If the effects, symptoms, and/or time course of toxicity were different, it might indicate that the test is questionable or that additivity, synergism, or antagonism occurred in site water. Such information might be particularly useful when comparing tests that produced unusually low or high WERs with tests that produced moderate WERs.

## 4.4. LABORATORY DILUTION WATER TEST ACCEPTABILITY

- The acceptability of the laboratory dilution water must be evaluated by comparing results obtained with two sensitive tests using the laboratory dilution water with results that were obtained using a comparable laboratory dilution water in one or more other laboratories.
- If, after taking into account any known effect of pH and temperature on toxicity, the new values for the endpoints of both of the tests are more than a factor of 1.5 higher than the respective means of the values from the other laboratories or more than a factor of 1.5 lower than the respective means of values from the other laboratories or lower than the respective lowest values available from other laboratories, the new and old data must be carefully evaluated to determine whether the laboratory dilution water used in the WER determination was acceptable. For example, there might have been an error in the chemical measurements, which might mean that the results of all tests performed in the WER determination need to be adjusted and that the WER would not change. It is also

possible that ammonia is more or less toxic in the laboratory dilution water used in the WER determination. Further, if the new data were based on measured concentrations but the old data were based on nominal concentrations, the new data should probably be considered to be better than the old. Evaluation of results of any other toxicity tests using the same laboratory dilution water might be useful.

- If, after taking into account any known effect of pH and temperature on toxicity, the new values for the endpoints of the two tests are not either both higher or both lower in comparison to data from other laboratories and if both the new values are within a factor of 2 or the respective means of the previously available values or are within the ranges of the values, the laboratory dilution water used in the WER determination is acceptable.
- A control chart approach may be used to determine acceptability of the laboratory dilution water test if sufficient data are available.
- If the comparisons do not indicate that the laboratory dilution water, test method, etc., are acceptable, the tests probably should be considered unacceptable, unless other toxicity data are available to indicate that they are acceptable.

## 4.5. WER CALCULATIONS AND ACCEPTABILITY

The appropriateness of the tests and the resulting WER calculation needs to be reviewed for differences in the site water from typical conditions and the individual results need to be compared for significant differences between individual calculations.

- The results of the chemical measurements of hardness, alkalinity, pH, TSS, TOC, ammonia, etc. on the site water should be examined and compared with previously available values for the water to determine whether the samples were representative and to get some indication of the variability in the composition, especially as it might affect the toxicity of ammonia and the WER, and to see if the WER correlates with one or more of the measurements.
- The WERs obtained with the primary and secondary tests should be compared to determine whether the WER obtained with the secondary test confirmed the WER obtained with the primary test. A WER is considered confirmed if the WERs obtained with the primary and secondary tests are within a factor of 3 and/or the test that gives a higher endpoint in the laboratory dilution water also gives the larger WER. If the WER obtained with the secondary test does not confirm the WER obtained with the primary test, the results should be investigated. In

addition, WERs probably should be determined using both tests the next time samples are obtained and it would be desirable to determine a WER using a third test. It is also important to evaluate what the results imply about the protectiveness of any proposed site-specific criterion.

- If the WER is larger than 5, it should be investigated.
- All data should be reviewed for implications for the national criterion.

# Section 5. Data Analysis/SSO Development Procedure

The data analysis and SSO development procedure is composed of the following steps:

- Initial data review
- Calculation of hWERs and FWERs for each waterbody
- Determination of SSOs
- Data reporting

## 5.1. INITIAL DATA REVIEW

As results are received for each event, the data will be reviewed for QA/QC per the QA/QC plan and for the appropriate calculation of the endpoints. After any QA/QC issues have been resolved with the laboratory, the data will be distributed to the coordinating committee and technical advisory committee for review. Any discrepancies or questions with the data will be discussed by the members and resolved if possible prior to the next sampling event. The following summarizes the requirements for the calculation of the test results.

- If the data for the most sensitive effect are dichotomous, the endpoint must be calculated as a LC50, EC50, LC25, EC25, etc. using methods described by the USEPA (1993 a, b, c) and/or ASTM (1993 a,b,c,d,e). If two or more treatments affected between 0 and 100 percent in both tests in a side-by-side pair, probit analysis must be used to calculate results of both tests, unless the probit model is rejected by the goodness of fit test in one or both of the acute tests. If probit analysis cannot be used, either because fewer than two percentages are between 0 and 100 percent or because the model does not fit the data, computational interpolation must be used; graphical interpolation must not be used.
- The same endpoint and the same computational method must be used for both tests used in the calculation of the WER.
- If no treatment killed or affected more than 50% of the test organisms and the test was otherwise acceptable, the LC50 or EC50 should be reported to be greater than the highest test concentration.
- If no treatment other than the control killed or affected less than 50% of the test organisms and the test was otherwise acceptable, the LC50 or EC50 should be reported to be less than the lowest test concentration.

- If data for the most sensitive effect are not dichotomous, the endpoint must be calculated using a regression type method, such as linear interpolation or a nonlinear regression method. The endpoints in the side-by-side test must be based on the same amount of the same adverse effect so that the WER is a ratio of identical endpoints. The same computational method must be used for both tests used in the calculation of the WER.
- Results should be based on the time-weighted average ammonia concentrations.

## 5.2. CALCULATION OF HWERS AND FWERS

The WER guidance outlines a calculation procedure for determining the final WER (FWER) on which the SSO will be based. To determine the FWER, a number of intermediate calculations are required. First, because the site water and laboratory dilution water tests are most likely conducted at different pHs, the results must be normalized to the same pH. The chosen pH could be the value in the site water or a standard value (such as the pH to be used to calculate the permit limits). Because the WER guidance was written for the development of FWERs for metals, the guidance addresses the issue of different hardness waters, but does not describe calculation procedures that address the variation of pH and temperature. As a result, the hardness adjustments in the WER guidance were used as the basis for pH and temperature adjustments for ammonia. Secondly, the highest WER (hWER) must be determined for wet weather samples to account for the different flow conditions under which these samples were collected. Finally, a FWER is calculated from the individual dry weather WERs and the wet weather hWERs. To prevent roundoff error in subsequent calculations, at least four significant digits must be retained in all endpoints, WERs, and FWERs during the calculations.

### 5.2.1. pH and Temperature Adjustment Calculations

The procedure presented below is based on the hardness adjustments presented in the 1994 WER guidance (pages 41-43), the Streamlined WER Procedure for Copper (pages 13 and 14), and the 1997 WER guidance update to clarify the hardness calculations. It is recognized that there are differences between the hardness relationships for metals and the pH and temperature relationships for ammonia. However, there is no other guidance available at this time to address pH adjustments for ammonia WERs.

In the 1999 Updated Ammonia Criteria document, a relationship between pH and ammonia toxicity was developed based on a regression analysis of a pooled dataset of all species for which pH and ammonia toxicity data were available. Based on a small number of samples, the pH relationship to ammonia toxicity for *Hyalella* does not appear to follow the pooled data relationship (see Figure 8, page 32 of the criteria document). For this reason, this study included additional testing to develop a pH relationship for *Hyalella*. The study combines the results of the laboratory dilution water side-by-side tests and additional pH and toxicity testing to fill in any gaps in the pH range of 7.0-9.0. The combined data will be used to develop a regression analysis of the pH and toxicity data. The regression equation will be used to normalize the *Hyalella* site water and laboratory dilution water samples to the same pH for calculation of the WER. Based on the discussion presented in Appendix 2 Methods for Regression Analysis on pH Data of the 1999 Updated Ammonia Criteria, standard regression analysis procedures will be used for developing the regression equation. The developed equation and associated WER calculations will be reviewed by the TAC.

For fathead minnow samples, the site water and laboratory dilution water will be normalized to the same pH using equation 8 (page 29) presented in the Ambient Water Quality Criteria for Ammonia (USEPA, 1999). The pH relationship for fathead minnow appears to closely match the pooled data pH relationship (see Figure 8, page 32 of the criteria document). As a result equation 8 from the criteria document can be used to normalize the pH for the fathead minnow samples. These equations are presented below.

Acute criteria adjustment equation:

$$AV_{s,pH_L} = \frac{(AV_{s,pH_s})\left(\frac{0.00704}{1+10^{7.204-pH_s}} + \frac{1}{1+10^{pH_s-7.204}}\right)}{\left(\frac{0.00704}{1+10^{7.204-pH_L}} + \frac{1}{1+10^{pH_L-7.204}}\right)}$$

Chronic criteria adjustment equation:

$$CV_{s,pH_L} = \frac{(CV_{s,pH_s})\left(\frac{0.0232}{1+10^{7.688-pH_s}} + \frac{1}{1+10^{pH_s-7.688}}\right)}{\left(\frac{0.0232}{1+10^{7.688-pH_L}} + \frac{1}{1+10^{pH_L-7.688}}\right)}$$

where:

$AV_{s,pHL}$, $CV_{s,pHL}$ = The result determined in site or laboratory water adjusted to the normalized pH .

$AV_{s,pHs}$, $CV_{s,pHs}$ = The result measured in the site water or laboratory dilution water at the site water or laboratory pH.

$pH_s$ = The pH of the site water or laboratory water.

$pH_L$ = The pH to which the values are to be normalized.

The TAC will determine whether the samples should be normalized to the pH of the site water at the time of sample collection or to a standardized pH (such as the basis for the permit limits). Using a standardized pH would allow all of the sample WERs to be normalized to the same pH for calculation of a final WER.

Once the adjustment has been made so that both the laboratory dilution water and the site water samples are determined at the same pH and temperature, the calculation of the WER value may proceed. The WER for that sample is determined by dividing the site water sample by the laboratory dilution water result. This result is the WER for that sample. To calculate a final WER (FWER), the results for the individual WERs are combined using the calculation procedure outlined in the guidance (1994 Guidance, pages 28-43). A FWER will be calculated for each waterbody based on the results of the study. If appropriate, one FWER will be calculated based on all of the samples collected from all of the waterbodies. The decision as to the appropriateness of this approach will be based on a statistical analysis of the data to determine whether or not data from different water bodies is statistically similar. Additionally, the data will be reviewed to determine if any relationships exist between ammonia toxicity and other constituents such as hardness or ionic strength. If strong relationships are determined to exist, a multifactorial relationship (i.e. EC20=f(pH, ionic strength) may be developed as the adjustment equation for the WER calculations. This adjustment equation would allow the determination of SSOs for all of the waterbodies based on the pooled dataset rather than just the data from one site.

### 5.2.2. FWER Calculation

The calculation of the FWER is dependent on the number and types of samples collected. The guidance presents three different ranked approaches for determining the FWER. The sampling plan is designed to allow calculation of the FWER using the highest ranked procedure described by the guidance. The calculation procedure described here is based on the collection of samples as outlined in the plan. However, if the samples collected varies from this plan, a different procedure may have to be used.

#### 5.2.2.1. hWER Calculation

First, the highest WER that could be used to develop a site-specific criterion (hWER) needs to be developed for each of the wet weather samples collected during the monitoring. An hWER is calculated using the following equations:

$$HCE = \frac{[(CCC)(WER)(eFLOW + uFLOW)] - [(uCONC)(uFLOW)]}{eFLOW}$$

$$hWER = \frac{(HCE)(eFLOWdf) + (uCONCdf)(uFLOWdf)}{(CCC)(eFLOWdf + uFLOWdf)}$$

where:

| | | |
|---|---|---|
| HCE | = | the highest concentration of ammonia in the effluent. |
| CCC | = | the chronic criteria to be adjusted. |
| eFLOW | = | the effluent flow at the time of sample collection |
| uFLOW | = | the upstream flow at the time of sample collection |
| uCONC | = | the concentration of ammonia in the upstream water |
| eFLOWdf | = | the effluent flow at design flow conditions |
| uCONCdf | = | the upstream concentration at design flow conditions |
| uFLOWdf | = | the upstream flow at design flow conditions |

Assuming that at least 19% of the data were collected during flows two to ten times higher than design flows and the range of the WERs are not more than a factor of five apart, the FWER is the lower of the adjusted geometric mean of all the design flow (dry weather) WERs and the lowest hWER.

The adjusted geometric mean is calculated using the following process (1994 guidance page 71):

- Take the natural logarithm of each of the WERs.
- Calculate the arithmetic mean of the logarithms ( $\bar{x}$ ).
- Calculate the sample standard deviation of the logarithms (s): $s = \sqrt{\frac{(x - \bar{x})^2}{n-1}}$
- Calculate the standard error of the arithmetic mean (SE): $SE = \frac{s}{\sqrt{n}}$
- Calculate the adjusted geometric mean (A): $A = \exp(\bar{x} - (t_{0.7})(SE))$ where $t_{0.7}$ is the value of the Student's t statistic for a one-sided probability of 0.70 with n-1 degrees of freedom (df). The following table summarizes some typical values of $t_{0.7}$.

| **Degrees of Freedom** | **$t_{0.7}$** |
|---|---|
| 1 | 0.727 |
| 2 | 0.617 |
| 3 | 0.584 |
| 4 | 0.569 |
| 5 | 0.559 |
| 6 | 0.553 |
| 7 | 0.549 |
| 8 | 0.546 |
| 9 | 0.543 |
| 10 | 0.542 |
| 11 | 0.540 |
| 12 | 0.539 |

Using the results from the initial acute toxicity testing, the adjusted geometric mean FWER for the San Gabriel River was calculated as an example.

San Gabriel River WERs = 3.9, 4.2, 4.8, and 4.9

$$\bar{x} = \frac{\ln(3.9) + \ln(4.2) + \ln(4.8) + \ln(4.9)}{4}$$

$$\bar{x} = 1.488$$

$$s = \sqrt{\frac{(\ln(3.9) - 1.488)^2 + (\ln(4.2) - 1.488)^2 + (\ln(4.8) - 1.488)^2 + (\ln(4.9) - 1.488)^2}{4-1}}$$

$$s = 0.1091$$

$$SE = \frac{0.1091}{\sqrt{4}}$$

$$SE = 0.05455$$

$$A = \exp(1.488 - 0.569(0.05455))$$

$$A = 4.29$$

### 5.2.3. FWER Reporting Requirements

The report describing the derivation of the FWER must include the following:

- A report of the determination of each WER that was determined for the derivation of the FWER; all WERs determined with secondary tests must be reported along with all WERs that were determined with the primary test.
- The design flow of the upstream water and the effluent and the pH and temperature used in the derivation of the permit limits.
- A summary table must be presented that contains the following for each WER that was derived:
    - the value of the WER and the two endpoints from which it was calculated.
    - the hWER calculated from the WER.
    - the test and species that was used.
    - the date the samples were collected.
    - the flows of the effluent and upstream water when the samples were taken.
    - the following information concerning the laboratory dilution water, effluent, upstream water, and actual and/or simulated downstream water:  hardness (salinity), alkalinity, pH, and concentrations of ammonia, TSS, and TOC.
- A detailed explanation of how the FWER was derived from the WERs that are in the summary table.

## 5.3. CALCULATION OF SSO

The calculation of the site-specific objective for each waterbody is based on the FWER calculated above and the discharge conditions for the waterbody.  If all of the results of the study have been combined into the development of one FWER, then the SSO will be the same for all of the waterbodies.  However, if individual waterbodies are found to have different WERs, then the SSO will be different for the individual waterbodies.

Once the FWER is determined, a preliminary SSO is calculated based on multiplying the FWER by the acute or chronic criteria at the pH at which the FWER was developed.  The preliminary SSO is then compared to the SMCV and SMAV of the species used to develop the criteria.  If any of the species not tested has a SMCV or SMAV lower than the preliminary SSO, the species need to be reviewed to determine if any of the species are ecologically or commercially important species.  If one or more of the species are considered to be ecologically or commercially important species, the criteria to which the FWER is to be applied needs to be recalculated prior to the application of the FWER. The new criteria will be calculated based on the SMCV or SMAV of the ecologically or commercially important species using the procedures in *Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses* (USEPA, 1985). The new acute criteria would be equal to half of the SMAV at pH = 8 for the important species. The new acute criteria at pH 8 is substituted into the following equation to determine the new criteria equation. The chronic criteria calculation is more complicated because it is based on pH, temperature, and the presence of early life stages of fish. The criteria adjustments depend on whether the species is a fish or an invertebrate and whether data on the toxicity of ammonia to early life stages of the fish are available. All three scenarios are presented below. The final SSO is then equal to the adjusted acute or chronic criteria at the pH at which the FWER was developed, multiplied by the FWER.

Adjusted Acute criteria:

$$CMC = (AV_{t,8})\left(\frac{0.0489}{1+10^{7.204-pH}} + \frac{6.95}{1+10^{pH-7.204}}\right)$$

Adjusted Chronic criteria:

If the ecologically or commercially important species is an early life stage of a fish with a SMCV less than 2.85 mg N/L, replace 2.85 in the ELS present chronic equation with the SMCV for the early life stage fish (as shown in the equation below).

$$CCC = \left(\frac{0.0577}{1+10^{7.688-pH}} + \frac{2.487}{1+10^{pH-7.688}}\right) * MIN(SMCV, 1.45 * 10^{0.028*(25-T)})$$

If the ecologically or commercially important species is a non-early life stage of a fish with a SMCV less than 3.95 mg N/L use the following equation with the SMCV for the fish species:

$$CCC = \left(\frac{0.0577}{1+10^{7.688-pH}} + \frac{2.487}{1+10^{pH-7.688}}\right) * MIN(SMCV, 1.45 * 10^{0.028*(25-MAX(T,7))})$$

If the ecologically or commercially important species is an invertebrate that is more sensitive to ammonia than *Hyalella*, then a temperature relationship for the species must be developed and the *Hyalella* temperature relationships in the equations replaced by the one developed for the ecologically or commercially important species.

where:

CMC = The acute criteria at the pH at which the FWER is to be applied.

CCC = The chronic criteria at the pH at which the FWER is to be applied.

$AV_{t,8}$ = The adjusted acute criteria at pH = 8.

pH = The pH at which the FWER is to be applied.

## 5.4. DATA REPORTING

As outlined in the WER guidance, the final report summarizing the results of the SSO work will include the following:

- Name(s) of the investigator(s), name and location of the laboratory, and dates of initiation and termination of the tests.
- Description of the laboratory dilution water, including source, preparation, and any demonstrations that an aquatic species can survive, grow, and reproduce in it.
- The name, location, and description of the discharger, a description of the effluent, and the design flows of the effluent and the upstream water.
- A description of each sampling station, date, and time, with an explanation of why they were selected, and the flows of the upstream water and the effluent at the time the samples were collected.
- The procedures used to obtain, transport, and store the samples of the upstream water and the effluent.
- Any pretreatment, such as filtration, of the effluent, site water, and/or laboratory dilution water.
- Results of all chemical and physical measurements on upstream water, effluent, actual and/or simulated downstream water, and laboratory dilution water, including hardness (or salinity), alkalinity, pH, and concentrations of ammonia, TSS, and TOC.
- Description of the experimental design, test chambers, depth and volume of solution in the chambers, loading and lighting, and numbers of organisms and chambers per treatment.
- Source and grade of salt, and how the stock solution was prepared, including any acids or bases used.
- Source of the test organisms, scientific name and how verified, age, life stage, means and ranges of weights and/or lengths, observed diseases, treatments, holding and acclimation procedures, and food.

- The average and range of the temperature, pH, hardness (or salinity), and the concentration of dissolved oxygen (as % saturation and as mg/L) during acclimation, and the method used to measure them.
- Average and range of the test temperature and the method used to measure it.
- The schedule for taking samples of test solutions and the methods used to obtain, prepare, and store them.
- A summary table of the ammonia concentrations in each treatment, including all controls, in which they were measured.
- A summary table of the values of the toxicological variable(s) for each treatment, including all controls, in sufficient detail to allow an independent statistical analysis of the data.
- The endpoint and the method used to calculate it.
- Comparisons with other data obtained by conducting the same test using laboratory dilution water in the same and different laboratories; such data may be from the criteria document or from another source.
- Anything unusual about the test, any deviations from the procedures described above, and any other relevant information.
- All differences, other than the dilution water and the concentrations of metal in the test solutions, between the side-by-side tests using laboratory dilution water and site water.
- Comparison of results obtained with the primary and secondary tests.
- The WER and an explanation of its calculation.

The final data report, after review and input by the technical advisory committee and the coordinating committee, will be submitted to the Regional Board for use in the development of a Basin Plan amendment. Additional support and information will be provided as necessary to complete the SSO adoption process.

# Section 6. References

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APPENDIX 1

# Initial *Hyalella* Toxicity Testing Sampling Plan

DRAFT

# Sampling Plan for Ammonia Water Effects Ratio *Hyalella* Study

Submitted to:

City of Burbank

City of Los Angeles

County Sanitation Districts of Los Angeles County

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# Section 1. Introduction

## 1.1. STUDY OBJECTIVE

The purpose of this monitoring is to provide a preliminary indication of the potential for development of a Water Effects Ratio (WER) for ammonia in waterbodies in Los Angeles and Ventura County. Additionally, should the preliminary studies indicate that an acceptable WER may be possible, the data developed in this study may be useable as part of the information needed for the development of the WER. Finally, the initial study is intended to answer as many of the questions about the development of the WER study as possible (i.e. location of sample collection, site of WER, range finding for the species, etc.).

## 1.2. BASIS FOR INITIAL STUDY

In the 1999 Update of the Ambient Water Quality Criteria for Ammonia (USEPA, 1999), the updated chronic criteria were developed based on a limited number of chronic toxicity studies. The most sensitive species used in the development of the criteria was *Hyalella azteca*. The chronic study used in the development of the criteria was conducted by Uwe Borgmann in 1994. Borgmann has also done other work using acute toxicity tests that indicates that hardness and concentrations of certain ions may have a significant impact on the toxicity of ammonia to *Hyalella*. Because the waterbodies in Los Angeles and Ventura County are primarily effluent-dominated, the hardness and ionic concentrations in these waterbodies are much higher than the concentrations found in the laboratory dilution water used in the study that is the basis for the ammonia criteria. For this reason, there is a potential to develop a WER for ammonia in these waterbodies. Because *Hyalella* is the most sensitive species on which the chronic criteria is based, initial studies done to determine the difference in toxicity to this species that occur in site water versus laboratory dilution water should give an indication of the WER that could be developed for ammonia.

### 1.2.1. Summary of *Hyalella* Studies

The Borgmann study used in the development of the chronic criteria was published in 1994. Four sets of 2-3 experiments each were conducted to examine various aspects of chronic ammonia toxicity to *Hyalella*. Two of these sets of experiments were looking at ammonia effects on survival and reproduction on 0-1 week old young and the reproduction in 4-5 week old adults, respectively. The other two were looking at the impact of pH and hardness on the ammonia toxicity. The first set of experiments (with 0-1 week old young) were the only results used in the development of the criteria. Three separate experiments were run with the 0-1 week old young, one for 4 weeks and the other two for 10 weeks. The studies compared survival, growth and reproduction relative to the control. EPA took the data from the two ten week studies and combined them into one dataset from which they used a multiple regression analysis to determine an EC20 for the species. At the lowest tested concentration, survival was reduced by 25% and reproduction was reduced by 55%. The EC20 found from this dataset is lower than the lowest tested concentration so the EC20 was determined to be less than the lowest tested concentration or <1.45 mg N/L.

No acute studies for *Hyalella* were used in the development of the acute ammonia standards. There were studies done on the species that were considered acceptable, but they were conducted between the 1984 and 1999 criteria documents and were not considered to add any information that would affect the criteria (i.e. they did not impact the lowest five genera). However, the data were compared to the criteria to make sure the criteria were protective. In soft water at high pHs, *Hyalella* results were below the criteria suggesting that this species may be one of the more sensitive species under those conditions. However, in moderately hard water, *Hyalella* is not one of the most sensitive species, based on the acute test endpoint. The acute tests conducted by Borgmann that demonstrated a reduction in toxicity due to ionic concentrations was included in this review, but was not included in the development of the acute criteria.

# Section 2. Questions to Answer

The goal of this initial study is to provide the information necessary to make a determination as to whether or not to proceed with development of a WER and at the same time gather information that will be useful in the development of WER should that path be chosen. For this reason, a list of issues were identified that could potentially be addressed through this initial study.

## 2.1. ACUTE VS. CHRONIC TOXICITY TESTS

Ideally, the tests conducted to develop a WER should match as closely as possible the studies used in the development of the criteria document and should be conducted so that they would be considered acceptable for inclusion in development of the criteria document. Because a chronic study was used in the development of the criteria, replication of the chronic study would be the best mechanism for developing a WER. However, there are several complications with using chronic studies in this initial assessment of the potential for a WER.

Chronic *Hyalella* tests can be either 4-week or 7-week tests that require either on-site testing or twice daily water renewals. These tests are complex and require diligent monitoring to be successful. As a result, there is significant cost and time associated with these tests. It would not be feasible to conduct chronic toxicity tests on all of the receiving waters in this study. Acute *Hyalella* testing is a much less time consuming test than the chronic studies. The tests are conducted over a 96 hour period and it is possible to test all receiving waters with multiple sites and/or replicates using the acute test. Additionally, the studies conducted on *Hyalella* to determine their sensitivity to water hardness and ions were done using acute tests. However, acute *Hyalella* tests were not used in the development of the acute ammonia criteria, though acceptable studies have been done. The acute *Hyalella* tests conducted indicate that *Hyalella* would be in the mid-range of the other species tested, except in soft water (less than 50 mg/L CaCO3). At low hardness, *Hyalella* becomes one of the more sensitive species tested.

The WER guidance (EPA, 1994) requires that the primary toxicity test used in the development of a WER have an endpoint as close as possible to, but not lower than, the criteria to which the WER will be applied. It also states that the endpoint is the critical factor in determining whether or not the test is acceptable, not the designation of the test as acute or chronic. For example, an acute test with an endpoint near the chronic criteria could be used to develop a WER for the chronic criteria and visa versa. In addition, the more sensitive the species, the higher the WER is likely to be. Because less sensitive tests are likely to give lower WERs, acute *Hyalella* tests may be acceptable for the overall development of a WER for either the acute or chronic criteria, however, they may not result in the highest possible WER (unless their sensitivity to ions and hardness is significantly greater than other species).

Because of the costs involved in conducting chronic toxicity tests, it is not feasible to conduct these tests at all of the stations involved in this study. As a result, acute studies are recommended as the basis of this initial assessment. However, the combined resources of the three agencies involved in the study have made it possible to potentially conduct one chronic study during this initial assessment. By conducting one chronic study, it will be possible to compare the results of the acute and chronic studies for differences and give an indication of whether or not it is necessary to use chronic studies in the development of the WER. The chosen approach in this study plan provides the option for conducting this study at one site, if desired.

## 2.2. ADDITIONAL SPECIES

The development of a WER requires toxicity tests on at least two species. It is unclear what other species may be sensitive to the site water in Los Angeles County. Previous studies for the development of a WER for a similar creek in Nebraska used fathead minnow (*Pimephales promelas*), a water flea (*Ceriodaphnia dubia* ) and channel catfish without much success (WER of approximately 1.3) (Christianson, 2000). Review of the criteria document suggests that blue gills (L. macrochirus) may be an appropriately sensitive species to use. Blue gills are one of the most sensitive species used in the development of both the acute and chronic criteria, but there is no data available for their sensitivity to hardness or ions. They are the only species used in the development of the criteria that is in the lowest 5$^{th}$ percentile for both the acute and chronic criteria development. Some funds could be used to do an initial assessment of this or other species to determine another species that could be appropriate for development of a WER.

### 2.3. SAMPLING CONSIDERATIONS

In the development of a WER, several key sampling issues need to be addressed. The first is the extent of the area that the WER is to cover, and how many sampling locations are required to determine a WER for that area. Secondly, seasonal, temporal, and spatial variability need to be addressed. Finally, appropriate sample locations need to be determined. The WER guidance allows for the use of upstream, downstream, or simulated downstream water (known amount of effluent combined with known amount of upstream water) as the site water for the study.

The number of POTWs involved in the study allows for the analysis of many of these questions through the choice of sampling locations, time of sample collection, etc. The study plan approach looks at a variety of sampling locations and sampling conditions to attempt to address some of the issues listed above.

### 2.4. STUDY QUESTIONS

The study approach will focus on answering the following questions:

- Is there potential for the development of a WER significantly greater than 1 in receiving waters in Los Angeles County?
- What is the variability in ammonia toxicity between receiving waters and sites in Los Angeles County (i.e., what area can the development of a WER cover?)
- What differences are there between acute and chronic toxicity study results in the context of a WER? Do the differences dictate the use of one or the other types of tests in the development of an SSO for ammonia?
- What are other potential test species for use in the development of a WER?

# Section 3. Approach

By combining the resources of multiple agencies, it has been possible to suggest an approach which expands the scope of the initial study to gather more useful information without increasing the costs to the individual agencies. The approach to this study will use two different stages to answer as many of the questions needed to proceed with development of a WER as possible. The first stage will be initial acute toxicity testing at five stations. Depending on the initial results of this testing, stage two may consist of chronic toxicity testing at one station or may be simply additional acute toxicity testing. During phase two, additional samples may be collected to conduct rangefinding toxicity tests on a second test species (e.g. blue gill).

The first step in the monitoring program will be to collect acute toxicity samples for *Hyalella* at three stations on the Los Angeles River and two stations on the San Gabriel River. At each sampling location, two samples will be collected. Analysis will be run on these ten samples and initial results reviewed to guide action on the next phase of the study.

Based on the results of the initial round of testing, a decision will be made whether or not to proceed with one 4 week chronic toxicity test. Conducting one chronic toxicity test would involve a significant reduction in the number of samples collected at the remaining stations for acute testing. In the proposals for this project, it was assumed that 5 samples would be collected per POTW involved in this study. Conducting one chronic study would reduce the number of samples collected per POTW to between 2 and 3 per POTW. The chronic study will also require the collection of significant volumes of water every three days over the four week study to provide renewal samples for the lab. Additionally, a maximum of one acute study on a second test species could be conducted. Without conducting the chronic toxicity test, more investigation of spatial and temporal variability at the sites could be investigated and it would be possible to conduct more tests on a second test species. The initial toxicity tests will give an indication as to the extent of a WER possible from acute tests and some idea of spatial variability among the sites and receiving waters. Based on these results, a decision will be made to conduct a chronic toxicity test or to proceed with additional acute toxicity tests without a chronic test.

## 3.1. SAMPLING LOCATIONS

The sampling locations were chosen as much as possible to correspond with NPDES monitoring locations for the POTWs. In order to avoid having to remove ammonia from the samples or dilute the samples with upstream water, the lab required samples to contain less than 10 mg/L of total ammonia as nitrogen and less than 5 mg/L-N if possible. Historical monitoring results were reviewed to assess appropriate monitoring locations based on this requirement. The following table summarizes the monitoring locations.

Table 1. Sampling Locations

| Location ID [1] | Receiving Water | Description | Agency | Ammonia Range (mg/L-N) | Average Ammonia (mg/L-N) |
|---|---|---|---|---|---|
| LA-R7 | Los Angeles River | Downstream of DC Tillman | City of LA | 2.2-10.0 | 5.5 |
| LA-R4 | Los Angeles River | Upstream of LA-Glendale, 0.04 mile(will move upstream closer to the confluence with Burbank Western Wash if a suitable location can be determined) | City of Burbank | 1.5-9.2 | 7.0 |
| LA-R7 | Los Angeles River | Downstream of LA Glendale at Los Feliz | City of LA | 2.2-6.7 | 5.2 |
| BW-R5 | Burbank Western Wash | Downstream of Burbank WTF just upstream of confluence with the Los Angeles River | City of Burbank | Not available | Not available |
| SGR-R4 | San Gabriel River | Downstream of San Jose Creek WRP and upstream of Los Coyotes at Artesia Blvd. | LACSD | 0.07-12.1 | 7.5 |
| SGR-R9W | San Gabriel River | Downstream of Los Coyotes | LACSD | 1.3-13.7 | 6.6 |
| SGR-RA | San Gabriel River | Downstream of Whittier Narrows WRP 150 feet upstream of Whittier Narrows Dam | LACSD | 1.2-15.4 | 5.6 |
| SJC-RC | San Jose Creek | Downstream of Pomona WRP on downstream side of Old Brea Canyon Road | LACSD | 0.07-5.98 | 0.77 |
| CC-RA1 | Coyote Creek | Upstream of Long Beach | LACSD | 0.1-6.6 | 0.44 |
| CC-R9E | Coyote Creek/SGR | Downstream of Long Beach near Atherton St. in the eastern low flow channel | LACSD | 0.07-11.9 | 4.7 |
| RH-RD | Rio Hondo | Downstream of Whittier Narrows WRP 1000 feet upstream of San Gabriel Boulevard | LACSD | 0.08-12.5 | 3.7 |
| SCR-RB | Santa Clara River | Downstream of Saugus- 300 ft downstream of discharge (may need to go farther if possible to reduce ammonia concentrations) | LACSD | 1.4-20.9 | 9.8 |
| SCR-RE | Santa Clara River | Downstream of Valencia, 1.6 miles upstream of Chiquita Canyon Road. | LACSD | 0.1-12.9 | 4.2 |

1 The location ID uses an abbreviation for the receiving water combined with the NPDES monitoring location identifier to distinguish between NPDES monitoring locations which have the same name for different POTWs.

Sample locations were chosen to look at conditions both upstream and downstream of POTWs in situations where there is sufficient flow to do so. Samples will be collected at stations LA-R7, LA-R4, LA-R7A, SGR-R4, and SGR-R9W during the first phase of the study. The remaining stations will be monitored during the following phase of the study and additional samples may be collected at the stations sampling in the first stage of monitoring.

## 3.2. SAMPLING SCHEDULE

Table 2 summarizes the sample collection for the first phase of the study. Tables 3 and 4 summarize sample collection at each of the sampling locations for phase two based on conducting a chronic study and not conducting a chronic study.

Table 2. Sample Schedule for Phase 1

| Location ID | Number of Samples | Date of Sample Collection | Volume per Sample | Type of sample collected | Tests run on sample | Frequency of Sample Collection | Sample location |
|---|---|---|---|---|---|---|---|
| LA-R7 | 2 | 10/4/00 | 5 gallons | Grab | *Hyalella* acute | 2 samples collected on one day | Mid-stream |
| LA-R4 | 2 | 10/4/00 | 5 gallons | Grab | *Hyalella* acute | 2 samples collected on one day | Mid-stream and 2 feet from edge |
| LA-R7A | 2 | 10/4/00 | 5 gallons | Grab | *Hyalella* acute | 2 samples collected on one day | Mid-stream and 2 feet from edge |
| SGR-R4 | 2 | 10/4/00 | 5 gallons | Grab | *Hyalella* acute | 2 samples collected on one day | Mid-stream |
| SGR-R9W | 2 | 10/4/00 | 5 gallons | Grab | *Hyalella* acute | 2 samples collected on one day | Mid-stream and 2 feet from edge |

Table 3. Sample Schedule Including Chronic Study

| Location ID | Number of Samples | Date of Sample Collection[2] | Volume per Sample | Type of sample collected | Tests run on sample | Frequency of Sample Collection | Sample location |
|---|---|---|---|---|---|---|---|
| SGR-RA | 2 | TBD | 5 gallons | Grab | *Hyalella* acute | 1 sample every 2 weeks for total of 2 samples | Mid-stream |
| BW-R5 | 1<br>1 | TBD | 5 gallons<br>5 gallons | Grab<br>Grab | *Hyalella* acute<br>*Hyalella* acute | Morning<br>Afternoon | Mid-stream |
| SJC-RC | 2 | TBD | 5 gallons | Grab | *Hyalella* acute | 1 sample every 2 weeks for total of 2 samples | Mid-stream |
| CC-RA1 | 2 | TBD | 5 gallons | Grab | *Hyalella* acute | 1 sample every 2 weeks for total of 2 samples | Mid-stream |
| CC-R9E | 2 | TBD | 5 gallons | Grab | *Hyalella* acute | 1 sample every 2 weeks for total of 2 samples | Mid-stream |
| RH-RD | 2 | TBD | 5 gallons | Grab | *Hyalella* acute | 1 sample every 2 weeks for total of 2 samples | Mid-stream |
| SCR-RB | 3 | TBD | 5 gallons | Grab | *Hyalella* acute | Morning and afternoon one day, one sample 2 weeks later | Mid-stream |
| SCR-RE | 3 | TBD | 5 gallons | Grab | *Hyalella* acute | Morning and afternoon one day, one sample 2 weeks later | Mid-stream |
| Chronic Study[1] | 1 | TBD | 100 gallons | Grab | *Hyalella* chronic | Renewal samples collected every 3 days for 4 weeks | Mid-stream |
| Second Species[1] | 1 | TBD | 50 gallons | Grab | Acute | | Mid-stream |

1 Location of chronic study and second species sampling will be determined based on the results of the initial acute tests.
2 Dates of additional sampling will be determined based on when the initial results are received and a course of action determined.

Table 4. Sample Schedule Without Chronic Study

| Location ID | Number of Samples | Date of Sample Collection | Volume of Sample | Type of sample collected | Tests run on sample | Time of Sample Collection | Sample location |
|---|---|---|---|---|---|---|---|
| LA-R7 | 1 | TBD | 5 gallons | Grab | *Hyalella* acute | | Mid-stream |
| LA-R4 | 1<br>1 | TBD<br>TBD | 5 gallons<br>50 gallons | Grab<br>Grab | *Hyalella* acute<br>Second Species acute | | Mid-stream |
| LA-R7A | 1 | TBD | 5 gallons | Grab | *Hyalella* acute | | Mid-stream |
| SGR-R4 | 1<br>1 | TBD<br>TBD | 5 gallons<br>50 gallons | Grab<br>Grab | *Hyalella* acute<br>Second Species acute | | Mid-stream |
| SGR-R9W | 2 | TBD | 5 gallons | Grab | *Hyalella* acute | Morning and afternoon | Mid-stream |
| SGR-RA | 2 | TBD | 5 gallons | Grab | *Hyalella* acute | Morning and afternoon | Mid-stream |
| BW-R5 | 1 | TBD | 5 gallons | Grab | *Hyalella* acute | | Mid-stream |
| SJC-RC | 3 | TBD | 5 gallons | Grab | *Hyalella* acute | 1 sample every 2 weeks | Mid-stream |
| CC-RA1 | 3 | TBD | 5 gallons | Grab | *Hyalella* acute | 1 sample every 2 weeks | Mid-stream |
| CC-R9E | 3 | TBD | 5 gallons | Grab | *Hyalella* acute | 1 sample every 2 weeks | Mid-stream |
| RH-RD | 3 | TBD | 5 gallons | Grab | *Hyalella* acute | 1 sample every 2 weeks | Mid-stream |
| SCR-RB | 2<br>2 | TBD<br>TBD | 5 gallons<br>5 gallons | Grab<br>Grab | *Hyalella* acute<br>*Hyalella* acute | Morning and afternoon one day, additional samples 2 weeks later | Mid-stream |
| SCR-RE | 2<br>2<br>1 | TBD<br>TBD<br>TBD | 5 gallons<br>5 gallons<br>50 gallons | Grab<br>Grab<br>Grab | *Hyalella* acute<br>*Hyalella* acute<br>Blue Gill acute | Morning and afternoon one day, additional samples 2 weeks later | Mid-stream |

1 Dates of additional sampling will be determined based on when the initial results are received and a course of action determined. Sampling will be conducted approximately once every two weeks for a total of 4 additional sampling events.

The sample schedule outlined in Tables 2 and 3 includes sampling at different points in the stream at the same sample location to assess spatial variability in the stream, sampling at different times of the day to assess daily temporal variations, and sampling at the same location on different days to assess longer term temporal variations in the samples. Additionally, replicate samples will be collected as outlined in the tables above to assess the reproducibility of the monitoring results. Finally, the sampling schedule could be adjusted to include periods after a storm event, if desired. Flow-weighted composites may be substituted instead of grabs at any monitoring location for which the samples can be collected in that manner.

In addition to the toxicity testing, samples will be analyzed to determine the concentration of relevant constituents in the samples. The following constituents will be analyzed for each sample.

- Total Suspended Solids
- Total Dissolved Solids
- Total Organic Carbon
- Hardness
- Alkalinity
- Sodium
- Potassium

Ammonia, temperature, pH, and dissolved oxygen measurements will be taken prior to initiation of the toxicity tests and throughout the toxicity test period by the laboratory to ensure that appropriate conditions are maintained in the sample. Sample water from the toxicity testing containers (2.5 gallon glass containers) will be removed before the toxicity sampling is started and analyzed for the constituents listed above. This ensures that the water quality reported is the same as the quality of the water being used for the toxicity testing.

# Section 4. Monitoring Activities

This section discusses the monitoring activities from the steps required to prepare for sampling to the sample delivery procedure after completion of sample collection. All samples will be delivered to MEC Analytical Systems, Inc. in Carlsbad, CA for analysis.

## 4.1. SAMPLING PREPARATION

Prior to each sampling event, event summaries will be developed, sample bottles will be ordered and equipment maintenance performed as follows. Figure 1 provides a field equipment checklist.

Figure 1. Field Equipment Checklist

- Sampling Plan
- Event Summary Sheet
- Sample Bottles w/ labels
- Coolers w/ice
- Bubble wrap
- New powder-free gloves
- Chain of Custody forms
- Field Log Forms
- Pens
- Watch
- Camera
- Tape measure
- Hip waders
- First Aid Kit
- Cellular Phone
- Keys for gates (if necessary)

### 4.1.1. Sampling Event Summary

Prior to each monitoring event, a sampling summary will be produced that outlines the sites to be monitored during that event, samples to be collected, and time of sample collection based on the sampling schedule chosen after the review of the initial monitoring results. If a chronic study is to be conducted, a sampling schedule for the renewal samples will also be produced.

#### 4.1.2. Bottle Order/Preparation

Two weeks prior to each sampling event, sample bottle orders will be placed with the analytical laboratory. Field crews will inventory sample bottles upon receipt from the laboratory to assure that adequate bottles have been provided to account for the analytical requirements for each sampling event.

#### 4.1.3. Sample Bottle Labeling

All samples will be pre-labeled, to the extent possible, before each sampling event. Pre-labeling sample bottles simplifies field activities, leaving only sample collection time, sample number, and sampling personnel names to be filled out in the field. Custom bottle labels will be produced using blank water-proof labels and labeling software provided by LWA. Using this approach will allow the sites and analytical constituent information to be entered into the computer program in advance, and printed as needed prior to each monitoring event.

Labels should be placed on the appropriate bottles in a dry environment; attempting to apply labels to sample bottles after filling will cause problems, as labels usually do not adhere to wet bottles. The labels should be applied to the bottles rather than to the caps.

Field labels should contain the following information:

- program name
- site ID/code (see next section)
- event number
- date
- time
- collected by_________

#### 4.1.4. Sample ID Conventions

Sample bottles submitted to laboratories for analysis shall be labeled with the sampling site name, the date and time of sample collection, and a sample ID devised as follows:

*SITE*–Event #*XX*

Where: *SITE* = Site ID

*XX* = Event number (i.e., 01, 02, or 03)

The site ID will consist of the ID number listed in Table 1. The event number will also include an AM or PM for samples collected in the morning and afternoon on the same day.

## 4.2. FIELD ACTIVITIES

### 4.2.1. Sample Collection

All samples will be collected as grab samples. At most sites, grab samples will be collected by directly submerging sample bottles at mid-stream and mid-depth. This is the preferred method for grab sample collection, however, due to monitoring site configurations and safety concerns, direct filling of sample bottles is not always feasible. Monitoring site configuration and the type of grab sample will dictate grab sample collection technique. In general, grab samples will be taken at approximately mid-stream, mid-depth at the location of greatest flow (where feasible). Samples will be collected by wading to mid-stream and filling bottles by direct submersion of the sample bottle to approximately mid-depth. Clean powder-free nitrile gloves will be worn for collection of all grab samples. Grab samples will be collected directly into the appropriate sample bottles.

The grab sample techniques that may be employed are described below.

*Direct Submersion: Hand Technique*

Where practical, all grab samples may be collected by direct submersion to mid-stream, mid-depth using the following procedures.

- Wear clean gloves when handling bottles and caps;
- Pre-label sample containers (site code, location, date, time, analysis);
- Submerge bottle to mid-stream/mid-depth, remove lid, let bottle fill, and replace lid;
- Place sample on ice, fill out COC form, and deliver to MEC Analytical Systems, Inc.;
- Collect duplicate samples if needed using the same protocols described above.

*Intermediate Container Technique*

Samples for which the introduction of a secondary container is acceptable, and which will be collected from an open channel, may be collected with the use of a specially cleaned intermediate container following the steps listed below.

- Wear clean gloves when handling bottles and caps;
- Pre-label sample containers (site code, location, date, time, analysis);
- Submerge specially cleaned intermediate container to mid-stream/mid-depth, let container fill, and pour off into individual sample bottles;
- Place sample on ice, fill out COC form, and deliver to MEC Analytical Systems, Inc.;
- Collect duplicate samples if needed using the same protocols described above.

If at any time the collection of samples by wading appears unsafe, do not attempt to collect mid-stream, mid-depth measurements. If in-stream sampling is not safe, collect samples from a stable, unobstructed area at the river's edge. Attach the bottle to an expandable pole to reach out into the creek to collect samples and record the position of sample collection on the field log.

4.2.1.1. Clean Sampling Techniques

Samples will be collected using "clean sampling techniques" to minimize the possibility of sample contamination. Sampling methods will generally conform to EPA "clean sampling" methodology (USEPA 1995a). Although these methods are specific to metals, the techniques may be applied to collection of other water quality samples.

Clean sampling techniques are summarized below:

- Samples are collected only into rigorously pre-cleaned sample bottles.
- At least two persons, wearing clean powder-free nitrile gloves at all times, are required on a sampling crew.
- One person ("dirty hands") touches and opens only the outer bag of all double bagged items, avoiding touching the inside of the bag.
- The other person ("clean hands") reaches into the outer bag, opens the inner bag, and removes the clean item.
- After a grab sample is collected, or when a clean item must be re-bagged, it is done in the opposite order from which it was removed.
- Clean, powder-free nitrile gloves are changed whenever something not known to be clean has been touched.

To reduce potential contamination, sample collection personnel must adhere to the following rules while collecting samples:

- No smoking.
- Never sample near a running vehicle. Do not park vehicles in immediate sample collection area (even non-running vehicles).
- During wet weather events avoid allowing rain water to drip from rain gear or any other surface into sample bottles.
- Do not eat or drink during sample collection.
- Do not breathe, sneeze or cough in the direction of an open sample bottle.

#### 4.2.2. Field Observations

Standard receiving water observations including odor, color, floating material, etc., together with observations of aquatic life will be recorded on the field log shown in Figure 2. Photographs will be taken to supplement observations recorded on the field log and to provide evidence of observations.

#### 4.2.3. Flow Measurement

Flow measurement will be recorded or estimated at each sampling collection point during each monitoring event. Where flow measurement equipment is not available, depth, width, and velocity will be estimated to provide an estimate of flow. Depth will be estimated by using the average of several depth measurements taken along the channel. Width will be measured by extending a tape measure from one side of the bank to the other. Velocity will be estimated by measuring the time it takes a floating object (e.g. stick, orange) to travel a known distance and applying a factor to translate from surface velocity to average cross-sectional velocity.

### 4.3. POST-SAMPLING ACTIVITIES

#### 4.3.1. Chain-of-Custody

Chain-of-custody (COC) forms will be filled out for all samples submitted to each laboratory. Sample date, sample location, sample collection person(s), and analysis requested shall be noted on each COC.

#### 4.3.2. Transport to Lab

Samples will be stored in coolers with ice and delivered to MEC Analytical Systems, Inc. immediately after collection. Samples may be hand delivered to the laboratory or sent by courier for same-day delivery. Following are directions to the laboratory and contact information for the lab.

David Moore
MEC Analytical Systems, Inc.
2433 Impala Dr.
Carlsbad, CA 92008
760-931-8081
760-931-1580-fax

Directions to MEC Analytical Systems, Inc.:

- Take I-5 South to the TAMARACK AVENUE exit in Carlsbad.
- Turn LEFT onto TAMARACK AVE.
- Turn RIGHT onto EL CAMINO REAL.
- Turn LEFT onto FARADAY AVE.
- Turn LEFT onto PALMER WAY.
- Turn RIGHT onto IMPALA DR.

### 4.4. DATA ANALYSIS AND REPORTING

The stage 1 reports will be received from the laboratory by the week of October 23, 2000. LWA will develop a recommendation based on the stage 1 results within one week of receiving the results from the laboratory. At this time, LWA will provide a summary of the results and recommendations to the three agencies for their consideration. The course of action for stage 2 will be determined in consultation with the three agencies and potentially include discussions with the EPA.

# Section 5. References


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APPENDIX 2

# Example Sample Summary and Field Log

| | | | |
|---|---|---|---|
| Ammonia WER and Site-Specific Objective Workplan LA County Waterbodies | | | |
| | April 01, 2002 Dry Sample | | |
| | City of Los Angeles and LACSD's Sites | | |
| | **Event Summary** | | |
| **Sample Type** | **Requirements** | **Bottles** | **Lab** |
| Bridge @ Van Nuys – **LA1**, Downstream of Tillman at Van Nuys Blvd Bridge (LA River) | | | |
| Grabs: | *Hyalella* Chronic | 8 - 5 gallon glass jars<br>(40 gallons total) | MEC Analytical Systems |
| Bridge @ Los Feliz - **LA2**, Downstream of LAGWRP at Los Feliz (LA River) | | | |
| Grabs: | *Fathead Chronic* | 8 - 5 gallon glass jars<br>(40 gallons total) | MEC Analytical Systems |
| | *Hyalella* Chronic | 8 - 5 gallon glass jars<br>(40 gallons total) | MEC Analytical Systems |
| Bridge – **SCR2** – Downstream of Valencia, 1.6 miles upstream of Chiquita Canyon Road (Santa Clara River) | | | |
| Grabs: | *Hyalella Acute* | 3 - 2.5 gal glass pickle jars | MEC Analytical Systems |
| Bridge or side of stream – **RH1** – Downstream of Whittier Narrows WRP, 150 ft upstream of the Whittier Narrows Dam (Rio Hando) | | | |
| Grabs: | *Hyalella Acute* | 3 - 2.5 gal glass pickle jars | MEC Analytical Systems |

Field Log Ammonia SSO Study

**GENERAL INFORMATION**

Station ID____________ Date____________________ Time: Arrival_____________

Departure___________

Location:_______________________ Sampler's Name(s)_____________________________________________

_____________________________________________

_____________________________________________

**OBSERVATIONS**

Weather:_________________________________________________________________________________

Floating material or debris:__________________________________________________________________

Oil (extent):_______________________________________________________________________________

Water color or odor:_________________________________________________________________________

Photograph No. (if taken):___________________________________________________________________

Other Notes: ______________________________________________________________________________

__________________________________________________________________________________________

WATER QUALITY MEASUREMENTS

**pH:** _________________

**Temperature:** ___________

**Conductivity:** ________________________

FLOW ESTIMATES

**Measured flow:** flow_________________ or

**Estimated flow:** average depth___________ estimated width of flow____________estimated velocity___________ or

**Estimated river stage:** ________________________

APPENDIX 3

# Driving Directions to Sample Locations

# Ammonia WER Sample sites

## Driving Directions

SCR –1  Downstream of Saugus WRP

From the 126 Fwy / I-5 intersection, proceed south on the 5 Fwy.  Exit the 5 Fwy using the Magic Mountain Parkway off ramp. Proceed east from the off ramp on Magic Mountain Parkway.  At Bouquet Canyon Road turn left.  Turn left onto Valencia Blvd and turn into the driveway of the ARCO gas station and drive onto the sidewalk.  From the sidewalk, turn right and enter onto the bike path. Follow the path down towards the Bouquet Canyon overpass.  Collect sample on the west side of the bike bridge.

SCR –2  Downstream of Valencia WRP

Phone Jesse Gomez at the Newhall Ranch office the day before you plan to sample and arrange to have him open the gate at Humble Crossing.  His work number is 661-257-1095 and his cell number is 805-341-2736.

From the 126 Fwy / I-5 intersection, proceed westbound on the 126 Fwy.  After passing the RV campground, turn left at the first signal.  Follow the dirt road leading to the rear of the property.  Be cautious of areas of mud and soft dirt.  Meet Jesse at the gate past the storage/utility building and follow the dirt trail down to Santa Clara River (Station RE).

SJC-1  Downstream of Pomona WRP

Go East on Pomona (60) Freeway. Take this to the northbound 57 Freeway.  Exit Temple and make a right at the light.  Turn left on Mission Blvd. and then right on Pomona Blvd.  Turn right, after passing under the freeway, into the driveway immediately before the Altec entrance. The street address is 2882 Pomona Blvd.  There is a footbridge with a ladder and handrail.  This is Station RA (SJC-1). To locate this station using a GPS device, the latitude and longitude readings (± 10 meter) for this station is: N 34° 03' 10.6"    W 117° 48' 07.3

RH-1  Downstream of Whittier Narrows WRP

Take the Pomona (60) Freeway west and exit at Rosemead Blvd.  Proceed south to San Gabriel Blvd.  Turn right on San Gabriel Blvd and turn right at the first green gate (first right after the WN WRP).  From the gate, make a quick left onto a gravel road. Proceed on the gravel road, passing green tanks on the left. Bear right onto the asphalt road. You will pass oil pump #5. At apex, follow right trail through trees and brush, passing between pumps #15 and #16, and over a little wood bridge. Turn right onto the asphalt bike trail to verify flow from the WRP at the outfall (on left @ 10 feet after turning on bike path). Turn around, go past the intersection with the dirt road (that you just turned off), and proceed all the way to a bridge that is the San Gabriel Blvd. overpass. You will see a large wood sign on your right, just before the sample site. GPS coordinates are not available.

SGR-1  Downstream of San Jose Creek WRP

Take 605 South to Alondra Blvd. R3 (or SGR-1) is on the San Gabriel River at the Alondra overpass. Sample from bridge.  To check if there is flow (if necessary), first exit at Florence Blvd, go right at end of offramp, and then turn left almost immediately before bridge. You will need a river access key to open gate and proceed along bike path.  Go down ramp on right towards SGR. SJC effluent is about 60 yds. north of ramp on the opposite side of the concrete low flow channel. GPS coordinates are not available.

SGR-2  Downstream of Los Coyotes WRP

Take 605 South to Willow St. R5 (or SGR-2) is on the San Gabriel River at the Willow St. overpass. Sample from bridge. See above.

CC-1  Downstream of Long Beach WRP

Take the 605 Freeway South.  Exit at Spring Street and turn right. Turn left at Studebaker. Proceed on Studebaker, and then turn left on Willow Street.  Pass over the San Gabriel River; the Long Beach plant is visible on the right. Turn into the LBWRP driveway. Go through the gate to the left of the LBWRP entrance. Continue down dirt road, to foot/bike- bridge. Park a safe distance before the bike-path, as bikers tend to pass quickly. Sample from middle of bike-bridge. GPS coordinates are not available.

LA – 2 (LA River, Downstream of LAG outflow)

From the San Fernando Valley, head East on the 101 Fwy.  Merge onto the 134 Fwy headed East (left two lanes of 101Frwy). Merge onto I-5 (Santa Ana) headed South.  Exit at the Colorado Street exit and follow road to the left (East) exiting at first Right, onto Colorado Blvd.  At stop sign  go left. Then make first Right into LAGWTP facility.  Once inside facility, make way to Southwestern most corner of facility. Pass through chain-linked gate (key required).  Turn left, heading south, travel on paved berm on eastern side of LA River.  About 0.75 miles south take cement access road down eastern side of LA River channel. Head south at rivers edge 100 yards.  Sample at side of river, within sight of Los Feliz Blvd.  Bridge (bridge on your left side).

LA – 1 (LA River at Van Nuys Bridge)

From the 101 Frwy in the San Fernando Valley, exit Van Nuys Blvd. and head North. Make a right turn onto Riverside Drive and park, just past the bus stop. Sample at rivers edge or on Van Nuys bridge.

BW – 1 (Burbank Wash at Riverside Dr.)

From the South bound 101 Frwy in the San Fernando Valley, exit at Bob Hope Dr. and head North past NBC Studios and St Joseph Medical Center. Turn Right onto W. Alameda Ave. Turn Right on Main Street, then Left on Riverside Drive. Park on right (West) side of Bridge at Riverside Drive.