Economic Considerations of Proposed Whole Effluent Toxicity Control Provisions for California

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Acronyms and Abbreviations

BAT	Best available technology economically achievable
BCT	Best conventional pollutant control technology
BMP	Best management practice
CEQA	California Environmental Quality Act
CTR	California Toxics Rule
CWA	Clean Water Act
CWAD	Conditional Waiver for Agricultural Discharges
CWC	California Water Code
EPA	Environmental Protection Agency
ESJ	East San Joaquin
ILRP	Irrigated Lands Program
IWC	Instream waste concentration
MDEL	Maximum daily effluent limitation
MEP	Maximum extent practicable
MGD	Million gallons per day
MS4	Municipal separate storm sewer system
NPDES	National Pollutant Discharge Elimination System
NPS	Non-Point Source
NSEC	No significant effect concentration
PCS	Permit compliance system
POTW	Publicly owned treatment works
RMD	Regulatory management decision
RTA	Refractory toxicity assessment
SIC	Standard industrial classification
SIP	Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays and Estuaries
SWMP	Storm water management plan
SWPPP	Storm Water Pollution Prevention Plan
TIE	Toxicity identification evaluation
TMDL	Total maximum daily load
TRE	Toxicity reduction evaluation
TRE/IE	Toxicity reduction evaluation/identification evaluation
TST	Test of significant toxicity
TU	Toxicity unit
WDR	Waste discharge requirement

Executive Summary

The State Water Resources Control Board is proposing to amend the statewide *Water Quality Control Plans for Inland Surface Waters, Enclosed Bays and Estuaries* to include updated water quality objectives for toxicity consistent with the U.S. Environmental Protection Agency's Test of Significant Toxicity (TST). Under a contract with the United States Environmental Protection Agency, PG Environmental provided the State Water Board with an analysis of economic factors related to the proposal, including compliance with the water quality objective options, available methods to achieve compliance with these options, and the costs of those methods.

The proposed amendment establishes toxicity objectives applicable to all inland surface waters, enclosed bays, and estuaries to protect aquatic life.

The chronic toxicity objective is expressed as a null hypothesis with a regulatory management decision (RMD) of 0.75 for chronic toxicity methods, where the following null hypothesis shall be used:

H_o: Mean response (ambient water) ≤ 0.75 • mean response (control)

Attainment of the water quality objective is demonstrated by rejecting this null hypothesis in accordance with the TST statistical approach.

The acute toxicity objective is expressed as a null hypothesis with an RMD of 0.80 for acute toxicity methods, where the following null hypothesis shall be used:

H_o: Mean response (ambient water) ≤ 0.80 • mean response (control)

Attainment of the water quality objective is demonstrated by rejecting this null hypothesis in accordance with the TST statistical approach.

Based on the total population of individually permitted municipal and industrial permittees subject to the Provisions, an estimation of potential incremental statewide costs associated with the Provisions are presented in **Exhibit ES-1**.

Exhibit ES-1. Summary of Estimated Statewide Incremental Compliance Costs

Cost Category	Low Range Estimate ($/year)	High Range Estimate ($/year)
Chronic Routine Monitoring	$1,025,000	$2,823,000
Species Sensitivity Testing	$256,000	$516,000

Note: detail may not add to total due to independent rounding

1 Introduction

This report documents an analysis on economic considerations associated with the State Water Resources Control Board's (State Water Board) Amendment to the Water Quality Control Plan for Enclosed Bays and Estuaries of California (Provisions) incorporating statewide numeric whole effluent toxicity objectives for aquatic life beneficial use protection and minimum requirements for implementation. This report updates previous analyses in 2008 by Science Applications International Corporation (SAIC), and 2012 and 2018 by Abt Associates.

1.1 Background

The Clean Water Act (CWA) directs states, with oversight by the U.S. Environmental Protection Agency (EPA), to adopt water quality standards to protect the public health and welfare, enhance the quality of water, and serve the purposes of the CWA. Under Section 303, state water quality standards must include: (1) designated uses for all water bodies within their jurisdictions, (2) water quality criteria sufficient to protect the most sensitive of the uses, and (3) an antidegradation policy consistent with the regulations at 40 CFR 131.12. The CWA also requires states to hold public hearings once every three years for the purpose of reviewing applicable water quality standards and, as appropriate, modifying and adopting standards. The results of this triennial review must be submitted to EPA, and EPA must approve or disapprove any new or revised standards.

In implementing the CWA, the State Water Board and the Regional Water Quality Control Boards (Regional Water Boards; together the Water Boards) follow the integrated approach to water quality-based toxics control recommended by EPA. This approach combines the use of chemical-specific and WET limits to control the discharge of toxics to surface waters. Chemical-specific limits provide control of known pollutants in a discharge; WET limits provide control of unknown pollutants and the aggregate effects of combined pollutants in a discharge. Both chemical-specific and WET limits are crucial to water quality-based control in California.

The California Toxics Rule (CTR) establishes chemical-specific criteria applicable to inland surface waters, enclosed bays, and estuaries. The Amendment for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California (SIP) provides procedures for implementing the criteria in National Pollutant Discharge Elimination System (NPDES) permits. The SIP also addresses toxicity control. As directed by the State Water Board, the Provisions will supersede the toxicity control provisions in the SIP to clarify the appropriate form of WET effluent limits in NPDES permits and standardize implementation in the permitting process. The Provisions also applies to Waste Discharge Requirements (WDR), storm

water permits, and the irrigated lands regulatory program, and supersedes numeric toxicity provisions in the Regional Water Board Basin Plans.

1.2 Scope of the Analysis

The California Water Code (CWC) requires the Regional Water Boards to take "economic considerations," among other factors, into account when they establish water quality objectives. In doing so, State Water Board (1999; 1994) concluded that, at a minimum, the Water Boards must analyze:

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Under the requirements of Water Code sections 13170 and 13241, subdivision (d), and the California Code of Regulations, title 23, section 3777, subdivisions (b)(4) and (c), the State Water Board must consider economics when establishing water quality objectives. This consideration of economics is not a cost-benefit analysis and, particularly with respect to the analysis required by the certified regulatory program, the State Water Board is not required to engage in speculation or conjecture and the consideration of economics should include consideration of potential costs of the reasonably foreseeable measures to comply with the Provisions.

Consistent with State Water Board (1999; 1994) guidance, this report provides analysis of whether dischargers are likely to be able to comply with the Provisions, the potential control methods to achieve compliance for dischargers that would be in violation, and the potential cost of such controls. The evaluation is based on currently available data only, and needed controls and costs reflect only incremental expenditures associated with the Provisions (not controls needed to comply with existing regulatory requirements). This analysis does not address potential benefits of the Provisions.

1.3 Organization of Report

The remainder of this report is organized as follows:

- **Section 2: Current Regulatory Framework** – describes the current applicable toxicity criteria and implementation procedures that provide the baseline for the analysis of the incremental impact of the Provisions.
- **Section 3: Proposed Provisions** – describes the toxicity control amendment.
- **Section 4: Method for Evaluating Compliance and Costs** – describes the method for evaluating compliance under the current regulatory framework and the Provisions and estimating potential incremental Provisions costs.
- **Section 5: Results of the Analysis** – provides the estimates of compliance and costs, and discusses the uncertainties associated with the estimates.
- **Section 6: References** – provides the references used in the analysis.
- **Appendix A**: Provides information on general permits referenced in developing the analysis.

2 Current Regulatory Framework

This section identifies the current framework for regulating discharges to inland surface waters, enclosed bays, and estuaries. The current regulatory framework is the baseline against which cost changes associated with the Provisions are determined. Thus, only costs that are greater or less than the costs associated with the baseline (i.e., incremental costs) would be attributable to the Provisions.

2.1 Existing Toxicity Provisions

Exhibit 2-1 shows the toxicity provisions in existing Regional Water Board Basin Plans.

Basin Plan Toxicity Provisions

Exhibit 2-1. Existing Regional Water Board Toxicity Provisions

North Coast Regional Water Quality Control Board

- All waters shall be maintained free of toxic substances in concentrations that are toxic to, or that produce detrimental physiological responses in human, plant, animal, or aquatic life.
- The survival of aquatic life in surface waters subjected to a waste discharge, or other controllable water quality factors, shall not be less than that for the same water body in areas unaffected by the waste discharge, or when necessary for other control water that is consistent with the requirements for “experimental water” as described in Standard Methods for the Examination of Water and Wastewater. As a minimum, compliance with this objective shall be evaluated with a 96-hour bioassay.
- Effluent limits based on acute bioassays of effluents will be prescribed. Where appropriate, additional numerical receiving water objectives for specific toxicants will be established as sufficient data become available, and source control of toxic substances will be encouraged.

San Francisco Bay Regional Water Quality Control Board

- All waters shall be maintained free of toxic substances in concentrations that are lethal to or that produce other detrimental responses in aquatic organisms, including but not limited to, decreased growth rate and reproductive success of resident or indicator species.
- There shall be no acute toxicity in ambient waters, defined as a median of less than 90% survival, or less than 70% survival, 10% of the time, of test organisms in a 96-hour static or continuous flow test.
- There shall be no chronic toxicity in ambient waters, defined as a detrimental biological effect on growth rate, reproduction, fertilization success, larval development, population abundance, community composition, or any other relevant measure of the health of an organism, population, or community.

- The health and life history characteristics of aquatic organisms in waters affected by controllable water quality factors shall not differ significantly from those in areas unaffected by controllable water quality factors.

Central Coast Regional Water Quality Control Board Basin Plan Toxicity Provisions

- All waters shall be maintained free of toxic substances in concentrations which are toxic to, or which produce detrimental physiological responses in, human, plant, animal, or aquatic life.
- Survival of aquatic life in surface waters subjected to a waste discharge or other controllable water quality conditions, shall not be less than that for the same water in areas unaffected by the waste discharge or, when necessary, for other control water that is consistent with the requirements for "experimental water" described in Standard Methods for the Examination of Water and Wastewater. As a minimum, compliance with this objective shall be evaluated with a 96-hour bioassay.
- Effluent limits based on acute bioassays of effluents will be prescribed; where appropriate, numeric receiving water objectives for specific toxicants will be established as sufficient data become available, and source control of toxic substances is encouraged.

Los Angeles Regional Water Quality Control Board Basin Plan Toxicity Provisions

- All waters shall be maintained free of toxic substances in concentrations which are toxic to, or which produce detrimental physiological responses in, human, plant, animal, or aquatic life.
- Survival of aquatic life in surface waters subjected to a waste discharge or other controllable water quality conditions shall not be less than that for the same water in areas unaffected by the discharge or, when necessary, for other control water.
- There shall be no acute toxicity in ambient waters, including mixing zones. The acute toxicity objective for discharges dictates that the average survival in undiluted effluent for any 3 consecutive 96-hour static or continuous flow bioassay tests shall be at least 90%, with no single test having less than 70% survival when using an established EPA, State Board, or other protocol authorized by the Regional Water Board.
- There shall be no chronic toxicity in ambient waters outside of mixing zones. To determine compliance with this objective, critical life stage tests for at least three test species with approved testing protocols shall be used to screen for the most sensitive species. The test species used for screening shall include a vertebrate, an invertebrate, and an aquatic plant. The most sensitive test species shall then be used for routine monitoring.
- Effluent limits for specific toxicants can be established by the Regional Water Board to control toxicity identified under TIEs.

Central Valley Regional Water Quality Control Board Basin Plan Toxicity Provisions

- All waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life. This objective applies regardless of whether the toxicity is caused by a single substance or the interactive effect of multiple substances.
- The survival of aquatic life in surface waters subjected to a waste discharge or other controllable water quality factors shall not be less than that for the same water in areas unaffected by the waste discharge, or, when necessary, for other control water consistent with the requirements for “experimental water” as described in Standard Methods for the Examination of Water and Wastewater. As a minimum, compliance with this objective shall be evaluated with a 96-hour bioassay.
- In addition, effluent limits based on acute biotoxicity tests of effluents will be prescribed where appropriate; additional numerical receiving water quality objectives for specific toxicants will be established as sufficient data become available; and source control of toxic substances will be encouraged.

Lahontan Regional Water Quality Control Board Basin Plan Toxicity Provisions

- All waters shall be maintained free of toxic substances in concentrations that are toxic to, or that produce detrimental physiological responses in human, plant, animal, or aquatic life.
- The survival of aquatic life in surface waters subjected to a waste discharge, or other controllable water quality factors, shall not be less than that for the same water in areas unaffected by the waste discharge, or when necessary, for other control water consistent with the requirements for “experimental water” as defined in Standard Methods for the Examination of Water and Wastewater.
- For acute toxicity, compliance shall be determined by short-term toxicity tests on undiluted effluent using an established protocol.
- For chronic toxicity, compliance shall be determined using the critical life stage toxicity tests. At least three approved species shall be used to measure compliance with the toxicity objective: a vertebrate, an invertebrate, and an aquatic plant. After an initial screening period, monitoring may be reduced to the most sensitive species.

Colorado River Regional Water Quality Control Board Basin Plan Toxicity Provisions

- All waters shall be maintained free of toxic substances in concentrations which are toxic to, or which produce detrimental physiological responses in, human, plant, animal, or indigenous aquatic life.
- Effluent limits based on bioassays of effluent will be prescribed where appropriate, additional numerical receiving water objectives for specific toxicants will be established as sufficient data become available, and source control of toxic substances will be encouraged.
- The survival of aquatic life in surface waters subjected to a waste discharge or other controllable water quality factors, shall not be less than that for the same water in areas unaffected by the waste discharge, or other control water which is consistent

with the requirements for “experimental water” as described in Standard Methods for the Examination of Water and Wastewater. As a minimum, compliance with this objective shall be evaluated with a 96-hour bioassay.

Santa Ana Regional Water Quality Control Board Basin Plan Toxicity Provisions

- Toxic substances shall not be discharged at levels that will bioaccumulate in aquatic resources to levels which are harmful to human health.
- The concentrations of toxic substances in the water column, sediments, or biota shall not adversely affect beneficial uses.
- The Regional Water Board requires the initiation of a TRE if a discharge consistently exceeds its chronic toxicity effluent limit. The Regional Water Board, to date, has interpreted the “consistently exceeds” trigger as the failures of three successive monthly toxicity tests, each conducted on separate samples. Initiation of a TRE has also been conditioned on a determination that a sufficient level of toxicity exists to permit effective application of the analytical techniques required by a TRE.

San Diego Regional Water Quality Control Board Basin Plan Toxicity Provisions

- All waters shall be maintained free of toxic substances in concentrations that are toxic to, or that produce detrimental physiological responses in human, plant, animal, or aquatic life.
- The survival of aquatic life in surface waters subjected to a waste discharge or other controllable water quality factors, shall not be less than that for the same water in areas unaffected by the waste discharge or, when necessary, for other control water consistent with requirements specified in EPA, State Water Board, or other protocol authorized by the Regional Water Board. As a minimum, compliance with this objective shall be evaluated with a 96-hour acute bioassay.
- Effluent limits based on acute bioassays of effluents will be prescribed where appropriate, additional numerical receiving water objectives for specific toxicants will be established as sufficient data become available, and source control of toxic substances will be encouraged.

TIE = Toxicity identification evaluation
TRE = Toxicity reduction evaluation

In addition, the provisions in the SIP supplement Basin Plan requirements; they do not supersede existing Regional Water Board toxicity requirements.

The SIP contains minimum chronic toxicity control requirements for implementing the narrative toxicity objectives for aquatic life protection contained in Regional Water Board Basin Plans. Under the SIP, Regional Water Boards impose chronic toxicity limits for discharges that have the reasonable potential to cause instream chronic toxicity. Compliance with toxicity objectives and limits is determined through short-term chronic toxicity tests performed on at least three test species (a plant, an invertebrate, and a

vertebrate) during a screening period, after which the most sensitive species can be used alone.

If a discharge causes or contributes to chronic toxicity in a receiving water body, the SIP requires that dischargers perform a toxicity reduction evaluation (TRE) study, which may include a toxicity identification evaluation (TIE). The TRE study is used to identify the sources of toxicity, after which the discharger must take all reasonable steps necessary to eliminate the toxicity. Permit writers should then assign chemical-specific permit limits for pollutants identified by the TRE. Failure to comply with required toxicity testing and TRE studies within a designated period will result in the addition of chronic toxicity limits in the permit or appropriate enforcement action.

2.2 Affected Dischargers

The types of discharges potentially affected by the Provisions include NPDES-permitted dischargers (e.g., municipal and industrial dischargers, storm water dischargers) as well as some dischargers subject to WDRs (e.g., agriculture, non-point source dischargers).

2.2.1 Municipal and Industrial Wastewater Dischargers

In municipal wastewater effluents, toxicity has been attributed to several chemicals commonly found in or added during treatment including chlorine used for disinfection, and ammonia produced from the breakdown of organic substances (SETAC, 2004; Norberg-King, et al., 2005). Indirect industrial or commercial dischargers may also contribute to effluent toxicity if discharging toxic chemicals in violation of pretreatment limits or that are not removed with conventional wastewater treatment controls. In addition, toxicity may result from household chemicals that are improperly disposed of down the drain, including organic solvents and pesticides or commonly used soaps and detergents that can be highly toxic if inadequately treated prior to discharge.

In industrial wastewater, effluent toxicity can result from the use of chemicals known as biocides (e.g., chlorine) added to control nuisance biological growth in plumbing or cooling water systems (SETAC, 2004; Norberg-King, et al., 2005). Also, ions such as potassium, magnesium, and calcium can be toxic when the ions are added or taken out of water during various industrial processes (Goodfellow et al., 2000; SETAC, 2004; Norberg-King, et al., 2005). Industrial chemicals or byproducts, if not treated properly, can cause effluent toxicity as well.

Most pollutants in the effluents of municipal and industrial wastewater treatment facilities that may cause instream acute or chronic toxicity are currently regulated through the NPDES permit program. However, effluents may still be toxic despite compliance with existing permit limits due to interactions of regulated pollutants as well as the presence of unregulated pollutants (alone or in combination).

There are 325 individually permitted facilities (not including storm water) that discharge to inland surface waters, enclosed bays, and estuaries in California. Of these facilities, 190 are municipal wastewater treatment plants and the remaining 135 facilities are

other types of dischargers, including industrial facilities. Data in the California Integrated Water Quality System (CIWQS) database indicate that most individual permittees have effluent limits and/or monitoring requirements for acute and/or chronic toxicity in their NPDES permits. General permits provide coverage for 1,000 dischargers and, of these, 471 have WET monitoring requirements included in their permits (SWRCB, 2019).

2.2.2 Storm Water Dischargers

Regional Water Boards regulate most storm water discharges under general permits. General permits often require compliance with standards through an iterative approach based on storm water management plans (SWMP), rather than through the use of numeric effluent limits. In other words, permittees implement management practices and best management practices (BMPs) identified in their SWMPs. Then, if those BMPs do not result in attainment of water quality standards, Regional Water Boards would require additional practices until pollutant levels are reduced to the necessary levels. Because Regional Water Boards use this iterative approach that increases requirements until water quality objectives are met, current levels of implementation may not reflect the maximum level of control required to meet existing standards. The State Water Board has four existing programs for controlling pollutants in storm water runoff to surface waters: municipal, industrial, construction, and California Department of Transportation (Caltrans).

Municipal

The State Water Board's municipal program regulates storm water discharges from municipal separate storm sewer systems (MS4s). The MS4 permits require the discharger to develop and implement a SWMP, with the goal of reducing the discharge of pollutants to the maximum extent practicable (MEP). MEP is the performance standard specified in Section 402(p) of the CWA. The management programs specify BMPs addressing public education and outreach; illicit discharge detection and elimination; construction and post-construction; and good housekeeping. In general, medium and large municipalities must conduct chemical monitoring, but not small municipalities.

Larger MS4s usually represent a group of co-permittees encompassing an entire metropolitan area. There are 21 area-wide medium and large MS4 permitted discharges in California that discharge, at least in part, to inland waters, enclosed bays, or estuaries (SWRCB, 2016). Some of the permittees monitor chronic and/or acute toxicity in receiving waters; others monitor specific pollutants identified as causing toxicity (e.g., pyrethroids, diazinon and chlorpyrifos). **Exhibit 2-2** shows existing toxicity requirements in permits for large and medium MS4s as of May 2016. Permit requirements may have changed since that date.

Exhibit 2-2. Toxicity Requirements in Large and Medium MS4 Permits[1]

Region	Name (NPDES Number, Permit Number	Requirements
1	County of Sonoma, City of Cloverdale, City of Cotati, City of Healdsburg, City of Rohnert Park, City of Santa Rosa, City of Sebastopol, Sonoma County Water Agency, City of Ukiah, Town of Windsor (CA0025054; R1 2015 0030)	Chronic tests twice per year during storm events, three locations in receiving waters and downstream from discharge outfalls; test species shall be *Pimephales promelas*, *Ceriodaphnia dubia*, and *Selenastrum capricornutum*.
2	San Francisco Bay Regional (CAS612008; R2 2015 0049)	The permittees shall collect a minimum of 6.2 samples per year during the dry season, and 4.21 samples per year during wet weather. All samples shall be analyzed for *Selenastrum* growth and *Ceriodaphnia* and *Pimephales* with lethal and sublethal endpoints; *Hyalella azteca* and *Chironomus dilutus* for lethal endpoint.
3	City of Salinas (CA0049981; R3-2012-0005)	Monitoring background and receiving water sites for chronic toxicity once during the first runoff of the wet season, and once during dry weather for *Ceriodaphnia dubia*, *Pimephales promelas*, and *Selenastrum capricornutum*. If receiving water samples are toxic, the permittee shall conduct a TIE.

[1] The minimum sample number is reported fractionally due to a 1/5 years sampling frequency required at on sampling site.

Region	Name (NPDES Number, Permit Number	Requirements
4	Long Beach (CAS004003; R4-2014-0024)	Monitoring shall occur a minimum of twice per year, with one sample collected during the first rainfall, and once per month during the month with the historically lowest flows. For freshwaters, multiple species toxicity testing (*Pimephales promelas*, *Ceriodaphnia dubia*, and *Selenastrum capricornutum*) is required. For marine and estuarine waters, multiple species toxicity testing (*Atherinops affinis*, *Dendraster excentricus*, and *Macrocystis pyrifera*) is required and TRE/IE studies.
4	County of Los Angeles (CAS004001; R4 2012 0175)	Monitoring shall occur a minimum of twice per year, with one sample collected during the first rainfall, and once per month during the month with the historically lowest flows. For freshwaters, multiple species toxicity testing (*Pimephales promelas*, *Ceriodaphnia dubia*, and *Selenastrum capricornutum*) is required. For marine and estuarine waters, multiple species toxicity testing (*Atherinops affinis*, *Dendraster excentricus*, and *Macrocystis pyrifera*) is required and TRE/IE studies.

Region	Name (NPDES Number, Permit Number	Requirements
4	Ventura County (CAS004002; R4 2010 0108)	Toxicity monitoring twice during the first year of the permit term (once in the wet season and once in the dry season), and once during the first storm event of the wet season for the following four years. During the first year, toxicity testing will be performed using three-species testing and the most sensitive species in the following years. For freshwaters, multiple species toxicity testing (*Pimephales promelas*, *Ceriodaphnia dubia*, and *Selenastrum capricornutum*) is required. For marine and estuarine waters, multiple species toxicity testing (*Atherinops affinis*, *Dendraster excentricus*, and *Macrocystis pyrifera*) is required. A TIE must be performed when significant toxicity is present.
5	Bakersfield-Kern County (CA00883399; R5 2013 0153 01)	Narrative receiving water limit and for the development and implementation of a stormwater management plan containing; no specific toxicity monitoring requirements.
5	Contra Costa Clean Water (CA083313; R5-2010-0102)	Toxicity monitoring twice per year with one event during dry season and one event during a storm event at a minimum of two sites. If toxicity results < 50% of control results, repeat sample. If 2nd sample yields < 50% of control results, conduct a TRE.
5	Fresno (CA0083500; R5-2013-0080)	Narrative receiving water limit; no specific toxicity monitoring requirements.

Region	Name (NPDES Number, Permit Number	Requirements
5	Modesto (CAS083526; R5-2015-0025)	Chronic toxicity monitoring during two storm events and one dry weather monitoring event using *Pimephales promelas* and *Ceriodaphnia dubia*. If 100% mortality is detected, must conduct dilution series; if statistically significant toxicity is detected and a greater than or equal to 50% increase in either mortality, or reduction in reproduction compared to the control is observed, then TIEs shall be conducted on the initial sample that caused toxicity.
5	Port of Stockton (CAS084077; R5-2011-0005)	Chronic toxicity monitoring of *Pimephales promelas* and *Ceriodaphnia dubia*. If 100% mortality is detected, must conduct dilution series; if statistically significant toxicity is detected, then TIEs shall be conducted on the initial sample that caused toxicity.
5	Sacramento (CAS082597; R5-2015-0023)	Conduct toxicity testing at each receiving water station during two of the five fiscal years of the Order including samples from two storm events and one during the dry season from each receiving water station; species should be *Pimephales promelas* and *Ceriodaphnia dubia*. If 100% mortality is detected within 24 hours of test initiation, then a dilution series shall be initiated. If statistically significant toxicity is detected and there is more than a 50% increase in mortality compared to the laboratory control, then TIEs shall be conducted; a TRE shall be conducted whenever a toxicant is successfully identified through the TIE.

Region	Name (NPDES Number, Permit Number	Requirements
5	Stockton and San Joaquin County (CAS083470; R5-2015-0024)	Conduct toxicity testing at each receiving water station annually including samples from two storm events and one during the dry season from each receiving water station; species should be *Pimephales promelas* and *Ceriodaphnia dubia*. If 100% mortality is detected within 24 hours of test initiation, then a dilution series shall be initiated. If statistically significant toxicity is detected and there is more than a 50% increase in mortality compared to the laboratory control, then TIEs shall be conducted; a TRE shall be conducted whenever a toxicant is successfully identified through the TIE.
6	South Lake Tahoe, El Dorado and Placer County (CAG616001; R6T-2011-0202A1)	No toxicity provisions.
7	Riverside County Flood Control and Water Conservation District (CAS617002, R8-2013-0011)	No toxicity provisions.
8	Orange County (CAS618030; R8-2009-0030 as amended by R-2010-0062)	*Ceriodaphnia dubia* and *Dendraster excentricus* shall be used to evaluate toxicity from the first rain event, plus one other wet weather sample and two dry weather samples; TIEs and TREs if monitoring indicates studies are needed.

Region	Name (NPDES Number, Permit Number	Requirements
8	Riverside County (CAS618033; R8-2010-0033)	*Ceriodaphnia dubia*, *Pimephales promelas*, and *Selenastrum capricornutum* shall be used to evaluate toxicity on the sample from the first rain event, plus one other wet weather sample. In addition, where applicable, collect two dry weather samples or propose equivalent procedures in the CMP. Identify criteria which will trigger the initiation of TIEs and TREs.
8	San Bernardino County (CAS618036; R8-2010-0036)	Collect a minimum of one sample per year during the dry weather index period using *Ceriodaphnia dubia* or *Hyalella azteca* if conductivity is too high for survival of control organisms.
9	Orange County (CAS108740; R9-2013-0001 as amended by R9 2015 0001)	During the term of the permit, the permittee must sample during at least three dry weather events and at least three wet weather events at each monitoring station. Monitoring shall encompass three species testing for freshwaters (*Pimephales promelas*, *Ceriodaphnia dubia*, and *Selenastrum capricornutum*) and one species testing for marine and estuarine waters (*Dendraster excentricus*).
9	Riverside County (CAS108766;	The Permittees shall analyze all storm samples (at least three annually) using three species: *Ceriodaphnia dubia* (water flea); *Hyalella azteca* (freshwater amphipod); and *Pseudokirchneriella subcapitata*, (unicellular algae). TIEs shall be used to determine the cause of toxicity, and TREs shall be used to identify sources and implement management actions to reduce pollutants in urban runoff causing toxicity.

Region	Name (NPDES Number, Permit Number	Requirements
9	San Diego (CAS108758)	The following toxicity testing shall be conducted for each monitoring event at each station as follows: (1) chronic test with *Ceriodaphnia dubia* (2) chronic test with the freshwater algae *Selenastrum capricornutum* (3) Acute survival test with amphipod *Hyalella azteca*. TIEs shall be conducted to determine the cause of toxicity.

CMP = Coordinated Monitoring Program
NPDES = National Pollutant Discharge Elimination System
RMP = Regional Monitoring Program
SFEI = San Francisco Estuary Institute
TIE = Toxicity identification evaluation
TRE = Toxicity reduction evaluation
TU = toxicity unit (chronic or acute)
1. Permits at http://www.swrcb.ca.gov/water_issues/programs/stormwater/phase_i_municipal.shtml . Accessed May 2016.

The State Water Board adopted a Phase II MS4 general permit for smaller municipalities, including nontraditional small MS4s such as military bases, public campuses, and prison and hospital complexes. Few of these permittees currently monitor for toxicity as part of their SWMPs.

Industrial

Under the industrial program, the State Water Board issues a general NPDES permit that regulates discharges associated with ten broad categories of industrial activities. This general permit requires the implementation of management measures that will achieve the performance standard of best available technology economically achievable (BAT) and best conventional pollutant control technology (BCT). The permit also requires that dischargers develop a Storm Water Pollution Prevention Plan (SWPPP) and a monitoring plan. Through the SWPPP, dischargers are required to identify sources of pollutants, and describe the means to manage the sources to reduce storm water pollution. For the monitoring plan, facility operators may participate in group monitoring programs to reduce costs and resources.

Construction

The construction program requires dischargers whose projects disturb one or more acres of soil or whose projects disturb less than one acre but are part of a larger common plan of development that in total disturbs one or more acres to obtain coverage under the storm water general permit for construction activity. The construction general permit requires the development and implementation of a SWPPP that lists BMPs the discharger will use to protect storm water runoff and the placement of those BMPs. Additionally, the SWPPP must contain a visual monitoring program; a chemical monitoring program for nonvisible pollutants to be implemented if there is a failure of BMPs; and a sediment monitoring plan if the site discharges directly to a water body impaired for sediment.

The permit also contains specific toxicity provisions for active treatment system dischargers. Any of these dischargers operating in batch treatment mode must initiate acute toxicity testing using *Pimephales promelas* or *Oncorhynchus mykiss* for effluent samples representing effluent from each batch prior to discharge. The permit does not contain specific toxicity requirements for any other discharger types.

Caltrans

Caltrans is responsible for the design, construction, management, and maintenance of the state highway system, including freeways, bridges, tunnels, Caltrans' facilities, and related properties. Before July 1999, storm water discharges from Caltrans' storm water systems were regulated by individual NPDES permits issued by the Regional Water Boards. On September 19, 2012, the State Water Board issued a statewide permit (Order No. 2012-0011-DWQ) which regulated all storm water discharges from Caltrans-owned MS4s, maintenance facilities, and construction activities.

The existing permit allows Caltrans to implement BMPs rather than require compliance with numeric effluent limits. The BMPs must reflect pollutant reduction based on either MEP (MS4s) or BAT/BCT (construction activities), whichever is applicable. In addition, if receiving water quality standards are exceeded, Caltrans is required to submit a written report providing additional BMPs or other measures to be taken that will be implemented to achieve water quality standards. The permit requires Caltrans to develop and implement a SWMP describing the procedures and practices used to reduce or eliminate the discharge of pollutants to storm drainage systems and receiving waters and includes discharge monitoring requirements for acute and chronic whole effluent toxicity.

2.3 Irrigated Lands and Agriculture

Agricultural activities that may affect aquatic life can be caused by farming activities that cause excessive erosion, resulting in sediment entering receiving waters; improper use and over application of pesticides, fertilizers, and soil amendments; and over application of irrigation water resulting in runoff of sediments, nutrients, and pesticides.

Potential sources of funding for agricultural water quality programs include:

- Private financing by individual sources;
- Bonded indebtedness or loans from government institutions;
- Surcharge on water deliveries to lands contributing to the drainage problem;
- Ad Valorem tax on lands contributing to the drainage problem;
- Taxes and fees levied by a district created for the purpose of drainage management;
- State or federal grants or low-interest loan programs such as:
    - U.S. Department of Agriculture Environmental Quality Incentive Program grants, administered by the Natural Resources Conservation Service;
    - Consolidated grant program administered by the State Water Resources Control Board, including Proposition 40 grants, 319 NPS Implementation Program grants, and Proposition 50 CalFed Watershed Program;
    - State Revolving Fund Loan program for non-point source (NPS) pollution; and
- Single purpose appropriations from federal or state legislative bodies (including land retirement programs).

Agricultural dischargers do not receive NPDES permits because irrigated agriculture is exempt from the Federal Clean Water Act NPDES Program. In California, the Water Boards regulate discharges from irrigated land including storm water runoff, irrigation tailwater, and tile drainage through WDRs or waivers of WDRs. CWC Section 13269 allows the Regional Water Boards to conditionally waive WDRs if it is in the public interest.

Most historical waivers require that discharges not cause violations of water quality objectives, but do not require water quality monitoring. In 1999, Senate Bill 390

amended CWC Section 13269 and required Regional Water Boards to review and renew waivers that include requirement/conditions set by SB 390, or replace the waivers with WDRs by January 1, 2003; otherwise, the waivers expired.

Of the nine Regional Water Boards, seven have adopted either WDRs or Conditional Waivers. The North Coast and Lahontan Regional Water Boards are in the development process. To comply with the WDR or Conditional Waiver, irrigated agricultural dischargers monitor water quality, implement best management practices, implement corrective actions as needed to protect water quality, and participate in multi-agency partnership demonstration projects. There are significant differences in the regulatory approaches for irrigated agriculture due to Regional Water Board discretion in approving proposals for approaches to protect water quality. Some of these differences can be attributed to varying water quality threats posed by the diverse agricultural operations around the state. Other differences can be explained by the need for more stringent requirements to protect vulnerable or impaired receiving waters.

On February 7, 2018, the State Water Board adopted Order WQ 2018-0002 (East San Joaquin or ESJ Order). The ESJ Order modifies the petitioned Central Valley Regional Board Waste Discharge Requirements General Order No. R5-2012-0116 for Growers Within the Eastern San Joaquin River Watershed that are Members of the Third-Party Group. Many of the provisions in the ESJ Order implement the conclusions of an agricultural expert panel that made recommendations to the State Water Board on an appropriate regulatory program for irrigated lands in September 2014 (Agriculture Expert Panel). The ESJ Order provides direction for development and implementation of the program by including precedential requirements to be incorporated in all Irrigated Lands Regulatory Program (ILRP) orders statewide.

The ILRP began implementation in 2003 to address agricultural runoff discharging to surface and groundwater. The program requires the development of WDRs or waivers, outreach for enrollment, reporting, and regular inspections.

The Regional Water Boards have developed the program at different times through the years. Some Regional Water Boards may currently be focusing on program enrollment, while others have advanced to focus on implementing orders with a focus on reducing risk to water quality from agricultural operations. Exhibit 2-3 summarizes regional implementation as of June 2019.

Exhibit 2-3. Irrigated Lands Regulatory Program Implementation by Regional Water Boards

Regional Water Boards	Year First Implemented	Estimated Acres of Agriculture	Primary Commodities
Region 1 – North Coast Region	Pending	270,000	Grapes, lily bulbs, potatoes, alfalfa

Regional Water Boards	Year First Implemented	Estimated Acres of Agriculture	Primary Commodities
Region 2 – San Francisco Bay Region	2018	53,000	Wine grapes
Region 3 – Central Coast Region	2003	439,000	Lettuce, celery, broccoli, cabbage, strawberries
Region 4 – Los Angeles Region	2005	96,000	Fruit, nuts, nursery stock, cut flowers, vegetables
Region 5 – Central Valley Region	2003	6,200,000	Almonds, rice, tomatoes, alfalfa, grapes
Region 6 – Lahontan Region	Pending	220,000	Alfalfa, managed wetlands, grains, pistachios, wild rice
Region 7 – Colorado River Basin	2012	606,000	Dates, celery, other vegetables
Region 8 – Santa Ana Region	2016	46,000	Citrus, wheats, various
Region 9 – San Diego Region	2017	70,000	Nursery, cut flowers, avocado, citrus, nuts

In February 2018, the State Resources Water Control Board (State Water Board) adopted WQO-2018-0002 in response to petitions filed against an order issued to the Eastern San Joaquin Coalition by the Central Valley Water Regional Water Board. The order issued by the State Water Board included several requirements that are precedential for all orders in the ILRP, with a deadline of five years for the Regional Water Boards to include the precedential requirements in their agricultural orders.

The North Coast Regional Water Board has no approved coalition. The only permit currently being developed is for vineyards and orchards. Current agricultural conditional waivers for dairies and the Scott and Shasta TMDL do not have toxicity testing

requirements. Other agricultural orders are in development and assessment phase, and requirements for the 3 species toxicity testing will be based on the results of monitoring data assessment.

The San Francisco Regional Water Board ILRP has approved four Third-Party Groups. The Third-Party Groups will be focused primarily on helping farmers to prepare and implement farm plans to meet performance standards for discharge. It is possible at a future date, that one or more, may also provide the service of collecting and submitting permit fees. Region 2 Order for vineyard properties does not include toxicity monitoring/testing requirements.

The Central Coast Regional Water Board's waiver requires monitoring focused on nutrients and toxicity. Toxicity testing is used to determine if applied pesticides and other constituents are impacting beneficial uses. More detailed characterization, involving additional toxicity testing, chemical analysis, analysis of pesticide application data, and/or TIEs are required as necessary in areas where toxicity problems are documented (CCRWQCB, 2012). Receiving water toxicity monitoring requirements include: water column toxicity to Ceriodaphnia dubia. (water flea); water column toxicity to *Pimephales promelas* (fathead minnow); water column toxicity to *Selenastrum capricornutum* (algae); and sediment toxicity to *Hyalella azteca*.

The Los Angeles Regional Water Board's conditional waiver requires chronic toxicity testing be conducted for three test species: *Pimephales promelas* (fathead minnow), *Ceriodaphnia dubia* (water flea) and *Selenastrum capricornutum* (green algae). Based on the test results, the dischargers select the most sensitive species for subsequent toxicity monitoring and document its rationale in its annual monitoring report. If toxicity tests indicate the presence of significant toxicity in the sample, TIE procedures have to be initiated to investigate the cause of toxicity. Chronic toxicity testing is required for both Ventura and Los Angeles counties within the Los Angeles Region, but the TIE is required just for Ventura County. Sediment toxicity testing is required by one TMDL in a small watershed in Ventura County.

Central Valley Regional Water Board has adopted several coalition-based WDRs which require receiving water toxicity monitoring. These requirements include: water column toxicity to Ceriodaphnia dubia (water flea); water column toxicity to *Pimephales promelas* (fathead minnow); water Column toxicity to *Selenastrum capricornutum* (algae); and sediment toxicity to *Hyalella azteca*. If toxicity tests indicate the presence of significant toxicity in the sample, TIE procedures have to be initiated to investigate the cause of toxicity.

The Lahontan Water Board May include toxicity testing upon adoption of an Agricultural Order.

The Colorado River Basin Regional Water Board has adopted watershed based WDRs. The WDRs require chronic toxicity tests for *Pimephales promelas* (fathead minnow); *Ceriodaphnia dubia* (water flea); and *Selenastrum capricornutum* (green algae).

The Santa Ana Water Board has adopted a Conditional Waiver that requires the installation of BMPs to address impacts to the receiving water that includes toxicity.

The San Diego Regional Water Board adopted a WDR to regulate irrigated agricultural land. The WDR requires chronic toxicity testing be conducted for three test species: *Pimephales promelas* (fathead minnow), *Ceriodaphnia dubia* (water flea) and *Selenastrum capricornutum* (green algae). Based on the test results, the dischargers select the most sensitive species for subsequent toxicity monitoring and document its rationale in its annual monitoring report. If toxicity tests indicate the presence of significant toxicity in the sample, TIE) procedures have to be initiated to investigate the cause of toxicity. It should be noted that final requirements may be revised and are subject to final Board adoption. Exhibit 2-5 summarizes baseline regional toxicity monitoring programs for agricultural dischargers.

Exhibit 2-4. Regional Agricultural Toxicity Monitoring Programs

Region 3 (Central Coast)

- Conduct the following water column toxicity tests for each site, twice in the dry season and twice in the wet season: (1) 4-day test with the algae *Selenastrum capricornutum* (2) 7-day chronic test with the water flea *Ceriodaphnia* (3) 7-day chronic test with the fathead minnow *Pimephales promelas*. At sites where persistent unresolved toxicity is found, the Executive Officer may require a TIE.
- Schedule toxicity tests once during the wet season and once during the dry season.
- At sites where persistent unresolved toxicity is found, the Executive Officer may require concurrent toxicity and chemical analyses and a TIE to identify the individual discharges causing of the toxicity.

Region 4 (Los Angeles)

- Conduct chronic toxicity tests for the three test species: (1) fathead minnow, *Pimephales promelas* (2) water flea, *Ceriodaphnia* (3) green algae, *Selenastrum capricornutum*. After one toxicity sample has been collected and analyzed in the first year, the most sensitive species is to be selected for subsequent toxicity monitoring.
- Schedule toxicity tests once during the wet season and once during the dry season.
- Annual monitoring consisting of 4 sampling events: 2 in the dry season and 2 in the wet season.
- If a 50% or greater difference in *Ceriodaphnia dubia* or *Pimephales promelas* mortality, or a 50% or greater reduction in *Selenastrum capricornutum* growth, as compared to the laboratory control, is detected at any time in an acceptable test, a TIE is required.

Region 5 (Central Valley)

- Conduct water column toxicity tests for the following species: (1) *Ceriodaphnia dubia* (2) *Pimephales promelas* (3) *Selenastrum capricornutum*.
- If a 50% or greater difference in *Ceriodaphnia dubia* or *Pimephales promelas* mortality, or a 50% or greater reduction in *Selenastrum capricornutum* growth, as compared to the laboratory control, is detected at any time in an acceptable test, a TIE is required within 48 hours.
- If within the first 96 hours of the initial toxicity screening, the mortality reaches 100%, initiate a multiple dilution test. The dilution series must be initiated within 24 hours of the sample reaching 100% mortality, and must include a minimum of five (5) sample dilutions in order to quantify the magnitude of the toxic response.
- Daily sample water renewals shall occur during all acute toxicity tests to minimize the effects of rapid pesticide losses from test waters.
- A feeding regime of 2 hours prior to test initiation and 2 hours prior to test renewal shall be applied.
- If more than one exceedance of the same parameter at the same location occurs within a three-year period, then a schedule for Management Plan development and implementation shall be provided to the Regional Water Board staff within 10 business days.

SWAMP = Surface Water Ambient Monitoring Program
TIE = Toxicity Identification Evaluation

3 Description of the Provisions

This section summarizes the toxicity Provisions (July 25, 2019 first revised draft version of the Provisions) which supersedes any Basin Plan provisions for the same waters to the extent of any conflict. The Provisions does not supersede the narrative toxicity objectives established in the Basin Plans.

The following sections generally summarize the Provisions. Please refer to the Provisions for specific requirements.

3.1 Objectives

The Provisions establishes toxicity objectives applicable to all inland surface waters, enclosed bays, and estuaries to protect aquatic life.

3.1.1 Chronic Toxicity

The chronic toxicity objective is expressed as a null hypothesis and a regulatory management decision (RMD) of 0.75 for chronic toxicity methods, where the following null hypothesis shall be used:

H_o: Mean response (ambient water) < 0.75 • mean response (control)

Attainment of the water quality objective is demonstrated by rejecting this null hypothesis in accordance with the Test of Significant Toxicity (TST) statistical approach. Chronic aquatic toxicity generally refers to longer exposure duration and measures of both lethal and sub-lethal adverse response.

3.1.2 Acute Toxicity

The acute toxicity objective is expressed as a null hypothesis and an RMD of 0.80 for acute toxicity methods, where the following null hypothesis shall be used:

H_o: Mean response (ambient receiving water) < 0.80 • mean response (control)

Attainment of the water quality objective is demonstrated by rejecting this null hypothesis in accordance with the TST statistical approach. Acute aquatic toxicity refers to adverse response (typically lethality) from a short-term exposure.

3.2 Implementation Procedures

The Provisions establishes a program of implementation used to assess whether ambient water meets the numeric aquatic toxicity water quality objectives, whether a permitting authority shall require aquatic toxicity effluent limitations for non-storm water NPDES dischargers, and whether dischargers' effluent complies with permit terms. The program of implementation also describes requirements for storm water dischargers and nonpoint source dischargers.

3.2.1 Species Sensitivity Screening

The Provisions generally requires continuous dischargers to conduct a minimum of four sets of WET tests for purposes of chronic species sensitivity screening— with one set of tests conducted in each quarter of a year—for each species, either prior to, or within 18 months after the first permit issuance and reissuance, or reopening (if the permit reopening is to address toxicity requirements) of the permit after the effective date of toxicity provisions. The Provisions requires non-continuous dischargers to conduct a minimum of two sets of tests within one year, with a set of testing conducted in each quarter in which there is expected to be at least 15 days of discharge. For both continuous and non-continuous dischargers, the Permitting Authority, which is often the Regional Water Board, may allow use of a species sensitivity screening conducted prior to the effective date of the Provisions if the species sensitivity screening is conducted in accordance with Section IV.B.2.a of the Provisions. Chronic aquatic toxicity test species must, at a minimum, include one aquatic plant, one vertebrate, and one invertebrate. The Regional Water Boards may require a species sensitivity screening for chronic toxicity prior to every subsequent permit issuance and reissuance, or reopening (if the permit reopening is to address toxicity requirements). At a minimum, a species sensitivity screening shall be required no less than once every 10 years.

The Permitting Authority may require non-storm water NPDES dischargers to conduct a species sensitivity screening for acute aquatic toxicity.

3.2.2 Reasonable Potential

Except for POTW dischargers who are authorized to discharge at a rate equal to or greater than 5 million gallons per day (MGD), all non-storm water NPDES dischargers are required to conduct a reasonable potential analysis for chronic toxicity prior to every permit issuance, reissuance, or reopening (if the permit reopening is to address toxicity requirements). POTW dischargers who are authorized to discharge at a rate equal to or greater than 5 MGD, are not required to conduct a reasonable potential analysis since the Regional Water Boards are required to establish chronic toxicity limitations for these dischargers.

The Regional Water Board may require non-storm water NPDES dischargers to conduct a reasonable potential analysis for acute toxicity prior to every permit issuance, reissuance, or reopening (if the permit reopening is to address toxicity requirements).

Under the Provisions, a non-storm water NPDES discharger is considered to have reasonable potential to cause or contribute to an excursion above the chronic or acute toxicity water quality objectives, respectively, if any chronic or acute test analyzed using the TST results in a “fail” at the instream waste concentration (IWC) or if a chronic or acute test has a percent effect greater than 10 percent at the IWC. The percent effect is calculated as the difference between the mean control response and the mean response at the IWC divided by the mean control response. Other information (e.g., fish

die-off observation, existing data on toxic pollutants) may be also be used to make a reasonable potential determination.

3.2.3 Effluent Limits

The Provisions requires that Regional Water Boards apply the objectives for chronic aquatic toxicity directly in permits as numeric limits expressed as a maximum daily effluent limitation (MDEL), and a median monthly effluent limitation (MMEL) for dischargers with reasonable potential. If reasonable potential is demonstrated for chronic toxicity, or if the discharger is a POTW discharger authorized to discharge 5 MGD or more, then chronic toxicity effluent limitations shall be established. In addition, if reasonable potential is found for acute toxicity, then the Regional Water Boards shall establish an MDEL and MMEL for acute toxicity.

A MDEL is an effluent limit based on the outcome of the TST statistical approach and the percent effect. For chronic toxicity, the MDEL is violated when a chronic toxicity test, using the TST, results in a fail at the IWC, and the percent effect for the survival endpoint is equal to or greater than 50%. If the most sensitive species chronic toxicity test does not include a lethal endpoint then the MDEL is violated when a chronic toxicity test results in a fail for any endpoint at the IWC, with a percent effect for that endpoint of greater than or equal to 50%. For acute toxicity, the MDEL is violated when a most sensitive species test at the IWC results in a fail for the survival endpoint with a percent effect for the survival endpoint of greater than or equal to 50%.

The MMEL is an effluent limit based on the median TST statistical results of three independent toxicity tests taken within the same calendar month. The MMEL is violated when the median TST result (two tests within a calendar month) result in a fail at the IWC.

3.2.4 Mixing Zones

The Regional Water Board may grant mixing zones and dilution credits to dischargers in accordance with Section 1.4.2 of the *Policy for Implementation of Toxics Standards for Inland Surface Water, Enclosed Bays, and Estuaries of California* (2005). Allowance of a mixing zone is discretionary. If a Regional Water Board grants a mixing zone, compliance with the objectives for toxicity shall be met at the edge of the authorized mixing zone. The permitting authority shall not grant a mixing zone for acute toxicity.

When a mixing zone and dilution credit is granted by the Regional Water Board, the IWC is the concentration of effluent in the receiving water after mixing (i.e., the inverse of one plus the dilution credit; IWC = 1/ (1 + D)) as determined by the Regional Water Board. The Regional Water Board may set the IWC at a concentration of effluent greater than the inverse of one plus the dilution credit in order to protect beneficial uses, or because of site-specific conditions. However, the IWC should not be established at a level less than the inverse of one plus the dilution credit. If no dilution credit is granted for toxicity, then the undiluted effluent shall be used as the IWC.

3.2.5 Routine Monitoring

The Provisions requires POTW dischargers authorized to discharge at a rate greater than or equal to 5 MGD and other non-storm water NPDES dischargers with reasonable potential to conduct routine chronic aquatic toxicity monitoring using the most sensitive species. The chronic and acute toxicity methods manuals required by the Provisions specify that chronic and acute toxicity tests include five concentrations of test water sample compared to the control. However, the dischargers or laboratories may receive an approved alternative test procedure. The number of concentrations approved in an alternative test procedure may vary, but tests must include a minimum of one test concentration at the IWC and a control.

POTW dischargers authorized to discharge at a rate greater than or equal to 5 MGD and other non-storm water NPDES dischargers with reasonable potential, that are authorized to discharge at a rate of greater than or equal to 5 MGD, must conduct monthly routine monitoring for chronic toxicity in every month in which there is expected to be at least 15 days of discharge.

Non-storm water NPDES dischargers authorized to discharge less than 5 MGD, with reasonable potential, must conduct quarterly routine monitoring for chronic toxicity in every quarter in which there is expected to be at least 15 days of discharge.

If required, dischargers shall also conduct acute toxicity monitoring at intervals determined by the applicable Water Board, but no less than once per calendar year. Water Boards also may, at their discretion, require periodic monitoring for chronic or acute toxicity of NPDES wastewater and point source WDR dischargers even in the absence of reasonable potential.

3.2.6 Compliance

A chronic toxicity test result indicating a “fail” with a percent effect at or above 50 percent for the survival endpoint is a violation of the chronic MDEL, unless the chronic toxicity test does not have a survival endpoint. If a chronic toxicity test does not have a survival endpoint, then a chronic toxicity test result indicating a “fail” for any endpoint with a 50 percent effect for that endpoint is a violation of the chronic MDEL. An acute toxicity test result indicating a fail for the survival endpoint with a percent effect at or above 50 percent for the survival endpoint is a violation of the acute MDEL.

For non-storm water NPDES dischargers with a less than monthly monitoring frequency, whenever there is a single MDEL or MMEL violation in a calendar month, but not two violations, the discharger will be required to conduct an additional routine monitoring test in the subsequent calendar month. This additional routine monitoring test is necessary to determine if a TRE will be required. If the additional routine monitoring test results in a “fail” the discharger must conduct MMEL compliance tests, consistent with the Provisions. If the additional routine monitoring test and any associated MMEL compliance tests lead to an MDEL or MMEL violation the discharger

will be required to conduct a TRE. This additional routine monitoring test is not required if the discharger is already conducting a TRE.

If a chronic or acute toxicity test results in a “fail” at the IWC, dischargers shall conduct maximum of two additional toxicity tests within the same calendar month in order to determine compliance with the MMEL. These two MMEL compliance test must be initiated in the same calendar month as the initial routine toxicity test that resulted in a “fail”. If either of these two additional MMEL compliance tests results in a “fail,” the median monthly effluent limitation is exceeded, and the discharger will be in violation of the MMEL. If the first chronic MMEL compliance test results in a “fail” at the IWC, then the second MMEL compliance test is waived.

A TRE is required when a discharger has any combination of two or more chronic or acute MDEL or MMEL violations within a single calendar month or within two successive calendar months. In addition, if other information indicates toxicity (e.g., results of additional monitoring, fish kills, or intermittent recurring toxicity, etc.), then the Regional Water Board may require a TRE at its discretion.

As noted above, if a non-storm water NPDES discharger with a less than monthly monitoring frequency has a single violation in any calendar month, the discharger is required to conduct a routine monitoring test in the following month. There are also some economic considerations that have been taken into account when considering the necessity of additional tests. They are as follows:

a. The Provisions do not require accelerated monitoring. The need for a TRE is determined using the existing routine monitoring tests and MMEL compliance tests.
b. For non-storm water NPDES dischargers that monitor on a less than monthly frequency, there will be an additional 1 to 3 monitoring tests whenever there is a single violation in any calendar month (an additional routine monitoring test and a maximum of 2 MMEL compliance tests if that routine monitoring test results in a “fail”).

3.2.7 Compliance Schedules

The applicable Water Board has the discretion to grant a compliance schedule to NPDES wastewater and point source WDR dischargers in order to achieve the objectives. Compliance schedules must be consistent with the State Water Board’s Policy for Compliance Schedules in National Pollutant Discharge Elimination System Permits.

3.2.8 Exceptions

The Provisions would allow the State Water Board and Regional Water Boards to exempt biological pesticide and residual pesticide discharges, drinking water system discharges, natural gas facilities discharges, and certain non-storm water NPDES dischargers that are considered to be insignificant dischargers from some or all of the requirements of the Provisions including effluent limits, routine monitoring, and

compliance provisions of the Provisions unless the applicable Water Board finds them to have an impact on receiving water quality. Insignificant dischargers are NPDES dischargers that are determined to be a low threat to water quality by the Regional Water Board.

Although some dischargers may be exempted from some or all of the implementation requirements in the Toxicity Provisions, the Water Boards still need to make a finding that a discharger does not have reasonable potential to cause or contribute to an exceedance of the water quality objectives. Nonetheless, to make this determination, the Water Boards does not need to follow the reasonable potential analysis procedure specified in Section IV.B.2.b of the Provisions. Additionally, the Provisions allows the Water Boards to assign routine monitoring as necessary, even if the discharger is exempted and the discharger will still have receiving water limitations based on the water quality objectives.

The Provisions also allows the Water Boards, after compliance with the California Environmental Quality Act (CEQA), to grant short-term or seasonal exceptions from meeting the toxicity objectives if determined to be necessary to implement control measures for resources or pest management (e.g. vector or weed control, pest eradication, or fishery management) conducted by private or public entities.

In addition, where site-specific conditions in individual water bodies or watersheds differ sufficiently from statewide conditions and those differences cannot be addressed through other provisions of this Provisions, the State Water Board may, in compliance with CEQA, subsequent to a public hearing, and with the concurrence of the U.S. EPA, grant an exception to meeting the toxicity objectives or any other provision of the Provisions where the State Water Board determines:

- The exception will not compromise protection of enclosed bay, estuarine, and inland surface waters for beneficial uses; and
- The public interest will be served.

3.2.9 Storm Water Dischargers

Under the Provisions, all storm water dischargers subject to existing toxicity monitoring requirements will be required to analyze toxicity data using the TST approach and to report results as a “pass” or “fail” and report the percent effect, if the discharger is using aquatic toxicity test methods described in Section IV.B.1.b. of the Toxicity Provisions.

3.2.10 Nonpoint Source Dischargers

Under the Provisions, nonpoint source dischargers subject to existing toxicity monitoring requirements under a conditional waiver or nonpoint source WDR will be required to analyze toxicity data using the TST approach and to report results as a “pass” or “fail”, and report the percent effect if the discharger is using aquatic toxicity test methods described in Section IV.B.1.b. of the Toxicity Provisions.

4 Method for Evaluating Compliance and Costs

This section describes the method for evaluating compliance with the Provisions and estimating incremental cost impacts. The attached spreadsheets provide the data used in the analyses.

4.1 Municipal and Industrial Wastewater

The method for evaluating potential impacts of the Provisions for municipal and industrial wastewater dischargers is based on the total population of permittees subject to the Provisions. This section discusses methods for determining reasonable potential, evaluating compliance with revised effluent limits, identifying necessary compliance mechanisms, and estimating the costs associated with achieving and maintaining compliance.

4.1.1 Identifying Potentially Affected Facilities

There is a total of 325 (190 municipal POTWs and 135 industrials) individually-permitted NPDES dischargers that discharge wastewater to inland surface waters, enclosed bays, and estuaries in California. However, Regional Water Boards may determine some of these dischargers are insignificant and, therefore, exempt from routine monitoring, sensitive species testing, and effluent limit requirements in the Provisions as described in Section 3.2.8, above. PG Environmental lacks sufficient information to develop accurate projections regarding which dischargers are likely to be deemed insignificant. Instead, PG has conservatively assumed all individual permittees will be subject to the Provisions.

PG Environmental reviewed 54 NPDES general permits providing discharge authorization to municipal dischargers and a variety of other discharge categories (e.g., aquaculture facilities, treated groundwater discharges, dry-dock operations, etc.). Some portion, but not all, of municipal and industrial general permittees will be subject to the Provisions. Insufficient information regarding this sub-population was available to identify dischargers likely to be affected; therefore, this analysis does not estimate costs for facilities with discharge authorization under general NPDES permits. Refer to Appendix A for a list of general permits reviewed in June 2019 as part of this analysis.

Factors that may affect the potential magnitude of compliance costs include:

- Facility type (municipal/industrial)
- Flow (for process controls)
- Industrial processes
- Dilution allowances.

The CWA requires municipal dischargers to have secondary treatment or an equivalent, and most major POTWs treat wastewater from a combination of residential, commercial, and industrial sources. Thus, treatment controls are likely to be similar across municipal

dischargers. Larger flows are typically associated with the largest treatment costs, although per-unit costs may decrease due to economies of scale.

For industrial dischargers, minimum treatment requirements vary based on the type of industry. Treatment processes and potential effluent quality also vary based on industry type. Categories of concern for aquatic toxicity include chemical manufacturers, metal manufacturers and finishers, petroleum refineries, and pulp and paper mills.

The availability of dilution may also be indicative of compliance costs. In waters for which mixing zones would not be allowed (e.g., ephemeral and low flow streams, impaired water bodies), the IWC would be based on 100% effluent samples. Ephemeral and low flow streams are more common in the southern region of the state due to a drier climate.

Compliance costs associated with baseline (i.e., requirements contained in existing permits prior to adoption of the Provisions) and with the Provisions have been evaluated on a permittee-by-permittee basis for the sub-population of individually-permitted dischargers. Estimated costs were then aggregated on a sub-population wide basis for the entirety of the State.

Insufficient information is available regarding the subject population covered by general permits to estimate aggregate compliance costs; however, a discussion of unit costs associated with likely compliance activities is included in the analysis. General permittees subject to the Provisions will likely experience compliance costs similar to individual permittees of similar scale and from similar industries. Hereafter, references made to municipal and industrial dischargers refer to plants covered under individual NPDES permits, unless otherwise indicated.

4.1.2 Evaluating Effluent Limitation Compliance with Existing Requirements

Current permit requirements range from narrative or numeric acute and/or chronic limitations to accelerated monitoring and/or TRE/IE triggers only. The expression of limits and triggers also range from thresholds for single test results to median values for a series of consecutive tests. Limits and triggers for some facilities reflect dilution credits while those for other facilities do not.

Evaluation of existing permit requirements is necessary to determine the incremental impacts of the Provisions. Baseline compliance actions (i.e., those applicable under the status quo policy regime) would need to be undertaken even in the absence of the Provisions. Thus, only incremental actions (those above and beyond baseline activities) are attributable to the Provisions.

PG Environmental utilized data provided by the SWRCB (2019) to estimate chronic toxicity routine monitoring costs for municipal and industrial dischargers. This data set described the following information contained in existing permits: (1) the identity and discharge category of permittees, (2) existing chronic aquatic toxicity monitoring frequencies, and (3) required chronic test species. Insufficient information is available to

distinguish between permittees required to utilize single-concentration tests and those required to utilize a multiple-concentration or dilution series test. For purposes of estimating routine monitoring costs under baseline conditions, PG Environmental has assumed all chronic toxicity tests utilize dilution series.

Insufficient information is available to evaluate baseline and policy compliance with monitoring and TIE/TRE triggers for the entirety of the population; therefore, aggregate compliance costs for baseline conditions and Provision conditions were not estimated.

4.1.3 Determining Reasonable Potential under the Provisions

Discharge data necessary to determine reasonable potential under the Provisions were unavailable for the entirety of the affected population. Therefore, PG Environmental conservatively assumed that all potentially affected individual municipal and industrial permittees demonstrate reasonable potential for chronic toxicity under the Provisions. As discussed in Section 3.2.5, permittees demonstrating reasonable potential are required to conduct tests at five concentrations of test water plus a control for acute and chronic tests unless an alternative test procedure has been approved. When estimating routine monitoring costs under the Provisions, PG Environmental utilized costs based on multiple-concentration tests for chronic toxicity.

Among those plants with reasonable potential for chronic toxicity, routine chronic toxicity monitoring varies from quarterly (dischargers with less than 5 MGD flow) to monthly (greater than or equal to 5 MGD) under the Provisions. When estimating routine chronic toxicity monitoring costs, PG assigned either a monthly or quarterly monitoring frequency depending on the permitted flow rate of the facility.

The test species used for routine monitoring will vary from permittee to permittee on the basis of species sensitivity testing outcomes. PG Environmental assumes the most sensitive species identified under baseline will be the same as the most sensitive species identified under the Provisions. Since routine monitoring test costs vary according to test species and test method, a range of costs was used to estimate chronic routine monitoring costs under baseline conditions and under the Provisions. PG Environmental selected a pair of surrogate test species for freshwater dischargers (*S. capricornutum* and *C. dubia*) and a pair for marine dischargers (*H. rufescens* and *S. purpuratus*). These test species reflect the low and high range of test costs captured in the survey data of commercial testing laboratory test prices and, as such, represent a conservative estimate of routine monitoring costs using each permittee's most sensitive species under baseline conditions and under the Provisions. Baseline monitoring frequencies and the number of test species required for each test event were taken from permittees' existing NPDES permits. For additional detail on the computations involved in estimating baseline and Provision estimated costs, please refer to Section 4.1.6.

Permittees will be required to conduct reasonable potential analyses for acute toxicity at the discretion of the Regional Water Boards, which is equivalent to the status quo or

baseline policy. Where reasonable potential exists, acute monitoring frequencies are set at the discretion of the Regional Water Board at rates anywhere from annual to monthly monitoring frequencies. Since, reasonable potential testing and monitoring frequencies are discretionary, PG Environmental was unable to estimate likely routine monitoring costs for acute toxicity.

4.1.4 Evaluating Effluent Limitation Compliance under the Provisions

Under the Provisions, the chronic MDEL is violated when a chronic toxicity test, using the TST approach, results in a fail and the percent effect for the survival endpoint is equal to or greater than 50%. If the most sensitive species chronic toxicity test does not include a lethal endpoint then the MDEL is violated when a chronic toxicity test results in a fail for any endpoint at the IWC, with a percent effect for that endpoint of greater than or equal to 50%. For acute toxicity, the MDEL is violated when a most sensitive species test at the IWC results in a fail for the survival endpoint with a percent effect for the survival endpoint of greater than or equal to 50%.

If a chronic or acute toxicity test results in a “fail” at the IWC, dischargers must conduct a maximum of two additional toxicity tests (MMEL compliance tests) within the same calendar month in order to determine compliance with the MMEL. If the first MMEL compliance test results in a “fail” the second MMEL compliance test may be waived. A MMEL violation occurs when any two MMEL compliance tests register “fail” in a single calendar month. The MMEL compliance tests must be conducted regardless of the MDEL exceedance of toxicity tests or not. These two MMEL compliance tests must be initiated in the same calendar month as the initial routine toxicity test that resulted in a “fail”. Note, however, that the Provision eliminate the need for accelerated monitoring when a trigger is exceeded, thus offsetting some of the costs for MMEL compliance tests when a test results in a “Fail”. If any combination of two or more MDEL or MMEL compliance tests indicate a violation in a single month or within two successive months then the Provisions requires dischargers to conduct a TRE.

Insufficient information (i.e., testing data collected in response to a “fail” as registered under the TST approach) is available in all cases to evaluate MMEL compliance costs or TRE/IE costs under the provisions on a permittee-by-permittee basis for the affected population. Where sufficient information is available, it is infeasible to efficiently extract and analyze the relevant data for such a large discharger population. Therefore, it is infeasible to estimate aggregate MMEL monitoring costs or TRE/IE costs. Instead, unit-cost information on specific compliance activities is presented in the following section. Refer to Section 4.1.5, subsection Toxicity Reduction Evaluation Unit Costs, for additional discussion.

4.1.5 Estimating Potential Compliance Mechanisms

The potential for incremental actions under the Provisions reflects a comparison of compliance with current permit requirements compared to the Provisions. Under the Provisions, there may be incremental differences in monitoring frequencies, test types

(e.g., chronic or acute; single-concentration or multiple-concentration tests), and/or number of required test species that could result in additional costs or cost savings. For example, under the Provisions, non-storm water NPDES dischargers are not required to conduct a reasonable potential analysis for acute toxicity. The Regional Water Boards have the discretion to include acute reasonable potential analyses for non-storm water NPDES dischargers, which may result in effluent limits for acute toxicity if they deem such testing necessary.

Current NPDES permit regulations indicate that effluent limits should be based on the more stringent of acute or chronic long-term averages. With toxicity, long term averages based on chronic toxicity tests are the more stringent than those for acute toxicity in most cases. In addition, the Provisions requires permit writers to justify in the permit why both acute and chronic toxicity limits would be necessary. Because, under the Provisions, all non-storm water NPDES dischargers will be required to either have routine monitoring and effluent limitations for chronic toxicity, or be required to conduct a reasonable potential analysis for chronic toxicity, it is expected that most non-storm water NPDES dischargers will have monitoring requirements and effluent limitations for chronic toxicity. Because in most cases chronic aquatic toxicity testing is generally protective of both chronic and acute toxicity and permitting authorities must document the basis for their decision to require an acute toxicity reasonable potential analysis, establishing both chronic and acute effluent limitations is less likely.

Incremental costs also may result from the need for facilities to add replicates to the aquatic toxicity test method. The TST statistical approach is designed to declare a chronic test toxic (i.e., a “fail”) when the treatment mean at the IWC is ≥25% compared to the control mean, and nontoxic (i.e., a “pass”) when the treatment mean at the IWC is ≤10% compared to the control mean. One way to improve statistical test power is either to reduce within-test variability and/or increase the replicates beyond the minimum as specified. The State Board (2011; Diamond et al., 2013) found that the few cases of the TST indicating toxicity at effects less than the toxic RMD (25%) but above the nontoxic RMD (10%) are due to high within-test variability between replicates in the control and IWC treatment. The State Board (2011) projected that adding a minimal number of replicates to these tests would have resulted in the sample being declared nontoxic using the TST procedure in most cases. Thus, PG Environmental assumed that incremental costs associated with the addition of replicates would be minimal.

The Provisions also allow permitting authorities the discretion to reduce the routine monitoring frequency from monthly to quarterly, or from quarterly to twice per year for eligible non-storm water NPDES dischargers that have demonstrated a good compliance history.

Monitoring Costs

Incremental monitoring costs could result from species sensitivity screening, reasonable potential analysis screening, routine monitoring, and verification/follow-up monitoring.

The State Water Board has accredited 23 laboratories under the Environmental Laboratories Accreditation Program (ELAP) to perform aquatic toxicity tests (SWRCB, 2019). These laboratories have demonstrated capability to analyze environmental samples using approved methods (CA DHS, 2012). The accredited laboratories include both commercial and private testing facilities.

Unit costs vary with species and test type (e.g., acute or chronic, single-concentration or multiple dilutions). In addition, laboratories may offer discounts related to the number of tests or longer turnaround times, or charge additional fees related to delivery charges, shorter turnaround times.

Some municipal and industrial dischargers with State Water Board-accredited laboratories collect samples and perform toxicity tests onsite. These dischargers may not keep records of per sample testing costs; rather, testing costs may be rolled up into the facility's operating budget. Presumably, both municipal and private industrial dischargers perform in-house testing because it is less expensive than contracting the work out to a commercial laboratory, or they want to perform the tests themselves. Thus, price information from commercial laboratories establishes market costs relevant to the potential impacts of changes in aquatic toxicity test requirements; these prices may overstate costs to dischargers using in-house laboratories.

Exhibit 4-1 shows acute and chronic toxicity test species and methods for fresh and marine waters.

Exhibit 4-1. Aquatic Toxicity Test Types

Common Name (Species)	EPA Method	Endpoint
Freshwater Acute Tests		
Fathead minnow (*Pimephales promelas*)	2000.0	Mortality
Water flea (*Ceriodaphnia dubia*)	2002.0	Mortality
Rainbow trout (*Oncorhynchus mykiss*)	2019.0	Mortality
Brook trout (*Salvelinus fontinalis*)	2019.0	Mortality
Water flea (*Daphnia magna*)	2021.0	Mortality
Water flea (*Daphnia pulex*)	2021.0	Mortality
Freshwater Chronic Tests		
Fathead minnow (*Pimephales promelas*)	1000.0	Larval survival and growth

Common Name (Species)	EPA Method	Endpoint
Water flea (*Ceriodaphnia dubia*)	1002.0	Survival and reproduction
Green alga (*Selenastrum capricornutum*)	1003.0	Growth
Marine Acute Tests		
Sheepshead minnow (*Cyprinodon variegatus*)	2004.0	Mortality
Bannerfish shiner (*Cyprinella leedsi*)	2004.0	Mortality
Inland silverside (*Menidia beryllina*)	2006.0	Mortality
Silverside (*Menidia menidia*)	2006.0	Mortality
Silverside (*Menidia peninsulae*)	2006.0	Mortality
Mysid (*Mysidopsis bahia*)	2007.0	Mortality
Topsmelt (*Atherinops affinis*)	N/A	Mortality
West Coast mysid (*Holmesimysis costata*)	N/A	Mortality
Marine Chronic Tests		
Pacific Oyster (*Crassostrea gigas*) and Mussel (*Mytilus* sp.)	1005.0	Larval development
Topsmelt (*Atherinops affinis*)	1006.0	Survival and growth
West Coast Mysid (*Holmesimysis costata*)	1007.0	Survival and growth
Giant Kelp (*Macrocystis pyrifera*)	1009.0	Germination and germ tube growth
Sand dollar (*Dendraster excentricus*); Purple Urchin (*Dendraster excentricus*)	N/A	Embryo development
Red abalone (*Haliotis rufescens*)	N/A	Larval development

N/A – Not applicable

PG Environmental collected toxicity test price information from a number of the California State Water Board-accredited laboratories, as summarized in **Exhibits 4-2 and 4-3**.

In instances where laboratory price data was not available for a test species required under a particular NPDES permit, PG Environmental used an average of the available test species prices (e.g., the average of all chronic multiple-concentration test species prices).

Exhibit 4-2. Summary of Aquatic Toxicity Test Costs for Multiple-Concentration Test Designs

Test Method and Species	N	Range (May 2019 $)	Average (May 2019 $)
Acute Methods			
EPA Method 2000.0 - *Cyprinodon variegatus*	2	$413 to $457	$435
EPA Method 2000.0 - *Oncorhynchus mykiss*	2	$413 to $457	$435
EPA Method 2000.0 - *Pimephales promelas*	11	$251 to $892	$588
EPA Method 2002.0 - *Ceriodaphnia dubia*	9	$307 to $892	$658
EPA Method 2004.0 - *Cyprinodon variegatus*	3	$558 to $837	$744
EPA Method 2006.0 - *Menidia beryllina*	6	$435 to $948	$765
EPA Method 2006.0 - *Menidia peninsulae*	2	$837 [1]	$837
EPA Method 2007.0 - *Mysidopsis bahia*	5	$558 to $864	$753
EPA Method 2019.0 - *Oncorhynchus mykiss*	5	$446 to $1,070	$794
EPA Method 2019.0 - *Salvelinus fontinalis*	2	$837 [1]	$837
EPA Method 2021.0 - *Daphnia magna*	2	$502 to $837	$669
EPA Method 2021.0 - *Daphnia pulex*	1	$1004	$1,004
EPA Method - *Atherinops affinis*	4	$441 to $948	$731

Test Method and Species	N	Range (May 2019 $)	Average (May 2019 $)
EPA Method - *Holmesimysis costata*	2	$837 [1]	$837
Chronic Methods			
EPA Method 1000.0 - *Pimephales promelas*	2	$1,338 to $1,394	$1,366
EPA Method 1001.0 - *Pimephales promelas*	4	$1,160 to $1,394	$1,303
EPA Method 1002.0 - *Ceriodaphnia dubia*	7	$1,195 to $1,617	$1,380
EPA Method 1003.0 - *Selenastrum capricornutum*	6	$781 to $1,394	$1,026
EPA Method 1005.0 - *Crassostrea gigas* or *Mytilus* sp.	3	$1,562 to $2,454	$2,026
EPA Method 1006.0 - *Atherinops affinis*	6	$1,193 to $1,617	$1,379
EPA Method 1009.0 - *Macrocystis pyrifera*	4	$1,338 to $2,064	$1,603
EPA method *Haliotis rufescens*	5	$1,071 to $2,231	$1,675
EPA method Sand dollar *Dendraster excentricus*; *Strongylocentrotus purpuratus*	3	$1,562 to $2,454	$1,896

ND = not cost data available
N/A = no method number specified
N = number of per test costs available from certified commercial labs performing aquatic toxicity tests.
1. All survey responses listed the same price for these tests.

Exhibit 4-3. Summary of Aquatic Toxicity Test Costs for Single-Concentration Test Designs

Test Method and Species	N	Range (May 2019 $)	Average (May 2019 $)
Acute Methods			
EPA Method 2000.0 - *Cyprinodon variegatus*	4	$290 to $468	$368
EPA Method 2000.0 - *Oncorhynchus mykiss*	4	$290 to $468	$368
EPA Method 2000.0 - *Pimephales promelas*	19	$201 to $669	$392
EPA Method 2002.0 - *Ceriodaphnia dubia*	12	$201 to $669	$415
EPA Method 2004.0 - *Cyprinodon variegatus*	1	$335	$335
EPA Method 2006.0 - *Menidia beryllina*	4	$218 to $711	$469
EPA Method 2006.0 - *Menidia peninsulae*	0	ND	ND
EPA Method 2007.0 - *Mysidopsis bahia*	3	$335 to $558	$428
EPA Method 2019.0 - *Oncorhynchus mykiss*	11	$290 to $502	$432
EPA Method 2019.0 - *Salvelinus fontinalis*	0	ND	ND
EPA Method 2021.0 - *Daphnia magna*	8	$279 to $627	$448
EPA Method 2021.0 - *Daphnia pulex*	1	$753	$753
EPA Method - *Atherinops affinis*	4	$223 to $711	$471

Test Method and Species	N	Range (May 2019 $)	Average (May 2019 $)
EPA Method - *Holmesimysis costata*	0	ND	ND
Chronic Methods			
EPA Method 1000.0 - *Pimephales promelas*	1	$669 to $669	$669
EPA Method 1001.0 - *Pimephales promelas*	3	$502 to $725	$602
EPA Method 1002.0 - *Ceriodaphnia dubia*	5	$502 to $1,213	$751
EPA Method 1003.0 - *Selenastrum capricornutum*	4	$390 to $1,046	$610
EPA Method 1005.0 - *Crassostrea gigas* or *Mytilus* sp.	2	$1,171 to $1,450	$1,311
EPA Method 1006.0 - *Atherinops affinis*	5	$613 to $1,213	$778
EPA Method 1009.0 - *Macrocystis pyrifera*	3	$669 to $1,255	$902
EPA method *Haliotis rufescens*	4	$535 to $1,338	$943
EPA method Sand dollar *Dendraster excentricus*; *Strongylocentrotus purpuratus*	3	$480 to $1,450	$1,034

ND = no cost data available
N/A = no method number specified
N = number of per test costs available from certified commercial labs performing aquatic toxicity tests.

In addition, costs for three-species chronic aquatic toxicity testing to determine the most sensitive species are needed for those sample facilities not currently conducting such tests. **Exhibit 4-4** summarizes these costs based on average species type costs for freshwater and marine tests. These costs reflect the total cost for all three species tests combined (i.e., the average cost for species 1 plus the average cost for species 2 plus the average cost for species 3).

Exhibit 4-4. Average Costs for Three-Species Chronic Aquatic Toxicity Tests

Test Type	Multiple-Concentration	Single-Concentration
Freshwater 3-species [1]	$3,730	$1,720
Marine 3-species [2]	$4,850	$2,880

1. Based on the sum of average costs of *Ceriodaphnia dubia*, *Pimephales promelas*, and *Selenastrum capricornutum*
2. Based on the sum of average costs of *Atherinops affinis*, the average of *Macrocystis pyrifera*, and *Selanastrum capricornutum*, and the average of *Crassostrea gigas*, *Mytilus* sp., *Ceriodaphnia dubia*, *Haliotis rufescens*, and *Dendraster excentricus*.

Replicate multiple-concentration toxicity test price information was collected from a number of the California State Water Board-accredited laboratories. PG Environmental estimated that the cost for adding an additional 1 to 2 replicates (SWRCB, 2011) could range from $60 to $225 as shown in **Exhibit 4-5**.

Exhibit 4-5. Summary of Replicate Costs

Test and Species	One Replicate: Number of Estimates	One Replicate Average Cost [1]	Two Replciates Number of Estimates	Two Replicates Average Cost [2]
EPA Method 1001.0 - *Pimephales promelas*	1	$112	3	$206
EPA Method 1002.0 - *Ceriodaphnia dubia*	2	$99	3	$169
EPA Method 1003.0 - *Selanastrum capricornutum*	2	$84	2	$141
EPA Method 1005.0 - *Crassostrea gigas* or *Mytilus* sp.	1	$84	0	NA
EPA Method 1006.0 - *Atherinops affinis*	2	$112	2	$225
EPA Method 1008.0 - *Strongylentrotus purpuratus*	1	$56	0	NA
EPA Method 1009.0 - *Macrocystis pyrifera*	2	$99	1	$225
N/A - *Haliotus rufescens*	1	$84	1	$225
N/A - *Strongylentrotus purpuratus*	1	$84	0	NA

1. Average cost for one additional replicate.
2. Average cost for two additional replicates (i.e., not a per-replicate cost)

However, the purpose of adding replicates to toxicity tests would be to improve statistical power; thereby, reducing risk of false positives. Adding replicate costs should reduce the more costly (relative to the costs of added replicates) MMEL compliance tests and possibly TREs that could be needed to address permit violations, which could decrease the overall incremental costs for a given facility. Because of the potential for cost savings, PG Environmental did not include replicate costs in estimates for municipal and industrial dischargers.

In addition, PG Environmental did not include costs associated with sample collection and shipping in the per test unit costs. For major POTW dischargers required to monitor chronic toxicity monthly under the Provisions, information from the sample facilities indicates that these dischargers all likely have monthly monitoring requirements for other pollutants. For minor POTW dischargers required to monitor chronic toxicity quarterly under the Provisions, available permits indicate that most facilities are currently required to conduct quarterly monitoring for conventional pollutants (e.g., BOD, TSS, bacteria). Thus, the aquatic toxicity samples under the Provisions can be collected at the same time as other pollutant samples with minimal additional effort. For those non-storm water dischargers that do not use in-house laboratories, sample transportation and shipping costs are likely the same in that the additional aquatic toxicity samples can be shipped with other samples for a minimal additional cost. Therefore, PG Environmental did not include an estimate of incremental labor and transportation costs of the Provisions.

Toxicity Reduction Evaluation Unit Costs

If any combination of two or more MDEL or MMEL compliance tests indicate a violation in a single month or within two successive months then the Provisions requires dischargers to conduct a TRE. EPA defines a TRE as a site-specific study conducted in a step-wise process designed to identify the causative agents of effluent toxicity, isolate the sources of toxicity, evaluate the effectiveness of toxicity control options, and confirm the reduction in effluent toxicity (U.S. EPA, 1991). TREs comprise all measures taken to reduce aquatic toxicity to required levels. TREs can involve many steps and are seldom the same for all situations. Major components of a TRE include (U.S. EPA, 1999):

- Information and data acquisition
- Facility performance evaluation
- Toxicity identification evaluation
- Toxicity source evaluation
- Toxicity control evaluation
- Toxicity control implementation.

The exact components of a TRE will vary for each discharger. For example, if toxicity occurred after the addition of a new treatment chemical or process change, the investigation can likely be conducted in-house and for a minimal cost. However, in many situations simply examining operational records is of little value without knowledge of

the specific toxicant causing the problem (Pillard and Hockett, 2002; U.S. EPA, 2001). Identifying the toxicant of concern often increases treatment and control options while decreasing total control costs.

A TIE is a set of procedures that uses physical and chemical treatments to identify or classify the specific chemical compounds causing toxicity in an effluent sample (U.S. EPA, 2001). EPA recommends that permittees conduct TIEs early in the TRE process (U.S. EPA, 2001). TIE procedures are commonly performed in three phases: characterization, identification, and confirmation. The phases can be performed sequentially (using the results of one phase to influence the next) or simultaneously. TIE costs vary based on effluent complexity and the number of phases conducted. For example, Nautilus Environmental (2012) indicates that a Phase I TIE would cost $5,600 to $7,900; however, costs for Phase II and III TIEs are site-specific.

The difficulty in conducting a TIE, and the time required to complete it, will likely increase in direct proportion to the complexity of toxicants in wastewater. As the number of chemical constituents in wastewater increases, the interactions of those chemicals (e.g., with biological and analytical systems and with each other in the wastewater) can increase the difficulty of identifying toxicants (U.S. EPA, 2001). However, TIE studies do not need to be prohibitively expensive. ENSR indicates that relatively low-cost investigations can be extremely useful in providing cost-effective solutions to effluent toxicity problems (Pillard and Hockett, 2002).

Based on TIE results, the permittee may decide to conduct treatability tests on the effluent or source investigations to determine the appropriate control actions. However, not all TREs need to include TIEs. In some cases, dischargers may first conduct treatability tests that use bench-scale treatment units to identify process changes that reduce toxicity through changes in treatment type, arrangement, or method. While these tests may not identify which toxicant is being removed or reduced, they can still be effective in reducing aquatic toxicity.

Costs for a TRE (not including implementation of specific control actions) can range from $28,000 to $45,000 (Pillard and Hockett, 2002). For example, the City of Bryan (Texas) received bids from two laboratory service providers to perform a TRE of $36,222 and $28,560, plus up to an additional $5,000 for all 3 phases of a TIE.

Process Controls

EPA considers any technically reasonable actions taken to resolve aquatic toxicity as TRE activities (EPA, 2001). Such actions may include chemical substitution/addition, process optimization or enhancements, pretreatment modifications, or treatment of process streams.

Chemical substitution removes the source of toxicity in effluents. Common chemicals for which substitution may be an option include cooling tower slimicides, ammonia nutrients, lime, polymers, and oxidizing agents (U.S. EPA, 1989). Adding chemicals to

the treatment process may also improve toxicant or toxicity removal. EPA (1999) provides a number of examples:

- Nutrients can be added to influent wastewaters that have low nutrient levels (relative to their organic strength) to improve biological treatment
- Lime or caustic chemicals can be used to adjust wastewater pH for optimal biological treatment or for coagulation and precipitation treatment
- Other chemical coagulants are used to aid in removal of insoluble toxicants and to improve sludge settling
- Powdered activated carbon may be applied in activated sludge systems to remove toxic organic compounds.

Process optimization entails modifying existing operations and facilities to improve operation, maintenance, and performance (Metcalf and Eddy, 2003). Optimization usually involves two main steps: process analysis and process modifications. Process analysis is an investigation of the performance-limiting factors of the treatment process and is a key factor in achieving optimum treatment efficiency. Process modifications include activities short of adding new treatment technology units (conventional or unconventional) to the treatment train. For example, modifications could include modifying baffles, adding chemicals to enhance coagulation and solids removal, equalizing flow, training operators, and installing automation equipment including necessary hardware and software. Potential modifications vary based on the type of facility and existing treatment train.

The primary advantages of pretreatment control of toxicity are that a smaller volume of waste can be managed by addressing individual sources and the costs are usually the responsibility of the industrial users. Pretreatment requirements may involve a public education effort or the implementation of narrative or numerical limitations for dischargers to POTWs. If the problem toxicant is not already regulated under the existing pretreatment program, municipalities may need to (U.S. EPA, 1999; Norberg-King et al., 2005):

- Investigate public education approaches, if the toxicant is widely used in the service area (e.g., organophosphate insecticides)
- Perform an allowable headworks loading analysis
- Decide whether to establish local limits or implement a more directed approach, such as industrial user management or case-by-case requirements
- Develop a monitoring program to evaluate compliance with the requirements.

Treatment of wastewater is another option for controlling effluent toxicity. However, end-of-pipe treatment can be costly, making dischargers more likely to first pursue lower cost options such as process optimization and pollution prevention (e.g., chemical substitution and pretreatment modifications). The treatment technology selected will depend on the toxicant of concern. For example, enhanced biological nutrient removal

technologies target reductions in nutrients such as ammonia, whereas, reverse osmosis primarily removes dissolved contaminants (e.g., mercury and pesticides).

Exhibit 4-6 provides examples of the types of control actions that may be necessary for different discharger categories. Note that unit costs for these actions are not readily available, and PG Environmental could not develop unit costs for these specific actions due to a lack of site-specific data for each facility and activity.

Exhibit 4-6. Examples of Aquatic Toxicity Control Actions

Discharger Category	Pollutants of Concern	Control Actions	Source
Municipal wastewater	Copper	Implemented additional pretreatment controls/requirements	U.S. EPA (1999)
Municipal wastewater	Diazinon and chlorpyrifos	Public awareness program; source control program; identify processes and operations that remove organophosphate insecticides	U.S. EPA (1999)
Municipal wastewater	Surfactants	Pretreatment to minimize or eliminate industrial chemicals	U.S. EPA (1999)
Municipal wastewater	Ammonia, non-polar organic compounds, surfactants	Developed pretreatment limits specific to ammonia and general toxicity limits for non-ammonia pollutants	U.S. EPA (1999)
Municipal wastewater	Bacteria regrowth in effluent samples	Replaced old auto samplers; revised sample tubing replacement protocol; optimized sample collection to reduce bacterial growth	SRCSD (2008)
Petroleum refinery	Organic chemicals	Installed granular activated carbon to treat 5-10 MGD (in addition to existing biological treatment)	Calgon Carbon (no date)

Discharger Category	Pollutants of Concern	Control Actions	Source
Petroleum refinery	Semi-volatile aromatics, high MW aliphaties, substituted phenols, aromatic amine and indole compounds, long-chain fatty acid esters, and substituted PAHs	Added more aeration horsepower to combined equalization/aeration tank; modified secondary clarifiers; and added new permanent pumps, piping, instrumentation, and controls for return and waste activated sludge flow control	Stover and Walls (2004)
Petroleum refinery	Neutral organic Chemicals	Ammonia recovery and foul water stripper; preliminary bench scale testing indicated that activated carbon will reduce final effluent toxicity to acceptable levels	U.S. EPA (1989)
Steel production	Bacteria	Improved housekeeping and increased frequency of clarifier cleaning and floc removal	Hall and Lockwood (2004)
Latex production	Mixture of nitrite and ammonia	Upgrades in solids pretreatment and the biological nitrification system (i.e., an anoxic basin and additional nitrification)	Hall and Lockwood (2004)
Organic chemicals	Calcium and chloride salts	Implemented source controls	Hall and Lockwood (2004)
Gas-fired power plant	Copper	Using commercial additive containing EDTA chelating agent	ENSR (2008)

Control costs are highly site-specific. However, in general, pretreatment modifications, source controls, and process optimization are less costly to implement than end-of-pipe treatment. As shown in the exhibit, in certain cases, such as removal of organics from petroleum refinery wastewater, end-of-pipe treatment may be the most technologically and economically feasible alternative for compliance.

4.1.6 Estimating Potential Incremental Statewide Costs

PG Environmental estimated statewide incremental costs for municipal and industrial dischargers with individual NPDES permits based on costs for species sensitivity testing, and routine monitoring. Baseline (i.e., under existing NPDES permits) and Provision costs were estimated by utilizing the range of test prices collected from commercial laboratories (see Exhibit 4-3). The minimum and maximum prices for the suite of tests required were multiplied by the annual routine monitoring frequency required and the number of test species required per test event.

In order to capture the range of potential costs that could occur under routine monitoring, PG Environmental utilized the minimum and maximum lab test prices observed for marine and freshwater dischargers (refer to Exhibit 4-3 for lab survey price data) in lieu of actual test species specified in existing permits. This simplification results in a more conservative range of cost outcomes than would be otherwise be found using test species and methods specified in each discharger's permit. The range of estimated incremental costs is likely to encompass the "true" costs borne by permittees using publicly available commercial laboratories (i.e., the high range of the cost estimate is likely to be much greater than typical costs). The minimum and maximum priced surrogate test species used in the calculation were *S. capricornutum* ($781 per set of dilution series test set) and *C. dubia* ($1,617 per test set) for dischargers to freshwater; and *H. rufescens* ($1,071 per test set), and *S. purpuratus* ($2,454 per test set) for dischargers to marine waters.

Since the same test species were used in both the baseline and Provision scenarios, the difference in costs between the two are due to changes in chronic toxicity monitoring frequencies specified in existing permits and under the Provisions. Incremental costs were computed by subtracting the estimated baseline costs from the cost estimated under the Provisions, as shown in the following equations:

$$Cost_{incremental} = Cost_{provisions} - Cost_{baseline}$$

Where,

$$Cost_{baseline} = Price_{species}\ x\ MonitoringFrequecy_{baseline}$$

$$Cost_{provisions} = Price_{species} \ x \ MonitoringFrequency_{provisions}$$

Insufficient data were available to identify individual facilities likely to need a TRE under the Provisions, rendering it infeasible to estimate statewide TIE/TRE or process control costs. Insufficient information was available to estimate incremental statewide costs for general permittees. Refer to Appendix A for a list of general NPDES permits reviewed in the development of this analysis.

4.2 Storm Water Dischargers

Under the Provisions, the only change to permit requirements for storm water dischargers with existing toxicity monitoring requirements is that toxicity data must be analyzed using the TST statistical approach to analyze toxicity test data and will be required to report the results along with the percent effect to the Water Boards. There are no toxicity monitoring data from storm water dischargers from which to determine the change in compliance actions for storm water dischargers under the Provisions and thus, the incremental controls that may be needed under the Provisions. However, the State Water Board (2011) evaluated storm water samples collected during dry weather, storm events, and irrigation seasons in agricultural areas and found that using the TST approach is not expected to result in a change in the number of enforcement actions compared to use of the current toxicity methods.

These dischargers may decide to add replicates to samples to improve statistical power. As discussed above, this may add anywhere from $60 to $225 per test but would be motivated by efforts to reduce total costs by avoiding accelerated monitoring and possibly TREs that could be needed to address violations. Stormwater dischargers required to run a dilution series after detecting 100% mortality would not add additional replicates.

4.3 Nonpoint Source Dischargers

Under the Toxicity Provisions, the only change to permit requirements for all nonpoint source dischargers required to monitor for toxicity, using test methods specified in the Toxicity Provisions will be required to use the TST statistical approach to analyze test data and will be required to report the results, along with the percent effect to the Water Boards. However, the State Water Board (2011) evaluated storm water samples collected during dry weather, storm events, and irrigation seasons in agricultural areas and found that using the TST approach is not expected to result in a change in the number of enforcement actions compared to use of the current toxicity methods. These dischargers may decide to add replicates to samples to improve statistical power. As discussed above, this may add anywhere from $60 to $225 per test but would be motivated by efforts to reduce total costs by avoiding accelerated monitoring and possibly TREs that could be needed to address violations.

The conditional waivers in the Central Coast, Los Angeles, and Central Valley regions already contain toxicity monitoring requirements and TRE/TIE provisions for addressing potential toxicity. Thus, to the extent that toxicity results analyzed using the TST approach would remain unchanged, incremental compliance costs would consist primarily of replicate costs, and thus could be minimal in these regions.

The North Coast, San Francisco, Colorado River and San Diego Regional Water Boards' conditional waivers for agriculture do not contain any specific monitoring or control requirements for toxicity. Thus, if permit writers require specific toxicity provisions in the waiver as a result of the Provisions, there could be some incremental cost associated with compliance. However, the magnitude of this incremental cost, if any, is uncertain due to uncertainty associated with baseline activities for individual growers and estimates of the number of growers covered by each waiver.

The Santa Ana Regional Water Board's conditional agriculture waiver is still being developed and implemented. Thus, it is uncertain whether baseline conditions would include toxicity monitoring provisions and whether incremental costs are likely. In addition, it is uncertain how many farmers are covered by the waiver and whether they would participate in the group or individual monitoring programs.

The Lahontan Regional Water Board does not currently have conditional waivers for agricultural lands. Whether those waivers would have included toxicity monitoring in the absence of the Provisions or whether permit writers will revise waivers to include monitoring provisions is uncertain.

5 Results

This section summarizes the potential incremental Provisions actions and statewide costs. Incremental impacts represent the costs of activities above and beyond those that would be necessary in the absence of the Provisions under baseline conditions. This section also discusses the limitations and uncertainties associated with the analysis.

5.1 Municipal and Industrial Wastewater

Exhibits 5-1, 5-2, and **5-3** summarize the potential chronic routine monitoring incremental costs to municipal and industrial facilities of complying with the Provisions. **Exhibits 5-1** and **5-2** separately display results for freshwater and marine permittees, while **Exhibit 5-3** aggregates together the results from **Exhibits 5-1** and **5-2**. Incremental costs (i.e., the difference between costs under the current policy baseline and costs under the proposed Provisions) represent the estimated change in costs if the proposed policy were adopted in California (refer to Section 4.1.6 for additional discussion regarding the estimation of incremental costs). Negative values represent cost savings associated with reduced aquatic toxicity testing requirements—either a lower monitoring frequency or use of fewer test species—under the Provisions. Estimated costs are presented as ranges to account for the variation in test price data and/or for instances where insufficient information was available to state with confidence whether a particular facility would be assigned quarterly or monthly monitoring; thus, costs were estimated for both frequencies with the low range reflecting a lower monitoring frequency and the higher range more frequent monitoring. Average per-facility incremental costs are the incremental costs divided by the number of plants in a particular category. Note that all costs estimated in the report are in May 2019 dollars (using a consumer price index value of 256.092) unless stated otherwise.

Exhibit 5-1. Summary of Chronic Routine Monitoring Incremental Costs for All Non-Stormwater-NPDES Dischargers (Freshwater)

Number of Facilities	Current Frequency (per year)	Proposed Frequency (per year)	Change in Test Frequency (per year)	Incremental Costs ($/year)	Average Per Facility Incremental Costs ($/year/plant)
10	0	4	4	$31,000 to $65,000	$3,100 to $6,500
8	0	12	12	$75,000 to $155,000	$9,400 to $19,400
8	0	4 to 12 [1]	4 to 12	$25,000 to $155,000	$3,100 to $19,400
10	0.2	4	3.8	$30,000 to $61,000	$3,000 to $6,100
1	0.2	12	11.8	$9,000 to $19,000	$9,200 to $19,100
4	0.2	4 to 12 [1]	3.8 to 11.8	$12,000 to $76,000	$3,000 to $19,100
3	0.4	4	3.6	$8,000 to $17,000	$2,800 to $5,800
1	0.5	4	3.5	$3,000 to $6,000	$2,700 to $5,700
76	1	4	3	$178,000 to $369,000	$2,300 to $4,900
12	1	12	11	$103,000 to $213,000	$8,600 to $17,800
12	1	4 to 12 [1]	3 to 11	$28,000 to $213,000	$2,300 to $17,800
16	2	4	2	$25,000 to $52,000	$1,600 to $3,200

Number of Facilities	Current Frequency (per year)	Proposed Frequency (per year)	Change in Test Frequency (per year)	Incremental Costs ($/year)	Average Per Facility Incremental Costs ($/year/plant)
4	2	12	10	$31,000 to $65,000	$7,800 to $16,200
2	2	4 to 12 [1]	2 to 10	$3,000 to $32,000	$1,600 to $16,200
22	4	4	0	$0 to $0	$0 to $0
27	4	12	8	$169,000 to $349,000	$6,200 to $12,900
3	6	12	6	$14,000 to $29,000	$4,700 to $9,700
6	12	4	-8	$-37,000 to $-78,000	$-6,200 to $-12,900
30	12	12	0	$0 to $0	$0 to $0

Note: Costs are rounded and may not sum.

1. Insufficient information to assign a monitoring frequency under the Provisions. Costs reflect the potential range of monitoring frequencies likely to be assigned (i.e., quarterly to monthly).

Exhibit 5-2. Summary of Chronic Routine Monitoring Incremental Costs for All Non-Stormwater NPDES Dischargers (Marine)

Number of Facilities	Current Frequency (per year)	Proposed Frequency (per year)	Change in Test Frequency (per year)	Incremental Costs ($/year)	Average Per Facility Incremental Costs ($/year/plant)
1	0.2	4 to 12 [1]	3.8 to 11.8	$4,000 to $29,000	$4,100 to $29,000

Number of Facilities	Current Frequency (per year)	Proposed Frequency (per year)	Change in Test Frequency (per year)	Incremental Costs ($/year)	Average Per Facility Incremental Costs ($/year/plant)
1	0.5	4	3.5	$4,000 to $9,000	$3,700 to $8,600
1	0.5	4 to12 [1]	3.5 to 11.5	$4,000 to $28,000	$3,700 to $28,200
18	1	4	3	$58,000 to $133,000	$3,200 to $7,400
2	1	12	11	$24,000 to $54,000	$11,800 to $27,000
8	1	4 to12 [1]	3 to 11	$26,000 to $216,000	$3,200 to $27,000
7	2	4	2	$15,000 to $34,000	$2,100 to $4,900
5	2	12	10	$54,000 to $123,000	$10,700 to $24,500
5	2	4 to12 [1]	2 to 10	$11,000 - $123,000	$2,100 to $24,500
6	4	4	0	$0 to $0	$0 to $0
14	4	12	8	$120,000 to $275,000	$8,600 to $19,600
2	12	12	0	$0 to $0	$0 to $0

Note: Costs are rounded and may not sum.

1. Insufficient information to assign a monitoring frequency under the Provisions. Costs reflect the potential range of monitoring frequencies likely to be assigned (i.e., quarterly to monthly).

Exhibit 5-3. Summary of Chronic Routine Monitoring Incremental Costs for All Non-Stormwater NPDES Dischargers (Freshwater and Marine Aggregated)

Number of Facilities	Current Frequency (per year)	Proposed Frequency (per year)	Change in Test Frequency (per year)	Incremental Costs ($/year)	Average Per Facility Incremental Costs ($/year/plant)
10	0	4	4	$31,000 to $65,000	$3,100 to $6,500
8	0	12	12	$75,000 to $155,000	$9,400 to $19,400
8	0	4 to 12 [1]	4 to 12	$25,000 to $155,000	$3,100 to $19,400
10	0.2	4	3.8	$30,000 to $61,000	$3,000 to $6,100
1	0.2	12	11.8	$9,000 to $19,000	$9,200 to $19,100
5	0.2	4 to 12 [1]	3.8 to 11.8	$16,000 to $105,000	$3,200 to $21,100
3	0.4	4	3.6	$8,000 to $17,000	$2,800 to $5,800
2	0.5	4	3.5	$6,000 to $14,000	$3,200 to $7,100
1	0.5	4 to 12 [1]	3.5 to 11.5	$4,000 to $28,000	$3,700 to $28,200
94	1	4	3	$236,000 to $501,000	$2,500 to $5,300
14	1	12	11	$127,000 to $267,000	$9,000 to $19,100
20	1	4 to 12 [1]	3 to 11	$54,000 to $429,000	$2,700 to $21,500

Number of Facilities	Current Frequency (per year)	Proposed Frequency (per year)	Change in Test Frequency (per year)	Incremental Costs ($/year)	Average Per Facility Incremental Costs ($/year/plant)
23	2	4	2	$40,000 to $86,000	$1,700 to $3,700
9	2	12	10	$85,000 to $187,000	$9,400 to $20,800
7	2	4 to 12 [1]	2 to 10	$14,000 to $155,000	$2,000 to $22,100
28	4	4	0	$0 to $0	$0 to $0
41	4	12	8	$289,000 to $624,000	$7,000 to $15,200
3	6	12	6	$14,000 to $29,000	$4,700 to $9,700
6	12	4	-8	$-37,000 to $-78,000	$-6,200 to $-12,4900
32	12	12	0	$0 to $0	$0 to $0

Note: Costs are rounded and may not sum.

1. Insufficient information to assign a monitoring frequency under the Provisions. Costs reflect the potential range of monitoring frequencies likely to be assigned (i.e., quarterly to monthly).

Total statewide chronic toxicity incremental routine monitoring costs are estimated to range from $1,025,000 per year to $2,823,000 per year.

For species sensitivity screening costs, PG Environmental assumed each municipal and industrial discharger would conduct screenings quarterly in the first year of every other permit term (i.e., four in the first year every ten years, or 0.4 tests per year). Screening unit costs were based on the average 3-species (vertebrate, invertebrate, and plant) for single-concentration screening tests ($1,720 for freshwater permittees; and $2,880 for marine) and for multiple-concentration tests ($3,730 for freshwater, and $4,850 for marine). Statewide species sensitivity testing costs are estimated to range from $256,000 per year to $516,000 per year. The low-end of the range assumes all dischargers are assigned single-concentration test based on according to their receiving waterbody type (i.e., freshwater or marine) and the high-end of the range assumes all are assigned multiple concentration tests.

Costs were not estimated for acute toxicity routine monitoring. Acute toxicity reasonable potential analyses and routine monitoring are assigned at the discretion of the Regional Water Board. The Provisions state that chronic toxicity testing is generally protective of acute toxicity. However, it is not possible to determine if the number of dischargers required to conduct routine monitoring for acute toxicity will increase, decrease, or remain the same under the Provisions. As of August 2019, 41 permittees utilize flow-through acute toxicity monitoring and these plants are not expected to experience any change in costs under the Provisions.

Costs were not estimated for general permittees. However, unit costs associated with compliance activities associated with those affected facilities covered by general permits are expected to be similar to those for individual permittees.

5.2 Storm Water Dischargers

Incremental compliance costs to storm water discharges associated with additional enforcement actions due to a change in statistical approach specified under the Provisions are unlikely based on the State Water Board (2011) comparison of toxicity results for storm water data using the TST statistical approach and current aquatic toxicity methods. However, these dischargers may decide to add replicates to samples to improve statistical power. As discussed above, this may add anywhere from $60 to $225 per test but would be motivated by efforts to reduce total costs by avoiding accelerated monitoring and possibly developing management plans.

5.3 Nonpoint Source Dischargers

Incremental costs to discharges from nonpoint source dischargers required to monitor toxicity associated with additional enforcement actions due to a change in test analysis methods under the Provisions are unlikely based on the State Water Board (2011) comparison of toxicity results for storm water runoff from agriculture areas using the TST statistical approach and aquatic toxicity methods.

5.4 Limitations and Uncertainties

There are a number of uncertainties associated with the analysis of potential compliance and costs under the Provisions due to data limitations**. Exhibit 5-3** summarizes the key uncertainties and the potential effect on estimated costs.

Exhibit 5-4. Key Limitations and Uncertainties in the Analysis of Compliance and Costs

Issue or Assumption	Impact on Estimated Costs	Comments
Treatment costs not estimated.	Costs may be understated	If a TRE is necessary, dischargers could incur some costs for reducing effluent toxicity. However, without information on the pollutants causing the toxicity, the magnitude of those costs cannot be estimated. It is unlikely that a significant number of dischargers, if any, would need to implement additional treatment controls under the Provisions that would not already be needed to meet existing toxicity permit requirements.
Assumption that all municipal and industrial permittees will have reasonable potential for chronic toxicity, and will be subject to routine monitoring.	Costs may be overstated	In general, it is expected that Regional Water Boards will establish chronic effluent limitations for non-storm water NPDES dischargers. However, some dischargers will be exempted from the Provisions entirely.
Acute toxicity routine monitoring costs not estimated.	Uncertain	The Provisions state that chronic toxicity testing is generally protective of acute toxicity. However, it is not possible to determine if the number of dischargers required to conduct routine monitoring for acute toxicity will increase, decrease, or remain the same under the Provisions.

Issue or Assumption	Impact on Estimated Costs	Comments
Costs for general permittees not estimated.	Costs may be understated	Those general permittees who are subject to the Provisions are likely to experience costs similar to individual permittees from similar industries and of similar scale.
Costs for TRE/IEs is not estimated.	Costs may be understated	Some proportion of permittees may experience non-compliance events under the provisions. The cost impact of TREs under the provisions is likely to be greater than zero, though several factors will mitigate these incremental costs like (1) no accelerated monitoring, and (2) the assumption that conducting a TRE is based on repeated violations (either 2 violations in a month or 2 successive calendar months occurrence). Additionally, for storm water and nonpoint sources; there is no required TRE/IEs specification in the Provisions.
Incremental costs associated with a change in monitoring requirements are not estimated for nonpoint source required to monitor toxicity.	Uncertain	Costs to dischargers with existing toxicity provisions may be minimal or there may be cost savings. Dischargers with no existing toxicity provisions could incur costs if permit writers choose to include them in permits; however, such costs could be offset by potential cost savings from nonpoint source dischargers.

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Appendix A: General Permits

NPDES No.	Order No.	Permit Name	Issue Date	Expiration Date
CAG719001	R9-2013-0026	BOATYARDS GENERAL PERMIT	2013-05-30	2018-09-30
CAG993003	R3-2013-0041	NPDES R3-2013-0041 FOR AQUACULTURE & AQUARIUMS	2013-12-05	2019-02-01
CAG585001	R5-2017-0085	NPDES GO R5-2017-0085 FOR MUNICIPAL WASTEWATER DISCHARGES THAT MEET OBJECTIVES/CRITERIA AT THE POINT OF DISCHARGE TO SURFACE WATER	2017-08-11	2022-11-30
CAG911001	R1-2016-0034	DISCHARGES OF HIGHLY TREATED GROUNDWATER TO SURFACE WATERS FOLLOWING EXTRACTION AND TREATMENT OF GROUNDWATER POLLUTED WITH PETROLEUM HYDROCARBONS AND VOLATILE ORGANIC COMPOUNDS	2016-10-20	2021-10-31
CAG915001	R5-2013-0075	PETROLEUM CLEANUP	2013-05-31	2018-05-01
CAG916001	R6T-2010-0024	TREATED GROUNDWATER	2010-06-09	2015-06-09
CAG917001	R7-2009-0400	TREATED GROUNDWATER FROM VOLATILE ORGANIC CONSTITUENTS	2009-09-17	2014-09-16

NPDES No.	Order No.	Permit Name	Issue Date	Expiration Date
CAG919001	R9-2007-0034	GENERAL WDRS FOR DISCHARGES FROM TEMPORARY GROUNDWATER EXTRACTION AND SIMILAR WASTE DISCHARGES TO SAN DIEGO BAY, TRIBUTARIES THERETO UNDER TIDAL INFLUENCE, AND STORM DRAINS OR OTHER CONVEYANCE SYSTEMS TRIBUTARY THERETO	2007-10-10	2012-10-10
CAG919002	R9-2008-002	GENERAL WDRS FOR DISCHARGES FROM TEMPORARY GROUNDWATER EXTRACTION AND SIMILAR WASTE DISCHARGES TO SURFACE WATERS WITHIN THE SAN DIEGO REGION EXCEPT FOR SAN DIEGO BAY	2008-03-12	2013-03-12
CAG919003	R9-2015-0013	GROUNDWATER EXTRACTION DISCHARGES	2015-06-24	2020-09-30
CAG993001	R3-2017-0042	DISCHARGES WITH LOW THREAT TO WATER QUALITY	2017-12-07	2017-12-07
CAG993002	R3-2016-0035	DISCHARGES OF HIGHLY TREATED GROUNDWATER TO SURFACE WATER	2016-12-08	2022-01-28
CAG995002	R5-2016-0076-01	THE NPDES GO R5-2016-0076-01 FOR LIMITED THREAT DISCHARGES TO SURFACE WATER	2016-10-14	2022-01-30
CAG382001	R2-2016-0009	DISCHARGES OF FILTER BACKWASH FROM DRINKING WATER FILTER FACILITIES	2016-03-09	2021-03-31
CAG616002	R6T-2011-0019	CA CONSTRUCTION STORMWATER LAKE TAHOE	2011-04-14	2016-04-13

NPDES No.	Order No.	Permit Name	Issue Date	Expiration Date
CAG648001	R8-2013-0031	WELLHEAD TREATMENT SYSTEMS	2013-12-06	2018-12-01
CAG674001	R4-2009-0068	HYDROSTATIC TEST WATERS	2009-06-04	2014-06-04
CAG834001	R4-2018-0086	NPDES GEN PERMIT R4-2018-0086 FOR GW INVEST/CLEANUP OF PETROLEUM FUEL-CONTAMINATED SITES	2018-06-14	2023-08-13
CAG912002	R2-2017-0048	DISCHARGE OR RECLAMATION OF EXTRACTED AND TREATED GROUNDWATER RESULTING FROM THE CLEANUP OF GROUNDWATER POLLUTED BY VOLATILE ORGANIC COMPOUNDS (VOCS), FUEL LEAKS, FUEL ADDITIVES, AND OTHER RELATED WASTES (VOC AND FUEL GENERAL PERMIT)	2019-01-01	2023-12-31
CAG912004	R2-2018-0026	DISCHARGE OR RECLAMATION OF EXTRACTED BRACKISH GROUNDWATER, REVERSE OSMOSIS CONCENTRATE RESULTING FROM TREATED BRACKISH GROUNDWATER, AND EXTRACTED GROUNDWATER FROM STRUCTURAL DEWATERING REQUIRING TREATMENT TO SURFACE WATERS (GROUNDWATER GENERAL PERMIT)	2018-06-13	2023-12-31
CAG914001	R4-2018-0087	NPDES GEN PERMIT R4-2018-0087 FOR GW INVEST/CLEANUP OF VOC SITES	2018-06-14	2023-06-13
CAG918001	R8-2012-0027	TREATED GROUNDWATER PETROLEUM HYDROCARBONS	2012-07-20	2017-07-01

NPDES No.	Order No.	Permit Name	Issue Date	Expiration Date
CAG918002	R8-2007-0041	TREATED GROUNDWATER PETROLEUM HYDROCARBONS #2	2007-11-30	2012-11-01
CAG982001	R2-2015-0035	DISCHARGES OF PROCESS WASTEWATERS FROM AGGREGATE MINING, MARINE SAND WASHING, and SAND OFFLOADING FACILITIES TO SURFACE WATERS	2015-07-08	2020-08-30
CAG994003	R4-2014-0060	NON-PROCESS WASTEWATER TO SURFACE WATER	2014-05-08	2019-06-30
CAG994004	R4-2018-0125	NPDES GEN PERMIT R4-2018-0125 FOR GW CONSTRUCTION & PROJECT DEWATERING	2018-09-13	2023-11-13
CA0024902	R1-2015-0003	GENERAL NPDES PERMIT FOR LOW THREAT DISCHARGES	2015-03-12	2020-09-20
CA0038849	R2-2017-0041	WASTE DISCHARGE REQUIREMENTS FOR MERCURY AND PCBS FROM MUNICIPAL AND INDUSTRIAL WASTEWATER DISCHARGES TO SAN FRANCISCO BAY	2018-01-01	2022-12-31
CA0038873	R2-2014-0014	WASTE DISCHARGE REQUIREMENTS FOR NUTRIENTS FROM MUNICIPAL WASTEWATER DISCHARGES TO SAN FRANCISCO BAY	2014-07-01	2019-06-30
CAG011001	R1-2012-0001	CONCENTRATED ANIMAL FEEDING	2012-01-19	2017-01-18

NPDES No.	Order No.	Permit Name	Issue Date	Expiration Date
CAG015001	R5-2011-0091	CONCENTRATED ANIMAL FEEDING	2011-12-01	2015-12-10
CAG017001	R7-2013-0800	CONCENTRATED ANIMAL FEEDING	2013-06-20	2019-09-29
CAG018001	R8-2018-0001	NPDES R8-2018-0001 GENERAL WDR FOR CAFO'S	2018-12-07	2024-03-15
CAG032012	R2-2017-0027	DISCHARGES FROM DRY DOCK OPERATIONS	2017-07-12	2022-08-31
CAG131015	R1-2015-0009	COLD WATER CONCENTRATED AQUATIC ANIMAL PRODUCTION FACILITY DISCHARGES TO SURFACE WATERS	2015-11-19	2021-01-31
CAG135001	R5-2014-0161	NPDES CAAP GO R5-2014-0161 (5F) FOR COLD WATER CONCENTRATED AQUATIC ANIMAL PROD FAC	2014-12-05	2019-12-31
CAG140001	2014-0194-DWQ	DRINKING WATER SYSTEM DISCHARGES (STATEWIDE)	2014-11-18	2020-02-25
CAG616003	R6T-2016-0038	GENERAL WDRS AND NPDES PERMIT FOR STORM WATER RUNOFF ASSOCIATED WITH MARINA OPERATIONS IN THE LAKE TAHOE HYDROLOGIC UNIT EL DORADO AND PLACER COUNTIES	2016-06-0	8 2021-10-31
CAG618001	R8-2018-0069	STORM WATER RUNOFF FROM SCRAP METAL RECYCLING FACILITIES	2018-10-19	2023-10-18

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CAG670001	2017-0029-DWQ	STATEWIDE GENERAL NPDES/WDR PERMIT 2017-0029-DWQ FOR NATURAL GAS FACILITY DISCHARGES	2017-12-05	2022-12-01
CAG679001	R9-2010-0003	HYDROSTATIC TEST WATERS	2010-09-08	2015-10-31
CAG990002	2014-0174-DWQ	UTILITY VAULTS (STATEWIDE)	2014-10-21	2020-06-29
CAG990004	2016-0039-DWQ	STATEWIDE GENERAL NPDES PERMIT 2016-0039-DWQ FOR VECTOR CONTROL	2016-03-01	2021-06-30
CAG990005	2013-0002-DWQ	PESTICIDE-WEED CONTROL (STATEWIDE)	2013-03-05	2018-11-30
CAG990006	2011-0003-DWQ	PESTICIDE-AQUATIC ANIMAL INVASIVE SPECIES (STATEWIDE)	2011-03-01	2016-02-28
CAG990007	2011-0004-DWQ	PESTICIDE-SPRAY APPLICATION (STATEWIDE)	2011-03-01	2016-02-28
CAG994006	R4-2014-0141	NPDES GEN PERMIT R4-2014-0141 FOR GW FROM SGV VALLEY GW BASIN IN UPPER SG RIVER & RIO HONDO WATERSHEDS LA CNTY	2014-07-10	2019-08-31
CAG995001	R5-2013-0074	WDRS FOR DEWATERING AND OTHER LOW THREAT DISCHARGES TO SURFACE WATERS	2013-05-31	2018-05-01

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CAG996001	R6T-2008-0023	LIMITED THREAT DISCHARGE TO SURFACE WATER(REPLACES2003-0034)	2008-07-23	2013-07-23
CAG996001	R6T-2014-0049	LIMITED THREAT DISCHARGES TO SURFACE WATER	2014-06-18	2019-06-17
CAG997001	R7-2015-0006	GENERAL ORDER FOR DISCHARGES OF LOW THREAT WASTEWATERS TO SURFACE WATERS NPDES R7-2015-0006	2015-09-17	2020-09-30
CAG998001	R8-2015-0004	NPDES R8-2015-0004 - GENERAL DE MINIMIS PERMIT	2015-06-19	2020-06-30
CAG999002	R9-2011-0022	SAN DIEGO REGION PUBLIC FIREWORKS DISPLAYS	2011-05-11	2016-05-31
CAG999003	R9-2012-0063	GENERAL NPDES R9-2012-0063 LANTHANUM MODIFIED CLAY	2012-12-12	2018-01-01