Los Angeles Region Framework for Climate Change Adaptation and Mitigation

Potential Regulatory Adaptation and Mitigation Measures

Los Angeles Regional Water Quality Control Board

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Potential Regulatory Adaptation and Mitigation Measures

April 2019

Note: This framework is intended to foster discussion among the Los Angeles Water Board, the regulated community, and other stakeholders as well as help inform work plan development within the Los Angeles Water Board's programs. The framework does not establish new policies or requirements.

This report is available online at:
https://www.waterboards.ca.gov/losangeles/water_issues/programs/climate_change

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1. Introduction

The Los Angeles Water Board started considering climate change issues in 2014 and included the development of a regional climate change strategy as a priority project for the 2014-2016 triennial review. Overall, the objective of this strategy is to protect beneficial uses and water quality under a changing climate, while achieving the following goals:

- Improve ecosystem resilience,
- Protect coastal and inland infrastructure and prevent it from failing,
- Promote groundwater recharge and water recycling,
- Promote a sustainable watershed approach,
- Expand monitoring and research to track the effects of climate change and effectiveness of mitigation measures, and
- Protect vulnerable communities

Early efforts towards the development of this strategy resulted in the publication in 2015 of the Los Angeles Region Framework for Climate Change Adaptation and Mitigation - *Current State of Knowledge & Water Quality Regulatory Program Considerations*[1] (herein referred to as Part 1 of the Framework). The document looked at the impacts of climate change through the lens of water quality and began a discussion on issues that will need to be considered and tackled over time.

To summarize, Part 1 described how human activities over the past century have resulted in releases of large quantities of carbon dioxide and other greenhouse gases (GHG) into the atmosphere, leading to the onset of significant changes in the earth's climate that will have substantial impacts on water resources, including water quality. Part 1 discussed how the predicted increase in temperatures, increased occurrence of extreme weather conditions (e.g., extreme precipitation events and drought), and rising sea level could drastically alter hydrological and ecosystem processes in our region and how such impacts could manifest, such as:

- Decreases in stream flow overall, together with potential for increased short-term rapid increases in flow following precipitation events that can cause scour and erosion;
- Reductions in, and changes to, aquatic habitats;
- Increases in surface water temperature;
- Increases in sedimentation (resulting from flooding and wildfires followed by post-fire rain and mudslides);
- Increases in pollutant levels (resulting from increased sedimentation and sediment-bound pollutants, decreased streamflow, potential inundation of or overflow/bypass from wastewater treatment facilities, and release of chemicals used for fighting wildfires);

[1] http://www.waterboards.ca.gov/losangeles/water_issues/programs/climate_change/docs/2015/Climatechange-frameworkforclimatechangeadaptation-final7-20-2015.pdf.

- Increased algal growth and occurrence of harmful algal blooms;
- Increased coastal erosion; and
- Ocean acidification and hypoxia.

It further identified that many beneficial uses could be impacted, including aquatic and riparian habitats and associated species, as well as municipal supply, recreational and commercial uses. Impacts to municipal supply and recreational uses, such as the potential increase in the occurrence of harmful algal blooms or sewer overflows, heighten risks to public health.

Protecting water quality is essential to both human populations and natural ecosystems into the future. Therefore, it is imperative to assess these impacts, develop strategies for adapting to the upcoming changes, and mitigate their effects on water quality and on the beneficial uses of our waters. Building on Part 1, the Los Angeles Water Board has continued its efforts to develop a regional strategy, while also supporting statewide efforts. Following is a brief overview of these efforts.

In February 2016, Board management organized an information item during a regularly scheduled Board meeting to share with Board members and stakeholders the results of the latest research assessing climate change effects on a regional level. Presentations by Dr. Alex Hall (University of California, Los Angeles [UCLA]), Dr. Patrick Barnard (United States Geological Survey [USGS]) and Dr. Juliette Hart (University of Southern California [USC]) introduced the results of local models describing the effects of climate change on temperature, precipitation, runoff and snowpack in the Los Angeles region, as well as the potential impacts of sea level rise and storms in coastal zones. Board staff and the presenters discussed the results in the context of future water availability, vulnerability assessment and possible adaptation strategies for the Los Angeles region.

In response to Part 1 of the Framework, staff developed permit language addressing climate change, which included permit provisions requesting that permittees prepare a climate change vulnerability assessment and Mitigation Plan (Climate Change Plan) that would include an assessment of short- and long-term vulnerabilities as well as plans to mitigate vulnerabilities. The Los Angeles Water Board began implementing this language in permits and other orders in 2016, and to date have incorporated it in seven Waste Discharge Requirements (WDRs).

Efforts were also directed towards research needs for addressing climate change. In spring 2017, the Water Boards allocated funding for two research contracts that will help further understanding of the impacts of climate change in the Los Angeles Region. The purpose of the first contract, awarded to UCLA, is to use climate models to predict both future precipitation levels and stream temperatures in Los Angeles and Ventura counties. This prediction information will help the Los Angeles Water Board effectively adapt its requirements in permits and other orders to future climatic conditions and will inform Basin Plan actions to protect beneficial uses. The second contract was awarded to the Southern California Coastal Water Research Project (SCCWRP). This research uses the data generated by UCLA to consider the consequences future changes in flow and stream temperature would have on the riparian populations in our region. This will help the Los Angeles Water Board prioritize

management actions based on the relative vulnerability of local species and their importance from conservation and ecosystem perspectives.

On March 7, 2017, the State Water Resources Control Board (State Water Board) adopted a resolution in recognition of the challenges posed by climate change that requires a proactive approach to climate change in all Board actions, including drinking water regulation, water quality protection, and financial assistance (Resolution No. 2017-0012).[2] The resolution lays the foundation for a response to climate change that is integrated into all State Water Board actions, by giving direction to the State Water Board divisions and encouraging coordination with the Regional Water Boards. The resolution includes actions aimed at reducing greenhouse gas emissions, improving ecosystem resilience, responding to climate change impacts, and ensuring that decisions are made using sound modeling and analyses. It also takes funding and outreach issues into consideration.

In addition to these efforts, Board staff and local stakeholders were consulted to identify the specific challenges that will likely arise due to climate change within the activities of the Los Angeles Water Board's programs and a menu of potential actions that could be implemented to address those challenges. The list of programs considered includes:

- Water Quality Standards/Basin Planning
- Total Maximum Daily Loads
- Control of Nonpoint Sources of Pollutants
- Regulation of Dredge and Fill Activities
- Watershed Regulatory (i.e., National Pollutant Discharge Elimination System [NPDES] permitting of wastewater from POTWs, industrial facilities and some other categories of waste discharge and water reclamation requirements [WRRs])
- Stormwater permitting (i.e., Municipal Separate Storm Sewer System [MS4] permitting, Industrial and Construction stormwater permitting)
- Groundwater Permitting
- Land Disposal
- Groundwater Remediation
- Management of Underground Storage Tanks
- Oil and Gas Operation – Water Quality
- Enforcement

For each of the programs considered, Board staff considered the impacts of climate change on their program's objectives and primary tasks and the various steps that could be taken to address these impacts. Specifically, Board staff deliberated on: 1) what type(s) of regulatory action could be implemented, 2) what type(s) of monitoring and research would be needed, 3) potential areas of

[2] http://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/2017/rs2017_0012.pdf

collaboration, and 4) how the program could address environmental justice where climate change will likely have greater impacts on disadvantaged communities.

In addition to this internal consultation, Board staff held a public workshop on August 8, 2017, during which interested stakeholders were asked to consider the following:

1) How the various impacts of climate change may affect facilities, the regulatory environment, and the region's water resources and associated beneficial uses,
2) How the Los Angeles Water Board could take these issues into consideration, and
3) How the Los Angeles Water Board could take into account environmental justice when dealing with these issues.

Appendix A presents a summary of the discussions and ideas generated during the workshop.

Building on these efforts, on May 10, 2018, the Los Angeles Water Board adopted "A Resolution to Prioritize Actions to Adapt to and Mitigate the Impacts of Climate Change on the Los Angeles Region's Water Resources and Associated Beneficial Uses" (Resolution No. R18-004).[3] The objectives of the proposed resolution are:

- To acknowledge the need to adapt to, and where possible mitigate the impacts of, climate change in various Board programs/actions,
- To briefly summarize the actions the Board has already begun to take in some program areas, and
- To begin to identify some future actions.

The resolution summarizes the steps taken so far to address the impacts of climate change within the Los Angeles Water Board and lists a series of steps to move forward. These include the identification of potential regulatory adaptation and mitigation measures that could be implemented on a short-term and long-term basis by each of the Los Angeles Water Board's programs to take into account, and assist in mitigating where possible, the effects of climate change on water resources and associated beneficial uses.

In response to Resolution No. R18-004, this document presents programmatic considerations regarding potential regulatory adaptation and mitigation measures that were identified following consultations with both staff and stakeholders. This document constitutes Part 2 of the Los Angeles Region Framework for Climate Change Adaptation and Mitigation, and follows Part 1, which introduced the issue of climate change in the context of the Los Angeles Water Board's mission and programs.

[3]https://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/130_new/ResolutionNoR18-004.pdf

2. Water Quality Standards/Basin Planning

The Water Quality Standards Program (or Basin Planning Program) is charged with developing and updating Water Quality Standards (comprised of beneficial uses, numeric and narrative water quality objectives and an anti-degradation policy), and developing plans and policies designed to protect water quality in the region.

2.1. Impacts to the program

The effects of climate change on water quality will potentially affect numerous beneficial uses as well as water quality objectives for waters in the Los Angeles Region. This will subsequently have certain repercussions for the Standards/Basin Planning program. Considerations regarding potential impacts of climate change to beneficial uses and water quality objectives are discussed in detail in Section 3.1.2 of Part 1 of the Framework. This section presents a summary of these concepts.

Most of the existing and potential beneficial uses of waters in the Region would potentially be impacted by climate change (see Tables 1 and 2 of Part 1 of the Framework). Examples of these impacts include:

For wildlife-related uses:

- Impairment of the COLD (Cold Freshwater Habitat) beneficial use as the expected increase in water temperatures endangers fish populations that thrive in cold waters.
- Endangerment of beneficial uses to protect the ecological integrity of inland and coastal waters, such as COLD, WARM (Warm Freshwater Habitat), WET (Wetland Habitat), WILD (Wildlife Habitat), BIOL (Preservation of Biological Habitats), RARE (Rare, Threatened, or Endangered Species), SPWN (Spawning, Reproduction, and/or Early Development), EST (Estuarine Habitat), MAR (Marine Habitat) and MIGR (Migration of Aquatic Organisms), as the combination of lower flows, increase in water temperatures, increasing pollutant loadings (resulting from increased sedimentation and sediment-bound pollutants, decreased streamflow, potential inundation of or overflow/bypass from facilities, and release of chemicals used for fighting wildfires) and increasing algal growth (which could bring a decrease in oxygen levels) could potentially affect the hydrological and chemical quality of the region's waters.
- Disruption of EST, WET, MAR, WILD, BIOL, RARE, SPWN and MIGR uses due to impairment of coastal lagoons with sand bars that naturally open and close seasonally, affecting aquatic life, including many endangered species.

For recreational uses:

- Impacts to REC-1 (Water Contact Recreational Use), LREC-1 (Limited Water Contact Recreational Use) and REC-2 (Non-contact Recreational Use) beneficial uses due to sea level rise and the associated potential loss of beaches and recreational areas, as well as increasing

algae growth and potential harmful algal blooms, and decreasing flow resulting in shallower water depth.

- Disruption of REC-1, LREC-1 and REC-2 uses due to warmer temperatures, changes in water circulation patterns resulting from lower flows, and sewer overflows resulting from flood events potentially favoring bacterial growth.

For commercial uses:

- Disruption of COMM (Commercial and Sport Fishing) uses as a result of the potential ecological changes mentioned above.
- Endangerment of SHELL (Shellfish Harvesting), COMM and AQUA (Aquaculture) beneficial uses resulting from ocean acidification and hypoxia.
- Interruption of beneficial uses designated to protect human activities that rely on water quality, including PROC (Industrial Process Supply), GWR (Ground Water Recharge), FRSH (Freshwater Replenishment), MUN (Municipal and Domestic Supply), AGR (Agricultural Supply) and AQUA uses, due to increasing pollutant and sediment loadings and increasing algae growth in surface waters as well as the potential increase of pollutant loads and the intrusion of saltwater in coastal groundwater basins.
- Compromised NAV (Navigation) uses, as decreasing flows and increased sedimentation could result in water depths that no longer support navigation.

Besides beneficial uses considerations, the impacts on some water quality objectives and their application may need to be addressed. For example, the definition of the water quality objective for temperature may need to be revisited. Currently, the Basin Plan water quality objective for temperature has a broad definition, which states:

> *For waters designated WARM, water temperature shall not be altered by more than 5 ^{o}F above the natural temperature. At no time shall these WARM designated waters be raised above 80 ^{o}F as a result of waste discharge.*
>
> *For waters designated COLD, water temperature shall not be altered by more than 5 ^{o}F above the natural temperature.*

The application of this objective requires that staff determine the "natural temperature" of individual waterbodies. This determination can be difficult. In many cases, waterbodies have been significantly altered from their natural state and often staff must rely on potentially limited information such as historical data records. In addition to those existing challenges, the expected increase in temperatures due to climate change will further complicate the determination of what constitutes a "natural temperature," as the definition of the reference condition itself may change.

Other water quality objectives that may need further attention include dissolved oxygen (concentrations of which may decrease as a result of increasing temperatures and eutrophication), pH (levels of which will be impacted by ocean acidification), salts (concentrations of which could

increase both as a result of a decrease in flows and conservation efforts), and nutrients (concentrations of which could exacerbate harmful algal blooms and hypoxia).

To complicate matters further, the physical and chemical alterations of the natural systems associated with climate change may alter the critical levels of a beneficial use-impairing pollutant. For example, the predicted increase in water temperatures may intensify the level of toxicity for some pollutants such as ammonia. If the water quality objective is not expressed a variable equation, this may necessitate a reconsideration of the objective.

In addition to these reconsiderations, new water quality objectives may need to be developed. For example, climate change may result in increases in observed pollutant loads that could raise the concentrations of pollutants that to date have not been identified at levels of concern. The heightened concentrations of such pollutants to levels of concern would then spur development of a new water quality objective. This may be an issue particularly for constituents of emerging concern (CECs) that are present in effluents from publicly owned treatment works (POTWs), but for which objectives have not yet been established (e.g., personal care products, pharmaceuticals, N-nitrosodiumethylamine [NDMA], Perfluorooctanesulfonic acid [PFAS]).

Finally, climate change will have an impact on reference conditions, which are crucial tools for the development of water quality regulations. Finding unperturbed waterbodies can be challenging in heavily urbanized southern California, and may become even more so as climate conditions change, regardless of local anthropogenic perturbations. In addition, as climate change progresses, the characteristics of reference conditions themselves may change as ecological, physical and chemical conditions are altered in these unperturbed systems.

2.2. Potential adaptation/mitigation measures

Per a State and federal mandate, the Standards/Basin Planning program periodically reviews the Los Angeles Region's Basin Plan and the water quality standards contained therein. This process is known as the triennial review and includes the identification and prioritization of the most important or compelling projects that should be undertaken by the program. During the 2014-2016 and 2017-2019 triennial reviews, the development of a climate change strategy was identified as a priority project. Future triennial reviews could prioritize additional projects to address climate change.

Because the potential impacts of climate change on standards are so numerous, the Standards/Basin Planning program will need to prioritize its actions. In order to properly do so, the vulnerability of all beneficial uses and water quality objectives in the Basin Plan should be reviewed. An evaluation of the pace and significance of impacts to individual beneficial uses by climate change would allow the creation of a priority list of actions, and of a short list of water quality objectives that would need to be updated/reevaluated. If necessary, these updates could require the creation of new monitoring/research strategies to identify and quantify the projected changes.

The expected disruptions to beneficial uses mean that the Standards/Basin Planning program will have to consider options to preserve them or mitigate negative impacts. In some cases, there may be little that can be done to preserve beneficial uses, such as the loss of the COLD use due to rising water temperatures even in waterbodies that are not influenced by waste discharges. Similarly, special attention should be given to flow issues, as the expected decrease in flow in the region's streams could lead to a significant portion of headwater streams drying up, leading to a loss of beneficial uses in those areas. To mitigate impacts to the human beneficial uses (PROC, GWR, FRSH, and MUN), the Standards/Basin Planning program could take actions in coordination with other Water Board programs to facilitate the use of stormwater and recycled water as a water source.

In addition to the potential update/reevaluation of specific water quality objectives, the Los Angeles Water Board could consider developing implementation provisions that would take into account the new hydrological conditions. For example, such provisions could give more flexibility to permittees in times of drought, and then be more stringent when there is an abundance of water.

Furthermore, anti-degradation provisions may be a useful tool to protect the region's groundwater basins against degradation during drought conditions. California's Antidegradation Policy (State Water Board Resolution No. 68-16) protects waterbodies where existing quality is higher than necessary for the protection of beneficial uses by considering the assimilative capacity of a waterbody, which is the difference between the current water quality and the water quality objective for any particular pollutant. Adequate management of this "buffer" could guarantee appropriate protection of beneficial uses and water quality during severe drought conditions. An example of the application of this approach is the development of Salt and Nutrient Management Plans (SNMPs). Those plans are designed to facilitate basin-wide management of salts and nutrients from all sources in a manner that optimizes recycled water use while ensuring protection of groundwater supply and beneficial uses, agricultural beneficial uses, and human health. SNMPs include analyses of future conditions in the basin, including land use, recycled water projects and climate change. Eight SNMPs have been developed or are currently in development by stakeholders for nine groundwater basins in the region, and management measures are being incorporated in the Basin Plan following completion.

Finally, other day-to-day actions from the Standards/Basin Planning program could include continuing to stay up-to-date with the latest information regarding climate change (including research, implementation and regulatory aspects), coordinating with the other Los Angeles Water Board programs to ensure the most up-to-date information and tools about climate change are available to them, and sharing pertinent information with stakeholders.

2.3. Areas of monitoring and research needed

Further monitoring and research are needed to better predict climate change impacts on water quality standards and understand their repercussions. The following are potential areas of research related to climate change that would inform the Standards/Basin Planning program:

- Evaluations of which pollutants and beneficial uses are more susceptible to climate change, and which ones would be impacted the most quickly, would allow the Standards/Basin Planning program to prioritize its actions.
- Focused studies for pollutants determined to be a priority should explore the specific mechanisms and the extent of the impacts of climate change. This would help determine what specific Basin Panning actions are needed.
- Studies to identify the geographical extent and amplitude of specific impacts (e.g., flooding) would also help prioritize actions.
- Continuous long-term monitoring surveys for both surface water and groundwater are necessary to help consider changes to water quality when they happen and evaluate their impact relative to the baseline. Such surveys could use traditional sampling methods, as well as imagery and collection of available data from dischargers and other stakeholders. A review of historic data from all available sources would help identify a baseline for future assessment.
- A regional groundwater quality assessment is necessary to understand trends and take relevant basin planning actions. SNMPs currently fill this role, but only for salts and nutrients. In addition, two studies financed through the agricultural waiver also looked at trends in groundwater quality, but with a focus on areas where groundwater quality is impacted by agricultural uses.
- Modeling/monitoring of seawater intrusion in coastal aquifers is critical to understand potential adverse effects on water quality in those areas.
- Implementation of a monitoring program or study such as a Los Angeles Water Board led pilot project to determine the effects of climate change on watersheds and the results of the Los Angeles Water Board's efforts on ameliorating those impacts.

2.4. Potential areas of collaboration with other agencies

Potential areas of collaboration include:

- Coordination with the State Water Board Division of Water Quality (DWQ) and the US Environmental Protection Agency (US EPA) on standards-related issues
- Coordination with the State Water Board's Division of Water Rights on flow-related issues
- Work with other resource agencies (e.g., USGS, US Fish and Wildlife, California Fish and Wildlife, DWR, local agencies, NGOs) to obtain and share relevant data
- Coordination with agencies implementing requirements of the Sustainable Groundwater Management Act (SGMA) on groundwater sustainability issues
- Coordination with SWAMP for monitoring efforts
- Per State Water Board Resolution No. 2017-0012, coordinate with DWQ to recommend areas of research needed to improve the Water Boards' ability to support resilient ocean and coastal ecosystems, and, where applicable and feasible, to maximize use of natural infrastructure/living shorelines for shoreline protection

- Coordination with State Water Board Division of Drinking Water (DDW) on water recycling issues

3. Total Maximum Daily Loads

Total Maximum Daily Loads (TMDLs) are developed for waterbodies that exceed water quality standards. TMDLs specify the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards, and then allocate that allowable amount of a pollutant to point and non-point sources. Those allocations are later incorporated into permits or other regulatory mechanisms.

3.1. Impacts to the program

Climate change will likely have various impacts on the TMDL program. Increased temperature and drought conditions may require re-evaluation of TMDL elements such as source assessments, linkage analyses, allocations, and margins of safety to account for warmer water and decreased stream flows. Decreased stream flows may affect the amount and relative distribution of pollutant loading from various sources, requiring TMDL source assessments and water quality models to be revised. Decreased stream flows may also reduce a waterbody's assimilative capacity for pollutants, requiring a re-evaluation of linkage analyses and a potential reduction of allocations in order to meet water quality standards.

In addition, new water quality impairments may arise as a result of warmer water and decreased stream flows. For example, increased concentrations of salts caused by evapotranspiration and increased recycled water use could lead to an increase in impairments due to salts. Additionally, more eutrophication is likely as warmer water temperatures and decreased shading promote algal growth. Similarly, the increased frequency of wildfires and flooding may increase pollutant loads, particularly affecting sediment loading from erosion or nutrient loading from nitrogen- and phosphorus-based fire retardants, which could also lead to additional water quality impairments.

Sea level rise may affect the salinity of inland surface waters as sea water intrudes further inland, which may affect the applicability of some water quality standards that are distinct for freshwater and saltwater.

Finally, increased flooding may cause municipalities to build additional flood control structures and increase imperviousness in watersheds, which may cause additional erosion, stream bank destabilization, and sedimentation downstream.

3.2. Potential adaptation/mitigation measures

In order to address impacts to the TMDL program caused by climate change, several measures can be considered. TMDL requirements could be adapted to the predicted changes to incentivize

implementation that includes climate change mitigation actions. In order to keep track of these efforts, a section could be added in the staff report as well as in the resolutions adopting TMDLs and TMDL reconsiderations. This section would present how the TMDL addresses climate change issues and discuss climate resilience benefits expected to result from implementation of the TMDL.

Potential effects of climate change should be considered during the source assessment and linkage analysis stage of TMDLs, especially when considering TMDLs involving an extended implementation period. These considerations should include not only the direct effects of climate change, such as warmer temperatures and lower flow rates, but also indirect effects, such as the increased application of recycled water by users in the watershed. In order to take these various potential changes to the environment into account when setting load allocations and waste load allocations, it may be appropriate for TMDLs to include larger margins of safety specifically to address climate change impacts. The decision to increase a margin of safety and by how much would be specific to the pollutant being addressed and would consider stakeholder input and best available science.

Similarly, climate change should be taken into consideration when contemplating implementation measures, depending on specific TMDLs and the vulnerability of individual watersheds. Particularly in vulnerable watersheds, early consideration of watershed impacts from climate change during implementation planning will improve the likelihood that TMDL planning efforts will not be negatively impacted as result of climate change impacts, and that additional implementation will not be needed as a result of changing conditions. In addition, an evaluation of current stakeholder efforts to mitigate climate change impacts may aid in developing a strategy that will provide consistency across programs, capitalize on efforts already underway, and expedite the process of responding to water quality impacts due to climate change.

TMDL implementation could include multi-benefit restoration projects, in addition to source control and treatment alternatives, that would help mitigate the effects of climate change. Examples of the effects of multi-benefit restoration include increasing natural shading to reduce temperature and light penetration, as well as stabilizing streambanks and planting buffer zones around waterbodies to minimize erosion and filter pollutants prior to their reaching waterbodies.

In order to incentivize this type of action, TMDLs could require responsible entities to consider climate change effects mitigation planning as part of their TMDL implementation plans, where the development of TMDL implementation plans are included as a TMDL deliverable. TMDLs could also provide responsible entities with a choice to either meet requirements without taking into account climate change or mitigate for expected changes and meet less stringent requirements. Multi-benefit implementation actions could also be incentivized with longer schedules and prioritization for funding.

In order to track the progression of expected changes due to climate change and verify the accuracy of the assumptions used in the TMDL, responsible entities could be required to report on how climate change affects their individual TMDL monitoring results, including identifying trends and the speed

of observed changes. Specific climate change indicators could also be used as tools to require additional monitoring and set up trigger levels. For example, TMDLs could include flow triggers, whereby additional actions are required or TMDLs are reconsidered if flows are below certain levels. This would guarantee an adaptive approach to climate change effects as they occur.

3.3. Areas of monitoring and research needed

The following are potential areas of research related to climate change that would inform the TMDL program:

- A baseline of stream flows is needed for all waterbodies in the region, in order to track future changes. Multiple tools could be used to get this information, such as flow gage data, aerial photography, or field measurements. Additional flow gages are needed for the main stems of the region's rivers; however, they may not be technically feasible for smaller tributaries because of a lack of sufficient flow for accurate measurement.
- Monitoring of climate change indicators such as stream flow, stream width, lake depth/volume, temperature, dissolved oxygen, and salinity in the waterbodies of the region would enable gauging of long-term trends.
- Reference systems used in previously adopted TMDLs to set numeric targets may need to be re-evaluated because they no longer represent a desirable water quality condition. New reference conditions could possibly be evaluated using existing reference sites.
- The effect of new technologies to address climate change impacts on water quality may need to be investigated (e.g., the possibility of silver used in cloud seeding entering waterbodies).

3.4. Potential areas of collaboration with other agencies

Potential areas of collaboration include:

- Coordinate with the State Water Board's Division of Water Rights on flow-related issues
- Work with other resource agencies (e.g., USGS, US Fish and Wildlife, California Fish and Wildlife, Department of Water Resources [DWR], local agencies, non-governmental organizations [NGOs]) to establish baseline conditions and track changes in waterbodies using remote sensing, autosampling, and field surveys.
- Consult with the California Department of Forestry and Fire Protection while reviewing or overseeing the implementation of TMDLs to make sure implementation measures employ natural solutions that ensure better resilience to fire and drought.

4. Control of Nonpoint Source Pollutants

The Nonpoint Source program manages measures to control pollutants originating from diffuse sources. These include, among others, agricultural sources, grazing activities, sediment erosion, and

marinas. The regulatory mechanisms used to control nonpoint source discharges include Waste Discharge Requirements (WDR) and waivers of WDRs.

4.1. Impacts to the program

As concluded above, increased temperatures and drought will likely reduce stream flows and consequently make receiving waters more vulnerable to pollutants discharged from nonpoint sources. Higher temperatures may also increase the frequency of wildfires that could lead to the discharge of eroded soils, organic matter, and fire retardant into waterbodies via nonpoint source runoff. More frequent droughts would cause nonpoint sources of pollution to build up on land that would then be washed into waterbodies during subsequent high intensity runoff when rains do come.

Conversely, more intense precipitation could increase flow rate and energy in streams, causing excessive erosion, stream bank destabilization, and sedimentation. Sea level rise will cause flooding in coastal areas that are often heavily farmed, which may cause episodic discharge of agriculture-related chemicals from fertilizers and pesticides into coastal waters, and damage to on-farm management practices that were put in place to control the discharge of pollutants to receiving waters during normal agricultural operations. Sea level rise could also lead to a disturbance of contaminated sediments as infrastructure is modified to adapt to rising waters (e.g., reinforcing/lifting of docks and pilings in marinas).

With respect to agriculture specifically, changes in crops and growing practices, increased reliance on local groundwater supplies, and responses to new pest and disease invasions can potentially increase discharges from agricultural activities.

4.2. Potential adaptation/mitigation measures

In order to combat the effects of climate change on nonpoint sources of pollutants, stakeholders could implement specific implementation measures. To encourage such measures, WDRs and waivers of WDRs could contain specific management practice requirements to protect against climate change impacts. For example, to address agricultural impacts, growers could enhance water conservation practices and irrigation efficiency to reduce impacts on groundwater supply and could implement additional structural and non-structural management practices to improve surface and groundwater quality. Note that although the Region's current Conditional Waiver of WDRs for Discharges from Irrigated Agricultural Lands within the Los Angeles Region does not address directly climate change and impacts to agriculture, it includes specific management practice requirements to protect against climate change impacts, such as improved irrigation efficiency and water conservation practices. For grazing practices, riparian exclusion requirements could be considered in WDRs or Waivers of WDRs, as keeping animals out of streambeds would reduce the erosion of stream banks. In addition, rotational grazing practices could limit the depletion of ground cover, therefore controlling erosion and the risk of pollutant runoff.

In addition to these specific provisions, WDRs and Conditional Waivers of WDRs could include iterative improvements and management practices in order to adapt to the evolving changes in climate as well as in practices. They could also incentivize multi-benefit projects that would help mitigate the effects of climate change.

Furthermore, in order to promote a more integrated approach to climate change adaptation, watershed planning could coordinate nonpoint and point source efforts to focus on stream and wetlands restoration, dam removal, increasing tree canopy, and establishing buffer areas to protect against increased erosion and discharge of pollutants. Watershed planning can consider the impacts of flood control structures on downstream erosion and lead to more holistic decisions about flood risk management.

In order to keep track of these efforts, findings could be added in all NPS WDRs and Waivers of WDRs summarizing how the permit's requirements improve ecosystem resilience to the impacts of climate change.

4.3. Areas of monitoring and research needed

The following are potential areas of research related to climate change that would inform the Nonpoint Source program:

- Groundwater and surface water monitoring is needed to establish baseline levels of water quantity and quality and to track trends and potential impacts due to agricultural activities.
- Research on drought- and pest-resistant crops will help develop more sustainable farming options for growers in our region, reducing the need for additional water supplies and pesticides, which will reduce nonpoint source pollution from agriculture.

4.4. Potential areas of collaboration with other agencies

Potential areas of collaboration include:

- Coordination of efforts with the State Water Board's Division of Drinking Water and county health officials to sample domestic groundwater wells
- Continued coordination of efforts with the Natural Resources Conservation Service (NRCS) and the Ventura County Resource Conservation District (VCRCD) to help farmers implement specific management practices and irrigation efficiency improvements
- Continued coordination with the Department of Pesticide Regulation (DPR) to investigate pesticide use data availability
- Consultation with the California Department of Forestry and Fire Protection while reviewing or overseeing the implementation of WDRs or Waivers of WDRs to make sure implementation measures employ natural solutions that ensure better resilience to fire and drought.

5. Regulation of Dredge and Fill Activities

The Clean Water Act Section 401 Water Quality Certification program regulates activities that result in dredge or fill to Waters of the U.S. and state.

5.1. Impacts to the program

Expected changes in sea level rise will likely have the greatest effect on the 401 program and the resources protected by the program. The Los Angeles Water Board can anticipate a greater number of projects proposed to build structures, and to rebuild structures, to manage the effects of sea level rise.

Where roads or structures are already located near the ocean or on cliffs or bluffs, there will likely be a demand for permits for more seawalls, revetments and other armoring in order to prevent damage and continue service. Proposed strengthening and raising of existing seawalls and revetments is also expected.

Structures or roads near the ocean and structures or roads on cliffs and bluffs will also be more likely to be destroyed by storms, and emergency permitting will be required for post-event cleanup. Clean-up and Abatement Orders may be necessary to compel cleanup.

Aside from hard structures, the natural landscape will be affected as well. Beaches will be inundated, and dunes will retreat. Indeed, a recent study predicts between 31 percent and 67 percent of Southern California beaches could be completely eroded by 2100.[4] To combat this trend, more proposed beach re-nourishment projects are anticipated, as well as potentially more projects to protect beaches and to encourage sand placement, such as groins and offshore breaks.

Many of these projects are expected to be controversial, as private property, public beaches and natural environments will either be protected at high cost or lost.

In addition, more episodic and catastrophic events, such as extreme rain conditions and wildfires, are expected due to climate change, which may create pulses of sediment loading into the river-estuarine system and thus increase the demand for maintenance dredging within the ports and harbors for navigability and safety purposes. The demand for wharf maintenance and improvement as well as dike or seawall fortification is also likely to increase as a result of sea level rise.

5.2. Potential adaptation/mitigation measures

In order to prevent future damage to new or rebuilt structures, Clean Water Act Section 401 Water Quality Certifications could include requirements for resistant design and/or long-term adaptive management plans. When reviewing projects, staff could ask if the project is resilient to climate

[4] Vitousek et al. (2017) A model integrating longshore and cross-shore processes for predicting long-term shoreline response to climate change. *Journal of Geophysical Research*. DOI: 10.1002/2016JF004065

change impacts, such as sea level rise and more intense storms. They could also refer applicants to projections of sea level rise provided in the most recent Ocean Protection Council Sea-level Rise Guidance Document, the most current data available through Cal-Adapt, and the California Coastal Commission's Sea Level Rise Policy Guidance, and encourage them to consult with the Ocean Protection Council, the Coastal Commission, Bay Conservation and Development Commission, State Lands Commission, and other relevant agencies.

The Los Angeles Water Board could also incentivize managed retreat and/or active management of natural environments in areas at risk from sea level rise. Managed retreat (also called managed realignment) is the process of removing, or relocating inland, buildings and other infrastructure to allow the ocean to advance inland. It can include removing actively maintained defenses (seawalls, revetments) to a new location inland, or raising the ground level to protect the inland areas and allowing or creating intertidal habitat between the old and new defenses. However, in the Los Angeles region's heavily built-out environment, managed retreat may not be economically or politically possible in many locations, and active management of natural environments (e.g., beach re-nourishment, management of wetlands to support berms, management of a species which damages reefs protecting coastlines, such as sea urchin populations damaging kelp beds) may be more appropriate. Beaches may require artificial nourishment to continue to exist. Estuaries or lagoons, as they are inundated, may also require active management to continue to exist such as the addition of sand or restructuring of boundaries.

As projects are developed to address the impacts of climate change, lessons learned may inform future decisions. For example, the Broad Beach nourishment project, permitted by the Los Angeles Water Board in 2017, includes a ten-year monitoring program. Information gathered during that period will be valuable to inform future permits for similar projects. Overall, long term monitoring of projects could be useful to account for the effects of climate change. The potential for such long-term monitoring is highest for projects developed by mitigation banks, given that those entities own projects in perpetuity and are therefore well suited for long term planning.

5.3. Areas of monitoring and research needed

Potential areas of research related to climate change that would inform the Los Angeles Water Board Dredge and Fill Activities include:

- Identification of areas in the Region that are most vulnerable to sea level rise,
- Cooperative (i.e. Federal, State, County, City, NGO) identification of priorities and strategies to address sea level rise,
- Monitoring of the speed and extent of alterations to beaches, cliffs, harbors and other coastal waters as a result of sea level rise,
- Consideration of the potential to strengthen protection for remaining coastal wetlands to provide natural protection from storm surges.

5.4. Potential areas of collaboration with other agencies

Potential areas of collaboration include:

- Closer collaboration with the California Coastal Commission and the California State Lands Commission when developing permits in the coastal zone, since the former permits coastal development permits, while the latter oversees tidal lands.
- Participation in the interagency review team for mitigation banks, along with California Fish and Wildlife, US EPA, and the Army Corps of Engineers.
- Continued collaboration with the Southern California Dredged Materials Management Team (DMMT) with regards to dredging activities in coastal waters

6. Watershed Regulatory

The Watershed Regulatory Section issues NPDES permits and water recycling requirements (WDRs and water reclamation requirements [WRRs]) to dischargers that release pollutants from any point source into surface waters of the region. The section includes Municipal Permitting (Publicly Owned Treatment Works [POTWs]), Industrial Permitting (e.g., refineries, power plants, manufacturing, desalination plants) and General Permitting/Special Projects programs.

6.1. Impacts to the program

Flooding will be one of the primary impacts of climate change to permitted wastewater and stormwater treatment facilities. For municipal permittees, the increased intensity and frequency of storms may result in an exceedance of the plant's capacity to treat stormwater and wastewater. Storage facilities may be needed if excessive stormwater cannot bypass the treatment system.

Similarly, industrial permittees may not be able to hold all of the stormwater generated at their site. Current operations allow stormwater to subsequently either evaporate, infiltrate, be discharged to the sanitary sewer or be reused for dust control or in their industrial processes. Climate change may result in a sudden overabundance of water such that they will not be able to dispose of it as planned or to collect it all.

For permittees enrolled in general permits such as the permit for construction and project dewatering, increased precipitation could generate localized flooding that could result in power failures, dewatering pump failures, etc. These impacts could result in treatment system failures (where treatment systems are used) and commingling of stormwater and dewatering wastewater, such as in sumps in subterranean parking. Where dewatering systems are overwhelmed by stormwater infiltration, discharge in excess of effluent limitations for constituents such TSS and turbidity may occur.

In addition to these flood-related impacts, water conservation efforts could lead to a rise in pollutant concentrations in municipal wastewater as the region's population uses less water. Even after treatment, POTW effluent discharged to receiving waters may have increasing pollutant concentrations that would lead to exceedances of existing water quality objectives. Such effects are already observed locally and will likely intensify as climate change progresses, as more water is conserved, and as stream flows decrease. Furthermore, although ocean acidification is largely driven by global greenhouse gas emissions, local nutrients inputs from permitted facilities could have an exacerbating effect on acidification rates and levels in coastal areas.

6.2. Potential adaptation/mitigation measures

In order to address impacts from flooding issues, dischargers should assess their current readiness to meet these predicted challenges. This type of assessment could be added as a requirement to the Los Angeles Water Board's NPDES permits. Permit language would require dischargers to prepare a Climate Change Effects Vulnerability Assessment and Mitigation Plan (Climate Change Plan) using the best available science. The Plan would include an assessment of short and long term vulnerabilities of the facility(ies) and operations and potential impacts to water supplies, water quality and beneficial uses, as well as plans to mitigate vulnerabilities to ensure that facility operations are not disrupted, receiving water is not adversely impacted by discharges, discharges do not exceed the capacity of the receiving waterbody (particularly if it is a constructed channel), or cause excessive scouring or flooding of the adjacent land to the streambed. The Climate Change Plan should be adaptively managed, and any required updates should be provided to the Los Angeles Water Board.

In order to help with these assessments, the Los Angeles Water Board could provide guidance and optimal boundary conditions for planning purposes. For example, the Los Angeles Water Board could establish a maximum design storm event to ensure that tolerable mitigation measures are in place to handle the excessive flow and that best management practices (BMPs) are designed appropriately and accordingly. Isopleth maps could also be developed showing areas within the Los Angeles Water Board's jurisdiction that will be mostly impacted by different significant storm events and/or climate change events. The development of such guidance may require some research, as indicated below.

Because of the large number of NPDES permits handled by the Los Angeles Water Board, prioritization will likely be necessary. Priorities could be developed based on the facilities' level of vulnerability to climate change effects, using the best available science. For sea level rise, Los Angeles Water Board staff could utilize projections of sea level rise provided in the most recent Ocean Protection Council Sea-level Rise Guidance Document, the most current data available through Cal-Adapt, and the California Coastal Commission's Sea Level Rise Policy Guidance. Prioritization should also take into account potential impacts to water supplies, water quality and beneficial uses, years of operation ahead, and/or the size of the facility (minor vs major discharger). Vulnerability assessment and mitigation plans would be especially critical for major dischargers with long-term operations. Plan requirements could be tailored to adapt to the needs and resources of smaller dischargers.

In addition to those measures aimed at protecting water quality, the treatment of wastewater for recycled water use should continue to be encouraged in order to augment water resources. Simultaneously, monitoring of recycled water should continue to assess potential impacts on water quality, including from constituents of emerging concern. The State Water Resources Control Board Recycled Water Policy, adopted in February 2009 (Resolution No 2009-001)[5], intends to increase the use of recycled water in a manner that implements state and federal water quality laws. When recycled water is used in compliance with the Policy, Title 22, and all applicable state and federal water quality laws, the State Board and the Los Angeles Water Board strongly support its use as a safe alternative to potable water for approved uses. Overall, the volume of recycled water available in the Los Angeles region based on adopted NPDES permits increased by 14-fold over the last 30 years. In 2016, 11 acre-feet per year (AFY) of recycled water was used for irrigation and industrial uses, 58,800 AFY was used for groundwater recharge, and 16,600 AFY was injected in seawater intrusion barriers.

6.3. Areas of monitoring and research needed

Potential areas of research related to climate change that would inform the watershed regulatory program include:

- The development of current vs. future isopleth maps showing areas within the Los Angeles Water Board's jurisdiction that will be mostly impacted by different significant storm events and/or climate change events.
- The development of a maximum design storm event taking into account future climatic changes.
- The implementation of regional monitoring that would track changes in temperature, water level, and flow of the receiving waters. Monitoring changes in physical and chemical properties of the receiving water which will likely affect the types of aquatic life and plants present in and adjacent to the receiving water would also be helpful.
- The development of early warning systems to timely deliver National Oceanic and Atmospheric Administration (NOAA) climate change information regarding sea rise, El Niño information to dischargers resident in areas that could be adversely impacted by the predictions. To ensure dischargers preparedness, multiple media sources could be used to disseminate the same information to dischargers.
- The exploration of research on the potential impacts of local nutrients inputs on coastal ocean acidification in the region.

6.4. Potential areas of collaboration with other agencies

Potential areas of collaboration include:

[5] http://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/2009/rs2009_0011.pdf

- Sharing the receiving water data will other agencies including NOAA and Fish and Wildlife.
- Seeking and developing a communication mechanism with NOAA to provide early warning notification for significant weather events that potentially could impact dischargers. In return, the Los Angeles Water Board could develop a means for relaying these critical weather and other potential discharge impacting predictions timely to dischargers. One way to do this would be to develop a readily available email database of all active dischargers that could be used to provide this time sensitive information to the dischargers.
- Providing notices of climate change related risks to other concerned agencies. The Los Angeles Water Board may categorize the risk for all dischargers according to the vulnerability of each system based on its location and population served. Dischargers in a higher risk category could be required to provide notices to other concerned agencies such as the Division of Drinking Water, the Department of Fish and Wildlife, and the Department of Toxic Substances Control when notifying the Los Angeles Water Board.

7. Stormwater Permitting

The Stormwater Permitting program regulates storm water discharges from industrial facilities, construction sites, and municipal systems by issuing NPDES permits and WDRs. While municipal systems are regulated under a permit delivered by the Los Angeles Water Board, industrial facilities and construction sites may apply for coverage under the State's General Permits for Stormwater Discharges Associated with Industrial Activities (Industrial General Permit; Order No. 2014-0057-DWQ) and for Discharges of Storm Water Associated with Construction Activity (Construction General Permit; Order No. 2009-0009-DWQ), respectively. Alternatively, they can apply to the Los Angeles Water Board for an individual NPDES Permit. Those individual permits are handled under the Watershed Regulatory program and are addressed in Section 6. Discharges associated to the State highway system are regulated under a statewide permit (Order No. 2012-0011-DWQ) which regulates all discharges from Caltrans municipal separate storm sewer systems (MS4s), maintenance facilities and construction activities.

7.1. Impacts to the program

Because the discharge of stormwater runoff is dependent on precipitation within the region, the Stormwater Permitting program could be impacted by climate change in various ways, especially by the expected changes in rain patterns. More specifically, the parameters that influence stormwater runoff include (1) the intensity of storm events, (2) the frequency of storm events, and (3) the time between storm events. All of these parameters may be impacted by changes in precipitation patterns, especially as extreme weather events are predicted to change in prevalence and magnitude.

The current Phase I MS4 Permits issued by the Los Angeles Water Board emphasize the 85th percentile, 24-hour storm “design standard”. This standard is referenced in two components of the MS4: (1) the Enhanced Watershed Management Program (EWMP) provisions, in which Permittees are deemed compliant with applicable water quality-based effluent limitations and receiving water

limitations for drainage areas where they can retain all non-storm water runoff and runoff from the 85th percentile, 24-hour storm event; and (2) the Planning and Land Development Program, in which new developments and re-developed lands need to comply with certain storm water retention requirements. This design standard is not static since the 85th percentile, 24-hour storm event could change depending on the area of the region considered. Existing BMPs may be undersized with respect to the design standard if a future regional percentile/statistical analysis calculates a higher 85th percentile, 24-hour storm.

In addition, Phase I MS4 Permits are also moving towards a paradigm in which watershed modeling and forecasting play an important role in stormwater management. This new paradigm is reflected in the requirement that Permittees must conduct a Reasonable Assurance Analysis (RAA) for any pollutant that they are addressing through a Watershed Management Program. Because climate change may affect precipitation, temperature, and hydrologic patterns in the region, watershed models may need to be recalibrated.

Aside from the direct effect of climate change on the characteristics of storm events and on the watershed's overall hydrologic patterns, the changing climate may also impact the type of implementation measures that should be considered. For example, the wide range of BMPs currently being implemented by permittees depend on living and non-living components (for example, many bioretention BMPs depend on plants and soil). These components could be affected by intense rainfall, elevated groundwater levels, temperature changes, drought, etc.

Furthermore, coastal, estuarine, and freshwater monitoring locations could be impacted by sea level rise. The LA County MS4 Permit, the City of Long Beach MS4 Permit and the Ventura County MS4 Permit Monitoring and Reporting Programs (MRPs) implement much of the receiving water monitoring in our region (in addition to MS4 outfall monitoring). Sea level rise could change the extent of the region's estuaries. This in turn, could render receiving water monitoring stations constructed by Permittees ineffective or inaccurate. For example, freshwater mass emission stations that are located immediately above an estuary may in the future be within the estuary portion of the waterbody. This would affect regional data collection.

Finally, nutrient runoff from stormwater systems could have an exacerbating effect on acidification rates and levels in coastal areas. Increased nutrient levels encourage the production of excessive algae and a subsequent release of CO_2 during its decay. When combined with increasing CO_2 levels in the atmosphere, this phenomenon can accelerate the acidification of coastal seawater.

7.2. Potential adaptation/mitigation measures

In order to address the effects of climate change, the MS4 program would need to address the potential changes to the 85th percentile, 24-hour storm design standard. Clarifying the storm design standard with respect to the potential for a change in 85th percentile storm depths will be essential to retain the efficiency of pollutant removal, and to allow permittees to implement appropriate

BMPs. Clarification would also be needed for the definition of extreme weather phenomena (such as a quantification of expected amplitude, frequency and time between storms), and what is expected of permittees during these events.

Furthermore, as noted above, MS4 permittees are relying on stormwater models to develop Watershed Management Programs. Those models should be linked to regional climate models, in order to ensure the relevance of long-term implementation measures.

Since MS4 components must also provide flood control, any impacts to MS4 flood control function should be considered by permittees as they design and manage their infrastructure; and understood/acknowledged by Regional Water Board staff.

MS4 permits could also include considerations of climate change impacts on the MS4 and on the receiving water monitoring stations, and could request plans to mitigate potential vulnerabilities. As part of the system, BMP performance should also be tracked with time, and their vulnerability to climate change should be considered when designing mitigation plans. The adaptation of monitoring requirements to potential climate change effects would occur through the incorporation of TMDL requirements that would take into account these considerations.

Adaptive management, which is essential when dealing with climate change adaptation, is already part of the permitting process, as permits are renewed every 5 years. The renewal process involves a reconsideration of existing data and the incorporation of updated TMDL provisions. In addition, permittees are required to review their monitoring data every 2 years. This review would allow the prioritization of necessary actions to react to observed trends, including those related to climate change.

Furthermore, as part of the current Phase I MS4 Permits, permittees are offered the choice to comply with an alternative compliance program instead of strict compliance with waste load allocations. This alternative pathway not only allows for more flexibility in compliance choices, but it also favors the recycling of stormwater, and the development of multi-benefit regional projects that helps communities, for example by way of mitigation of the heat island effect. This type of approach is desirable to mitigate the effects of climate change.

7.3. Areas of monitoring and research needed

Potential areas of research related to climate change that would inform the MS4 program include:

- Hydrologic modeling of the changes in regional waterbodies given different sea level rise scenarios and flood/drought scenarios.
- Further BMP performance and efficiency studies under different conditions that are expected to occur due to climate change (e.g., elevated/low groundwater levels, temperature changes, and drought).

- Linkage and/or comparison of RAA stormwater models to regional climate models, in order to assess the relevance of existing RAA models under climate change conditions.
- A study of predicted groundwater levels taking into account future stormwater retention implementation. MS4 implementation is putting emphasis on stormwater retention as a way to improve local water resources. Such study would quantify the impact of those efforts on groundwater levels.
- A study of the dry weather accumulation of pollutants. Many of the pollutants in stormwater originate as material present on land surfaces. A question to ask is whether there are direct or indirect climate change impacts to how pollutants accumulate on land surfaces. For example, atmospheric deposition patterns may change with changes in climate (e.g. wind patterns, humidity, temperature).
- Research on the potential impacts of local nutrient inputs on coastal ocean acidification in the region.

7.4. Potential areas of collaboration with other agencies

Potential areas of collaboration include:

- Working with the Los Angeles County Department of Public Works, the Los Angeles County Flood Control District and Ventura County Watershed Protection District to obtain data. Those entities perform a number of activities (e.g., operation of flood gages, precipitation gages, and Mass Emission Receiving Water Monitoring Stations; management of dams, spreading grounds and reservoirs; production of fire and flood information; forecast modeling; production of an LID manual in Los Angeles County) that make them valuable partners.

8. Groundwater Permitting

The Groundwater Permitting program issues WDRs to regulate discharges of waste to groundwater. These include, but are not limited to, discharges from small POTWs to ponds, from onsite wastewater treatment systems (OWTS), commonly known as septic systems, from soil treatment units, and from dredge sediment disposal.

8.1. Impacts to the program

As climate change will result in more severe and extreme weather patterns, many disposal sites and their anticipated soil treatment capacity risk being seriously impacted.

When flooding occurs due to heavy rainfall, disposal locations adjacent to surface waterbodies may become lost or fully saturated. Under circumstances when the wastewater cannot be discharged, the dischargers would be required to have additional storage capacity to prevent overflow from the onsite treatment system. Heavy rainfall could also raise the groundwater table and decrease the

needed separation for soil treatment between the discharge of wastewater and the groundwater. In addition, sea level rise may exacerbate ocean water intrusion, leading to changes in water quality.

Significant and extended drought conditions in Southern California would indirectly increase salt content, including total dissolved solids, sulfate and chloride in groundwater, as salt concentrations increase with the accelerated evapotranspiration due to warmer weather.

8.2. Potential adaptation/mitigation measures

To ensure that groundwater and its beneficial uses continue to be adequately protected as climate change progresses, more precautionary measures should be taken prior to and after permit issuance. In order to better understand the potential impacts of flooding, such precautionary measures should include the evaluation of hydraulic conditions such as distance to surface water, depth to groundwater, and potential flooding zones for more severe storms. In order to ensure facilities are prepared for potential flooding risks, requirements for advanced treatment processes and/or alternative disposal methods as well as sufficient wastewater storage capacity considering consecutive rainy days could be implemented.

To avoid the loss or failure of a treatment system, WDRs could include language requiring the preparation of a climate change vulnerability assessment using the best available science. Important elements of a climate change vulnerability assessment include (1) a description of hydraulic conditions such as the distance to surface water and an evaluation of whether the treatment system may be threatened by flooding, (2) an assessment of possible impacts/damage to the treatment system and mitigation measures for such impacts, (3) an assessment of potential impacts to water supplies, water quality and beneficial uses that may result due to loss or failure of a facility's treatment system, and (4) a description of mitigation measures to prevent or address potential impacts. Although there is currently no fixed time period for renewal of WDRs, new language could be added to permits requiring an update of this vulnerability assessment every five years. WDRs could also include language requiring the preparation and submittal of a report assessing damages and a plan for corrective actions after severe storm events.

The Los Angeles Water Board has already started implementing some of these proposals beginning in 2016 by adding language to new and renewed WDRs, requiring dischargers to operate and maintain facilities, treatment operations, associated collection systems, and outfalls in ways that prevent adverse impacts to groundwater due to climate change. Dischargers are required to prepare a Climate Change Effects Vulnerability Assessment and Mitigation Plan (Climate Change Plan), including an assessment of short and long term vulnerabilities of the facility(ies) and operations, as well as plans to mitigate vulnerabilities of collection systems, facilities, treatment systems, and outfalls for predicted impacts in order to ensure that facility operations are not disrupted, compliance with permit conditions is achieved, and receiving waters are not adversely impacted by discharges.

Moreover, each permit includes a Monitoring and Reporting Plan (MRP) that requires groundwater and effluent quality monitoring. MRPs may need to be revised to increase the frequency of monitoring to better track changes in groundwater quality associated with climate change. In addition, language may need to be added to MRPs requiring permittees to drill deeper monitoring wells if the groundwater level falls below a predefined threshold for a specified period.

In addition to those measures aimed at protecting water quality, the treatment of wastewater to create recycled water used for irrigation or groundwater recharge should continue to be encouraged in order to augment water resources. Simultaneously, monitoring of recycled water should continue to assess potential impacts on water quality, including from constituents of emerging concern.

8.3. Areas of monitoring and research needed

Potential areas of research related to climate change that would inform the Groundwater Permitting program include:

- A study to correlate potential groundwater quality change with the magnitude of climate change. Such research could assist the Los Angeles Water Board in identifying strategies to cope with future changes, promptly responding to the impacts, and incorporating necessary requirements into the permit.

8.4. Potential areas of collaboration with other agencies

Potential areas of collaboration include:

- Providing notices of climate change related risks to other concerned agencies. The Los Angeles Water Board may categorize the risk for all dischargers according to the vulnerability of each treatment plant based on its location and population served. Dischargers in a higher risk category could be required to provide notices to other concerned agencies such as the Division of Drinking Water, the Department of Fish and Wildlife, and the Department of Toxic Substances Control when notifying the Los Angeles Water Board.

9. Land Disposal

The Land Disposal Unit regulates the discharge of wastes to land for disposal, treatment, or storage at waste management units, including landfills, waste piles, surface impoundments, land treatment units, and mining waste management units. The discharge of wastes to land has the potential to impact groundwater resources. The Los Angeles Water Board regulates such dischargers by adopting WDRs and conditional waivers of WDRs to ensure that water resources are not impacted by these activities. WDRs for waste management units normally include requirements for construction, operation, and post-closure maintenance.

9.1. Impacts to the program

One of the potential consequences of climate change that could affect the Land Disposal Program is sea level rise. Although no active landfills in the Region are located near the coastline, some closed, abandoned, or inactive waste disposal sites (CAI sites) are close enough to the ocean to be impacted. Such CAI sites are usually unlined and not equipped with leachate and gas collection and removal systems. When municipal solid wastes or hazardous wastes buried in the landfills are submerged in groundwater or inundated by surface water, pollutants, such as heavy metals and volatile organic compounds (VOCs), may be leached out of the wastes and released to the environment. Most of the CAI sites in the Region are not regulated under waste discharge requirements. Climate change may increase the risks of pollution from those sites.

In addition, the severe drought periods that are predicted under climate change may increase the frequency and intensity of wildfires that could generate large volumes of debris that would need to be disposed of in a short time. Active landfills in the Region need to be prepared to handle such large volumes of debris waste. The more frequent occurrence of extreme precipitation events, such as back-to-back severe storms, may produce excessive stormwater runoff that can subsequently cause significant erosion problems at both closed and active landfills. The Land Disposal Program may need more resources to deal with these changes.

Finally, municipal solid waste landfills generate landfill gas (LFG), which is comprised mainly of carbon dioxide and methane, both greenhouse gases. While the ratio of the two components in LFG is approximately 1:1, the global warming potential of methane is 21 time stronger than that of carbon dioxide. In southern California, most municipal solid waste landfills are closed with monolithic soil covers (also known as evapotranspiration covers or water balance covers), due to the relatively dry weather. Unlike the prescriptive final cover system that includes a watertight and airtight geo-membrane layer, the monolithic soil layer allows moisture and gas to migrate through the final cover profile. At least a portion of the methane in LFG that penetrates the landfill cover is believed to be converted to carbon dioxide within the soil cover profile, while the rest is released to the atmosphere.

9.2. Potential adaptation/mitigation measures

The Land Disposal Program has included specific findings and provisions in waste discharge requirements for a number of facilities to address climate change. The WDRs require the dischargers to submit Climate Change Effects Vulnerability Assessment and Management Plans (Climate Change Plans) to assess the short and long-term vulnerabilities of solid waste management facilities to climate change. Facility operators are required to develop control measures that may include emergency procedures, contingency plans, alarm/notification systems, training, backup power and equipment, and the need for planned mitigation to address climate-induced impacts. These requirements will be updated with the change of site conditions and/or when new information related to climate change in the Region is available.

In addition to these measures already in place, the Los Angeles Water Board may need to take more stringent regulatory actions to ensure that water resources in the vicinity of CAI sites are protected.

9.3. Areas of monitoring and research needed

Potential areas of research related to climate change that would inform the Land Disposal program include:

- Research on the environmental benefits of monolithic soil covers compared to traditional prescriptive final covers, in the context of their effectiveness to prevent the release of greenhouse gas, would be helpful to Los Angeles Water Board staff when approving landfill final cover designs.

9.4. Potential areas of collaboration with other agencies

Potential areas of collaboration include:

- Coordination with other agencies regulating solid waste management facilities in the Region, such as the California Department of Resources Recycling and Recovery (CalRecycle), local enforcement agencies (LEAs) including county and city environmental and public health agencies, the South Coast Air Quality Management District (AQMD), the California Department of Toxic Substances Control (DTSC), US EPA, and other state and federal regulatory agencies. When coordinating with these agencies to regulate solid waste disposal facilities, the Land Disposal Program staff should ensure that climate change is fully acknowledged and addressed. For example, when reviewing the siting of a new landfill that needs to be approved by multiple agencies, Los Angeles Water Board staff should ensure that the landfill would not be located within an area that may be affected by sea level rise.
- Providing notices of climate change related risks to other concerned agencies. The Los Angeles Water Board may categorize the risk for all dischargers according to the vulnerability of each landfill based on its location. Dischargers in a higher risk category could be required to provide notices to other concerned agencies such as the Division of Drinking Water, the Department of Fish and Wildlife, and the Department of Toxic Substances Control when notifying the Los Angeles Water Board.

10. Remediation and Underground Tanks

The Remediation section of the Los Angeles Water Board investigates unauthorized discharges of pollutants to the environment, including soil, groundwater, surface water, and sediments. Upon confirming that an unauthorized discharge is polluting or threatens to pollute regional waterbodies, the Los Angeles Water Board oversees site investigation, monitoring, and cleanup actions.

The Underground Storage Tank (UST) Program addresses contamination due to petroleum products (e.g., gasoline and diesel fuel) and other hazardous substances leaking from USTs. Leaking USTs can cause soil, groundwater, and surface water contamination and can present a fire or explosion hazard. The UST program directs responsible parties to carry out corrective actions to mitigate unauthorized releases from leaking USTs.

Those two programs are combined for this analysis because of the similar effects of climate change on their activities, and of the similar approaches that can be considered to address them.

10.1. Impacts to the programs

Potential direct impacts to the remediation facilities operations from climate change effects include power outages, physical damage to remedial treatment components, water damage, degradation of covers in the case of a contained system, and reduced accessibility. Potential indirect impacts include chemical spills, accidental fire, explosions, and ecosystem damage. [6,7]

In groundwater remediation systems, groundwater table fluctuations and alteration to the groundwater flow could result in an inadequate capture of targeted groundwater and alterations in treatment efficiency. Rising groundwater tables could result in an increase in contaminant concentrations because of the water table's closer proximity to surface contaminant sources. In addition, during intense flooding, responsible parties may not be able to hold all the stormwater generated on their site. This could result in the release of waste in the stormwater to surrounding areas and consequent impacts to soil, surface water, groundwater and/or ocean water. In addition, fluctuations in temperature may affect treatment; lower temperature or temperature fluctuations for extended periods may result in slowdown of biological activity. During periods of drought, decreasing groundwater levels may lead to inadequate treatment and monitoring.

Regarding sediment remediation, the increased intensity, frequency and/or duration of storms may affect treatment efficiency by creating increased turbidity in a treatment zone, increased scouring of a sediment cap or underlying sediment, increased runoff and debris from upland or upstream sources entering the sediment containment/treatment zone, or increased discharge of groundwater to the associated waterbody. During drought periods, sediment containment/treatment zones may also experience desiccation, which could affect groundwater wells or containment barriers.[8]

In coastal areas, sea level rise may have additional impacts on treatment sites. In-situ groundwater remediation sites may be subject to seawater intrusion, which could decrease the efficiency of treatment or increase the permeability of a clay liner in a contained system. Sediment remediation

[6] U.S. EPA; Climate Change Adaptation Technical Fact Sheet: Groundwater Remediation Systems; EPA 542-F-13-004; December 2013; https://semspub.epa.gov/work/HQ/175851.pdf

[7] U.S. EPA; Climate Change Adaptation Technical Fact Sheet: Landfill and Containment as an Element of Site Remediation; EPA 542-F-14-001; May 2014; https://semspub.epa.gov/work/HQ/175853.pdf

[8] U.S. EPA; Climate Change Adaptation Technical Fact Sheet: Contaminated Sediment Remedies; EPA 542-F-15-009; April 2015; https://semspub.epa.gov/work/11/177110.pdf

sites impacted by sea level rise may also experience slumping of banks and increased sediment deposition in floodplains and littoral zones. Other potential long-term indirect impacts to consider may include land use shifts and ecosystem damage. [9,10,11]

10.2. Potential adaptation/mitigation measures

To avoid damages to treatment operations, the Los Angeles Water Board could request that future remediation plans contain a climate change vulnerability assessment and mitigation plan, including an assessment of short and long-term vulnerabilities of the facility(ies) and operations, potential impacts to water supplies, water quality and beneficial uses that could occur if the facility was impacted, and plans to mitigate those vulnerabilities. For example, aboveground remedial components could include secondary containment systems to capture hazardous liquids escaping from flood-damaged containers, and housing to protect monitoring equipment from flooding. Designs for subsurface remedial components such as groundwater wells or containment barriers should take into account potential surface mounding, desiccation, or groundwater flow changes.[12] Such considerations will be especially important for systems anticipated to operate for long periods (e.g., 30 years or longer), as climate change effects are expected to expand over long periods of time. Considering these extended periods of operation, the vulnerability assessment and mitigation plan should be reviewed every five to seven years (or in conjunction with updated science and projections) and include an analysis of the remediation system's vulnerability and available monitoring data, in order to incorporate new information as well as newly identified options into the adaptation strategy.[13]

Vulnerability assessment and mitigation plans would be especially critical for bigger facilities with long-term projects, such as refineries, tanks farms, chemical companies, aerospace facilities and ports since those types of facilities have the most waste on-site and have more readily available financial resources. The requirements in these larger facilities' plans could be tailored to the needs and resources of smaller sites.

When reviewing and amending remediation plans, the Los Angeles Water Board should consider groundwater table fluctuations and temperature changes in groundwater remedial actions. If the groundwater level is rising, it may be necessary to increase the degree and extent of active remedial actions. If the water level is becoming too high or too low, new groundwater monitoring wells may

[9] U.S. EPA; Climate Change Adaptation Technical Fact Sheet: Groundwater Remediation Systems; EPA 542-F-13-004; December 2013; https://semspub.epa.gov/work/HQ/175851.pdf

[10] U.S. EPA; Climate Change Adaptation Technical Fact Sheet: Landfill and Containment as an Element of Site Remediation; EPA 542-F-14-001; May 2014; https://semspub.epa.gov/work/HQ/175853.pdf

[11] U.S. EPA; Climate Change Adaptation Technical Fact Sheet: Contaminated Sediment Remedies; EPA 542-F-15-009; April 2015; https://semspub.epa.gov/work/11/177110.pdf

[12] U.S. EPA; Climate Change Adaptation Technical Fact Sheet: Groundwater Remediation Systems; EPA 542-F-13-004; December 2013; http://www.epa.gov/superfund/climatechange/cca-tech-fact-sheet-gw-remediation-systems.pdf

[13] U.S. EPA; Climate Change Adaptation Technical Fact Sheet: Groundwater Remediation Systems; EPA 542-F-13-004; December 2013; http://www.epa.gov/superfund/climatechange/cca-tech-fact-sheet-gw-remediation-systems.pdf

be needed with well screens across the water table in order to monitor the water quality at the water table.

Part of the review of remediation plans should also consider water and energy savings and greenhouse gas benefits, and how these balance with water quality benefits. The Los Angeles Water Board could require facilities to provide this type of information when considering different clean up alternatives.

In addition, the Los Angeles Water Board could encourage the use of remediation practices that ensure resilience to climate change, such as:

- In-situ groundwater remedial systems. This type of system saves water by using injection wells to treat water and keep it in situ, as opposed to pump-and-treat systems that often do not re-inject water and instead release it to surface water.
- De-mineralization and de-nitrification groundwater treatment systems. Those treatments can increase water quality and allow water to be reused or released for augmentation purposes in uncontaminated waters.
- Conjunctive groundwater uses and cleanup. For example, pumping and cleaning contaminated water with the purpose of using it as drinking water.
- Recycling of well development and sampling purging water.
- More wellhead treatment. Those systems pump water from a contaminated well, and treat it for reuse, therefore increasing water resources.

Discouraging pump-and-treat systems that do not re-inject or use the treated groundwater could also be considered. Permit funding could be contemplated as an incentive for in-situ groundwater remedial actions.

Furthermore, the Los Angeles Water Board could take into account the changing climate conditions, which are resulting in more frequent and severe droughts, and the consequent need for water resources when establishing clean-up requirements, consistent with existing regulations and laws. For example, for non-drinking water uses, slightly higher TDS levels could be considered.

The Los Angeles Water Board could also encourage projects that produce multiple benefits, such as sites rehabilitated into parks following remediation. This type of project can provide water quality benefits, contribute to climate change mitigation through the incorporation of trees and other vegetation, and provide health benefits by increasing shade. The Los Angeles Water Board could incentivize these types of projects by giving them a higher priority.

Finally, in order to improve efficiency, the Los Angeles Water Board could prepare a regional 10- to 20-year climate-based assessment plan, including site-specific monitoring, a regional contingency plan, and a regional enforcement plan. The plan should establish guidelines and protocols that staff would implement and follow-up on with periodic meetings. A priority/hierarchal system could be set-

up for groundwater cleanup decision-making efforts based on program objectives, goals, and resources, including the number of staff needed to implement required work.

As groundwater levels drop and leave behind exposed contaminants in the soil during drought periods, it is likely that the focus of the Remediation and UST Programs would shift towards deeper (vertically) soil/soil gas cleanups and human health in terms of the contaminants in soil and soil gas. In addition, sites that require remediation could be prioritized by considering (1) the severity of the contamination and (2) the risks potentially incurred at the site because of climate change. Such prioritization could be informed by overlaying available climate change projections (for example, sea level rise) using the most current data and the best available science with maps of remediation sites, underground tanks, plumes and wellfields locations.

10.3. Areas of monitoring and research needed

Potential areas of research related to climate change that would inform the Remediation and Underground Tanks programs include:

- Long-term monitoring of groundwater elevation trends, in relation to historical records.
- Research on the impacts of relevant factors on groundwater elevations, such as severe weather events (e.g., intensive rainfall and drought), recharge and recycled water recharge, and groundwater pumping by water purveyors. Resolving these various impacts would allow the modeling of future groundwater elevations.
- Studies to model the expected extent of seawater intrusion along the coast following sea level rise. Mapping potential seal level intrusion along the coast and overlaying it with the location of UST and Remediation sites would allow the Los Angeles Water Board to prioritize its actions.
- Studies on the impacts of temperature on microbial populations that are used to remediate groundwater contamination.
- Studies on regional groundwater hydrology and water recharge budgets.
- Studies on regional temperature, rainfall, and groundwater recharge and levels.

10.4. Potential areas of collaboration with other agencies

Potential areas of collaboration include:

- Setting up semi-annual meetings to discuss common objectives, goals, and milestones. Those meeting could include permitting agencies such as Los Angeles County, AQMD, water purveyors, Federal agencies, local certified and unified program agencies (CUPA), local land use and planning agencies, sanitation agencies, and the local public health agencies.
- Collaborate with the California Air Resources Board and AQMD to reduce greenhouse gas emissions by optimizing soil vapor extraction periods.
- Providing notices of climate change related risks to other concerned agencies. The Los Angeles Water Board may categorize the risk for all dischargers according to the vulnerability

of system based on its location. Dischargers in a higher risk category could be required to provide notices to other concerned agencies such as the Division of Drinking Water, the Department of Fish and Wildlife, and the Department of Toxic Substances Control when notifying the Los Angeles Water Board.

11. Oil and Gas Operation – Water Quality

The Oil and Gas Monitoring Program (OGMP) focuses on the protection of waters in relation to oil and gas production activities. This program was initiated in 2014 to assess potential impacts to groundwater associated with well stimulation (hydraulic fracturing) activities. It now includes activities associated with oilfield produced water which includes underground injection control (UIC) and produced water ponds. The State Water Board and the Regional Water Boards are working in conjunction with the Department of Conservation's Division of Oil, Gas & Geothermal Resources (DOGGR) to monitor and address issues relating to oil and gas operations and their impacts on surface and groundwater resources. The OGMP makes sure operators of oil and gas operations located within Los Angeles and Ventura counties are adhering to all regulations associated with groundwater and surface water protection.

11.1. Impacts to the program

In California, concerns regarding climate change involve extreme weather changes. Hydraulic fracturing, a well stimulation, enhanced oil and gas recovery technique, requires considerable amounts of water. Higher temperatures brought about by extreme changes in climate will lead to more evaporation and longer precipitation-free periods in summer and fall. Water for industrial use from nearby water sources may not be available or may be restricted during low-flow periods.[14] Warmer and drier summers may increase forest fire frequency and severity, which may impact production facilities creating potential releases. At the other climate extreme, intensified flooding and winds could result in infrastructure damage and severely disrupt oil distribution as well as cause potential releases to land, river systems, and the atmosphere. Landslides associated with extreme precipitation events can damage roads, tanks, pipelines, and drilling pads. Sea level rise and storm surge associated with climate change will also affect the infrastructure of many oil and gas production facilities that are located in coastal areas.

11.2. Potential adaptation/mitigation measures

With a potential need for additional groundwater resources due to climate change, the protection of deeper aquifers near oil and gas reservoirs will become increasingly important. Specified in California Water Code Section 10783 (Senate Bill 4, Pavley Statues of 2013), the State Water Board has

[14] U.S. Climate Change Science Program, 2007, Our Changing Planet, Subcommittee on Global Change Research.

developed and adopted (July 2015) Model Criteria for Groundwater Monitoring of Oil and Gas Well Stimulation Activities (Model Criteria). The Model Criteria has three main components:

1. Area Specific required groundwater monitoring near stimulation wells by operators
2. Requirements for Designated Contractor Sampling and Testing
3. Regional scale groundwater monitoring to be implemented by the State Water Board

Oil and gas injection wells, which carry and permanently place produced fluids underground, are a potential groundwater contamination source if not properly sited, constructed and maintained. Injection wells are regulated by the United States Environmental Protection Agency (US EPA) under the authority of the UIC Program. In 1983, DOGGR received primacy from the US EPA to regulate Class II UIC wells in California. A 2018 Revised Memorandum of Agreement (MOA) between DOGGR and the State Water Board calls for DOGGR to consult with the State and Regional Water Boards (Water Boards) during its consideration of UIC project permitting so the State Water Board could assist DOGGR with the protection of water resources. New and more stringent UIC regulations have also recently been finalized and will be effective April 1, 2019. These intense and scrutinized reviews by the Water Boards will increase protection of potential beneficial use waters.

Rapid response to releases associated with ruptured tanks, pipelines, or other oil and gas infrastructure is key to protecting waterways and near surface groundwater resources. The OGMP staff reviews all State of California, Office of Emergency Services (Cal OES) Hazardous Materials Spill Notifications related to the oil and gas industry and responds accordingly to determine if impacts exist. The OGMP works closely with the Los Angeles Water Board Stormwater Compliance Unit and Enforcement Unit to ensure operators remain diligent in their best management practices and responsibilities. The Los Angeles Water Board then has the authority to direct assessment and remediation if required.

11.3. Areas of monitoring and research needed

Potential areas of research related to climate change that would inform the Oil and Gas Monitoring Program include:

- Increase research associated with California's *Climate Change Research Plan* for impacts to the oil and gas production industry to prepare internally as well as provide guidance to stakeholders.
- Studies on potential severe climate changes in California.
- Updated studies on modeling sea level fluctuations and storm water surge along the California coast.
- Studies on new weather predicting technologies.

11.4. Potential areas of collaboration with other agencies

Potential areas of collaboration include:

- Continued and increased collaboration with DOGGR and oil field operators to maintain good communication when weather impacts have caused releases as well as providing guidance for best management practices to prevent such releases.
- Stay informed by joining the State of California's Climate Action Team Working Groups, such as the *Climate Change, Land Use and Infrastructure* and the *Coastal and Ocean Resources Working Groups*.
- Collaborate with the National Oceanic and Atmospheric Administration (NOAA) to obtain updates and training on expected severe regional climate and weather changes.
- Working with environmental groups studying severe weather and climate change impacts to provide guidance to the oil and gas industry.
- Providing notices of climate change related risks to other concerned agencies. The Los Angeles Water Board may categorize the risk for all dischargers according to the vulnerability of each treatment plant based on its location and population served. Dischargers in a higher risk category could be required to provide notices to other concerned agencies such as the Division of Drinking Water, the Department of Fish and Wildlife, and the Department of Toxic Substances Control when notifying the Los Angeles Water Board.

12. Enforcement

The Enforcement program is comprised of the following units:

Enforcement Unit I and II

The Enforcement Program ensures that dischargers comply with their permits in order to meet the water quality goals of the federal Clean Water Act and California Water Code. Enforcement staff do this by implementing the State Board's Water Quality Enforcement Policy and by reviewing monitoring reports, inspecting sites, and taking follow up enforcement as needed for the Region's NPDES and Sanitary Sewer System Permittees. Enforcement staff also manage the supplemental environmental project (SEP) Program, the Complaint Triage Program, the California Attorney General's Office (AGO) Pilot Project, Cross Program enforcement, the San Jose Creek Pilot Project, and the California Integrated Water Quality System (CIWQS) and electronic self-monitoring reporting (ESMR) Programs.

Stormwater Compliance and Enforcement Unit

The Storm Water Compliance and Enforcement Unit regulates stormwater discharges from industrial facilities and construction sites. The Unit oversees compliance with, and enforcement of, the NPDES Storm Water General Permits for Construction Sites and for Industrial Activities. Unit staff ensure facilities are enrolled in the Permits, conduct inspections and review annual reports submitted by the facilities. Stormwater unit staff also serve as the Los Angeles Water Board's coordinator for the

SMARTS database. There are a total of about 4,500 stormwater construction and industrial permittees in the region.

12.1. Impacts to the program

Several expected changes resulting from climate change could result in dischargers failing to meet regulatory requirements. Those include:

- Increased rates of erosion and sediment discharge and increased pollutant and sediment loadings resulting from the changing precipitation patterns and the associated reduction of seasonal surface water flows, particularly during the summer, coupled with an increase in the frequency of large storms.
- Lower flow rates and higher concentration discharges to surface waters resulting from an increased focus on water conservation and recycling.
- Hazardous releases in areas that become inundated due to sea level rise or rising groundwater if the natural attenuation expected from the soil column is no longer available.

Under such circumstances, compliance will become more difficult, which will result in the need for flexible, adaptable regulatory mechanisms. Failures to meet regulatory requirements will trigger a need for increased compliance assurance, outreach, and progressive enforcement effort.

12.2. Potential adaptation/mitigation measures

In order to protect water quality, some efforts by the Enforcement Program could be revised or enhanced to reflect the effects of climate change. For example:

- The Stormwater Compliance and Enforcement Unit may consider the need for BMPs at industrial facilities and construction sites to be expanded in order to address extreme weather events by increasing the rate of infiltration, evapotranspiration, or reuse of storm water.
- Enforcement staff may need to increase outreach, education, and progressive enforcement efforts.
- In order to address the increase in effort, priorities may need to be restructured or resources may need to increase.
- The program could solicit and add SEPs that address climate change to the Los Angeles Water Board's SEP list.

12.3. Areas of monitoring and research needed

Potential areas of research related to climate change that would inform the Enforcement Program include:

- Tracking the frequency of bypass/stormwater overflow events at facilities due to extreme weather events and the water quality impact of those events.

12.4. Potential areas of collaboration with other agencies

Potential areas of collaboration include:

- Collaboration with local, state, and federal agencies, environmental organizations, NGOs and community groups, which would provide synergy and efficiency in:
    - Identifying areas vulnerable to climate change
    - Assisting with outreach and education through joint public meetings and workshops
    - Conducting joint enforcement actions
    - Accessing and exchanging of technical data, equipment, knowledge, and skills

13. Environmental Justice Considerations

13.1. Climate change impacts on disadvantaged communities

In addition to environmental concerns, climate change poses major human rights, public health, and social equity issues. A community's susceptibility to climate change and its capacity to anticipate, respond to, and recover from adverse impacts is dependent on various stressors. Such stressors include but are not limited to income, poverty, linguistic isolation, proximity to pollution producing industries (e.g., living, working, going to school), race, agricultural work, physical and/or mental illnesses and disabilities, age, insurance, sexuality, education, females as heads of household, housing type, etc. Examples of factors that heighten the impact of climate change especially on disadvantaged communities include:

- The frequent lack of proper infrastructure to deal with extreme weather events, and lack of economic resources necessary to prepare and respond to these events within disadvantaged communities. For example, the cost of addressing flood damage to OWTS, or to recover from the impact of sewage spills due to collection system failures can be prohibitive for some individuals and communities. As these types of events multiply, the impact on vulnerable communities will intensify.
- Linguistic isolation, which limits some communities in their ability to access and understand emergency response protocols.
- Restricted access to critical services, including medical facilities, for people with physical and mental disabilities and socially isolated communities during extreme weather events.
- The heat island effect. Disadvantaged communities are especially susceptible to the heat island effect as they tend live in areas where minimal shade cover is available, and where most surfaces are impervious. As temperatures rise, this will become a more prevalent health issue.

- Health complications. Climate change is likely to bring an increase in food and waterborne disease, which will likely impact disproportionately disadvantaged communities with limited access to health care. In addition, extended periods of drought could bring an increase in air pollution. Added to higher temperatures, this could make conditions harsher for children playing in the open air or for people working outdoors. For example, this is often the case for predominately immigrant agricultural and construction workers.
- The proximity of environmental hazards. Disadvantaged communities are often located close to industrial facilities that are a source of local pollution. Cap and trade pollution credits that are meant to fight climate change are often purchased by facilities located near low-income communities, in lieu of mitigating or correcting their negative environmental impacts in the communities they operate in.
- Limited access to water and food. Some communities are already facing limited access to clean and affordable water. The situation is likely to get worse with climate change. Furthermore, climate change will have impacts on food production and food prices. This will affect food banks, as well as the ability of disadvantaged communities to purchase food.
- Tourism and recreation. Some disadvantaged coastal communities rely on beach tourism as a source of income, and some low-income communities depend on local beaches as a source of recreation. Those uses may be lost as sea level rise progress and the beaches are lost.

13.2. Potential best practices

Although most of the impacts presented above are not directly related to water, the Los Angeles Water Board's mission "to preserve, enhance, and restore the quality of California's water resources and drinking water for the protection of the environment, public health, and all beneficial uses, and to ensure proper water resource allocation and efficient use, for the benefit of present and future generations" intrinsically aims to protect disadvantaged communities. For example, the Los Angeles Water Board is tasked to preserve clean water that is appropriate for municipal drinking water uses. Similarly, encouraging the use of recycled water will ensure sufficient water supplies are available for the region's population.

In addition, on February 16, 2016, the State Water Board adopted Resolution No. 2016-0010[15], which identified the human right to water as a top priority and core value of the Water Boards. Likewise, pursuant to Water Code section 106.3, "every human being has the right to safe, clean, affordable, and accessible water adequate for human consumption, cooking, and sanitary purposes."

Aside of these general considerations, the Los Angeles Water Board could also take some specific actions aimed explicitly at addressing disadvantaged communities. However, the full application of

[15] http://waterboards.ca.gov/board_decisions/adopted_orders/resolutions/2016/rs2016_0010.pdf

those measures would likely be hindered by the lack of sufficient resources. Potential measures include:

- Encouraging and incentivizing projects that provide multiple benefits, and are located in disadvantaged communities, such as sites rehabilitated into parks following remediation, or natural stormwater BMPs. These types of projects can provide water quality benefits, increase water supply, contribute to climate change mitigation through the incorporation of trees and other greenery, and provide health benefits by increasing shade and lowering the heat island effect.
- Ensuring SEPs address environmental justice areas. SEPs are environmentally beneficial projects used by the Enforcement Program as an alternative mean to satisfy part of the monetary assessment imposed in an administrative civil liability (ACL). The SEP Policy encourages projects that address environmental justice, climate change, as well as the human right to water. SEPs could also be brought back to the Underground Tanks Program to address penalties.
- Considering which and how disadvantaged populations may be impacted by a proposed project; structuring program priorities using CalEnviroScreen for a baseline community assessment.
- Reaching out and soliciting input on Los Angeles Water Board projects from stakeholders in environmental justice areas, community groups and environmental organizations.
- Participating in local, state, and federal environmental justice workgroups and initiatives.
- Ensuring Los Angeles Water Board material is available in the appropriate languages, and translators are available at meetings if needed.
- Ensuring that restoration projects meet the communities' needs and encouraging community involvement in restoration efforts.
- Providing educational workshops on potential climate change impacts to water quality, and options and funding opportunities for adapting to those impacts, especially in low-income communities. The Los Angeles Water Board could coordinate with local partners such as colleges and universities for this type of effort.

14. Anticipated Challenges Moving Forward

This document presents a variety of potential approaches to address climate change impacts within the Los Angeles Water Board. Moving towards implementation, several challenges can be anticipated from this analysis.

First, although some climate change impacts are better defined (e.g., sea level rise), there remains a vast amount of research needed. For example, there is still little research available on the impacts of climate change inland, both for drought and extreme precipitation scenarios. Lack of available climate change research results in less capacity to make accurate predictions and thus identify options for

curbing impacts of climate change. In many cases, research should be conducted to better inform specific regulatory decisions. These efforts will take time and funding, and a strategy for developing this information statewide is needed.

Second and similarly, vulnerabilities to climate change should be assessed prior to implementing mitigation actions and further research is generally needed in order to conduct those assessments. From a Los Angeles Water Board perspective, these vulnerabilities include vulnerabilities of beneficial uses, water quality objectives, and permitted facilities and clean-up sites. In addition to research, guidance on what level of risk should be considered when assessing vulnerabilities may be needed. In the case of facilities at risk, permittees are being asked to prepare vulnerability assessments. However, they will need guidance on the levels of impacts to prepare for, such as what level of sea level rise or what storm design they should take into consideration.

Third, because climate change is a dynamic process and climate change science is constantly evolving, the Los Angeles Water Board needs to be able to monitor impacts and to adapt regulatory tools as new information becomes available. This means extensive monitoring of key climate change indicators is needed (e.g., flow and temperature), with regular review of available data that will allow the Los Angeles Water Board to adapt its actions as the impacts of climate change progress. Adaptation and mitigation plans requested from permittees will also need to be updated regularly to take into account new information.

Fourth, the Los Angeles Water Board's efforts should be coordinated with stakeholders and other regional efforts to ensure that stakeholders can take the lead where possible, and so that Los Angeles Water Board actions complement other regional efforts, rather than duplicate or impede them.

Finally, the Los Angeles Water Board must prioritize its actions in order to put efforts into the most relevant and efficient actions. Potential approaches to prioritize the Los Angeles Water Board's actions moving forward include:

- Overlaying available climate change projections with maps of permitted facilities locations, as well as with locations of remediation sites, underground tanks, plumes and wellfields. Climate change projections include sea level rise and storm surge, for which the COSMOS model developed by the US Geological Survey is available in the region. For other projections, such as inland flooding, more research is needed to understand the future risks. Once the facilities at risk are identified, a second level of prioritization could occur, taking into account the potential impacts the facility could have on water supply, water quality and vulnerable beneficial uses.
- Mapping ecological vulnerabilities in the region. The ongoing Los Angeles Water Board contract with SCCWRP, which will link future changes in flow and stream temperature to the health of riparian populations, will provide useful information for streams in the region.

- Assessing the relative vulnerability of beneficial uses and water quality objectives. An evaluation of which ones will be more impacted (both magnitude and timeframes) by climate change, would allow the creation of a priority list of actions.

These considerations will be taken into account when selecting appropriate measures to address climate change within the activities of the Los Angeles Water Board's programs.

15. Next Steps

Efforts to address climate change will be pursued on an ongoing basis by the Los Angeles Water Board in conjunction with stakeholders and other regulatory agencies, and will include the consideration of research, monitoring, and other contract needs, as well as the development of climate change provisions in the Board's regulatory actions as appropriate. This Framework will be used as a guide to help inform decisions regarding specific measures to be implemented on a short-term and long-term basis by each of the Los Angeles Water Board's programs to take into account, and assist in mitigating where possible, the effects of climate change on water resources and associated beneficial uses.

In order to carry out these efforts efficiently across the Los Angeles Water Board's programs, a "Climate Change Team" could be formed, comprised of staff spanning the agency. The tasks of such a group could include:

- Sharing current efforts applied within the various programs of the agency,
- Identifying needs and strategies and discussing further measures,
- Sharing information about stakeholders' efforts,
- Sharing information about the latest available science and resources,
- Discussing coordination with other agencies, and
- Considering training needs.

Los Angeles Water Board's activities related to climate change adaptation and mitigation efforts will be reported quarterly as part of the Executive Officer report.

APPENDIX A

Los Angeles Regional Water Board Climate Change Strategy Stakeholder Workshop Notes

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Los Angeles Regional Water Board Climate Change Strategy Stakeholder Workshop Notes

1. Introduction

On August 8, 2017, the Los Angeles Regional Water Board organized a public workshop to seek input on how climate change will affect dischargers and other stakeholders and consider the relationship between these impacts and how the Board regulates discharges. The meeting included two breakout sessions under the following four themes:

- Habitat/Ecology
- Stormwater
- Infrastrucure
- Groundwater

For each theme, stakeholders were asked to consider (1) How the various impacts of climate change might affect facilities, the regulatory environment, and our water resources and associated beneficial uses, (2) How the Regional Board could take these issues into consideration, and (3) How the Regional Board could take into account environmental justice when dealing with these issues. The notes from the discussions around each theme, as well as transcripts of the comment cards filled out by stakeholders at the end of the workshop are provided below.

2. Habitat/Ecology

Group 1

1. **Habitat Restoration**
    a. Example: habitat restoration performance standard is 95%+ natives
        i. Climate change causes intense rain events -> intense weed growth -> makes the native standard difficult to accomplish -> more intensive herbicide usage
        ii. Need a balance between new conditions and increased effort to remove invasives/natives and arbitrary standard to allow actual competition between invasives and natives
        iii. Drier years, 95%+ natives standard is more easily accomplished
        iv. Build in project costs ahead of time; not always the money, need to evaluate higher herbicide usage; consider integrated pest management and adaptive management plan: cut but no herbicide, decreased herbicide use, adaptive

management can respond better to local situations; care to avoid overacting with negative consequences, soft solutions

1. Environmental Justice – manpower issue for weed/invasive removal? Connect communities more to restoration efforts; being done on smaller projects

2. **Facilities**
    a. Poor design to deal with new conditions (i.e., sea level rise, flooding) can result in adverse effects to habitats (e.g., inundation, chemical contamination, pipe failures) -> need guidance from Regional Board
        i. Pumps are particularly vulnerable, gravity driven pumps have less gravity difference to pump as effectively (sewer pumps, stormwater)
            1. Venice pump station: electricity goes out with sea level rise, pump off
            2. Auxiliary pumps are most threatened
                a. Water tight walls, solar panels to prevent power failure
3. **Restoration projects**
    a. Consider climate change in planning
4. **Reference Conditions**
    a. Shifting baselines
5. **Stream flows, water levels, temperature**
    a. Consider how it will impact natural patters -> need more robust habitat/ecosystems
    b. A lot of water currently coming out of treatment plants, temp/flow variability impacts on ecology should be researched further
        i. Focus on enhancement of habitat function/size; increased resilience, net positive effect on habitat after all decisions and permitting; Adding habitat and vegetation where possible
    c. Consider impacts of increased recycling on beneficial uses, especially more impact during drought periods as demand for use increases
        i. Complex relationship between water flow for beneficial uses and health of river vs water flow for habitats
    d. What can be done with effluent that is warmed due to climate change, but standard is fixed for temperature? How are these balanced? Cooling solutions?
6. **Groundwater**
    a. Root systems require groundwater; overpumping and lowering the water tables during drought could impact root systems -> decreased viability of trees, deep root system plants
        i. Existing protection is 5 ft to avoid contamination [this commenter may have been thinking about impact of stormwater recharge on groundwater quality, not overpumping on groundwater levels?]
7. **Ocean acidification**

a. While ocean acidification is largely driven by global CO_2, local nutrient and chemical inputs can have exasperating effects on acidification rates/levels -> current research
    i. Limit further pressures and stresses on the local level on marine habitats
    ii. Effluent level revised to handle lowered assimilative capacity
    iii. Consider synergistic/cumulative effects
    iv. Adjusting TMDLs to take climate change into account
        1. Consider more variable impacts (i.e., ocean)

8. **Environmental Justice**
    a. Greater LA area is park poor
        i. How to maximize living space vs habitat space
            1. Coordinate habitat restoration with Environmental Justice community needs
        ii. Try to use Water Board authorities to promote more green space, habitat amenities, fine moneys going to local green projects; draw pollinators, tree canopy to shade/cool effluent
        iii. Agencies have to build up infrastructure to deal with new permit regulation, level of nutrients/temp considerations, costs will be passed on to rate payers which would disproportionately affecting vulnerable communities/payers, flat/regressive as current state law mandates

Group 2

1. **EPA Clean Air/Water -> planning -> a lot of monitoring -> actual planning**
    a. How can monitoring play a beneficial role in protecting habitats/ecology and improving resiliency without going overboard with monitoring/regulatory costs?
        i. Monitor enough to plan and then work with adaptive mitigation/restoration
        ii. What standards are currently being used affects the amount of monitoring
        iii. Weakening of standards needs to be well-reasoned; accounting for uncertainty caused by climate change is paramount
        iv. beneficial uses could be changing with the climate
            1. Should the Regional Board change water quality objective component or beneficial use component of water quality standards?
2. **Understand connection between habitat/ecology with infrastructure, groundwater, stormwater**
    a. Improve education; consideration of future technology; multi-benefit projects, coopt ideas from other states
    b. The Regional Water Board works using closed, more isolated systems, whereas reality is a much more interdependent and open system
        i. San Gabriel estuaries – habitat naturally cleans pollutant concentrations
            1. Increase/enhance in situ water treatment
3. **Balancing competing Beneficial uses**

a. Competing beneficial uses: habitat vs GW recharge vs recreation vs water use needs

4. **Climate change effects on restoration efforts**
    a. Storms will be more intense but potentially more spaced out; washing away work
        i. Storm water treatment systems as designed now will be overwhelmed
        ii. More infiltration, more wetlands, reduce concrete, integrate rivers/waterways with communities, engage communities in multi-use projects
            1. Reducing need for concrete solutions, reduce runoff flow
            2. Balance with reality of drought events, longer dry periods, more intense rain events - > use native vegetation to withstand
            3. Recognize land needs
        iii. Cooperation with other regional boards to increase water capture upstream
        iv. More flexibility for permits and design standards to deal with changing, more unpredictable climate; permittee will need to be the one actually adapting and taking the time to look at the permit from scratch each time is not workable. Current permits tend to be too inflexible
        v. Captured water has very strict limits
5. **Environmental Justice**
    a. Use local talent in water quality projects- Ongoing disadvantaged community funding is needed to be able to conduct planning and set up the grants. Communities seem to be more open when funding is available
    b. Federal/state funding related to cap-and-trade is required to spend 25% of the funds to be spent in Environmental Justice communities -> more focus on greener projects, use of local talent/labor
    c. Care for gentrification as communities are improved, don't want to price residents out of their homes
    d. Permit holders in disadvantaged communities -> contribute back to that specific community
        i. Current programs work with this to some degree but these can be expanded and focused
6. **TMDL focused on strict limits**
    a. Prepare for prioritization and trade-offs; difficult choices ahead
    b. How can these informed decisions be made? -> more time/money for planning

3. Stormwater

Group 1

Extreme Weather Events and Design Storms

- What changes will there be to design storm event definitions? Will there be updates that take into account a lesser overall frequency of rain events and a greater frequency of extreme rain events? Possible changes include restructuring the definition of design storms and updating 85th percentile regional maps. *[Alta Environmental]*
- Any update of design storms needs to consider the feasibility and flexibility of volume design storms/permitting *[Ventura County Watershed Protection District (VCWPD)]*

Environmental Justice and Disadvantaged Communities

- Board staff should provide educational workshops to communities, especially low income communities *[Luz Vargas].*
- When focusing on disadvantaged communities, increased funding towards education and outreach is needed. However, there should also be an increase in educational workshops and outreach for wealthy/better-off communities because there is strong resistance for projects in those communities. Although the funding is available there needs to more cooperation and investment of public support. *[VCWPD]*
- Consider a Regional Board partnership with CSU system to educate communities. Currently CSULA staff support educational outreach on campus and have educational materials. *[CSULA]*
- Ventura County is working with CSU Channel Islands currently on outreach. The Regional Board could look into their work as a model for any future partnerships with neighboring colleges and universities. *[VCWPD]*
- There should be an increase in multi-benefit projects and funding for projects within disadvantaged communities.
    - Examples of the positive impacts of multi-benefit project include increasing cooling effects with green infrastructure, water retention that channels towards tree canopy, increase in water supply, and lower urban heat island effect
    - Allow these water retention projects into disadvantaged communities
    - Also, considering the overall benefits for disadvantaged communities, there needs to be a greater focus on dry weather flows in city planning as opposed to wet weather stormwater capture because these flows are more consistent and tangible; wet weather events (especially extreme wet events) are less predictable and the benefits are not as recognizable to disadvantaged communities (e.g., the perception that it never rains in California).
        - Example: capturing dry weather flow (year-round flow) and make it recycled water for recreational uses and maintain water supply/flow
    - Multi-benefit projects are more recognizable to disadvantaged communities and will create more green jobs
        - BMPs aiding communities is more impactful than BMPs simply achieving compliance requirements and will allow for more public support

BMP Design Reevaluation

- Reevaluate low impact development/BMP design and maintenance to incorporate climate change considerations

Regional Prioritization of Projects among Different Benefits

- Prioritization of project types and funding is a dilemma and adding climate change impacts is another complex layer; cities face the decision to implement single-benefit projects; for example, bacteria treatment, flood control, single-benefit work or multi-benefit projects to recharge groundwater
    - Cities need to be creative and prioritize projects that won't be so popular - make hard decisions. There should be the opportunity for regulatory trade-offs.
- With sea level rise, groundwater aquifers may not be appropriate for filtration and not viable long term.
- Groundwater recharge is largely prioritized right now
- BMPs need to consider social and environmental impacts

Permit and Watershed Management Program Compliance

- How is climate change impacting watershed compliance plans? (exa,mple: increase of impairments, pollutants in watershed)
- How do we address adaptive management in design storm standards for treatment control BMPs?
    - Some BMPs are designed with 85th percentile 24-hour rainfall
- Concerns: How to keep up with future realities/climate change impacts for current projects?
    - How to enforce current standards with the reality of the future?
    - How to locate areas within watersheds will benefit watersheds as a whole
- Projects and funding aren't taking into account the changing weather patterns, they are molded around either a drought or rain storm and don't allow for the flexibility of encountering weather changes within the time frame of the project. They should allow for year to year variability.
    - Should projects declare emergency scenarios in the event of changes in wet and dry periods? (in order to meet all standards)

Reuse of Captured Runoff

- During the drought season we should retain water for cooling purposes, drain into tree canopy and community gardens, even help reduce carbon emissions.
    - Counter: When storing water for later use we encounter problems with mosquitos. In addition, there are strict water treatment standards. It is expensive to update.
    - Maximum contaminant levels for water use; have to build treatment plants to use for irrigation purposes. Mosquitoes come with water storage.
- More risk assessments/studies should be conducted to determine the appropriate standards/regulations for protecting human health for water capture reuse

- There are gaps in knowledge in water reuse and public health protection
- Example of technology that could benefit water storage and be protective of human health: How to keep water circulating in storage to prevent mosquitoes from growing - increase in technology and studies
- More research on how to apply technology with standards that are changing

Permit Compliance Timeframes

- Concerns about realistic implementation time frames
  - Worries of compliance taking a long time to update, increase of technology, limited resources, time to acquire funding, prioritization and support

Funding Availability

- In the future will we have access to superfund or federal funding in the future; if federal funding is cut off where can we access other sources of funding to support projects?
- Determine actual impact and mitigation and grant/funding and basic engineering
- There is a need to spread the wealth to disadvantaged and/or newer grant applicants. Current grants have high standards and require research and/or partial designs to prove suggested BMPs will work, which requires funding in order to even apply.
  - This reinforces cycle of failure since disadvantage communities fall short in competition with large funded cities for grant funding.
  - The problem currently is that funding is constantly funneled to the same areas.
- Prop 82 and 1 grants already require 30% completion of ongoing projects
- Should be more grants available for planning, technical development and assistance

Group 2

Los Angeles County Water Resiliency Plan / Sustainability / Collaborations *[Heal the Bay]*

- LA County is working on water resilience plan and SW funding measure will follow; They need assessment incorporating every city's input of water uses through surveys
- There is disconnection with the regional board and cities because there is lack of education and involvement with the LA County
- How can we get cities to see past compliance and to resilience?
  - What expectations does the regional board have for small cities and how do we help cities plan projects involving stormwater?
  - Currently cities do not include planning of stormwater because they do not view it as their jurisdiction or priority, this occurs because there is a disconnect and lack of knowledge of beneficial uses of stormwater
  - How can the regional board address this and aid cities with incorporating stormwater and into county/city planning?

- How to increase relationship with the water board and educational resources to benefit resilience efforts involving stormwater?

Permit Compliance

- Permittees are concerned about compliance because penalties are high. Permittees need more flexibility in funding within the permit *[City of Redondo Beach]*
  - Suggest an increase of collaboration with the Regional Board in climate change adaptive efforts and how to stretch funding to support both compliance and CC resiliency.
  - How do they prepare for flooding infiltration, greening, broken pipelines while dealing with compliance?
- Cities can tell there is an apparent disconnect between communication with the state and regional boards.
- Can the regional board support EWMPs more because they don't have consistent funding sources?
  - Suggestion for the regional board to create a venue for combining multi-benefit projects with the IRWMP because the IRWMP is an already existing plan with a strong emphasis on water supply
  - Don't reinvent the wheel but augment the IRWMP program. Sub-regions already meet and LAFCD run the program.
- The regional board should provide a template for leveraging funding to support projects long-term; more guidance

Compliance Flexibility

- Incorporating climate change adaptive measures into planning is problematic because numbers, impacts, and expected time frames are not concrete. Cities are looking for flexibility in implementing resiliency efforts in order to allow for time to plan and strategize incorporating each resiliency effort.
  - When cities are avoiding fines by creating plans right away to address new standards this affects long-term planning because there is lack of time invested in research and knowledge. The goal is to allow for flexibility in implementation time frames.
- Incorporate adaptive capacity/flexibility in standards

Permit Compliance can get in the way of Regional Long Term Plans

- Suggestion use TMDL model in the climate change efforts; which creates a strategy outside of the permit and set deadlines
  - Help small cities think of long-term planning because currently permit requirements are affecting long-term planning.
- Cities experience a "never-ending feeling" because in the process of trying to comply with some permit requirements and they keep increasing and changing

Concerns Regarding Defining Climate Change and Expectations in Regulatory Measures

- As long as we don't have a definite measure for particular counties/cities (small scale cities) it becomes difficult to allow for planning. In many small city planning measures emergency regulations talk about consider climate change, but not actual plans because there is limited assessment.
    - How do you assess any progress of climate change resiliency if efforts if time frames are immeasurable?
    - 10 years is not enough time to plan projects for 2050 predicted impacts; measures can be challenged because they are not definitive
    - Baseline measures assessing impacts of climate change and a set timeline ex. 2050 (year, index, model)
    - Counter: Instead not force a prediction or model but consider the current effects of ex. Increase heat days and the social/env impacts
    - Need more definitive research that is consistent Counter: there is a plethora of research and data
    - Define resiliency success so that cities have some baseline to evaluate success
- UCLA and LA Water HUB have great data this needs to be available for public education

4. Infrastructure

Group 1

- City of LA: recognizes that Regional Board has responsibility and leadership. But,each agency should have leadership roles. Suggests that Regional Board allows space and flexibility in leadership in the arena of climate change.
- State Board: Identify what the hazards are to infrastructure. What kind of risk? What kind of threat? Then, divide up responsibility and leadership.
- City of Redondo Beach: we need codes and laws to address risk
- 401 permits….can waterboard reduce mitigation requirements because the waterway is going away
- Environmental justice: people in LA still lacking clean drinking water…not appropriate to reduce mitigation.
- Environmental justice: let's be sure that we don't create solutions that make additional problems later on
- Two types of infrastructure

    - Infrastructure that we need to build to protect ourselves from sea level rise
    - Infrastructure that we need to protect
- Sand is an infrastructure. Sand protects homes, PCH
- City of Redondo Beach: residents are struggling now.
- Funding options…prop a, prop 1, potential grants
- EcoKai: Can regional board (MS4 permits) help cities respond to sea level rise.
    - Requirements in the permits?
    - Exceptions in the permits?
- Regional Board is too harsh with the mitigations and sometimes counteracts environmental justice
- City of Redondo Beach: cafeteria plan for funding infrastructure so that each municipalities can prioritize individualities
- Waste dischargers. Cities who are doing water conservation may find higher concentrations of pollutants in water. Can regional board modify requirements?
- Studies to ascertain effectiveness of programming
- Regional board should ask legislature to tax new residential developments to address new infrastructure.
- Consideration what other states/countries are doing in similar situations: New York, Florida, New Jersey, Japan
- Can regional board push building code to do more? Is it appropriate for Regional Board to take leadership on this?? Is this within Regional Board responsibility?
- Try to reduce pollutant sources.
- Flexibility in funding, multi-benefit funding

Group 2

- Proposition 1 is multi-benefit. Regional board only gives funding for sewer, water. Not roads.
- Coastal commission is trying to promote policies of building with set-backs.
    - Engineered protections vs planned retreat
- Flash storms inundating the wastewater treatment plants (POTW). How to deal?

- Might regional board require vulnerability studies before building? Already being done WDRs
- Maybe only cities are doing vulnerability studies, but businesses need to do vulnerability studies too
- Board already collaborates with LA Regional Collaborative: Cities focused on climate adaptation
- One role of water board is to provide collaborative connection between dischargers
- But, don't duplicate efforts. Make sure it's stakeholder driven, not board driven
- Regional board can help by staying aware of urgency of 401. Better permitting processing time. More important with climate change
- Educate permittees or ask permittees if they've considered sea level rise/climate change with their project
- New weather events will produce new infrastructure needs. Can we get in front of it or will we need to wait until a couple of these hit before action
- State board could designate a new design storm. Evaluate your project's vulnerability against new storm definition.
- What kind of responsibility do applicants have of their projects robustness with regard to climate change
- Would regional board be able to use a reserve similar to 401 mitigation.
- Should board identify lost causes? And not require mitigation in those areas? How to identify which areas should be abandoned.
- Is there a prioritization of infrastructure to protect from impacts due to climate change? Could Regional Board create one?
- Rating system for water infrastructure. There is a software Envision which rates infrastructure projects, similar to LEED for buildings. Envision includes a climate change element in the rating. These could go into a best practices on how to build with respect to climate change.
- CEQA process. Isn't this the place to consider climate change impacts? Is the best tool for assessing/understanding impact?
- Regional Board should collaborate with municipalities. Regional board can participate with General Plans. Possibly it's public works plans that need to include climate change impacts.

5. Groundwater

Groundwater Quality

- With the weather extremes associated with climate change, groundwater basin elevations and quality are a concern
- Climate change will probably increase the price of groundwater (more expensive to extract due to dropping water levels and more expensive to treat due to pollutant concentrations). This is especially true for low income communities (see Environmental Justice notes below).
- Need to speed up groundwater remediation projects (refer to Regulatory section)

Environmental Justice

- Potable water supply, and the associated costs, for low income communities dependent on groundwater will be impacted by climate change. Suggestions were made to:
    - DDW should take a larger role in the monitoring of small water agencies that are being impacted
    - A stress test should be developed to help identify water agencies in trouble
    - SWQCB and RWQCB should take a more active role in conducting audits to identify water suppliers with rising costs and reductions in water quality and to help provide grant money or other financial assistance.
- Everyone should know where their potable water supply comes from. Board member Glickfield pointed out that a UCLA shows the boundaries of all of the water agencies in Region 4.

Data

- Transparency of data is needed, both groundwater quality data and water consumption (pumping rates/water extraction).
- The same is true with groundwater modeling of the aquifers

Sea Water Intrusion

- Currently flood control district does not see a current problem with sea water intrusion, but are continuing to monitor to see if more sea water intrusion barriers will be needed in the future.
- They are confident they could handle an increase in sea level of one foot, but in the worst case scenario of ten feet there would be issues.
- Monitoring of groundwater data should be done by the water agencies to note any increases in salinity and to anticipate any new barriers or modifications to the existing ones.

Regulatory

- Inform and be transparent about where people get their water from (potable water supply), who owns it, and the water quality. A map of the region showing the distribution of water districts is available from UCLA (refer to Ms. Glickfield). This knowledge will be even more valuable with the onset of climate change (droughts and extreme storms). It was suggested that the RWQCB add the link to this document on the RWQCB website.
- There should be a greater emphasis on communication to the public on water regulations, including information on water resources (website links, school age programs).
- Regulatory requirements are limiting how much recycled water/stormwater is available for infiltration because the monitoring and soil testing costs are prohibitive. Is there any way to make the regulatory requirements more flexible without risking groundwater quality? This idea should be investigated along with potential funding mechanisms.
- The RWQCB should be able to help remove (or adjust) regulatory barriers for smaller projects through flexibility, and assistance with funding for monitoring, treatment.
- SWQCB should take a larger role in the managing and /or oversight of extraction rates from non-adjudicated basins.
- RWQCB should address issues by watershed and not by cities, including conflicts, in relation to groundwater usage, monitoring, treatment, and distribution of groundwater.

Quantity/ Storage

- An example of the impact of climate change on groundwater basins is that overpumping due to extended droughts limits the amount of groundwater available, (eg. for agricultural irrigation).
- Agency or facility that collects rain water now has the water rights for that water per a current State bill.
- More instruction/communication is needed to inform the public about rain water and grey water collection, treatment and usage.
- More communication to the public is necessary concerning ground water pumping rights and the potential treatment requirements.
- Extraction rates are controlled for adjudicated basins.
- The water rights of water injected /infiltrated into a groundwater basin should be given to the entity that supplemented the aquifer. Watermasters/groundwater managers should develop a system to do that water accounting. (An example is that the City of Oxnard is expanding their groundwater extraction credits by supplying advanced treated recycled water to the farmers of the Oxnard Plain. By selling treated recycled water to the farmers, the farmers don't have to extract as much groundwater. The City of Oxnard is storing those groundwater credits for when they need them.)
- Right now the RWQCB and UCLA have a program that is studying how you can measure the amount of water infiltrated into the groundwater.
- Another example to mitigate the impact from climate change is to Increase recycling from POTWs and reduce the effluent discharged to the ocean

- SIGMA act and Sustainability groundwater agencies to assist, to help with access and monitoring (transparency).
- RWQCB and SWQCB should take a more active role in the division of groundwater resources by monitoring usage, and treatment. (DDW has been working on trying to get landowners and others to assist with this)
- RWQCBs should do what they can to help Division of Water Rights and to resolve water rights issues in their region.
- Strategic plan to expedite the implementation of the remedies at groundwater remediation sites controlled by different agencies for groundwater in the region. (eg. DTSC, vs EPA, vs RWQCB)

Groundwater Losses due to Dewatering

- The data of the amount of water lost via groundwater dewatering should be readily available from the RWQCB or SWQCB websites. (Right now the data is only available by searching through all of the dewatering permits and downloading pdf reports)
- Dewatering water is discharged to either the storm drain or the wastewater sewer. Most of the time it is discharged to the storm drain since that discharge is free. (Beverly Hills has imposed a fee on the storm drain as well as the wastewater sewer).
- The amount of high quality groundwater lost to the storm drain and the wastewater sewer due to dewatering is astounding. These extractions are regulated by permits from the groundwater unit at the RWQCB. The RWQCB should tabulate and publicize the amounts of dewatering water lost each year.
- The cost to treat and reuse the dewatering water is less than treatment at Water Reclamation Plants.
- There should be some entity to capture and recycle that water, especially with groundwater supplies being so low.
- Is there some way that the construction contractors can be required to inject that water somewhere else in the aquifer?
- There is also the issue of groundwater upwelling (caused by too much water trying to infiltrate, but it comes to the surface because the soil can't handle the infiltrating flow.

6. Comment Cards

LA Water Keeper

Most important topics discussed:

1) Stronger regulations because of climate change
2) Infiltration
3) Environmental Justice

Additional Comments:

- Less concrete would help the problem
- More local communities outreach on the city level
- Greater collaboration
- Reinvent the wheel

Heal The Bay

Most important topics discussed:

1) Stormwater
2) Ecology

Additional Comments:

- Heal The Bay sees itself as an organization that will help the Regional Board with the known and unknown problems of climate change

USC - Seagrant

Most important topics discussed:

1) Sea level rise: coastal flooding, erosion, storm surge
2) Ocean acidification and hypoxia
3) Habitat ; water temperature

Additional Comments:

- Link more with the Ocean Protection Council work on ocean acidification. Limiting/reducing local water discharge of nutrients and pollution may be one of the few management decisions we can do locally on this global issue.

LA Metro

Most important topics discussed:

1) LID/Green infrastructure
2) Climate change resilience
3) Long-term community planning

Additional Comments:

- The individual subjects touched on each other, playing in the larger theme discussed during the presentation. Master planning for the Regional Board is imperative, and seems to boil down to enforcement/incentives, design criteria updates, and regional collaborations.

LA Sanitation, Regulatory Affairs

Most important topics discussed:

1) Infrastructure
2) Ecology

Additional Comments:

- Climate resilience will require lots of regulatory flexibility… of regulated persons who genuinely want to move forward.
- Monitoring will be the yellow canary that tells us if we are seeing a change in beneficial uses. Appropriate interpretation of monitoring is important.

LA Sanitation – Watershed Protection Division (1)

Most important topics discussed:

1) Stormwater

Additional Comments:

- There could have been a table that discussed wastewater specifically

LA Sanitation – Watershed Protection Division (2)

Most important topics discussed:

1) Stormwater

Additional Comments:

- There could have been a table that discussed wastewater specifically

LA Sanitation – Watershed Protection Division (3)

Most important topics discussed:

1) How to fund and support multibenefit stormwater capture projects
2) Outreach and consider community needs/motivation pro project support

Additional Comments:

- Beneficial conversations

LA Sanitation – One Water LA

Most important topics discussed:

1) Infrastructure
2) Stormwater
3) Groundwater

LA Sanitation – Wastewater Engineering Division

Most important topics discussed:

1) Infrastructure
2) Groundwater
3) Habitat/Ecology

Additional Comments:

- Very Important workshop

LA Sanitation

Most important topics discussed:

1) Stormwater
2) Infrastructure
3) Groundwater

Ecokai Environmental (1)

Most important topics discussed:

1) Flexibility with permittees
2) Groundwater pumping rights and dewatering
3) Sea level rise and use of sea walls

Ecokai Environmental (2)

Most important topics discussed:

1) Groundwater – Effective use
2) Stormwater regulatory flexibility

State Water Resources Control Board – Division of Drinking Water

Most important topics discussed:

1) Concept of systems, interdependencies, interregulation standards
2) Learning from others – States/solution
3) Understanding impacts of climate change in different sectors

Additional Comments:

- Perhaps good to go by a system – such as Threat Hazard Assessment Identification and Risk Assessment (THIRA)
- Perhaps may be better to take a more directed approach

- Was good to get input from others over their priorities/impressions