Master Response 8.5
Assessment of Potential Effects on the San Francisco Bay Area Regional Water System

Overview

The San Francisco Public Utilities Commission (SFPUC) is a department of the City and County of San Francisco (CCSF)[1] that provides retail drinking water and wastewater services to CCSF and wholesale water to three San Francisco Bay Area (Bay Area) counties. SFPUC operates the Hetch Hetchy Project, located in Yosemite National Park and the Stanislaus National Forest in the Upper Tuolumne River Watershed, which supplies water and power to the City of San Francisco and surrounding Bay Area communities (SFPUC 2011–2017). The Tuolumne River Watershed is a critical piece of a state plan to maintain and restore the Bay-Delta aquatic ecosystem, including native migratory fish populations that migrate through the Bay-Delta and its upstream tributaries (Appendix C, *Technical Report on the Scientific Basis for Alternative San Joaquin River Flow and Southern Delta Salinity Objectives*). The San Joaquin River (SJR) Basin, which includes the Tuolumne, Stanislaus, and Merced Rivers, once supported large spring-run and fall-run Chinook salmon populations; however, the basin now only supports fall-run Chinook salmon populations, and these populations are facing a high risk of extinction (Master Response 3.1, *Fish Protection*). Half of the time, more than 60 to 70 percent of each river's flow is diverted out of the river from February through June (State Water Board 2016a). Accordingly, the State Water Resources Control Board (State Water Board) is amending a water quality control plan, known as the Bay-Delta Plan, to protect beneficial uses of the Bay-Delta Watershed, including upstream waters such as the Tuolumne River that support migratory native fish populations. The plan amendments recommend increasing flows on the Tuolumne, Stanislaus, and Merced Rivers from February through June within a range of 30 to 50 percent of unimpaired flows, with a starting point of 40 percent to achieve measurable benefits. Please refer to Master Response 2.1, *Amendments to the Water Quality Control Plan*, for a detailed discussion of the plan amendments.

This master response addresses public comments raised, primarily by CCSF, the Bay Area Water Supply and Conservation Agency (BAWSCA), and individual BAWSCA member agencies[2] regarding the scope and accuracy of the substitute environmental document's (SED) analysis of the potential water supply reductions to the SFPUC Regional Water System (RWS) service area that could result from implementing the plan amendments presented in the SED and the types of actions that SFPUC could take to meet water supply demands within the RWS service area. Generally, BAWSCA and individual BAWSCA member agencies raised issues in their comment letters similar to those raised by CCSF. For those issues that are similar or related, this master response addresses them. To the extent that issues raised by BAWSCA and/or individual member agencies are specific or unique to those respective agencies, those issues are addressed in unique responses. In large part, comments submitted by SFPUC, BAWSCA, and other commenters question whether the information and impact determinations in the SED are supported by substantial evidence. Specifically, the commenters question the SED's assumptions about specific future actions by water users in response to the

[1] This master response uses SFPUC and CCSF interchangeably as the public agency that provides potable water to the RWS service area.

[2] References in this master response to BAWSCA are intended to include BAWSCA's individual member agencies, where appropriate.

Lower San Joaquin River (LSJR) plan amendments. The California Environmental Quality Act (CEQA) requires the State Water Board to analyze reasonably foreseeable impacts from the project, which the State Water Board has done in the SED by analyzing a suite of potential future responses to the LSJR plan amendments. CEQA does not require the State Water Board to engage in speculation. As described in this master response, the State Water Board's impact analysis is sound, and the methods and conclusions in the SED regarding potential significant impacts are supported by substantial evidence.

The State Water Board prepared the SED pursuant to a certified regulatory program. The environmental review in the SED is conducted at a programmatic level of analysis. Programmatic analyses are by their very nature broader and less detailed than project-level analyses, because the details that are needed to conduct a project-level analysis are not known and cannot be described in sufficient detail to allow for project-specific analysis. The SED's programmatic analysis of the environmental and other impacts of the LSJR alternatives is supported by facts, relevant information, and reasonable assumptions based on such facts and information. A commenter's disagreement with that analysis does not make the SED inadequate. (Cal. Code Regs., tit. 14, § 15151.)[3] As discussed in this master response, the record contains substantial evidence to support the scope of analyses, assumptions, methods, and conclusions of the SED.

This master response identifies the main points of disagreement or differing assumptions in the section on key differences in modeling and analytical approaches. "Disagreement among experts does not make an EIR inadequate, but the EIR should summarize the main points of disagreement among the experts. The courts have looked not for perfection but for adequacy, completeness, and a good faith effort at full disclosure." (§ 15151.)

The State Water Board prepared the SED with a sufficient degree of analysis to inform the decision-makers about the environmental consequences of its decision and in light of what is reasonably feasible considering the magnitude, complexity, and geographic scope of the plan amendments. The SED addresses potential reductions in surface water supply relevant to SFPUC in appropriate discussions in the document. For example, Chapter 4, *Introduction to Analysis*, describes the framework for analysis, including evaluating reasonably foreseeable methods of compliance and other indirect actions that could affect SFPUC's water supply. As described in Chapter 13, *Service Providers*, and Chapter 16, *Evaluation of Other Indirect and Additional Actions*, potential reductions in surface water diversions could affect service providers by reducing some portion of the water supply obtained from the LSJR tributaries during certain dry water-year conditions. Chapter 13 evaluates potential environmental impacts on service providers in the SFPUC RWS service area that could result from the LSJR alternatives. Chapter 16 evaluates additional indirect actions, including ones that the regulated community could take to address potential water supply effects associated with the plan amendments, and the environmental impacts associated with those actions. As noted in the SED, the exact actions that affected entities would take to develop alternative water supply sources in response to potential reductions in surface water supplies, and the environmental consequences that may result from those actions, are uncertain and speculative. Nonetheless, the SED discloses the estimated surface water reductions and actions that could be taken to address those reductions, including subsequent environmental effects, to the extent reasonably feasible (§ 15151). The State Water Board further advances CEQA's policy of public disclosure by providing a focused assessment in Appendix L, *City and County of San Francisco Analyses,* of the potential impacts on SFPUC's water supply and actions that SFPUC could take that would minimize potential economic and social effects associated with reductions in its water supplies.

[3] All regulatory references are to the State CEQA Guidelines in title 14 of the California Code of Regulations unless otherwise provided.

The SED evaluates the effects of future actions that service providers such as SFPUC, BAWSCA agencies, and similarly-situated water users may take in response to the flow objectives on a programmatic level based on a review of water supply planning documents and related information. The precise future actions or combination of actions, that water users may take are uncertain and speculative. A summary of the major decision points from implementation of the flow objectives to compliance to responding to potential water supply reductions helps to illustrate the inherent uncertainties associated with precisely defining such future actions and evaluating their impacts. The State Water Board will impose responsibility for implementing the flow objectives in a future proceeding (see Master Response 1.2, *Water Quality Control Planning Process* for information regarding Bay-Delta Plan implementation.) Appendix K, *Revised Water Quality Control Plan*, states that the State Water Board will require implementation through water right and water quality actions, including adopting regulations, conducting adjudicative proceedings, or conditions in water quality certifications. Appendix L, Section L.2.1, *CCSF Responsibility*, describes examples of several ways in which CCSF may be responsible for implementing the flow objectives, including as a water right holder or under an agreement with other water users, such as Modesto Irrigation District (MID) and Turlock Irrigation District (TID). At this time, however, it cannot be predicted how responsibility for implementing the flow objectives will be allocated.

The allocation of responsibility affects whether and how SFPUC must comply with the flow objectives or, if it is not held directly responsible by the State Water Board, whether it agrees to share responsibility with other water users such as the irrigation districts. Appendix L reasonably assesses the 1966 Fourth Agreement as an existing agreement setting forth the responsibilities for water banking and operations involving New Don Pedro Reservoir, and acknowledges that such agreements have been and can be amended. The terms of any future agreement are uncertain and unknowable, including whether the parties agree to financial terms (payments for water) or to physical releases of water to meet the flow objectives, or a combination. All of these in turn would affect the quantity (and timing) of SFPUC's water supply that may be reduced by the flow objectives. Hydrologic and climatic variations also contribute to the complexities in assessing potential impacts.

Further, as discussed in this master response, the precise actions and combinations of actions that SFPUC and water users may take in response to potential water supply reductions are also uncertain. For this reason, the SED programmatically evaluates reasonably foreseeable actions that affected entities may take and the resulting impacts based on reliable information, including facts and reasonable assumptions predicated on facts.

CEQA requires that the State Water Board analyze a reasonable range of methods of compliance, alternatives to methods of compliance, and mitigation measures. (Pub. Resources Code, § 21159, subd. (a); Cal. Code Regs., tit. 23, § 3777.) The SED analysis also takes into account a reasonable range of environmental, economic, and technical factors associated with the reasonably foreseeable methods of compliance and other actions. (Pub. Resources Code, § 21159, subd. (c).) As required by Public Resources Code Section 21159 and the State Water Board's regulations (Cal. Code Regs., tit. 23, § 3777), the SED evaluates the environmental impacts related to reasonably foreseeable methods of compliance with plan amendments. The methods of compliance evaluated for the LSJR alternatives include the following:

- Releasing or bypassing flow at existing reservoirs or at existing diversion points—flows being released into the rivers to meet the unimpaired flows as defined by the LSJR alternatives with or without adaptive implementation.
- Re-operating reservoirs—modifying reservoir operations to meet the unimpaired flows as defined by the LSJR alternatives with or without adaptive implementation.
- Reducing surface water diversions—reducing surface water diversions to allow for the release or bypass of flows or reoperation of reservoirs meet the unimpaired flows as defined by the LSJR alternatives with or without adaptive implementation. (Chapter 4, Section 4.2.11,

Alternatives, Adaptive Implementation, and Analysis, Methods of Compliance and Other Indirect and Additional Actions.)

CEQA does not require the State Water Board to speculate or to consider every potential method of compliance, particularly in a programmatic analysis of a planning document. (*San Joaquin River Exchange Contractors v. State Water Resources Control Bd*. (2010) 183 Cal.App.4th 1110, 1127-28 [project-level CEQA analysis cannot reasonably be performed until entities choose methods and infrastructure].)

As described in the SED, during sequential dry years, the plan amendments could reduce water supplies available for diversion by SFPUC from the Tuolumne River and the Hetch Hetchy Project. However, the magnitude of potential reductions in SFPUC's water supply during a prolonged drought, and therefore the potential severity, depends on a variety of factors and actions by water suppliers that cannot be predicted with certainty. As described above and discussed in Chapter 4, the SED includes an environmental analysis of reasonably foreseeable methods of compliance with the flow objectives, such as reducing surface water diversions and releasing or bypassing flows at reservoirs. The future response of any water user to water supply reductions resulting from the flow objectives, however, is not a method of compliance.[4] The SED also analyzes the effects of indirect actions that affected entities may take to develop alternative water supply sources needed to replace surface water that may be reduced due to implementation of the objectives. It is not feasible to analyze all possible decisions available to water users; accordingly, the SED evaluates in general terms the potential environmental effects and costs of supplying water from potential sources other than from the Tuolumne River.

SFPUC adopted a different analytical approach to assessing potential water supply effects. The SFPUC approach uses project-level detail to simulate the effects of a hypothetical design drought on their existing facility configuration. The SFPUC approach does not consider actions identified in the SED to reduce potential water supply effects associated with implementing the LSJR flow objectives. Rather, the SFPUC approach identifies severe increased water rationing as the "most" reasonably foreseeable method of compliance with the objectives. SFPUC contends that the SED must analyze the environmental impacts of the "most" reasonably foreseeable method of compliance with the flow objective by San Francisco. SFPUC maintains the only feasible method of compliance to effectively address potential water supply reductions incurred by the plan amendments would be imposing highly restrictive water rationing in the SFPUC RWS service area, including for wholesale customers. The primary reason cited in the comments for relying exclusively on water rationing is that this is the only option entirely within San Francisco's control. For various reasons, SFPUC dismisses other potential actions that entities could take in response to water supply reductions. SFPUC, too, broadly construes the applicability and scope of Section 21159 by including actions taken in response to water supply reductions as methods of compliance, and it unduly limits the types of actions it may take to water rationing.

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[4] The SED evaluates the reasonably foreseeable methods of compliance in accordance with Public Resources Code section 21159. Future responses of water users to potential reductions in water supply resulting from the flow objectives are indirect actions, not reasonably foreseeable methods of compliance with the flow objectives, and the SED appropriately evaluates them as such. (e.g., Chapter 4; Chapter 16.) Reducing surface water diversions is one method of compliance analyzed in the SED; any future water rationing that results in response to the reduction in diversions is an effect of the reduction, not a method of compliance itself. While compliance may, under certain circumstances, require a diverter to divert less water, SFPUC's comment is directed to its future actions in response to a reduced water supply as a means of compliance. In this context, Public Resources Code section 21159 is not relevant to SFPUC's comment. Even assuming for the sake of argument that SFPUC's future actions in response to reduced water supply are methods of compliance (they are not), the Public Resources Code expressly states that the State Water Board is not required to conduct a project-level review of the methods of compliance. (Pub. Resources Code, § 21159, subd. (d); Cal. Code Regs., tit. 23, § 3777, subd. (d).)

Several commenters also asserted that the SED underestimates the economic effects of the plan amendments on the economy of the SFPUC RWS service area and the potential environmental impacts associated with implementing the plan amendments. These assertions stem from different underlying assumptions by SFPUC relative to the State Water Board regarding how SFPUC would respond to potential water supply reductions. Commenters claimed that because a part of their water supply may be reduced, their entire water supply would be adversely affected or there would be no alternative but to institute rationing, which would affect urban growth and development throughout the RWS service area.

The State Water Board reviewed all comments related to the economic and environmental effects associated with potential water supply effects related to the RWS service area and developed this master response to address recurring comments and common comment themes not addressed more specifically in Master Responses 3.6, *Service Providers* and 8.0, *Economic Analyses Framework and Assessment Tools*. This master response references related master responses, as appropriate, where recurring comments and common comment themes overlap with other subject matter areas. This master response addresses comments related to SFPUC-specific issues and includes, for ease of reference, a table of contents on the following page to help guide readers to specific subject areas. Two of the main topics addressed in this master response are as follows:

- The programmatic scope of the analysis conducted by the State Water Board in the SED and the adequacy of the analysis.
- Estimated water supply effects of the plan amendments on the SFPUC from the Tuolumne River and Hetch Hetchy project prepared by the State Water Board and SFPUC and the uncertainty associated with those effects.

Additionally, the following topics are discussed in this master response to help clarify the assumptions and information supporting the SED's analysis:

- Key differences between the analytical approach taken by the State Water Board and SFPUC and why the State Water Board approach to address potential water supply reductions is considered reasonable.
- Characterization of a *water supply planning approach*, primarily based on information contained in the SED, to address the potential economic effects of water supply reductions resulting from implementing the plan amendments, including identification of potential economic effects and other considerations and the role of water supply sources and management techniques that SFPUC employs during dry and normal water year conditions.
- Characterization of a *water rationing-only approach*, as described by SFPUC in its comments on the SED, as a means to address the effects of water supply reductions resulting from implementing the plan amendments, including identification of potential associated economic effects and other considerations.

The SED analysis is based on the reasonable assumption that affected entities such as SFPUC would use a water supply planning approach, to prepare for times when water supplies would be reduced. SFPUC's economic analysis concludes that a water rationing-only approach would be highly destructive in the RWS service area. SFPUC's exclusive rationing-only approach to address potential water supply reductions in the RWS service area is speculative, is not a reasonable method of compliance, and is not based on reasonable assumptions. It is unsupported by information in the SED, including this master response, regarding SFPUC's water supply management actions and those typically taken by other water suppliers. In contrast, the SED's assumption of potential water transfers and other actions to obtain water supply is economically justified and supported by substantial evidence, such as information regarding past transfers, including transfers from irrigation districts to San Francisco, and future transfers contemplated by water supply planning documents such as SFPUC's *2015 Urban Water Management Plan for the City and County of San*

Francisco (hereafter, "CCSF 2015 UWMP [SFPUC 2016a]). For these reasons, the State Water Board was not required to evaluate the water rationing-only approach in the SED.

Please refer to Master Response 2.4, *Alternatives to the Water Quality Control Plan Amendments*, for a discussion of SFPUC's proposed alternative submitted with their comments.

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Programmatic Analysis and Adequacy of the SED

As discussed in Master Response 1.1, *General Comments*, the SED has been prepared pursuant to the State Water Board's certified regulatory program and contains a programmatic level of analysis. Programmatic analyses are by their very nature broader and less detailed than project-level analyses, because the details that are needed to conduct a project-level analysis are not known and cannot be described in sufficient detail for an appropriate analysis. The plan amendments establish the broad policy and the water quality objectives that would apply to future water right and water quality proceedings for implementing the water quality objectives. The Bay-Delta Plan does not in itself impose conditions on any water right, nor does it direct or approve any particular project-specific activity. It provides a regulatory framework that will be implemented through subsequent processes. Subsequent State Water Board activities in the program, such as discretionary actions to implement the plan amendments, will be examined in light of the SED to determine whether an additional environmental document must be prepared. Other actions taken in response to the plan amendments may also be subject to future project-specific CEQA review by those entities with authority over those projects once they are developed and proposed.

Accordingly, the SED adequately identifies the significant effects of the planning approval at hand while deferring the development of detailed site-specific information to future project-specific review. CEQA does not require an analysis of speculative and uncertain actions. (§§ 15064, subd. (d)(3) ["A change which is speculative or unlikely to occur is not reasonably foreseeable"], 15144 ['foreseeing the unforeseeable is not possible"], 15145 ["If, after thorough investigation, a lead agency finds that a particular impact is too speculative for evaluation, the agency should note its conclusion and terminate discussion of the impact"].) Project-specific impacts cannot presently be identified because they depend in part on how the State Water Board assigns responsibility for implementing the water quality objectives, how the regulated community will comply with the objectives, and actions the community will take in response to potential reductions in water supply.

The SED's program-level analysis is based on relevant information, facts, and reasonable inferences and assumptions that support conclusions regarding potential environmental impacts and economic considerations. The State Water Board recognizes municipalities have various mechanisms (e.g., contracts, negotiated agreements, water rights) by which to obtain water (Chapter 13, Section 13.4.2, *Methods and Approach, LSJR Alternatives, Surface Water Supply*, and Chapter 20, *Economic Analyses*, Section 20.3.3, *Effects on Municipal and Industrial Water Supplies and Effects on Regional Economies*). The State Water Board also recognizes that water users, including service providers, are uniquely situated and their specific, individual responses cannot be predicted. For example, SFPUC has entered into different agreements with irrigation districts on the Tuolumne River with terms affecting water supply and operations. In turn, each retail and wholesale water provider serviced by SFPUC has a different agreement with different terms by which it receives water from SFPUC. The precise parameters of future use cannot be predicted and will vary depending on the entity entering into an agreement, the scope of the agreement, the location, amount, timing, and other factors. The SED appropriately provides a watershed-scale evaluation of potential changes in available supply to SFPUC and the RWS service area and a comparison of different scenarios under the LSJR alternatives that includes general categories of actions. Thus, the SED has been prepared with a sufficient degree of analysis to provide decision-makers with adequate information to enable them to make a decision that intelligently takes into account environmental consequences (§ 15151).

Pursuant to CEQA, the adequacy of the SED is governed by the substantial evidence standard. "Substantial evidence" means "enough relevant information and reasonable inferences from this information that a fair argument can be made to support a conclusion, even though other conclusions might also be reached." (§ 15384, subd. (a).) Substantial evidence includes facts, reasonable assumptions based on facts, and expert opinion supported by facts. (*Id*., subd. (b).) It does not include argument, speculation, unsubstantiated opinion or narrative, evidence that is clearly inaccurate or erroneous, evidence that is not credible, or evidence of economic or social impacts that do not contribute to or are not caused by physical impacts. (*Id.,* subd. (a).) Under the substantial evidence test, a reviewing court does not reweigh the evidence but determines whether the record contains enough relevant information to support the conclusion reached. (*Laurel Heights Improvement Assn. v. Regents of University of California* (1988) 47 Cal.3d 376, 393.) A reviewing court will not weigh conflicting evidence and determine who has the better argument but must resolve reasonable doubts in favor of the administrative finding, even though other conclusions might be reached from the same body of evidence. (*Ibid*.) The SED is supported by substantial evidence in the record.

As discussed in Master Response 1.1, the State Water Board's consideration and adoption of the proposed plan amendments is distinct from the CEQA environmental review process. The State Water Board acts in a regulatory capacity when amending a water quality control plan, and deference must be given to the State Water Board's determination. CEQA's substantial evidence standard does not apply in that context.

Assessment of Potential Effects of Plan Amendments on SFPUC Water Supply

The SED was "prepared with a sufficient degree of analysis to provide decision makers with information which enables them to make a decision which intelligently takes account of environmental consequences." (§ 15151.) "[T]he sufficiency of an EIR is to be reviewed in the light of what is reasonably feasible." (*Ibid*.) While "foreseeing the unforeseeable is not possible," the SED discloses all that it reasonably can. (§ 15144.) Among other things, the SED evaluates the types of physical actions and the impacts that may result from implementation of the plan amendments to the extent reasonably feasible and without engaging in speculation. For example, in Chapter 16, *Evaluation of Other Indirect and Additional Actions,* the SED identifies general categories of actions that the affected entities may take in response to reduced surface water supplies and the resulting impacts that are reasonably foreseeable, including impacts associated with water transfers, groundwater substitution, and development of recycled water, in-Delta diversions, and desalination. In light of the importance of the Tuolumne River to SFPUC's water supply, the SED provides additional information regarding how SFPUC's water supply could be affected by the plan amendments. The SED, however, cannot predict which actions every water supplier within the plan area, extended plan area, or RWS service area, may undertake, nor can it speculate as to the project-level impacts of those actions. Instead of engaging in speculation, the SED discloses the potentially significant impacts of the types of projects that service providers may undertake in response to the plan amendments.

Uncertainty and differences in key assumptions and results between the State Water Board's analytical approach and commenters' analytical approaches are discussed in this section. This section also describes the hydrologic modeling performed by the State Water Board and SFPUC. The State Water Board information is based on the hydrologic modeling results and analysis of water banking scenarios for operations of New Lake Don Pedro contained in Appendix L, *City and County of San Francisco Analyses*.

Uncertainty

As explained in the previous section, the SED appropriately evaluates and discloses the significant environmental impacts associated with changes in river flows and water supplies on a programmatic level based on reasonably foreseeable general categories of actions affected entities may undertake to address possible water supply reductions resulting from the plan amendments. The SED, however, cannot predict or provide precise details on actions that an agency may take to comply with the LSJR flow objectives or to reduce potential water supply effects. Commenters have also pointed to this uncertainty. For example, BAWSCA indicated that the threshold at which water supply reductions would require water rationing by the commercial and industrial sectors is unknown because that threshold would be dependent upon the alternative water supplies available to each BAWSCA member agency, which is also not known with any certainty at this time. As described in Appendix L the extent to which CCSF's water supply diversions from the Tuolumne River Watershed would be potentially reduced by the plan amendments is highly uncertain. It would depend on a number of factors, including:

- The assignment of responsibility to CCSF or the irrigation districts (i.e., MID/TID) to meet the flow requirements through a proceeding amending water rights, water quality certification associated with Federal Energy Regulatory Commission (FERC) relicensing, or other proceeding.
- The interpretation of the Fourth Agreement[5] between CCSF and the irrigation districts, including whether CCSF pays the irrigation districts to release water to meet the flow requirement.
- Any future agreement between the irrigation districts and CCSF.

Both the State Water Board analysis and the SFPUC analysis of the potential surface water reductions begin with a relatively large uncertainty related to who will be responsible for meeting the flow objectives and the magnitude of the potential reduction. The existence and extent of potential water supply reductions in turn informs the potential actions that may be reasonably taken in response to the reductions. The inherent uncertainty in this type of analysis, however, means that the possible actions that could be taken in response to potential water supply reductions, as described in the *Water Supply Planning Approach* section of this master response, and the magnitude of reduced deliveries under the water rationing-only approach described by SFPUC, cannot be identified with precision. For example, SFPUC may or may not renegotiate its contracts but the parties have renegotiated agreements involving the Tuolumne River flows and the New Don Pedro Project in the past (e.g., 1995 Side Agreement)[6] and they may choose to renegotiate the current agreements in light of the plan amendments. Renegotiation, for example, could result in either a Scenario 1 water supply reduction or potentially even less of a reduction in water supply (Appendix L, Section L.2.1, *CCSF Responsibility*). Further, SFPUC's own interpretation of the Fourth Agreement is subject to change. SFPUC repeatedly has acknowledged that the Raker Act and the Fourth Agreement are susceptible to differing interpretations, stating that, "[i]n presenting potential water supply and socioeconomic effects from certain interpretations of the Raker Act and the Fourth Agreement San Francisco does not thereby waive arguments it may have about how the Raker Act or Fourth Agreement should or will be interpreted in future proceedings before the [State Water Board] or other bodies." (SFPUC 2013a)[7] It is also reasonable to include water transfers in the SED analysis because transfers are used by willing buyers and sellers to supply water where it is needed most, typically as determined by a buyer's willingness to pay. The SED does not suggest that SFPUC or any affected water user is limited to, or will rely on, only one type of action; rather, water users likely will employ a suite of potential measures to meet their water supply needs.

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[5] The 1966 Fourth Agreement, between CCSF, TID, and MID, in part, sets forth the parties' responsibilities for water banking and operations involving New Don Pedro Reservoir, including sharing responsibility for additional instream flow requirements imposed as a result of FERC licensing. See Appendix L for further detail.

[6] Please see Appendix L, Section L.4, *Water Bank Account Modeling*, for a discussion of the 1995 agreement between CCSF, MID, and TID, referred to as the 1995 Side Agreement.

[7] City and County of San Francisco. 2017. *Comments by the City and County of San Francisco to the State Water Resources Control Board's Draft Substitute Environmental Document in Support of Potential Changes to the Bay-Delta*. March 16. Footnote 6.

Despite the lack of project-specific information, Appendix L discloses potential impacts on CCSF's water supply based on available information. The analysis in Appendix L, Section L.4, *Water Bank Account Modeling*, quantifies a potential reduction in the SFPUC water supply during a drought under each of the LSJR alternatives (Table L.4-2). As a practical matter, however, SFPUC's and other water user's potential responses to meeting the LSJR flow objectives, contributing some measure of responsibility to meeting the objectives, or to reduced water supply diversions are difficult to predict and likely could involve multiple actions concurrently or consecutively.

Furthermore, as explained in Chapter 16, the SED programmatically evaluates the cost and potential environmental effects of indirect actions using reference projects, standard assumptions regarding the type and potential location of these actions, and impact mechanisms likely to occur as a result of taking these actions. While any one action alone is unlikely to replace surface water that may be needed under the LSJR alternatives, a combination of actions would reduce the potential water supply effects. Affected entities are all uniquely situated, and because of these unique circumstances, the SED cannot predict how each service provider would respond to reductions in surface water supplies. It is speculative to make assumptions regarding how affected entities will respond to implementation of the flow objectives because responses will depend on many individual and collective decisions, including the discrete actions of other water users in response to reductions in surface water and alternative sources of water supply. Thus, the combination of actions that affected entities would take under each alternative is speculative and unknowable.

As a result, analyzing and disclosing the economic and environmental effects of such actions is complex, and impacts cannot be precisely determined. Despite the inherent uncertainty and unpredictability associated with SFPUC's and other water users' (e.g., BAWSCA agencies) water supply management decisions, the SED makes reasonable assumptions and analyzes a reasonable range of actions and impacts associated with reduced water supplies, as discussed in the *Water Supply Planning Approach* section, that sufficiently discloses environmental and other impacts.

From a more narrow economic perspective, some uncertainty regarding water supplies is inevitable in California given its highly variable climate, location, and diversification of water supply sources relative to population centers (Hanak et al 2011). Uncertainty is influenced by risks associated with different water resource management strategies. For example, risk tends to be higher for urban water systems that rely heavily on a single source of potentially vulnerable supplies (e.g., San Francisco and the peninsula and other parts of California) (Hanak et al 2011). If the uncertainty associated with having secure and reliable water supplies is too great, this uncertainty can constrain investment in water supply infrastructure by potentially undermining commitments of responsible agencies to finance investments in water supply infrastructure while also discouraging business investments that contribute to local and regional economic growth (Hanak et al 2011).

Hydrologic Modeling

The State Water Board evaluated potential water supply reductions using the water bank in New Don Pedro Reservoir and information related to the Fourth Agreement. SFPUC used their operations model with specific limitations and management constraints to evaluate potential water supply reductions. The decision by SFPUC to respond to potential water supply reductions through a water rationing-only approach and minimizing use of the water bank defines the approach to the hydrologic modeling and distinguishes the results. In general, SFPUC assumes that anticipated shortages would be passed directly to their wholesale and retail customers, which may amplify the water supply shortage and occurrence of water rationing, collectively referred to by SFPUC as more severe water rationing. The section that follows presents a summary of the different hydrologic models used and the assumptions associated with the modeling.

SED Hydrologic Modeling

The SED generally evaluates water supply effects resulting from the LSJR flow objectives, while Appendix L quantifies and describes how CCSF's water supply could be affected by the LSJR flow objectives based on certain assumptions. Appendix L acknowledges, however, that the ultimate water supply effects on CCSF cannot be determined with certainty. As discussed in Section L.6, LSJR Alternatives 2, 3, and 4 may affect the ability of SFPUC to supply water to its retail and wholesale customers (e.g., BAWSCA member agencies) under drought conditions. Appendix L describes the operation of the water bank for New Don Pedro Reservoir, by which CCSF obtains storage credits in the reservoir pursuant to the Fourth Agreement. The State Water Board uses the Water Supply Effects (WSE) model to estimate the potential changes to overall surface water supply from each river due to different LSJR alternatives. The WSE model is also used to evaluate the changes in instream flow requirements for the Tuolumne River between the baseline FERC instream flow requirements and the increased instream flow requirements for each of the LSJR alternatives. A post-processing spreadsheet analysis, using the changes in flow requirements as one of the inputs, evaluates the subsequent change in the New Don Pedro Reservoir water bank account governed by the Fourth Agreement Article 8(b) described below and Raker Act entitlements. For a detailed description of the water bank analysis, please see Appendix L, Section L.4, *Water Bank Account Modeling*. For a detailed description of the WSE model, please see Appendix F.1, *Hydrologic and Water Quality Modeling*.

As described in the *Uncertainty* section of this master response, it cannot be predicted whether and how CCSF and the irrigation districts would agree to apportion responsibility for meeting future flow requirements. However, Appendix L analyzes the potential water supply effects associated with the allocation of responsibility under paragraph (b) of Article 8 of the Fourth Agreement, which states:

> That at any time Districts demonstrate that their water entitlements, as they are presently recognized by the parties, are being adversely affected by making water releases that are made to comply with Federal Power Commission license requirements, and that the Federal Power Commission has not relieved them of such burdens, City and Districts agree that there will be a reallocation of storage credits so as to apportion such burdens on the following basis: 51.7121% to City and 48.2879% to Districts.

The SED New Don Pedro Reservoir water bank analysis evaluates the effects of the LSJR alternatives for water years 1983–2003. The water bank balance under baseline conditions is compared with the estimated running balance under the LSJR alternatives.[8] The difference in the estimated water bank balance between baseline and the LSJR alternatives, based on the Fourth Agreement apportionment of 51.7121 percent of increased flow requirements, is used as the indicator of the level of changes the LSJR alternatives could have that would affect SFPUC's water supply. The New Don Pedro Reservoir water bank operates as a hedge against supply shortfall, a water reserve to minimize the frequency and magnitude of water supply deficits. Although the additional apportionment due to increased flow requirements is continuous in nature and draws down the water bank, deficits occur only when the water bank would be drawn below zero. These deficits are considered "supplement needed to maintain a positive balance" in Table L.4-1. The SED results show that the only times the water bank account reaches zero, under all of the LJSR alternatives, are during times of extended drought. One of the most severe drought sequences in the 82-year study period in the WSE model was the 1987–1992 drought, which corresponds to available data regarding the New Don Pedro water bank for the 1983–2003 period (CCSF 2011). This 6-year drought sequence and the greater

[8] Appendix L demonstrates, in Figure L.4-1, close agreement between SED calculation of baseline water bank credit balance 1982-2003 and historical balance reported by CCSF (CCSF 2011).

21-year period of available data are considered sufficiently representative to illustrate the potential effects of the LSJR alternatives on the water bank balance.

Under Scenario 1 of the analysis, storage credits would be reallocated only if CCSF has a positive credit balance in the water bank account. Under Scenario 2, storage credits would be reallocated even if CCSF has a negative balance in the water bank account.[9] All LSJR alternatives under each of the two water bank scenarios cause an annual increase in bank account deficits over the six-year drought period compared to baseline conditions. The increase in bank account deficit from baseline, in the severe drought period of 1987–1992, ranges from 14 to 30 thousand acre-feet per year (TAF/y) under Scenario 1 and from 35 to 208 TAF/y under Scenario 2 (Table 8.5-1). This is the assumed water supply that would need to be replaced to meet the demand of the SFPUC RWS service area. In other words, according to the analysis as shown in Appendix L, Table L.4-1, under the plan amendments (i.e., LSJR Alternative 3), the only time that SFPUC's water supply would be affected is during the 6-year drought between 1987 and 1992; in all other years, SFPUC's water supply would not be affected and would be replenished.

As shown in Appendix L, Table L.4-1 and in Table 8.5-1 below, the differing assumptions under Scenario 1 and Scenario 2 for water bank operations (i.e., whether the water bank account is positive or negative) have a substantial effect on the estimated water supply reductions. Under LSJR Alternative 3, the average annual increase in water bank deficit from baseline associated with the plan amendments would be 27 TAF/y under Scenario 1 but would increase to 119 TAF/y under Scenario 2 for the 6-year major drought period.

Table 8.5-1. Annual Average CCSF Water Bank Deficit for 6-Year Drought Period (1987–1992)

	Scenario 1 Storage credits would be reallocated only if SFPUC has a positive credit balance in the water bank account		Scenario 2 Storage credits would be reallocated even if SFPUC has a negative balance in the water bank account	
	Annual Average Deficit (TAF)	Increase from Baseline (TAF)	Annual Average Deficit (TAF)	Increase from Baseline (TAF)
Baseline Account Deficit	18	-	18	
Deficit for LSJR Alternative 2 (20% UF)	32	14	53	35
Deficit for LSJR Alternative 3 (40% UF)	45	27	137	119
Deficit for LSJR Alternative 4 (60% UF)	48	30	226	208

TAF = thousand acre-feet; UF = unimpaired flow
Source: Table L.4-2 in Appendix L

For reference, results of the WSE model show that the average annual water diversion reduction for all Tuolumne River consumptive uses would be 119 TAF under LSJR Alternative 3; i.e., a 14 percent reduction from baseline for the entire 82 years of the WSE modeling period (*Executive Summary*, Table ES-2). In the 6-year drought period of 1987–1992, the average annual water diversion

[9] In the interpretation of Scenario 1, when the water bank balance reaches zero, there are no more storage credits to be reallocated to account for Article 8(b) apportionment. It should be noted that in periods of drought, the net water available to CCSF after Raker Act entitlements can be very low. In Scenario 2, the burden of increased flow requirements can continue to accrue to CCSF even though there may be little to no water available to CCSF in a given drought year.

reduction for the Tuolumne River would be 228 TAF under LSJR Alternative 3; i.e., a 34 percent reduction from baseline for the 6-year period (data from Attachment 1 to Appendix F.1).

Several commenters noted that the demand of the RWS service area has been reduced or has fluctuated over time, and that the SED describes in one instance for illustrative purposes a demand level (e.g., 260 million gallons per day (mgd) [290 TAF]) higher than that of the RWS service area's current demands. The water bank balance evaluation presented in Appendix L is primarily based on the agreements between CCSF and the irrigation districts, how the water bank has operated in the past, and the water supply provided by the water bank without regard to demand. This is an appropriate proxy for evaluating water supply changes because the plan amendments have the potential to affect water supply, as opposed to water demand. The baseline diversion from Hetch Hetchy is implicit in New Don Pedro inflows and thus is included in the water bank evaluation. Appendix L also identifies a demand in 2010 for comparison (e.g., 226 mgd [253 TAF]), which can be considered an approximate estimate of baseline demand. As noted in Master Response 2.5, *Baseline and No Project*, there is year-to-year variation in some of the data used, and the State Water Board attempted to use data from periods close to the baseline year of 2009 (see Master Response 3.2, *Surface Water Analyses and Modeling*, for information regarding the baseline). Demand fluctuates, however, depending on the water year type and as technologies evolve and municipal water users use water more efficiently. Demand may continue to decrease, as it has over the last several decades (see the *Demand Management* section in this master response for related information). Fluctuations in demand, however, do not affect the validity of the water bank analysis for assessing changes in water supply.

In addition to the general discussion of service providers in the SED, Appendix L addresses the SFPUC RWS service area, which generally would include the BAWSCA agencies. The assessment of the water bank in New Don Pedro and the amount of water that SFPUC receives from the Tuolumne River Watershed informs the regional economic effects of the LSJR alternatives on the regional water users and economy within the RWS service area. As discussed in Appendix L, Section L.6.1, costs were distributed to SFPUC water users (e.g., BAWSCA agencies) according to 2010 water deliveries, as shown in Table L.3-2. For the SFPUC retail service area, reported delivery allocations among user categories include 55.2 percent residential, 32.1 percent commercial and industrial, and 12.7 percent government and other. Across the wholesale service area, delivery allocations among user categories include 58.5 percent residential, 20.8 percent commercial and industrial, 11.4 percent government and other, and 9.3 percent dedicated irrigation uses. Based on these methods, the costs of replacement water under each LSJR alternative are allocated to agencies, such as BAWSCA member agencies and user categories, and were then compiled by county for each scenario.

SFPUC Hydrologic Modeling

SFPUC used a different hydrologic modeling and analytical approach to assess potential water supply effects. SFPUC used the Hetch Hetchy/Local Simulation Model (HH/LSM) to evaluate the effects of LSJR Alternative 3, with adaptive implementation, under Scenario 2 on SFPUC's RWS service area by assuming a set of drought management decisions and corresponding system configurations. SFPUC claimed that rationing would be the only option that they could adopt, and therefore, the model only incorporates water rationing. This section summarizes information regarding the hydrologic modeling performed by SFPUC.

SFPUC used the HH/LSM to evaluate the effects of the LSJR flow objectives on the SFPUC RWS. The HH/LSM is a water supply planning tool used by SFPUC to evaluate performance of the RWS. Applying this model illustrates how average annual water delivery can be sustained by the RWS during an extended drought. The model incorporates certain aspects of the RWS including facilities (i.e., reservoir and conveyance capacities) and operating procedures and "rules" that determine how and when water is moved through the system to SFPUC customers.

SFPUC performed an initial model simulation of the system for a design drought sequence. SFPUC used a hypothetical drought that is more severe than historically experienced by the RWS. This drought sequence is referred to as the *design drought* and serves as the basis for SFPUC's planning and modeling. The design drought consists of the hydrology from years 1986 through 1992, followed by an additional 2.5 years of dry conditions from the hydrologic record, which include the 1976–77 drought. While the most recent drought (2012 to 2016) consists of some of the driest years on record for the SFPUC's watershed, the design drought still represents a more severe drought in duration and overall water supply deficit (SFPUC 2016a). Thus, the ability of the system to deliver water to the RWS service area through the entire design drought sequence under several percent of unimpaired flow scenarios can be reviewed in Appendix 2, Attachment 1 of comments submitted by CCSF (hereafter referred to as Attachment 1).

Rationing is determined in the model simulations by comparing the total system storage to threshold values. When total system storage is below a given threshold at the end of the annual snowmelt season (i.e., the end of the June), a system-wide water supply rationing level that corresponds to that storage threshold is initiated for the following year. These storage thresholds and rationing levels are developed uniquely for each specific combination of water supply system facilities, water demand, and instream flow responsibility to maintain delivery through the design drought planning sequence for each system configuration evaluated. Once rationing levels and corresponding storage threshold values are established for a particular system configuration using this methodology, they are used to simulate the operation of that system through a 92-year historical hydrologic record from 1920 through 2011.

To evaluate the water supply effects of the LSJR flow objectives, SFPUC's HH/LSM model simulates three levels of service area water demand using the methods previously discussed:

- 265 mgd, as an annual average, which represents the total contractual obligation to wholesale customers of 184 mgd, plus an estimate of future demand of 81 mgd for the San Francisco retail service area.
- 223 mgd, which was the actual water delivery to the RWS service area (including wholesale and retail) in fiscal year 2012–2013.
- 175 mgd, which was the actual water delivery to the RWS service area (including wholesale and retail) in fiscal year 2015–2016[10].

These demand levels represent the amount of surface water from the RWS that would be delivered to the SFPUC RWS service area in the absence of any water supply shortage. In years when surface water supply is sufficient, the demand is met entirely by delivery of surface water. In years when surface water delivery is insufficient, the demand is met by a combination of surface water delivery, groundwater delivery, and rationing. In the case of the 175 mgd level of demand, any rationing applied in the model simulations is additional to the delivery shortage that is inherently included in that demand assumption.

The HH/LSM simulates SFPUC's contribution to LSJR Alternative 3 as follows:

- The minimum instream flow schedule in the existing FERC license at New Don Pedro Reservoir was assumed to be in place. The releases to meet this schedule were assumed to be made by

[10] In response to drought conditions, SFPUC requested rationing within the retail and wholesale service area during this period, and the State of California also mandated water conservation measures for all municipal water agencies during this period. This represents a 21.5 percent reduction from fiscal year 2012–2013 demands as a result of drought rationing and these conservation measures.

MID/TID, the irrigation districts that own New Don Pedro Reservoir, under the current FERC license and in accordance with agreements with SFPUC.

- The responsibility to meet flows required by the LSJR alternatives from February through June in excess of the existing FERC schedule was assumed to be shared between SFPUC and the MID/TID. The SFPUC share is assumed 51.7 percent of the required flow in excess of the FERC schedule. This apportionment of responsibility is the same as Scenario 2 described in the SED.

Based on the methods described previously and different percentages of unimpaired flow (e.g., 20, 30, 40, and 50 percent), 15 water system configurations were simulated to evaluate the effects of the LSJR alternatives. The configurations are a combination of LSJR flow scenarios and service area water demand levels. For each level of demand evaluated, the only differences between the simulations are the release requirements at La Grange Dam (2 miles downstream of the New Don Pedro Dam) to meet the LSJR flow alternatives and the adjusted drought rationing levels.

The SFPUC analysis also shows estimates of the average annual water contribution from RWS storage potentially required to meet the LSJR alternatives under the highest simulated demand scenario in Tables 8 and 9 of Attachment 1. Results related to RWS storage using the other simulated demand levels evaluated by SFPUC are not provided. The average annual water contribution from SFPUC storage in all years is a different metric to estimate the potential water supply cost of the LSJR alternatives than the water supply deficit (SFPUC rationing) or water bank deficit (SED) metrics. Attachment 1 suggests that the average annual water contribution metric captures even more negative water supply effects then the simulated demand deficits or SED water bank deficits that could occur when RWS contributions to meet the LSJR alternatives are the cause of substantial reductions in storage, but may not cause a water bank balance deficit. Results of the HH/LSM hydrologic modeling effort are summarized in Table 8.5-2 in the *Key Differences in Analytical Approaches* section of this master response.

Key Differences in Analytical Approaches

SFPUC uses a different model and analytical approach to assess potential effects resulting primarily from an evaluation of LSJR Alternative 3, with adaptive implementation, under Scenario 2. With this analysis, SFPUC asserted that water supply reductions would be more severe than those estimated in the SED, as would the resultant economic effects and potential environmental effects. This section discusses key differences between SFPUC's analytical approach and the State Water Board's approach. The operative differences between the SED and SFPUC analyses are the degree of resolution of system operations, demand levels, and potential actions for responding to and allocating water supply reductions.

SFPUC used the HH/LSM to evaluate a range of conditions associated with water supply reductions. The State Water Board has used the WSE model to estimate the potential changes to overall surface water supply from each river due to different LSJR alternatives and a post-processing spreadsheet analysis (water bank balance) to describe potential water supply effects. While the HH/LSM is a more detailed model that simulates operation of the RWS service area, the WSE model and water bank balance provide similar water supply effects as the HH/LSM under the SFPUC middle demand level and SED Scenario 2 (Table 8.5-2).

Table 8.5-2. Comparison of SFPUC HH/LSM Model Results and SED Water Bank Balance Results

	SFPUC HH/LSM			SED Water Bank Balance	
	Drought Demands	Actual Demands	Future Demands	Scenario 1	Scenario 2
	175 MGD/ 196 TAF	223 MGD / 250 TAF	265 MGD/ 297 TAF	*Storage credits would be reallocated only if SFPUC has a positive credit balance in the water bank account*	*Storage credits would be reallocated even if SFPUC has a negative balance in the water bank account*
Period of record	(TAF)	(TAF)	(TAF)	(TAF)	(TAF)
FY1920/21 – FY2010/2011	8	21	31	N/A	N/A
FY1982/83 – FY2002/03	16	36	41	8	34
FY1987/88 – FY1992/93	51	111	115	27	119

HH/LSM = Hetch Hetchy/Local Simulation Model; MGD = million gallons per day; TAF = thousand acre-feet

The SFPUC analysis evaluates water delivery under three levels of demand (175 MGD, 223 MGD, and 365 MGD) for five flow scenarios including baseline, 20, 30, 40, and 50 percent of unimpaired flow. The SFPUC analysis uses the term rationing to refer to water deliveries that are lower than the demand value. The SED uses the water bank balance to estimate supply and considers any water bank balance below zero (a water bank deficit) to be a water supply effect.

The SFPUC analysis suggests that SED methods underestimate the negative water supply impact to SFPUC. The SFPUC water demand deficit (rationing) analysis and the SED water bank deficit analysis estimate water shortage as a proxy for water supply effect. The SFPUC analysis asserts that estimating the volume of water released from RWS storage is a better metric to represent water supply effects. For example, Attachment 1 uses several years (1987, 1994, and 2002) as examples of dry year conditions in which RWS storage was negatively impacted in order to maintain a positive water bank balance (avoid a water bank deficit). Table 9 in Attachment 1 shows that the SFPUC supply analysis estimates an average drought water supply reduction of 129,884 AF/year for each of the 6 years in the 1987-1992 drought period, resulting in a loss of an additional 10,884 AF/year, or 65,304 AF in total for the 6-year period, relative to the SED water bank analysis.

The SED water bank balance uses water bank deficits to estimate negative water supply effects to the SFPUC RWS, as explained in the *SED Hydrologic Modeling* section of this master response. The tools used in the SED provide an estimation of water supply effects that are very close to the SFPUC demand deficit analysis (see Table 8.5-2, 111 TAF and 119 TAF) and also fairly similar to the water supply effect estimated by the SFPUC simulated system storage analysis for the 6-year drought (129 TAF and 119 TAF). Table 9 in Attachment 1 shows that the average SFPUC system storage contribution to the LSJR flow objective of 40 percent unimpaired flow is 129, 884 acre-feet (~130 TAF) which is approximately 9 percent greater than the water supply effect estimated by the SED water bank deficit of 119 TAF under Scenario 2.

As described in the *SFPUC Hydrologic Modeling* section of this master response, SFPUC illustrated water supply effects by: 1) the degree of water shortage to customers in the rationing-only approach, and 2) the volume of water released from storage to maintain a positive water bank balance in light of operations considerations and the 8-year design drought methodology. As shown above, the volume of water released from storage is higher (~130 TAF) than the amount assigned to customer rationing. However, water releases or changes in storage in the operation of reservoirs do not comprise shortages or effects by themselves. The SED water bank balance does not equate water supply deficits with rationing and does not simulate re-operation of the RWS. The SED analysis allows full utilization of the water bank to characterize water supply effects, while the SFPUC analysis uses the water bank in conjunction with other reservoirs.[11] In both cases, real water supply effects accrue when either the water bank or overall storage are insufficient to meet demands. As discussed in the *Uncertainty* section of this master response, there is uncertainty in identifying the magnitude of reduced deliveries or storage releases because of system operation choices that are speculative, and other methods of diversifying water supplies.

The SFPUC analysis attributes mandatory water rationing as the only means of responding to potential reductions in water supply. The SED analysis evaluates the subsequent change in the New Don Pedro Reservoir water bank account governed by the Fourth Agreement Article 8(b) and Raker Act entitlements. It applies the Fourth Agreement requirement of 51.7 percent directly to the water bank account and determining net deficits that result. The SED uses a simple method to assess potential water supply reductions in the absence of having access to a model that simulates the operation of the entire RWS service area. It would be speculative for the SED analysis to assume operational rules and actions SFPUC would take to manage a potential reduction in water supply even if the WSE model and water bank balance could have incorporated them. Using water in the water bank is the most direct method to calculate potential changes in water supply, but results in additional obligations to MID and TID. The SED analysis further assumes that this shortfall could be addressed by either planning for and procuring other supplemental water supplies, and/or by a water transfer (see Transfer of Surface Water section of this document). The SED water bank balance is a tool with a reasonable level of specificity to evaluate potential reductions of water supply to SFPUC (Appendix L, Table 8.5-2).

SFPUC's analysis uses a method that plans for a hypothetical 8-year design drought (Attachment 1). This approach incurs shortages sooner than the water bank balance analysis described in Appendix L because operations planning for an 8-year drought assign reductions to customer deliveries and plans for long-term utilization of storage reserves.[12] The SED analysis does not speculate regarding changes to the manner of Hetch Hetchy system operations or operational decisions leading to reductions to customer deliveries. Nevertheless, the SED analysis, which assumes New Don Pedro Reservoir water bank reserves to be potentially exhausted, is a rational and reasonable method for determining water supply effects of increased flow requirements.

In the SED analysis, water bank storage acts as a buffer for shortage in the SED analysis. The LSJR alternatives are evaluated on the change from baseline in the magnitude and frequency of water bank deficits, assuming Hetch Hetchy diversions would remain unchanged. In the SFPUC analysis, all

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[11] In neither the SED Appendix L or SFPUC analyses are water supply effects calculated directly from the increase in streamflow requirements. Rather, water supply effects depend on the real water cost of supplement needed to maintain water bank solvency, as in SED Appendix L, or in the SFPUC case, as a level of rationing to pass on to customers in order to sustain the 8-year design drought with full system reoperation evaluated by the HH/LSM and accounting for more complex dynamics of multiple reservoirs operated together. As described above, the rationing-only approach is unreasonable, even though the estimates of water supply effects are comparable.

[12] "In configurations with greater net demands for water supply relative to available supplies and total system storage, *rationing will be relatively greater and may be initiated at a higher value of total system storage* than in configurations with relatively lesser water demands." (emphasis added; Attachment 1 page 4).

of the system reservoirs and the water bank collectively act as a buffer and Hetch Hetchy diversions are reduced in accordance to SFPUC operations (Attachment 1). Essentially, the calculation of 51.7 percent of the increased flow requirements is the same in both analyses and could result in either similar or different estimates of supply shortages depending on the SFPUC demand scenario and operations decisions. As shown in Table 8.5-2, short- and long-term estimates of water supply effects are comparable for the SED Appendix L Scenario 2 and the SFPUC 223 MGD/250 TAF demand scenario.

The SFPUC analysis evaluates the strictest interpretation of the Fourth Agreement while the SED evaluates two interpretations of the Fourth Agreement in recognition of the potential for differing interpretations. In the SED Water Bank Balance Scenario 1 interpretation of the Fourth Agreement reallocates storage credits only if SFPUC has a positive credit balance in the water bank account; Scenario 2 reallocates storage credits even if SFPUC has a negative credit balance in the water bank account. Scenario 2 is a stricter interpretation of the Fourth Agreement and has higher water supply costs. Table 8.5-2 shows substantially lower water supply effects for LSJR Alternative 3 under Scenario 1 than Scenario 2 for the SED and SFPUC model results. The actual reduction in water supplies, however, would largely depend on the assignment of responsibility to meet the flow objectives and the operation of the water bank (e.g., Scenario 1 or Scenario 2, or a completely different scenario). The actual reduction during times of extended drought would be expected to influence SFPUC's response (i.e., smaller reductions would require more limited and/or less intensive actions).

SFPUC identified water rationing as the most reasonably foreseeable method of compliance and as such only models rationing from both a hydrologic perspective and an economic perspective. As described in the *Overview* section*,* water rationing is not a reasonably foreseeable method of compliance and is not the most reasonable response action. The State Water Board did not evaluate severe water rationing because reliable information contained in this master response and the SED supports a conclusion that other measures are reasonably foreseeable (e.g., see the following sections in this master response: *Overview, Programmatic Analysis and Adequacy of the SED, Water Supply Planning Approach*). A water supply planning approach is consistent with state policy under the Urban Water Management Planning Act that encourages long-term water supply planning, and it is consistent with SFPUC's own policies and actions to make long-term water supply investments. The water rationing-only approach is an unproven approach that has not been implemented at the suggested scale described by SFPUC. It is not reasonably foreseeable that SFPUC would undertake a course of action that would have potentially devastating effects on the San Francisco Bay Area economy and that would be expected to be widely unacceptable to residents of the Bay Area community.

SFPUC claimed that potentially significant environmental effects would occur and that these effects were not evaluated in the SED based on their analysis that assumed the rationing-only approach. In addition, BAWSCA and agency members claimed that other potential environmental effects would occur, triggered by actions that BAWSCA members could take in response to a water rationing only approach. For the reasons discussed in this master response, a water rationing-only approach and related impacts are not reasonably foreseeable. The SED evaluates potentially significant environmental effects associated with indirect actions that could be taken under a water supply planning approach.

Economic Evaluation

The SED appropriately evaluates and discloses the significant environmental impacts associated with changes in river flows and water supplies on a programmatic level based on reasonably foreseeable general categories of actions affected entities may undertake to address possible water supply reductions resulting from the plan amendments. These include meeting water demands during drought periods by purchasing water or otherwise developing new sources of water (Appendix L, Section L.5, *Potential Actions to Meet Water Supply Demand*, and Chapter 16). However, SFPUC identifies severe water rationing as the "most" reasonably foreseeable method of compliance and does not consider any other indirect actions to reduce potential water supply reductions associated with implementing the LSJR flow objectives. As such, all of the economic-related effects identified by SFPUC stem from a water rationing-only approach.

A socioeconomic analysis prepared for SFPUC (referred to as the 2017 Brattle Group Report)[13] explicitly considers the estimated water supply reduction conditions associated with LSJR Alternative 3 Scenario 2. The analysis of economic effects and other considerations conducted for the SED evaluated three additional LSJR alternatives under two water bank scenarios (as described in the *Assessment of Potential Effects of Plan Amendments on SFPUC Water Supply* section of this master response) in addition to LSJR Alternative 3 Scenario 2. The SFPUC socioeconomic analysis is further discussed in this master response in the section entitled, *Water Rationing-Only Approach*.

The sociodemographic data used in a 2014 report prepared for SFPUC by the Brattle Group (referred to as the 2014 Brattle Group Report)[14] were updated for the 2017 analysis. The 2014 Brattle Group Report focuses on assessing the socioeconomic impacts of potential instream flow conditions under different FERC-imposed requirements at New Don Pedro Reservoir. As such, the analysis conducted for the 2017 Brattle Group Report provides a more recent and applicable analysis for comparison with the analyses in the 2016 Recirculated SED.

The analyses in both the 2014 Brattle Group Report and the 2017 Brattle Group Report rely substantially on information presented in a report prepared in 1994 by MHB Consultants. entitled "*The Economic Impact of Water Delivery Reductions on the San Francisco Water Department's Commercial and Manufacturing Customers*," [MHB Consultants, Inc. 1994]). Key information in that report (Tables 13 and 14) appears consistent with estimates of economic output and employment elasticities (percent change in economic output or employment resulting from a 1 percent change in water availability)[15] used to estimate economic output and employment effects of water supply shortages as presented in both the 2014 and 2017 Brattle Group Reports. The elasticities estimated by MHB Consultants were based on responses to a survey of a presumably stratified random sample of commercial and manufacturing water customers in the San Francisco area. Both the timing of the survey of commercial and industrial manufacturers (post 6-year extended drought, when water customers would tend to be hypersensitive to water supply reductions), and the use of marginal coefficients to estimate the response of businesses to water shortages would be expected to contribute to an upward bias in the elasticities used to estimate the economic effects. Marginal coefficients[16] measure the response of water customers to the most recent shortages of water, whereas average coefficients measure responses to a water shortage over a more extended period.

In addition to these elasticity measurement issues, substantial changes in the Bay Area economy have occurred since 1994. Estimating water demand elasticities from data collected in 1993 or 1994 raises important issues of sample-to-population, especially when the survey response rate is low. In

[13] *Bay Area Socioeconomic Impacts Resulting from Instream Flow Requirements for the Tuolumne River,* prepared by David Sunding, Ph. D., for the Brattle Group, 2017.

[14] *Socioeconomic Impacts of Water Shortages within the Hetch Hetchy Regional Water System Service Area.* Prepared for the San Francisco Public Utilities Commission. The Brattle Group, Inc. San Francisco, CA, 2014.

[15] In this this application, an elasticity measures the responsiveness of a business' level of production to a change in the amount of water delivered. Elasticities are typically expressed in numerical values that describe how a change in one variable affects the value of another variable. For example, a price elasticity of demand of -0.1 is interpreted to mean that a 10 percent increase in the price of a good would be expected to have a 1 percent decrease in the quantity demanded of that good.

[16] In general, marginal coefficients are multiplier factors that adjust, at the margin as opposed to under average conditions, the numerical value of one variable in relation to a change in the value of another variable.

the MHB Consultants' survey, the response rate to the mail survey of commercial and industrial businesses was 13 percent and 30 percent, respectively (MHB Consultants, Inc. 1994). These response rates are considered very low, which brings into question the validity of the sample to accurately represent the larger population that the sample is supposed to represent.

Contrary to using marginal coefficients and water demand elasticities estimated from dated information, the State Water Board used an economic input-output model called IMPLAN (IMpact analysis for PLANning) to estimate the economic effects of marginally higher water costs to replace potential water supply shortages in the RWS service area as described in Appendix L, Section L.6, *Regional Economic and Ratepayer Effects of Water Supply Changes*. IMPLAN is the most widely used economic input-output model for assessing regional economic impacts of regulatory and policy actions (see Master Response 8.2, *Regional Agricultural Economic Effects*, for general information regarding the IMPLAN model). It can provide a snapshot of the interrelationships among sectors and institutions in a regional economy. A change in production in one or more sectors of the economy is simulated in IMPLAN using fixed factors that characterize key production relationships, such as production per unit of input, value added, and employment. IMPLAN then applies these factors in a social accounting matrix, which accounts for changes in transactions between producers and intermediate or final consumers in other sectors of the economy. For evaluating the economic effects of a possible indirect action such as a water transfer, the change in production costs are used as inputs to IMPLAN to determine regional economic effects.

The State Water Board acknowledges there are many site specific and project specific factors that influence costs (as also acknowledged in the *Water Supply Planning Approach* section of this master response). As such, the State Water Board conducted sensitivity analyses on the assumed price of water transfers to estimate a range of the regional economic effects associated with higher and lower costs of replacing water supplies (Appendix L, Section L.6.4, *Sensitivity Analysis*). The State Water Board also compiled estimates of costs associated with different potential sources of replacement water, based on different Bay Area-projects and other cost information in the public record, to characterize ranges in costs for different non-water transfer actions (Appendix L, Section L.5.2, *In-Delta Diversion*; L5.3, *Desalination; Chapter 16, Section 16.X.X, title and 16.X.X, title*). However, analyses were not conducted of potential regional economic effects associated with the costs of these actions. Although SFPUC likely would employ a suite of water supply replacement actions to address water shortages in the RWS service area attributable to the plan amendments, the specific combination of actions that would be implemented under any given set of water demand and supply circumstances cannot be accurately predicted.

Approaches to Address Potential Water Supply Reductions

This master response describes the differing approaches taken in the SED and by SFPUC to evaluate the potential impacts resulting from reductions in surface water supply associated with implementing the LSJR alternatives. The differing approaches are based on fundamentally different water resource management strategies. The approach used in the SED to conduct the economic analysis and to consider potential environmental impacts, referred to in this master response as the *water supply planning approach*, is based on standard water supply planning concepts involving a combination of water supply management strategies; i.e., diversified water supply sources to achieve resiliency against drought, population growth, and climate change (DWR 2018a; CNRA et al. 2014). These strategies include replacing water by obtaining water through transfers from other suppliers or by developing new sources of water supply.

In contrast, although SFPUC similarly describes developing a diverse portfolio of water supply management strategies in its own planning documents (e.g., CCSF 2016a 2016b), SFPUC takes a much more narrow approach in its comments on the SED. SFPUC's analysis is selectively based on a water rationing-only approach that presumes limiting water supply deliveries to all SFPUC customers (both retail and wholesale) and no replacement supply strategies. In other words, SFPUC's analysis does not consider replacing water supplies through transfers, expanding yields from existing sources of water, or developing water supplies from new sources of water even though SFPUC's own water supply planning strategy emphasizes diversifying its water supply portfolio (SFPUC 2017a, 2017b). SFPUC's comment letter relies on a water rationing-only approach to address water supply reductions. Potential economic and environmental impacts associated with the water rationing-only approach, in most instances, are dramatically different from potential economic and environmental effects disclosed in the SED because of the differences identified in the *Key Differences in Analytical Approaches* section and further elaborated in the *Water Rationing-Only Approach* section. The following sections describe the extent to which each approach is supported by information in the SED and details associated with implementing each approach.

Water Supply Planning Approach

The SED's assumptions and analyses are generally based on established categories of water supply management strategies used by water agencies. The following section describes water supply planning, both generally and specifically as it relates to SFPUC. The water supply planning approach incorporated in the SED analyses is also discussed. Pursuant to state requirements for the planning and management of water supplies and demand, SFPUC has prepared UWMPs, drought contingency plans, and other planning documents. SFPUC's efforts to secure a reliable and secure water supply for the RWS service area are well documented. Relevant planning efforts and measures taken by SFPUC, and BAWSCA agencies, in response to the recent drought in California (2010 through 2015) also are described. The information presented in this section amplifies information contained elsewhere in the SED and does not change the severity of significant environmental impacts or results of other analyses presented in the SED.

Urban Water Management Plans

As explained in Chapter 13, *Service Providers*, and Master Response 8.4, *Non-Agricultural Economic Considerations*, the Urban Water Management Planning Act (UWMP Act) (Wat. Code, § 10610 et seq.) requires urban water agencies to prepare a plan every 5 years to ensure that water suppliers are planning for long-term reliability and efficient use of California's water supplies to meet existing and future demands (SFPUC 2016a). As described in the CCSF 2015 UWMP (SFPUC 2016a), SFPUC has identified opportunities to expand the capacity of existing sources of water supply, develop new sources of water supply, and obtain supplies through transfers from other water districts. Some commenters noted that the SED analysis should have considered their specific urban water suppliers' UWMPs as part of determining what actions water suppliers may take in response to a reduced water supply. To ensure that the State Water Board considered sufficient information to appropriately analyze impacts at a programmatic level, UWMPs of the entities that receive water from the Stanislaus, Tuolumne, and Merced Rivers (e.g., irrigation districts and those that receive surface water from the irrigation districts, including SFPUC) were reviewed. The *Regulatory Background* section of Chapter 13 summarizes information from those UWMPs, and the SED considered this information in various discussions, including in the impact analyses, the economic considerations in Chapter 20, and in Appendix L. The State Water Board's assessment of the selected UWMPs is governed by considerations of reasonableness and practicality. While an individual agency's plan may differ in specific details, the plans reviewed demonstrate that water supply planning strategies share common elements such as water supply diversification and development of water supply sources through different efforts (e.g., water transfers or water desalination).Considering this, the SED identifies common reasonably foreseeable actions that affected entities may undertake and sufficiently discloses the environmental and other effects of such actions at a programmatic level.

Analytical Approach and Description

As explained in the *Overview*, the SED identifies reasonably foreseeable methods of compliance and indirect actions that regulated entities may take in response to potential water supply reductions based in part on information gathered from relevant sources. The water supply planning approach assumes that water suppliers will make rational decisions concerning the replacement of reductions in water supply by implementing actions to develop one or more existing or new water sources, consistent with approaches described in relevant planning documents. This section describes the water supply planning approach, including underlying premises and economic and other potential consequences, such as ratepayer effects, as analyzed in the SED. The sources described include among others water transfers, in-Delta diversions, and desalination; how these sources fit within a water supply planning approach also is described.

The development of effective water management strategies involving diverse and resilient water supply options is a long-standing principle of California water (UWMP Act; CNRA et al 2016). This principle is continually evolving through the identification and evaluation of different combinations of strategies and actions (UWMP Act; CNRA et al 2016). The SED identifies common elements of water management strategies that are consistent with widespread water supply planning practices implemented by SFPUC and other water agencies. For purposes of the discussion, a water supply planning approach includes actions to expand the yield of existing sources of water or to develop new sources of water supply. Depending on the presumed frequency, magnitude, and duration of potential water supply reductions, this strategy involves relying on one or more sources of supply, or a mix of different options, as part of a diversified water supply portfolio. This approach is consistent with the water resource management approach outlined in the resource management strategy of the California Water Plan, which notes that “the new and continuing challenges of California’s diverse and extreme conditions require local agencies to use new and different methods of managing water” (DWR 2016). Water supply planning documents prepared by SFPUC, BAWSCA, and the Association of Bay Area Governments (ABAG) suggest that many of common water supply strategies are viable and economically feasible options for SFPUC and other local agencies because they are identified as potential components of drought contingency plans.

As explained in the CCSF 2015 UWMP, SFPUC is committed to developing a comprehensive water portfolio that considers future needs. SFPUC intends to work with other Bay Area water agencies to explore regional water supply opportunities such as transfers and desalination. These actions and others are evaluated programmatically in the SED, including in Chapters 13, 16, 20, and Appendix L. As explained previously, the SED identifies environmental impacts at a program level, noting that site-specific projects will be evaluated in the future by the agencies proposing them once the project details are known.

Some commenters asserted that the specific projects that the SED uses to identify and disclose environmental impacts of analogous indirect actions must be feasible options for them to undertake. For example, SFPUC asserts that it is not reasonably foreseeable or feasible for it to obtain a “significant source” of replacement water through the development of a large-scale desalination plant at Mallard Slough. The SED, however, does not identify a desalination plant as a “significant source” of water, but instead clearly acknowledges that SFPUC may need multiple sources of water supplies to augment its drought supply. The SED further acknowledges that a desalination project may need to be larger than described in the Bay Area Regional Desalination Project feasibility studies and, accordingly, evaluates the costs and environmental impacts associated with a larger project. The SED does not speculate whether an affected entity will decide if a specific future project is feasible or what the details of that project may be. Instead, in keeping with the programmatic-level analysis, the SED's review of environmental documents related to specific projects helps to explain the types of actions that may be taken and the associated environmental impacts and costs.

SFPUC recognizes the need to diversify its water supply sources (SFPUC 2016a). As described in its *Division of Water Resources Annual Report for Fiscal Year 2016-2017*, SFPUC is currently in the final stages of a multi-year capital water supply improvement program (WSIP) to upgrade its water supply systems (SFPUC 2017c). Most of the projects that are part of the WSIP are either currently underway or are completed or nearing completion. The WSIP goals and objectives are identified in Table 8.5-3.

Table 8.5-3. Water System Improvement Program Goals and Objectives Related to Water Supply

Program Goal	System Performance Objective
Water Supply: meet customer water needs in non-drought and drought periods	• Meet average annual demand of 265 mgd from the SFPUC watersheds for retail and wholesale customers during non-drought years for system demands through 2018. • Meet dry year delivery needs through 2018 while limiting rationing to a maximum 20% system-wide reduction in water service during extended droughts. • Diversify water supply options during non-drought and drought periods. • Improve use of new water sources and drought management, including groundwater, recycled water, conservation, and transfers.

Source: SFPUC 2016a (2015 Urban Water Management Plan, Table 7-2).
mgd = million gallons per day; SFPUC = San Francisco Public Utilities Commission

SFPUC's WSIP is intended to increase the base supply to meet the service area's growing demands, as well as to provide reliability and water supply during a drought (SFPUC 2006). Based on water supply and demand projections developed by SFPUC for the CCSF 2015 UWMP, current supplies plus those identified in the WSIP are expected to be adequate to meet current and future demand under annual average precipitation patterns. As described previously and in Appendix L, implementation of the plan amendments could affect SFPUC's available water supply during extended drought periods. During prolonged annual sequences of less-than-average precipitation, however, SFPUC would invoke drought operations. This would involve the use of supplies from WSIP dry year supply projects, which include supplies in Calaveras Reservoir, Alameda Creek Recapture, Crystal Springs Reservoir, regional groundwater storage and recovery projects, and water transfers (SFPUC 2016a: Table 7-3.]). These supplies could provide from 0.5 mgd to 9.3 mgd of water between 2020 and 2040 (SFPUC 2016a: Table 7-3.]). Water transfers are identified as having a potential supply of 2.0 mgd (SFPUC 2016a: Table 7-3.]). Allocations from these sources are provided in Table 8.5-4.

Table 8.5-4. Wholesale Regional Water System Allocations in Normal, Dry, and Multiple Dry Years

	Normal Year		Single Dry Year[b]		Multiple Dry Years					
					Year 1 [b]		Year 2 [c]		Year 3[c]	
Year	mgd	%	mgd	%	mgd	%	mgd	%	mgd	%
2015[a]	184.0	100.0	152.6	82.9	152.6	82.9	129.2	70.2	129.2	70.2
2020	184.0	100.0	152.6	82.9	152.6	82.9	132.5	72.0	132.5	72.0
2025	184.0	100.0	152.6	82.9	152.6	82.9	132.5	72.0	132.5	72.0
2030	184.0	100.0	152.6	82.9	152.6	82.9	132.5	72.0	132.5	72.0
2035	184.0	100.0	152.6	82.9	152.6	82.9	132.5	72.0	132.5	72.0
2040	184.0	100.0	152.6	82.9	152.6	82.9	132.5	72.0	132.5	72.0

Source: SFPUC 2016a (2015 Urban Water Management Plan, Adapted from Table 8-5).

Notes:

Normal, single dry, and multiple dry year conditions are on a water year basis. Dry year availability is presented in terms of percentage of normal year availability.

While Groveland CSD is reported in this 2015 UWMP as a wholesale customer, it is considered a retail customer of the SFPUC solely for purposes of allocating RWS supplies between retail customers and Wholesale Customers. Thus, RWS supplies to Groveland CSD are accounted for in the retail supply allocation shown in Table 8-2.

[a] RWS supply allocations for 2015 reflects current WSIP conditions (i.e., not yet fully complete). RWS supply allocations for projected years 2020 through 2040 reflect full completion of the WSIP.

[b] Single dry year and multiple dry year 1 reflect a system-wide shortage of 10%. Under the WSIP, wholesale supply allocation at this stage of shortage is 64.0% of available RWS supply, or 152.6 mgd.

[c] Multiple dry years 2 and 3 reflect a system-wide shortage of 20% (or 22% for 2015). For this analysis, a 20% (or 22% for 2015) shortage is considered equivalent to Stage 4, 16-20% system-wide shortage. Under the WSAP, wholesale supply allocation at this stage of shortage is 62.5% of available RWS supply, or 132.5 mgd (or 129.2 mgd for 2015).

mgd = million gallons per day; CSD = Community Services District; UWMP = Urban Water Management Plan; SFPUC = San Francisco Public Utilities Commission; RWS = regional water system; WSIP = water supply improvement program

As described in the *Assessment of Potential Effects of the Plan Amendments on SFPUC Water Supply* section of this master response and Table 8.5-1, SFPUC may experience potential surface water reductions. As explained previously, although common types of water supply options are described, the specifics of indirect actions in response to a potential water supply reduction are uncertain and speculative. The following sections illustrate the role that each of the potential indirect actions could have in SFPUC's range of water supply sources and the potential costs to develop each water supply source. Some examples of potential costs are identified in Table 8.5-5. Factors that influence the capital costs to construct and the operation and maintenance costs include site-specific details and location. Similar to different costs discussed in Chapter 16 and Chapter 20, examples are provided to show the ranges and types of costs, but these may not be the costs incurred under a particular set of circumstances. It is appropriate to use examples for types of costs because they provide insight to the range of costs that could be incurred. Furthermore, identifying and quantifying the mix and match of options under multiple circumstances would not provide more accurate information, because the specific details of such projects and combinations of projects are not known; they would simply be as good as the assumptions on which they were predicated.

Table 8.5-5. Costs for Developing Alternative Sources of Water Supplies.

Supply Source	Cost Estimate ($/AF)	Details	Source of Cost Information	Data Year
Groundwater	$1,290	Sunnyvale Groundwater	BAWSCA Long-Term Reliable Water Supply Strategy	2015
Recycled Water	$4,005	South San Francisco Recycled Water	SFPUC 2040 WaterMAP	2016
	$5,225	Eastside Recycled Water Project	SFPUC 2040 WaterMAP	2016
	<$2,000	Daly City Recycled Water Expansion	SFPUC 2040 WaterMAP	2016
	$1,950–$2,450	Mountain View Recycled Water	BAWSCA Long-Term Reliable Water Supply Strategy	2015
	$2,830	Palo Alto Recycled Water	BAWSCA Long-Term Reliable Water Supply Strategy	2015
	$3,310	Daly City Recycled Water Expansion	BAWSCA Long-Term Reliable Water Supply Strategy	2015
Water Transfer	$700[a]	SFPUC potential transfer from MID	Agreement between Modesto Irrigation District and San Francisco Public Utilities Commission for a Firm Long Term Transfer of 2 mgd of Water Supply	2012
	<$1,000	Potential water transfer	SFPUC 2040 WaterMAP	2016
	$950–$1,750	EBMUD-BAWSCA Water Transfer	BAWSCA Long-Term Reliable Water Supply Strategy	2015
Desalination	$3,200	Bay Area Brackish Water Treatment Plant (Bay Area Regional Desalination Project)	SFPUC 2040 WaterMAP	2016
	$1,400–$4,700	Brackish Well Desalination	BAWSCA Long-Term Reliable Water Supply Strategy	2015

Supply Source	Cost Estimate ($/AF)	Details	Source of Cost Information	Data Year
	$2,100–$2,400	Open Bay Intake Desalination	BAWSCA Long-Term Reliable Water Supply Strategy	2015
In-Delta Diversion	$255	Diversion project	SFPUC Water Supply Options report	2007

AF = acre-feet

Sources: SFPUC 2016b; BAWSCA 2015; MID and SFPUC 2012; SFPUC 2007.

[a] The agreement was for $700/AF. However the water was to be taken only in dry years. According to SJR hydrologic data, dry and critically dry water years occur approximately 35% of years. As such $2,000/AF could be estimated as the actual price of delivered water.

Note: Information included in this table is limited to cost estimates for recent projects located in the Bay Area only. Although this limitation substantially reduces the number of projects with relevant cost information, this requirement helps to ensure that the projects that are included in this table are generally representative of Bay Area conditions. It also should be noted that no costs associated with implementing conservation measures are included in the table in recognition of the unique water efficiency conditions that currently exist in the Bay Area and of the lack of relevant cost estimates.

Water Transfers

This section discusses state policy favoring water transfers and a brief overview of the increase in the use of water markets, including water transfers within the state market, SFPUC's incorporation of water transfers as an option in its planning documents and efforts to participate in transfers and recent transfers in the Bay Area, and the inclusion of water transfers in the SED (e.g., Appendix L, Chapter 16, and Chapter 20).

State policy encourages voluntary transfers. Voluntary water transfers provide a means for reallocation of water supplies from a water right holder to others who can make more efficient use of the resource or have more immediate needs. This furthers the constitutional policy that "the water resources of the State be put to beneficial use to the fullest extent to which they are capable . . ." (Cal. Const., art. X, § 2)

Water Code section 475 states, "[t]he Legislature hereby finds and declares that voluntary water transfers between water users can result in more efficient use of water, benefiting both the buyer and the seller." Water Code section 109 also establishes state policy to facilitate the voluntary transfer of water and water rights where consistent with the public welfare of the places of import and export. It directs state agencies, including the State Water Board, to encourage such voluntary transfers. In addition, Water Code sections 1810–1814 require a state, regional or local public agency that has unused capacity in its water conveyance system to make that capacity available if certain conditions are met. These conditions include fair compensation to the public agency making its conveyance system available.

Transfers can take different forms, and different procedures apply depending on the type of transfer and type of water right or contractual right involved. Where a transfer involves a change in appropriator's point of diversion, place of use or purpose of use, the procedures for changes in appropriative water rights must be followed (Wat. Code, § 1701 et. seq., 1706.) These include expedited procedures for urgency changes. (*Id*., § 1435 et seq.) There are also special procedures for changes involving transfers of water or water rights. (*Id.*, §§ 1725 et seq., 1735 et seq.) These include expedited procedures for short-term transfers that are exempt from CEQA. (*Id*., § 1725 et seq., § 1729.])

While the rules governing approval of transfers are complicated, water markets have grown over time and are an essential tool for managing the state's water resources sustainably and efficiently (Hanak and Stryjewski 2012). In California and in the Bay Area, municipalities and water suppliers use water transfers as a source of water supplies to meet demand. For decades, water markets have been used for the temporary, long-term, or permanent transfer of water in exchange for compensation. Water market activity has grown substantially since early efforts to facilitate the transfer of water began in the late 1970s in response to a severe drought (Pacific Institute 2015). Although market activity slowed in the early 1980s, with an annual average of 100,000 acre-feet (AF) in traded volume, the voluntary water market expanded significantly after the 1987–1992 drought (Pacific Institute 2015). This expansion was mostly influenced by state and federal agencies' dry year purchases of water for resale and environmental protection (Pacific Institute 2015). Between 2003 and 2011, an average of 2.1 million AF was committed annually for sale or lease, with 1.4 million AF actually moving between parties (Hanak and Stryjewski 2012). The volume of water traded was 3.2 percent of statewide water use during that period (Pacific Institute 2015). As shown in Figure 8.5-1 the total volume of water that was transferred between 2009 and 2014 in California generally increases between 2012 and 2014 and is generally lower in wetter years (i.e., 2011). This indicates water transfers continue to exist between willing buyers and sellers even in sequential dry years.

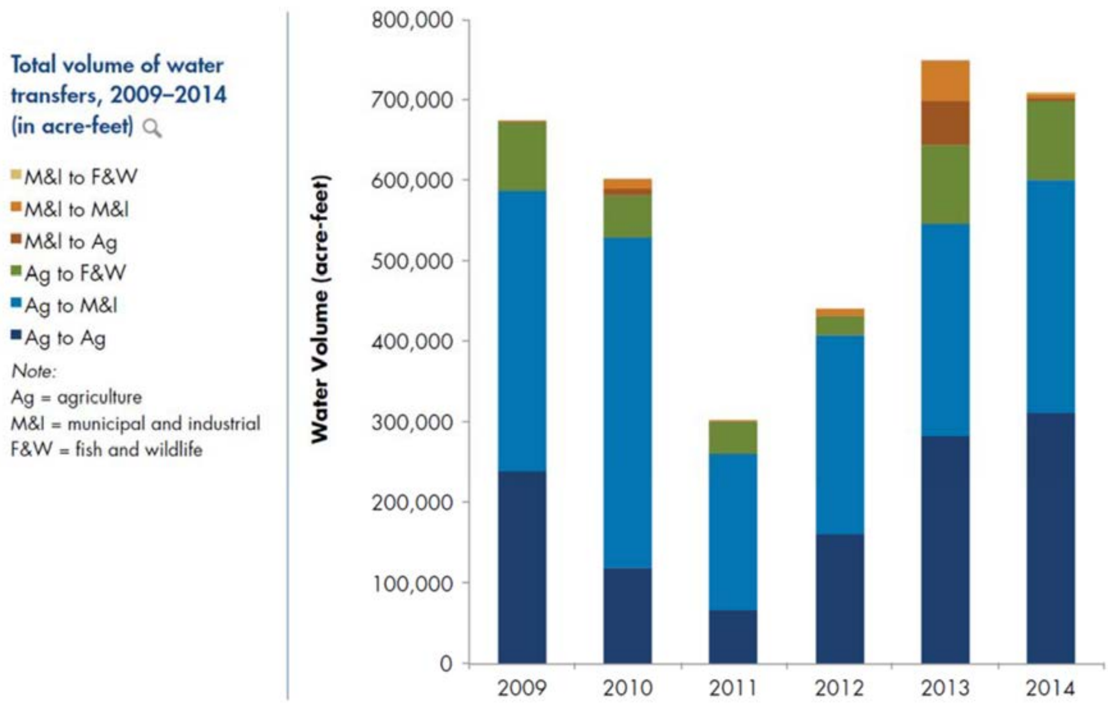

Figure 8.5-1. Total Volume of Water Traded between 2009 and 2014 by Buyer Sector (Source: Pacific Institute 2015).

For more recent information that captures the entirety of the recent drought and the volume of water transfers during the dry water years from 2009 to 2016, refer to Figures 8.5-2 and 8.5-3. Figure 8.5-2 shows the total volume of water transferred in the three primary geographic regions in California by buyer sector, and the number of transfers that occurred annually between 2009 and 2016. California has three primary geographic regions that support water transfers: the Sacramento Valley area; the San Joaquin River, San Francisco Bay, Central Coast, and Tulare Lake area; and the South Coast, South Lahontan, and Colorado River area. Water transfers occur within and between these three geographic regions. The total volume of water traded within these areas is shown in Figure 8.5-2. Figure 8.5-3 shows the total volume of water transferred in the San Joaquin River and San Francisco Bay Area between 2009 and 2016.

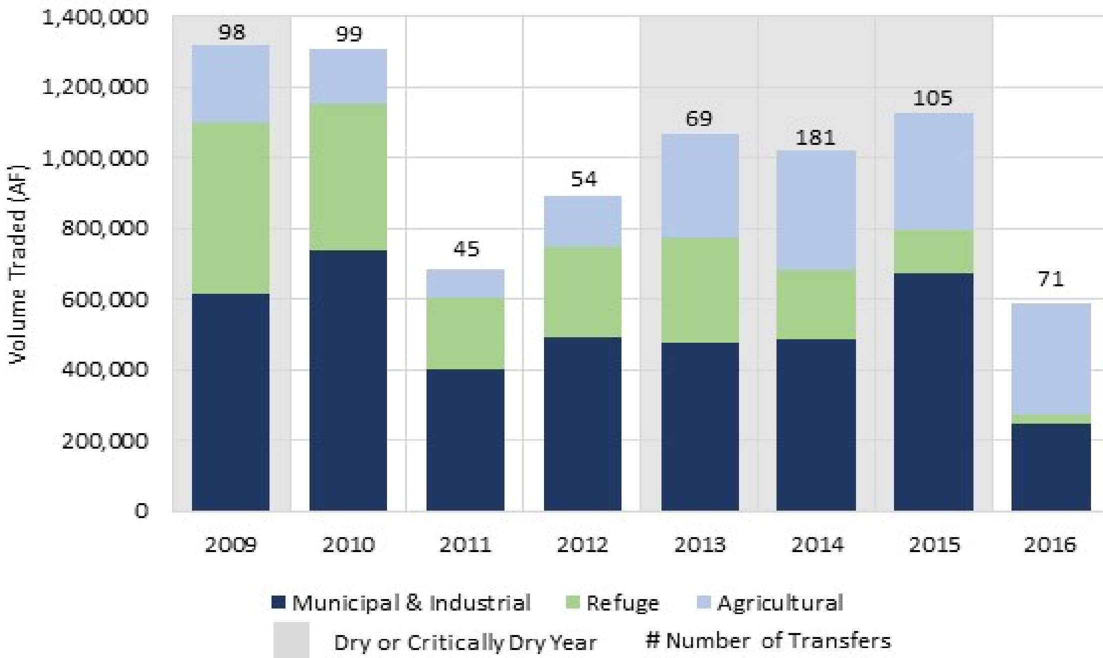

Figure 8.5-2. Total Volume of Water Traded between 2009 and 2016 by Buyer Sector in the Primary Geographic Regions of California. (**Source: WestWater Research - Waterlitix™ transaction database**).

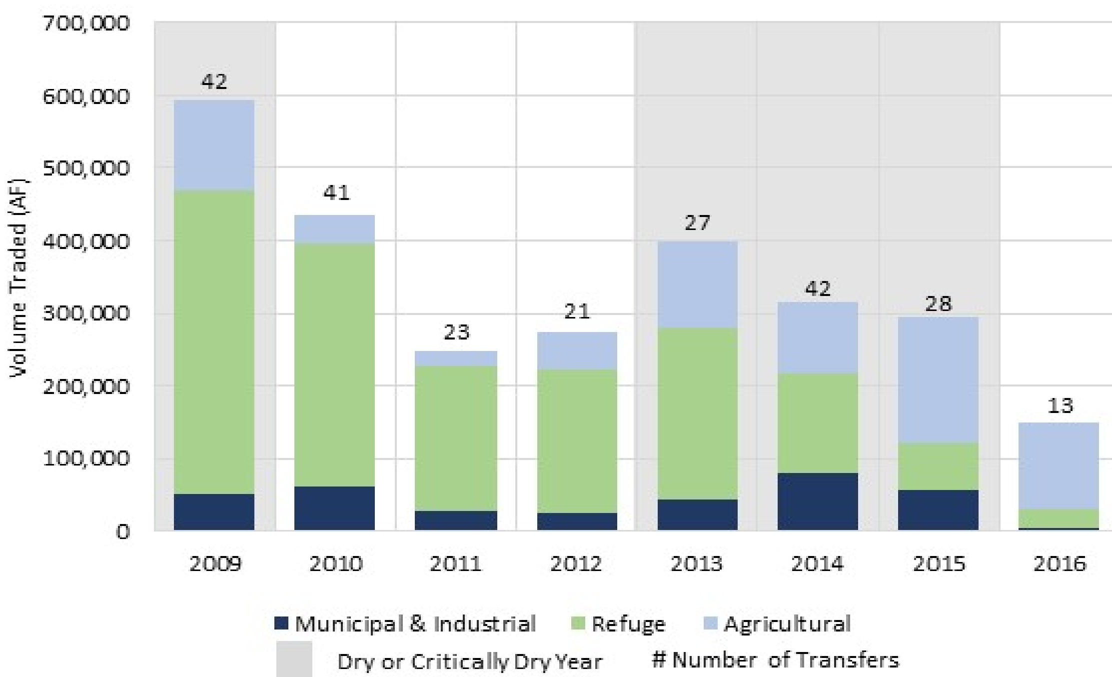

Figure 8.5-3. Total Volume of Water Traded between 2009 and 2016 by Buyer Sector in the San Joaquin River and San Francisco Bay Area (Source: WestWater Research - Waterlitix™ transaction database).

As evidenced by the data in Figures 8.5-2 and 8.5-3, transfers occur in different regions of California for agricultural uses and municipal uses in wet years, dry years, and sequential dry years. The prices paid for transfers depend on a number of factors, including the type of water year and the current availability of water resources for trade, the amount of water needed by a buyer, and the geographic region of potential buyers and sellers. Table 8.5-6 identifies a subset of water transfers that occurred in California in 2015 with the following characteristics transfers that occurred in the Central Valley region of California, were temporary (one-time) transactions involving agricultural and urban water users, and were confirmed and executed. As shown in Table 8.5-6, the prices paid for these five water transfers, which all occurred at the end of California's most recent drought, ranged from $665 per AF to $1,000 per AF. These reported prices support information in Appendix L regarding the estimated cost per acre-foot for developing or obtaining replacement water supplies (Appendix L, Section L6.2., *Regional Economic Effects of the LSJR Alternatives*).

Table 8.5-6. Confirmed and Executed Temporary Water Transfers between Agriculture and Urban Water Users in 2015

Seller	Buyer	Quantity of Water (Acre Feet)	Purchase Price per Acre Foot (AF)
Pleasant Grove/Verona Mutual Water District	San Luis Delta-Mendota Water District	15,194	$665
Conaway Preservation Trust	San Luis Delta-Mendota Water District	20,684	$665
River Garden Farms	San Luis Delta-Mendota Water District	14,727	$665
San Joaquin Exchange Contractors	Friant Water Authority	10,000	$1,000
Sycamore Mutual Water Company	East Bay Municipal Utility District	5,000	$700

Source: WestWater Waterlitix database (Seely pers. comm.)

Planning documents prepared by SFPUC identify transfers as part of its water supply source options and SFPUC continues to explore potential water transfer opportunities on the Tuolumne River and throughout the San Joaquin Valley. As identified in the CCSF 2015 UWMP, SFPUC continues to assume a 2 mgd dry year transfer will be secured as part of implementing the Phased WSIP Variant. SFPUC assumed an estimated cost of $700 per AF in the CCSF 2015 UWMP (SFPUC 2016a). In addition, as part of developing a water supply program for a 2019 to 2040 planning horizon in the 2040 WaterMAP, SFPUC has identified water transfers as a means of developing additional supplies. The WaterMAP indicates that SFPUC should prioritize working with its wholesale customers to enable transfers of individual supply guarantees and should actively pursue transfers. SFPUC estimates that up to 25 mgd in transfers could be available to them (SFPUC 2016b).

SFPUC has a history of actively pursuing water transfers. During the 1987–1992 drought, San Francisco purchased approximately 107,848 AF of water.[17] The *WSIP Draft Program Environmental Impact Report* (WISP PEIR), prepared in 2008, considered a water transfer of up to an equivalent of 26 mgd between SFPUC and MID/TID during drought years. This proposed water transfer, however, was reduced to 2 mgd in the final WSIP PEIR (SFPUC 2008) for the Phased WSIP Variant, which was adopted in 2008. From 2011 to 2012, SFPUC negotiated with MID for a water transfer, but these

[17] City and County of San Francisco. 2017. *Comments by the City and County of San Francisco to the State Water Resources Control Board's Draft Substitute Environmental Document in Support of Potential Changes to the Bay-Delta*. March 16. Footnote 6. Pg. 66.

negotiations were terminated because MID and SFPUC were unable to reach mutually beneficial terms (SFPUC 2013b). Subsequently, SFPUC initiated discussions with the Oakdale Irrigation District to secure a similar dry year transfer for 2 mgd. The transfer from the district would be accompanied by a corresponding demand reduction through conservation and system improvement efforts funded by the revenue generated by the water transfer (SFPUC 2016b).

In addition to water transfers between SFPUC and entities outside the RWS service area, there could be water transfers within the SFPUC RWS service area (e.g., transfers of individual supply guarantees). For example, the City of East Palo Alto, a BAWSCA member agency, is adding to its water supply portfolio to better manage reductions in supply and to support planned development and economic growth through water transfers with two other BAWSCA member agencies—the Cities of Mountain View and Palo Alto. These permanent transfers would total 1.5 mgd and would provide East Palo Alto with entitlements to purchase from SFPUC sufficient water supplies to accommodate the development that is contemplated by East Palo Alto's General Plan (City of East Palo Alto 2017). Specifically, these transfers would provide East Palo Alto with 1 mgd of Mountain View's individual supply guarantee (City of East Palo Alto 2017) and with 0.5 mgd from Palo Alto (The Stanford Daily 2018). East Palo Alto acquired the right to purchase up to 0.5 mgd from SFPUC, which would reduce Palo Alto's supply from 17.1 mgd to 16.6 mgd. About the recent water transfer, the City of Palo Alto noted that it had not consumed more than 16.6 mgd since the 1970s, prior to initiating various water conservation measures (The Mercury News 2018a). The City of Mountain View, pursuant to its water supply agreement with SFPUC, is required to purchase a minimum of approximately 8.9 mgd or pay a penalty, which the City of Mountain View has paid twice in the past 10 years (City of Mountain View 2017) because demand for water was less than available supply. Through conservation efforts and policies, Mountain View has reduced its potable water demand over the past several years, and anticipates that this trend would continue and that water demand for the city would be less than the reduced allocation for decades (City of Mountain View 2017). This type of expansion and diversification of the East Palo Alto's existing water supply portfolio exemplifies its ability to develop options to accommodate potential water supply reductions to SFPUC resulting from implementation of the LSJR plan amendments. It also demonstrates why the State Water Board cannot engage in a project-level analysis in the SED. The State Water Board cannot speculate as to every single potential action that could be taken by each BAWSCA agency, and CEQA does not require such speculation.

The SED appropriately identifies surface water transfers as actions that affected entities, including water suppliers, could take to augment their water supply in response to reductions in surface water resulting from implementation of the LSJR plan amendments. The details of specific transfers are not known at this time (e.g., type, location, volume of water, timing, participating entities, conditions of transfer approval); thus, water transfers are analyzed at a programmatic level. The analysis in the SED does not assume that water transfers alone would necessarily replace the entire potential reduction in surface water to entities such as SFPUC. Rather, this action is considered as only one potential action within, and in addition to, a range of actions that may be taken to address the reduction. Chapter 16 includes a discussion of the most common types of water transfers in California, groundwater substitution, cropland idling, and reservoir storage releases but does not identify any single type of transfer that entities such as SFPUC would pursue in response to surface water reductions except to indicate that water transfers associated with cropland idling or groundwater substitution would be more likely to occur under the LSJR alternatives because, as the available surface water supplies become more limited, a higher value is placed on the supply.

Commenters indicated that the SED's reliance on the environmental analysis in the WSIP PEIR is misplaced, in part, because the 2 mgd water transfer analyzed in that document "solely involved the use of conserved water." The SED, however, does not limit its transfer discussion to a particular type of transfer, such as a conserved water transfer. A 2 mgd water transfer is discussed in Chapter 16 as it relates to SFPUC as a point of reference for the overall water transfer discussion because that volume was considered as part of the Phased WSIP Variant (SFPUC 2008). The analysis in the WSIP PEIR for the Phased WSIP Variant did not note specifically that the 2 mgd dry year transfer would definitively be a conserved water transfer (SFPUC 2008: p. 13-10). A conserved water transfer was considered in the WSIP PEIR as part of the Modified WSIP Alternative and was included in Mitigation Measure 5.3.6-4a to reduce the impacts of the WSIP on fisheries and terrestrial biological resources in the Tuolumne River below La Grange Dam (Appendix H, *Supporting Materials for Chapter 16*, Attachment 1, *Water Transfers Applicable Mitigation Measures)*. However, as noted in Appendix H, Section H.3, *Potential Mitigation Measures for Potential Selling Party,* "At this time, it is unknown what sources of water or water users could be affected by a water transfer arrangement with TID, MID, or other agency or agencies that involves use only of conserved water." As previously noted, the State Water Board evaluated water transfers at a programmatic level, as informed by categories of actions that agencies are likely to undertake and relevant information regarding the impacts of such actions.

Water Supply Desalination

In California, including in the Bay Area, municipalities and water suppliers are exploring, funding, and building different types of desalination facilities. A desalination project could provide a reliable water supply regardless of the water year type or other surface water supplies used by SFPUC. SFPUC and BAWSCA have identified both brackish desalination and San Francisco Bay water and ocean desalination a water supply that could provide substantial yield and as a water supply option that merits further evaluation (SFPUC 2016a, 2016b; BAWSCA 2015). Thus, water supply desalination is considered in the SED as one other indirect action that SFPUC could choose to implement to augment the RWS water supply and is analyzed at a programmatic level in Chapter 16. The SED does not assume that SFPUC would rely on this potential action alone as a means of replacing all potentially reduced surface water supplies due to implementation of the LSJR alternatives. Rather, this action is considered as only one potential action within, or in addition to, a suite of actions that affected entities may take to address possible surface water supply reductions anticipated under LSJR Alternatives 2, 3, and 4.

As discussed in Chapter 16, Section 16.2.6, *Water Supply Desalination*, desalination projects currently under development or completed in the past 5 years in California have costs estimated at between $1,000 and $3,000 per AF (WaterReuse 2012; SDCWA 2015). The cost information specifically presented in Table 8.5-5 regarding the Bay Area Brackish Water Treatment Project is updated from the information presented in Section 16.2.6 and Section L.5.3 with respect to this project. These two sections identified estimates of total capital construction costs, as well as, approximately $173 to $226 per AF of delivered water for using existing infrastructure (CCWD 2014) and approximately $475 per AF/y of delivered water (22,175 AF/y) for operating costs (total annual operating costs of $10.5 million).

Although generally more expensive than conventional water supply costs but less costly than ocean desalination, the desalination of brackish water (brackish desalination) is relatively economical; in 2013, costs in California ranged from $500 to $900 per AF (Gellerman 2013). California Department of Water Resources (DWR) provides grants to local agencies for planning, design, and construction of water desalination facilities for both ocean water and brackish water. Three rounds of funding have been implemented since 2005 using Proposition 50 funding (DWR 2018b). The current, and fourth, round of funding would use primarily Proposition 1 monies, and eight projects have been recently funded (DWR 2018c). The City of Antioch in the Bay Area received funding ($10 million) for a proposed project (DWR 2018c). The City of Antioch plans to build a brackish water desalination facility at its existing water treatment plant to generate 6 mgd of treated water. This desalination facility would treat water from the San Joaquin River when the salinity of the San Joaquin River is too high for public consumption; historically these times have occurred during the summer and fall, but it is anticipated that this period may extend in the future due to changes in Delta water management and drought frequency (City of Antioch 2017).

There are currently 24 brackish desalination projects in the state. Although the majority of these are in southern California, there is one in the Bay Area—the Newark Desalination Facility (Newark Desal Facility), which is owned and operated by the Alameda County Water District (ACWD). From brackish groundwater, the Newark Desal Facility produces up to 10 mgd of desalinated water, which is blended with groundwater to reduce hardness and meet drinking water standards for a total volume of 12 mgd. The Newark Desal Facility effectively reclaims approximately 70 percent of the water that would have otherwise been discharged to the San Francisco Bay[18] (ACWD 2016).

In-Delta Diversion

The SED acknowledges that SFPUC evaluated and rejected the option of an in-Delta diversion project in the 2008 WSIP PEIR, and acknowledges that the precise action and cost associated with this option are unknown (Section 16.2.5, *In-Delta Diversions*). Nonetheless, the SED evaluates an in-Delta diversion, such as that evaluated in the WSIP PEIR, as a potential means of augmenting water supplies because circumstances may change. A decade-old determination of infeasibility does not preclude reassessment of an option's feasibility in light of changing circumstances. As highlighted by the recent drought, water agencies manage their water supply portfolios in a manner that diversifies supplies. Therefore, an agency determination that an in-Delta diversion was infeasible under one set of circumstances does not render it infeasible in all future circumstances. Thus, in light of changed circumstances since 2008 and increasing awareness of the need to prepare for a variety of hydrologic and water supply conditions in the future, it is reasonable to identify an in-Delta diversion as one potential action in a suite of actions to augment water supplies regardless of whether SFPUC ultimately concludes in the future that an in-Delta diversion remains infeasible. While the SED identifies possible indirect actions that agencies may undertake for purposes of the programmatic-level analysis, it cannot predict with certainty whether agencies will actually take those actions in the future or the project-level effects of those actions. It is important to note that the SED does not assume that an in-Delta diversion or any of the other potential indirect actions (as identified in Chapter 16) alone would be relied upon to replace reductions in surface water supplies due to implementation of the LSJR alternatives. Rather, each individual action, like implementing an in-Delta diversion, is considered as one potential action within, or in addition to, a suite of actions that affected entities may take to address possible surface water supply reductions anticipated under LSJR Alternatives 2, 3, and 4.

Groundwater

The San Francisco area includes seven groundwater basins. The 45-square-mile Westside Groundwater Basin, which extends from Golden Gate Park in San Francisco to Burlingame in San Mateo County, is an important municipal and irrigation water supply for the communities and businesses that overlie the basin. Daly City, California Water Service Company (Cal Water) and San Bruno operate a series of wells that distribute groundwater from the Westside Groundwater Basin to their respective systems. These entities also receive water from SFPUC (SFPUC 2016a). The volume of groundwater historically pumped in the Westside Groundwater Basin ranged from 6,770 AF in 2009 to 95 AF in 2014 (SFPUC 2016a).

The current (2015) and projected groundwater supply for the SFPUC retail service area is identified in Table 8.5-7. Based on projections to 2040, total groundwater supplies are expected to increase by approximately 127 percent relative to 2015. Current groundwater supply, storage, and recovery

[18] As part of ACWD's Aquifer Reclamation Program, ACWD pumps brackish water from the Niles Cone Groundwater Basin to San Francisco Bay to stop/slow saline intrusion (ACWD 2016).

projects in San Francisco include the Regional Groundwater Storage and Recovery Project and the San Francisco Groundwater Supply Project. These two projects are expected to have annual capacity of 3,723 million gallons (11.4 TAF) when completed, which is scheduled for 2018 or 2019. The Regional Groundwater Storage and Recovery project, which is currently under construction, is expected to yield more than 60 TAF per drought cycle. As previously discussed, according to the CCSF 2015 UWMP, the remaining shortage associated with meeting the demand of SFPUC's design drought would be by transfers from irrigation districts. As indicated in Table 8.5-9, the cost to pump groundwater (Sunnyvale Groundwater) as part of the BAWSCA long-term water reliability strategy is estimated at $1,290 per AF.

Table 8.5-7. Groundwater Supplies for the SFPUC Retail Service Area (mgd)

	Actual	Projected				
Retail Supply	2015	2020	2025	2030	2035	2040
San Francisco Groundwater Supply Project[a]	--	4.0	4.0	4.0	4.0	4.0
Westside Groundwater Basin for In-City Irrigation[a]	1.5	0.3	0.3	0.3	0.3	0.3
Castlewood Well System[b]	0.3	0.4	0.4	0.4	0.4	0.4
Sunol Filter Gallery[c]	0.4	0.3	0.3	0.3	0.3	0.3
Total	2.2	5.0	5.0	5.0	5.0	5.0

Source: SFPUC 2016a (2015 UWMP, Table 6-7).

[a] About 1.5 mgd of groundwater currently serves irrigation at Golden Gate Park, the San Francisco Zoo, and the Great Highway medians. A reserve of 0.3 mgd for irrigation purposes will remain as part of the non-potable groundwater supply, while 1.2 mgd will be converted to potable supply under the San Francisco Groundwater Supply Project.

[b] Castlewood CSA is served by the Castlewood Well System.

[c] Irrigation uses in Sunol (currently the Sunol Valley Golf Club) are served by subsurface diversions from the Sunol Filter Gallery.

mgd = million gallons per day

BAWSCA and its member agencies commented that the water rationing-only approach described by SFPUC would result in increased reliance on local groundwater. However, as described in this master response in sections *Approaches to Address Potential Water Supply Reductions* and *Conclusions*, it is not reasonably foreseeable that a water supplier would impose mandatory water rationing on its customers without first attempting other actions to replace any reductions in water supplies with alternative sources. Thus, the extent of the groundwater impacts suggested by the commenters (i.e., increases in groundwater pumping to such a degree that seawater intrusion and subsidence occur) are not based on reasonably foreseeable actions and are speculative. Moreover, historical water production data from wet and critically dry years, as reported by BAWSCA agencies, illustrates that surface water reductions do not necessarily result in corresponding increases in groundwater pumping. For example, data in Table 8.5-8 (illustrated in Figure 8.5-4) show that reductions in surface water to BAWSCA agencies in 2014, a critically dry year relative to 2011, a wet year, did not result in increased groundwater pumping that fully compensated for the surface water reductions, although certain entities came close. In many instances, however, there was either a reduction in groundwater pumping in 2014 relative to 2011 (e.g., Alameda County Water District and San Bruno) or relatively little to no change (e.g., Santa Clara, Milpitas, and Palo Alto).

Table 8.5-8. Self-Reported Groundwater and Surface Water Supply for Select BAWSCA Agencies in a Wet Year (2011) vs. a Critically Dry Year (2014) [a]

	2011 (wet water year)		2014 (critically dry water year)		Change in Production (2014 vs. 2011)	
BAWSCA Agency[b,c]	Surface Water (TAF)	Groundwater (TAF)	Surface Water (TAF)	Groundwater (TAF)	Surface Water	Groundwater
Alameda County Water District	27.5	19.3	21.4	14.8	-6.1	-4.5
Daly City	4.6	2.7	3.5	3.4	-1.1	0.7
East Palo Alto	2.2	0	1.9	0	-0.3	0
San Bruno	2.0	2.1	1.7	2.0	-0.3	-0.1
Milpitas	10.2	0	9.8	0	-0.5	0
Palo Alto	12.4	0	11.5	0	-0.9	0
Santa Clara	6.8	13.9	5.7	14.1	-1.1	0.2
Stanford University	2.4	0	2.3	0	-0.1	0
Sunnyvale	18.6	0.47	16.9	2.1	-1.7	1.6
Mountain View	10.7	0.4	9.9	0.9	-0.8	0.4

Sources: Burke pers. comm. 2017, 2018 (for 2011 data); State Water Board 2014 (for 2014 data)

[a] Values have been rounded to the nearest tenth.

[b] These agencies are identified in this table because comment letters indicated they would pump groundwater under the plan amendments. These agencies have groundwater wells that could be used for potable purposes, non-potable purposes, or emergency purposes.

[c] The City of San Jose, San Jose Municipal Water System–North is a BAWSCA member agency that also submitted a comment on the SED indicating that it would pump more groundwater under the plan amendments. The State Water Board obtained its self-reported 2011 and 2014 surface water and groundwater production data with the intention of including it in this table. However, the data did not appear to be accurate and therefore were excluded. According to the self-reported data, the City of San Jose, San Jose Municipal Water System–North purchased 99.9% less surface water in a critically dry year (2014) than in a wet year (2011), with no reported surface water or groundwater production in either of the 2 years. It is possible that the volumetric units may have been misreported in one of those two years because in 2011, the data was reported in their data in million gallons (MG), and in 2014 it was reported in 100 cubic feet (CCF).

BAWSCA = Bay Area Water Supply and Conservation Agency; TAF = thousand acre-feet

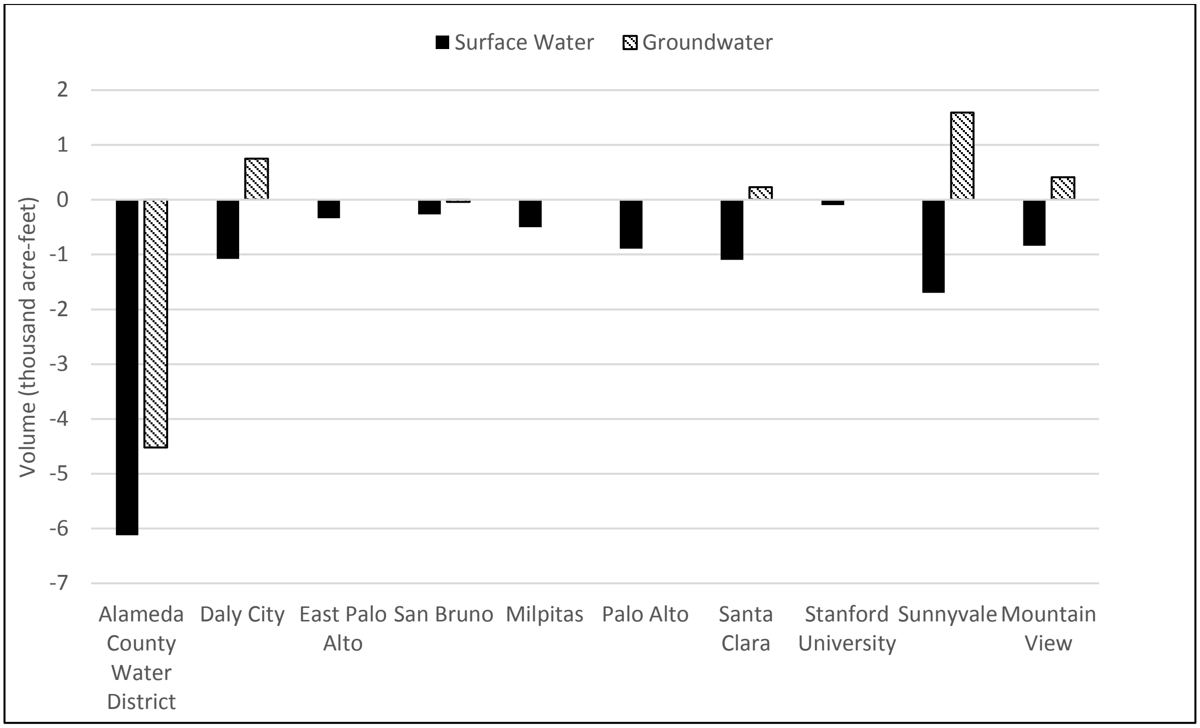

Figure 8.5-4. Difference in Surface Water and Groundwater Production for Select BAWSCA Agencies—Critically Dry Year (2014) vs. Wet Year (2011)

Recycled Water

The State Water Board supports and encourages the sustainable use of recycled water to promote conservation of water resources through its established policy and program (State Water Board 2013, 2018). Recycled water is wastewater from municipal wastewater sources that is treated to an acceptable water quality standard and then distributed for use. Categories of recycled water uses include landscape irrigation, agricultural irrigation, direct potable reuse, and process water. The State Water Board's Recycled Water Policy, revised in 2013, establishes a mandate to increase the use of recycled water in California by 200 TAF/y by 2020 and by an additional 300 TAF/y by 2030 (State Water Board 2013). A survey conducted by the State Water Board and DWR in 2009 indicated that the volume of municipal wastewater recycled for beneficial uses was increasing in most regions of California (State Water Board and DWR 2011). Survey results indicated that the San Francisco Bay Area under the jurisdiction of the Regional Water Board 2 used about 41,000 acre-feet of recycled water for beneficial uses in 2009. The San Francisco Bay region represents a larger area than the SFPUC service area and includes Contra Costa, Marin, Sonoma, Napa, and Solano Counties that are outside of the SFPUC service area. The current (2015) and projected recycled water supply for the SFPUC retail service area is identified in Table 8.5-9. Based on projections to 2040, the total supply of recycled water is expected to increase from 0.2 mgd in 2015 to 3.9 mgd in 2040, approximately 1,850 percent. Thus, while recycled water currently is a small source of water supply for the region, state and local efforts encourage its increased use over time.

Table 8.5-9. Recycled Water Supplies for the SFPUC Retail Service Area (mgd)

	Actual	Projected				
Retail Supply	2015	2020	2025	2030	2035	2040
Westside Recycled Water Project	--	1.6	1.6	1.6	1.6	1.6
Eastside Recycled Water Project	--	--	--	2.0	2.0	2.0
Harding Park Recycled Water Project[a]	0.2	0.2	0.2	0.2	0.2	0.2
Pacifica Recycled Water Project[b]	0.0	0.1	0.1	0.1	0.1	0.1
Subtotal Recycled Water[c]	0.2	1.9	1.9	3.9	3.9	3.9
Non-potable water[d]	0.0	0.1	0.2	0.2	0.3	0.4
Total	0.2	2.0	2.1	4.1	4.2	4.3

Source: SFPUC 2016a (CCSF 2015 UWMP, Table 6-7).

[a] Irrigation at Harding Park and Fleming Golf Courses is provided recycled water from North San Mateo County Sanitation District.

[b] Irrigation at Sharp Park Golf Course is provided recycled water from North Coast County Water District. Approximately 0.01 mgd was provided in 2015 after deliveries began in October 2014.

[c] A small amount of recycled water is dispensed from the Southeast Water Pollution Control Plan recycled water truck-fill station for various approved uses, but the annual volume is not considered large enough to be reported in the CCSF 2015 UWMP (about 739,000 gallons, or 0.002mgd, in 2015).

[d] Non-potable water indicates onsite water reuses as mandated by the Non-Potable Water Ordinance.

mgd = million gallons per day

Typically, recycled water costs less than potable water because it does not need to be treated to the same water quality standards depending on its end use. Landscape irrigation recycled water projects can typically range between $400 and $2,100 per AF, including capital, operations, and maintenance (WRF 2011). Direct potable reuse and process water recycling projects can also range between $700 and $1,200 per AF, including capital, operations, and maintenance (WRF 2011). However, site-specific conditions and the quantity of water treated also effects costs. And as identified in Table 8.5-4, the costs for developing recycled water projects can range from about $2,000 to $4,000 per AF, depending on the effect of local conditions on treatment and distribution.

Demand Management

SFPUC's 2015 Retail Conservation Plan estimates that conservation efforts accounted for a 9.6 mgd (13.0 percent of unadjusted use) reduction in system-wide use in 2015, and will account for 20.7 mgd by 2040 (19.8 percent of unadjusted use) (SFPUC 2016c). Without SFPUC's conservation efforts, retail demand is projected to increase by 40 percent by 2040, but with conservation, SFPUC projects that the retail demand would increase by approximately 29 percent by 2040 (SFPUC 2016c). BAWSCA conducted an analysis of savings among RWS wholesale customers and estimated that, in the wider RWS service area, water use is projected to increase by 9 percent by 2040, whereas population growth is projected to increase by 27 percent (BAWSCA 2014).

Measures such as rainwater harvesting and stormwater capture[19] can reduce potable water demand. The City of San Francisco, for example, has developed a non-potable water program, which establishes guidelines for developers interested in installing non-potable water systems in buildings, and local regulations to ensure appropriate water quality standards (SFPUC 2014a). The City of San Francisco also has a rainwater harvesting program, which offers residents and businesses discounts

[19] Rainwater harvesting refers to collecting precipitation from roofs or other engineered above-grade surfaces, and stormwater capture refers to collecting precipitation from at- or below-grade surfaces.

on rain barrels and cisterns (SFPUC 2018a). However, the projects that would implement these types of actions are not sufficiently widespread or developed to be considered reasonably foreseeable, significant sources of water supply that would help substantially offset the potential surface water reductions with implementation of LSJR alternatives. For example, it was just under 6 years ago that it became legal, through the Rainwater Recapture Act of 2012, to capture and use precipitation in California.[20] In addition, purchasing and installing rainwater capture systems at the residential level can be relatively expensive for homeowners; to capture 10,000 gallons of water a year, a homeowner would need two 5,000-gallon tanks, each of which would range in price from $2,500 to $5,000 (The Mercury News 2018b). For a typical home on the California coast, the pattern of storms in a year may yield 50 to 150 gallons, which was less than 0.1 percent of a household's annual water use in California in 2015 (Lund 2015). For homes in inland California, the water produced would be much less because "the rain barrel is capturing runoff that likely would have been used by others downstream anyway" (Lund 2015).

BAWSCA commented that customers would be unable to conserve additional water in response to periods of reduced water supply because of past efforts. In other words, reductions in water demand during periods of water shortage would be more difficult to achieve under long-term conservation programs or would be unachievable altogether because there would be less discretionary water use to cut back. Water purveyors refer to this as *demand hardening* (Alliance for Water Efficiency 2015). The degree to which water can be conserved is dependent not only on the ability of customers to make adjustments in water-use efficiency as well as behavior, but also on their willingness to do so. A study by the Alliance for Water Efficiency (2015) examined the historical water shortage experiences of seven water suppliers[21] to address whether long-term increases in the efficiency of water use influence an area's ability to adapt to extended water shortages. The study found that how customers respond to water shortages depends, in large part, on the perceived severity of the shortage and the vigor with which mandatory water use restrictions are enforced. In other words, the study concluded that it is not apparent that the ability to reduce water demand during shortages is weakened as a result of taking part in previous, long-term, conservation programs. As noted in the *Drought Contingency Planning* section of this master response, SFPUC's adoption, albeit temporary, of a 45-percent system-wide rationing plan in the middle of the 1987–1992 drought drew a negative response from retail customers, and it was noted in the 2005 UWMP for CCSF that water demand at that point was "likely hardened as compared to the 1987 level of water demand." However, during the most recent California drought, water users in the RWS service area lowered their usage by approximately 12.5 percent as of 2016, which exceeded SFPUC's request for 10 percent voluntary reductions (State Water Board 2016b), illustrating that users were not only able but willing to conserve.

SFPUC has been implementing water conservation programs for several decades (SFPUC 2016a). The purpose of long-term conservation programs (e.g., incentive-based or ordinance-based retrofit programs) is to reduce year-round per-capita water demand and, when focused on outdoor water use, to reduce peak-season (i.e., summer) demand (Alliance for Water Efficiency 2015). When dealing with extended water shortages, water suppliers generally rely on the ability of customers to make time-limited adjustments to their water use, such as substantially reducing irrigation during mild shortages, or discontinuing irrigation and reducing indoor water use (e.g., flushing less or washing fewer laundry loads) during more severe shortages. According to the Alliance for Water Efficiency (2015), until recently, increases in indoor water use efficiency have been primarily the

[20] Prior to the passage of the Rainwater Recapture Act of 2012, it was illegal to capture and use precipitation based on the prior appropriation doctrine. The Rainwater Recapture Act of 2012 exempts the capture and use of rainwater from rooftops from the State Water Board's permitting authority over appropriations of water (Slater and Davis 2013).

[21] Providers were located in Boulder, Colorado; Santa Fe, New Mexico; San Antonio, Texas; and four suppliers in California (Petaluma, Santa Rosa, Monte Vista Water District, and Irvine Ranch Water District).

result of replacement of plumbing fixtures and appliances with more efficient varieties. The study maintains that recent end-use metering studies do not show that indoor water consumption behavior is significantly different now compared to previously, which indicates that in these types of circumstances, at least, there is potentially considerable ability to change indoor water-use behavior (Alliance for Water Efficiency 2015). In addition, the study indicates that, generally, water suppliers have pursued long-term conservation programs directed at making outdoor water use more efficient (e.g., promoting drought-tolerant plants and lawn removal), but outdoor water use can still be considerable, according to the case studies presented (Alliance for Water Efficiency 2015).

The results of the customer surveys undertaken as part of the Alliance for Water Efficiency study indicated that customers are willing to repeat the actions they undertook during previous water shortages and try out additional coping strategies (e.g., graywater reuse) in future water shortage periods. In addition, and not surprisingly, the results from retail customer surveys in the study also show that customers want to keep their water bills low. These results suggest that retail customers are willing to modify their behavior and conserve additional water in spite of existing investments in water-use efficiency and in spite of substantial declines in per-capita demand across the seven case studies. The Alliance for Water Efficiency study indicated that the key to incentivizing customers to reduce water use during shortages is an understanding of how and where water is being used as well as customer preferences about the order in which cutbacks should be requested, and that this information should be reflected in water suppliers' water shortage contingency plan with appropriate enforcement mechanisms. (Alliance for Water Efficiency 2015).

While considerable progress has been made in water use efficiency, opportunities to do even better appear feasible based on the experiences of other developed economies with similar climates. Australia's urban water use in the early 2000s was 80 to 130 gallons per capita of daily use (gpcd), Israel's was 84 gpcd, and Spain's was 76 gpcd (Hanak et al. 2011). The U.S. Geological Survey reported that the average per capita water use in California in 2010 was 181 gpcd (Brandt et al. 2014). Residential as well as commercial, institutional, and industrial water users have made strides in water-use efficiency with advanced, more efficient appliances and plumbing retrofits (e.g., pre-wash spray nozzles in restaurants, low-flow toilets, low-water-use washing machines, and repaired leaky fixtures) as well as with reductions in outdoor watering (e.g., replacement of lawns with drought-tolerant plants and artificial turf). In addition, many industrial plants are now reusing process water, and under new regulations, the energy sector is expected to use less potable water for cooling. There are, however, considerable opportunities for cost-effective conservation in these sectors (Gleick et al. 2003). Efficient pricing can encourage water savings, and water markets can help ensure that water goes to higher-value agricultural, urban, and environmental uses. Storing surface water and recovering these supplies for resale during dry years also is promising for stretching current supplies.

Based on information from the California Public Utilities Commission (CPUC 2016), the costs for implementing conservation measures span a wide range, from $137 per AF for distributing water use reports to customers to $4,580 per AF, which reflects the average cost per AF reported by the California-American Water Company's conservation programs from 2006 to 2011. This range is reflective of the wide array of water conservation actions that can contribute to water consumption savings. As would be expected, relatively low-cost measures include practices that are typically implemented by water purveyors in the early phases of a water conservation program (e.g., distributing water use reports, distributing and installing high-efficiency shower heads to residential customers [SFPUC 2016c]), whereas more costly measures (e.g., installing and rebating for high-efficiency toilets to residential and non-residential customers [SFPUC 2016c]) likely apply to conservation efforts for water purveyors with a longer track record of implementing conservation measures. The more expensive measures are typically associated with conservation programs with water demands that are characterized as hardened because of intensive efforts to reduce consumption over time. The current demand for water in the SFPUC service area has been referred to by CCSF as hardened because of such intensive efforts, especially over the past 10 to 15 years. However, as indicated previously, cost-effective measures are still available—especially within SFPUC's wholesale service area.

During these previous (1987 to 1992 and 2012 to 2016) prolonged droughts, SFPUC followed prescribed procedures and water rationing actions outlined in the 2008 and 2015 UWMPs for CCSF and other documents. As part of those procedures, some amount of water rationing may be necessary in order to manage the demand in response to contributions from its water supply sources. For example, SFPUC imposed mandatory water rationing during the 1987–1992 drought without state intervention or direction. SFPUC anticipated the need, at one point during this drought, to reduce system-wide deliveries by 45 percent (SFPUC 2016a). As noted in the CCSF 2015 UWMP, customer response to a potential 45 percent rationing was overwhelmingly negative. Arrangements were made to obtain water supplies from the State Water Project (SWP) through the South Bay Aqueduct. This arrangement, combined with greater than anticipated conservation savings and high levels of precipitation in late spring, limited the needed reduction to 25 percent of normal deliveries (SFPUC 2016a). Furthermore, during the recent drought (2012 to 2016), the State Water Board imposed specific restrictions on urban water suppliers and outdoor water use. Likewise, SFPUC implemented actions in response to the drought pursuant to the state's directives through the implementation of the state's directives, and by adopting its own regulations. In April 2017, Governor Brown ended the drought state of emergency in most of California, and SFPUC lifted its call for 10 percent voluntary water use reductions and ended mandatory reductions for irrigation customers with interruptible rates (SFPUC 2017d). As a result of meeting the conservation targets, San Francisco's gross retail water demand decreased from 110 gallons per capita per day (gpcd) in 2005 to 81 gpcd in 2015, despite population growth (SFPUC 2016b). Similarly, among RWS wholesale customers, water consumption declined from approximately 150 gpcd in 2005 to about 130 gpcd in 2015 (BAWSCA 2014). This water demand reduction during a period of growth highlights the fact that water supply is only one variable of several that influence growth and development (See Master Response 8.4, *Non-Agricultural Economic Considerations*, for additional discussion of this issue).

Planned water demand management protocols, including rationing, typically do not result in substantial adverse effects on economic development and growth in a region, such as the Bay Area, and subregions that constitute the larger region. This is in part because water rationing measures are primarily limited to residential and outdoor watering uses (as described in the *Drought Contingency Planning and Stress Test* section of this master response). As described in the section entitled *Effects on Regional Growth and Housing Development*, the protocols followed from 2012 to 2016 by SFPUC did not appear to materially affect current levels of economic growth in the Bay Area.

Drought Contingency Planning and Stress Tests

According to the CCSF 2015 UWMP, drought operations include a design maximum of 20 percent retail rationing per year, groundwater conjunctive use, and agricultural water transfers. Water rationing is a component of SFPUC's current strategy to balance available water supplies with water demands during extended drought periods (SFPUC 2016a). The current planning objective is to keep supply shortfalls to under 20 percent by investing in dry year supplies. The percentage of rationing is not uniform across all customers (SFPUC 2016a). SFPUC currently operates under a plan that anticipates multiple stages of response to water supply shortages, ranging from use of dry year water supplies (when available) and voluntary customer water reductions to enforced rationing. A series of increasingly more stringent water conservation actions are targeted at outdoor and indoor uses, by sector, as described by Table 8.5-10. During a Stage 1 water shortage, voluntary conservation is called on to reduce demand. At higher levels of shortfall, a Stage 2 or 3 water shortage is declared, which would put into effect its water shortage contingency plans, specifically the regional water shortage allocation plan, which reduces the allocation of water supplies to wholesale customers, and the retail water shortage allocation plan, which implements water rationing to retail customers.

Table 8.5-10. Retail Water Shortage Stages of Action

Water Shortage Stage	Actions by SFPUC	Trigger Point (System-wide Shortage)	Target Water Use Reduction
1 Voluntary	Request voluntary rationing of customers Alert customers to water supply conditions Remind customers of existing water use prohibitions Increase education on, and possibly accelerate, incentive programs (e.g., toilet rebates)	10–20%	5–10%
2 Mandatory	Implement all Stage 1 actions Assign all customers an "allotment" of water based on the Inside/Outside allocation method (based on base year water usages for each account) Subject water use above the "allocation" level to excess use charges, installation of flow restrictor devices, and shut-off of water	21–50%	11–20%
3 Mandatory	Implement all Stage 2 actions with further reduced allocations	> 50 %	> 20 %

Source: SFPUC 2016a (2015 Urban Water Management Plan, Table 8-3).
SFPUC = San Francisco Public Utilities Commission

Since the recent drought, in May 2016, the State Water Board modified state-assigned percentage reduction-based water conservation standards for urban water suppliers with a localized stress test approach that requires that water suppliers plan ahead to ensure a minimum of a 3-year water supply under drought conditions using 2013–2015 hydrologic conditions. Each water supplier was required to evaluate its water supply portfolio and self-certify the accuracy of its information. Pursuant to this stress test, water agencies that determined they would experience shortage conditions in 2019 under the 3-dry-years assumptions would be required to meet a state-imposed conservation standard equal to the shortage level. For example, a supplier with a 12 percent shortage would have a 12 percent conservation standard. Water suppliers whose submittals show no shortage conditions are limited to their 2013 water use and are encouraged to conserve more. In June 2016, SFPUC and the majority of the BAWSCA member agencies indicated in their stress test that they would have a sufficient water supply, as is denoted by a zero percent conservation standard compared to 2013, shown in the fifth column of Table 8.5-11. In April 2017, the State Water Board rescinded the water supply stress test requirements and remaining mandatory conservation standards for urban water suppliers in response to the end of the drought state of emergency. However, the State Water Board maintained the water use reporting requirements and prohibitions against wasteful practices.

Table 8.5-11. Self-Certification Conservation Standards—Stress Test for SFPUC and BAWSCA Member Agencies[a]

Supplier	Population Served	Previous Conservation Standard (%) (Effective 3/1/16)	Achieved Monthly % Water Savings (June 2016)	NEW State-mandated Conservation Standard[b] (%) (Effective 6/1/16)
Alameda County Water District	346,167	16	28.7	0
Brisbane/Guadalupe Valley Municipal Improvement District	data not available	data not available	data not available	data not available
Burlingame	30,489	16	31.3	0
California Water Service Bear Gulch	68,095	36	27.5	2
California Water Service Mid-Peninsula District	134,914	16	19.7	0
California Water Service Company South San Francisco	61,584	8	22.5	0
Coastside County Water District	16,680	8	3.3	0
Daly City	107,197	8	0.1	4
East Palo Alto[b]	29,143	8	1.3	8
Estero Municipal Improvement District	37,238	12	16.5	0
Hayward	152,735	8	17.3	0
Hillsborough	10,850	36	33.4	0
Menlo Park	16,066	16	40.6	0
Mid-Peninsula Water District	26,672	20	23.6	0
Millbrae	21,532	16	17.6	0
Milpitas	70,817	12	24.2	0
Mountain View	76,250	16	27	0
North Coast County Water District	39,000	8	27.3	0
Palo Alto	64,403	24	17.9	0
Purissima Hills Water District	data not available	data not available	data not available	data not available
Redwood City	87,696	8	21.9	0
San Bruno	44,104	8	23.9	0
San Jose Municipal Water System North	data not available	data not available	data not available	data not available
Santa Clara	120,973	16	23.1	0
Stanford	data not available	data not available	data not available	data not available

Supplier	Population Served	Previous Conservation Standard (%) (Effective 3/1/16)	Achieved Monthly % Water Savings (June 2016)	NEW State-mandated Conservation Standard[b] (%) (Effective 6/1/16)
Sunnyvale	147,976	16	21.6	5
Westborough Water District	14,050	8	22.6	0
San Francisco Public Utilities Commission	846,601	8	12.5	0

Source: State Water Board 2016a.

[a] Data based on self-certification reports submitted by the June 22, 2016 deadline.

[b] The "NEW State-mandated conservation standard" is the self-certified conservation standard for those suppliers that self-certified with the exception of the City of East Palo Alto, which did not self-certify, and therefore they maintained their March 2016 conservation standard.

Regardless of the suspension of supply-based self-certification stress tests and mandatory conservation standards in 2017, it is apparent that SFPUC, BAWSCA, and other wholesale customers are committed to water use efficiency, long-term conservation, and drought planning as is evidenced by their water shortage contingency plans. Many Bay Area water agencies are already anticipating proposed state-mandated updates to water shortage contingency plan requirements pursuant to Governor Brown's Executive Order B-37-16[22] and water use efficiency framework.[23] For example, the Bay Area Regional Reliability (BARR)[24] partnership, established during the recent drought to "cooperatively address water supply reliability concerns and drought preparedness," released a regional drought contingency plan in December 2017, which focuses on water supply reliability, and addresses strategies for emergency response, drought mitigation and response, and water supply replacement and alternative supplies (EBMUD and BARR Agencies 2017). The BARR drought mitigation measures are actions, programs, and strategies to be implemented before a drought occurs in order to increase regional water supply reliability and improve resilience in the long-term (EBMUD and BARR Agencies 2017). Many of these drought mitigation measures would expand existing assets, and other measures would require new facilities (e.g., interties, water storage, water transfers and exchanges, and expanded treatment) (EBMUD and BARR Agencies 2017). In all, in their drought contingency plan, the BARR agencies have thus far identified 15 collaborative drought mitigation measures

Economic Effects and Other Considerations

This section describes potential economic effects and other considerations of a water supply planning approach. The analysis is based primarily on information presented in the economic analysis in Appendix L and includes a discussion of other considerations, such as ratepayer effects (which are also disclosed in Appendix L). Pursuing a water supply planning approach would not be without cost to SFPUC and its service area. The State Water Board conducted a regional-based

[22] Executive Order B-37-16 (May 2016) lays out a framework for "a more durable approach" for local water agencies to manage water in ways that support long-term water conservation.

[23] *Making Conservation a California Way of Life—Implementing Executive Order B-37-16* (DWR et al. 2017), released by DWR, the State Water Board, and other state agencies in April 2017 directs urban water agencies to submit water budget forecasts annually and Drought Risk Assessments every five years with their UWMPs, based on six standard shortage levels.

[24] BARR consists of Alameda County Water District, Bay Area Water Supply and Conservation Agency, Contra Costa Water District, East Bay Municipal Utility District, Marin Municipal Water District, San Francisco Public Utilities Commission, Santa Clara Valley Water District, and Zone 7 Water Agency.

assessment assuming a water transfer as the water supply planning source (Chapter 20, Section 20.3.3, *Effects on Municipal and Industrial Water Supplies and Affected Regional Economies*; Appendix L, Section 16.2.1, *Transfer/Sale of Surface Water*). The State Water Board also provides estimates of construction and operation costs based on other indirect actions that could require construction or operation of facilities (Chapter 16, Section 16.2.5, *In-Delta Diversions*; Section 16.2.6, *Water Supply Desalination*; and Appendix L, Sections L.5.2 and L.5.3.). The State Water Board did not perform a regional economic effects analysis on other indirect actions, given it would be highly speculative (as described in the *Key Differences in Analytical Approaches Economic Evaluation* section of this master response).

The State Water Board acknowledges in Chapters 16, 20, and Appendix L that costs are highly sensitive to the location and type of project being pursued. Ultimately, affected water districts would need to consider how to finance additional costs (potentially both capital and operating costs) of acquiring alternative water supplies, including implementing water conservation measures, and how these costs could affect the structure of water rates. The assumed costs presented in the SED and considered in this master response are provided for purposes of analyzing the economic effects of having to pay for marginally more costly water supplies. The cost evaluation in Appendix L, based on water transfer (Section L.6, *Regional and Ratepayer Effects*), is supportive of the type of information needed for the analysis of costs and associated economic effects using a water supply planning approach.

The economic analysis presented in Appendix L is based on the logical assumption that additional water supplies are available, and these supplies could be developed to address potential shortages associated with implementing the plan amendments. Based on the economic analyses conducted for the SED and by SFPUC, it is apparent that developing these supplies would be more cost-effective than implementing water rationing measures that would negatively affect commercial and industrial enterprises in CCSF's service area. Although developing new supplies or augmenting existing sources would be expected to be more costly than what SFPUC currently pays to obtain water from the Hetch Hetchy system, the additional cost for developing these sources would be expected to have substantially lesser negative economic effects than the water rationing-only approach described and analyzed by SFPUC.

The economic analysis procedures described in Appendix L are capable of analyzing the costs and regional economic effects of a range of potential water supply sources. The economic analysis procedures focus on identifying the marginal cost of replacement supplies, and the cost-related effects of obtaining water from a single source – in this case, water transfers. As described above in the *Transfer of Surface Water* section of this master responses, water transfers are supported by the State to provide a means for voluntary reallocation of water supplies from a water right holder to others who can make more efficient use of the resource, or who have more immediate needs. Water transfers occur throughout the state, and there is evidence that SFPUC and other BAWSCA agencies have pursued and continue to pursue water transfer opportunities. For the cost-based analysis described in Appendix L, assuming an average cost per acre foot reduces the complexity and level of analytical uncertainty of the analysis. However, the approach is flexible and can be used to analyze the cost and regional economic effects of a comprehensive water development program consisting of many different supply sources that jointly could meet small or large water supply shortages. By assuming an average cost per acre foot to obtain water through transfers, a value for replacement water supplies is established that inherently captures an assumed commodity price (in the case of the SED analysis, $1,000/AF). Assuming a mix of different water supply sources and/or demand management measures, as opposed to assuming just one average price for water supplies through transfers, would require many more assumptions, including those concerning different volumes of water needed from each source of water supply (e.g, the mix), and estimates of costs specific to each source of water supply.

Based on an average annual cost of $1,000 per AF, the costs to replace the water supply reductions associated with implementing the plan amendments are estimated to range from $14 million to $208 million during the years of an extended drought (Appendix L, Table L.6-1a). It is reasonably assumed that production costs do not appreciably decline when less water is delivered during drought conditions. In other words, system facilities still need to be operated and maintained regardless of the amount of water delivered through the system. As a result, the full value of the purchase price for water transfers would be added to overall SFPUC costs to provide water from the Hetch Hetchy system. Similarly, if other options were selected, the full value of those costs would also be added to the overall SFPUC costs to provide water.

The estimated costs to be incurred by SFPUC and its wholesale agencies due to a water supply reduction during a severe drought would not be expected to occur evenly over a defined period, as suggested by the calculation of an average annual value. Consequently, while the calculation of an average annual cost is useful for evaluating potential effects (both cost and regional economic effects) relative to ongoing budgetary conditions, the temporal accuracy of calculating an average annual cost is somewhat uncertain. Appendix L provides additional consideration of the return interval of such a severe drought.

As evaluated in the economic analysis in the SED, implementation of the water supply planning approach would be expected to have higher marginal costs to deliver water supplies to retail and wholesale customers in the SFPUC service area. The additional cost would result in a number of cost-related effects in the SFPUC retail and wholesale service area, including rate increases to ratepayers and reduced regional economic activity (Tables L.6-8 and L.6-9). Regardless of whether the source of the replacement water is a water transfer or a mix of other sources or methods of water management, the concept of marginally higher water supply costs affecting ratepayers and the regional economy is grounded in the economic evaluation presented in Appendix L.

Ratepayer Effects

As described in Appendix L, the budgetary effects of purchasing replacement water during severe drought periods (e.g., 1987 to 1992) are estimated to range from $14 million to $30 million under the Water Bank Balance Scenario 1. Compared to the adopted fiscal year 2013–2014 SFPUC budget of $483.12 million, water replacement costs in severe drought years under Scenario 1 would represent an increase in overall costs ranging from about 3 to 6 percent (Appendix L, Section L.6.3, *Ratepayer Effects of the LSJR Alternatives*). Reactions to rate increases by ratepayers would be expected to be largely negative. However, a rate increase of 3 to 6 percent is considered relatively small, particularly if the rate increase was spread over an extended period. SFPUC is a highly engaged public agency with a sophisticated ability to perform public outreach, as evidenced by its efforts during the recent drought to promote conservation efforts (see *Demand Management* section). Most BAWSCA member agencies likely are similarly sophisticated concerning public outreach about rate increases. As such, SFPUC and BAWSCA member agencies can be expected to effectively work with its ratepayers to convey the need for rate increases. As identified in Master Response 2.7, *Disadvantaged Communities*, there are a number of assistance programs to help disadvantaged communities. Additionally, as discussed in Chapter 16, Section 16.5, *Sources of Funding*, there are number of funding sources available to municipalities for developing water sources and water quality projects that could ultimately reduce potential effects on ratepayers.

Regional Economic Impacts

Under a water supply planning approach, SFPUC would continue to plan for and develop water supplies to prepare for periods of water shortages during extended droughts affecting the RWS service area. In turn, unplanned costs associated with these actions would likely be passed on to its retail customers in the form of a temporary rate surcharge and to its wholesale customers in the form of higher wholesale water rates. Wholesale customers would then be expected to pass on the higher costs to their own retail customers through a temporary rate surcharge. As higher water costs affect residential and commercial and industrial water customers throughout the four-county Bay Area region, less discretionary income would be available for water customers to spend on other goods and services, resulting in reduced economic output (sales) and employment throughout the region. Appendix L and Chapter 20 describe potential regional effects under Water Bank Operations Scenarios 1 and 2. Although the absolute numbers of reduced economic output and employment may seem large depending on the alternative and scenario,[25] the overall reductions would be relatively small in the context of the regional economy (Chapter 20, Tables 20.3.3-10 and 20.3.3-12). For example, under LSJR Alternative 3 Scenario 1, the reduction in regional economic output would be $31.4 million or 0.05 percent of the regional output of the Bay Area (Table 20.3.3-10). The total regional effects on employment also are relatively small, ranging from an estimated 117 to 1,700 jobs or less than 0.01 percent to 0.06 percent of total jobs in the Bay Area (Tables 20.3.3-11 and Table 20.3.3-13).

Effects on Regional Growth and Housing Development

Over the past 50 years, water conservation and other demand-reducing measures have contributed to reducing statewide per capita water use by half, while real per capita gross domestic product has doubled. In other words, each unit of water now generates four times more economic value than it did in 1967. While urban water use efficiency has been increasing, total urban water use has been relatively flat since the mid-1990s despite population growth (Hanak et al. 2012). Although the State of California essentially stopped expanding its vast surface storage network several decades ago, the economy has weathered periodic droughts, and enough water has been available to support a growing population and economy as a result of the development of different management innovations. Another reason for economic resilience is that California's economy, including the Bay Area economies, has become less reliant on water-intensive activities.

The availability of reliable water supplies for municipal and industrial purposes is important to maintaining the economic viability of the Bay Area, and reliable supplies are needed to foster future growth and economic activity. However, water supplies are just one of many factors affecting regional growth and housing development. The availability of an adequately trained labor pool, quality infrastructure for the transportation of goods, availability of support services for key basic industries, and a host of quality-of-life conditions also are important (Williams 2017). The following six factors have been identified as key elements to sustaining growth in a regional economy. Improving or increasing these factors can lead to an increase in economic growth in the regional economy (Argarwal 2017).

- Physical capital.
- Population. A growth in the labor force means there is a larger population and more labor.
- Human capital. An increase in investment in human capital can improve the quality of the labor force. A skilled labor force has a significant effect on growth.
- Technology. The advancement of technology could result in increased productivity with the same levels of labor, thus accelerating growth and development.
- Legal system. An institutional framework helps promote economic growth and regulate economic activity. Although no specific set of institutions is responsible for promoting growth, the existence of laws and rules can help facilitate it.

[25] Under Scenario 2 (see *SED Hydrologic Modeling* section in this master response for a description of the scenarios) output and job losses during drought periods are predicted to be substantially higher than under Scenario 1 because replacement water needs and related costs to customers would be much larger as evidenced by the results

- Natural resources (other than water resources).

For additional information regarding factors that relate to growth and housing in the Bay-Area, please refer to Master Response 6.1, *Cumulative Analysis*.

As demonstrated during the recent drought, limited water supplies and increases in water rates to encourage conservation do not appear to have materially affected current levels of economic growth in the Bay Area (Figure 8.5-5). As shown in Figure 8.5-6, the number of housing permits issued throughout the region generally increased during the 5-year drought period. The exception was the number of permits issued in 2015 and 2016. Although the year-to-year number of permits issued in the San Jose-Sunnyvale-Santa Clara area decreased over this period, the actual number of permits issued remained at historically high levels. Additionally, the 2-year decline in housing starts during 2015 and 2016 was more than offset by continued increases in permitting activity in the San Francisco-Oakland-Hayward area. Based on these data, potential effects of marginally higher water costs on economic growth and housing starts in the Bay Area would be expected to be minimal.

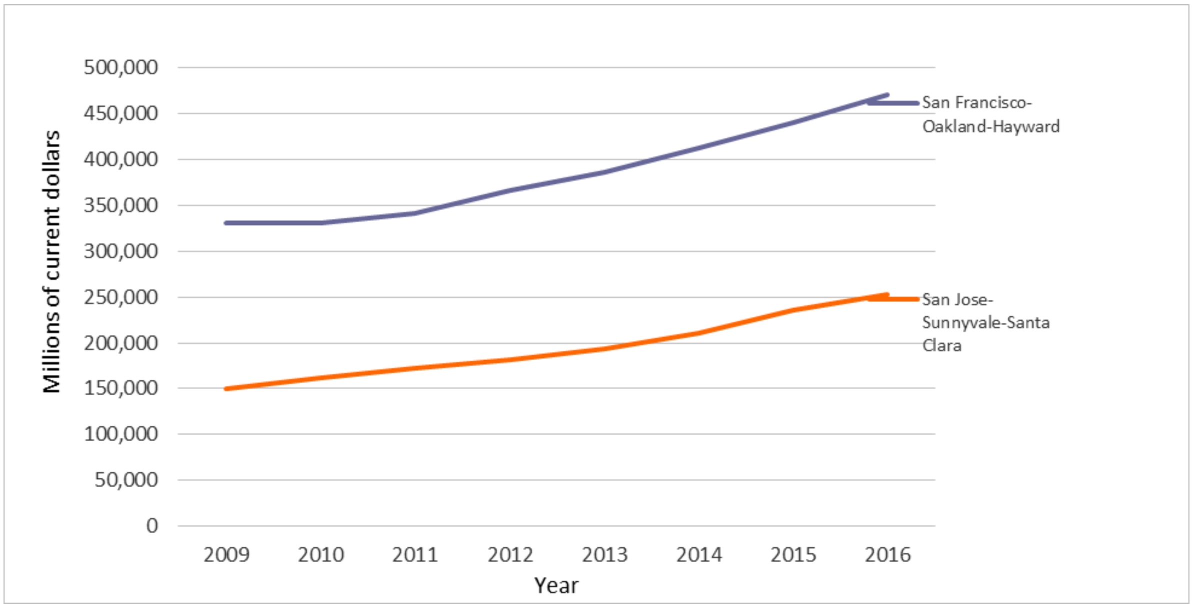

Figure 8.5-5. Current-Dollar Gross Domestic Product (2009–2016) for San Francisco-Oakland-Hayward, CA and San Jose-Sunnyvale-Santa Clara, CA Metropolitan Statistical Areas (Source: U.S. Department of Commerce n.d.)

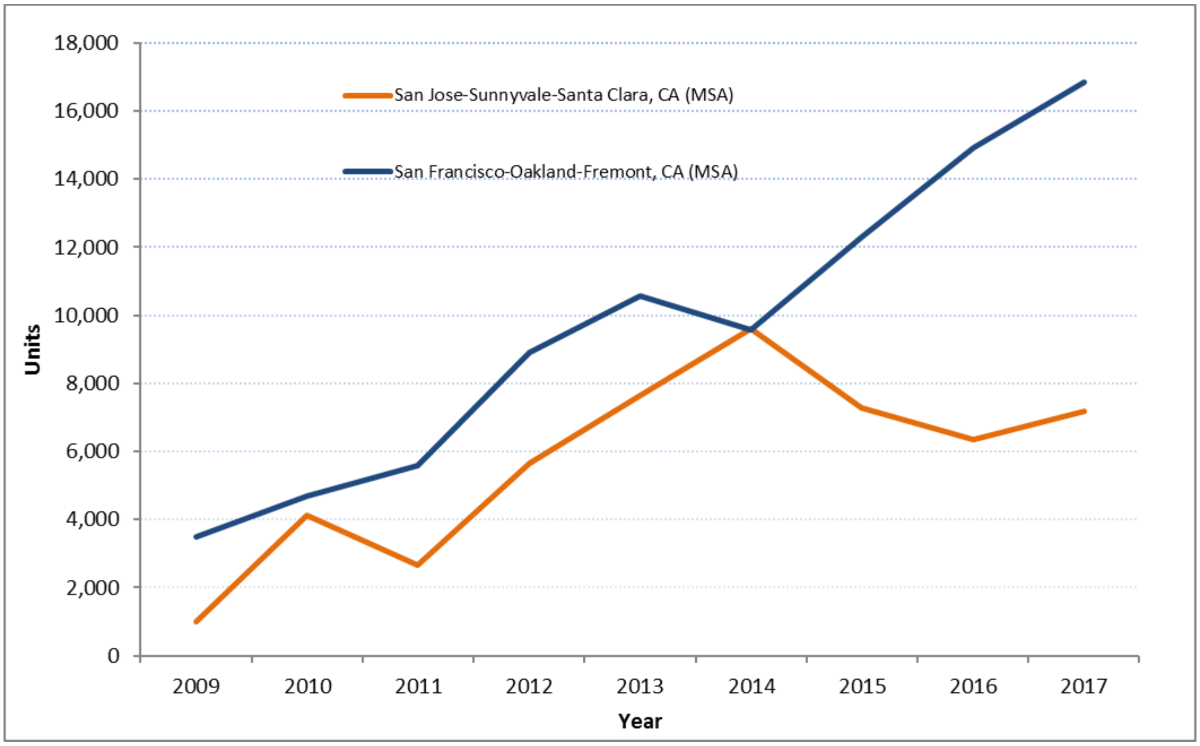

Figure 8.5-6. New Private Housing Units per Year (2009–2016) Authorized by Building Permits for San Francisco-Oakland-Fremont, CA and San Jose-Sunnyvale-Santa Clara, CA (Metropolitan Statistical Areas)(Units, Annual (Sum of Monthly Values); Not seasonally adjusted) (Source: Federal Reserve Bank of St. Louis n.d.)

Water Rationing-Only Approach

SFPUC asserted it is reasonable to assume that SFPUC would implement stringent water rationing-only measures across its entire service area for both retail and wholesale users. BAWSCA's comments concurred with SFPUC's arguments. Water rationing involves instituting allocations in the delivery of water to retail and/or wholesale customers. SFPUC's analysis does not account for other interpretations of the Fourth Agreement or contributions to helping meet the FERC-required instream flows, as described in sections entitled *Uncertainty*, *Key Differences in Modeling and Analytical Approaches,* and *Hydrologic Modeling*). This analytical limitation essentially presents worst-case water supply conditions, and the potential to renegotiate the Fourth Agreement to more favorable terms is not acknowledged. In addition, the analysis does not consider potential actions to replace water supply to be feasible. In other words, the analysis provides a very narrow and incomplete assessment of potential water supply effects.

This section provides a short description of the water rationing-only approach and references information presented in SFPUC's public comments.[26] As described in this section, the water rationing-only approach is conceptually different from the water supply planning approach. Because it is conceptually different, the two approaches cannot be compared directly, but this section identifies contrasts between the water rationing-only approach with the water supply planning approach as appropriate. As discussed throughout this master response, however, a water

[26] City and County of San Francisco. 2017. *Comments by the City and County of San Francisco to the State Water Resources Control Board's Draft Substitute Environmental Document in Support of Potential Changes to the Bay-Delta*. March 16.

rationing-only approach is neither reasonably foreseeable nor credible in light of information in the record, including SFPUC's own water supply planning program, that water agencies will take other actions in response to potential water supply reductions resulting from the plan amendments.

Analytical Approach and Description

The water rationing-only approach is conceptually different approach than the water supply planning approach. The water rationing-only approach relies on limiting deliveries of water supplies to customers (both retail and wholesale) based on supplies available for distribution (see *SFPUC Hydrologic Modeling* section of this master response for more information on the hydrologic modeling of the water rationing approach). The intent of the water rationing-only approach is to deliver the limited available supplies without expanding yields from existing sources of water or without developing water supplies from new sources. In other words, under the water rationing-only approach, SFPUC would not pursue opportunities to supplement current water supplies or to replace any of the potential water supply reductions; the entire reduction would be absorbed by implementing mandatory water rationing measures.

The main premises that underlie the water rationing-only approach include anticipating multiple stages of response to water supply shortages, ranging from use of dry year water supplies (if and when available) to mandatory rationing enforced with substantially higher use charges for noncompliance. Under the water rationing-only approach, SFPUC would address the entire reduction in water supply during extended drought years by imposing mandatory rationing on customers, potentially including commercial and industrial enterprises in its retail and wholesale service areas. Mandatory reductions would vary across the residential, commercial, and industrial customers and would affect both indoor and outdoor uses; all customers in the retail and wholesale service areas would be affected. According to SFPUC, even at low levels of demand, the 40 percent unimpaired flow objective (i.e., LSJR Alternative 3) would reduce water deliveries to the RWS service by 20 percent in the first 3 years of the design drought, and by 32 percent in the next 3 years. However, as discussed in the *Drought Contingency Planning and Stress Tests* section in this master response, water savings (i.e., water consumption reductions) were largely achieved through mostly voluntary conservation efforts taken during Fiscal Year 2015–2016 of the recent extended drought.

The water supply planning approach is consistent with policies stated in the CCSF 2015 UWMP that currently orient all planning efforts to limit water rationing to 20 percent reductions in water deliveries. The relatively recent CCSF 2015 UWMP, released to the public on March 10, 2017, does not mention increasing mandatory water rationing beyond the 20 percent level as a water resource management approach during drought periods. Furthermore, a water supply planning approach is generally consistent with goals conveyed in SFPUC's *Water Resources Annual Report for Fiscal Year 2016–2017:* "the SFPUC has a responsibility to plan and implement projects now to be ready in advance of the need so we can reliably maintain a high-quality water supply. Diversifying our water sources is one of the most important steps we are taking to prepare for the risks we face and ensure a sustainable water supply for generations to come" (SFPUC 2017c).

Other Modeling or Approaches

Several commenters took the information prepared by SFPUC and either extrapolated the rationing predicted by SFPUC to their wholesale or retail circumstance or used the SFPUC-predicted rationing in their own model (e.g., the Water Evaluation and Planning System [WEAP] model). To the extent the commenters took SFPUC rationing model results and information and applied it to their own unique circumstance, a water rationing-only approach is not a reasonably foreseeable method of compliance and is speculative and unsupported by information in the SED regarding SFPUC's own water supply management actions and those typically taken by other water suppliers. Accordingly, comments that applied SPFUC rationing model results and information to their own unique circumstances also use a water rationing-only approach that is not a reasonably foreseeable method of compliance.

For example, Santa Clara Valley Water District (SCVWD) submitted results from a staff analysis of water supply effects that used results from the SFPUC analysis. The SCVWD analysis is built on the SFPUC rationing-only approach that is not reasonably foreseeable and the Scenario 2 interpretation of the Fourth Agreement. These elements of the SFPUC analysis amplify water supply effects of the LSJR alternatives (see Table 8.5-1 and the section entitled *Key Differences in Analytical Approaches*). These assumptions are implicit in the SCVWD analysis because it uses SFPUC results.

In the SCVWD analysis, two additional assumptions further amplify the simulated water supply effects for SCVWD wholesale customers. The SCVWD analysis used SFPUC results from the highest level of demand evaluated. The SFPUC analysis evaluated three different levels of demand and the SCVWD used results from the highest level of demand. Water supply effects will be amplified if compared to a higher water demand target. The SCVWD assumes wholesale rationing will be pro-rated for system-wide shortages greater than 20 percent. The SCVWD analysis does not provide support for the prorating values, stating that "… if SFPUC determines that a system-wide shortage would be greater than 20 percent, then SFPUC and wholesale customers would meet and discuss how to allocate further supply reductions." The highest levels of demand and prorated wholesale rationing values elevate the potential water supply effects on SCVWD wholesale customers, creating a worst-case scenario for the wholesale customer base.

It is also important to observe that the SCVWD analysis does not display modeling results in context of the complete water supply portfolio for SCVWD. The RWS provides approximately 15 percent of SCVWD's water supply portfolio. Any reductions to the SFPUC portion of SCVWD's water supply portfolio are likely to be addressed by the substantial flexibility they currently have in their system (e.g., use of water from the Central Valley Project [CVP] or SWP).

As described in the *Key Differences in Analytical Approaches* section of this master response, the SED analysis used the WSE model and water bank balance to provide a programmatic evaluation of water supply effects on SFPUC. This analysis evaluated two scenarios representing two different interpretations of the Fourth Agreement (Scenario 1 and Scenario 2). Scenario 1 water supply effects are substantially lower than Scenario 2 water supply effects. Scenario 1 is not evaluated or considered by the SFPUC analysis or the SCVWD analysis. The water bank balance estimated water supply effects similar to the HH/LSM Model used by SFPUC for Scenario 2 under the middle water demand level evaluated by SFPUC. The SED analysis did not use a rationing-only approach because it is not reasonable foreseeable. Similarly, the SED analysis did not speculate how water districts may allocate water shortage among customers because those individual choices are not reasonably foreseeable. Accordingly, the programmatic approach and water bank balance analysis provide a reasonable representation of the water supply effects on SFPUC that would result from the LSJR alternatives.

Some commenters incorporated by reference points made by SFPUC related to SFPUC's hydrologic modeling, the water rationing-only approach and the economic effects that are resultant from the water rationing-only approach presented by SFPUC. However, some of these commenters rejected the SED's programmatic analysis of water transfers, claiming that they would not purchase water from SFPUC even if it was made available to them through a water transfer. It is uncertain that in all instances these commenters would refuse to enter into a water transfer agreement with SFPUC and would only obtain water from non-transfer sources. As discussed in the *Transfer of Surface Water* section, voluntary transfers of water are a common option identified in water management strategies; thus, it is likely that water agencies would enter into transfer agreements, if available. Employing diverse water management strategies would result in less extreme economic effects that are potentially more like those described in the *Water Supply Planning Approach* section of this master response. Comments such as this illustrate the complexity and difficulty of determining the water users' responses to implementation of the plan amendments and the resulting impacts, as discussed in the *Uncertainty* section.

Economic Effects and Other Considerations

As asserted by SFPUC, there would be substantial economic effects resulting from implementing the water rationing-only approach, particularly because this approach extends to the commercial and industrial sectors. Fiscal impacts associated with net revenue losses to SFPUC and its wholesale water customers would be expected. According to SFPUC's comment letter, which cites a Moody Rating Report[27] for the new SFPUC water bond, sustained deterioration of stored water supply could negatively affect its bond ratings (Moody's Investor Service 2016). This would increase the cost of financing future capital improvement projects that could in part be used to address the agency's projected supply shortfall.

Ratepayer Effects

As asserted by SFPUC, SFPUC and its wholesale customers would be required to raise its water rates, and reduced storage and lost revenue would likely affect SFPUC's ability to secure financing for future capital investments. Under a 40 percent unimpaired flow objective on the Tuolumne River, SFPUC asserts it would raise its retail rates by 7 percent and wholesale providers would need to raise rates to customers by 9 percent. This rate increase would be in addition to planned rate increases of 8 to 9 percent for existing infrastructure investment projects. The water rationing-only approach would be expected to result in extreme community dissatisfaction. Because per capita water use rates in some parts of the Bay Area are low already, requiring all customers to reduce water use by upwards of 40 percent would be expected to induce substantial hardship and negative community reaction. During the 1987–1992 drought when SFPUC initially attempted to implement a 45 percent system-wide rationing plan, they received 19,000 appeals, 12,000 telephone calls, and 1,500 walk-in complaints in a single month and subsequently revised the rationing goal down to 25 percent (SFPUC 2016a).

Another potential effect associated with the water rationing-only approach and increased rates is a loss in economic welfare. Economic welfare is the level of prosperity and standard of living of either an individual or a group of persons. It is associated with water supply rationing because individuals may experience a decreased standard of living or level of prosperity if customers have to get by with less water. Under the water supply planning approach, supplies would be obtained and available to customers, so there would be no loss in economic welfare to customers associated with adjusting to living with less water.

Regional Economic Impacts

In the commercial and industrial sector, as described by SFPUC, the water rationing-only approach would result in an estimated loss of nearly $19.4 billion in regional economic output and 116,474 jobs. Over all 6 years of the dry-water year scenario, SFPUC estimates total loss in economic output of over $117 billion and 698,800 jobs. Annual job losses would account for more than 8 percent of total employment in the RWS service area. The regional economic impacts asserted by SFPUC suggests that the water rationing-only approach would result in regional economic effects that are more than 100 times greater (or an order of magnitude of at least two) than potential effects of the water supply planning approach. In other words, the water supply planning approach has

[27] *Moody's Assigns Aa3 to San Francisco Public Utilities Commission (CA) Water Revenue Bonds*, September 27, 2016 included in City and County of San Francisco. 2017. *Comments by the City and County of San Francisco to the State Water Resources Control Board's Draft Substitute Environmental Document in Support of Potential Changes to the Bay-Delta*. March 16.

substantially less regional economic effects (i.e., estimated potential loss of $139.5 million in economic output and 1,005 jobs as described previously and in Appendix L) than the water rationing-only approach.

Effects on Regional Growth and Housing Development

As explained by SFPUC and supported by BAWSCA, if water supplies are not adequate to support new customers, cities and counties in the Bay Area may have to limit or prohibit new growth and housing development, exacerbating the Bay Area's existing housing shortage. Development moratoria or water-neutral development programs may be necessary. These would require new developments to offset increased demand from development through conservation or additional supplies to ensure that new development would not increase the supplier's overall system demand. SFPUC and BAWSCA asserted that implementation of the plan amendments would constrain the water supply and not support the growing needs of the region or the pattern of growth that ABAG calls for in its *Plan Bay Area 2013* and *Plan Bay Area 2040* planning documents. SFPUC and BAWSCA asserted that drastically reduced supplies would affect the rates of housing growth in the region and would be in conflict with planning efforts designed to reduce vehicle miles travelled.

Information identified in this master response (*Effects on Regional Growth and Housing Development* section above), as well as Master Response 8.4, *Non-Agricultural Economic Effects*, and Master Response 6.1, *Cumulative Analysis* (section describing housing needs and growth) supports that potential effects of water supplies generally do not appear substantially limiting to housing in the Bay Area.

Environmental Effects

As discussed previously, the SED adequately evaluates the indirect environmental effects associated with reasonably foreseeable methods of compliance and effects resulting from actions that entities employ to replace water supplies reduced by the plan amendments. SFPUC, however, contended that the SED does not evaluate the significant environmental impacts resulting from increased rationing. BAWSCA made similar arguments based on the rationing approach. This master response does not address each of the environmental issues raised; instead the SED addresses such unique comments in unique responses. It merits noting, however, that for the reasons described in this master response, a statement of intent regarding future extreme water rationing is not sufficient and reliable information on which to base an environmental analysis of related impacts. The environmental impacts purportedly arising under such extreme rationing conditions are wholly speculative. In contrast, the information in the SED and in this master response are based on facts and credible analyses supporting the conclusion that SFPUC and BAWSCA member agencies will use water supply options in response to potential reductions in supply resulting from the LSJR plan amendments. The environmental and other effects resulting from such indirect actions are disclosed in the SED.

Hydropower

Commenters expressed concern regarding the effects of the plan amendments on SFPUC's ability to generate hydropower during dry years. As noted in Appendix J, *Hydropower and Electric Grid Analysis of Lower San Joaquin River Flow Alternatives*, the Hetch Hetchy, Cherry Lake, and Lake Eleanor in the Upper Tuolumne River Watershed provide hydropower for CCSF. Chapter 14, *Energy and Greenhouse Gases*, describes existing hydropower production on the eastside tributaries, including on the Tuolumne River. The SED evaluates environmental impacts on hydropower in the extended plan area, where SFPUC hydropower facilities are located, in Chapter 14, and economic considerations related to hydropower generation at the rim dams in Chapter 20, *Economic Analyses*, Section 20.3.4, *Effects on Hydropower Generation, Revenues and the Regional Economy*. In general, the primary effects on hydropower may be in terms of the seasonal production, and these changes are accounted (Section 20.3.4). The analysis considers monthly water storage levels and monthly hydropower production quantity. The SED notes that the LSJR alternatives generally would result in increased storage during spring months and less storage in late summer and accounts for these changes explicitly in its analysis; this is discussed in detail in Master Response 8.4, *Non-Agricultural Economic Considerations*. The concerns expressed in the CCSF comments imply that the loss of flexibility manifests through lower prices in spring, when flows are abundant, and higher prices in summer, when flows are scarce but demand is greatest, as considered in the Chapter 20 analysis. The change in seasonal (and monthly) generation is the primary driver of assessing economic effects in Section 20.3.4. The SED ultimately concludes that the impacts of the LSJR alternatives on hydropower-related revenues would be relatively small.

SFPUC asserted that its hydropower operations would be significantly affected by LSJR Alternative 3 or Alternative 4 during dry years because SFPUC would be compelled to implement a water rationing-only approach to preserve system storage. Consequently, SFPUC asserted, hydropower generation at facilities situated along the route of the delivery pipeline would be reduced. This includes three facilities: Moccasin and Kirkwood Powerhouses, which rely on gravity-driven water flowing downhill from the Hetch Hetchy Reservoir, and Holm Powerhouse downhill from Cherry Lake. Their combined capacity is approximately 385 megawatts, and, on average, the Hetch Hetchy Power System (Hetchy Power) generates 1.6 billion kilowatt-hours of energy each year (SFPUC 2018b). For the reasons described in this master response, a water rationing-only approach is not a credible basis for the assumptions in SFPUC's analysis. Furthermore, the city operates under a water first policy with respect to Hetch Hetchy operations, such that water delivery is given a higher priority over power generation (SFPUC 2010). As described in the *Assessment of Potential Effects of Plan Amendments* section of this master response, SFPUC and other water user responses to meeting the LSJR flow objectives, contributing some measure of responsibility to meeting the objectives, or to reduced water supply diversions are difficult to predict and likely could involve multiple actions concurrently or consecutively. While any one action alone is unlikely to replace surface water that may be needed under the plan amendments, a combination of actions would reduce the potential water supply effects. Thus, the combination of actions that affected entities would take under each alternative is speculative and unknowable. As such, the State Water Board does not provide quantitative estimates of hydropower-based losses because to do so would require knowing the mix of water supply replacements or uses (e.g., all water transfer versus part water transfer and part desalination) and that mix would result in re-operations upstream in the route of the delivery pipeline. Identifying and quantifying the blend of options under multiple circumstances would not provide more accurate information because the specific details of such projects and combinations of projects are not known; they would simply be as good as the assumptions on which they were predicated (*Analytical Approach and Description* section in this master response).

The SED broadly and adequately discloses potential economic considerations resulting from the plan amendments. SFPUC provided a detailed modeling analysis to inform economic considerations regarding hydropower that do not alter the analysis contained in Chapter 20. In other words, the information provided by SFPUC does not change the general conclusion of relatively small effects on hydropower revenues. For example, to provide context, the annual revenue change presented by SFPUC in their comment letter can be compared to recent revenues generated by hydropower. SFPUC's analysis of effects of the proposed plan amendments estimates a loss of only $2 million for each year of a protracted drought. Revenues from Hetchy Power hydropower generation are approximately $90 million or higher each year (SFPUC 2014b). Historically, hydropower represents 96 percent of Hetchy Power's capacity (SFPUC 2014c). Even in Fiscal Year 2014, several years into drought, power enterprise revenues were $105.9 million, mostly from hydropower generation and sales (SFPUC 2014c). As such, the $2 million reflects a relatively small change in the context of the total annual revenues.

Please refer to Master Response 8.4, which discusses comments related to the economic considerations regarding hydropower and as these potential considerations relate to the energy market, including renewables. The plan amendments would not contribute to the ongoing need on the part of hydropower operators to plan, manage, and adjust accordingly, even with the growing renewable sector.

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