UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
501 West Ocean Boulevard, Suite 4200
Long Beach, California 90802-4213

September 22, 2021

Anthony Emmert
Executive Director
Fillmore and Piru Groundwater Basins
Groundwater Sustainability Agency
P.O. Box 110
Fillmore, CA 93106

Re: Proposed Fillmore Basin Groundwater Sustainability Plan Public Review Draft (August 6, 2021)

Thank you for the opportunity to review the Draft Fillmore Basin Groundwater Sustainability Plan (hereafter "Draft GSP"), which is intended to meet the requirement of the California Sustainability Groundwater Management Act (SGMA). In reviewing the Draft GSP, we considered whether it meets the SMGA, which includes specific requirements to identify and consider impacts to Groundwater Dependent Ecosystems (GDE) that have significant and unreasonable adverse impacts on all recognized beneficial uses of groundwater and related surface waters (Water Section 10720).

Unfortunately, the Draft GSP does not adequately address the recognized instream beneficial uses of the Santa Clara River or the principal tributaries within the boundaries of the Fillmore Groundwater Basin, or other GDE, potentially affected by the management of groundwater within the Fillmore Basin. In particular, Draft GSP does not adequately recognize or analyze the groundwater recharge program associated with the Fillmore Basin (and the interrelated upstream surface diversions), and its potential adverse effects on the federally endangered southern California steelhead (*Oncorhynchus mykiss*).

Additionally the Draft GSP does not adequately address the depletion of interconnected shallow groundwater basins and the pattern of groundwater extraction and surface water diversions that have occurred historically, currently, and are likely to occur in the future. Of particular concern is the potential adverse effects on designated critical habitat for southern California steelhead within the Santa Clara River, and tributaries that are essential for the recovery of endangered steelhead, including Sespe Creek within the boundaries of the Fillmore Basin. The surface flows at the confluence of Sespe Creek, for example, are important for maintaining surface hydrologic connectivity for steelhead (and other native aquatic-dependent species) attempting to migrate between these major tributaries and the middle reaches of the Santa Clara River.

NOAA's National Marine Fisheries Service (NMFS) has previously provided extensive comments on these issues, which remain largely unaddressed in the Draft GPS for the Fillmore Basin (see the enclosed NMFS letter of April 01, 2021 regarding the "Draft Technical Memorandum-Assessment of Groundwater Dependent Ecosystems for the Fillmore and Piru Basins Groundwater's Sustainability Plan").

NMFS appreciates the opportunity to comment on the proposed GSP for the Fillmore Basin. If you have a question regarding this letter or enclosure, please contact Mr. Mark H. Capelli in our Santa Barbara Office (805) 963-6478 or mark.capelli@noaa.gov.

Sincerely,

Anthony P. Spina
Chief, Southern California Branch
California Coastal Office

Enclosure

cc: Natalie Stork, Chief, DWR, Groundwater Management Program
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UNITED STATES DEPARTMENT OF COMMERCE
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April 01, 2021

Anthony Emmert
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Fillmore and Piru Groundwater Basins
Groundwater Sustainability Agency
P.O. Box 1110
Fillmore, CA 93016

Re: Draft Technical Memorandum- Assessment of Groundwater Dependent Ecosystems for the Fillmore and Piru Basins Groundwater Sustainability Plan (February 2021)

Dear Mr. Emmert:

Enclosed with this letter are NOAA's National Marine Fisheries Service's (NMFS) comments on the Draft Technical Memorandum- Assessment of Groundwater Dependent Ecosystems for the Fillmore and Piru Basins Groundwater Sustainability Plan (Draft Memorandum).

The Draft Memorandum was developed to meet the requirement the requirements of the California Sustainable Groundwater Management Act (SGMA). The SMGA includes specific requirements to identify and consider adverse impacts on all recognized beneficial uses of groundwater and related surface waters, including Groundwater Dependent Ecosystems (GDE). (See Cal. Water Code §§ 10720.1, 10721, 10727.2.)

As explained more fully in the enclosure, the Draft Memorandum does not, but should, adequately address the recognized instream beneficial uses of the Santa Clara River, or other GDE, potentially affected by the management of groundwater within the Fillmore and Piru Groundwater Basins. In particular, the revised Draft Memorandum should adequately recognize or analyze the important relationship between the extensive groundwater extractions program within Fillmore and Piru Groundwater Basins (and the conjunctively managed Fox Canyon Groundwater Basin) and its potential adverse effects on the federally endangered steelhead (*Oncorhynchus mykiss*) and habitat for this species.

The revised Draft Memorandum should be re-circulated to give NMFS, and other interested parties, an opportunity to review the revisions before the Draft Memorandum is finalized.

NMFS appreciates the opportunity to comment on the Draft Memorandum. If you have a question regarding this letter or enclosure, please contact Mr. Mark H. Capelli in our Santa Barbara Office (805) 963-6478 or mark.capelli@noaa.gov.

Sincerely,

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NOAA's National Marine Fisheries Service's Comments on Draft Technical Memorandum - Assessment of Groundwater Dependent Ecosystems for the Fillmore and Piru Basins Groundwater Sustainability Plan (February 2021)
April 1, 2021

Overview

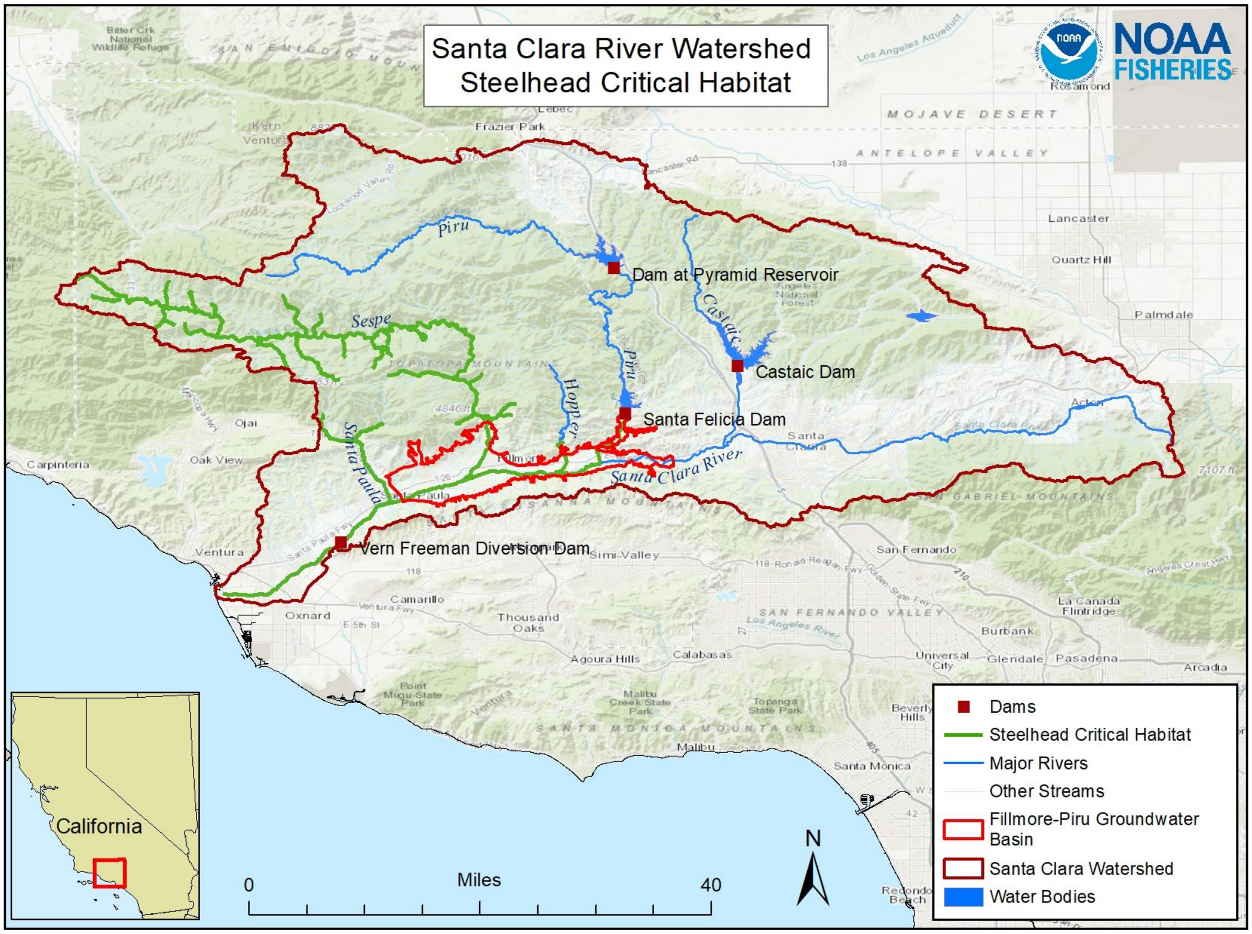
NOAA's National Marine Fisheries Service (NMFS) provides the following comments on the Fillmore and Piru Groundwater Sustainability Agencies' (FP-GSA) Draft Technical Memorandum – Assessment of Groundwater Dependent Ecosystems for the Fillmore and Piru Basins Groundwater Sustainability Plan (February 2021) prepared by Stillwater Sciences (hereafter "Draft Memorandum"). The Draft Memorandum was prepared as background for the Fillmore and Piru Groundwater Sustainability Plan (GSP). Prior to presenting the comments, NMFS first provides background information on the endangered steelhead (*Oncorhynchus mykiss*), which utilize the Santa Clara River Watershed, including the reach of the mainstem of the Santa Clara River (and tributaries) underlain by the Fillmore and Piru Groundwater Basins (Becker and Reining 2008, Titus et al. 2010). That background information includes the status of the species, actions that are essential for recovery of the species, and life history and habitat requirements. That information is essential for understanding the potential implications of implementing the Fillmore and Piru Basin (GSP) in the Santa Clara River for the endangered Southern California Distinct Population Segment (DPS) of steelhead. Our general and specific comments on the Draft Memorandum are presented in subsequent sections.

Status of Steelhead, Recovery Needs, and Life History and Habitat Requirements

Status of steelhead and habitat for the species in the Santa River Watershed. —NMFS listed southern California steelhead, including the populations in the Santa Clara River watershed (which includes the Fillmore and Piru Groundwater Basin), as endangered in 1997 (62 FR 43937), and reaffirmed the endangered listing in 2006 (71 FR 5248).

NMFS designated critical habitat for southern California steelhead in 2005 (70 FR 52488). Within the Fillmore and Piru Basins, this designation includes the mainstem of the Santa Clara River, Sespe Creek, and the lower reaches of Hopper Creek and Piru Creek (*See* map of "Santa Clara River Watershed Steelhead Critical Habitat" on the following page).

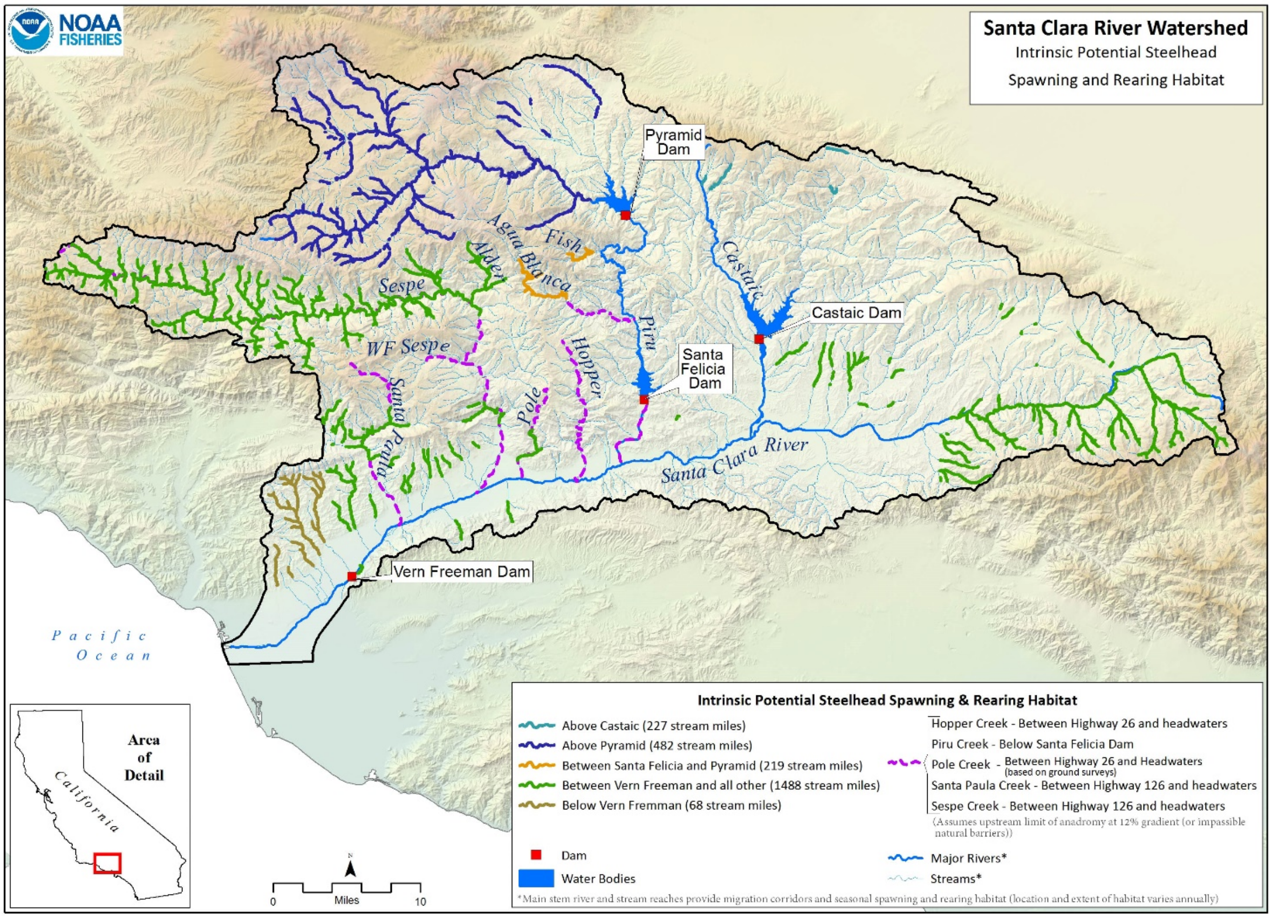
Critical habitat for endangered steelhead includes: 1) freshwater spawning habitat with water quality and quantity conditions and substrate that support spawning, incubation, and larval development, 2) freshwater rearing sites with water quality and floodplain connectivity to form and maintain physical habitat conditions that support juvenile growth and mobility, and natural cover such as shade, submerged and overhanging vegetation that provide forage and refugia, and 3) freshwater migration corridors free of passage impediments that promote adult and juvenile mobility and survival.



Santa Clara River Steelhead Critical Habitat

Habitat for this species has been adversely affected by loss and modification of physical or biological features (substrate, water quality and quantity, water temperature channel morphology and complexity, passage conditions, riparian vegetation, introduction of non-native invasive species, etc.) through activities such surface water diversions and groundwater extractions (NMFS 2012, "Current DPS-Level Threats Assessment", pp. 4-1 – 4-11; Monte Arido Highlands Biogeographic Population Group, "Threats and Threat Sources", pp. 9-14 – 9-17). Thus many of the physical and biological features of designated critical habitats have been significantly degraded (and in some cases lost) in ways detrimental to the biological needs of steelhead. These habitat modifications have hindered the ability of designated critical habitat to provide for the survival and ultimately recovery of this federally listed endangered species.

NMFS has also modeled and mapped potential intrinsic potential spawning and rearing habitat in the Santa Clara watershed using the "envelop method" as part of its recovery planning process for the endangered Southern California DPS of Steelhead. This method uses observed associations between fish distribution and the quantitative values of environmental parameters such as stream gradient, summer mean discharge and air temperature, valley width to mean discharge, and the presence of alluvial deposits – habitat features that are critical to steelhead spawning and rearing (Boughton and Goslin 2006, Map 5, Santa Barbara to Point Dume, pp. 20-21) (*See* map of "Santa Clara River Intrinsic Potential Steelhead Spawning and Rearing Habitat" below).



Potential spawning and rearing habitat within the Santa Clara River watershed modeled and mapped using the "envelop method". This method is based on observed associations between fish distribution and environmental factors such as stream g gradient, summer mean discharge, air temperature, valley width, and the presence of alluvial deposits which are essential to spawning and rearing. Discrepancies between the modeled intrinsic potential habitat predictions and documented occurrence of fish spawning and rearing are noted in a separate dashed purple line. Data Source: Boughton and Goslin 20026 NOAA -TM-NMFS-SWFSC-391; Boughton et al 2006 NOAA-TM-SWFSC-394; with supplemental data from Becker and Reining. 2008, Blecker et al. 1997, Francis 2010, Kajtaniak 2008, Kelley 2008, Moore 1980a and 1980b, Titus and Erman 2010, and Yoder 2003.

Santa Clara River Intrinsic Potential Steelhead Spawning and Rearing Habitat

Steelhead life history and habitat requirements.—Adult steelhead spend a majority of their adult life in the marine environment. However, much of this species' life history occurs in the freshwater environment (migration to and from spawning areas, spawning, incubation of eggs and the rearing of juveniles), including in the mainstem and tributaries such as those in the Santa Clara River Watershed. Many of the natural variables (such as seasonal surface flow patterns, water quality, including water temperature) are significantly impacted by the artificial modification of these freshwater habitats. This includes both surface and sub-surface extractions that lower the water table and can, in turn, affect the timing, duration, and magnitude of surface flows essential for steelhead migration, spawning and rearing. In southern California, warm, dry summers require that juvenile steelhead spend rearing time in sections of the stream network that maintain surface flow (or pools sustained by groundwater) or do not overheat beyond thermal-tolerance levels. The over-summering period can be challenging to juvenile steelhead survival and growth. Surface diversions in combination with lowered groundwater tables during the dry season can indirectly affect rearing individuals by reducing vegetative cover, and directly by reducing or eliminating the summertime surface flows (or pool depths) in parts of the watershed. These conditions have been and are being exacerbated by global climate change (Gudmundsson et al. 2021, Feng et al. 2019, Beighley et al. 2002, 2008).

Recovery needs of endangered steelhead.—Among other federally mandated responsibilities, NMFS is responsible for administering the U.S. Endangered Species Act for the protection and conservation of endangered steelhead utilizing the Santa Clara River Watershed. As part of this responsibility, NMFS developed the Southern California Steelhead Recovery Plan (NMFS 2012)[1] and through a comprehensive analysis of systemic threats to this species, diversion of surface flow and groundwater extractions were identified as "very high" threats to the long-term survival of endangered steelhead in the Santa Clara River (NMFS 2012, pp. 9-1 through 9-17; *see* also NMFS 2016).

To address the identified threats to endangered steelhead in the Santa Clara River Watershed, NMFS' Southern California Steelhead Recovery Plan identifies a number of recovery actions targeting surface diversions and groundwater extraction (NMFS 2012, p. 8-6, Table 9-7, p. 9-61). These include:

SCR-SCS-4.2 Develop and implement a water management plan to identify the appropriate diversion rates for all surface water diversions that will maintain surface flow necessary to support all *O. mykiss* life history stages, including adult and juvenile *O. mykiss* migration, and suitable spawning, incubation, and rearing habitat.

SCR-SCS-6.1 Conduct groundwater extraction analysis and assessment. Conduct hydrological analysis to identify groundwater extraction rates, effects on the natural stream pattern (timing, duration and magnitude) of surface flows in the mainstem and tributaries, and the estuary, and effects on all *O. mykiss* life history stages, including adult and juvenile *O. mykiss* migration, spawning, incubation, and rearing habitats.

SAC-SCR-6.2 Develop and implement groundwater monitoring and management program. Develop and implement groundwater monitoring program to guide management of groundwater extractions to ensure surface flows provide essential support for all *O. mykiss* life history stages, including adult and juvenile *O. mykiss* spawning, incubation and rearing habitats.

The GSP developed under SGMA provide an important mechanism for implementing these recovery actions for the Santa Clara River watershed.

General Comments

[1] National Marine Fisheries Service. 2012. Southern California Coast Steelhead Recovery Plan. West Coast Region, California Coastal Area Office, Long Beach, California.

Groundwater inputs to surface flows can buffer daily temperature fluctuations in a stream (Heath 1983, Brunke et al. 1996, Barlow and Leake 2012, Hebert 2016). Artificially reducing the groundwater inputs can expand or shrink the amount of fish habitat and feeding opportunities for rearing juvenile steelhead (Fetter 1997, Sophocleous 2002, Glasser et al. 2007, Croyle 2009), and reduce opportunities for juveniles to successfully emigrate to the estuary and the ocean (Bond 2006, Hayes et al. 2008, 2011, Stillwater Sciences 2011b). Low summer base flow, likely caused by both surface water diversions and pumping hydraulically connected groundwater, is noted as a significant stress to steelhead survival in the Santa Clara River and tributaries (NMFS 2012, Table 9-2, Threat source rankings in each watershed in the Monte Arido Highlands BPG, p. 9-15; *see* also NMFS 2016).

Management of the groundwater of the Fillmore and Piru Basins has affected the water resources and other related natural resources in the Santa Clara River Watershed. For example, extraction of groundwater from these basins has lowered groundwater levels to the point of inducing eliminated artesian springs that supported a wide variety of plant and animal species, and affected surface flows that support the migrations of endangered steelhead in the Santa Clara River Watershed (Stillwater Sciences 2007a, 2007b, 2011a, 2011b, Beller et al. 2011).

The development and operation of surface water supply facilities throughout the Santa Clara River are integral in the management of the groundwater resources associated with the Santa Clara River. Facilities such as Pyramid Reservoir, Santa Felicia Dam, Piru Creek Diversion and spreading basins, and the Vern Freeman Diversion Dam and spreading basins have profoundly altered the natural surface flow and groundwater recharge patterns in the Santa Clara River Watershed, from the headwaters to the Pacific Ocean (e.g., NMFS 2008a, 2008b). Unless the Draft Memorandum is revised to reflect the operation of these integral components of the groundwater management program for the Santa Clara River, the future adopted GSP will be unable to meet the requirement of SGMA to explicitly provide for the protection of habitats, including those recognized instream beneficial uses that are dependent on groundwater such as fish migration, spawning and rearing, as well as other GDE.

When analyzing impacts on steelhead or other aquatic organisms resulting from groundwater and related streamflow diversions, identifying flow levels that effectively support essential life functions of this organism is critical (Belin 2018, Barlow and Leake 2012). Specifically, it is essential to determine what flows (and pool depths) adequately supports adult steelhead migration during the winter and spring, and juvenile rearing year round. Without an understanding of these hydrologic/biotic relationships, a GSP cannot ensure that significant and unreasonable adverse impacts from groundwater depletion (and in the case of the Santa Clara River, the integrally related surface water diversion/groundwater recharge program) are avoided (Heath 1983, California Department of Water Resources 2016).

Specific Comments

The following specific comments on the Draft Recommendations are arranged by section and page number.

1. Background and Setting

Page 1

The Draft Memorandum relies heavily on the Nature Conservancy's (TNC) guidance for GDE analysis (Rohde et al. 2018). According to this guidance, GDE are defined on their dependence on groundwater for all or a portion of their water needs. The Draft Memorandum concludes, "Mapping GDEs requires mapping vegetation that can tap groundwater through their root systems, assessing where the depth of groundwater is within the rooting depth of that vegetation, and mapping the extent of surface water that is interconnected with groundwater (Rohde et al. 2018)."

The method used by TNC in identifying GDE is based on statewide data on "vegetation known to use groundwater", and therefore does not adequately reflect the uses made of groundwater by other biological resources, such as seasonal migration of fishes, or other organisms such as invertebrates that have differing life-cycles and environmental requirements than plants (TNC 2018). In addition to supplying water to the root zone of plants, groundwater can also contribute to surface flows, influencing the timing, duration, and magnitude of surface flows, particularly base flows. These base flows provide essential support to aquatic invertebrates, avian fauna, and fish species, including native resident and anadromous fishes. In addition, groundwater that only seasonally supports surface flows can contribute to the life-cycle of migratory fishes, such as steelhead, that can make use of intermittent flows for both migration, spawning and rearing (Boughton et al. 2009, 2006).

1.4. Historical Ecology

Pages 5-7

The Draft Memorandum relies almost exclusive on historical ecology study of Beller et al. (2011). This study, while providing valuable information on the type and distribution of various vegetative communities does not provide comparable information on aquatic species associated with the Santa Clara River. The habitats covered Beller et al (2011) are principally riparian and terrestrial, omitting coverage of various types of aquatic habitats (e.g., pools, runs, riffles, glades, etc.) should be covered explicitly.

2. GDE Identification

Pages 8-14

The Draft Memorandum uses a method for defining the relevant GDE that underestimates the true variety GDE. In this regard, the Draft Memorandum indicates that:

> "Potential GDE units in the Fillmore and Piru groundwater basins were identified using the California Department of Water Resources' (DWR) indicators of groundwater dependent ecosystems (GDE) database. The database, which is published online and referred to as the Natural Communities Commonly Associated with Groundwater dataset (DWR 2020), includes vegetation and wetland natural communities. These data were reviewed and augmented with additional vegetation mapping datasets to produce a map of

> final GDE units; additional information on vegetation community composition, aerial imagery, depth to groundwater modeled from local wells (where available), plant and species distributions in the area, and plant species rooting depths were also reviewed to support this determination. Maximum rooting depths from the literature are provided in Appendix C, Table C-1. Another way to explore the rooting depth of plants is to assess their elevation relative to the river channel surface (the relative elevation). Assuming that the groundwater elevation near the stream is similar to the stream elevation, we can assess the likely rooting depth of plants based on their relative elevation. Stillwater Sciences (2007a) assessed the relative elevation of various plant types in the Santa Clara River. Those results are provided in Appendix C, Table C-2." (Page 8)

This methodology focuses exclusively on vegetation known to use groundwater and, therefore, ignores the seasonal variation in the groundwater levels in the reach of the Santa Clara River underlain by the Fillmore and Piru Basins that can periodically (seasonally, or intra-annually) support surface flows by affecting their timing magnitude, and duration.

The surface flows at the confluence of Piru Creek, Hopper Creek, Pole Creek and Sespe Creek are important for maintaining surface hydrologic connectivity for steelhead (and other native aquatic-dependent species) attempting to migrate between these major tributaries and the middle reaches of the Santa Clara River (Kelley 2004, Kajtaniak 2008, Francis 2009). While these groundwater-influenced flows may not be sufficient to support permanent vegetative cover, they can nevertheless support seasonal use of this reaches of the Santa Clara River for migratory or rearing purposes, depending on the amount and timing of annual rainfall and runoff and the groundwater elevation. (For a study of the role of intermittent flows in the rearing phase of *O. mykiss*, *see* Erman and Hawthorne 1976, Boughton et al. 2009).

Page 16

In describing its procedure to identifying sensitive species, the Draft Memorandum includes "Direct—species directly dependent on groundwater for some or all water needs (e.g., cottonwood with roots in groundwater, juvenile steelhead in dry season)."

We would note that groundwater levels can influence late spring surface flows, and these flows can be important for juvenile *O. mykiss* attempting to emigrate out of the Santa Clara River Watershed, including from the Piru Creek, Hopper Creek, and Sespe Creek tributaries that are within the boundaries of the Fillmore and Piru Basins.

3 Groundwater and Interconnected Surface Water Hydrology

3.1 Groundwater Levels

Page 19

The Draft Memorandum notes, "Historical dry periods and droughts play a major influence on groundwater elevations across the Fillmore and Piru groundwater basins. Droughts in 1974–

1977, 1986–1991 and 2012–2016 have significant signatures in the hydrographs of shallow wells located besides the identified GDEs. Most recently, basins were near to full capacity in 2011 (i.e., groundwater levels very close to the surface) ahead of the 2012–2016 drought, which generally caused in water levels in wells to decline."

The revised Draft Memorandum should recognize that the effects of droughts on groundwater levels can be and often are exacerbated by groundwater extractions. One of the primary purposes of SGMA is to identify these anthropogenic effects on groundwater levels (and the related GDE) so that groundwater resources may be managed in a way to protect all beneficial uses of groundwater, including fish and wildlife, such a southern California steelhead (as well as other native aquatic resources). Therefore, when revising the Draft Memorandum, every effort should be made to ensure that: 1) all anthropogenic effects on the amount and extent of groundwater are properly and accurately cataloged, 2) practices are defined to remedy the cataloged effects on GDE, and 3) the practices are instituted and the effects adaptively managed to ensure GDE receive sufficient protection in accordance with the SGMA.

The Draft Memorandum also notes, "Long-term records of shallow groundwater are relatively rare in the Fillmore and Piru groundwater basins." And, "We were unable to examine the groundwater levels in the Tributary Riparian GDE unit because there are no representative wells located in or near the unit."

As noted above, groundwater levels that support surface flows, particularly in the late spring can be important in maintaining surface flow connectivity between the Santa Clara River and the tributaries (Sespe Creek, Pool Creek, Hopper Creek, Piru Creek) which lay within the boundaries of the Fillmore and Piru Basins. These surface flows can be important for juvenile *O. mykiss* attempting to emigrate out of the Santa Clara River watershed, including from the Piru Creek, Hopper Creek, Pole Creek, and Sespe Creek tributaries. Interrupting the timing, magnitude, and duration of these flows as a result of groundwater extraction can be deleterious to juvenile *O. mykiss*. Groundwater levels should be monitored in the Tributary Riparian GDE, and any potential effects should be addressed in the revised Draft Memorandum.

3.3 Interconnected Surface Waters

Page 27

The Draft Memorandum notes, "Surface waters within the Piru and Fillmore groundwater basins have varying degrees of connection to groundwater." And the "Santa Clara River has alternating perennial and intermittent reaches with perennial reaches occurring where rising groundwater contributes the vast majority of the surface water (except during storm events with significant runoff) and the intermittent reaches are losing reaches that are disconnected from groundwater during most of the year."
The pattern of alternating perennial and intermittent/or ephemeral surface flows are known as an "interrupted" surface flow regime, and is common in southern California watersheds, particularly where groundwater play a role in maintaining surface flows. This pattern can be altered through

changing the groundwater elevations; this issue should be addressed in the revised Draft Memorandum.

3.3.1 Piru Groundwater Basin

The Draft Memorandum notes, "Several small ephemeral tributaries to the Santa Clara River and Piru Creek occur in the reach and are disconnected from groundwater."
It is not clear what tributaries are being referred to here. In addition to several unnamed tributaries in this reach (which may be ephemeral), there are also two other significant tributaries which enter from the north side of the Piru Basin (Piru Creek and Hopper Creek); neither of these should be classified as intermittent, though both have been impacted by water surface water diversions (Santa Felecia Dam on Piru Creek) and groundwater extractions (from both Piru Creek and Hopper Creek).
The Draft Memorandum also notes, "To our knowledge, there has not been a systematic exploration of the extent of surface water in lower Piru Creek." We would note that similarly there is no known systematic exploration of the extent of surface water in lower Hopper Creek. For a discussion of the hydrology and steelhead resources of Piru Creek, (including lower Piru Creek, *see* NMFS (2008b).

3.3.2 Fillmore Groundwater Basin

Page 28

The Draft Memorandum notes, "Other tributaries within the Fillmore Groundwater Basin, including Pole Creek, Boulder Creek, and Timber Creek are typically ephemeral or intermittent."

The upper reaches of Pole Creek maintains perennial flows, but surface flows in the lower reaches within the Fillmore Groundwater Basin have been impacted by development on the alluvial fan formed by the confluence of Pole Creek and the Santa Clara River. As noted above groundwater levels that support surface flows, particularly in the late spring can be important in maintaining surface flow connectivity between the Santa Clara River and the tributaries (Pole Creek and Sespe Creek) which lay within the boundaries of the Fillmore Basin. These surface flows are important for juvenile *O. mykiss* attempting to emigrate out of the Santa Clara River watershed. Interrupting the timing, magnitude, and duration of these flows as a result of groundwater extraction can be deleterious to juvenile *O. mykiss*. This potential effect should be addressed in the revised Draft Memorandum.

3.3.3 Variations in the extent of surface water 2011–2017

Page 28

The Draft Memorandum noted, "This period includes [a] relatively wet 2011 and the 2012–2016 drought."

The revised Draft Memorandum should provide correlative groundwater extraction rates for these years to better understand the effects of variable groundwater levels and precipitation.

Additionally, the timeframe for depicting historic hydrologic conditions is relatively short, and does not capture the hydrological conditions that prevailed before large-scale water development in the Santa Clara River Watershed. Using an environmental baseline that has been highly modified as framework for identifying impacts to GDE and developing management strategies to address those impacts runs the risk of falling into the "shifting baseline syndrome" that results in a distorted view of ecosystem functions, and inappropriate conservation goals and objectives (Pauly 1995, 2019).

4 GDE Conditions

4.1 Ecological Conditions

Page 30

The Draft Memorandum noted, "There are few shallow groundwater wells in the Fillmore and Piru groundwater basins, but many of the deeper wells show that there continues to be shallow groundwater and interconnected surface water at the basin boundaries at the historical Del Valle, Cienega, and East Grove riparian woodlands (Figure 1.4-1)."

Without shallow groundwater wells that would provide specific data on relationship between groundwater levels and surface flows is not clear how an assessment can be made of the effects extracting groundwater from these areas might effect GDE. This appears to be a significant data gap. The revised Draft Memo should address this by identifying the installation of shallow groundwater wells (or piezometers) to better describe these relationships.

4.1.1 Vegetation Communities and GDE habitats

Pages 30-35

See comments above regarding the focus on vegetative GDE.

4.1.2 Beneficial uses

Page 35-38

In addition to designating critical habitat for the federally listed endangered Southern California Steelhead DPS, NMFS has also identified intrinsic potential habitat in the watershed for this species as part of its recovery planning process. As noted above, this habitat includes habitats that has the potential to provide spawning and rearing habitat. Within the Fillmore and Piru Basin, NMFS identified intrinsic potential habitat in Sespe Creek, upper Pole Creek, Hopper Creek, and Piru Creek (Boughton and Goslin 2006). The ability of these habitats to provide spawning and rearing opportunities has been negatively affected by surface water diversions and groundwater extractions. As noted above, reducing the connectivity between the mainstem of the Santa Clara River and the lower reaches of these tributaries impairs the intrinsic potential of these habitats. Restoring and maintaining surface hydrologic connectivity for steelhead attempting to migrate to or emigrate out of these major tributaries to the middle reaches of the Santa Clara River is an important objective of NMFS's Southern California Steelhead Recovery Plan. When revising the Draft Memorandum, the recognition of this GDE is should be explicit, and the GSP should ensure that, this GDE is not unreasonably impacted by groundwater extraction from the Fillmore and Piru Basin.

Piru

Terrestrial and Aquatic Wildlife

Fish

Pages 47 – 51

This section of the Draft Memorandum contains only a brief discussion fishes, and specifically discusses only one tributary, Piru Creek. There is no recognition or discussion of the Hopper Creek. The lower reach of Hopper Creek within the Piru Basin boundaries has been designated critical habitat; additionally NMFS has identified intrinsic potential spawning and rearing habitat throughout the Hopper Creek watershed; *see* Francis 2009.

The Draft Memorandum indicates, "Most of the fish species listed in Table 4.1-4 are likely to occur in perennial reaches within the basin." It should also recognize that the anadromous species (e.g., *O mykiss* and *Entosphenus tridentata)* may also occur in the intermittent reaches, and that non-migratory species (e.g., *Catostomus santaanae*) fishes (as well as other native aquatic organisms) may occur in intermittent reaches.

Therefore, the Draft Memorandum should be revised to provide a complete and accurate characterization of the environmental setting.

Fillmore

Terrestrial and Aquatic Wildlife

Fish

Pages 62-65

This section of the Draft Memorandum contains only a brief discussion fishes, and specifically mentions only one tributary, Sespe Creek. There is no recognition of discussion of the Pole Creek; see, Kajtaniak (2008) for a survey of this watershed.

The Draft Memorandum indicates, "Disconnected ephemeral tributaries in the Fillmore Groundwater Basin can be used by fish species seasonally, but do not contain surface water year-round and are not connected to groundwater and thus not considered here."

Sespe Creek is a major tributary to the Santa Clara River whose confluence is within the boundaries of the Fillmore Basin. This tributary is currently intermittent in its lowermost reaches. However, its base surface flows have been and continued to be impacted by both surface diversions and groundwater extraction.

Pole Creek, which is joins the Santa Clara River within the boundaries of the Fillmore Basin is intermittent (not ephemeral) in its lower reaches, and is perennial in its upper reaches; *see* Kajtaniak (2008) for a survey of this watershed.

The revised Draft Memorandum should reflect this information.

4.3 Ecological Value

Page 69

The Draft Memorandum indicates, "The ecological value of each GDE unit was characterized by evaluating the presence and groundwater-dependence of special-status species and ecological communities, and the vulnerability of these species and their habitat to changes in groundwater levels (Rohde et al. 2018)."

As noted above the method used by The Nature Conservancy in identifying GDE is based on statewide data on "vegetation known to use groundwater", and therefore does not adequately reflect the uses made of groundwater by other biological resources, such as seasonal migration of fishes, or other organisms such as invertebrates that have differing life-cycle and environmental requirements than plants.

4.3.1 Piru Basin

Pages 69-70

In assessing the ecological values of the GDE in the Piru Basin, the Draft Memorandum did not, but should, consider the ecological values of Hopper Creek. This is a significant omission, because the surface hydrologic connectivity between Hopper Creek and the mainstem of the Santa Clara River can be affected by groundwater extractions; see additional comments above regarding Hopper Creek.

4.3.2 Fillmore

Page 70-71

In assessing the ecological values of the GDE in the Piru Basin, the Draft Memorandum did not, but should, consider the ecological values of Pole Creek. This is a significant omission, because the surface hydrologic connectivity between Pole Creek and the mainstem of the Santa Clara River can be affected by groundwater extractions; see additional comments above regarding Pole Creek.

5 Potential Effects of Groundwater Management on GDEs

5.2 Biological Data

Page 74

The Draft Memorandum notes, "This section focuses on changes in vegetation through time using remote sensing data. While increases or decreases in vegetation health do not provide a definitive indication that other components of the ecosystem are thriving or under stress, it provides a reasonable first-order check on the clear linkage between groundwater and the other communities that compose the ecosystem."

While changes to vegetation is an important component in assessing the ecological health aquatic habitats (Faber et al. 1989), it should not be used, as it is here, essentially as a substitute for other metrics, e.g., such as measured effects on surface flows, or depth or extent of pool habitat in response to artificial depletion of groundwater levels. See comments above regarding GDE Identification.

5.2.1 Piru Groundwater Basin

Pages 75-79

The focus of the analysis is on vegetative features of four areas: De Valle Riparian Scrub GDE, Santa Clara River Riparian Scrub GDE, Piru Creek Riparian GDE, and Piru Basin Tributary GDE. None of these directly involves aquatic habitats. Also, the Draft Memorandum does not, but should, recognize Hopper Creek. As noted above, the surface flows at the confluence of Hopper Creek are important for maintaining surface hydrologic connectivity for steelhead (but also other native aquatic species) attempting to migrate between this tributary and the middle reaches of the Santa Clara River. Interrupting the timing, magnitude, and duration of these flows as a result of groundwater extraction can be deleterious to juvenile *O. mykiss.* This potential effect should be addressed in the revised Draft Memorandum.

5.2.2 Fillmore Groundwater Basin

Pages 79-86

The focus of the analysis is on vegetative features of five areas: Santa Clara River Riparian Scrub, Cienega Riparian Complex GDE, East Grove Riparian Complex GDE, Fillmore Basin Tributary Riparian GDE, and Sespe Creek Riparian. None of these deals directly with aquatic habitats. Also, the Draft Memorandum does not recognize or provide any consideration or discussion of Hopper Creek. As noted above, the surface flows at the confluence of Pole Creek are important for maintaining surface hydrologic connectivity for steelhead (but also other native aquatic species) attempting to migrate between this tributary and the middle reaches of the Santa Clara River. Interrupting the timing, magnitude, and duration of these flows as a result of groundwater extraction can be deleterious to juvenile *O. mykiss*. This potential effect should be addressed in the revised Draft Memorandum.

5.3 Climate Change Effects

Page 86

The Draft Memorandum asserts, **"**As an overview, the future groundwater levels forecast with assumed climate change factors (2070CF [climate change factor]) are not materially different from those recorded during the historical record. There is no suggestion of long-term chronic declines in groundwater levels."

The basis for this statement is unclear, and appears to conflict with general predictions for a drying climate in southern California, with consequent reduction in rainfall, runoff, and groundwater recharge. The reduction in surface water supplies stored in reservoirs, has frequently led to increased extraction of groundwater basins, with consequent reductions in base flows of rivers and streams, like the Santa Clara River and its tributaries that are interconnected groundwater-surface water systems.

Ensuring groundwater recharge (and control of groundwater extraction for out-of-stream uses) can be an important mechanism for protecting base flows that are critical for the rearing phase of juvenile steelhead (as well as other native aquatic resources). Maintaining groundwater levels can serve as a buffer against projected climate change effects on stream flow. For a recent assessment of the effects of climate change on mean and extreme river flows, and effects of over pumping of groundwater basins on stream flow, see Burke et al. (2021), Gudmundsson et al. (2021), Jasechko (2021).

5.4 Summary of Potential Effects

5.4.1 Piru

Page 86

As noted above, there is no recognition or discussion of Hopper Creek. This omission should be addressed in the revised Draft Memorandum.

Santa Clara River Riparian Shrubland GDE Unit

Page 89

<u>Ecological Value</u>: The Draft Memorandum concludes, "Although the Santa Clara River in the Unit provides migration habitat for Southern California steelhead and Pacific lamprey, the migration habitat has low vulnerability to groundwater reduction because most fish migration occurs during seasonal high surface water flow periods."

This assertion does not appear to be corroborated in any meaningful way in the Draft Memorandum. Also, be aware that while adult steelhead are more likely to migrate during higher flows during winter months, steelhead smolts can emigrate downstream through the late spring in the absence of winter flows. Groundwater extractions that decrease these base surface flows can therefore negatively affect the successful emigration of steelhead (and possibly Lamprey ammocoetes) out of the Santa Clara River to the ocean. This assertion should be revised in the Draft Memorandum to accurately reflect what is known about the migratory behavior and ecology of steelhead and the expected impacts of groundwater withdrawals on habitat characteristics and condition for this species.

<u>Ecological Condition</u>: The Draft Memorandum concludes, "Groundwater provides little or no contribution to the ecological function and habitat value of the Santa Clara River in the Unit, which is intermittent and mainly supports seasonal migration habitat for anadromous fishes."

The intermittent nature of a reach is not determinative of the contribution of groundwater to a GDE. Additionally, as noted above, steelhead smolts emigrate downstream through the late spring, among other times of the year, including during periods between elevated rain-induced discharge pulses. Groundwater extractions that decrease these base surface flows can therefore negatively affect the successful emigration of steelhead out of the Santa Clara River to the ocean (Booth 2016, 2020).

Page 90

Susceptibility to Changing Groundwater Conditions: The Draft Memorandum concludes, "The Unit includes an intermittent reach of the mainstem Santa Clara River that does not provide perennial aquatic habitat or beneficial uses."

While groundwater-influenced flows may not be sufficient to support perennial flows, they can nevertheless support seasonal use of this reach of the Santa Clara River for migratory or rearing purposes, depending on the amount and timing of annual rainfall and runoff and the groundwater elevation.

Potential for Effects

Page 90

The Draft Memorandum concludes, "Modeling suggests that groundwater levels are likely to be stable in this reach. Moreover, the vegetation that makes up this unit may use groundwater when groundwater levels are high in the spring, but high groundwater levels are likely not persistent in this unit. The unit is therefore likely not strongly dependent upon groundwater and is comprised of sparse low water use species with relatively shallow rooting depths. Therefore, the potential for effects on this unit is low. "

This conclusion, as much of the analysis, is based almost entirely on effects on vegetation, and ignores the potential effects on aquatic organisms that are dependent on surface flows (or ponding), and may make seasonal use of aquatic habitats, even though they are intermittent.

Piru Creek Riparian GDE Unit

Page 92

Susceptibility to Changing Groundwater Conditions: The Draft Memorandum concludes, "Piru Creek in this GDE unit has perennial flow due to releases from Santa Felicia Dam, but surface flow is not connected to groundwater. The lower portion of Piru Creek near the confluence with the Santa Clara River periodically lacks surface flow. As described previously, releases from Santa Felicia Dam likely raise groundwater levels and help maintain baseflows in Piru Creek."

The construction of both Santa Felicia Dam and Pyramid Dam have significantly altered natural the flow patterns in Piru Creek, including those below the current site of Santa Felicia Dam (see, for example, NMFS 2008b). The language of this section incorrectly implies that but for the releases from Santa Felicia Dam, lower Piru Creek would *naturally* exhibit an intermittent, or ephemeral flow regime. Also, the claim that the "surface flow is not connected to groundwater" is contradicted by the assertion that "releases from Santa Felicia Dam likely raise groundwater levels and help maintain baseflows in Piru Creek".

Potential Effects

The Draft Memorandum notes, "Available data are insufficient to discern a clear effect on GDEs related to groundwater management in the Piru Creek Riparian Complex GDE Unit."

The GSP should identify and include monitoring provisions that would enable the effects of groundwater extractions or recharge activities on this GDE to be determined.

Tributary Riparian GDE Unit

Page 92

Groundwater Dependence: The Draft Memorandum notes, "There are no shallow groundwater measurements in this unit."

The GSP should identify and include monitoring provisions that would enable the effects of groundwater extractions or recharge activities on this GDE to be determined.

Page 93

Ecological Value: The Draft Memorandum concludes, "The species and ecological communities in the Unit have low vulnerability to changes in groundwater levels. The tributary streams in this GDE Unit are considered ephemeral and are not connected to groundwater, thus they provide little habitat value for fish and other aquatic species. They do, however, support valuable riparian habitat and likely movement corridors for a variety of native wildlife species." This Tributary Riparian GDE includes Hopper Creek, which is not ephemeral. Hopper Creek is not recognized or discussed. This omission should be addressed in the revised Draft Memorandum. See comments above regarding Hopper Creek.

Ecological Condition: The Draft Memorandum concludes, "Groundwater likely provides little or no contribution to the ecological function and habitat value of the ephemeral tributaries in the Unit, which support vegetation but have little habitat value for fish or other aquatic species."

See comments above regarding Hopper Creek.

Susceptibility to Changing Groundwater Conditions: The Draft Memorandum concludes, "Streams within the Unit includes [sic] are ephemeral and do not provide perennial aquatic habitat or beneficial uses."

This Tributary Riparian GDE includes Hopper Creek, which is not ephemeral. Hopper Creek is not recognized or discussed. This omission should be addressed in the revised Draft Memorandum. See comments above regarding Hopper.

Potential Effects

The Draft Memorandum concludes, “Based on the position of this GDE unit in the watershed it is unlikely that groundwater management will affect the health of the GDE. Model results suggest that the groundwater levels will remain constant in the Fillmore and Piru Basins under climate change (DBS&A 2021). If groundwater pumping were to increase in this GDE unit, monitoring of groundwater levels and GDE health (using remote sensing) would be necessary. GDEs in the unit likely have low susceptibility to future changes in groundwater conditions and the synergistic effects of climate change.”

As noted above, the basis for this statement regarding climate change is unclear, and appears to conflict with general predictions for a drying climate in southern California, with consequent reduction in rainfall, runoff, and groundwater recharge. The reduction in surface water supplies stored in reservoirs has frequently led to increased extraction of groundwater basins, with consequent reductions in baseflows of rivers and streams, like the Santa Clara River and its tributaries, which are interconnected groundwater-surface water systems.

Ensuring groundwater recharge (and control of groundwater extraction for out-of-stream uses) can be an important mechanism for protecting base flows that are critical for the rearing phase of juvenile steelhead (as well as other native aquatic resources). Maintaining groundwater levels can serve as a buffer against projected climate change effects on streamflow. For a recent assessment of the effects of climate change of mean and extreme river flows, and effects of over pumping of groundwater basins on stream flow, *see* Burke et al. (2021), Gudmundsson et al. (2021), Jasechko (2021).

5.4.2 Fillmore Basin

Page 94

As noted above, there is no recognition or discussion of Pole Creek. This omission should be addressed in the revised Draft Memorandum.

Santa Clara River Riparian Shrubland GDE

<u>Groundwater Dependence</u>: The Draft Memorandum notes, “There are few shallow groundwater measurements in this unit. Spring 2019 water contours provided by United water showed groundwater levels within 5-10 feet of the ground surface in parts of the unit.” But nevertheless concludes, “Surface water flows are not interconnected with groundwater.”

The conclusion is questionable for a for at least two reasons: First, though the data provided in the Spring of 2019 followed an above average wet year it was proceed by a pronounced drought that lasted six years, depressing groundwater levels. Second, the number of wells were limited (and screened below shallow groundwater depths) and not likely to provide a complete picture of the groundwater conditions throughout the GDE. The GSP should identify and include monitoring provisions that would enable the effects of groundwater extractions or recharge activities on this GDE to be determined.

Ecological Value: The Draft Memorandum note, "Although the Santa Clara River in the Unit provides migration habitat for Southern California steelhead and Pacific lamprey, the migration habitat has low vulnerability to groundwater reduction because most fish migration occurs during seasonal high surface water flow periods."

While adult steelhead are more likely to migrate during higher flows during winter months, steelhead smolts emigrate downstream through the late spring, among other times of the year, including between periods of elevated flows. Groundwater extractions that decrease this base surface flow can therefore negatively affect the successful emigration of steelhead (and possibly ammocoetes) out of the Santa Clara River to the ocean (Reid and Goodman 2016).

Ecological Conditions: The Draft Memorandum concludes, "Because surface water in this reach is largely disconnected from groundwater, groundwater provides little or no contribution to the ecological function and habitat value of the Santa Clara River in the Unit, which is intermittent and mainly supports seasonal migration habitat for anadromous fishes."

It is not clear what is meant by "largely disconnected". Also, this assertion appears to be contradicted by the assessment of susceptibility to changing groundwater conditions (see below). This should be addressed in the revised Draft Memorandum.

Susceptibility to Changing Groundwater Conditions: "The Draft Memorandum notes, "Future changes in groundwater conditions in the Unit related to increased groundwater production or climate change could cause groundwater levels to fall below the baseline range and *result in mortality to vegetation that comprises the GDE*."(emphasis added). Additionally, the Draft Memorandum notes, "Projections of climate change and groundwater pumping in the future suggest that changes in groundwater elevation are unlikely. However, based on widespread tree mortality during the 2012–2016 drought, future changes in the frequency or duration of droughts similar to 2012–2016 could have a deleterious effect on the GDE, particularly at the downstream margin of the unit."

These two statements appear to contradict each other, and should clarified in the revised Draft Memorandum

Page 94

Also, "The Unit includes an intermittent reach of the mainstem Santa Clara River that does not provide perennial aquatic habitat or beneficial uses."

As noted previously, while groundwater-influenced flows may not be sufficient to support perennial flows, they can nevertheless support seasonal use of this reach of the Santa Clara River for migratory or rearing purposes, depending on the amount and timing of annual rainfall and runoff and the groundwater elevation.

Potential for Effects

Page 95

The Draft Memorandum notes, "Modeling suggests that groundwater levels near the Santa Clara River Riparian Shrubland GDE unit are unlikely to change due to climate change or modest changes to groundwater pumping. However, GDEs in the Unit are moderately susceptible to future changes in groundwater conditions and the synergistic effects of climate change, which in combination could cause groundwater levels to fall below the baseline range and result in potential effects on GDEs."

Again, these two statements appear contradictory. See comments above regarding climate change.

Tributary Riparian GDE

Page 97

<u>Groundwater Dependence:</u> The Draft Memorandum notes, "There are no shallow groundwater measurements in this unit. Based on the position in the landscape a connection to the regional aquifer is unlikely."

The GSP should identify and include monitoring provisions that would enable the effects of groundwater extractions or recharge activities on this GDE to be determined. Also, we note that this Tributary Riparian Unit include Pole Creek, which was omitted from the investigation. See comments above.

Page 98

<u>Ecological Value</u>: The Draft Memorandum concludes, "The species and ecological communities in the Unit have low vulnerability to changes in groundwater levels. The tributary streams in this GDE Unit are considered ephemeral and are not connected to groundwater, thus they provide little habitat value for fish and other aquatic species. They do, however, support valuable riparian habitat and likely movement corridors for a variety of native wildlife species."

This Tributary Riparian Unit includes Pole Creek, which was omitted from the investigation. See comments above.

<u>Ecological Condition</u>: The Draft Memorandum concludes, "Groundwater provides little or no contribution to the ecological function and habitat value of the ephemeral tributaries in the Unit, which support vegetation but have little habitat value for fish or other aquatic species."

This Tributary Riparian Unit includes Pole Creek, which was omitted from the investigation. See comments above.

Potential for Effects

The Draft Memorandum concludes, "Based on the position of this GDE unit in the watershed it is unlikely that groundwater management will affect the health of the GDE. If groundwater pumping were to increase in this GDE unit monitoring of groundwater levels and GDE health (using remote sensing) would be necessary. GDEs in the Unit likely have low susceptibility to future changes in groundwater conditions and the synergistic effects of climate change."

See the above comments regarding the potential effects of climate change.

Sespe Creek Riparian Complex

Page 99

Groundwater Conditions: The Draft Memorandum notes, "Surface water flows are perennial for the upper portions of the reach and intermittent downstream. The connection to groundwater in the upper portion is unknown but unlikely."

The GSP should identify and include monitoring provisions that would enable a determination of connectivity, and any potential effects of groundwater extractions or recharge activities on this GDE to be determined.

Susceptibility to Changing Groundwater Condition: The Draft Memorandum notes, "Sespe Creek's connection to groundwater is undetermined"

The GSP should identify and include monitoring provisions that would enable a determination of connectivity, and any potential effects of groundwater extractions or recharge activities on this GDE to be determined.

Potential for Effects

The Draft Methodology concludes, "The GSP should identify and include monitoring provisions that would enable the effects of groundwater extractions or recharge activities on this GDE to be determined."

See comments above regarding the potential effects of climate change.

5.4.3 GEDs Important for GSP Analyses

Page 100

The following additional GDE should be added to the list of GDE to be included in the GSP analyses for the development of "Sustainable Management Criteria": lower reaches of Sespe Creek, Pole Creek, Hopper Creek, and Piru Creek. As noted above, each of these contains either or/both designated critical habitat or intrinsic potential habitats for the federally listed endangered southern California steelhead DPS.

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