RESPONSE TO COMMENTS				
Comment number	**Comment**	**Organization**	**Issue**	**Response**
GDE_001	**Do Not Eliminate GDEs Based on the 30-foot Depth to GroundwaterCriterionComment:** 2.1.2 Procedure, starting on p. 11 - GDE identification, required per California Code of Regulations, Title 23 § 354.16(g), is based on methods that risk exclusion of ecosystems that may depend on groundwater. **Issue #1:** The GDE-FPB Memo utilizes Rohde *et al* . (2018) by "*assigning GDE status to vegetation communities either within 30 feet of the ground surface or where interconnected surface waters are observed* " (pg. 11). This depth-to-groundwater method applied to the Natural Communities Commonly Associated with Groundwater (NCCAG) dataset to eliminate potential GDEs is fallible.	CDFW	Do not use 30 ft depth to Groundwater	The 30 foot depth to water threshold does a reasonable job of capturing phreatophytes in the basins and is considerably deeper than the rooting depth of most of the mapped vegetation which is <15 ft. In addition, because the gradient in groundwater is relatively steep outside the zones of rising groundwater, increasing the threshold depth would not change the extent of GDEs very much (see Figure 2.1-2 in the revised document).
GDE_002	**Issue #2:** CDFW is concerned with the removal of potential GDEs with a depth to groundwater greater than 30 feet from the 2005-2015 baseline. The 2005-2015 baseline that the analysis depends on (starting pg. 74) falls several years into a historic drought when groundwater levels throughout the Fillmore Basin were trending lower than usual due to reduced surface water availability. As such, this period of groundwater elevations with several years of a historic drought does not consider representative climate conditions or account for GDEs that can survive a finite period without groundwater access (Naumburg et al. 2005). Naumburg *et al* .(2005) presents several models that evaluate how GDEs rely on fluctuating groundwater elevations for long-term survival. GDEs have been sustained by groundwater, despite the depth of the groundwater table being greater than 30 feet below ground surface due to these fluctuating groundwater elevations.	CDFW	Do not use 30 ft depth to Groundwater	Our approach used the highest groundwater data (e.g., Spring 2019) that was available to us. Our goal was to include vegetation communities that could potentially use groundwater at any time in their life history (i.e., not just in summer or drought years). We did not exclude GDEs within 30 ft, but do note where the rooting depth of most plants is shallow and groundwater is deep. The text was revised to clarify the approach we used.
GDE_003	**Recommendation:** CDFW recommends developing a hydrologically robust baseline that considers the groundwater elevation fluctuations associated with climate conditions. This approach would also account for the inter-seasonal and inter-annual variability of GDE water demand.	CDFW	Develop new baseline hydrology	See above, we do this by using the highest groundwater available.
GDE_004	**Comment**: 3.3.1 Piru Groundwater Basin, p. 27 - data gap regarding effluent releases in Los Angeles County. Issue: CDFW agrees with the GDE-FPB Memorandum that effluent releases in Los Angeles County are believed to be a significant contributor to surface water flow. Riparian habitat, a GDE within the basin, relies on various locations with a high groundwater table and the subsurface flows that help to maintain the high groundwater table.	CDFW	Effluent into basin as a data gap	Given the relatively thin alluvial sediments in this reach, the team was unable to find a suitable place to monitor groundwater.
GDE_005	Recommendation: CDFW recommends closely monitoring effluent releases in Los Angeles County, to understand and incorporate how much the effluent releases contribute to not only surface flow, but also subsurface flow and groundwater recharge.	CDFW	Effluent into basin as a data gap	Releases from Los Angeles County will continue to be monitored by UWCD.
GDE_006	Comment #3: Additional Remote Sensing and Shallow Groundwater Wells are Needed to Understand Groundwater Elevations for GDE Units Comment: 3.1 Groundwater Levels, p. 19 - data gaps "because there are no representative wells located in or near the unit. Many of the wells used in the analysis below are screened below the shallow groundwater depths used by GDEs and may not accurately represent the actual groundwater elevation."	CDFW	Sparse monitoring network	See response GDE_008
GDE_007	Issue: CDFW agrees with the GDE-FPB Memorandum that the groundwater levels may not be accurate under the GDEs due to lack of critical groundwater level data. According to p. 30 - "The role of shallow groundwater elsewhere in the basin is less certain and will be assessed based on interpolated groundwater elevation and vegetation." The current monitoring network lacks enough representative distribution of shallow groundwater monitoring wells to monitor impacts to environmental beneficial uses and users of groundwater and interconnected surface waters [23 CCR § 354.34(2)].	CDFW	Sparse monitoring network	See response GDE_008
GDE_008	Recommendation: CDFW recommends the installation of shallow groundwater monitoring wells near potential GDEs and interconnected surface waters, potentially pairing multiple-completion wells with additional streamflow gauges. CDFW agrees with the GDE-FPB Memorandum's recommendation on p. 91 that states: "remote sensing and shallow groundwater elevation monitoring, particularly during and following droughts is recommended." This will facilitate an improved understanding of surface water-groundwater interconnectivity and the overall health of GDEs.	CDFW	Sparse monitoring network	The Fillmore and Piru Basins GSA has identified 6 new or modified wells to monitor groundwater elevations. These wells are located near GDEs and cover gaps in the data record.
GDE_009	Many wells are located at higher elevations compared to GDEs, and when comparing depth-to-groundwater well data to plant rooting depths this can result in misinterpretation in groundwater-connectivity. Recommendation: Instead of using groundwater well data near GDEs, correct for land surface elevation at GDEs to determine depth-to-groundwater at the GDEs. See Best Practice #5 in this TNC guidance: https://groundwaterresourcehub.org/public/uploads/pdfs/TNC_NCdataset_BestPracticesGuide_2019.pdf	FSCR	Sparse monitoring network	Added description of GDE elevation transects to Section 3.1. Added maximum and minimum GDE elevations to depth to water plots and discussion.
GDE_010	Section 5.4.3 should describe groundwater thresholds for the 3 GDE units most susceptible to groundwater impacts. For example, it is highly recommended that groundwater levels at Cienega be restored to pre-drought (circa 2011) levels. This will ensure that groundwater conditions can facilitate riparian succession can occur, that the invasive non-native Arundo donax doesn't take over and increase evapotranspiration losses in the basin, and critical species habitat isn't permanently lost. Recommendation: One way to determine thresholds and objectives (ideal conditions) for your three target GDEs is to plot NDVI versus depth to groundwater (DEM corrected). This would assist in determining what depth to groundwater conditions are needed to maintain GDE conditions. Use a baseline prior to the recent drought, which is more hydrologically robust, building in resilience and taking precautions for future droughts and accounting for projected mega-droughts. The average 2011 hydrograph and groundwater level in the shallowest aquifer could perform as a measurable objective.	FSCR	Describe groundwater thresholds for GDE units	Added depth to water and NDVI plots to the technical memo.
GDE_011	The Nature Conservancy has new updated guidance on developing groundwater thresholds and objectives for ecosystems. Recommendation: Please review https://groundwaterresourcehub.org/public/uploads/pdfs/GroundwaterThresholdFramework_Final_updated_Dec2020.pdf	FSCR	Updated Nature Conservancy guidance on depth to water	Added description of GDE elevation transects to Section 3.1. Added max/min GDE elevations to depth to water plots and discussion.
GDE_012	Reevaluate Elimination of GDE's Based on a 30-foot Depth to Groundwater Criteria. At the March 18, 2021 FPBGSA stakeholder workshop, California Department of Fish and Wildlife representative Steve Slack noted that the Department has noted GDE's with the rooting depth to groundwater that was greater than 30 feet and voiced concern with the removal of potential GDEs using this criteria. Page 3 of 9 FPBGSA Draft GDE Tech Memo Recommendation: Follow CDFW suggestion to develop a hydrologically robust baseline that considers groundwater elevation fluctuations associated with climate conditions, inter-seasonal and inter-annual variability of GDE water demand and source species list noting GDE's with a rooting depth greater than 30 feet.	FSCR	Do not use 30 ft depth to Groundwater	See Response to GDE_002.
GDE_013	Projected Flow Releases from Los Angeles County. Effluent releases from Santa Clarita wastewater treatment works and bypass flows from Pyramid Dam (Southern State Water Project) are contributors to surface water flow, and riparian habitat and GDEs within the basin. Both facilities are going through re-permitting processes. Recommendation: Monitoring and/or request reporting of effluent releases from Los Angeles County needs to be adequately captured in the inter-basin memorandum of understanding. The MOU should include timelines to adequately capture any and all foreseen changes to future releases, particularly if these trigger minimum thresholds associated with sustainable management criteria for beneficial users and uses.	FSCR	Effluent into basin as a data gap	UCWD will continue to monitor effluent releases from LA County.
GDE_014	However, the potential effects on non-vegetative beneficial users and uses such as Southern steelhead, and the subsequent steps of setting of sustainability criteria for these, needs further development and improvement. Without a thorough understanding of hydrologic/biotic relationship, the draft Groundwater Sustainability Plan cannot ensure that significant and unreasonable adverse impacts from groundwater depletion are avoided (California Department of Water Resources 2016).	FSCR	Non-vegetation GDEs	Text changes were made to section to specifically address O. mykiss.
GDE_015	Recommendation: Further analysis and efforts to assess the quantity and timing of interconnected surface water and groundwater is necessary for GDE's. These either need to be developed or captured as a data gap with actionable study to address data gap by the five-year review of the GSP. Installation of additional shallow groundwater monitoring wells and streamflow gauges near GDEs are necessary to understand the interconnectedness and monitor ongoing health and SMC compliance.	FSCR	Interconnected surface water	Additional monitoring wells are discussed in the monitoring appendix. These wells are located near GDEs and should improve our understanding of shallow groundwater dynamics. There is a section on interconnected flows in the document and we have more explicitly discussed fish passage and interconnected surface water.

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GDE_016	Currently, the Draft Sustainability Criteria for GDEs are based on statewide data on "vegetation known to use groundwater" and doesn't include minimum thresholds and measurable objectives for groundwater used by other biological resources, such as seasonal migration of fishes. The TNC framework does call for further biological assessment in the case of endangered species. The lack of further biological assessment and SMC development would be a gross omission in thoroughly identifying GDE needs in the Draft Plan. 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 that support aquatic invertebrates, avian fauna, and fish species, including native resident and anadromous fishes. Groundwater that supports seasonal surface flows can also contribute to the life-cycle of migratory fishes, such as steelhead and lamprey, that can make use of intermittent flows for both migration, spawning and rearing. While we appreciate and commend Stillwater Sciences on identifying GDE, the current vegetative-centric approach to minimum thresholds and measurable objectives of GDE's is not sufficient to capture the potential impact to other beneficial uses/biota.	FSCR	Interconnected surface water	We have added more information on O. mykiss passage related to groundwater. O. Mykiss rearing in the mainstem is a data gap. SMC development is discussed elsewhere in the GSP.
GDE_017	Recommendation: All identified environmental beneficial uses and users need to be explicitly included in the Draft Plan's sustainability goals, not solely vegetative communities. SMC's need to be developed that will capture and protect all GDE's identified. Model-based predictions suggest a minimum flow of 800 cfs is required to provide a depth of 0.6 ft continually across 10ft of channel (Keller et.al, 2006), and should be considered when setting sustainability criteria for a wider set of beneficial uses/users in the GSP.	FSCR	Assess impacts on in-stream habitat	The beneficial users have been more explicitly described in the text. Text changes were made to section to specifically address O. mykiss in relation to interconnected surface water.
GDE_018	While these groundwater-influenced flows may not support permanent vegetative cover, 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. The Santa Clara River along its entire reach is always connected to an aquifer because it either receives water from the surrounding sediments or supplies water to the surrounding sediments, or both. This reach is also designated critical steelhead habitat and constitutes a beneficial use.	FSCR	Assess impacts on in-stream habitat	We have expanded this discussion. Note that interconnected surface water requires that the groundwater be connected to surface flows through a continuous saturated zone. Groundwater recharge from disconnected surface water is common in many reaches of the Santa Clara River.
GDE_019	It is also important to recognize that the TNC assessment of groundwater water conditions reflects conditions that have been and continue to be significantly influenced by extensive water developments within the Santa Clara River watershed, including extensive water diversion and groundwater pumping programs (e.g., Pyramid, Santa Felicia, and Castaic dams); these activities have had a cumulative affect on groundwater levels and related surface flows within the Fillmore and Piru basins (Stillwater 2011a). Past and/or current effects of anthropogenic activities should not exclude or significantly delay the capacity of the aquatic environment to develop or maintain essential physical or biological features that species rely upon for growth and survival, otherwise the SMC's and ultimately the GSP would not be consistent with the sustainability requirements of SGMA. This reiterates the importance of the MOU and inter-basin agreement with upstream users aforementioned...To ensure that the Fillmore and Piru Basins GSA's GDE Tech Memo and subsequent GSP's adequately recognizes instream beneficial uses of the Santa Clara River that are potentially affected by the management of groundwater within the basins, the sustainable management criteria, minimum thresholds, and measurable objectives, must analyze and capture the important relationship between the extensive surface diversions and groundwater recharge program within the basins, and its potential adverse effects on GDE's and namely the federally endangered steelhead (Oncorhynchus mykiss).	FSCR	Assess impacts on in-stream habitat	Text changes were made to section to specifically address O. mykiss in relation to interconnected surface water.
GDE_020	Undesirable results for Southern steelhead include any adverse loss or modification to critical steelhead habitat (rearing, spawning and migration corridors) that hinders the ability of designated critical habitat to provide for steelhead survival because of pumping. Outside of the aforementioned flow metricadditional complementary sustainability metrics could include those used in NMFS "envelope method"3. Many natural variables such as seasonal surface flow patterns, water quality including temperature and established wetted channel, are significantly impacted by artificial modification in freshwater habitat and are possible metrics for minimum thresholds and measurable objectives. Ultimately identifying a metric that will identify an affect to the timing, duration and/or magnitude of surface flows essential for steelhead migration, spawning and rearing due to sub-surface extractions. Steelhead metrics will likely have a spatial and temporal component, as sustainability needs may vary due to life-cycle needs and migration windows, which may require dedicated management areas.	FSCR	Assess impacts on in-stream habitat	Steelhead rearing in the Santa Clara River is a data gap. There is no data on steelhead rearing in the Fillmore and Piru basins, although previous research has identified the mainstem Santa Clara River as a migration corridor (Stoecker and Kelley 2005). We have adjusted the text to reflect the connection bewteen rising groundwater and steelhead passage.
GDE_021	. To adequately address Southern steelhead impacts, a steelhead limiting factor analysis may likely be needed, as the Recovery Plan's analysis may be too course for these two basins. This is a data gap that can better inform management decisions that invariably may impact the endangered species. The GSA needs to identify the flow levels that effectively support essential life-history functions, specifically flows that adequately support adult steelhead and smolt migration during the winter and spring, and juvenile rearing year-round. The steelhead limiting factor analysis, shallow groundwater monitoring wells paired with stream flow gauges will begin to address the existing data gap around hydrologic/biotic relationships. Low summer baseflow is a significant stress to steelhead, and groundwater inputs can affect fine scale surface flow conditions and will need to be closely monitored in identified GDE areas.	FSCR	Assess impacts on in-stream habitat	Based on the lack of data on steelhead use of interconnected surface water in the Fillmore and Piru Basins, a limiting factors analysis is beyond the scope of the GSA's responsibility, but the GSA would offer letters of support for such a study.
GDE_022	While pool depths and riffle depth were discussed as possible sustainability metrics, it was acknowledged that changing channel morphology makes it difficult to map in a reliable way. Furthermore, we would caution using a minimum instream flow need, as these don't necessarily address broader life history needs and habitat requirements for long-term survival and recovery. Functional flows that incorporate and provide migration cues for adult steelhead and ecological flow functions will need to be sustained.	FSCR	Assess impacts on in-stream habitat	See previous comments regarding steelhead.
GDE_023	FSCR requests that a revised Draft Tech Memo and Sustainable Management Criteria Matrix be re-circulated to give interested parties an opportunity to review and comment on the memo before it is finalized. Particularly, as per the TNC Critical Species Lookbook, it behooves the GSA to formally request NMFS' comments on the draft at this juncture. Further input from the Santa Clara River Steelhead Coalition could also be requested to ensure pertinent stakeholders are adequately engaged.	FSCR	Additional agency input	Noted.
GDE_024	We do however recommend removal of the California Condor, as known condor habitats are not associated valley floor riparian areas.	UWCD	Change species inventory	Condor is removed as a GDE species because the habitat is not part of a GDE in these basins.
GDE_025	As noted by the authors, the Tech Memo also includes multiple incorrect references to Pacific lamprey occurrence in the Santa Clara River upstream of Sespe Creek and in lower Piru Creek. Please remove those inaccurate references.	UWCD	Change species inventory	This has been fixed.

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GDE_026	The authors appear to presuppose that all riparian habitats in the Piru and Fillmore basins are Groundwater Dependent Ecosystems (GDEs). The documents consistently refers to all riparian communities as "GDE Units." Simply "riparian plant communities" or "potential GDE Units" would be a much better working reference throughout the document. Consistent use of the GDE Unit term applied to areas that are finally determined to not be GDEs provides ample opportunity for inaccurate or misleading citations or references to the Tech Memo. Notable, the authors drop the GDE Unit tag in Section 5.4.3 when three Riparian Complexes are identified as important GDEs for consideration in the Groundwater Sustainability Plans (GSPs) for the Piru and Fillmore basins.	UWCD	GDE vs riparian unit	We've added some discussion to clarify this and describe the GDEs as potential GDEs, then discuss GDE likelihood in Section 5.
GDE_027	The Tech Memo lacks a clear definition of what distinguishes a GDE from other riparian communities sustained by surface water flows, soil moisture, or shallow local/perched groundwater occurrence that is not subject to significant influence from pumping from the main aquifers of the basins. It would be helpful if these definitions were included early in the document.	UWCD	GDE vs riparian unit	This has been clarified in the text.
GDE_028	Discussion of the hydrology associated with the Del Valle Riparian Complex could be much improved. United's understanding is that rising groundwater primarily occurs in the upper portions of this complex in the western portion of the Eastern basin (in Los Angeles County). Less than a mile downstream of the county line (the rather arbitrary head of the Piru basin), the abandoned Blue Cut gaging station is located on a bedrock high. From this point downstream to the Las Brisas bridge, surface flow is thought to be stable, and sustained by the rising water and recycled water discharges in Los Angeles County. The river transitions to a losing reach near the Las Brisas bridge, the current location of the USGS stream gage. A shallow water table commonly exists in this area, but is clearly sustained by the surface water flows from upstream areas. Please take care to describe this area in more detail and note that the occurrence of rising water in this area is not influenced by any known groundwater pumping in the Fillmore basin.	UWCD	Del Valle hydrology discussion	Added description of Del Valle and upstream hydrology, following UCWD comments.
GDE_029	Please take care when referencing United's groundwater elevation contours. Noting a shallow depth to water in a single year near the western margins of Santa Clara River Riparian Shrubland habitats in the Piru and Fillmore basins should not suggest that United believes shallow groundwater is common across those habitats. United agrees with Stillwater's assessment that Tributary Riparian areas are not likely to be "connected to groundwater."	UWCD	UCWD groundwater elevation contour references	We've added a map of the contour depth and text that clarifies that these are high groundwater conditions and are not reflective of typical groundwater levels.
GDE_030	Well 03N20W08A01S may be a poor choice to represent shallow groundwater elevations in the East Grove Riparian Complex. Water level records from this well appear to show a confined aquifer response from deeper production zones. One would expect shallow groundwater levels to be much more stable in this area known to commonly have groundwater discharge to the channel of the Santa Clara River.	UWCD	Selection of representative wells	Well deleted.
GDE_031	Regarding the Del Valle Riparian Complex, surface water flow in the first mile of the Santa Clara River within the Piru basin likely includes groundwater inputs, but below Blue Cut the river is stable or losing. Care should be taken to appropriately characterize how or if groundwater production in the Piru basin would significantly influence the health or extent of the Del Valle Riparian Complex.	UWCD	Impact of groundwater production in Piru basin on Del Valle unit	Added discussion of Del Valle.
GDE_032	Page 2 states flows on Piru Creek have been regulated except for the 1969 flood. In 2005 the dam also spilled (12,000 cfs?) and so there may be other instances of this. UWCD staff should check the records to verify this statement.	Ventura Co Public Works	Piru surface water	Refer this question/comment to United.
GDE_033	Page 4, reference to USGS gauge 11114000 seems to indicate it is still active. The USGS has not maintained or published the data for this gauge for sometime. Currently this is done by Watershed Protection for their gauge 723 and wehave operated the gauges at locations 720 and 724 as well.	Ventura Co Public Works	Gage 11114000	The period of record (1927-2004) was added to the text.
GDE_034	The inconsistent use of plant community nomenclature throughout the document, as well as the lack of clear community descriptions, invalidates the conclusions regarding ecological value and dependence on groundwater.	Ventura Co Public Works	Vegetation descriptions	We have clarified some of the community names in the text (e.g., tamarisk versus saltcedar). We decided to use the community name assigned by the relevant vegetation map (there were 3 different). We then used our experience in the basin to assess dominant species and things like rooting depth.
GDE_035	Incorrect usage/spelling of common and scientific names occurs throughout the text.	Ventura Co Public Works	Vegetation descriptions	This has been edited.
GDE_036	For special-status species, we suggest emphasizing that SWFL and WYBC requiremore extensive and contiguous riparian woodlands, compared to LBVI which canmake use of smaller scrub patches.	Ventura Co Public Works	Vegetation descriptions	Added text to describe this.
GDE_037	We agree that m ore shallow wells are needed to discern the true level and extent of groundwater in the GDEs. Incomplete data sets lead to many assumptions in the analyses.	Ventura Co Public Works	Sparse monitoring network	Comment noted.
GDE_038	We agree with the conclusion that the Del Valle, Cienega, and East Riparian Complexes are the most important GDE units Grove to consider in the GSP analyses. We recommend more study and data collection to determine how the Santa Clara River Riparian Shrubland GDE units are affected by groundwater and if its management wou ld affect them. The Shrublands form substantial cover within the river and provide habitat connectivity among the Riparian Complexes.	Ventura Co Public Works	Sensitivity of SCR Riparian Shrubland units to GW changes	One of the monitoring wells proposed by FPBGSA is located near the downstream end of the riparian shrubland. This unit has very shallow rooted plants, disconnected surface water and very rare shallow groundwater.
GDE_039	In this section, please clarify why the FPBGSA has not determined projects and/or management actions are needed. Do the conclusions in this and other reports indicate the GDEs are adequately sustained and current groundwater extractions are not affecting them? Or has the FPBGSA not yet developed management actions due to a need for more information or time?	Ventura Co Public Works	Projects and management actions	This is clarified in the Draft GSPs.
GDE_040	The Stillwater Sciences 2013 reference page 11 is not included in the list of literature cited.	Ventura Co Public Works	References	Reference updated.
GDE_041	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.	NMFS	Assess impacts on in-stream habitat	We have clarified the discussion of interconnected surface water where the interconnected water occurs and have highlighted special status species dependent on interconnected water.
GDE_042	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.	NMFS	Assess impacts on in-stream habitat	We have expanded the discussion of O. mykiss and compared groundwater flows with passage flows and more explicitly indicated that while this reach of the Santa Clara is thought to be primarily a migration corridor, the use of the interconnected portions of the stream for rearing is a data gap.

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GDE_043	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	NMFS	Assess impacts on in-stream habitat	We have added information on passage flows for the mainstem Santa Clara. See response to NMFS 2 regarding rearing habitat.
GDE_044	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).	NMFS	Non-vegetation GDEs	We have expanded the discussion of interconnected surface water as GDEs and the influence of base flows.
GDE_045	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.	NMFS	Assess impacts on in-stream habitat	See discussion of aquatic habtats in the Section 4.1.4. Given the correspondence between the historical wetlands and interconnected surface water Beller et al. (2011) seems appropriate. We do not know the changes to the extent of habitat units through time, but this is likley tied to changes in geomorphology rather than groundwater.
GDE_046	pages 8-14 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.	NMFS	Interconnected surface water	We have clarifiied the correspondence between the historical wetland units and interconnected surface water.
GDE_047	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).	NMFS	Assess impacts on in-stream habitat	Groundwater connection of these reaches is not known.
GDE_048	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.	NMFS	Assess impacts on in-stream habitat	We expanded the discussion of O. Mykiss.
GDE_049	page 19. 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.	NMFS	anthropogenic effects on groundwater levels	New modeling information discussing the effects of groundwater pumping on surface flows have been added to the discussion.
GDE_050	page 19. 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.	NMFS	Interconnected surface water	It is not clear that these reaches have interconnected surface water and most of the Tributary Riparian Unit is unlikley to be affectd by groundwater extraction.
GDE_051	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.	NMFS	Interconnected surface water	The area's rising and falling groundwater have persisted since the earliest records (see Beller et al. 2011) and are geologically controlled by variations int the valley width rather than by grounwater extractions.
GDE_052	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).	NMFS	Piru surface water	We are not aware of evidence suggesting that Piru Creek was historically perennial in the basin and would be happy to get some. Similarly, the degree to which Hopper Creek within the basin is disconnected due to groundwater pumping rather than due to deep surface groundwater is not known.

RESPONSE TO COMMENTS				
Comment number	**Comment**	**Organization**	**Issue**	**Response**
GDE_053	page 28. 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).	NMFS	Piru surface water	Uncertainty surrounding Hopper Creek has been added.
GDE_054	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.	NMFS	Assess impacts on in-stream habitat	The lower reaches of Pole Creek are not currently connected to groundwater, and the degree to which the upper reaches are connected to groundwater or to the main aquifer is a data gap.
GDE_055	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.	NMFS	anthropogenic effects on groundwater levels	We have included a model showing the change to surface flows if 50% of the pumping (pumping near the river) was eliminated.
GDE_056	page 28. 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).	NMFS	Develop new baseline hydrology	We are limited in our baseline hydrology by the available groundwater data.
GDE_057	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.	NMFS	Sparse monitoring network	The text has been updated to be more clear. Shallow groundwater wells will be installed near the Cienega site and East Grove.
GDE_058	pages 30-55. See comments above regarding the focus on vegetative GDE.	NMFS	Non-vegetation GDEs	We have clarified the correlation between GDE units and surface water extent.
GDE_059	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.	NMFS	Assess impacts on in-stream habitat	We have expanded our discussion of O. mykiss needs. The degree to which groundwater pumping inhibits passage is not known.
GDE_060	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.	NMFS	Non-vegetation GDEs	Added Hopper Creek critical habitat to the text. Added potential use of Hopper Creek to the text.
GDE_061	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 yearround 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.	NMFS	Non-vegetation GDEs	Added a discussion of Pole Creek to the document. Given that access to Pole Creek is blocked, only about 500 feet of the channel occurs upstream of the community within the basin, we have not included an extensive investigation of Pole Creek.
GDE_062	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.	NMFS	Non-vegetation GDEs	The GDEs include interconnected surface waters and aquatic beneficial users. We have made this more explicit in the updated draft.
GDE_063	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.	NMFS	Interconnected surface water	A discussion of Hopper Creek has been been added to the tributary riparian section.

RESPONSE TO COMMENTS				
Comment number	**Comment**	**Organization**	**Issue**	**Response**
GDE_064	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.	NMFS	Interconnected surface water POLE CREEK	Pole Creek has been added to the text.
GDE_065	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.	NMFS	Interconnected surface water	We have added text in the report to clarify this point and point to the difficulty of assessing changes in other features of the ecosystem.
GDE_066	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.	NMFS	Assess impacts on in-stream habitat	Hopper Creek has been added to the discussion on tributary ripairan streams.
GDE_067	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.	NMFS	Assess impacts on in-stream habitat	We have adapted the text to clarify that three of the areas (Del Valle, Cienega, and the East Grove) have interconnected surface water. Pole Creek does not appear to be interconnected within the Fillmore and Piru Basins and currently has both passage and barriers. Nevertheless we do discuss the potential for O. mykis habitat in Pole Creek.
GDE_068	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).	NMFS	Climate change	The analysis of climate change was based on the model used for the GSP and recommendations from DWR.
GDE_069	Page 86 As noted above, there is no recognition or discussion of Hopper Creek. This omission should be addressed in the revised Draft Memorandum.	NMFS	Interconnected surface water	Hopper Creek has been added to the tributary riparian section.
GDE_070	Page 89 Ecological Value: 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.	NMFS	Non-vegetation GDEs	We have added text to quantify flows from rising groundwater relative to upstream passage. We also clarified that for the Riparian shrubland, surface water flows are not connected with groundwater. United water releases water from Santa Felicia dam for outmigration of juveniles. Because this migration requires continuous surface flows, rising groundwater on its own is not sufficient to promote migration.
GDE_071	page 89 Ecological Condition: 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).	NMFS	Assess impacts on in-stream habitat	Comment noted. The role of groundwater in supplying downstream passage flows is not clear, but, where reaches are disconnected from groundwater, changes to pumping are unlikely. Booth 2020 also states that "Migration opportunities only result from storm events of sufficient magnitude and duration to generate extended surface flows." The degree to which groundwater extraction has altered surface flows in the Fillmore and Piru Basins is not clear, but the intermittent reaches betweeen the groundwater upwelling zones are currently dependent on surface water flows rather than rising groundwater.
GDE_072	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.	NMFS	Assess impacts on in-stream habitat	We do not see evidence that flow in the intermittent reaches is supported by groundwater within the basin.
GDE_073	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.	NMFS	Non-vegetation GDEs	We do not see evidence that flow in the intermittent reaches is supported by groundwater within the basin.

RESPONSE TO COMMENTS				
Comment number	**Comment**	**Organization**	**Issue**	**Response**
GDE_074	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.	NMFS	anthropogenic effects on groundwater levels	Added under current conditions to clarify that currently releases from Santa Felicia help maintain baseflow.
GDE_075	page 92. 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".	NMFS	Interconnected surface water	The conceptual model of this reach is that releases from Santa Felicia infiltrate into the subsurface while also maintaining baseflows. Clarified that baseflows over some portion of the length of Piru Creek are maintained by releases.
GDE_076	Page 92 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.	NMFS	Sparse monitoring network	Clarified that under current conditions it is disconnected. It is unknown if Piru Creek was connected under historical conditions.
GDE_077	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.	NMFS	Sparse monitoring network	The monitoring plan has gained access to a privately owned well to monitor groundwater levels in Piru Creek.
GDE_078	Tributary Riparian Unit 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.	NMFS	Assess impacts on in-stream habitat	See above. Hopper Creek has been added.
GDE_079	Tributary Riparian Unit 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.	NMFS	Assess impacts on in-stream habitat	See above. Hopper Creek has been added.
GDE_080	Tributary Riparian Unit 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.	NMFS	Assess impacts on in-stream habitat	See above. Hopper Creek has been added.
GDE_081	Tributary Riparian Unit 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).	NMFS	Climate change	The assessment of climate change on hydrology in the Santa Clara River was completed following DWR guidelines and is the best information we currently have for the basin.
GDE_082	Page 94 As noted above, there is no recognition or discussion of Pole Creek. This omission should be addressed in the revised Draft Memorandum.	NMFS	Interconnected surface water	Pole Creek included.
GDE_083	SCR riparian shrubland Groundwater Dependence: 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.	NMFS	Interconnected surface water	We added a discussion about the uncertainty of the contours in this reach. The lack of surface flows suggest surface water is not connected to groundwater in this reach.
GDE_084	page 94 SCR riparian shrubland 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).	NMFS	Assess impacts on in-stream habitat	There is no evidence that surface flows are interconnected with groundwater, and the intermittent nature of the reach suggests the flows are disconnected and not dependent on groundwater. United currently releases water to support outmigration of juvenilles.
GDE_085	page 94 SCR riparian shrubland 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.	NMFS	Interconnected surface water	"largely" was deleted.

RESPONSE TO COMMENTS				
Comment number	**Comment**	**Organization**	**Issue**	**Response**
GDE_086	page 94 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	NMFS	Climate change	Added "climate changes that differ from modeled predictions "
GDE_087	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.	NMFS	Assess impacts on in-stream habitat	Our understanding of this reach is that groundwater is never shallow enough to connect with surface water (i.e., even during wet years this is a losing reach).
GDE_088	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.	NMFS	Climate change	Clarifed that climate change effects could influence groudnwater levels if the models are incorrect.
GDE_089	Page 97 Groundwater Dependence: 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.	NMFS	Sparse monitoring network	A sentence discussing Pole Creek has been added. We propose monitoring the GDEs rather than groundwater in this reach because there is little pumping in the tributaries and the resources to install new wells were focused in higher priority areas more susceptible to groundwater management.
GDE_090	Page 98 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 Unit includes Pole Creek, which was omitted from the investigation. See comments above.	NMFS	Interconnected surface water	Pole creek has been added to the discussion here.
GDE_091	Page 98 Ecological Condition: 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.	NMFS	Interconnected surface water	Pole creek has been added to the discussion here.
GDE_092	page 98 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.	NMFS	Climate change	Clarified the climate change effects on groundwater levels are unlikely.
GDE_093	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.	NMFS	Interconnected surface water	See below for additional monitoring well.
GDE_094	Page 99 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.	NMFS	Interconnected surface water	Modifications to an existing shallow well are planned for one site in Sespe Creek.
GDE_095	Page 99 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.	NMFS	Climate change	Clarified uncertainty on Sespe Creek.
GDE_096	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.	NMFS	Additional GDE	It is not clear that these reaches have interconnected surface water and hence may not be GDEs. O. mykiss was considered when setting SMCs.
GDE_097	Page 11 principal aquifer. This is an important distinction.	TNC (MMR inline)	GDE determination	Changed "regional" to "principal".
GDE_098	Page 11 with no connection to a principal aquifer	TNC (MMR inline)	GDE determination	Changed "regional" to "principal".
GDE_099	Page 14 Thank you for doing this!	TNC (MMR inline)	GDE determination	Noted.
GDE_100	Page 30 I highly recommend using the well data and a digital elevation model to estimate depth to groundwater under GDEs. Most wells exist at higher elevation than GDEs. See Best Practice #5 in this TNC document: https://groundwaterresourcehub.org/public/uploads/pdfs/TNC_NCdataset_BestPracticesGuide_2019.pdf	TNC (MMR inline)	Updated Nature Conservancy guidance on depth to water	Added description of GDE elevation transects to Section 3.1. Added max/min GDE elevations to depth to water plots and discussion.
GDE_101	Page 89 If you corrected for land surface elevation at the GDE, does the groundwater surface get within mulefat rooting depths?	TNC (MMR inline)	Updated Nature Conservancy guidance on depth to water	Text updated to clarify use of depth to water surface.
GDE_102	Page 91 But, groundwater levels must also be restored to pre-drought conditions to promote riparian succession of cottonwoods/willows and avoid establishment of arundo.	TNC (MMR inline)	Cienega riparian complex	Noted.
GDE_103	Page 91 Is this still true if you correct for land surface elevation at the GDE using a DEM?	TNC (MMR inline)	Updated Nature Conservancy guidance on depth to water	Text updated to clarify use of depth to water surface.
GDE_104	Page 96 I'd say the ecological condition is "Poor" given the widespread mortality that occurred here.	TNC (MMR inline)	Cienega riparian complex	Agreed and changed.
GDE_105	Page 97 And increased ET losses from arundo in the basin water budget... Also, reduced habitat for two federally listed species.	TNC (MMR inline)	Cienega riparian complex	Noted.
GDE_106	Page 99 Low or uncertain? How do you know the model output is correct if there are no shallow monitoring wells in the vicinity?	TNC (MMR inline)	Sespe Creek Riparian Complex	Changed to undetermined, likely low.
GDE_107	Page 100 GDEs Important to Consider When Establishing Sustainable Management Criteria.	TNC (MMR inline)	Text	Changed text.
GDE_108	Page 100 i	TNC (MMR inline)	Text	Typo fixed.
GDE_109	Page C-1 Why is this species not considered a GDE?	TNC (MMR inline)	Blue oak	Blue Oak occurs outside of the aquifer on the ridges and noses of the uplands and is not likley affected by pumping.