FOX CANYON GROUNDWATER MANAGEMENT AGENCY

MEMORANDUM

Date: May 19, 2021

To: Operations Committee

From: Kim Loeb, Groundwater Manager

Subject: Item F – Water Supply and Infrastructure Projects in the Oxnard and Pleasant Valley Basins

Background

Natural sources of recharge and current infrastructure do not supply sufficient water to ensure sustainable management and support current rates of groundwater extraction in the Oxnard and Pleasant Valley (OPV) Basins. Without implementation of substantial infrastructure and water supply projects, extraction will need to be significantly reduced to address seawater intrusion and bring the basins into sustainable management.

GSP Projects

The Groundwater Sustainability Plans (GSPs) adopted by the Agency in December 2019 include a number of potential projects. To be included in the GSP projections of future sustainable yield, projects must meet the checklist feasibility requirements in the GSP Regulations including expectation and evaluation of benefits and estimated cost and description of funding plan. Projects were selected for inclusion in the GSPs through an Operations Committee process with significant stakeholder engagement conducted over seven meetings in February through August 2018. The Board approved the Operations Committee's recommendations for projects to include in the GSPs at the August 29, 2018 meeting. The projects included in the GSP modeling of future sustainable yield are summarized in the following table.

Project	Estimated Water / Increased SY
Oxnard GREAT Program Advanced Water Purification Facility (AWPF) delivery of 4,600 AFY to agricultural operators in the vicinity of Hueneme Road[1]	4,600 AFY
Expansion of GREAT AWPF Program to increase groundwater recharge by 4,500 AFY in the Saticoy Spreading Grounds[2]	4,500 AFY
Riverpark – Saticoy Groundwater Replenishment and Reuse Project to construct pipeline to deliver AWPF water to spreading grounds[2]	-
Freeman Diversion Expansion Project Phase 1	4,500 AFY
Voluntary temporary fallowing of farmland in the area of the pumping depression	2,700 AFY

SY = Sustainable Yield
AF = Acre-foot
AFY = Acre-foot per year

1. The Oxnard GREAT program currently can deliver 4,600 AFY to growers for which the City of Oxnard receives a Recycled Water Pumping Allocation (RWPA). The GSP project consists of purchasing the water for farmers in lieu of groundwater production rather than generating an RWPA.
2. The City of Oxnard's position subsequent to GSP adoption is that the spreading of the GREAT water in the Saticoy Spreading Grounds is not regulatorily feasible. However, the City indicates that this water could be available for other projects in the basin.

OPV Stakeholder Group Projects

As part of the OPV Stakeholder Group facilitation provided through a Department of Water Resources (DWR) program, an ad hoc projects committee formed to investigate potential projects for further study in the OPV Basins. The committee met over eight meetings between September and December 2020 assisted by Agency and United Water Conservation District (UWCD) staff. Three project scenarios were considered: Scenario A, anchored on a seawater intrusion barrier; Scenario B, anchored on full-scale optimization; and Scenario C, anchored on "optimization light." The ad hoc projects committee recommended moving forward with additional review of a hybrid of Scenario A seawater intrusion barrier and Scenario B basin optimization which is referred to as the "hybrid scenario." Hybrid scenario projects are listed in the following table.

Project	Estimated Water / Increased SY	Rough Estimated Cost
Oxnard GREAT Program Advanced Water Purification Facility (AWPF) delivery of 4,600 AFY to agricultural operators in the vicinity of Hueneme Road (2021) (GSP project)	4,600 AFY	$400–$600/AF O&M
Voluntary temporary fallowing of farmland in the area of the pumping depression (2021) (GSP project)	2,700 AFY	$1,200–$1,800/AF
Freeman Diversion Expansion Project Phase 1 (2028) (included in GSP with estimate of 4,500 AFY)	4,000 AFY	$25M capital $50 - $100/AF incremental O&M
State Water Project interconnect flushing/recharge (2027)	500 AFY	$5M capital $1,500/AF Purchase of MWD water
State Water Project purchases of Article 21, exchanges, transfers (2021)	6,000 AFY	$400/AF (rev. $500–$1,000/AF)[1] + $50/AF O&M
Brackish Water Extraction Barrier Project Phase 1 (2027)	10,000 AFY	$160M capital $1,500/AF O&M
Optimization Measure 1: stop pumping in the seawater intrusion area (2027)	4,000 AFY	$500/AF for water Capital pipeline infrastructure not estimated
Optimization Measure 2: Shift UWCD PTP wells from LAS to UAS (2030)	1,000 AFY	$500/AF

SY = Sustainable Yield
AF = Acre-foot
AFY = Acre-foot per year
PTP = Pumping Trough Pipeline
LAS = Lower Aquifer System
UAS = Upper Aquifer System
1. Cost revised based on UWCD April 30, 2021, Technical Memorandum: Estimation of Future Supplemental State Water Imports by United Water Conservation District (attached).

The OPV ad hoc projects committee presented its recommendations to the OPV Stakeholder Group at its December 15, 2020, meeting. The OPV Stakeholder Group concurred with the recommendation to conduct initial modeling of the hybrid scenario. More details are in the attached "OPV Projects Committee Recommendations" memo dated December 12, 2020, prepared by the Consensus Building Institute.

UWCD estimated it would have initial groundwater modeling results available for discussion in February or March 2021. However, for reasons UWCD staff will discuss including groundwater model updates and modeling of surface-water routing, the initial results were not available until late last week. UWCD provided Agency staff and Dudek, the Agency's consultant, an overview of initial model results in an April 13, 2021, meeting. UWCD staff will provide a presentation of initial results of modeling the hybrid scenario to the Operations Committee. Members of the ad hoc projects committee were invited to attend this Operations Committee.

Next Steps

Following are the next steps in project evaluation:

- Review initial modeling results to assess the extent to which the hybrid suite of projects addresses undesirable results, principally seawater intrusion, and the estimated increase in sustainable yield of the OPV Basins including additional water supply.
- Identify additional projects, or a different suite of projects, as needed to address any deficiencies identified in the initial groundwater modeling.
- Conduct additional groundwater modeling as needed.
- Return to the Operations Committee with a suite of projects recommended for further study.
- Take the recommended suite of projects to the Board for direction.
- Further evaluate feasibility and costs of recommended projects including cost-benefit analysis.

Attachments: UWCD Technical Memorandum: Estimation of Future Supplemental State Water Imports by United Water Conservation District, April 30, 2021

OPV Projects Committee Recommendations, December 16, 2020

Date: April 30, 2021
From: Bram Sercu, Senior Hydrologist, United Water Conservation District
To: Kim Loeb, Groundwater Manager, Ventura County Watershed Protection District
Jeff Pratt, Executive Officer, Fox Canyon Groundwater Management Agency
Glenn Shephard, Director, Ventura County Watershed Protection District
Cc: Dan Detmer, Supervising Hydrogeologist, United Water Conservation District

TECHNICAL MEMORANDUM: ESTIMATION OF FUTURE SUPPLEMENTAL STATE WATER IMPORTS BY UNITED WATER CONSERVATION DISTRICT

Introduction

United Water Conservation District (United) is significantly involved in regional efforts related to groundwater basin sustainability planning and water supply planning. United has created and recently updated a regional groundwater flow model to assist in these efforts. A variety of water supply and conservation projects are currently being evaluated, including but not limited to: supplemental State Water imports, United's Freeman Expansion Project, a coastal brackish water well field and treatment facility, delivery of recycled water to farms, limited voluntary fallowing of agricultural lands, and regional optimization of water deliveries to reduce pumping in critical areas.

The Fox Canyon Groundwater Management Agency (FCGMA) is currently working towards establishing a replenishment fee to generate funds to purchase supplemental State Water when available. To adopt a replenishment fee, FCGMA must prepare an analysis of the water available for purchase, and associated costs, to meet Proposition 26 and/or Proposition 218 requirements.

This memo details United's methodology and analyses for determining how much State Water from various programs or purchase arrangements is likely to be available, and how much of the imported State Water received and stored in Lake Piru would directly benefit the Oxnard and Pleasant Valley groundwater basins after release from Lake Piru and diversion at the Freeman Diversion.

State Water Project Background

As a State Water Contractor (Contractor), Ventura County Watershed Protection District administers a long-term water supply contract with the State of California Department of Water Resources (DWR), for delivery of a maximum about of 20,000 acre-Feet (AF) of State Water Project (SWP) Table A water. United has 5,000 AF of Table A allocation, Casitas Municipal Water District has 5,000 AF of Table A allocation, and 10,000 AF of Table A allocation is held by the City of Ventura. The Port Hueneme Water Agency uses 1,850 AF of United's allocation and takes delivery directly through Calleguas Municipal Water District pipelines, leaving United with an allocation of 3,150 AF of Table A water.

United generally receives delivery of State Water via middle Piru Creek releases from Pyramid Lake to Lake Piru. State Water is stored in Lake Piru together with natural runoff from the Piru Creek watershed until United releases the water to benefit downstream groundwater basins. Groundwater basins that receive direct benefits during conservation releases include the Piru, Fillmore, Santa Paula, Oxnard and Pleasant Valley basins. In order to optimize the benefits to the downstream groundwater basins, conservation releases generally are conducted during late summer and fall. The Federal Energy Regulatory Commission (FERC) license for DWR's South SWP Facilities (FERC Project No. 2426) limits SWP water deliveries to United via the Pyramid Reach to 3,150 acre-feet between November 1 and the end of February of each water year. United is currently working with DWR to remove the maximum release limitation in their FERC license, in order to facilitate importation of supplemental State Water in addition to United's SWP Table A allocation of 3,150 AF. Note that United can also import State Water via release from Castaic Lake, but this option is generally not preferred because it does not allow storage of imported State Water in Lake Piru, therefore offering limited flexibility to optimize release benefits.

SWP Table A water is allocated annually to Contractors based on hydrological conditions, and allocations have ranged from 5% to 100% historically. Contractors have access to additional water supplies from the SWP, including Article 21 water, and transfers and exchanges of State Water allocated to other Contractors. Article 21 water is non-Table A water that becomes available on an intermittent, interruptible basis, generally during periods of abundant precipitation in northern California. It is offered to Contractors when there is ample water in the SWP system, forecasts are showing more precipitation on the way, and there is available pumping capacity in the SWP system. Article 21 is allocated based on a Contractor's share in Table A allocations (0.5% for Ventura County). However, there are years when the availability of Article 21 water exceeds the demand, and Contractors may be able to purchase more than their allocated share. For example, this occurred in 2017 and 2019, and United had or was granted funding by FCGMA (in 2019) to purchase 10,000 AF and 15,000 AF of Article 21 water, respectively. The cost of Article 21 water is based on the conveyance charge for power to deliver the water, which depends on where the water will be taken. For Ventura, the cost of Article 21 water is currently approximately $200/AF.

SWP transfers and exchanges are voluntary actions proposed by willing buyers and sellers, and are approved and managed by State agencies. United assumes that any future supplemental State Water, acquired in addition to its 3,150 Table A allocation and imports of Article 21 water, will consist of transfers. Exchanges of State Water are less desirable, since the buyer is required to return exchange water to the seller at a later date, potentially reducing the buyer's future water supplies. Moreover, the recently negotiated amendment to the SWP contract (Water Management Tools Amendment), once implemented, will provide increased flexibility and fewer restrictions for water transfers. Buyers and sellers in a transfer agreement have a lot of flexibility on the terms of the agreement, and it is difficult to forecast quantities, delivery times and cost for State Water transfers with reasonable accuracy before engaging potentially willing sellers. The annual amount of State Water transfers that can be purchased by United largely depend on the price United and other Ventura County agencies are willing to pay, and the delivery terms (e.g. purchases during dry or wet years). For planning purposes, United anticipates that the cost for State Water transfer will fall between $500/AF and $1,000/AF. This cost is in the upper range of the recent Nasdaq Veles California Water (NQH2O) Index values (Figure 1).

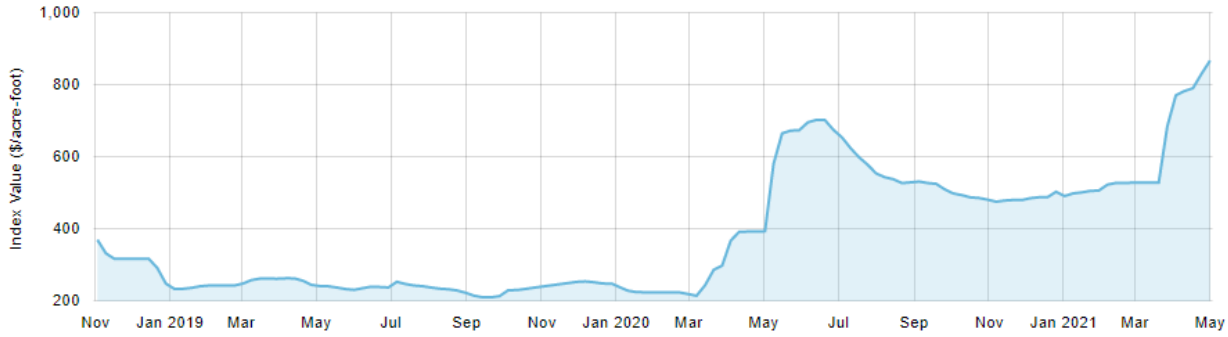


Figure 1. NQH2O Index trends from November 2019 to April 2021.[1]

Methods

Supplemental State Water at Freeman Diversion

United set a target to receive approximately 6,000 AF/yr of supplemental State Water imports (including Article 21 purchases and transfers) at the Freeman Diversion in the future, in addition to its current Table A allocation. The 6,000 AF/yr target was set based on the following considerations:

1. United's recent purchases of supplemental State Water (Article 21, exchanges and transfers) for a total of 35,250 AF during the period 2017-2021,
2. Opportunities for water transfers for United will likely increase in the future with the adoption of the Water Management Tools Contract Amendment,
3. United's SWP consultant confirmed that it is reasonable to anticipate being able to purchase 6,000 AF/yr on the water transfer market a cost of $500/AF to $1,000/AF,
4. Even if supplemental State Water purchase are not cheap, the cost is near the mid-point of other water supply projects that are being considered within Ventura County.

To achieve diversion of 6,000 AF/yr of supplemental State Water at the Freeman Diversion, a higher amount of State Water imports to Lake Piru will be needed, due to conveyance losses after releasing from Lake Piru. Surface water hydrology and operations models were used to estimate required State Water imports to Lake Piru. The future supply of Article 21 was determined from DWR forecasts on SWP deliveries and demands, while the future need for water transfers was calculated as the volume of water needed to make up the deficit between Article 21 supply and the 6,000 AF/yr total supplemental State Water target.

Article 21

Future imports of Article 21 water were modeled based on DWR's forecasted Article 21 deliveries and demands in the 2019 Delivery Capability Report (DCR).[2] The report technical addendum provides monthly

[1] The NQH2O Index tracks the spot rate water price in California. The value is priced at the source, excluding conveyance cost and losses. Source: WestWater Research, https://www.waterexchange.com/ca-water-index/ (accessed April 30, 2021)

[2] DWR, 2020, The Final State Water Project Delivery Capability Report 2019, August 26, 2020

Article 21 delivery and demand data based on the hydrology for the period 1928 to 2003.[3] An Excel spreadsheet model was used to calculate the portion of Article 21 deliveries to Contractors that would be available to United, and the portion of the available Article 21 water that could be beneficially used by United. For example, Article 21 water may be available when groundwater basins and/or Lake Piru have little to no available storage, in which case United would not purchase Article 21. Availability of Article 21 water to United was calculated as the sum of Article 21 water available based on the Ventura County Table A allocation and excess Article 21 water that may be available on some years.

Calculation of United's Article 21 water purchases were performed as follows:

1. Obtain monthly deliveries of Article 21 water from the 2019 DCR. Deliveries assumed DWR's "future conditions" scenario, which assumes existing infrastructure but accounts for climate change and sea level rise. Note that "future conditions" *do not* include the Delta Conveyance Project, for which water supply forecasts are not available.
2. Ventura County's allocation of Article 21 water was calculated by multiplying the deliveries south of the Delta by 0.5%.
3. Two alternative methods were used to calculate availability of Article 21 in excess of the Ventura County allocation. For **Method 1**, monthly Article 21 demand was obtained from the 2019 DCR technical addendum. Monthly demands were provided for "normal years" and "Kern wet years".[4] Excess Article 21 was assumed to be available to United when monthly Article 21 deliveries were within 62,000 AF of monthly demand. This assumption was supported based on the fact that historically Article 21 deliveries were lower than requests. For **Method 2**, Article 21 was assumed to be available to United when monthly and annual Article 21 deliveries south of the Delta exceeded 180,000 and 300,000 AF, respectively. These assumptions were based on Article 21 deliveries in 2017 when excess Article 21 water was available to United. For both methods, excess Article 21 availability was capped at 20,000 AF/month to reflect delivery constraints based on the Pyramid release rate and delivery window. Using two different methods to calculate the availability of excess Article 21 to United helps assess the reliability of the forecast, i.e., how much it depends on assumptions.
4. To calculate Article 21 water that could be beneficially used by United, it was assumed that the available Article 21 water (sum of Article 21 allocation and excess Article 21 water based on methods 1 or 2) was purchased when all of the following conditions were met:
    a. Historical available storage in Oxnard Forebay exceeds 25,000 AF
    b. Historical available storage in Piru basin exceeds 20,000 AF
    c. Historical storage in Lake Piru less than 52,000 AF
    d. Historical inflows to Lake Piru less than 15,000 AF/month

    Additionally, Article 21 purchases were limited so that the maximum historical storage in Lake Piru after purchase did not exceed 60,000 AF to 75,000 AF (depending on the month).

[3] DWR, 2020, Technical Addendum to The State Water Project Final Delivery Capability Report 2019, August 26, 2020.

[4] "Kern wet years" are identified by DWR and include 1941, 1952, 1969, 1978, 1980, 1983, 1986, 1995 and 1998. During these years, DWR assumes demand for Article 21 water by agricultural users is much lower than during "normal years".

5. Finally, Article 21 purchases that could benefit United were restricted to reflect the current delivery window (November through February) and also an expanded window that allows more Article 21 purchases (October through March). This approach yields Article 21 deliveries to United for four scenarios (two methods, two delivery windows), allowing an assessment of the sensitivity of the analysis depending on various assumptions, based on historic hydrology.
6. The Article 21 scenario with the highest delivery amounts was selected for planning purposes (Method 2, October through March delivery window), and was used in United's Lake Piru model to simulate conservation releases.

State Water Transfers

Surface water models were used to calculate how much supplemental State Water imports were required, combined with Article 21 purchases, to meet the target of 6,000 AF/yr at the Freeman Diversion. The surface water models simulate United's Lake Piru operations, losses to groundwater recharge upstream of the Freeman Diversion for conservation releases, and diversion operations. Historically, about 45% of the conservation releases from Lake Piru were delivered directly to the Freeman Diversion. The remaining water mostly percolated to the Piru and Fillmore groundwater basins, and a small portion was lost to evapotranspiration and diversions. Note however that much of the water that percolates to the Piru and Fillmore groundwater basins continues to flow downgradient, rises to the surface, and is ultimately diverted at the Freeman Diversion.

United's Lake Piru Reservoir model was used to simulate Lake Piru outflows (including conservation releases, habitat and migration releases, and spills) based on Lake Piru inflows (natural flows and State Water Imports) and a set of operational rules. The Excel spreadsheet model is run on a daily time step, for the period 1930-2019. The model is essentially a water balance model that takes into account the stage-storage relationship and evaporation.

United's Upper Basins Surface Water Model was used to simulate the transport of water released from Lake Piru to the Freeman Diversion, and incorporates streambed percolation and rising groundwater across the Piru, Fillmore and Santa Paula basins. Additional inputs to the model include Santa Clara River flows from Los Angeles County and flows from the major tributaries. Empirical relationships (based on observations) are used to model recharge to groundwater in the Piru and Fillmore basins, rising groundwater at the Piru/Fillmore and Fillmore/Santa Paula basin boundaries, underflow between Piru and Fillmore basins, and losses of surface flows in the Santa Paula basin. The Excel spreadsheet model is run on a daily time step, for the period 1930-2019.

United's Hydrological Operations Simulation System (HOSS) was used to simulate diversions based on flows obtained from the Upper Basins Surface Water Model. The HOSS is a hydrology-based operations model that simulates diversions and flow magnitudes in the Santa Clara River downstream of the Freeman Diversion (bypass flows), and the amount of water that is lost or gained to/from groundwater in the "critical reach" of the SCR in the Oxnard Forebay. The HOSS is based upon several decades of historical flow gage data, groundwater conditions in the Forebay, and diversion flow rates, and has been peer-reviewed by R2 Resource consultants.[5] The Excel spreadsheet model is run on a daily time step, for the

[5] R2 Resource Consultants, 2016, Riverine effects analysis of Freeman Diversion flow releases on steelhead and Pacific lamprey; Attachment A, model documentation report. September 2016.

period 1930-1979. Diversions were simulated assuming Bypass flow operations proposed by United in its Freeman Diversion Multiple Species Habitat Conservation Plan[6], and with implementation of the Freeman Expansion project. The HOSS was run twice, once with and once without supplemental State Water imports (Article 21 and State Water transfers). The difference in diversions between the two models is the yield at the Freeman Diversion associated with the supplemental State Water imports.

Results

Availability of Article 21

Forecasted average annual imports of Article 21 range from 588 AF to 1,390 AF/yr, depending on calculation method and delivery window assumptions (Table 1). Note that Article 21 is exclusively available for beneficial use by United during dry water years. Meaningful imports of Article 21 water occur only in model years 1951 and 1956, and the simulated imports on those years vary greatly depending on assumptions (Figure 2). For example, simulated imports in 1951 were 2,323 AF using method 1 and 42,323 AF using method 2, for the November to February delivery window. Article 21 imports for all other years were less than 1 AF. The most optimistic scenario for Article 21 imports (Method 2, Oct – Mar delivery window) was selected for modeling combined with State Water transfers using the Lake Piru model. Note that the hydrologic period characterized by DWR ends in 2003, so the Article 21 availability from years 2017 and 2019 is not included in the analysis.

Table 1. Simulated average annual imports of Article 21 (AF/yr) based on modeling period 1928-2003 (water years). Article 21 imports are shown for two calculation methods and the current (Nov-Feb) and expanded (Oct-Mar) delivery windows.

	Method 1		Method 2	
WY Type	**Delivery Nov-Feb**	**Delivery Oct-Mar**	**Delivery Nov-Feb**	**Delivery Oct-Mar**
Dry	924	960	1,740	2,184
Normal	0	0	0	0
Wet	0	0	0	0
All	588	611	1,107	1,390

[6] United Water Conservation District, 2020. Freeman Diversion Multiple Species Habitat Conservation Plan. June 30, 2020.

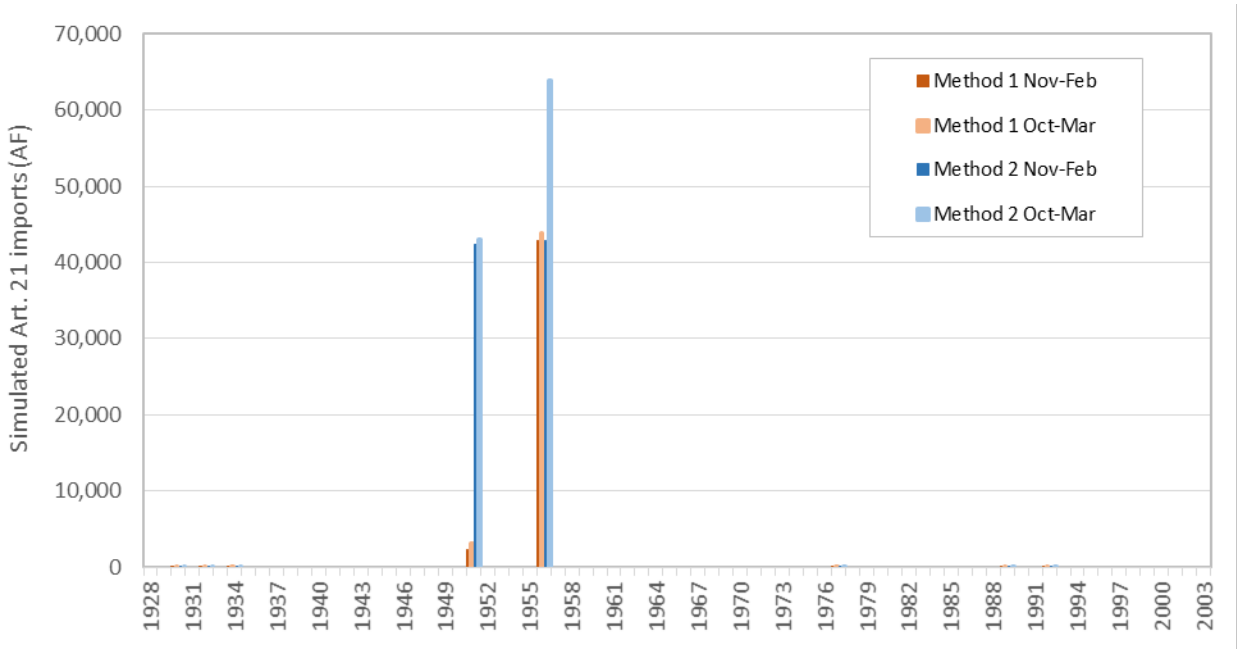


Figure 2. Simulated imports of Article 21 water by United during the 1928-2003 (water years) modeling period water.

Combined imports of Article 21 and State Water Transfers

Annual supplemental State Water purchases delivered to Lake Piru, based on combined modeling of Article 21 and State Water transfer purchases are shown in Figure 3. Compared to the model results presented in Figure 2 (Method 2, Oct – Mar), the Article 21 imports were adjusted downward somewhat for year 1956 as there was not sufficient available storage in Lake Piru to store the full amount of Article 21 available to United. The final estimate for annual average Article 21 purchases is 1,300 AF/yr.

After modeling different amounts of State Water transfers, it was found that additional State Water transfers of 10,000 AF during “normal” and “dry” years (no purchases during “wet” years) were required to achieve diversions of 6,000 AF/yr of total supplemental State Water at the Freeman Diversion. Annual purchases of State Water transfers are shown in Figure 3. On average, this amounted to a purchase of 7,900 AF/yr of supplemental State Water through water transfers for storage in Lake Piru.

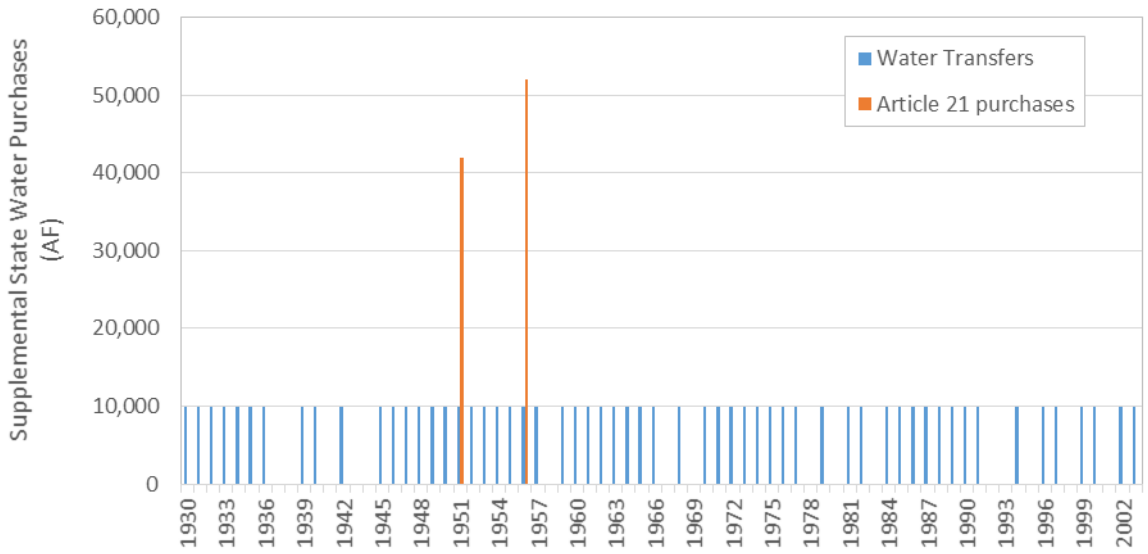


Figure 3. Simulated purchases of Supplemental State Water (water transfers and Article 21) by United for the 1930-2003 modeling period.

Diversions of Supplemental State Water at Freeman Diversion

The difference in modeled diversions with and without simulated purchases of supplemental State Water (1,300 AF/yr of Article 21 and 7,900 AF/yr of State Water transfers) is shown in Figure 4. Annual diversions of these supplemental State Water purchases vary depending on when the purchased water was released from Lake Piru. The highest diversions were modeled to occur in 1951 and 1956, when Article 21 was purchased. On average, simulated diversions of supplemental State Water purchases were 6,200 AF/yr, very close to the target of 6,000 AF/yr.

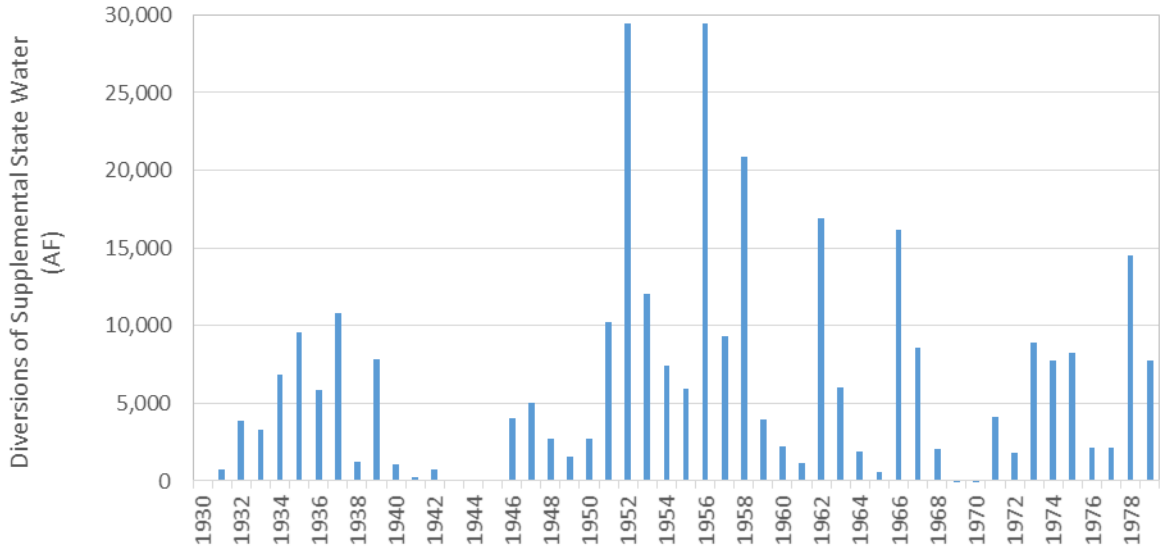


Figure 4. Simulated annual diversions of Supplemental State Water (water transfers and Article 21) at the Freeman Diversion.

Conclusions

For water supply planning purposes, United's current assumed target is to import supplemental State Water (in addition to United's current 3,150 AF Table A allocation) in order to increase diversions at the Freeman Diversion by 6,000 AF/yr. The supplemental State Water will consist of Article 21 and State Water transfer purchases. State Water Project supply and demand data from DWR as well as simulations of Lake Piru releases, downstream conveyance via the Santa Clara River channel and diversions at the Freeman Diversion were used to determine the relative amounts of Article 21 and State Water transfers that need to be imported to Lake Piru to meet United's target at the Freeman Diversion. Article 21 water is significantly less costly than State Water transfers, and imported amounts for each are required to estimate overall cost of supplemental State Water imports.

On average, purchase of 1,300 AF/yr of Article 21 water and 7,900 AF/yr of State Water transfers are required to increase diversions of supplemental State Water at the Freeman Diversions by 6,200 AF/yr. Article 21 water is rarely available for beneficial use to United, but large quantities can potentially be purchased when the water is available. State Water transfers can occur on a more regular basis, but here it is assumed they would not occur during wet years. Given the high annual variability of these supplemental State Water imports, associated increases in diversions at the Freeman Diversion also vary significantly annually. The cost of purchasing the water is currently $200/AF for Article 21 water and estimated at $500/AF - $1,000/AF for State Water transfers.

The simulation results presented here carry some uncertainty and may be adjusted in the future, as assumptions or supply/demand data change. For Article 21, uncertainty comes from operational constraints that are very difficult to model (decisions of individual water agencies on how much to purchase on a given year), unpredictable operational constraints in the State Water Project, and the potential impact of a future Delta Conveyance Project. For State Water transfers, there is uncertainty of the availability of transfer water and cost that can be negotiated with one or more willing sellers. Market conditions fluctuate constantly in response to drought cycles and other factors. Finally, United is currently modeling a variety of water supply projects to assist FCGMA and stakeholders in determining what combination of new water supply projects and pumping reductions are required to achieve sustainability in the Oxnard and Pleasant Valley groundwater basins. The outcome of these modeling efforts may lead United to adjust their target for supplemental State Water imports.

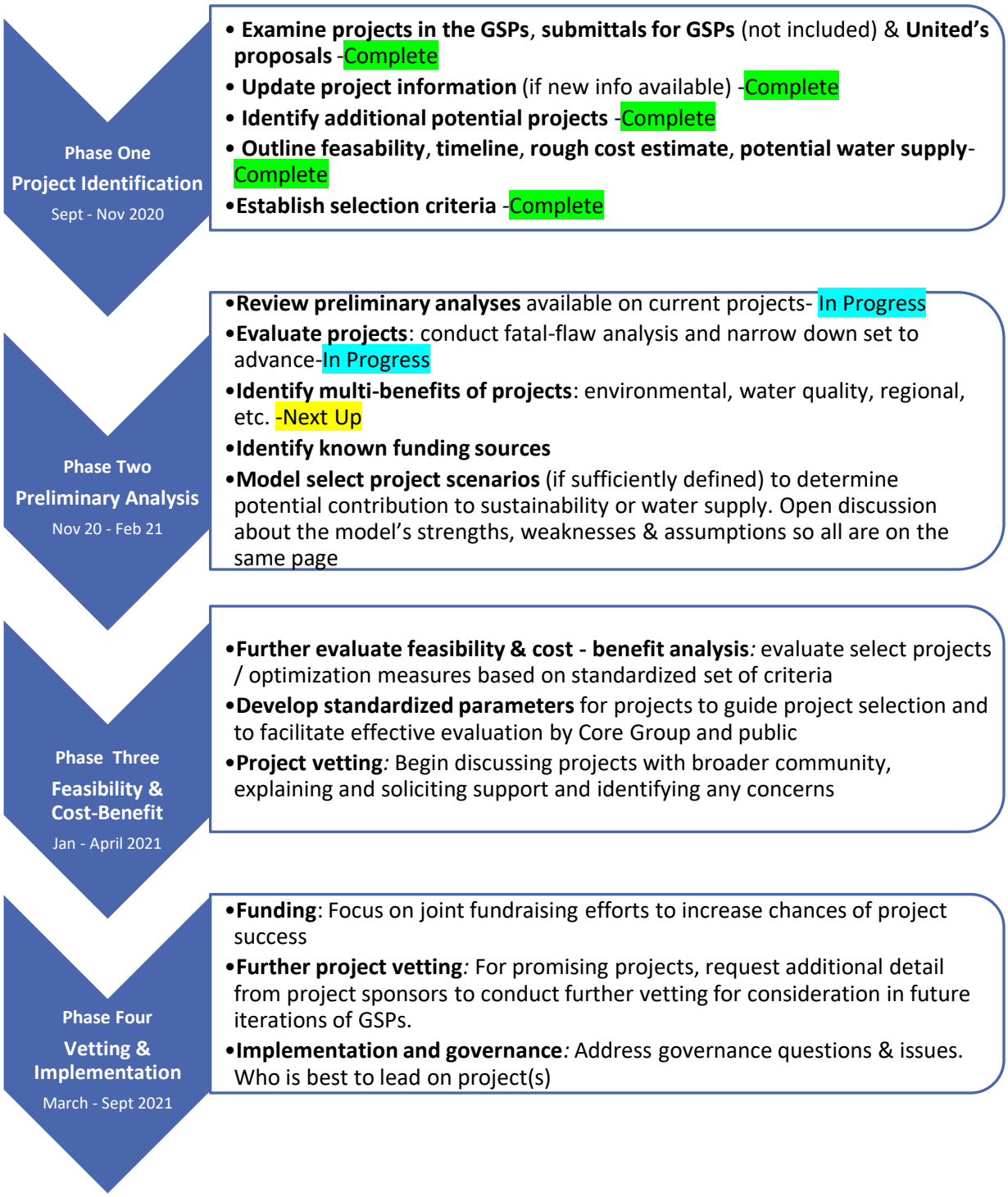
Fox Canyon Groundwater Oxnard Subbasin and Pleasant Valley Basin Facilitated Process

This set of recommended projects / optimization measures was approved by the OPV Core Stakeholder Group to move forward for further analysis at the group's meeting on 12/15/20

OPV Projects Committee Recommendations

This summary presents the Projects Committee's recommendations for a set of near-term to middle-term projects and optimization measures to move forward for further analysis. This summary also describes potential longer-term solution options and a suggested pathway for the modeling recommended prior to advancement of the projects / optimization measures under consideration. This summary concludes with a review of the projects the committee plans to further explore, but that were not included in the recommendations due to insufficient information.

Projects Work Plan



Recommendation for Set of Projects / Optimization Measures to Prioritize for Further Analysis

The chart below describes the Projects Committee's recommendations for a set of near-term to middle-term projects and optimization measures to move forward for further analysis. It also describes the phases of a potential longer-term solution: a "hybrid approach" that combines optimization with components of a seawater intrusion extraction barrier.

Project	Hybrid Approach
Recycled water to farms (2021)	4,600
Recycled water to recharge (---)	0
Voluntary fallowing (2021)	2,700
SWP Interconnect flushing (2027)	500
Freeman Expansion Ph. 1 (2028)	4,000
Freeman Expansion Ph. 2 (2036)	4,000
SWP Art. 21, exchanges, transfers (2021)	6,000
Optimization Ph. 1 (2027)	4,000
Optimization Ph. 2 (2030)	1,000
Optimization Ph. 3 (2035)	0
Brackish Water Ext. Ph. 1 (2027)	12,000-16,000
Brackish Water Ext. Ph. 2 (2035)	0
Reduce pumping	8,000-12,000?

Projects included in the GSPs' Sustainable Yield Estimates

The sustainable yield estimates in the GSPs include the following projects:

- Delivery of 4,600 AFY of recycled water from the Oxnard GREAT Program to farmers in the vicinity of Hueneme Road.
- Expansion of the GREAT Program to increase groundwater recharge by 4,500 AFY in the Saticoy Spreading Grounds.
- Approximately 2,700 AFY reduction of pumping, principally in the LAS, through temporary fallowing of farmland in the area of the pumping depression.

Oxnard Recycled Water Project Expansion

AWPF can be expanded from 7,000 AFY to 10,500 AFY using existing wastewater flow.

AWPF Expansion Costs: The estimated AWPF expansion capital cost (from 7,000 AFY to 10,500 AFY) is ~ $31 million. The estimated cost also includes a new recycled water reservoir. The estimated annual O&M cost is $400-600 per AF.

Riverpark-Saticoy Recycled Water Project -Note: Not included in the recommendation as this project is not likely to move forward

Artificial recharge using City of Oxnard's recycled AWPF water in UWCD's Saticoy basins. Potential gains to sustainable yield already captured in GSPs as part of AWPF.

Potential new water creation: 5,000 + AF/Yr.

Project cost estimate: $6.4 million in capital costs (~$30 AFY produce) and $5-7.5 million in annual costs ($1,000 – 1,500 AF/ yr produce).

Project status: Delivery of recycled water from the AWPF to United's spreading grounds for groundwater recharge does not seem to be a viable project due to the fact that Oxnard is planning to use the water for the City's ASR project.

Fallowing

The GSPs included a project to pay farmers to fallow land on a temporary basis. Farmers would stop groundwater pumping; that water demand would be retired during the contractual period. The GSP assumed fallowing was strategically applied in particular areas. This was targeted to reduce pumping from the Lower Aquifer System.

Fallowing in the GSPs yielded these results in reduced pumping annually:

- 2200 AFY in Pleasant Valley
- 500 AFY in Oxnard

Recommendations for Near-Term to Middle-Term Projects

Blow Off for Flushing SWP Interconnect Pipeline

The City of Ventura's planned SWP Interconnect Pipeline project will include a blow off within United's spreading grounds for discharging of flushed water generated as a result of operations and maintenance of the pipeline. Flushed water can be recharged at the Saticoy Spreading Grounds. The SWP Interconnection project also includes two turn outs that may provide opportunities for delivery of modest quantities of water from Calleguas MWD (and wheeled through the SWP Interconnect Pipeline) or the City of Ventura, if available and under certain circumstances. The additional water may serve as supplement M&I supply for customers served by United within Metropolitan-annexed areas.

Potential increase in water supply: approximately 500 AFY of flushed water (long-term average). Project cost estimate: $5 million.

Project status: United is coordinating with the City of Ventura and designing the extension pipeline for the two turnouts in the vicinity of Vineyard and Rose Avenues.

Challenges: Purchasing water from Calleguas MWD will be subject to the agencies' joint agreements and specific terms and conditions.

Freeman Expansion

Increase capacity of UWCD's existing diversion and groundwater recharge system, benefitting the basins of the Oxnard coastal plain by expanding and extending water conveyance and recharge capacity, taking advantage of the reclaimed Rose and Ferro aggregate mining pits.

Potential increase in sustainable yield: 6,000 to 9,000 AFY (long-term average).

Project cost estimate: $50 million spread over two phases of project development.

Project status: United plans to expand the Freeman Diversion in two phases, with Phase 1 completed in 2028 and Phase 2 completed in 2036. Yields and costs are contingent on some factors outside of United's control, such as permitting and fish passage.

Challenges: Permitting & weather dependent

State Water Project (SWP) - Imported Article 21 and other Table A Water Purchase/Exchange/Transfer

Likely gains to sustainable yield: 6,000 AFY. Assumes average cost of $400 per AF for water, $50 per AF incremental cost for planning, permitting, and O&M efforts.

Challenges: Weather dependent and competition for finite amounts of SWP water.

Recommendation for Longer Term Solution: Seawater Intrusion Barrier / Optimization-Hybrid Scenario

A seawater intrusion (SWI) barrier and full-scale optimization are by far the two highest potential opportunities to increase the sustainable yield / create additional water supply in OPV. A SWI barrier has the potential to yield greater gains to the basin than full-scale optimization in a one-for-one comparison. However, a SWI barrier approach would also likely be more expensive and have more permitting hurdles. Given these trade-offs, for the next stages of modeling the Projects Committee recommends prioritizing a hybrid approach between these two options. United would be able to model other scenarios later if that proves to be of interest.

United is planning to prepare model input in January 2021 and may request information from stakeholders during this period. Subject to availability of modeling staff, United hopes to run the "hybrid scenario" in February. The model may take multiple iterations to determine the optimal positioning of extraction wells, pumping rates, and reduced pumping at existing wells to achieve the sustainability goals. If the planned schedule is achievable, initial sharing out of preliminary results with the Projects Committee would occur in February or March. Modeling of other scenarios, including an updated "baseline" scenario for comparison, a seawater-intrusion-barrier-focused scenario, and a scenario that relies solely on optimization (shifts in existing pumping locations and depths) would occur later in spring of 2021.

Seawater Intrusion Barrier Concept

Seawater Intrusion Extraction Barrier & Treatment, Southern Oxnard Plain

Desalt brackish Upper Aquifer System water in areas south of Hueneme Road

Potential net gains to sustainable yield: 10,000-20,000 AFY, with an additional 2,000-4,000 AFY of net new water supply (total max net benefit of 12,000-24,000 AFY, combining both net "product water" and gain in sustainable yield).

Project cost estimate: $300 million spread over two phases (10,000 AF/yr each) of project development. Estimated total cost per acre foot is about $1,500 / AF, when improved sustainable yield is included as a benefit to the project. Modeling is in progress, so there is still uncertainty regarding whether the second phase would be necessary or achievable.

Other notes: A seawater intrusion barrier project would make most of the possible inland and northward optimization measures redundant. An important aspect of a SWI barrier (compared to counting solely on optimization) is that optimization is going to do better during wet years than in drought years, while a barrier should work well virtually all the time. Additionally, a SWI barrier provides additional control because barrier wells can be

strategically placed in select locations. At this time, United suspects that combining an extraction barrier with a modest optimization scenario will likely result in the best cost-benefit ratio for enhancing sustainable yield of the basin while providing good hydraulic control of seawater intrusion. However, significant modeling and design will be required in 2021 to firm up estimates of costs and benefits.

Challenges: First of its kind in the world, permitting, brine disposal, TDS similar to ocean water, relatively high cost

Seawater Intrusion Injection Barrier, Southern Oxnard Plain (Alternative SWI Model Under Consideration)

Creation of a seawater intrusion barrier via injection wells

This approach to the seawater intrusion barrier could theoretically have the potential to create similar gains in sustainable yield as the extraction barrier (10,000-20,000 AFY). However, it does not create additional new "product" water. In fact, it is unclear where the water to be used for injection would come from. There are no current cost estimates for this project, however the costs could be less than an extraction barrier because treatment of brackish water would not be included. However, injection barriers are a proven technology and have been in operation in Southern California for decades and therefore may represent lower permitting and environmental risks than the extraction barrier concept.

This project concept will require a water source which has yet to be identified, though the amount of water necessary for the injection could be significantly less than the optimization that the injection barrier yields. Orange County Water District claims they are able to recoup 95% of the injected water into the aquifer, so net water needed for injection may be less than what might otherwise have been assumed—on the order of 500 to 1,000 AFY.

Challenges: Uncertain injection water source, questions about the ultimate fate of existing seawater that has already intruded into the aquifer north of the ideal locations for an injection barrier (such water could potentially get "pushed" farther inland by an injection barrier located close to the heads of the Mugu and Hueneme submarine canyons).

Optimization Implementation

Summary of United's Analysis of Optimization Measures that could factor into Planning

United's proposed optimization scenarios are generally focused on shifting pumping away from the coast and up from the Lower Aquifer System (LAS) to the Upper Aquifer System (UAS), consistent with the GSPs. Estimates for yield and cost should be considered conceptual until United can model the optimization scenarios in detail:

- *Optimization Measure 1:* Stop pumping in the seawater intrusion area – increased yield: 2-4,000 AFY at $500 per AF
- *Optimization Measure 2:* Shift United's PTP wells from LAS to UAS –increased yield: 1,000 AFY at cost of $500 AF
- *Optimization Measure 3:* Shift most remaining LAS pumping into UAS in northern areas— increased yield: 12,000 AFY at cost of $500 AF

Projects Discussed but Not Included in the Proposal

Due to insufficient information, lack of feasibility, or low expected return on investment

Projects with Higher Near-term Potential for Additional Consideration

Conejo Creek Storage Expansion

Develop a storage facility to hold increased diversions from Conejo Creek for delivery to agriculture customers in the OPV area. The project could yield approximately 2,500 AFY in additional surface water supplies. Initial cost estimates vary widely depending on the eventual capacity (500-2,500 AFY), dimensions, location, and characteristics of the pond. Camrosa Water District, City of Camarillo, Pleasant Valley County Water District, and United Water Conservation District are beginning discussions about the scope of an initial study to further develop the concept and narrow the range of costs.

M&I Water Market

Conceptually, the development of an M&I Water Market is to allow flexibility within the M&I water user community that is presently available to the agricultural water user community. M&I groundwater producers in the FCGMA typically have a portfolio of sources that they conjunctively manage during wet and dry climatic periods. The ability to transfer groundwater within a market with set rules would allow greater flexibility for the M&I water suppliers. Ideas to benefit groundwater uses have been discussed and include use of an M&I water market that could allow users to sell a portion of their groundwater allocation in a given year making groundwater available to other users, including small mutual water companies. This concept would be open to the FCGMA purchase of groundwater from the market that could be left in the ground. An acre-foot left in the ground is equal to an acre-foot of water supply developed. Leveraging an M&I water market this way would be comparable to the "Ag land fallowing" concept that would leave water in the ground as opposed to creating a new supply.

Additional Opportunities with Oxnard Recycled Water Project Expansion

If Oxnard has availability of recycled water, then the Oxnard recycled water can be considered for regional benefit. The Oxnard Water Resource Plan will determine the availability of recycled water for regional benefit.

Projects Set Aside for Now

Storm Water Capture as source for AWPF

Developing new water by feeding Oxnard's stormwater to the AWPF system

Storm water sources are from Tsumas Creek and Ormond lagoon waterway.
Benefits of this project could include: 1) The source of water would be year-round and 2) The project does not require a lot of infrastructure. Challenges that would need to be addressed: 1) Siphoning water from the local wetlands may yield project opposition; 2) Elevated boron concentrate in the Ormond Lagoon Waterway; 3) May provide recharge water to the semi-perched aquifer on route to the Pacific Ocean which in turn may provide a water supply for groundwater dependent ecosystems (GDEs).

There are no current estimates of costs and potential supply for this project. The original GSP submittal included a preliminary estimate of a 1,000 – 2,000 AFY increase in sustainable yield.

Leveraging Hueneme Canyon Extraction Wells to feed AWPF [Unlikely to advance]

This water source has high total dissolved concentrations that exceed AWPF design criteria.

Leveraging the Semi-Perched Aquifer to feed AWPF [Unlikely to advance]

Due to the relatively low transmissivity of the semi-perched aquifer, it would be difficult to extract sufficient groundwater near the AWPF to provide source water. In addition, pumping from the semi-perched aquifer to feed the AWPF may cause environmental concerns (i.e., affect groundwater supply to coastal wetlands).

Using Ventura Wastewater to feed AWPF [Unlikely to advance]

The City of Ventura is pursuing VenturaWaterPure Program and will rely on its wastewater so a joint project with Oxnard's AWPF would not be possible.

Recycled Water Tile Project

Recycling tile drain water in Pleasant Valley to generate a new water source.

Bottom line – this project is perhaps a low return on investment.
Benefits to the basin are likely limited to about 190 AFY at a cost of ~ $2 million in treatment technology, $300,000 - $500,000 in operating cost and the additional cost of pipeline builds.

Three water supply level scenarios were analyzed by the Pleasant Valley County Water District. Two of the scenarios would have yielded greater than 190 AFY (potentially up to 800 AFY) but they proved unfeasible due to insufficient water supply to blend with the tile water and reduce chloride levels. Environmental impacts could also undermine this project's viability.

Challenges: High cost & low yield

Santa Paula Basin Purchases

Purchase water from the Santa Paula basin for delivery to OPV.

Bottom line- unlikely to see progress on this project as a real option until the Santa Paula Basin Technical Advisory Committee completes its yield-enhancement evaluations in 2022. Santa Paula basin's groundwater pumping is adjudicated, and extractions are approximately equal to the estimated safe (not "sustainable") yield of 25,500 AFY. Additionally, the Santa Paula Basin Judgment prohibits additional exports. Fillmore basin, under the right set of agreements, might be able to send water downstream but there are concerns that would need to be considered. If the ASAP pipeline progresses it would create additional opportunity to take advantage of these flows.

Imported Water

Purchase imported water from MET through Calleguas MWD.

Potential opportunities would require reciprocal benefits to work and be consistent with existing policies restricting the benefit of imported water from Calleguas to the areas within its service area. Calleguas' connection to MET could provide wheeling options for State Water Project water that is available through the Ventura County Watershed Protection District's contractor and its sub-allocations to United WCD, Casitas MWD, and the City of Ventura.

Challenges: Annexation, and MET water is not for agricultural application

Additional Fallowing on top of Level Described in GSPs

If fallowing is to be proposed, the committee would need to consider the following:

- How to modify demand assumptions to incorporate fallowed lands
- How to calculate the pricing of fallowing (Some estimates put cost around $1,600 /AF)
- How fallowing intersects with the water market
- Anticipating grower interest or willingness to fallow land
- Likely will require maintenance of a cover crop
- Requirements for California Environmental Quality Act (CEQA) evaluation, including the socioeconomic impact on community and County (e.g., decrease in workers employed and higher cost of food).

Appendix

Fox Canyon OPV Facilitated Process Projects Committee Evaluation Checklist

Background Information

- **Project Name Description Purpose of Project:** Water supply, infrastructure, water quality, etc.
- **Project Status:**
- **Estimated Time to Project Completion:**
- **Implementation Trigger** (if applicable)
- **Groundwater Basin:**
- **Location:**
- **Basins Benefiting:**
- **Sponsoring Agency:**

Evaluation Criteria

Sustainable Yield

Annual increase in Sustainable Yield (AF/year)
Sustainability indicators addressed (subcomponent of increase in SY) Project has benefit in impacted area of basin
Does project add additional water supply? How does water generation compare to other projects (high/med/low)?

Water-supply Resilience

Strengthen resiliency and operational flexibility of existing and future infrastructure **(**per DWR's California Water Plan Update 2018).

Technical

Construction feasibility
Appropriateness of location
Ability to accomplish purpose
Life expectancy of project (for 50-year sustainable management modeling) Level of uncertainty

Environmental

CEQA/NEPA type and status (timing)
Will project likely be permitted? / Consistent with environmental regs
Sensitivity of location
Multi-benefits?

Political

Consistent with adopted jurisdictional plans
Consistent with planning agency regulations Stakeholder support

Permitting

Permits required
Status / time required
Likelihood of project being permitted

Construction

Time-table to implement

Operation and Maintenance

Description

Funding

Total capital cost
Capital cost per AF/year produced
Annual cost
Annual O&M cost per AF
Funding source(s) - credible funding source Likelihood of project being funded
Likelihood to be grant funded / state funded
Timeline to secure funding