MODEL DOCUMENTATION REPORT UWCD OXNARD PLAIN SURFACE WATER DISTRIBUTION MODEL

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WATER RESOURCES DEPARTMENT
UNITED WATER CONSERVATION DISTRICT

THIS REPORT IS PRELIMINARY AND SUBJECT TO MODIFICATION BASED UPON FUTURE ANALYSIS AND EVALUATIONS

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2. INTRODUCTION

Water supply for agricultural irrigation and municipal, domestic and industrial uses on the Oxnard Plain (Oxnard subbasin and Pleasant Valley basin) comes from a combination of sources. Most of the demand is met by groundwater extractions by public agency and private wells, but surface water diversions, State Water imports, and recycled water also play an important role. United Water Conservation District (United) uses water diverted from the Santa Clara River at the Freeman Diversion for artificial groundwater recharge and for surface water deliveries to agriculture via its Pumping Trough Pipeline (PTP) and as wholesale deliveries to the Pleasant Valley Pipeline (PVP) system. Camrosa Water District (Camrosa WD) also provides water diverted from Conejo Creek to the PVP. The PTP and PVP systems are key water infrastructure components for conjunctive use on the Oxnard Plain.

The Oxnard and Pleasant Valley groundwater basins are defined by the California Department of Water Resources (DWR) as high-priority basins that are critically overdrafted, and new water supply projects and water supply optimization are being evaluated to avoid potential future pumping reductions, as demonstrated in the 2020 Groundwater Sustainability Plans for both basins (FCGMA, 2019a, 2019b). Potential new water supply and optimization projects rely on existing water supply infrastructure on the Oxnard Plain to the extent practical, and may affect or require changes in how facilities are operated.

The Oxnard Plain Surface Water Distribution Model (SWDM) is designed to model operations of United's recharge facilities and deliveries to the PTP and PVP systems, and calculate pumping demands for the Oxnard and Pleasant Valley basins. The model runs in daily timesteps to account for the highly variable diversions (due to variable river flows and bypass flow operations) and to reflect the daily variability in artificial recharge operations and irrigation demands. Some processes and calculations that are included in the model are dependent on groundwater elevations, and therefore iterative runs are often performed where groundwater elevation outputs from the Regional Groundwater Flow Model are input to the SWDM until groundwater elevations converge. The model includes existing recharge and surface water delivery infrastructure and the option to include several potential new water supply and optimization projects that are currently being assessed by United. The model setup is flexible so that different project alternatives can be analyzed, and additional projects can be added or the scale of the projects modified in the future.

3. MODEL SUMMARY

The SWDM is a water balance model that calculates the amounts of artificial recharge at United's facilities and surface water deliveries to the PTP and the PVP delivery systems. The model is constructed and operated in Microsoft Excel. The SWDM runs in daily timesteps, and is currently set up to run a 90-year period, based on historic hydrology from 1930 to 2019. The SWDM essentially matches supply from various sources with capacity for artificial recharge and user-demands for surface water, considering limitations in pipeline conveyance and operational constraints. The model does not include hydraulic modeling (e.g., heads or flow rates within conveyance infrastructure).

A schematic of the model is provided in Figure 1, and model inputs are summarized in Table 1. In Figure 1, existing infrastructure and projects are indicated in blue boxes, proposed projects and infrastructure in green boxes. A detailed description of the model components, projects and calculations is provided in the next section. The model workflow is as follows:

- Daily flows in the Santa Clara River (SCR) at the Freeman Diversion are calculated by a combination of hydrological and operations (for Lake Piru and Castaic Lake) models (UWCD, 2021a).
- Daily diversions and river flows downstream of the Freeman Diversion are calculated based on SCR flows by the Hydrological Operations Simulations System (HOSS, R2 Resource Consultants, 2016).
- The SWDM calculates, on a daily basis, how much of the diverted water is applied to recharge and how much goes to surface water deliveries to the PTP and PVP systems.
- Calculations for recharge are performed separately for the El Rio, Saticoy, Noble, Rose and Ferro recharge basins. Calculations consider the conveyance capacity to each recharge basin, available storage in each basin and the recharge capacity of each recharge basin (including recharge limitations during high groundwater conditions). When available diversions calculated by the HOSS exceed the simulated capacity for storage, recharge and surface water deliveries, the excess water is rejected and allowed to continue past the Freeman Diversion as bypass flows. When recharge to Ferro basin is applied in the SWDM (for modeling future scenarios, currently there is no conveyance to Ferro basin) a portion of the water recharged to Ferro basin is assumed to discharge back to the adjacent reach of the SCR when groundwater elevations are high (this phenomenon has been observed historically during particularly wet periods).
- Calculations of surface water deliveries are based on demand for surface water in the PTP and PVP systems, available water from the Freeman Diversion and pipeline conveyance capacities (no surface water deliveries are made to the coastal area because no pipelines currently exist connecting the PTP and PVP systems to coastal farmland, Figure 2).
- The SWDM includes prioritization rules to calculate how much of the diverted SCR water is delivered to each of the recharge basins and to surface water deliveries for the PTP and PVP. The prioritization rules vary depending on water year type, groundwater conditions, season and suspended sediment concentrations (associated with high flows in the SCR).
- Water supplies from Camrosa WD are the first supply used to meet PVP system demands (higher priority than surface water deliveries to the PVP from United).
- Groundwater extractions from United's existing Saticoy well field are used to reduce mounding in the Oxnard Forebay and provide additional pipeline deliveries to the PTP and PVP systems when a demand exists (after Camrosa WD deliveries to the PVP and surface water deliveries via the PTP and PVP).
- Groundwater extractions from assumed expansion of the Saticoy well field are used to supply PTP and PVP when demand exists that cannot be met by SCR surface water

deliveries and Camrosa WD supplies. The existing Saticoy wells are not in operation if the Saticoy wells expansion project is active.

- The SWP interconnect pipeline provides additional recharge to El Rio and Rose basins if water is available.
- Recycled water from the City of Oxnard's Advanced Water Purification Facility (AWPF) can be used to supply pipeline deliveries for agricultural use to the coastal area and/or the PVP and PTP systems.
- Treated brackish water from the proposed Coastal Brackish Groundwater Extraction and Treatment Project (CBG-WET) can be used to supply pipeline deliveries to the coastal area, the PVP and PTP systems, and/or deliver water to United's recharge basins.
- The model includes the option to simulate temporary storage of AWPF and CBG-WET water for periods with low pipeline demands (during rain events).
- Total pumping in several subdivisions of the Oxnard subbasin (PTP area, coastal area, Oxnard subbasin excluding PTP/coastal) and Pleasant Valley basin (PVP area, Pleasant Valley excluding PVP area) are calculated as total demand in those subdivisions minus the sum of pipeline deliveries. Calculated pumping rates from in the SWDM is input to the Regional Groundwater Flow Model (UWCD, 2018) to simulate specific impacts to groundwater levels and saline intrusion.
- SWDM-calculated river flows downstream of the Freeman Diversion are input to the Regional Groundwater Flow Model for downstream flow routing.
- Recharge volumes and pipeline deliveries are input to a pre-processing script, together with rainfall and other data, to calculate recharge from natural precipitation and return flows required as input to the Regional Groundwater Flow model.

Table 1. Oxnard Plain Surface Water Distribution Model Inputs.

SWDM Inputs	Description
1. Flow inputs (cfs)	
Diversions at Freeman	Diversion rate at United's Freeman Diversion Facility
Camrosa (Conejo Cr.)	Camrosa WD's Conejo Creek diversions delivered to PVP
Saticoy wells	Deliveries from United's existing Saticoy well field to PTP and PVP. Existing wells are shallow and are not operable when nearby groundwater elevations decrease below 41 feet above mean sea level (ft msl).
Saticoy wells expansion	Deliveries from United's proposed Saticoy well field expansion to PTP and PVP. This proposed well field is located in the vicinity of the existing Saticoy wells, and is designed to pump water at depths up to 700 feet below ground surface (ft bgs).
AWPF	Recycled water from the City of Oxnard's Advanced Water Purification Facility.
CBG-WET	Product water from United's proposed Coastal Brackish Groundwater Extraction and Treatment Project at Naval Base Ventura County Point Mugu.
SWP interconnect pipeline	Water available for recharge from the City of Ventura's State Water Project interconnection pipeline (flushing and supplemental water imports).
2. Other parameters	
WLE 02N22W12R01S	Groundwater elevation to determine available storage in Oxnard Forebay.
WLE 02N22W12E01S	Groundwater elevation to determine available storage in Oxnard Forebay.
WLE 02N22W12E04S	Groundwater elevation to determine mounding in vicinity of Saticoy Recharge Facility
3. Water demands (acre-feet per year)	
Oxnard subbasin	Total demand in Oxnard subbasin (pumping and surface water)
Pleasant Valley basin	Total demand in Pleasant Valley basin (pumping and surface water)
PTP area	Total water demand for the area in the vicinity of PTP system (pumping and surface water).
PTP surface water	Surface water demand for PTP system
PV area	Total water demand for the area in the vicinity of PVP system (pumping and surface water)
PVP surface water	Surface water demand for PVP system
Coastal area	Total water demand for coastal area
WLP	Total water demand for West Las Posas basin

4. MODEL CALCULATIONS

4.1 FREEMAN DIVERSIONS

The HOSS model calculates daily diversions based on inputs for streamflow in the SCR and bypass flow requirements for upstream and downstream migration of southern California steelhead (R2 Resource Consultants, 2016). The HOSS can model different bypass flow scenarios, e.g., current operations based on the more restrictive conditions in the National Marine Fisheries Service Biological Opinion (NMFS, 2008), or bypass flow operations proposed by United in its Multiple Species Habitat Conservation Plan for operations of the Freeman Diversion (UWCD, 2020).

Inputs for streamflow in the SCR at the Freeman diversion can be based on historic observations or can be calculated for various scenarios using United's Upper Basins Surface Water Model (UWCD, 2021a) or the recently expanded Regional Groundwater Flow Model (UWCD, 2021b). Future climate change scenarios can be simulated by modifying tributary discharges, e.g., by using DWR streamflow change factors (DWR, 2018), which is then reflected in simulated SCR streamflow inputs at the Freeman Diversion.

In the SWDM, diversion rates imported from the HOSS were reduced by 10% for days when bypass flows were provided, in order to account for inefficiencies in diversion operations due to flushing, maintenance and other reasons. Generally, this reduces annual diversions by 3-4%. The SWDM simulates maximum recharge capacity and available storage in each of United's recharge basins. During the wettest years there are brief periods when diversions from the HOSS are rejected in the SWDM due to limited recharge and storage capacity. In these cases, rejected potential diversions are added to bypass flows calculated in the HOSS.

4.2 WATER ROUTING PRIORITIZATION

Water routing prioritization defines the order in which recharge basins and surface water delivery systems receive water diverted at the Freeman Diversion. A priority assignment of 1 is the highest priority. Facilities assigned a priority of 3 or greater often receive no water, as all available surface water has been used by facilities with higher priority. Prioritization rules for water routing are summarized in Table 2, and depend on the following factors:

Water year hydrology: years are classified as dry, normal, wet, based on streamflow magnitude (R2 Resource Consultants, 2016).

Season: summer is defined as beginning on July 1st and continuing to the first significant storm event of the fall or winter (equal to first turn-out of the season); winter is the remaining period. During summer for dry and normal water years, the highest priorities for surface water routing are

El Rio, PTP and PVP (percentages to each facility are detailed in Table 2). During the winter season (all water year types) and summers for wet years, the highest priority is surface water deliveries (equally divided between PTP and PVP), followed by recharge at El Rio and then other recharge basins.

Forebay available storage: the estimated volume of additional groundwater that could be stored in the Forebay is calculated based on groundwater elevations in two key wells. Conditions with available storage >70,000 acre-feet (AF) indicate dry conditions, with increased priority for recharge in El Rio.

Suspended sediment concentrations: when sediment levels in the river exceed 3,000 mg/l, diversions are routed first to the Ferro basin (when used), then to the Noble and Rose recharge basins, to avoid clogging of the surface layer in the Saticoy and El Rio recharge basins. Sediment levels in the river are estimated based on a historical empirical correlation between average daily streamflow and sediment concentration.

Table 2. Prioritization order for surface water routing to recharge basins and PTP/PV systems. When facilities are assigned identical priorities, the percentages of supply received for each facility are included in parentheses.

Facility	Summer (dry)	Summer (normal-wet), winter	Forebay storage > 70,000 AF	Sediment > 3,000 mg/l
El Rio basin	1 (50%)	2	1	5
PTP system	1 (25%)	1 (50%)	2 (50%)	6 (50%)
PV system	1 (25%)	1 (50%)	2 (50%)	6 (50%)
Saticoy basin	2	3	3	4
Noble basin	3	4	4	2
Rose basin	4	5	5	3
Ferro basin	5	6	6	1

4.3 GROUNDWATER MANAGEMENT AREAS AND WATER DEMANDS

Three **groundwater management areas** are defined in the SWDM for modeling pipeline deliveries on the Oxnard Plain: the PTP area, PVP area and coastal area (Figure 2). These areas delineate the service areas for pipeline deliveries from expanded PTP and PVP systems and assumed new distribution pipelines in the coastal area. The SWDM models deliveries to these areas separately and assumes pipeline deliveries are made when the water is available, until demands in these areas are met. Pipeline deliveries to these areas may consist of surface water and/or water from other sources (e.g., brackish water, recycled water). Figure 2 also indicates an alternative expanded delineation for the coastal area (“Coastal Area Exp” was added to the initial delineation) that was used in some scenarios (the PVP area was reduced in area accordingly). Different area delineations may be analyzed in future model runs.

The PTP and PVP areas includes all land in the vicinity of the PTP and PVP systems, respectively. Pipeline deliveries to these areas will require expansion of the current PTP and PVP systems, such as construction of “infill” pipelines to convey water to isolated areas that currently don’t have direct access to pipeline deliveries. The purpose of simulating expansions of the PTP and PVP systems is to analyze the benefits of increased pipeline deliveries and reduced pumping in these areas. The SWDM has the option to run the following scenarios:

- Pipeline deliveries to meet current demand for surface water in the current service areas (no pipeline expansion required).
- Pipeline deliveries to meet all water demand within the PTP and/or PVP areas. The model can accept different pipeline expansion coverages (0-100%). The coverage indicates what percentage of water demand in the PTP and/or PVP area the expanded pipeline can theoretically meet (when water is available). Initial model runs assumed that optimal pipeline expansion can achieve 90% of the PTP and PVP area demands.

The coastal area includes all irrigated lands between the coastline and Highway 1 in the southern portion of the Oxnard subbasin. Water deliveries to this area would require construction of new pipelines (potentially with use of portions of the existing Ocean View and Oxnard-Hueneme pipelines). The purpose of simulating pipeline deliveries to the coastal area is to analyze the benefits of new pipeline deliveries and reduced pumping in this area where seawater intrusion is a known problem. The SWDM is currently set up to deliver recycled water and/or brackish water to the coastal area. Coverage of pipeline deliveries can be adjusted from 0-100%, to assess different pipeline buildout scenarios (initial model runs assume 90%).

Current demand for surface water deliveries to the PTP and PVP systems were estimated using historical data, reflecting seasonal changes, including increased October demands due to strawberry transplanting and the occurrence of Santa Ana winds (Table 3). Historical observations were used to model reduced demands during and shortly after rainfall events (linear increase of demand from 0 to 100% during the first seven days after a rain event exceeding 0.05 inches per day) and on Sundays (60% demand reduction, excluding October). Demands for surface water deliveries are only used in scenarios that assume no expansion of the PTP and PV systems. In scenarios that assume expansion of the PTP and PV systems, total pipeline demands are used instead (see below).

Total pipeline demands for period 1 (January to June) and period 2 (July to December) for the PTP, PV and coastal areas were calculated as the average of historical pumping for the years 2015-2017, which are years when no surface water deliveries were made. For the PV area, historic deliveries of Conejo Creek diversions by Camrosa WD were also included with the total demands (1,300 acre-feet per period). Total demands for two scenarios analyzed to date are summarized in Table 4. Note that these demands may change if area boundaries are adjusted in future model runs. Daily demands for these areas are calculated from Period 1 (January 1 through June 30 of each year) and Period 2 (July 1 through December 31) demands by calculating scaling factors (converting Period 1 and 2 totals to daily) that were applied for the PTP and PVP systems surface water deliveries, then applying the scaling factors for PTP deliveries to the PTP and coastal areas, and the scaling factors for PVP deliveries to the PVP area. The scaling factors account for the combined effect of monthly demand variability, rainfall and Sunday irrigation demand variability.

Groundwater pumping in the PTP, PVP and coastal areas was calculated as the difference between pipeline deliveries and total demands within each area. Pumping reductions can be implemented by reducing the area demands (e.g., a reduction by 35% in the Oxnard subbasin and 20% in Pleasant Valley basin during the first 20-year period to simulate decreases in pumping considered in the Groundwater Sustainability Plans (GSPs) for the Oxnard subbasin and Pleasant Valley Basin, FCGMA, 2019a, 2019b).

Table 3. Maximum demand for surface water deliveries (daily average cfs) without reduced demands associated with rainfall events or Sunday irrigation.

Month	Total	PVP	PTP
1	42	28	14
2	42	28	14
3	42	28	14
4	49	34	15
5	49	34	15
6	44	30.5	13.5
7	39	30.5	8.5
8	44	30	14
9	46	32	14
10	69	46	23
11	45	31	14
12	44	30	14

Table 4. Period 1 and Period 2 total demand in the PTP, PV and coastal groundwater management areas (AF). Alternative 1 shows initial model assumptions, alternative 2 shows model assumptions with optimization to reduce seawater intrusion in PV LAS.

<table>
<tr><th>Area</th><th>Period</th><th>Alternative 1</th><th>Alternative 2</th></tr>
<tr><td rowspan="2">PTP</td><td>1</td><td>7,769</td><td>8,631</td></tr>
<tr><td>2</td><td>9,382</td><td>10,234</td></tr>
<tr><td rowspan="2">PV</td><td>1</td><td>10,038</td><td>9,041</td></tr>
<tr><td>2</td><td>15,311</td><td>13,806</td></tr>
<tr><td rowspan="2">Coastal</td><td>1</td><td>2,633</td><td>3,630</td></tr>
<tr><td>2</td><td>4,102</td><td>5,608</td></tr>
<tr><td>Oxnard Total</td><td>n/a</td><td colspan="2">67,047</td></tr>
<tr><td>PV total</td><td>n/a</td><td colspan="2">26,682</td></tr>
<tr><td>WLP total</td><td>n/a</td><td colspan="2">14,565</td></tr>
</table>

4.4 RECHARGE

4.4.1 SIMULATION OF ARTIFICIAL RECHARGE

Water diverted at the Freeman Diversion is applied to United's artificial recharge facilities based on the priority order shown in Table 2. Deliveries of available water to each of the recharge facilities is limited by conveyance capacity, storage capacity and recharge rate (Table 5). The amount of water stored in each recharge basin is calculated daily as the carryover storage from the previous day plus the amount delivered, minus the recharge rate. When a recharge basin is full, water deliveries are limited to the daily recharge rate.

The maximum recharge rates shown in Table 5 apply when groundwater elevations at well 02N22W12R01S are less than 95 ft amsl. When groundwater elevations at well 02N22W12R01S exceed 95 ft amsl, recharge is also limited to the Forebay maximum recharge rate (sum of individual recharge basins' rates). The Forebay maximum recharge rate is 397 cfs (excluding Ferro basin) or 548 cfs (including Ferro basin) when groundwater elevations at well 02N22W12R01S are less than 95 ft amsl. At higher groundwater elevations, Forebay maximum recharge rates were gradually reduced according to the relationship shown in Figure 3. For example, at a groundwater elevation of 120 ft in well 02N22W12R01S, artificial recharge to the Oxnard Forebay is limited to 191 cfs (without Ferro basin) and 263 cfs (with Ferro basin). The individual basins' maximum recharge rates still apply, but once the Forebay maximum recharge is met, no additional artificial recharge can occur. The maximum artificial recharge rates and reduced infiltration rates at higher groundwater elevations are based on field observations.

4.4.2 FREEMAN EXPANSION PROJECT

The Freeman Expansion Project includes infrastructure improvements to allow higher diversion rates during storm events, when suspended sediment concentrations in the SCR are high. The necessary infrastructure improvements include a new diversion intake with new fish screens, removal of conveyance bottlenecks, improvements to the desilting basin and connection of the Ferro basin. Phase 1 of the project will include connection to the Ferro basin, with a maximum diversion rate of 375 cfs. This will allow more recharge during extended periods of high flows. Phase 2 of the project will increase the instantaneous diversion rate and conveyance capacity to Ferro basin to 750 cfs. Initial modeling assumes implementation of Freeman Expansion Phase 1 in 2028, and Phase 2 in 2036.

Table 5. Maximum conveyance capacity (cfs/day), storage volume (acre-feet) and maximum recharge rate (cfs/day) for the recharge basins used in the SWDM.

Recharge Basin	Conveyance Capacity	Storage Volume	Maximum Recharge Rate
El Rio	120	700	100
Saticoy	350	576	145
Noble	180/350[2]	1,763	100
Rose	80/160[2]	945	52
Ferro	0/375[1]/750[2]	2,057[3]	151

[1]With Freeman Expansion Project Phase 1
[2]With Freeman Expansion Project Phase 2
[3]Assumes 100% of Ferro basin is used for recharge

4.5 PIPELINE DELIVERIES (SURFACE WATER)

Water diverted at the Freeman Diversion is applied to surface water deliveries to the PTP and PVP systems based on the priority order in Table 2. Surface water deliveries only occur when there is a demand (see section 4.3). Surface water deliveries are also limited by conveyance capacity, which is 65 cfs for the PTP and PV systems (individually), and 75 cfs for the PTP and PV systems combined. Surface water deliveries to the El Rio recharge basins are limited to 120 cfs.

Demands in PVP system are first met by available Camrosa WD deliveries (4,500 AF/year is assumed, but other rates could be input), additional demands are met with surface water deliveries from the Freeman Diversion, and any remaining demands are met by United's Saticoy well field. Demands in the PTP system are first met by SCR surface water deliveries, and then by the Saticoy well field. Additional pipeline deliveries can be made to the PTP and PVP systems to meet demands, as discussed in section 4.6. Groundwater pumping in the PTP and PVP areas is used to meet demand when surface water supplies and additional pipeline deliveries are limited.

The Saticoy well field is used to pump down the groundwater mound that sometimes develops beneath the Saticoy recharge basins in wet years, and the pumped water is delivered to the PTP and PV systems. The SWDM assumes the Saticoy well field does not operate when deliveries to the El Rio recharge basins occur, or when diverted surface water alone can meet most of the irrigation demand in the PTP and PVP systems. The maximum production capacity $Q_{Sat,\,max}$ of the Saticoy well field is dependent upon groundwater elevation (WLE) at well 02N22W12R01S, as follows:

- $Q_{Sat,\,max} = 0$ (WLE < 41 ft)
- $Q_{Sat,\,max} = 24$ cfs (WLE > 90 ft)
- $Q_{Sat,\,max} = -0.006 \cdot WLE^2 + 1.198 \cdot WLE - 35.53$ (41 ft < WLE < 90 ft)

4.6 PIPELINE DELIVERIES (OTHER PROJECTS)

The SWDM is capable of simulating water deliveries by various proposed or potential projects and integrate these deliveries with the existing water infrastructure and operations. The model is flexible in that different project combinations can be analyzed, and important project design variables can be varied. All projects included here were recommended by the Oxnard and Pleasant Valley Basins (OPV) Core Stakeholder Group in 2020.

4.6.1 COASTAL BRACKISH GROUNDWATER EXTRACTION AND TREATMENT PLANT

United is currently designing a Coastal Brackish Groundwater Extraction and Treatment Project (CBG-WET or Coastal Brackish) located at Navy Base Ventura County (NBVC) - Point Mugu. The Coastal Brackish Project is being designed to create an extraction barrier to reverse the historical water-quality impacts of seawater intrusion, and by treating the produced water with reverse osmosis, to provide a reliable source of water for agricultural and potable use.

The following parameters for the Coastal Brackish Project are used in the SWDM:

- Annual extractions: Model accepts any value. Initial modeling assumed 10,000 AF per year. The SWDM calculates daily extraction rates assuming constant pumping.
- Efficiency of brackish-water treatment: Model accepts any value. Currently the efficiency is estimated at 50%.
- Product water demand for NBVC: Model accepts any value. Initial modeling assumes 1,000 to 1,500 AF per year.
- Product water deliveries for agricultural use equal total product water minus deliveries to NBVC. The model can simulate product water deliveries to the coastal, PVP and PTP areas (with or without temporary storage during storm events), and also pipeline deliveries to United's recharge basins.
- Increased irrigation efficiency with use of product water from the Coastal Brackish Project: Model accepts any value. Initial modeling assumed a 15% reduction in irrigation water use due to a reduced need for leaching salts from the root zone. The increased irrigation efficiency is only applied in the coastal area, where mixing with surface water does not occur.
- Project implementation year: Model accepts any year. Initial modeling assumes project implementation in 2027.

4.6.2 OXNARD ADVANCED WATER PURIFICATION FACILITY

The City of Oxnard's Advanced Water Purification Facility (AWPF) is currently equipped to produce 6.25 MGD (~7,000 AF per year) of advanced treated recycled water (City of Oxnard, 2021) and has the potential to deliver significant volumes of water to agriculture. The OPV Core

Stakeholder group included delivery of a portion of AWPF water to agriculture as a potential project.

The following parameters for the AWPF recycled water to agriculture are used in the SWDM:

- Annual deliveries: Model accepts any value. Initial modeling assumes 4,600 AF per year, consistent with assumed agricultural deliveries described in the Oxnard and Pleasant Valley Basin GSPs (FCGMA, 2019a, 2019b).
- The model can simulate advanced treated recycled water deliveries to the coastal, PVP and PTP areas (with or without temporary storage during storm events).
- Increased irrigation efficiency with use of recycled water in the coastal area: Model accepts any value. Initial modeling assumed a 15% reduction in irrigation water use due to a reduced need for leaching salts from the root zone. The increased irrigation efficiency is only applied in the coastal area, where mixing with surface water does not occur.
- Project implementation year: Model accepts any year. Initial modeling assumed immediate project implementation (year 2020).

4.6.3 STATE WATER INTERCONNECTION PROJECT

The City of Ventura is currently constructing an approximately 7-mile pipeline between its water-supply conveyance infrastructure in eastern Ventura to the existing terminus of Calleguas MWD's pipeline in the City of Camarillo. The project will enable delivery of SWP water to the City of Ventura. The project includes two turnouts to United's Saticoy recharge facility, allowing delivery of pipeline flushing water and supplemental SWP water in the Rose and El Rio recharge basins. Model runs assume a total 500 AFY of new water with this project, delivered as 125 AF to El Rio and Rose basins each, once during November and once during June of each year. The model can accept different volumes. Initial modeling assumed project implementation in 2027.

4.6.4 SATICOY WELL FIELD EXPANSION

The Saticoy well field expansion project proposes constructing new wells in the Oxnard Forebay area with connections to United's Main Supply Pipeline along Rose Ave. and Pleasant Valley Pipeline along Central Ave., allowing delivery of additional pumped groundwater to the PTP and PVP systems (Figure 2). The project is part of United's proposed optimization strategy, with increased pumping in the Forebay to offset pumping on the Oxnard Plain and near the coast. The SWDM assumes pumping of the Saticoy well field occurs when there is a demand in the PTP or the PVP systems that is not met by surface water deliveries from the Freeman Diversion. The Saticoy well field expansion wells are less limited by groundwater elevations in the Forebay compared to the existing Saticoy wells, which are not operable when nearby groundwater elevations decrease below 41 ft amsl.

The following parameters for the Saticoy Well Field Expansion Project can be adjusted in the SWDM:

- Well field capacity: Model accepts any value. Initial modeling assumes 50 cfs capacity (ten ~2.5 MGD extraction wells).
- Maximum available storage for well field operation: Model accepts any value. Initial modeling assumes no pumping when available storage in the Forebay exceeds 80,000 AF, in order to avoid groundwater quality issues such as high nitrate.
- Priority of Saticoy well field deliveries to PTP and PVP: can be adjusted to make Saticoy well field deliveries to PTP and PVP higher or lower priority than brackish water and recycled water, increasing or decreasing Saticoy well field deliveries, respectively.
- Project implementation year: Model accepts any year. Initial modeling assumes project implementation in 2027.

4.6.5 INCENTIVIZED FALLOWING

The Fox Canyon Groundwater Management Agency (FCGMA, 2019a and 2019b) included in the Oxnard and Pleasant Valley basin GSPs the Temporary Agricultural Land Fallowing Project, which would use replenishment fees to pay for temporary fallowing of small areas of agricultural land, to reduce pumping. Incentivized fallowing is implemented in the SWDM by reducing the demand in the PTP and PV areas accordingly. Based on the OPV Core Stakeholder Group recommendations, modeled demands were reduced by 2,000 AF per year in the PVP area and 700 AF per year in the PTP area. The SWDM can accept any demand reduction volume. The SWDM assumes that the project is implemented immediately (2020).

4.7 ITERATIVE RUNS WITH REGIONAL GROUNDWATER FLOW MODEL

In the modeling workflow to simulate groundwater elevations and seawater intrusion on the Oxnard Plain, outputs from the SWDM are used as inputs for United's Regional Groundwater Flow Model. Some variables in the SWDM, e.g., maximum recharge rates or groundwater discharge to the SCR, depend on available storage in the Oxnard Forebay and groundwater mounding in the vicinity of the Saticoy Recharge Facility, which are determined based on groundwater levels from three wells in the Oxnard Forebay. Therefore, iterative runs are performed where groundwater level outputs from the groundwater model run are used to re-run the same scenario in the SWDM. The model runs are repeated until groundwater elevations in two wells in the Oxnard Forebay (02N22W12R01S and 02N22W12E04S) and fluxes between the Oxnard Forebay and Mound basin converge (i.e., daily water levels mostly within 5 ft and monthly fluxes within 20 AF between consecutive runs). Initial groundwater elevations for each new scenario run in the SWDM are based on historic observations or predicted groundwater elevations for previously run similar scenarios.

5. REFERENCES

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6. FIGURES

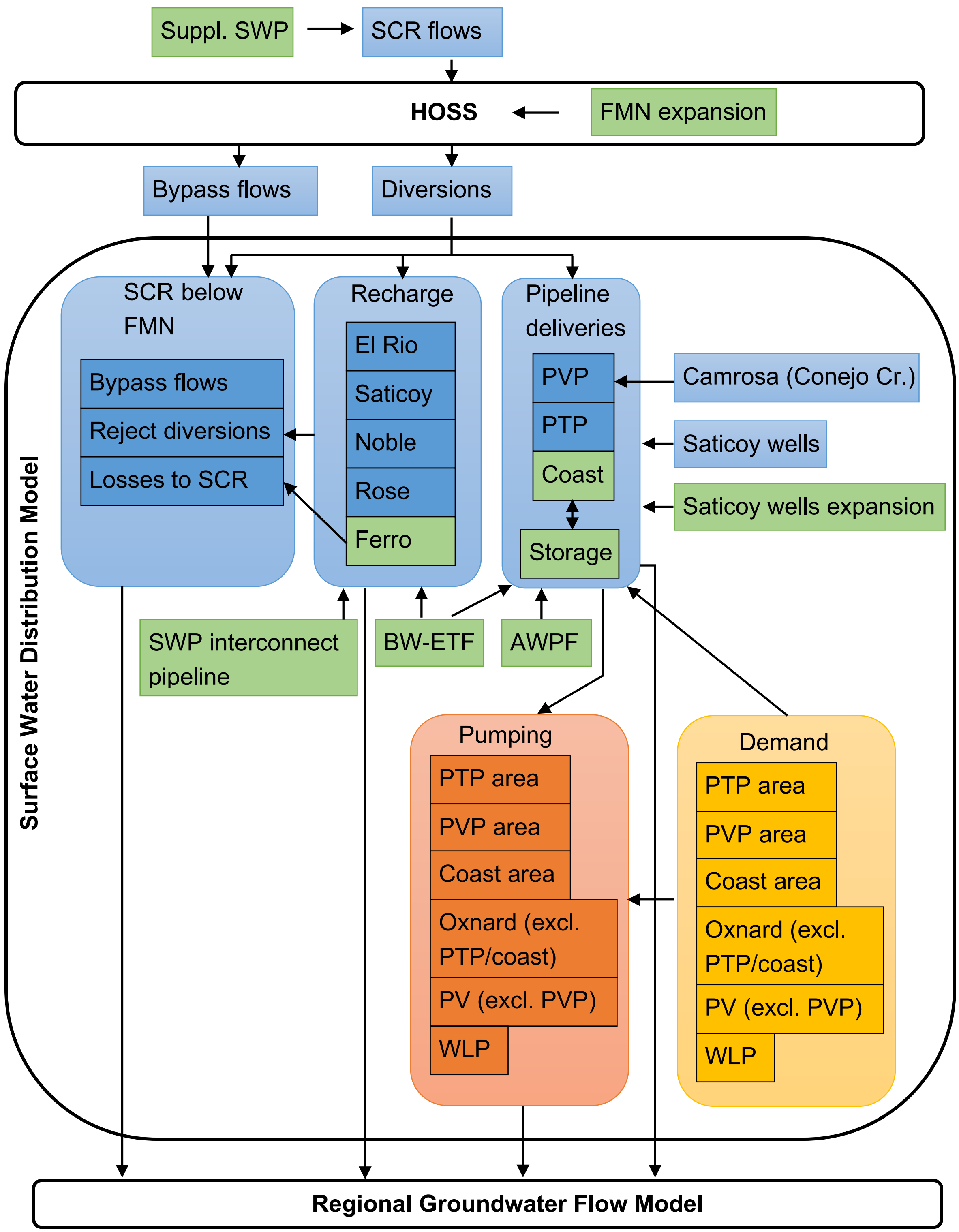

Figure 1. Schematic represenation of the Oxnard Plain Surface Water Distribution Model, including inputs and outputs from other models used in the workflow. Arrows indicate how daily flow information gets transferred between models and within the SWDM. Existing projects and facilities are shown in blue boxes, projects being evaluated/proposed are shown in green boxes. Information associated with water demand and pumping is shown in yellow and orange boxes, respectively.

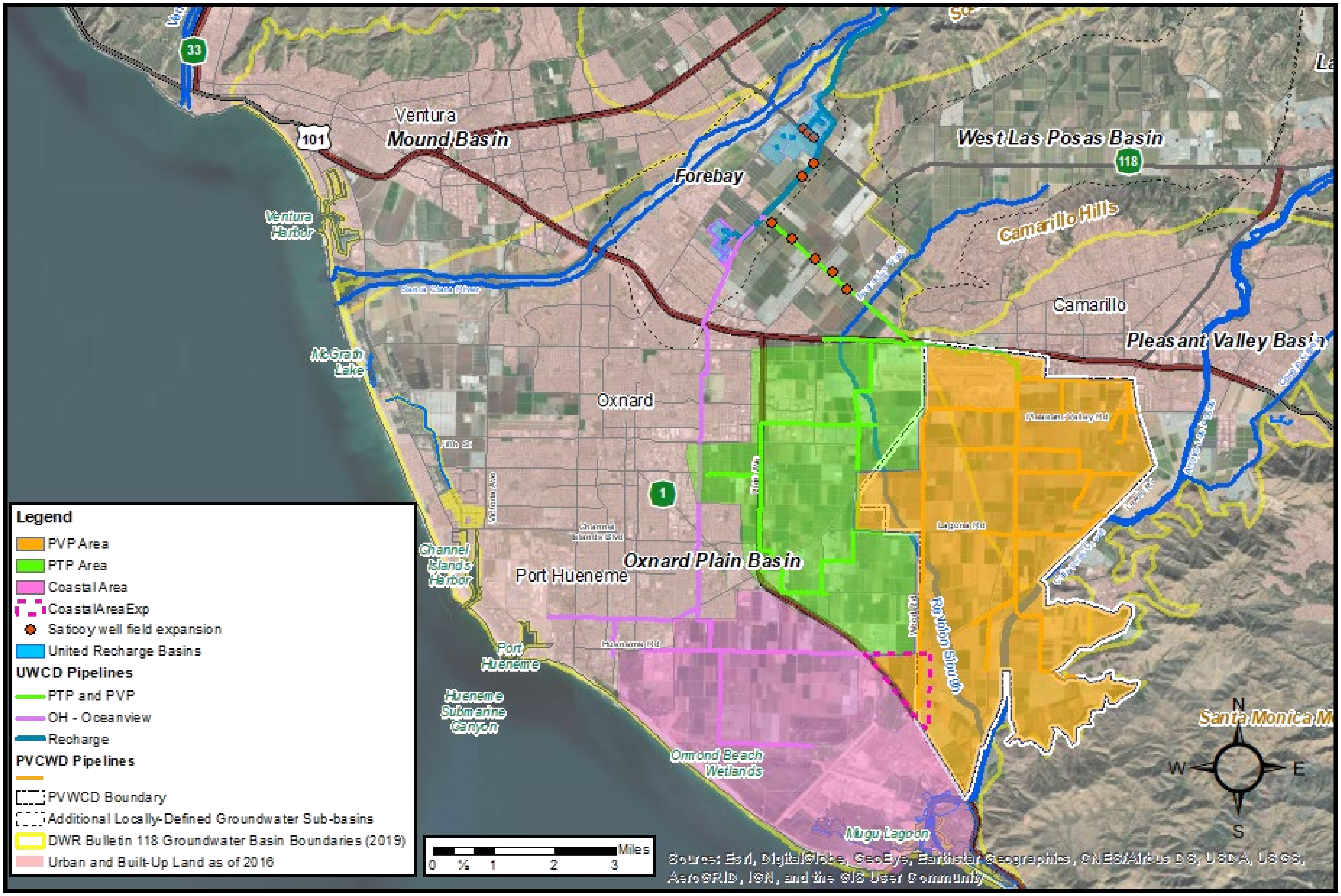

Figure 2. Map of Oxnard Plain and surrounding areas showing groundwater management areas used in SWDM and Saticoy well field expansion project.

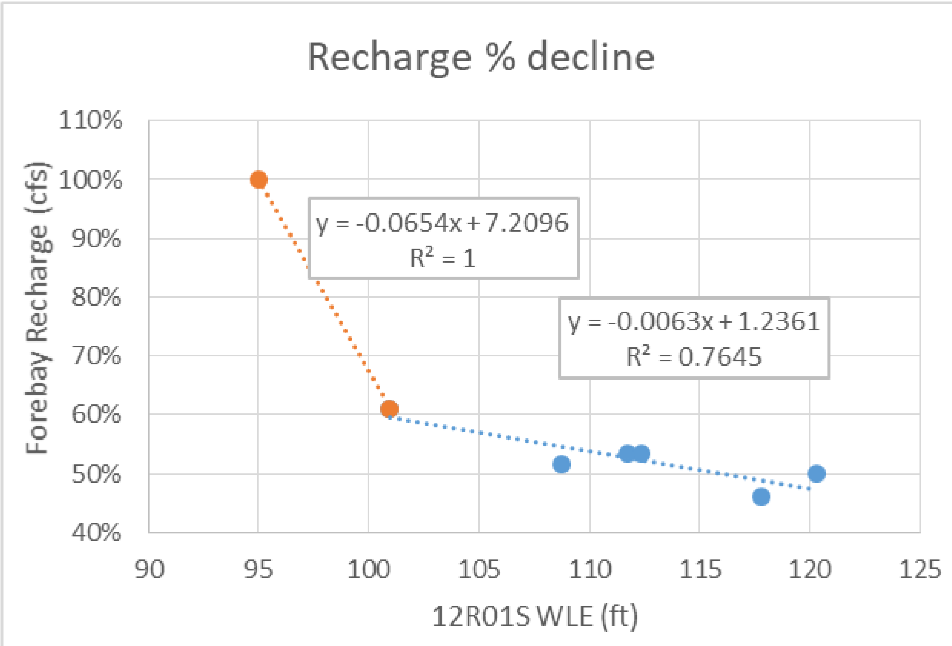

Figure 3. Decrease in maximum infiltration rate for artificial recharge to the Oxnard Forebay as a function of groundwater elevation at well 2N22W12R01S.